CMD 25-H12.1-Ref8

Date: 2025-10-15

Reference from NexGen Energy Ltd.

In the matter of

NexGen Energy Ltd.

Licence application to prepare a site for and construct its Rook 1 uranium mine and mill project

Commission Public Hearing
Part 1

November 19, 2025

Référence de NexGen Energy Ltd.

À l'égard de

NexGen Energy Ltd.

Demande de permis concernant la préparation de l'emplacement et la construction de son projet de mine et d'usine de concentration d'uranium Rook I

Audience publique de la Commission
Partie 1

Le 19 novembre 2025

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Canada

Volume 2: Rook I Project Environmental Impact Statement

Rook I Project

Environmental Impact Statement

Section 15 Human Health

Submitted to:
Canadian Nuclear Safety Commission
Saskatchewan Ministry of Environment

Submitted by:
NexGen Energy Ltd.
3150-1021 W Hastings St
Vancouver, BC
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November 2024

Executive Summary

Section Purpose

Section 15 of the Environmental Impact Statement (EIS) provides a comprehensive assessment of potential effects of the Rook I Project (Project) on human health. This assessment included consideration of both potential effects from the Project and cumulative effects from the Project and other reasonably foreseeable developments (RFDs). The human health assessment used widely accepted scientific practices and incorporated Indigenous and Local Knowledge.

Human health represented a valued component (VC) in the Environmental Assessment (EA); the selection was based on the Project's potential to cause exposures to hazards and sources of constituents of potential concern (COPCs) (i.e., chemical compounds, metals, and radionuclides). Atmospheric emissions from waste rock and ore handling and storage could produce air and dust emissions that could be inhaled by humans and deposited on soil. Release of treated effluent, runoff, and seepage into Patterson Lake may cause changes to surface water quality, which could be transferred to sediment, plants, fish, and wildlife. People ingesting water, plants, fish, and wildlife or contacting water and sediment, could subsequently be exposed to these constituents, which could adversely affect their health.

The human health habitat assessment provided information that was used to support other VC assessments such as Indigenous land and resource use, and other land and resource use.

Setting

At a regional scale, the Project would be located within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system, approximately 40 km east of the Saskatchewan-Alberta border and 640 km northwest of the city of Saskatoon.

The human health assessment focused on a local study area (LSA) of 685 km^2, which is in the area of the proposed Project where direct environmental effects would be most likely to occur, and a regional study area (RSA) of 1,076 km^2, where cumulative effects may occur. The RSA includes the LSA and extends from the headwaters of the Clearwater River to the confluence of the Clearwater River and Mirror River and includes major waterbodies along its course including Broach Lake, Patterson Lake, Forrest Lake, Beet Lake, Naomi Lake, and Lloyd Lake, as well as their contributing watersheds.

Existing Conditions (Section 15.3)

To characterize existing conditions, baseline data from several other disciplines were used to support the human health assessment, including:

Air Quality (Annex I, Atmospheric Baseline Report)

- Baseline air quality is indicative of a rural setting, relatively unaffected by outside influences on air quality. Baseline air quality was generally below the Saskatchewan Ambient Air Quality Standards or other relevant standards. Air quality conditions can generally be classified as good based on the monitoring conducted.

Water and Sediment Quality (Annex V.1, Aquatic Environment Baseline Report)

- Generally, concentrations of surface water constituents were below water quality thresholds (i.e., good quality) for both aquatic and terrestrial life and drinking water within the LSA waterbodies and watercourses, with some exceptions (i.e., iron, manganese, lead, nickel, and arsenic in some samples). Similarly, concentrations of sediment constituents were below sediment quality thresholds in waterbodies in the LSA and RSA, with some exceptions (i.e., arsenic, vanadium, and polonium-210 in some samples). Several constituents were measured at or below the analytical detection limit.

Soil Quality (Annex VI, Terrain and Soils Baseline Report)

- Baseline soil samples collected from locations in the Project footprint and the LSA as part of the baseline monitoring program indicated that soil quality was generally within the selected soil quality guidelines for protection of human and ecological health with the exception of boron, sulphur, and uranium at individual locations. The majority of the soil sample horizons were coarse textured (i.e., sand to loamy sand).

In addition to the information provided above, data collected with respect to blueberry and lichen quality, fish tissue, and wildlife were also used in the human health risk assessment (HHRA).

There are no known existing anthropogenic sources of radiation or radioactivity in the LSA and RSA.

Potential Effects and Proposed Mitigation (Section 15.4)

An analysis was completed to evaluate Project components and activities and associated effects pathways that could potentially affect human health. The evaluation also considered similar combined effects from the Fission Patterson Lake South Property, the identified RFD for the human health assessment.

Project activities that would have the potential to affect human health during the Project lifespan include:

- land clearing;
- site preparation;
- site traffic;
- construction of facilities and infrastructure;
- handling and storage of waste rock, special waste rock[1], and ore;
- storage of tailings in the underground tailings management facility (UGTMF) and mined out underground production stopes;
- transportation of personnel and materials to and from the site;
- power generation;
- process plant and underground operations;
- non-hazardous waste incineration;
- discharge of treated effluent; and
- removal of infrastructure, and reclamation and revegetation of facilities and infrastructure.

[1] Special waste rock is mine rock that is mineralized with insufficient grade to be considered ore (i.e., greater than 0.03% of triuranium octoxide [U_3O_8] and less than 0.26% U_3O_8). All special waste would be temporarily stored in the special waste rock stockpile.

Similar activities that could affect human health would be expected to occur for the Fission Patterson Lake South Property, with the exception of potential effects associated with a UGTMF, as the Fission Patterson Lake South Property includes an above-ground tailings management facility.

As part of the pathways analysis, proposed environmental design features and mitigation measures were considered to determine whether effects on the environment could be avoided or reduced to negligible levels, thereby removing the pathway. Project environmental design features such as the UGTMF and the engineered cemented paste tailings were designed to minimize the Project's effects on human health. In addition, proposed mitigation measures that would reduce effects on human health include:

- erosion and sediment control;
- progressive reclamation and revegetation of disturbed areas and areas where non-permanent Project features have been removed;
- treatment of effluent prior to discharging;
- recycling and reuse of process plant water;
- regular equipment maintenance;
- primarily using liquid natural gas for power generation;
- diffuser design to provide effective treated effluent mixing and to limit the area of the receiving water expected to have elevated COPC concentrations; and
- application of water and/or suppressants to the access road, site roads, and the airstrip.

Similar mitigation and adaptive management practices would also be expected to be implemented by the Fission Patterson Lake South Property.

After mitigation measures were considered, the pathways analysis determined that many of the potential pathways from the Project to the environment could be removed from the assessment. However, it was identified that the Project could still adversely affect human health from the following pathways:

- emission and deposition of fugitive dust and radon;
- emission and deposition of criteria air contaminants and suspended solids;
- release of treated effluent, including changes to surface water quality, and indirectly, sediment quality;
- site runoff;
- seepage from waste rock storage areas (WRSAs) causing changes to groundwater and surface water quality; and
- post-closure runoff and seepage from WRSAs and the UGTMF.

Therefore, these pathways were carried forward into a residual effects analysis.

Risk Assessment and Characterization (Section 15.5, Section 15.6)

To support the assessment of the human health VC, an HHRA was conducted to determine the potential effects on human health under two assessment cases: effects of the Project (i.e., Application Case), and combined effects of the Project and the Fission Patterson Lake South Property (i.e., RFD Case). The HHRA formed the basis for the characterization of risk to human health and the determination of significance. The HHRA considered four human health receptor groups:

- camp worker at the Project;
- subsistence harvester;
- seasonal resident / lodge operator; and
- future permanent resident of the Patterson Lake North Arm area.

The assessment of each receptor group included consideration of both and adult and a one-year-old child.

The selection of these four groups was based on members of the public potentially being exposed to low levels of airborne or waterborne constituents at locations on the landscape identified as important by Indigenous Groups and community members. Consistent with guidance in the Canadian Standards Association Group CSA N288.6-22 (CSA Group 2022), nuclear energy workers were excluded from the assessment since it is assumed these workers would participate in the Radiation Protection Program and Health and Safety Program. However, a worker at the Project camp (i.e., an individual working in food services) was included in the HHRA, since it was assumed that the camp worker consumes Traditional Foods fished, hunted, and harvested from within the LSA when not working. A summary of radiological and non-radiological effects on the health of workers during normal operations and through the potential occurrences of accidents and malfunctions is included in Appendix 15A, Radiological and Non-Radiological Worker Effects Summary.

The HHRA focused on COPCs that exceeded screening values in air and water based on predicted atmospheric releases and aqueous releases (i.e., treated effluent, treated sewage, site runoff, and groundwater solute releases) from the Project as well as considered COPCs predicted to exceed screening values in soil and sediment. The measurement indicators used to assess potential effects on human health were:

- hazard quotient (HQ) – a measure of the ratio of the predicted exposure (i.e., daily dose) to a non-carcinogen relative to the toxicity reference value (TRV);
- incremental lifetime cancer risk (ILCR) – the predicted increase in lifetime cancer risk from exposure to a carcinogen related to Project activities; represents risk above background cancer risk; and
- radiation dose – a measure of the risk to the overall health of the human body due to an exposure to ionizing radiation.

Risks were evaluated using HQs for non-carcinogens (i.e., cobalt, copper, molybdenum, uranium) and ILCRs for carcinogens (i.e., arsenic) as measurement indicators. Radionuclides, including the uranium-238 series and radon, were included as COPCs and their radiation doses were evaluated as these constituents are of interest to Indigenous Groups and the public.

A sensitivity scenario was developed for the Application Case that was representative of reasonable upper bound conditions. The purpose of this scenario was to examine a highly conservative estimation for water quality predictions to bound the uncertainty associated with the model input data.

Non-Carcinogens Findings

Project HQs were compared to an acceptable HQ value of 0.2, which was exclusive of background and consistent with Health Canada's guidance on human health preliminary quantitative risk assessment (Health Canada 2021a). As a result of releases from the Project, no significant adverse effect on any human receptors would be likely during the Project lifespan for the Application Case, reasonable upper bound sensitivity scenario, or the RFD Case. All estimated Project HQs for all non-carcinogenic COPCs remained below the acceptable risk level of 0.2 per pathway for the one-year-old and adult age groups assessed.

Carcinogens Findings

For assessment of risk for arsenic, the ILCR was estimated and compared against the negligible cancer risk level of 1 in 100,000 recommended by Health Canada (2021a). Incremental cancer risk was predicted to exceed the negligible cancer risk level of 1 in 100,000 for the relevant human receptors (i.e., camp worker, subsistence harvester, seasonal resident) in the LSA just outside the Project footprint, but did not exceed the negligible cancer risk within the RSA farther from the Project. The predicted incremental risk is in the negligible to low category, as the calculated ILCR is 4 in 100,000 for the Application Case, compared to a background level of approximately 50,000 in 100,000. This finding is based on the conservative assumption of high consumption of Traditional Foods including fish and terrestrial animals in the Project footprint and LSA.

Radionuclides and Radon Findings

The incremental radiation dose to all human receptors during the Project lifespan and the far-future projection, which includes all radionuclides in the U-238 decay chain (including radon), were predicted to be below the regulatory public dose limit of 1 mSv/yr for the Application Case, upper bound sensitivity scenario, and RFD Case. In the far-future projection, a future permanent resident living at the location of the previous camp could receive a dose up to 0.07 mSv/yr, which is well below the regulatory public dose limit and the dose constraint. Overall, since the radiation dose estimates are below the public dose limit; no discernable health effects are anticipated due to potential exposure of these receptors to radioactive releases from the Project.

Significance Determination (Section 15.6)

The weight of evidence from the analysis predicts that although changes to COPCs and the incremental radiation dose are possible, the predicted effects would be below the acceptable risk level and regulatory public dose limit for human health VC receptors. The residual effects on human health in the Application Case are therefore predicted to be **not significant**.

The incremental and cumulative effects resulting from the Project, previous and existing developments, and the Fission Patterson Lake South Property on human health are also predicted to be **not significant**.

Prediction Confidence and Uncertainty (Section 15.7)

Overall, there was a high degree of confidence in the predictions related to the human health assessment. The assessment used a precautionary approach that conservatively represented the potential Project-related effects on the human health VC. A number of conservative assumptions were incorporated in the HHRA including basing the Traditional Foods diet on high ingestion rates in the male diet. It was also assumed that drinking water and water for bathing for the camp worker would be sourced from Patterson Lake North Arm – East Basin while at work. It is not anticipated that there would be a permanent resident at a former mine site; therefore, this receptor is considered hypothetical, but it is assessed as a conservative assumption.

The assumptions used to characterize human health receptors and develop the conceptual site model followed industry best practices. There is inherent uncertainty in the estimates, which is related to uncertainty in the input information. Where possible, site-specific information was incorporated. Where site-specific information was not available, assumptions were made to confirm conservatism was included in the model, and that there is a high confidence that the risk was not underestimated.

Monitoring would be used to address residual uncertainty by focusing on collecting data to update model predictions as well as provide data to improve model predictions through the Project phases. Monitoring would support NexGen's adaptive management framework with the goal of reducing uncertainty over time through an iterative process.

Monitoring and Follow-Up (Section 15.8)

The Environmental Protection Program, Environmental Monitoring Plan, Effluent and Emissions Plan, and Traditional Foods Study would be implemented to verify effects predictions and effectiveness of mitigation on human health, identify unanticipated effects, and apply adaptive management.

Key components of human health monitoring are expected to include surface water, sediment, and soil samples, as well as fish tissue samples, benthic invertebrate tissue samples, and country foods such as blueberries. The Environmental Monitoring Plan would be developed in accordance with the Metal and Diamond Mining Effluent Regulations, the federal *Fisheries Act*, and conditions established through Project authorizations issued by the Canadian Nuclear Safety Commission and Saskatchewan Ministry of Environment.

Abbreviations and Units of Measure

Abbreviation	Definition
BNDN	Birch Narrows Dene Nation
BRDN	Buffalo River First Nation
CNSC	Canadian Nuclear Safety Commission
CRDN	Clearwater River Dene Nation
COPC	constituent of potential concern
CSA	Canadian Standards Association Group
EA	Environmental Assessment
EIS	Environmental Impact Statement
ERA	environmental risk assessment
ETP	effluent treatment plant
FNFNES	First Nations Food, Nutrition and Environment Study
HHRA	human health risk assessment
HQ	hazard quotient
ILCR	incremental lifetime cancer risk
JWG	Joint Working Group
LPA	local priority area
LSA	local study area
MN-S	Métis Nation – Saskatchewan
NexGen	NexGen Energy Ltd.
PAG	potentially acid generating
$PM_{2.5}$	particulate matter with a nominal diameter of 2.5 microns or less
PM_{10}	particulate matter with a nominal diameter of 10 microns or less
Project	Rook I Project
RFD	reasonably foreseeable development
RSA	regional study area
IKTLU	Indigenous Knowledge and Traditional Land Use
TRV	toxicity reference value
TSD	technical support document
TSP	total suspended particulates
UGTMF	underground tailings management facility
VC	valued component
WQO	water quality objective
WRSAs	waste rock storage areas
YNLR	Ya’thi Néné Lands and Resources

Unit	Definition
%	percent
°	degree
°C	degrees Celsius
µm	micron
ha	hectare
kg	kilogram
km^2	square kilometre
m	metre
mg/kg	milligrams per kilogram
mSv	millisievert
mSv/yr	millisieverts per year

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15 HUMAN HEALTH

15.1 Introduction

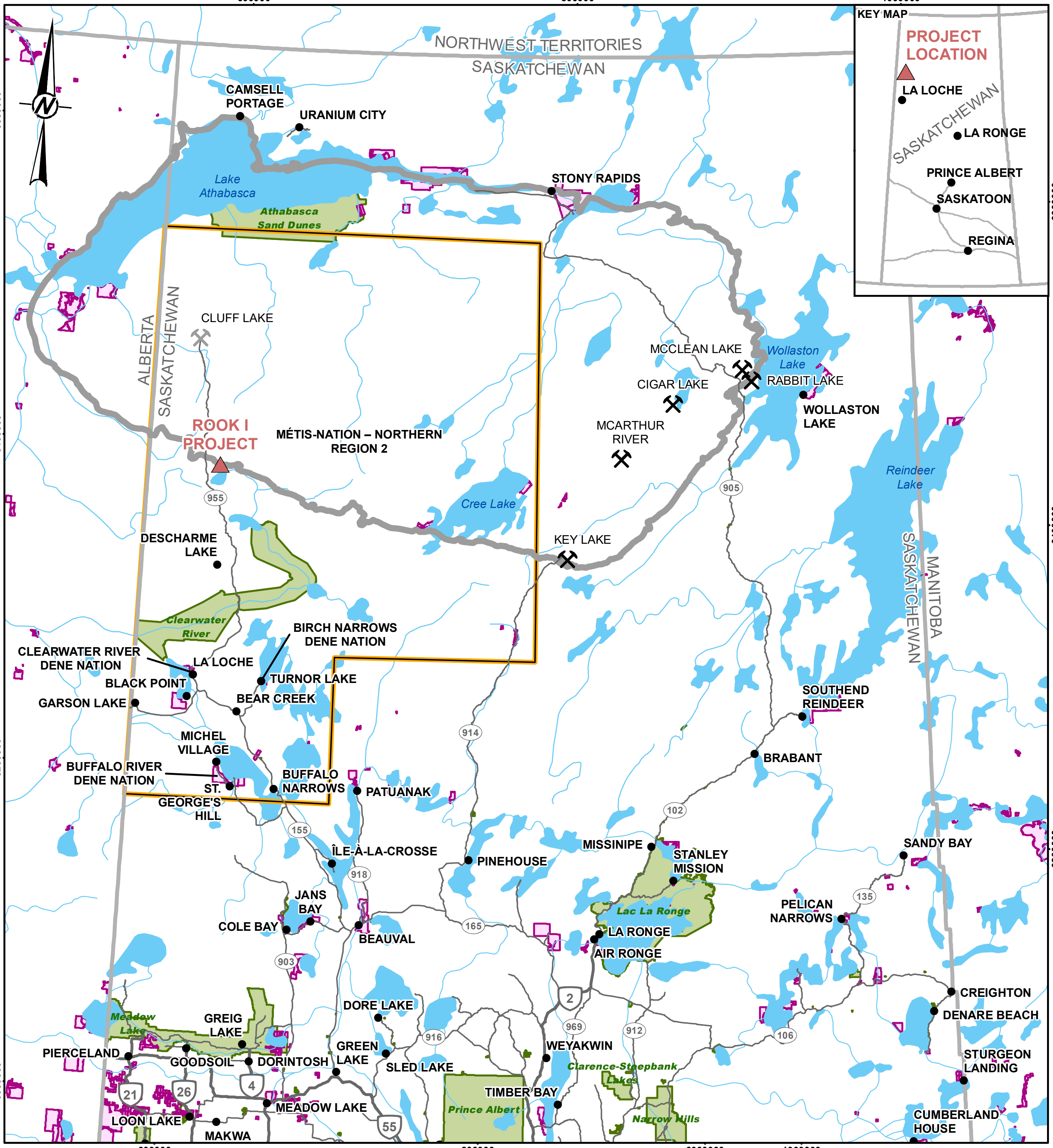
NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The Project would be located approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the Northern Village of La Loche, and 640 km northwest of the city of Saskatoon (Figure 15.1-1). The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Patterson Lake is at the interface of the Boreal Shield and Boreal Plain ecozones. Access to the Project would be from an existing road off Highway 955 (Figure 15.1-2), with on-site worker accommodation serviced by fly-in/fly-out access.

Section 15, Human Health, of the Environmental Impact Statement (EIS) characterizes the potential residual effects of the Project on human health, which is a component of the human environment. Human health represents a valued component (VC) for the Environmental Assessment (EA). The Project has the potential to cause adverse health effects on people through multiple mechanisms, including:

- Potential exposures to the hazards and sources of chemical compounds, metals, and radionuclides (i.e., constituents) in and around the process plant complex and the underground mine workings.
- Atmospheric emissions from sources such as waste rock and ore handling and storage; on-site combustion for power generation and transportation; the milling processes (e.g., calciner, acid plant) containing constituents that may be inhaled by humans and deposited on soil that could be contacted by humans.
- Release of treated effluent, runoff, and seepage into Patterson Lake that may cause changes to surface water quality, which may be transferred to sediment, plants, fish, and wildlife. People ingesting water, plants, fish, and game or contacting water and sediment may subsequently be exposed to these constituents, which could adversely affect their health.

The human health risk assessment (HHRA) focuses on off-site members of the public and camp workers who would potentially be exposed to low levels of airborne and waterborne constituents being released during Project activities. Nuclear energy workers are outside of the scope of this assessment as their health is managed through the Radiation Protection Program and Health and Safety Program, as discussed in Section 15.2.2.1, Valued Components and Receptors.

The assessment of human health provides information that is used to support the assessments of Indigenous land and resource use and other land and resource use VCs. A simplified linkage diagram, Figure 15.1-3, illustrates how proposed Project activities could result in a direct or indirect effect on human health and the VCs that could be influenced through changes to human health.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN BOUNDARY
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROJECT LOCATION
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

0 100 200
1:3,500,000 KILOMETRES

REFERENCE(S)
1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
LOCATION OF THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 15.1-1

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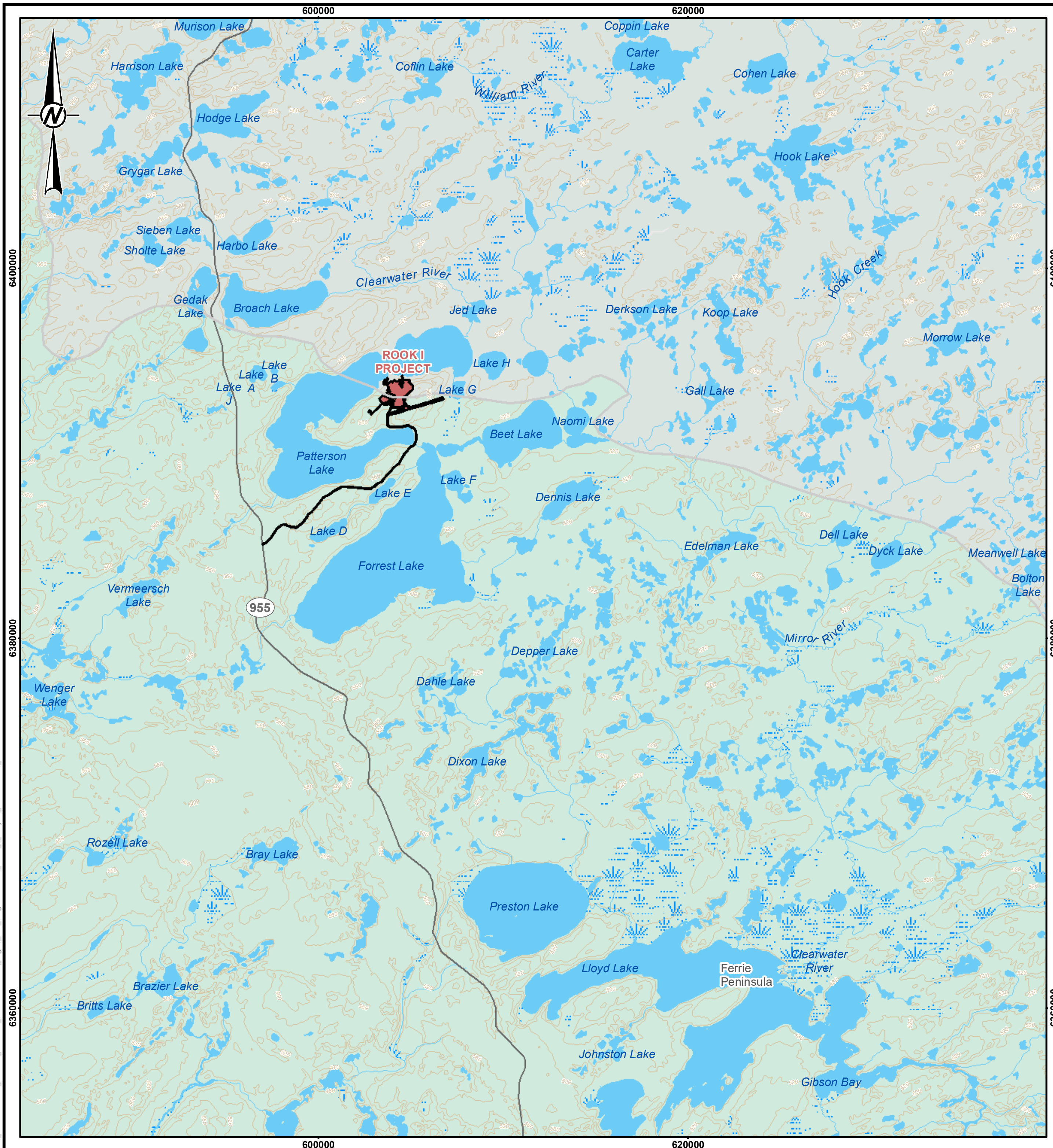

0 5 10
1:300,000 KILOMETRES

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN
- WATERBODY
- WETLAND
- WOODED AREA
- PROPOSED PROJECT FOOTPRINT

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 15.1-2

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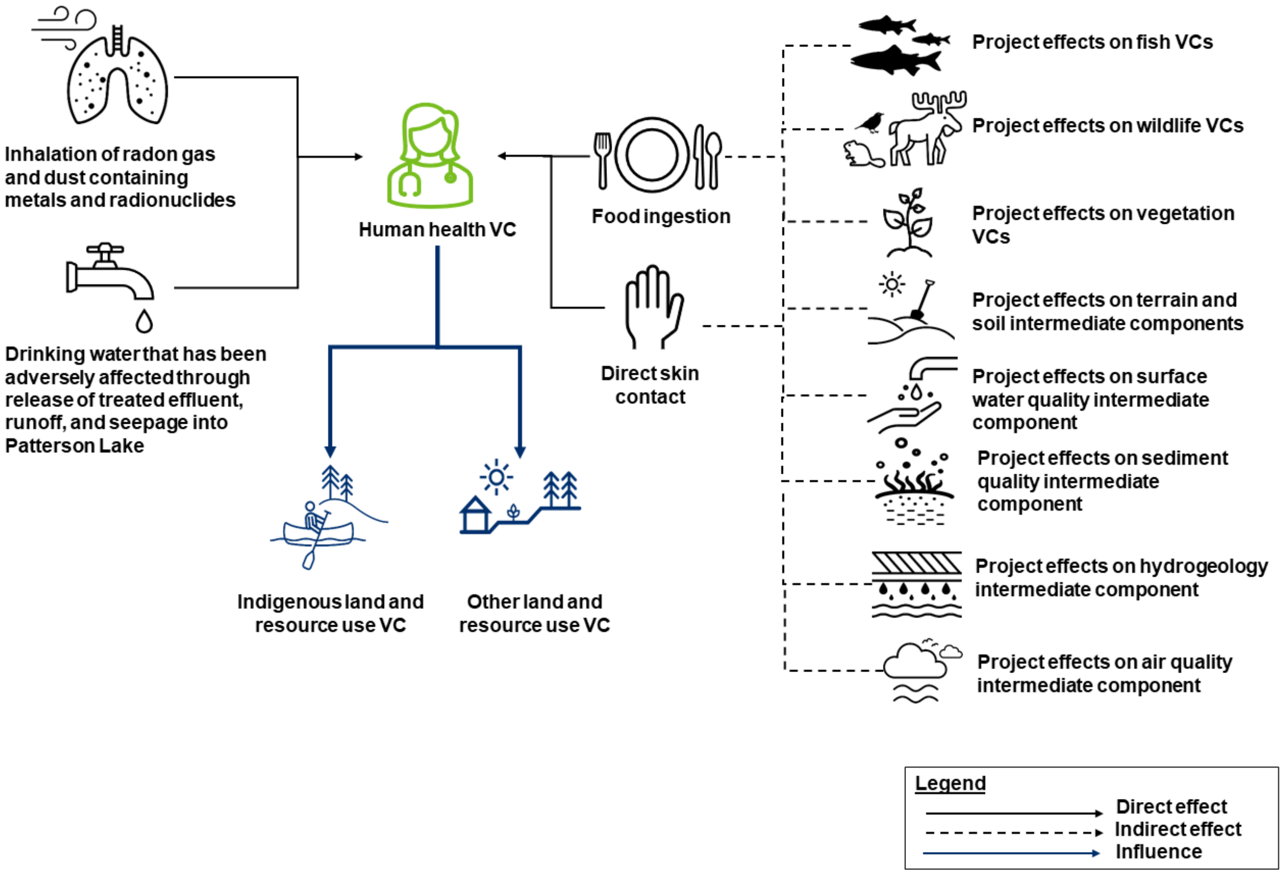
Figure 15.1-3: Linkage Diagram of Project Effects on Human Health and Influenced Valued Components



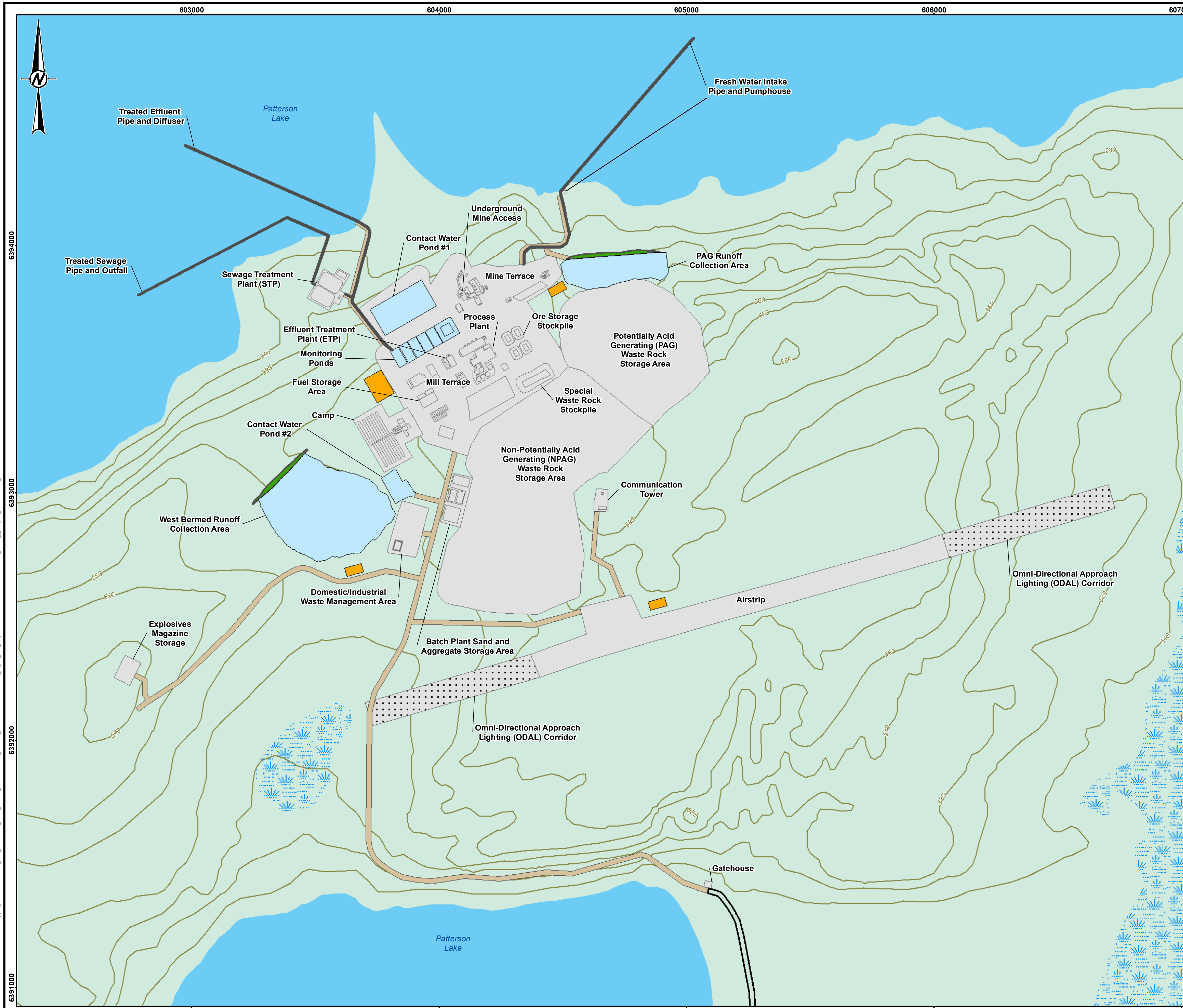
VC = valued component.

15.1.1 Project Summary

The Project would include the following key facilities to support the extraction and processing of uranium from the Arrow deposit for transportation off site (Figure 15.1-4):

- underground mine development;
- process plant buildings, including uranium concentrate packaging facilities;
- paste tailings distribution system;
- underground tailings management facility (UGTMF);
- potentially acid generating (PAG) waste rock storage area;
- non-PAG waste rock storage area;
- special waste rock[2] and ore storage stockpiles;
- surface and underground water management infrastructure, including water management ponds, effluent treatment plant (ETP), and sewage treatment plant;
- conventional waste management facilities and fuel storage facilities;
- ancillary infrastructure, including maintenance shop, warehouse, administration building, and camp;
- airstrip and associated infrastructure; and
- access road to Project and site roads.

[2] Special waste rock is mine rock that is mineralized with insufficient grade to be considered ore (i.e., greater than 0.03% of triuranium octoxide [U_3O_8] and less than 0.26% U_3O_8). All special waste would be temporarily stored in the special waste rock stockpile.



LEGEND

- ELEVATION CONTOUR (10 m INTERVAL)
- WATERBODY
- WETLAND
- WOODED AREA
- INTAKE OR DISCHARGE PIPE
- ACCESS ROAD
- CONTACT WATER CONTAINMENT BERM
- OMNI-DIRECTIONAL APPROACH LIGHTING (ODAL) CORRIDOR
- PROJECT INFRASTRUCTURE
- SITE ROAD
- TOPSOIL STORAGE AREA
- WATER MANAGEMENT POND

0 0.5 1

1:15,500 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021 AND UPDATED JUNE 8, 2021 .
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LAYOUT OF INFRASTRUCTURE AND FACILITIES FOR THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 15.1-4

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\15_Human_Health\11x17\20144150_Fig15_1-4_Layout-of-Infrastructure-and-Facilities_Rook_I_Project_NoTitleblock_Rev0.mxd PRINTED ON: 2023-02-09 AT 11:06:34 AM

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15.1.2 Purpose and Approach to the Assessment

The purpose of Section 15 is to provide a detailed and comprehensive assessment of all potential Project-specific effects and cumulative effects from the Project and other previous, existing, and reasonably foreseeable developments (RFDs), if applicable, on human health. This section meets the Terms of Reference for the Project submitted to the Saskatchewan Ministry of Environment and the Canadian Nuclear Safety Commission (CNSC) *Generic Guidelines for the Preparation of an Environmental Impact Statement – Pursuant to the Canadian Environmental Assessment Act, 2012* (Appendix 1A, Concordance Tables). A detailed and comprehensive characterization of potential residual effects of the Project on human health is provided in TSD XXI, Environmental Risk Assessment. The assessment of human health generally followed the overall EA approach and methods (Section 6, Environmental Assessment Approach and Methods), with adjustments to align with the HHRA in the Environmental Risk Assessment (TSD XXI), and included the following primary steps:

Step 1 – Define component-specific methods (Section 15.2): presents the specific approaches and methods used to measure and assess the effects of the Project on human health, as well as cumulative effects from the Project and those from previous, existing, and approved projects/activities and RFDs, if applicable.

Step 2 – Characterize existing conditions (Section 15.3): describes and characterizes existing conditions to provide context and a basis for evaluating potential changes to human health caused by the Project.

Step 3 – Evaluate Project interactions and mitigations (Section 15.4): identifies Project components and/or activities with the potential to affect human health and provides environmental design features and mitigation policies and actions committed to by NexGen to avoid or minimize potential adverse effects. A pathways analysis was used to focus further assessment on key interactions between the Project and human health by evaluating the different effects pathways to determine if, after incorporation of mitigation, there is still potential to cause residual adverse effects. Primary pathways anticipated to result in residual adverse effects after incorporation of mitigation are carried forward to Step 4 for further analysis. Where potential adverse effects are adequately mitigated, and thus not forwarded for further analysis (i.e., where mitigation results in negligible effects or avoids the pathway altogether), the reasons for concluding the assessment at this stage are provided.

Step 4 – Risk assessment (Section 15.5): evaluates and describes the potential Project effects on human health that are anticipated to occur through the primary pathways. The risk assessment presented in Section 15 is based on the HHRA (TSD XXI) and is presented as an integrated narrative that describes the effects of the Project over time and highlights predicted effects at the point when adverse effects of the Project are expected to be greatest. The risk assessment step includes a problem formulation, exposure assessment, and toxicity assessment. Characterizations of risks and uncertainties are included in Steps 5 and 6. The methods used in the risk assessment are based on guidance provided by the CNSC (2021), the Canadian Standards Association Group (CSA Group; 2020, 2022), and Health Canada (2010a, 2021a). This step also completes an analysis of residual cumulative effects from the Project, other previous and existing projects and activities, and RFDs.

Step 5 – Characterize risks and determine significance (Section 15.6): summarizes the results of the risk assessment using effects criteria (i.e., direction, magnitude, geographic extent, duration, reversibility, and frequency) based on the EA methods, as appropriate, for the risk assessment approach. Significance was determined for adverse effects only and for the maximum adverse effects of the Project and the cumulative effects from the Project and previous, existing, and RFDs.

Step 6 – Describe uncertainty and define prediction confidence (Section 15.7): identifies key uncertainties and explains how these uncertainties have been addressed to achieve a conservative, precautionary assessment. The implications of the approaches used to address uncertainties and the level of confidence in the risk characterization are discussed.

Step 7 – Identify monitoring and follow-up (Section 15.8): outlines the proposed actions to verify predicted residual effects. The purpose of these actions is to evaluate effectiveness of planned mitigation designs, policies, and practices, and address key sources of uncertainty.

Consistent with guidance in the CSA N288.6-22 (CSA Group 2022), workers (i.e., nuclear energy workers) were excluded from the assessment since they would be subject to monitoring under the Radiation Protection Program and Health and Safety Program, as explained further below.

To keep exposures to ionizing radiation hazards as low as reasonably achievable during all phases of the Project, exposures to gamma radiation, long-lived radioactive dust, radon progeny, and radon gas would be routinely monitored for workers designated as nuclear energy workers. Personal dosimetry equipment would be provided, and dose records would be maintained for each nuclear energy worker at the Project site. Effective (i.e., whole body) and equivalent (i.e., organ-specific) doses would be measured and recorded, as applicable. Doses would be routinely tracked and compared to internal and external limits. The processes for classifying nuclear energy workers and for managing worker dosimetry is outlined in the Radiation Protection Program.

Chemical, physical, or biological health and safety hazards encountered by workers during all phases of the Project would be monitored in accordance with established sample collection and analysis methods to quantify exposure risk to workers and confirm the effectiveness of applicable controls. Results from personal occupational exposure and workplace monitoring would be collected, maintained, stored, communicated, and used to identify improvement opportunities (as required).

Worker health in respect to both normal operations and potential accidents and malfunctions will be addressed independently as part of the CNSC licensing process, as required; however, for contextual purposes, a summary of radiological and non-radiological effects on the health of nuclear energy workers and non-nuclear energy workers during normal operations and through the potential occurrences of accidents and malfunctions is included in Appendix 15A (Radiological and Non-Radiological Worker Effects Summary). This appendix also presents a summary of the hazard analysis study completed for the Project and the proposed approach to human factors engineering. The process for identifying health and safety hazards and monitoring occupational exposures is outlined in the Health and Safety Program.

A worker at the Project camp (e.g., an individual working in food services) was included in the HHRA, since it is assumed that the camp worker consumes Traditional Foods fished, hunted, and gathered from the local study area (LSA) when not working (Section 15.2.2.1).

15.2 Component Methods

As indicated in Section 15.1.2, the component methods for Section 15 generally followed the overall EA approach and methods, with adjustments to align with the HHRA, where the risk assessment formed the basis for evaluating and characterizing the potential Project and cumulative effects on human health.

15.2.1 Incorporation of Indigenous and Local Knowledge

Indigenous and Local Knowledge included in the assessment of human health was shared by potentially affected First Nations and Métis Groups (collectively referred to as Indigenous Groups) and local priority area (LPA)[3] community members through the Project engagement process. The overall approach and methods for the incorporation of Indigenous and Local Knowledge into the EA is discussed in detail in Section 3, Indigenous and Local Knowledge. Issues and concerns related to human health raised by Indigenous Groups and LPA community members, and how these comments were addressed, are summarized in Appendix 2B, Summary of Issues and Concerns Identified by Indigenous Groups, and identified and addressed in this assessment, where applicable.

A key source of Indigenous and Local Knowledge is the Project-specific studies completed by Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies and Indigenous Rights and Knowledge studies (henceforth referred to collectively as Indigenous Knowledge and Traditional Land Use [IKTLU] Studies). The IKTLU Studies that were reviewed and referenced in the EIS as technical support documents (TSDs) are listed below:

- TSD II (BNDN), Birch Narrows Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;
- TSD III (BRDN), Buffalo River Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;
- TSD IV (MN-S), Métis Nation – Saskatchewan Northern Region 2 Traditional Land Use & Diet Study for the NexGen Rook I Project;
- TSD V.1 (CRDN), Preliminary Identification of Issues and Concerns Related to the Proposed NexGen Energy Ltd. Rook I Project in the Patterson Lake Area; A Review; Clearwater River Dene Nation; Traditional Land Use and Occupancy Mapping Interviews; 2010 – 2016;
- TSD V.2 (CRDN), Clearwater River Dene Nation Indigenous Rights and Knowledge Survey Related to the Proposed NexGen Energy Ltd. Rook 1 Project in the Patterson Lake Area;
- TSD V.3 (CRDN), Socio-economic and Harvest Study; Clearwater River Dene Nation; NexGen Rook 1 Project; and
- TSD VI (YNLR), Provision of Athabasca Denesųłiné Traditional Knowledge, Land Use and Occupancy Information for the NexGen Rook I Project Environmental Assessment.

Another key source of Indigenous and Local Knowledge was information shared by Indigenous Group representatives during Joint Working Group (JWG) meetings. The JWGs represent an agreed-upon primary engagement mechanism as outlined in the Study Agreements signed by each Indigenous Group and NexGen. More details regarding the JWGs can be found in Section 2, Indigenous, Regulatory, and Public Engagement and Section 3, Indigenous and Local Knowledge. There are four JWGs with the Project's primary Indigenous Groups (Section 2.4.1, Identification of Indigenous Groups for Engagement):

- Clearwater River Dene Nation (CRDN) JWG;
- Métis Nation – Saskatchewan (MN-S) JWG representing MN-S Northern Region 2 (NR2);

[3] The LPA consists of the local communities closest to the Project that would experience most of the Project effects and for which NexGen would prioritize local training, employment, and business opportunities for the Project. These communities are located along, or accessed via, Highways 155 and 955 north of the intersection of Highways 155 and 925.

- Birch Narrows Dene Nation (BNDN) JWG; and
- Buffalo River Dene Nation (BRDN) JWG.

The leadership of each Indigenous Group selected their JWG participants with consideration of group diversity; where possible, members included Elders, youth, different genders, a range of ages, and land users around Patterson Lake.

In addition to the IKTLU Studies and JWGs, Indigenous and Local Knowledge shared during specific engagement activities undertaken through the EA development process was incorporated into the assessment, where appropriate. These engagement activities included, but were not limited to:

- community information sessions held in four locations in 2019 (NexGen 2019);
- site tours;
- comments from the CRDN (2019a) on the Cluff Lake Mine licence renewal;
- other formal and informal meetings;
- workshops with specific groups (e.g., Fur Block N-19 trapper's workshop); and
- environmental and socio-economic baseline data collection.

Comments submitted by Indigenous Groups on the Project Description (CRDN 2019b; MN-S 2019; YNLRO 2019; ACFN 2019; CNSC 2019) were also reviewed for applicable Indigenous and Local Knowledge.

Indigenous and Local Knowledge related to human health was incorporated into the assessment by viewing the information as complementary and influential alongside scientific information. Where possible, knowledge from each potentially affected Indigenous Group or LPA community member was described separately and cited accordingly. Where information is described for multiple potentially affected Indigenous Groups, they are collectively referred to as "Indigenous Groups" throughout the assessment.

Indigenous and Local Knowledge was included in the human health assessment in the following ways:

- **Component Methods – VCs:** Indigenous and Local Knowledge was considered in the selection of the human health VC and reflects the importance of traditional hunting, trapping, fishing, and gathering to subsistence, survival, and livelihood, and as a key aspect of community well-being and culture. Traditional Foods, including wildlife, plant, and fish species, as well as water, are relied upon as a key part of diets and the promotion of health. Having access to a healthy land base, clean air and water, and high-quality resources is critical for human health (Section 15.2.2.1).
- **Component Methods – Spatial Boundaries:** Indigenous and Local Knowledge supported the spatial boundaries used in the assessment, which includes a portion of the Clearwater River system and connecting waterbodies. Indigenous and Local Knowledge has highlighted the interconnectedness of the region's waterways and the Clearwater River as a holistic river system that has many large lakes that are connected and integral to the river and cannot be viewed in isolation (Section 15.2.3).
- **Component Methods – Existing Conditions:** The initial assumptions for intake rates and components of the Traditional Foods diet for the HHRA were informed by Indigenous and Local Knowledge and feedback provided by Indigenous Groups and LPA communities (Section 15.2.6).
- **Component Methods – Risk Assessment:** The selection of human health receptor groups and receptor locations was informed by Indigenous and Local Knowledge received through feedback provided by

Indigenous Groups and LPA communities. Indigenous and Local Knowledge was shared regarding where people reside, locations where drinking water is collected, and Traditional Foods are hunted, fished, and gathered (Section 15.2.8).

- **Existing Conditions:** Feedback provided by Indigenous Groups and LPA communities informed the assumptions on the Traditional Foods diet, including the proportions of different Traditional Food categories consumed (e.g., prevalence of berries and representative plants, fish, game, and birds), and ingestion rates to be included in the Traditional Foods exposure assessment. Indigenous and Local Knowledge was also shared regarding the specific fish, mammal, bird, berry, and plant species that are traditionally used by Indigenous Groups and LPA community members for food, medicine, and other purposes, which informed the Traditional Foods categories (TSD XXI, Section 5.1.3.2.1, Total Food Diet General Assumptions). Indigenous and Local Knowledge informed the human health receptor locations used in the risk assessment based on harvesting locations (e.g., hunting, trapping, fishing, drinking water, gathering sites; TSD XXI, Section 5.1.1.2, Subsistence Harvester).
- **Project Interactions and Mitigation:** Indigenous and Local Knowledge helped to inform the scoping of Project interactions, pathway analysis, and consideration of mitigation measures (Section 15.2.7). This includes observations and experiences of Indigenous Groups related to the cumulative effects of industrial disturbances (e.g., mining and exploration activities) to air and water quality, aquatic and terrestrial ecosystems, and associated effects to the safety of wild foods and human health.
- **Monitoring, Follow-Up, and Adaptive Management:** Feedback provided by Indigenous Groups during engagement, including recommendations, was considered in the development of monitoring and follow-up activities (Section 15.8). In addition, it is planned that ongoing feedback from Indigenous Groups on the effectiveness of mitigations would be considered when updating monitoring programs and management plans. Independent Indigenous Monitors chosen by each primary Indigenous Group would have opportunities to participate in environmental monitoring programs for the proposed Project.

Specific references to Indigenous and Local Knowledge, and Project comments and concerns related to human health raised by Indigenous Groups and LPA community members, are included in the applicable sections of this assessment.

15.2.2 Valued Components, Receptors, Measurement Indicators, and Assessment Endpoints

15.2.2.1 Valued Components and Receptors

Valued components are aspects of the biophysical, cultural, and socio-economic environments that are considered to have scientific, social, cultural, economic, historical, archaeological, or aesthetic importance (Beanlands and Duinker 1983; CNSC 2021). The BNDN and BRDN define VCs as tangible biophysical resources (e.g., particular places and species) and less tangible social, economic, cultural, health, and knowledge-based values (e.g., social cohesion, place names, Indigenous language) (TSD II: BNDN; TSD III: BRDN).

Valued components were selected based on multiple considerations (Section 6.4.1, Valued Components) such as:

- potential for interaction with the Project and degree of interaction, including presence, abundance, and amount of spatial overlap of a VC with the Project;

- sensitivity of a VC to potential Project effects and level of damage or harm that could be realized should an adverse effect occurs;
- ecological and socio-economic/cultural value to Indigenous Groups and local communities, government agencies, and the public;
- recent experience with similar projects in Saskatchewan and other jurisdictions in Canada; and
- avoidance of redundancy with other VCs; for example, if two potential VCs represent the same attributes, mitigation actions, and potential effects from the Project, only one was evaluated as part of the assessment.

Importantly, the selection of human health as a VC and the specific human health receptors that support the assessment of human health is reflective of accepted standards for an EA and HHRA. It is based on current understanding of how people use the Project LSA and regional study area (RSA), including consideration of the potential for exposure to Project-related media (i.e., air, soil, water, and sediment) concentrations during one or more Project phases. Indigenous and Local Knowledge used to inform the human health VC and receptors was shared during community information sessions for the Project in La Loche, Turnor Lake, Buffalo River, and Buffalo Narrows (Section 2 and Section 3), in JWG meetings, and in IKTLU Studies (TSD II: BRDN; TSD III: BNDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR).

Indigenous Groups spoke of the importance of hunting, trapping, fishing, and plant gathering for subsistence and survival (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR). During community information sessions, LPA community members also identified wildlife, fish, and plants as important biological components of the environment, and human health as an important human component (NexGen 2019).

Indigenous Groups rely on a diversity of wildlife and fish resources as a key part of their diets and health. The CRDN noted that "harvesting activities . . . continue to physically, emotionally, and spiritually sustain CRDN individuals and families" and "southern Denesųłiné peoples . . . primarily depended on fish and more solitary big game animals" (TSD V.2: CRDN). The MN-S consider the Region 2 territory as a vital source of food and it is estimated that approximately 70% of their food comes from hunting, trapping, fishing, and gathering (TSD IV: MN-S). The BNDN reported that hunting and trapping "remain central to the subsistence lifeways of members of the BNDN" (TSD II: BNDN). For the BRDN, "meat obtained through hunting and trapping support community and household food security and nutrition" (TSD III: BRDN). Fish are also an important part of the traditional diets and the promotion of good health for BNDN and BRDN members (TSD II: BNDN; TSD III: BRDN). The Ya'thi Néné Lands and Resources also rely on large game harvesting and a variety of fish species as a source of food (TSD VI: YNLR).

Plants are also gathered for food and medicinal purposes (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR). The important role that traditional plants play in human health was highlighted by Indigenous Groups:

> We've got all kinds of berries there. They are all used for medicine. Even the leaves from the trees are used for medicine, you know. We get rat root from there. Rat root is used for everything from mental illness to physical pain . . . . In the summer there's beautiful blueberries, raspberries, all kinds of berries there. And if somebody had kidney problems or something, my mom said "You just go out in the bush, grab some cranberries.". . . . And gooseberries, you know, is good for your eyes. (TSD V.2: CRDN)

> Berries, such as blueberries, strawberries and raspberries, are another important traditional food source, as they are full of antioxidants and promote heart and brain health. The Patterson Lake area provides a bounty for harvest which is also important for the collection of natural medicines . . . . Rat root and birch bark are collected and used for medicine, as is birch syrup . . . . Some members make tea for medicine. Members, for example, [make] medicinal green tea and cranberry tea which promote bladder health . . . . There is also sweet grass that grows in the territory and most lake water is used for drinking. (TSD IV: MN-S)

> And we can have all our medicines on the land too, that we take because I practice medicine . . . . Because it was passed down from my mom and my dad to me . . . when people ask me to make them medicine . . . I go out and I look for medicines and I find them and I help people with it. (TSD II: BNDN)

> There is a lot of medicine, my dad and I use to collect them. Ts'aili Teli (Frog Tail) on the side of the road, it looks like red rose, that is medicine . . . . He used to bring it to mom, and mom would drink it. It is good for body aches, made into tea. She mixed it with another plant, and made it into a tea. (TSD VI: YNLR)

Indigenous Groups commented on the potential for Project-related contaminants to enter the food chain within the Clearwater River watershed through effects to water quality in Patterson Lake, the associated effects on aquatic and terrestrial health, and in turn, the safety of wild foods and human health (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; BRDN-JWG 2019a; BRDN-JWG 2020; BRDN-JWG 2021b; CRDN-JWG 2020b; CRDN-JWG 2021; MN-S-JWG 2019b). Indigenous Groups also expressed concerns about human health, including potential illnesses related to uranium poisoning, radiation, air quality affected by windblown dust, contaminated clothing, contamination of wildlife, contaminants leaching into drinking water, cumulative effects from other developments (e.g., Fort McMurray, other mining activities), and uncontrolled releases as a result of human error or extreme events such as floods, fires, or earthquakes. Potential lung cancer risk from exposure to radon gas was also raised as a concern.

In alignment with good practice for an HHRA and to address the concerns raised by Indigenous Group members, the HHRA focused on members of the public (i.e., receptors) potentially exposed to airborne or waterborne constituents. This process allowed for a comprehensive assessment of the human health VC.

The selected human health receptor groups included:

- camp worker at the Project;
- subsistence harvester;
- seasonal resident/lodge operator; and
- future permanent resident of the Patterson Lake North Arm area.

The specific characteristics of these receptors are provided in the environmental risk assessment (ERA; TSD XXI) and Section 15.2.8.1, Receptor Selection and Characterization.

15.2.2.2 Measurement Indicators

Measurement indicators are used to characterize changes to attributes of the environment from the Project, other human developments, and natural factors. The changes in measurement indicators are used to predict overall effects on VCs and assessment endpoints (Section 6.3.2, Assessment Endpoints and Measurement Indicators). Three measurement indicators were identified and used for the human health VC (Table 15.2-1):

- **hazard quotient (HQ):** a measure of the ratio of the predicted exposure (i.e., daily dose) to a non-carcinogen (i.e., a non-cancer-causing substance) relative to the toxicity reference value (TRV);
- **incremental lifetime cancer risk (ILCR):** the predicted increase in lifetime cancer risk from exposure to a carcinogen related to Project activities; represents risk above background cancer risk; and
- **radiation dose:** a measure of the risk to the overall health of the human body due to an exposure to ionizing radiation.

The measurement indicators for human health are connected to intermediate components in the EA such as changes to air quality (Section 7.2) and surface water quality and sediment quality (Section 10). Accordingly, the assessments of these intermediate components are fundamental to understanding the total effects of the Project on human health (Section 6.3.3, Intermediate Components). Further detail is provided on these measurement indicators in Section 15.2.8, Risk Assessment and Section 15.2.9, Risk Characterization and Determination of Significance.

15.2.2.3 Assessment Endpoints

Assessment endpoints are qualitative expressions that represent the key properties of VCs that should be protected; as such, assessment endpoints incorporate the concept of sustainability and function as significance thresholds (Section 6.3.2). The assessment endpoint is the protection of human health, and the measurement indicators were selected to allow for the interpretation of whether or not human health would be protected. The significance of effects from the Project and other human developments on the human health VC was evaluated by linking changes in measurement indicators to the influence on the protection of the human health receptors (Table 15.2-1). Details on the application of the protection of human health as a significance threshold are provided in Section 15.2.9, Risk Characterization and Determination of Significance. The compilation and interpretation of the results from analyzing changes in measurement indicators provided lines of evidence that collectively provided a determination of whether the assessment endpoint was maintained (Section 6.3.2).

Table 15.2-1: Valued Component and Receptors, Rationale, Measurement Indicators, and Assessment Endpoint

VC	Receptors	Rationale	Measurement Indicators	Assessment Endpoint
Human health	▪ camp worker ▪ subsistence harvester ▪ seasonal resident / lodge operator ▪ future permanent resident of the Patterson Lake North Arm area	▪ Protection of human health is a core value of NexGen and a key interest identified by communities and regulators ▪ People may be exposed to changes in air quality, soil, surface water, plants, fish, and wildlife resulting from Project activities ▪ Traditional and/or current food source security ▪ Socio-economic/cultural importance	▪ HQ ▪ ILCR ▪ Radiation dose	Protection of human health

VC = valued component; HQ = hazard quotient; ILCR = incremental lifetime cancer risk.

15.2.3 Spatial Boundaries

The spatial boundaries for human health, defined in Table 15.2-2 and in the ERA (TSD XXI, Section 1.3.1 Spatial Boundaries) and shown in Figure 15.2-1, consist of the Project footprint, an LSA, and a larger RSA. These spatial boundaries were largely influenced by the study areas for the aquatic and terrestrial environments and the Indigenous and other land and resource use assessments.

The site study area, or Project footprint, includes the anticipated mine and process plant, as well as accommodations where workers reside while at work. Human health receptors would be limited within the Project footprint, other than the camp worker, who would reside at the camp.

Table 15.2-2: Spatial Boundaries for Assessment of Human Health

Study Area	Area	Description/Rationale
Site study area	228 ha (2.3 km^2)	▪ Equivalent to the anticipated Project footprint, which includes all proposed mine infrastructure and facilities (199 ha), the access road (29 ha), and accommodations where workers reside while at work
LSA	68,530 ha (685 km^2)	▪ Encompasses the LSA for the aquatic and terrestrial environments and defines the expected extent of the direct and indirect effects from the Project on selected receptors ▪ Includes the spatial extents of potential air quality effects ▪ Provides local context for assessing the residual effects
RSA	107,600 ha (1,076 km^2)	▪ Encompasses the RSA for the aquatic and terrestrial environments, but also includes Lloyd Lake (cumulative watershed area to Lloyd Lake outflow is 4,370 km^2) ▪ Provides broader scale context for Project effects and assesses cumulative effects, if applicable

LSA = local study area; RSA = regional study area.

The LSA is defined at a scale that contains the expected direct effects of the Project on selected receptors. The LSA represents the area where direct Project-related changes in the quality of air, sediment, water, and soils would be expected to occur and human health receptors would be exposed via inhalation, ingestion, and skin contact. The LSA also represents the area where local movements in fish and wildlife could be expected to occur and is an area where potential environmental effects from Project activities and components can be predicted or measured with a suitable degree of accuracy and confidence. The LSA lies within the RSA and was defined by the Clearwater River watershed boundary to just downstream of the Naomi Lake outlet (Figure 15.2-1) and includes Broach Lake, Patterson Lake, Forrest Lake, Beet Lake, and Naomi Lake. Consistent with the surface water environment, due to lake size, existing conditions and Project effects were assessed in discrete sub-basins for Patterson Lake (i.e., North Arm – East Basin, North Arm – West Basin, and South Arm) and Forrest Lake (i.e., North Basin and South Basin). While the LSA follows aquatic boundaries, the spatial boundaries also include the extent of predicted potential effects to air quality, as assessed in Section 7.2, Air Quality.

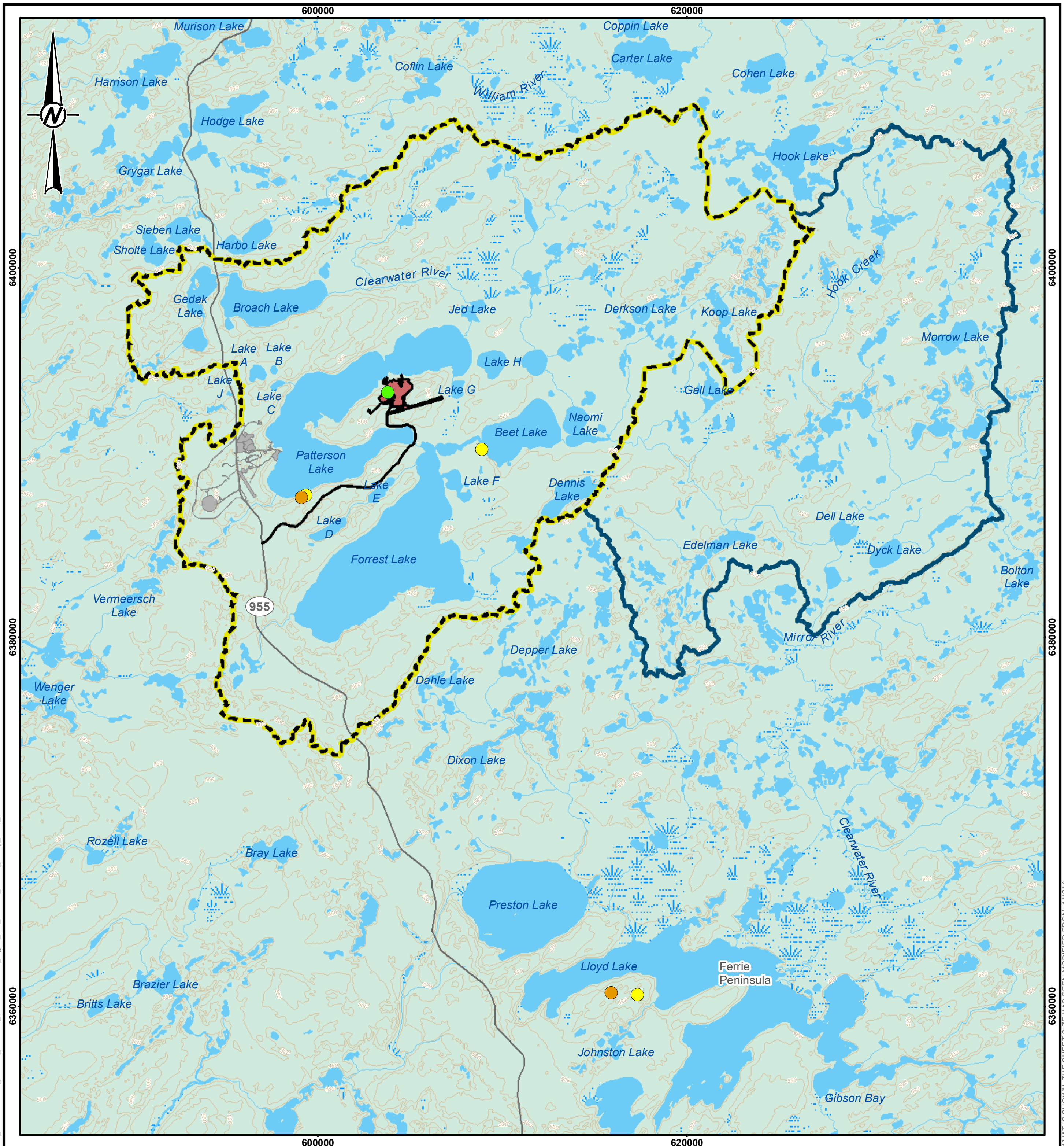
The RSA is defined to be an appropriate scale for the assessment of cumulative effects where there is potential for spatial overlap or interactions with Project effects and other previous and existing developments and RFDs. The RSA extends from the headwaters of the Clearwater River to the confluence of the Clearwater River and the Mirror River and includes major waterbodies along its course including Broach Lake, Patterson Lake, Forrest Lake, Beet Lake, Naomi Lake, and Lloyd Lake, as well as their contributing watersheds. The human health RSA encompasses the RSA for the aquatic and terrestrial environments, but also includes Lloyd Lake because of the Lloyd Lake Lodge, a fly-in lodge located on the western shore of Lloyd Lake that provides guided fishing and spring bear hunting trips for guests.

The approach used to select spatial boundaries aligns with Indigenous and Local Knowledge shared by Indigenous Groups about the interconnectedness of the region's waterways, and how rivers and lakes cannot be viewed in isolation (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.2: CRDN; BNDN-JWG 2021b;

BRDN-JWG 2019b; BRDN-JWG 2020; CRDN-JWG 2021). For example, the CRDN describe the Clearwater River as a holistic river system in which Patterson Lake, Forrest Lake, and downstream lakes (e.g., Beet Lake) are intrinsically connected to and integral to the river, and Patterson and other lakes cannot be viewed as discrete and separate waterbodies (TSD V.2: CRDN; CRDN-JWG 2021).

It is also understood that Patterson Lake, Forrest Lake, Clearwater River, and other waterbodies and watercourses in the region are important to Indigenous Groups and LPA communities for the use of water, fish, and wildlife (TSD II: BNDN; TSD III: BRDN; MN-S 2019; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; CRDN 2019a, 2019b; YNLRO 2019).

> All the lakes in the area are important, Patterson Lake especially so, as it feeds the lakes to the south and affects all the waterways from which many members fish. It is central to the river system for the entire area. Patterson Lake is an integral part of community fishing. (TSD IV: MN-S)
>
> Water is the most important thing, vital to life . . . ensuring water remains safe is the biggest concern with the project. (BNDN-JWG 2019b)
>
> I want this for the future generations. Water should be monitored, it should be kept clean, water is sacred for us. (TSD VI: YNLR)



0 5 10

1:300,000 KILOMETRES

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- WETLAND
- WOODED
- PROPOSED PROJECT FOOTPRINT
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT

HUMAN HEALTH RECEPTORS

- CAMP WORKER (REPLACED BY PERMANENT RESIDENT IN THE FAR-FUTURE SCENARIO)
- SEASONAL RESIDENT
- SUBSISTENCE HARVESTER
- HUMAN HEALTH REGIONAL STUDY AREA
- HUMAN HEALTH LOCAL STUDY

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).
3. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

HUMAN HEALTH SPATIAL BOUNDARIES

CONSULTANT

wsp

PROJECT		20144150	PHASE 3313-3
DESIGN	JMC	2023-02-09	SCALE AS SHOWN REV. 0
GIS	NO	2023-02-09	**FIGURE 15.2-1**
CHECK	JMC	2023-02-09	
REVIEW	JV	2023-02-09	

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15.2.4 Temporal Boundaries

The temporal scope of the assessment focuses on the 43-year period from initial Construction to the end of Decommissioning and Reclamation (i.e., Closure) as defined by the following Project phases (Section 6.4.2, Temporal Boundaries):

- **Construction Phase (Construction):** includes site preparation; mine, process plant, and additional infrastructure development; transportation of people and materials to and from the Project; and all activities associated with commissioning the Project up until Operations commences. The duration of Construction is expected to be four years.
- **Operations Phase (Operations):** includes all activities associated with mining and processing ore; tailings management; management of waste rock, domestic waste, and hazardous materials; water management; release of treated effluent; site maintenance; progressive reclamation; and transportation of staff and materials to and from the Project up until Decommissioning and Reclamation commences. The duration of Operations is expected to be 24 years.
- **Decommissioning and Reclamation Phase (Closure):** includes two stages expected to occur over 15 years:
  - **Active Closure Stage:** includes active decommissioning and reclamation activities that occur post-Operations, such as backfilling mine workings, removal of physical infrastructure, recontouring and revegetating disturbed areas, waste disposal and removal, and any other activities required to achieve decommissioning objectives and return the site to a safe and stable condition prior to the Transitional Monitoring Stage. The duration of the Active Closure Stage is expected to be five years.
  - **Transitional Monitoring Stage:** includes monitoring and reporting activities that occur post-Active Closure that would continue until monitoring and reporting verifies that the performance criteria have been met. Once performance criteria have been fully demonstrated, an application to be released from the CNSC licence would be submitted to the CNSC for approval. Once that is achieved, and upon Provincial approval, the land would be transferred back under Provincial management through the Institutional Control Program. The duration of the Transitional Monitoring Stage is nominally 10 years; however, NexGen acknowledges this duration would be dependent on the achievement of performance criteria.

The temporal boundaries for the assessment of human health are defined in TSD XXI (Section 1.3.2, Temporal Boundaries) and include all phases of the Project (i.e., the Project lifespan) described above and effects from the Project that may occur beyond Closure. Effects beyond Closure were assessed using a far-future projection. This far-future projection is not a Project phase; it encompasses the long-term period of extremely slow migration of constituents of potential concern (COPCs) from the UGTMF and waste rock storage areas (WRSAs) via the groundwater pathway to the receiving environment (Section 6.4.2 and Section 8.2.4, Temporal Boundaries). Consistent with the surface water quality and sediment quality assessment (Section 10), the assessment of the far-future projection includes the period of maximum release of groundwater solutes to the Patterson Lake North Arm – West Basin over the modelling timeframe. The modelling timeframe for the far-future projection was based on surface water quality modelling (Section 10.2.4, Temporal Boundaries).

Local Indigenous Groups noted that it is important to preserve water quality and aquatic and terrestrial habitats for generations into the future. For example, concerns surrounding the interaction of groundwater, and ultimately surface water, with the tailings have been raised by the CRDN (2019b), and concerns surrounding long-term effects that may affect future generations have been raised by the BRDN (TSD III: BRDN); the protection of water was a common theme identified by all local Indigenous Groups. By considering the far-future projection as described, such that potential long-term changes to surface water quality in Patterson Lake and downstream are included, the assessment addresses the desire to protect the environment and provide for future generations.

The temporal boundaries applied to cumulative effects assessments include the duration of residual effects from previous and existing developments that overlap with residual effects from the Project and the period during which the residual effects from RFDs overlap with the Project, if applicable.

15.2.5 Assessment Cases

The concept of assessment cases was applied to the human health assessment to estimate the incremental and cumulative effects from the Project and other developments (Section 6.5, Assessment Cases). The approach incorporated temporal boundaries for analyzing the potential effects from previous, existing, and approved projects and RFDs before, during, and after the anticipated lifespan of the Project. There are no known approved (but not yet constructed) projects in the LSA and RSA for human health. Assessment cases for the Project included a Base Case, Application Case, and RFD Case.

Base Case for human health is represented by existing conditions. The Base Case describes the existing environment in the RSA before application of the Project to provide an understanding of the current conditions that may be influenced by the Project. The temporal boundary of the Base Case includes the combined effects from previous and existing human disturbances and natural factors (e.g., fire, floods, drought) on the environment, and associated risks of exposure to COPCs for human receptors. As such, existing conditions represent the cumulative effects of historical and current environmental pressures that have influenced the observed condition and patterns of the observed condition and patterns of exposure pathways (CEA Agency 2018).

Application Case for human health represents predictions of the combined effects of the previous and existing projects/activities and natural factors in the Base Case plus the potential effects from the proposed Project. This case was also used to identify and assess incremental, Project-specific changes that are predicted to occur, and their effects on human health receptors. A sensitivity scenario was developed for the Application Case that was representative of reasonable upper bound conditions. The purpose of this scenario was to examine a highly conservative estimation for water quality predictions to bound the uncertainty associated with model input data.

Reasonably Foreseeable Development Case for human health includes the Base Case, Application Case, and RFDs that have not yet been approved. Reasonably foreseeable developments are defined as projects and activities that fit any of the first three and both of the last two criteria from the list below:

- are currently under regulatory review or have officially entered a formal regulatory application process;
- have been publicly disclosed by other proponents;
- may be induced by the Project;
- have the potential to change the Project or the effects predictions; and
- occur in the spatial assessment boundary defined by the VC.

A key criterion for selecting other projects to include in the RFD Case was that the projects must cause similar effects on the same receptors influenced by the Project (Hegmann et al. 1999). The Fission Patterson Lake South Property, which is planned by Fission Uranium Corp. (Fission 2019, 2021), was included in the RFD Case (Figure 15.2-1). Public information describes a projected three-year construction period and seven-year operating period (production and processing) (Fission 2019, 2021). The anticipated start of construction and duration of active decommissioning at the Fission Patterson Lake South Property were not publicly available at the time this assessment was completed. For the assessment, it was assumed that the duration of active decommissioning for the Fission Patterson Lake South Property would be similar to the Active Closure Stage for the Project (i.e., five years) (Section 6.5.3, Reasonably Foreseeable Development Case).

The proposed surface infrastructure layout plan (Fission 2019, 2021) is the anticipated physical footprint of the Fission Patterson Lake South Property and includes the proposed highway bypass, airstrip, and all proposed mine site infrastructure. The Fission Patterson Lake South Property is expected to withdraw fresh water from the Patterson Lake North Arm – West Basin and discharge treated effluent and treated sewage to the Patterson Lake South Arm. The CRDN and MN-S specifically mentioned the potential for of cumulative effects from the Project and the nearby proposed Patterson Lake South Property (CRDN 2019b; MN-S-JWG 2020; CRDN-JWG 2021).

As a scenario within the RFD Case (where applicable), potential effects from climate change, including how natural factors (e.g., fire and insects) may be altered resulting from climate change, was considered within the assessment. Indigenous Groups indicated concerns about cumulative effects from human development, policies, and climate change (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN).

The human health assessment includes a quantitative and qualitative analysis of the predicted changes on measurement indicators and the associated effects from the Fission Patterson Lake South Property on human receptors, and subsequently, the human health VC. Potential climate change influences on surface water quality in a scenario presented within the RFD Case were considered as a sensitivity scenario for the surface water quality model (Section 10). A quantitative assessment for the HHRA for this sensitivity scenario of the RFD Case was not performed, but the results are discussed qualitatively.

15.2.6 Existing Conditions

The HHRA describes and characterizes existing conditions for the human health VC and associated receptors within the LSA and RSA to provide context and a basis for evaluating potential changes from the Project. Detailed methods for the evaluation of potential changes to human health as a result of the proposed Project are provided in TSD XXI.

The existing conditions represent the Base Case in the HHRA. The baseline monitoring described below has been ongoing since 2018 and has provided sufficient baseline information to support the assumptions in the HHRA and underlying models. Other baseline programs for the Project, such as meteorological monitoring, have been in place since 2015. The following baseline data were used for the HHRA:

- waterbody physical characteristics including surface areas and volumes (Annex IV.2, Hydrometric Monitoring Characterization Report);
- baseline water and sediment quality, fish tissue data for northern pike (*Esox lucius*) and lake whitefish (*Coregonus clupeaformis*), and aquatic macrophyte tissue data (Annex V.1, Aquatic Environment Baseline Report);
- baseline soil quality (Annex VI, Terrain and Soils Baseline Report);

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- baseline blueberry (*Vaccinium myrtilloides*) and lichen quality (Annex VII.3, Vegetation Chemistry Characterization Report); and
- knowledge of existing mammals and birds (Annex VIII.1 Wildlife Baseline Report 1 [Mammals, Waterfowl, and Raptors], Annex VIII.2, Wildlife Baseline Report 2 [Amphibians, Birds and Bats], Annex VIII.3, Wildlife Baseline Report 3 [Bird Migration and Bats]).

Indigenous and Local Knowledge shared in IKTLU Studies was used to inform initial assumptions for human health receptors based on who hunts, gathers, or consumes Traditional Foods, in terms of locations, residency times, and components of the Traditional Foods diet (TSD XXI, Section 5.1.3.2, Dietary Assumptions). The IKTLU Studies are outlined in Section 15.2.1, Incorporation of Indigenous and Local Knowledge.

Human Diet

The initial assumptions for intake rates and components of the Traditional Foods diet for the HHRA used information from the First Nations Food, Nutrition and Environment Study (FNFNES) undertaken in Saskatchewan in 2015 and erratum (Chan et al. 2018, 2019). The average and 95th percentile of daily intake of Traditional Foods were used to characterize the traditional diet for an “average consumer” and “heavy consumer”. The assumptions were further refined with input from Indigenous Groups and local communities primarily through JWG discussions in October 2019 and February 2020, and later in discussions with representatives from the Saskatchewan Ministry of Environment, Saskatchewan Health Authority, and CNSC. The engagement activities informed changes to the initial assumptions regarding the prevalence of berries in the Traditional Foods diet and representative fish, game, and birds to be included in the environmental pathways model (Integrated Model for the Probabilistic Assessment of Contaminant Transport [IMPACT]) to support the Traditional Foods exposure assessment.

Engagement through the JWG sessions confirmed general agreement with the four Traditional Foods categories (i.e., fish, game, birds, berries, and plants) and their proportions in the diet (BNDN-JWG 2019a,b; BRDN-JWG 2019b, MN-S-JWG 2019a,b). For this diet, the bulk of the Traditional Foods diet was made up of fish and game meat in almost equal proportions. Birds and plants contributed to the Traditional Foods diet to a lesser extent, but also in almost equal proportions. This general Traditional Foods diet was used as the guide for developing the detailed Traditional Foods diet for the HHRA.

The feedback from the JWG meetings indicated that locally harvested berries were more prevalent in the regional diet than what was presented to the JWG in the initial assumptions (BNDN-JWG 2019a; MN-S-JWG 2019a,b), so the intake rate for berries was increased to be equivalent to 10% of the total ingestion rate of berries from all sources to accommodate that feedback.

Engagement also confirmed that the food types in the FNFNES were relevant to the Indigenous Groups, with some adjustments. Based on Indigenous Group feedback, the following adjustments were made:

- Beaver (*Castor canadensis*) was identified as a VC for the EIS and was included as part of HHRA Traditional Foods diet and as an ecological receptor, replacing muskrat (*Ondata zibethicus*).
- Spruce grouse (*Falcipennis canadensis)* replaced goose as a modelled Traditional Food item for the HHRA exposure assessment.

Once the IKTLU Studies were available, information generally confirmed selection of receptors that may be of interest to Indigenous Groups as part of the diet:

- terrestrial vegetation (e.g., lichen, blueberry [*Vaccinium myrtilloides]*, Labrador tea [*Rhododendron groenlandicum*]):
  - the CRDN identified the use of berries (i.e., blueberries, cranberries [bog (*Vaccinium vitis-idaea*), low bush (*Viburnum edule*)], gooseberries [spp.], Saskatoon (*Amelanchier alnifolia* var*. alnifolia*), cloudberry (*Rubus chamaemorus*), and strawberries [spp.]), medicines (i.e., kinnikinnick [*Arctostaphylos uva-ursi*], Labrador tea, mint [*Mentha canadensis*], spruce gum, sweet flag [rat root (*Acorus americanus*)], and mushrooms), shrubs (i.e., dogwood [*Cornus sericea,* red willow] and willows [spp.]), trees (i.e., birch [spp.], jack pine [*Pinus banksiana*], poplar [spp.], and spruce [spp.], tamarack [*Larix laricina*]), and other vegetal matter (i.e., barks, mosses, roots, and punk [rotten wood]; TSD V.1: CRDN).
  - the MN-S identified the use of berries, birch, blueberry, cranberry, mint, raspberry rat root, strawberry, and sweetgrass (*Fragaria vesca* ssp*. Americana)* (TSD IV: MN-S).
  - the BNDN identified the use of berries (spp.), birch, blueberry, bulrushes (*Vaccinium myrtilloides, Juncus alpinoarticulatus*), cranberry, mint, raspberry, and strawberry (TSD II: BNDN).
  - the BRDN identified the use of berries (TSD III: BRDN).
  - the Athabasca Denesųłiné identified specific plants harvested including Ts'aili Teli (Frog Tail [*Sarracenia purpurea ssp. gibbosa*]), Labrador tea, and blueberries, as well as berries in general (TSD VI: YNLR).
- fish (e.g., northern pike, lake whitefish):
  - the CRDN identified use of grayling (Arctic grayling [*Thymallus arcticus*]), jackfish (northern pike [*Esox lucius*]), herring (cisco; *Coregonus artedi*), lake trout (*Salvelinus namaycush*), ling cod (mariah; burbot [*Lota lota*]), pickerel (walleye [*Sander vitreus]*), and suckers (spp.; TSD V.1: CRDN; TSD V.2: CRDN).
  - the MN-S identified trout, whitefish, jack (jackfish, or northern pike), pickerel, suckers, and catfish[4] as being consumed (TSD IV: MN-S).
  - the BNDN identified fishing for lake trout, whitefish (lake whitefish [*Coregonus clupeaformis]*), jackfish, pickerel (walleye), suckers, and mariah (burbot [*Lota lota]*) (TSD II: BNDN).
  - the BRDN described fishing for lake whitefish, lake trout, jackfish, and pickerel (TSD III: BRDN).
  - Athabasca Denesųłiné identified lake trout, northern pike, suckers, pickerel, and whitefish as important species (TSD VI: YNLR).
- woodland caribou (*Rangifer tarandus caribou*):
  - the CRDN, MN-S, BNDN, BRDN, and Athabasca Denesųłiné identified woodland caribou as a culturally important species that was hunted traditionally (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR). Woodland caribou was reported to still be occasionally harvested by members of the BNDN and BRDN depending on their availability (TSD II: BNDN; TSD III: BRDN).

[4] Biological species identification is uncertain. Catfish are not known to occur in the area of the Project; however, the comment may have been referring to burbot, which have a similar appearance to catfish because of the barbel (feeler) on the chin.

- beaver (*Castor canadensis*):
  - the CRDN, MN-S, BNDN, BRDN, and Ya'thi Néné Lands and Resources identified that they trap beaver, which is also consumed by some members (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR).
- moose (*Alces alces*):
  - the CRDN, MN-S, BNDN, BRDN, and Athabasca Denesųłiné identified moose as a culturally important species that is harvested (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR).
- spruce grouse:
  - the CRDN, MN-S, BNDN, and Athabasca Denesųłiné identified spruce grouse as hunted (TSD II: BNDN; TRSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR).
- mallard (*Anas platyrhynchos*):
  - the CRDN, MN-S, BRDN, and Athabasca Denesųłiné identified ducks as important species that are hunted (TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN).

15.2.7 Project Interactions and Mitigations

Interactions (i.e., linkages) between Project components or activities, and the corresponding potential changes to measurement indicators, were identified by a pathway analysis that was then used to inform the residual effects analysis for the human health VC (Section 6.7, Pathways Analysis). The first part of the analysis was to identify all potential effects pathways for all phases of the Project (Section 6.7.1, Identification of Project Interactions). Each pathway was initially assumed to have a linkage to potential effects on receptors.

Potential pathways from Project activities to human health were identified using the following:

- review of the Project description (Section 5) and potential effect scoping by the project development, environmental, and socio-economic teams for the Project;
- input from Indigenous, regulatory, and public engagement (Section 2) and Indigenous and Local Knowledge (Section 3);
- scientific knowledge;
- previous experience with mining projects; and
- consideration of potential effects identified from the Terms of Reference (Section 1, Appendix 1A).

Potential adverse effects of the Project were then identified, and practicable mitigation was applied to avoid and/or minimize adverse effects on human health (Section 6.7.2, Identification of Mitigation). Avoidance designs and actions integrated into the Project were developed iteratively between the Project's environmental and project development teams. Minimization techniques and technology were also identified and implemented collaboratively between Project teams.

Each potential effect pathway was evaluated using proposed mitigation to predict whether the pathway had the potential to cause residual adverse effects (Section 6.7.3, Pathway Screening). A screening-level assessment was applied using Indigenous and Local Knowledge, scientific knowledge, logic, experience with similar developments, and an understanding of the effectiveness of mitigation (i.e., level of certainty that mitigation would work) to assign each pathway to one of the following categories:

- **No pathway:** Analysis reveals that the pathway could be removed (i.e., the effect is avoided) by mitigation so that the Project would result in no measurable environmental change relative to existing conditions or guideline values and, therefore, would have no residual effect on human health.
- **Secondary pathway:** The pathway could result in a measurable but minor environmental change relative to existing conditions or guideline values, but this change would be sufficiently small that it would have a negligible residual effect on human health. Therefore, the pathway is not expected to contribute to effects of RFDs to cause a significant effect.
- **Primary pathway:** The pathway is likely to result in an environmental change relative to existing conditions or guideline values and could cause a greater than negligible effect on human health.

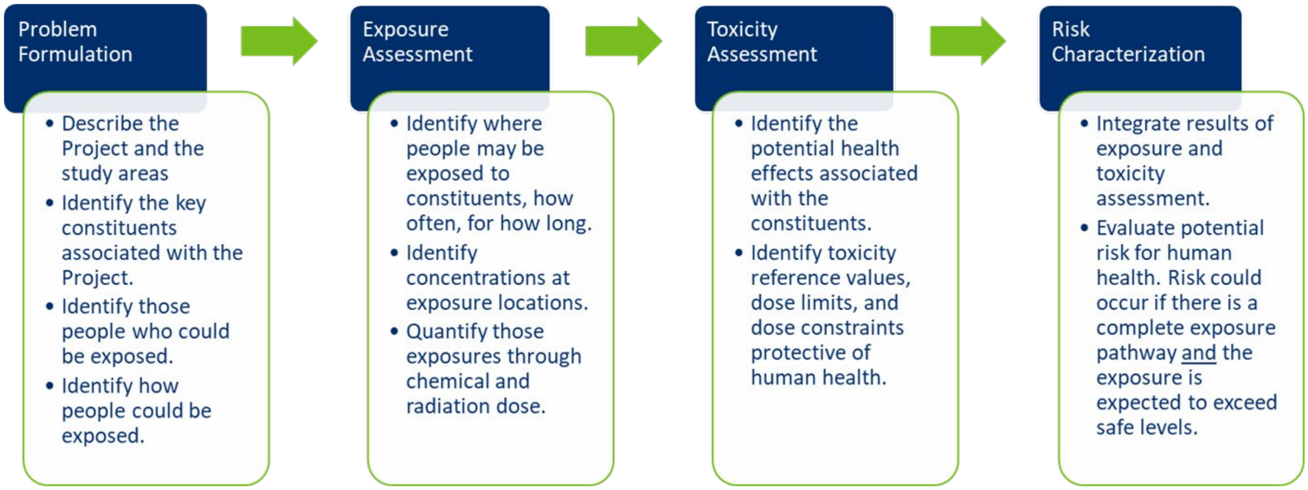
Project interactions determined as no pathway or secondary pathways were not carried forward for further assessment (Section 6.7.3). Pathways that could result in changes to the environment with one or more associated measurement indicator and that have the potential to cause a greater than negligible effect on receptors were carried forward for more detailed analysis in the Risk Assessment (Section 15.5).

15.2.8 Risk Assessment

An HHRA was completed as part of the ERA for the Project to assess potential adverse effects on human health during all Project phases (i.e., the Project lifespan) and the far-future projection. A summary of the methods and results of this assessment is provided in the subsections below for the Application Case and RFD Case. The risk assessment formed the basis for the characterization of risk to human health and the determination of significance (Section 15.2.9, Risk Characterization and Determination of Significance). Effects criteria were used as appropriate for the risk assessment approach to help characterize risks.

The HHRA was composed of the following steps: problem formulation, exposure assessment, toxicity assessment, and risk characterization (Figure 15.2-2).

Figure 15.2-2: Human Health Risk Assessment Process



The intent of the problem formulation for the HHRA was to define the goals of the risk assessment, establish an understanding of existing conditions, and develop working hypotheses as to how potential exposure of people to contaminants may result in potential risks to human health. The problem formulation defined human receptors that may be present in site study area, or Project footprint, the LSA and RSA and exposure pathways based on the fate and transport of constituents in the environment; it also identified the COPCs.

The exposure assessment included the identification of exposure locations and exposure factors for each human health receptor and the presentation of exposure concentrations and doses (i.e., non-radiological and radiological). The toxicity assessment considered potential adverse health effects from non-radiological and radiological exposures. In the toxicity assessment, TRVs and dose limits were defined. A TRV is a toxicological index associating specific health effects with a level of exposure to a chemical. Toxicity reference values used in this assessment include slope factors and unit risks for carcinogens and reference doses, tolerable daily intakes, or acceptable daily intakes for non-carcinogens. Toxicity reference values are meant to protect the most sensitive individuals.

In the risk characterization, the results of the exposure and toxicity assessments were used for each receptor to estimate the overall risk to the receptor. Risks were evaluated using HQs for non-carcinogens and ILCRs for carcinogens as measurement indicators. An HQ is the ratio of the exposure concentration or dose divided by the TRV concentration or dose. An ILCR is the product of the average lifetime exposure dose and the cancer slope factor (i.e., the risk of cancer based on exposure).

The HHRA followed guidance from CSA N288.6-22 *Environmental Risk Assessments for Class I Nuclear Facilities and Uranium Mines and Mills* (CSA Group 2022). It also met the requirements for an ERA outlined in Section 4.1 of Regulatory Document 2.9.1, *Environmental Principles, Assessments and Protection Measures* (CNSC 2020a). The ERA was developed in accordance with science and regulator expectations current to the time of writing.

15.2.8.1 Receptor Selection and Characterization

The selection of human health receptor groups was based on the current understanding of how people use the LSA and RSA, including information from IKTLU Studies, which was supplemented by information obtained during community information sessions (NexGen 2019) and JWG meetings, and the potential for exposure to Project-related media (i.e., air, soil, water, sediment) concentrations during one or more of the Project phases. Community information sessions were held by NexGen in June 2019. As part of the process, community members were invited to share information about their local land and resource uses in proximity to the Project site through a map-based exercise. Information collected during the mapping exercise informed the initial selection of receptor locations in the study areas relative to existing or previous uses. The IKTLU Studies were also used in the ERA as a primary source of information (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN, TSD VI: YNLR). These studies provided initial guidance for identifying locations where people may reside; areas where Traditional Foods are hunted, fished, and gathered; and mammal, bird, and plant species that are traditionally used by Indigenous Groups for food, medicine, and other traditional uses.

The human receptors for the HHRA were selected to be appropriate for the assessment of effects on human health from both radiological and non-radiological COPCs. Off-site members of the public would potentially be exposed to low levels of airborne or waterborne constituents being released during Project activities.

Nuclear energy workers are outside of the scope of this assessment. Consistent with CSA N288.6-22 (CSA Group 2022), nuclear energy workers would be classified and monitored in accordance with the requirements of the Radiation Protection Program and therefore did not require assessment in the HHRA. Non-nuclear energy workers at the Project site that would be subject to occupational exposure and workplace monitoring outlined in the Health and Safety Program were also excluded from the HHRA. However, in the HHRA, some workers at the Project were assumed to frequent the LSA and consume Traditional Foods, and fish, hunt, and harvest from the LSA when not working. For this reason, camp workers at the Project were assessed for both radiological and non-radiological exposures. This approach is consistent with CSA N288.6-22.

Adult and one-year-old receptors were used to assess potential risk to human health. The adult represents both male and female receptors. The one-year-old is equivalent to the CSA N288.1-20 (CSA Group 2020) age class “infant” and falls within the Health Canada age class “toddler”. As discussed in Section 15.2.2.1, the selected human health receptor groups are:

- **camp worker at the Project (adult):** Project lifespan;
- **subsistence harvesters at Patterson Lake South Arm, Beet Lake, and Lloyd Lake (adult and one-year-old):** Project lifespan;
- **seasonal residents / lodge operators at Patterson Lake and Lloyd Lake (adult and one-year-old):** Project lifespan; and
- **future permanent resident at Patterson Lake North Arm area (adult and one-year-old):** far-future projection only.

The rationale for receptor selection is provided in Table 15.2-3, and assumptions related to these receptor groups are provided in the subsections that follow the table.

Table 15.2-3: Rationale for Selection of Human Health Receptor Groups

Receptor	Rationale for Selection
Camp worker	The worker camp would be located within the Project footprint. A camp worker such as a camp cook would reside at camp for 50% of the year.
Subsistence harvester (Patterson Lake South Arm)	The subsistence harvester represents a high consumer of Traditional Foods. Patterson Lake is important to local Indigenous Groups who use the area for water, fishing, trapping, hunting, gathering, and cultural practices (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; CRDN 2019a,b; YNLRO 2019).
Subsistence harvester (Beet Lake)	The subsistence harvester is used to evaluate a high consumer of Traditional Foods in the LSA. Beet Lake is important to local Indigenous Groups, who use the area for water, fishing, hunting, and gathering (TSD V.2: CRDN, TSD IV: MN-S, TSD II: BNDN). The location is consistent with cabins identified by the MN-S and CRDN (MN-S; TSD V.1: CRDN; CRDN 2019a,b).
Subsistence harvester (Lloyd Lake)	The subsistence harvester is used to evaluate a high consumer of Traditional Foods in the RSA. Lloyd Lake is important to local Indigenous Groups, who use the area for camping, hunting, trapping, fishing, and gathering (TSD V.2: CRDN, TSD IV: MN-S, TSD II: BNDN). The location is consistent with cabins identified by the MN-S and CRDN (TSD IV: MN-S; TSD V.1: CRDN; CRDN 2019a,b).
Seasonal resident (Patterson Lake South Arm)	The seasonal resident represents an average consumer of Traditional Foods. A seasonal resident at Patterson Lake South Arm would also be representative of the Forest Lake Outfitters Camp at Beet Lake. Patterson Lake is important to local Indigenous Groups, who use the area for water, fishing, trapping, hunting, gathering, and cultural practices (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; CRDN 2019a,b; YNLRO 2019).
Seasonal resident (Lloyd Lake)	The seasonal resident represents an average consumer of Traditional Foods in the RSA. There is an existing fly-in lodge at Lloyd Lake that provides fishing and spring bear hunting excursions for guests.
Future permanent resident (Patterson Lake North Arm area)	Used to evaluate a resident living in the Patterson Lake North Arm area in the far future following Closure of the Project. This receptor is considered hypothetical as it is in the far future. The future permanent resident represents a high consumer of Traditional Foods.

MN-S = Métis Nation – Saskatchewan; CRDN = Clearwater River Dene Nation; LSA = local study area; RSA = regional study area.

Camp Worker

A camp worker at the Project (e.g., a non-nuclear energy worker such as a person preparing meals) would represent an adult male or female. This receptor group was assumed to work and reside at the Project site for 50% of the year and away from the Project for the other 50% of the year. A camp worker was assessed for the Project lifespan and not for the far-future projection.

When at work, the camp worker would be exposed to Project-related COPCs through inhalation of air and ingestion of and contact with water. Drinking water and water for bathing would be sourced from Patterson Lake North Arm – East Basin while at work. While at the Project site for work (i.e., during 50% of the year), it was assumed that the camp worker would not hunt, fish, or gather berries/plants in the area and therefore not ingest Traditional Foods from within the LSA.

A camp worker who also carries out subsistence harvesting was considered representative of the northern workforce for the HHRA. Therefore, the camp worker was assumed to consume Traditional Foods in their overall annual diet when not at work, with an ingestion rate consistent with an Indigenous Group's high consumer of Traditional Foods (TSD XXI, Section 5.2.3.1, Annual Food Ingestion Rates for Human Receptors in the Human Health Risk Assessment). For the HHRA, although the camp worker would live outside of the area of influence from the Project when not at work, it was assumed that they travel to the LSA for subsistence harvesting activities for a portion of the year (i.e., three months; 25%). This is consistent with Indigenous and Local Knowledge that suggests individuals are likely to travel to known fishing areas to catch a large supply of fish to be retained for later consumption (TSD IV: MN-S). During their time spent harvesting, they may have incidental ingestion of soil and sediment, come in direct contact with surface water through swimming and with sediments during wading, and obtain drinking water and water for bathing from Patterson Lake. The remainder of the time (i.e., three months; 25%), when not at work or harvesting in the LSA, the camp worker would reside outside of the area of potential influence from the Project and would be exposed to constituents in the environment at background levels.

Subsistence Harvester

Subsistence harvesters would represent adults and one-year-old children who reside outside the RSA full time and come to either the LSA or Lloyd Lake occasionally to hunt, fish, and gather Traditional Foods. This receptor reflects the observation that there are no documented permanent residences within the LSA but, based Indigenous and Local Knowledge shared during JWG meetings and in IKTLU Studies, the area is known to be used for subsistence harvesting including fishing, hunting, trapping, and gathering. The CRDN identified Patterson Lake as a “main lake” and “good for everything” harvesting (TSD V.1: CRDN). Harvesting activities in the Patterson Lake area are also practiced by the BNDN and BRDN, and the BNDN indicated that “hunting and trapping are central to the subsistence lifeways of members of the BNDN” (TSD II: BNDN). A subsistence harvester was assumed to be exposed to Project-related COPCs through inhalation of air and contact with the skin and/or incidental ingestion of dust deposited to soil while in the LSA or Lloyd Lake. During their time in the LSA or Lloyd Lake, they were assumed to use local surface water for drinking, bathing, and swimming and come in contact with sediments during the practice of activities such as wading.

Subsistence harvesters were assumed to ingest locally or regionally sourced Traditional Foods that are fished, hunted, trapped, and gathered and retain Traditional Foods collected from the same area for consumption throughout the year. The locally or regionally sourced Traditional Foods was assumed to comprise about 50% of their Traditional Foods diet. The portion of locally or regionally sourced Traditional Foods in the subsistence harvester overall annual diet was assumed to be consistent with a First Nations high consumer of Traditional Foods (TSD XXI, Section 5.2.3.1). In the HHRA, about 50% of the Traditional Foods for subsistence harvesters were assumed to be sourced from either Patterson Lake South Arm or Beet Lake in the LSA, or Lloyd Lake, and the other 50% from a reference location. The Patterson Lake receptor location is a near-field location within the LSA. The Beet Lake receptor location is in the area of a cabin identified by the MN-S, and the Lloyd Lake location is consistent with areas identified by the MN-S.

Seasonal Residents

Seasonal residents would represent adult and one-year-old members of the public who live in the LSA or at Lloyd Lake for part of the year, such as a lodge operator or employee. The seasonal residents were assumed to reside at a lodge either on Patterson Lake or Lloyd Lake for 30% of the year (i.e., approximately four months) and away from these areas for 70% of the year (i.e., approximately eight months) during the Project lifespan. The Patterson Lake receptor location is a hypothetical near-field location within the LSA. The Lloyd Lake receptor location is consistent with the closest existing lodge facility to the Project with on-site operators. The Lloyd Lake Lodge, which is located on the western shore of Lloyd Lake, is a fly-in lodge that provides guided fishing and spring bear hunting trips for guests. A recreational visitor at Lloyd Lake would be conservatively represented by the seasonal resident, who would have a longer residence time in the area.

The Forest Lake Outfitters Camp at Beet Lake and the Clearwater River Provincial Park were also evaluated as potential locations for seasonal residents. Forest Lake outfitters offer non-guided fishing camps for drive-in or fly-in customers with fishing access to six local lakes. Fresh water is available for customers of the Forest Lake Outfitters Camp, but groceries must be brought in by the guests. The Clearwater River Provincial Park is a wilderness park located south of the RSA at the south end of Lloyd Lake with no services or facilities

(Government of Saskatchewan n.d.). The Patterson Lake and Lloyd Lake receptor locations would conservatively bound any seasonal resident of Forest Lake Outfitters or Clearwater River Provincial Park.

While at Patterson Lake or Lake Lloyd Lake, seasonal residents were assumed to ingest local Traditional Foods fished, hunted, and gathered to the extent consistent with an average First Nation consumer of Traditional Foods (TSD XXI, Section 5.2.3.1). While at the lodge, water for drinking, bathing, and swimming was represented by water from either Patterson Lake or Lloyd Lake, and seasonal residents were assumed to come in contact with sediments of these lakes during wading. For the remainder of the year, when not at Patterson Lake or Lloyd Lake, the seasonal residents would reside in an area with constituents in the environment at background levels.

Future Permanent Residents

Indigenous Groups expressed concerns regarding the long-term potential health effects associated with mine waste materials stored at the proposed Project site following Closure (TSD II: BNDN; TSD IV: MN-S; TSD V.2: CRDN; BNDN-JWG 2019a,b; BNDN-JWG 2021a,b; BRDN-JWG 2021b; CRDN-JWG 2020b; MN-S-JWG 2019a). In consideration of these concerns, a future permanent resident was considered for the HHRA. The permanent resident group would represent potential risks to a family, adult, and one-year-old that would reside at the decommissioned and reclaimed Project site in the far future following Closure and would be exposed to Project-related COPCs at that time. It is not anticipated that there would be a permanent resident at a former Project site; therefore, this receptor is considered hypothetical, but it is assessed as a conservative assumption. The future permanent residents were assumed to reside at or near the former Project site for 100% of the year (i.e., in the Patterson Lake North Arm area).

Similar to the subsistence harvester, the future permanent resident was assumed to consume a large proportion of locally sourced Traditional Foods in their overall annual diet, consistent with a high First Nation consumer of Traditional Foods (TSD XXI, Section 5.2.3.1). For the HHRA, Patterson Lake was assumed to be a preferred fishing location due to its size and proximity to the former Project location. Water for drinking, bathing, and swimming was assumed to be from Patterson Lake. Contact with sediments in Patterson Lake during activities such as wading was also assumed.

15.2.8.2 Constituents of Potential Concern

The ERA considered inputs from Project activities through both aquatic and atmospheric pathways. These are described below.

Aquatic Sources

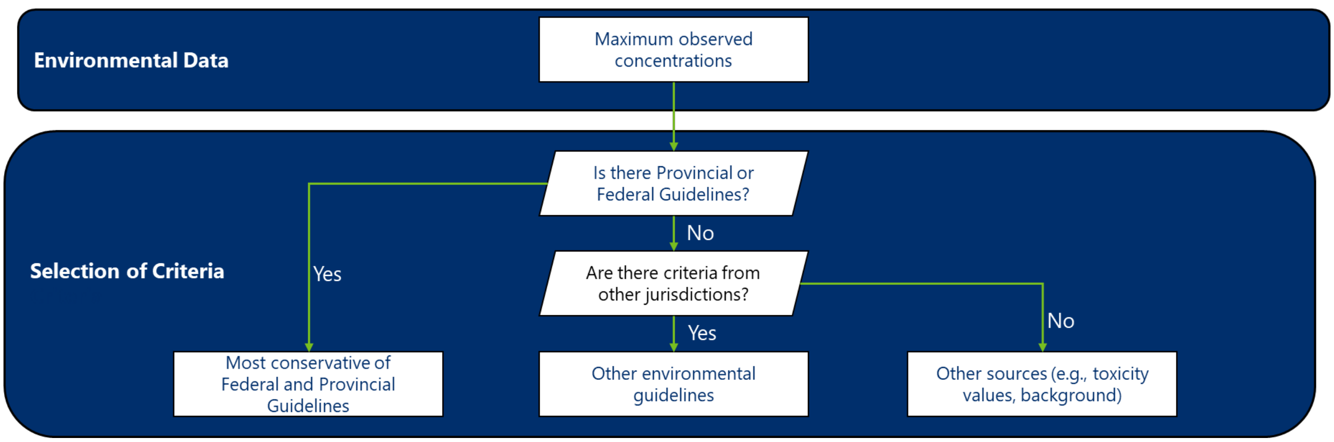
Project-related liquid releases to Patterson Lake would include the following:

- releases from the ETP to Patterson Lake North Arm – West Basin during the Project lifespan;
- releases from the sewage treatment plant to Patterson Lake North Arm – West Basin during the Project lifespan;
- site runoff to Patterson Lake North Arm – East Basin and to Patterson Lake North Arm – West Basin during the Project lifespan; and
- groundwater releases through the overburden and bedrock to Patterson Lake North Arm – West Basin in the far-future projection from the underground (e.g., UGTMF, mine workings) and above-grade sources (i.e., WRSAs).

Predicted source terms for the identified liquid releases were available for the Application Case and reasonable upper bound sensitivity scenario from TSD XVIII, Site-wide Water Balance and Water Quality Modelling Report (i.e., treated effluent and runoff); Appendix 10A, Surface Water Quality Modelling Report (i.e., water quality at the boundary of the mixing zone); and TSD XIV, Groundwater Flow and Solute Transport Modelling Report (i.e., release of soluble constituents from mine sources).

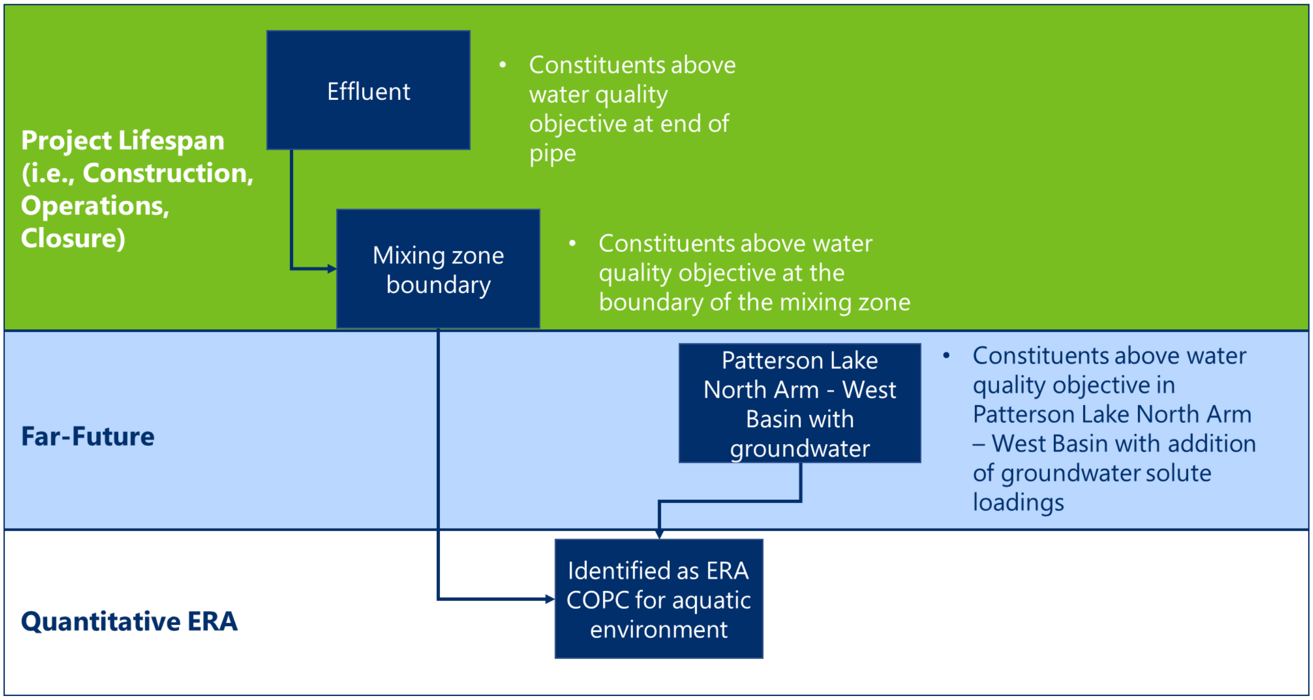
The predicted concentrations of constituents (i.e., from the near-field water quality model; Section 10) released to Patterson Lake were compared against water quality objectives (WQOs) based on the hierarchy of water quality guidelines outlined in Figure 15.2-3. The most restrictive federal or provincial guidelines for surface water quality, based on Canadian drinking water quality guidelines, are the Canadian Council of Ministers of the Environment water quality guidelines for the protection of fresh water aquatic life, the federal environmental quality guidelines, and the Saskatchewan environmental quality guidelines; these guidelines were selected as the screening values (i.e., WQOs) for most surface water COPCs. Applicable guidelines were adjusted for hardness and pH, where applicable.

Figure 15.2-3: Selection of Surface Water Screening Values for Constituents of Potential Concern for the Environmental Risk Assessment



Predicted reasonable upper bound concentrations from the Application Case reasonable upper bound sensitivity scenario were screened against WQOs according to the process outlined in Figure 15.2-4. Water quality objectives are numerical or descriptive criteria for constituents that represent an acceptable level of water quality that is protective of drinking water, aquatic life, and/or aesthetics.

Figure 15.2-4: Screening Process for Selection of Constituents of Potential Concern for the Environmental Risk Assessment



ERA = environmental risk assessment; COPC = constituent of potential concern.

As a first step, upper bound end-of-pipe treated effluent concentrations were compared against WQOs. Those constituents with predicted upper bound treated effluent concentrations above WQOs were considered further for additional screening. Upper bound concentrations at the boundary of the mixing zone were obtained from the near-field water quality model and then compared against WQOs, as a conservative approach. Those constituents with predicted upper bound concentrations at the boundary of the mixing zone above WQOs were considered COPCs for further quantitative assessment in the ERA. If upper bound concentrations of COPCs exceeded the WQOs in site runoff but not in the treated effluent, they were not considered COPCs in the ERA.

After the Project lifespan (i.e., 43 years), it is predicted that groundwater solutes would start to migrate from mine-related sources (i.e., mine workings, UGTMF, and WRSAs) to Patterson Lake North Arm – West Basin (i.e., far-future projection). A separate screening of predicted upper bound water quality after the addition of these sources was performed to determine if concentrations of any additional COPCs exceeded WQOs in the far-future projection. Maximum upper bound concentrations in Patterson Lake North Arm – West Basin in the far-future projection were used for comparison against WQOs. These concentrations were obtained from the near-field water quality model.

Additionally, predicted maximum upper bound concentrations of potential COPCs in sediment in Patterson Lake North Arm – West Basin were compared against sediment quality guidelines for the protection of aquatic life from Canadian Council of Ministers of the Environment (CCME 1999), Burnett-Seidel and Liber (2013), and Thompson et al. (2005). The IMPACT model (Section 15.2.8.4, Exposure Assessment and Model Software; TSD XXI, Appendix A), an environmental transport and pathways model, was used to predict sediment concentrations from water concentrations during the Project lifespan and for the far-future projection.

Based on the completed screening process, chloride, sulphate, arsenic, cobalt, copper, molybdenum, and uranium were identified as COPCs in the aquatic environment to be carried forward for evaluation in the ERA (TSD XXI, Section 4.2.3, Screening for Constituents of Potential Concern in Aquatic Environment).

No formal screening was conducted for radionuclides in surface water. However, since the radiation dose to human and ecological receptors is of great interest to Indigenous Groups, the general public, and regulatory agencies, the radionuclides in the uranium-238 decay series (i.e., uranium-238, uranium-234, thorium-230, radium-226, lead-210, and polonium-210) were carried forward as COPCs for further assessment in the ERA.

Radon-222 was not considered a COPC in surface water for the ERA. Radon is expected to volatilize (i.e., evaporate or disperse) rapidly to air. Health Canada (2020) considers that the health risk from ingesting radon-contaminated drinking water is negligible, as radon is expected to escape at the faucet or water outlet, leaving only negligible amounts in the water itself. This assumption is consistent with Clause 5.1.8 of CSA N288.1-20, *Guidelines for Modelling Radionuclide Transport, Fate, and Exposure Associated with Normal Operation of Nuclear Facilities* (CSA Group 2020), which indicates that noble gases, including radon-222, are not considered relevant for release to water because they do not enter environmental compartments other than air.

Atmospheric Sources

Project-related atmospheric sources of constituents released to the environment would include:

- fossil fuel combustion emissions from mobile equipment and stationary equipment (e.g., power plant, heaters);
- fugitive dust emissions from drilling and blasting, material handling, crushing, vehicle-generated road dust, and wind erosion from ore and mine rock storage piles;
- air emissions released from the milling processes (e.g., calciner, acid plant); and
- solid waste incinerators.

The screening of air quality constituents was based on maximum predicted concentrations of federal criteria air contaminants, total suspended particulates (TSP) deposition, dioxins and furans, radon, and 28 metals and metalloids at air quality model locations that correspond to ERA receptor locations. The predicted air concentrations were based on a single “maximum year” scenario modelled for each of Construction and Operations. Additionally, atmospheric emissions during Closure are expected to be lower than during Construction and Operations; and Closure modelling was not explicitly conducted. It was conservatively assumed that Closure air quality would be similar to Construction air quality (Section 7.2.2.4, Temporal Boundaries).

The modelled location at the Project camp within the Project footprint was retained for the screening as a conservative measure to verify that potential COPCs in air were captured in the ERA, since it is the closest location to the source. Maximum predicted concentrations of Project-related constituents in air at the Project camp within the Project footprint were screened using long-term (i.e., annual average) and short-term (i.e., 24 hours or less) screening values.

Additionally, receptors could be present near the boundary (i.e., fence line) of the Project footprint occasionally and for short periods (i.e., less than 24 hours) of time. Therefore, short-term maximum predicted concentrations of Project-related constituents in air at the boundary of the Project footprint were screened using short-term screening values (i.e., one hour or eight hours).

Maximum predicted concentrations of constituents in air were screened against ambient air quality criteria for the same duration. Ambient air quality criteria were selected based on the following, in descending order of importance:

- Saskatchewan Ambient Air Quality Standards are maximum concentrations in ambient air from all sources as stipulated in The Clean Air Regulations.
- Alberta Ambient Air Quality Objectives (Government of Alberta 2021) are based on an evaluation of scientific, social, technical, and economic factors.
- Ontario Ambient Air Quality Criteria (MECP 2020) are concentrations of a contaminant in air that are protective against adverse effects on health and/or the environment.
- Texas effects screening levels (ESLs) are air concentrations at or below which adverse health effect in the general public, including sensitive subgroups such as children, the elderly, pregnant women, and people with pre-existing health conditions, are not likely to occur (TCEQ 2016).

Following the screening process for selecting air quality COPCs, none of the modelled air quality constituents were considered COPCs for further evaluation in the ERA for direct atmospheric exposure (TSD XXI, Section 4.2.3). No constituents at any ERA receptor location exceeded associated annual screening values, indicating that unacceptable chronic effects from direct exposure to air would not be expected.

Exceedances for maximum predicted 24-hour concentrations within the Project footprint and at the fence line were identified for nitrogen dioxide and particulate matter, including uranium in TSP and PM_{10} (particulate matter with a nominal diameter of 10 µm or less). However, unacceptable levels of risk to people would not be expected from direct, infrequent, short-term, and highly localized exposures to these constituents in air.

Additionally, predicted maximum concentrations of constituents in soil from atmospheric deposition, modelled using the IMPACT model (Section 15.2.8.4; TSD XXI, Appendix A), were compared against Canadian Council of Ministers of the Environment soil quality guidelines. Soil concentrations at the closest receptor location (i.e., Project camp) were estimated based on maximum air concentrations from the atmospheric model using the atmospheric deposition model in IMPACT. The predicted maximum soil concentrations from atmospheric deposition would be below the soil quality guidelines for the protection of human and environmental health.

No concentration-based screening values are available for uranium-238 series radionuclides in air; however, because radionuclides are considered of interest by Indigenous Groups and the public, they were assessed further in the ERA. The ERA included the assessment of risk from exposure to radionuclides as part of the total radiological dose from atmospheric and aquatic pathways combined. Similarly, while radon concentrations in air were predicted to be below the screening value, this constituent was considered further in the ERA due to public interest.

Based on evaluation of Project-related water and atmospheric sources of constituents, including a conservative screening of maximum predicted concentrations in surface water, sediment, air, and soil, the final list of COPCs that were selected to be evaluated further in the ERA is provided in Table 15.2-4.

Table 15.2-4: Final List of Constituents of Potential Concern for the Rook I Project Environmental Risk Assessment

Metals and Metalloids
Arsenic
Cobalt
Copper
Molybdenum
Uranium
Radionuclides
Uranium-238
Uranium-234
Thorium-230
Radium-226
Radon-222[(a)]
Lead-210
Polonium-210

a) Radon-222 is evaluated as a COPC for air only.
COPC = constituent of potential concern.

While chloride and sulphate were identified as COPCs for further assessment in the ERA TSD, they were not considered in the human health assessment and HHRA. These COPCs are associated with water ingestion. Chloride does not have a drinking water standard and is not considered to present a risk to human health at concentrations found in drinking water or at concentrations predicted for Patterson Lake, even under the reasonable upper bound scenario. Sulphate in drinking water is associated with adverse physiological effects such as diarrhoea or dehydration at concentrations above 500 mg/L. The predicted upper bound concentration of sulphate at the edge of the treated effluent mixing zone would be below 500 mg/L (TSD XXI, Table 4-2); therefore, concentrations at exposure points farther downstream would be less than those associated with adverse physiological effects. For these reasons, chloride and sulphate were not assessed further with respect to human health in the HHRA.

15.2.8.3 Exposure Pathways and Conceptual Model

Radiological and non-radiological exposure pathways were assessed in the HHRA. The primary exposure routes for human health include:

- ingestion of food such as fish, vegetation, game, and store-bought foods;
- incidental ingestion of soil (i.e., while harvesting) or sediment (i.e., while wading);
- ingestion of surface water as drinking water;
- dermal (i.e., skin) contact with surface water and sediment while swimming or doing other recreational activities;
- dermal contact with soil while gardening or harvesting;
- inhalation of air (i.e., vapours and/or particulates); and
- external exposure to radiation from air, water, soil, and sediment.

Exposure pathways for selected human receptors are summarized in Table 15.2-5.

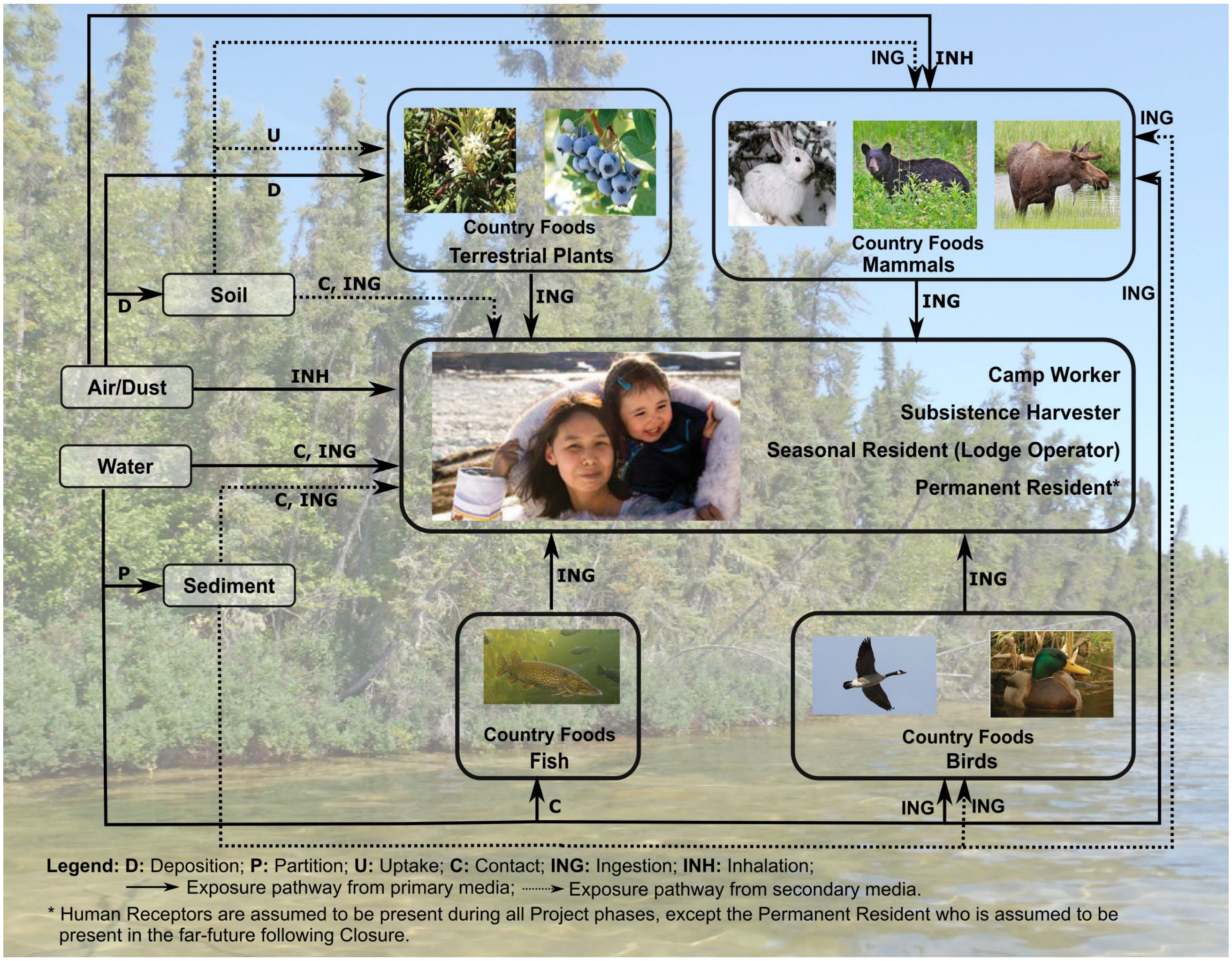
Table 15.2-5: Human Health Exposure Pathways Considered for the Rook I Project

Human Receptor Group	Environmental Exposure Pathway				
	Air	Soil	Water	Sediment	Traditional Foods[(a)]
Non-radiological Exposures					
Camp worker	Inhalation	Incidental ingestion Dermal contact	Ingestion Dermal contact	Incidental ingestion Dermal contact	Ingestion
Subsistence harvester					
Seasonal resident					
Permanent resident	Incomplete[(b)]				
Radiological Exposures					
Camp worker	Inhalation External	Incidental ingestion External	Ingestion External	Incidental ingestion External	Ingestion
Subsistence harvester					
Seasonal resident					
Permanent resident	Incomplete[(b)]				

a) Plants and animals that are ingested as a source of food and have been directly or indirectly exposed to Project-related COPCs.
b) The pathway is identified as incomplete as there is no ongoing source of air COPCs during the far-future projection when a future permanent resident may reside at or near the reclaimed Project.
COPC = constituent of potential concern.

The conceptual model illustrates how receptors would be exposed to COPCs. It represents the relationship between the source and receptors by identifying the source of COPCs, receptors, and the exposure pathways to be considered in the assessment for each receptor. Exposure pathways represent the various routes by which radionuclides and/or chemicals may enter the body of the receptor or, for radionuclides, how they may exert effects from outside the body. No pathways have been removed due to controls, mitigation, or treatment. The human health conceptual site model is illustrated in Figure 15.2-5.

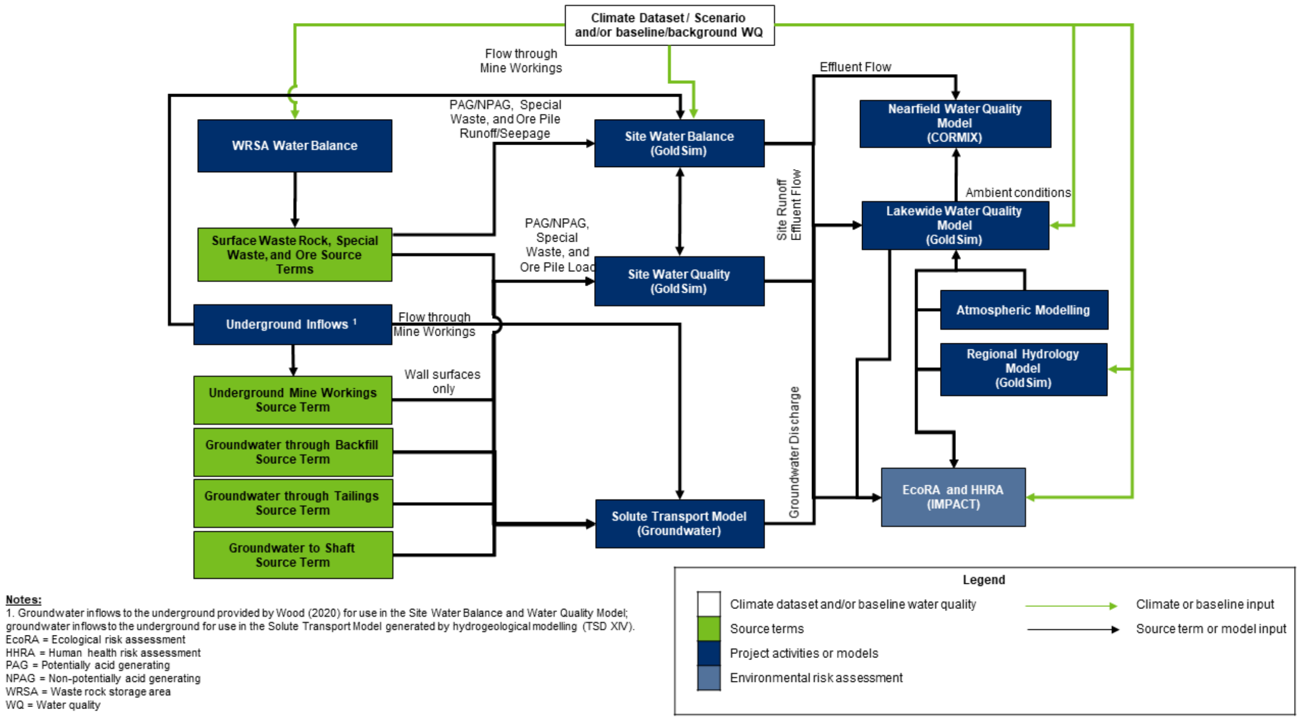
Figure 15.2-5: Human Health Conceptual Site Model



15.2.8.4 Exposure Assessment and Model Software

The ERA used predicted Project emissions for the assessment and integrated inputs and sources from other disciplines, as demonstrated at a high level in Figure 15.2-6. In general, the ERA received information directly from the site-wide water balance and water quality model, solute transport model, and atmospheric modelling.

Figure 15.2-6: Model Integration Diagram



An environmental transport and pathways model was used to evaluate the effects of ERA COPCs on the local environment, including human and ecological receptors. The software used for the exposure pathways analysis and for the calculation of radiological doses was IMPACT Version 5.6.0, which is consistent with the COPC transport equations and radiological dose calculations outlined in CSA N288.1-20 (CSA Group 2020). Equations used for non-radiological dose calculations are consistent with those from CSA N288.6-22 (CSA Group 2022), which have generally been obtained from Health Canada guidance. A more detailed description of the model, including all input parameters used, is provided in TSD XXI and associated appendices.

A sensitivity scenario was developed for the Application Case that was representative of reasonable upper bound conditions. The purpose of this scenario was to examine a highly conservative estimation for water quality predictions to bound the uncertainty associated with the model input data. This scenario was characterized by Base Case conditions and Project effects using reasonable upper bound inputs from the site-wide water balance and water quality model and the groundwater solute transport model.

15.2.9 Risk Characterization and Determination of Significance

The risk characterization used a reasoned narrative to describe anticipated changes to each measurement indicator caused by the proposed Project and other activities or projects and the associated effects on human health. This narrative description of anticipated effects is the foundation for the significance determination. The characterization of risks to human health is summarized in tabular form using EA effects criteria (i.e., direction magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence).

The potential for adverse effects on human health was determined in the risk assessment through the risk characterization step, where risk estimates were calculated to determine the potential for effects on the human receptors identified. The risk estimate was determined by comparing the predicted exposures, in terms of doses, with exposures that are known to be protective based on effects data (i.e., TRVs or radiation dose limits).

The risk estimate for non-carcinogens was quantified for the human receptor based on the calculation of a HQ. To account for uncertainty in pathways beyond Project activities (i.e., exposure to background sources unrelated to the Project), it was determined that to be protective, a benchmark HQ value of 0.2 per medium (e.g., water, soil, food, air), or less, would be considered acceptable for the assessment. This approach is consistent with the approach taken by Health Canada (2021a) in its guidance on human health preliminary quantitative risk assessment.

Hazard quotients were calculated in IMPACT, as shown below:

$$HQ = \frac{Exposure\ (Dose)\ Estimate}{TRV}$$

For carcinogens (e.g., arsenic), the incremental risk (i.e., total risk minus background risk) of developing cancer over a lifetime was estimated by multiplying the predicted dose above background by the cancer slope factor, as shown below:

$$ILCR = \sum LADD_i \times SF \times ADAF_i$$

Where:

ILCR = incremental lifetime cancer risk (unitless)

ADAFi = age-dependent adjustment factors for life stage i

LADDi = dose received during life stage i averaged over a lifetime (mg/kg/d)

SF = adult cancer slope factor (per mg/kg/d)

Incremental lifetime cancer risks were compared to de minimis risk levels; de minimis risk levels are those that are considered essentially negligible compared to background cancer risks. Cancer risks that are considered acceptable can range from 1 in 10,000 to 1 in 1,000,000 in different jurisdictions. Health Canada (2021a) considers an increase in lifetime cancer risk of 1 in 100,000 (or 0.00001) to be essentially negligible compared to the background cancer risk level in North America of approximately 5 in 10 (or 0.5).

Arsenic was evaluated in the HHRA as a non-threshold carcinogen (i.e., a linear dose-response relationship); therefore, predicted exposure was averaged over the receptor's lifetime to estimate a lifetime average daily dose representing a combination of all life stages (Health Canada 2021a). For this assessment, the lifetime average daily dose was estimated for various age groups (i.e., toddler, child, teen, or adult) to permit estimation of the lifetime risk to a composite receptor for each of the subsistence harvester, seasonal resident, and permanent resident. For the camp worker, an adult receptor was considered appropriate. The composite receptor represents a person exposed to the constituent throughout all stages of a lifetime. The cancer risk (i.e., ILCR) was estimated using the lifetime average daily dose and the cancer slope factor, and the age-dependent adjustment factors for all life stages were set at 1. The cancer slope factor for arsenic was set by Health Canada based on cancer studies and is intended to protect the most sensitive individuals. Given that certain inputs in the model were not easily adjusted, such as percent bioavailability, post-modelling adjustments were made on the outputs to account for bioavailability of arsenic in certain foodstuffs (i.e., moose organs and moose meat)

(Laird and Chan 2013) and the percent inorganic arsenic present in fish tissue, given that 90% is present in a relatively non-toxic, organic form (i.e., arsenobetaine; ATSDR 2007).

For radiation dose, the regulatory public dose limit and dose limit for a non-nuclear energy worker for radiation protection of 1 millisievert per year (mSv/yr; a measure of effective energy absorbed in the body per unit mass per year) was applied, as described in the Radiation Protection Regulations under the *Nuclear Safety and Control Act*. The limit is incremental and is exclusive of natural background, such as natural levels of radon and medical exposures. A dose constraint of 0.3 mSv/yr was established for the public from all radionuclides and all pathways for the Project, as recommended by Health Canada (2010b). The dose constraint represents a dose lower than the public dose limit that ensures the combined dose from multiple sources does not result in exceedance of the public dose limit. Radon dose was added to the radiation doses to account for the formation of radon-222 (and short-lived decay products) in the uranium-238 decay series and compared against the dose limit of 1 mSv/yr.

The determination of significance is not based solely on exceedance of the acceptable risk level for the HQ, ILCR, or radiation dose. Exceedance of the acceptable risk level may indicate that further evaluation is needed. Therefore, determination of significance of the results of the HHRA was based on evaluation of the applicable residual effects criteria, as well as the consideration of conservatism and uncertainty in the predicted risk estimates (Table 15.2-6).

Table 15.2-6: Description of the Risk Characterization Criteria for Assessment of Human Health

Criterion	Rating	Definition
Direction	Positive	Change in measurement indicator results in net improvement or benefit to human health VC
	Neutral	Change in measurement indicator results in no change to human health VC
	Negative	Change in measurement indicator results in net degradation or loss to human health VC
Magnitude	Qualitative narrative or numeric quantification	Change in measurement indicator/risk estimate is described by effect size (i.e., comparison of Project HQ to 0.2 per exposure pathway, cancer risk level to 1×10^{-05}, and radiation dose to regulatory public dose limit of 1 mSv/yr)
Geographic extent	Local	Change in measurement indicator is confined to the LSA
	Regional	Change in measurement indicator extends beyond the LSA but is confined to the RSA
	Beyond regional	Change in measurement indicator extends beyond the RSA
Duration	Qualitative narrative or numeric quantification	Change in measurement indicator is described by effect duration (e.g., months, years, decades, permanent)
Reversibility	Reversible	Change in measurement indicator is reversible within a clearly defined time period
	Irreversible	Change in measurement indicator is predicted to influence the component indefinitely
Frequency	Occasional	Change in measurement indicator is expected to occur rarely (e.g., once or a few times)
	Periodic	Change in measurement indicator is expected to occur consistently at regular intervals or associated with temporal events (e.g., during dry summers)
	Continuous	Change in measurement indicator is expected to occur all the time
Probability of occurrence	Unlikely	Change in measurement indicator is not expected to occur, but not impossible
	Possible	Change in measurement indicator may occur, but is not likely
	Probable	Change in measurement indicator is likely to occur, but is uncertain
	Certain	Change in measurement indicator will occur

HQ = hazard quotient; ILCR = incremental lifetime cancer risk; mSv/yr = millisieverts per year; HHRA = human health risk assessment; LSA = local study area; RSA = regional study area; VC = valued component.

15.2.10 Prediction Confidence and Uncertainty

The purpose of the assessment is to predict the future conditions for human health with the addition of the Project and the Fission Patterson Lake South Property. As with all predictions of future conditions, the predictions made in this assessment embody some degree of uncertainty. The assessment applied a precautionary (i.e., conservative) approach to address uncertainty by identifying the greatest magnitude, duration, and geographic extent of potential adverse effects when a range of possible outcomes were possible. Consequently, uncertainty was addressed in a manner that increased the level of confidence that residual effects were conservatively estimated. The key uncertainties for human health and the way they were addressed were presented as part of this assessment (Section 15.7, Prediction Confidence and Uncertainty).

The prediction confidence and uncertainty for human health focuses on the evaluation of conservatism in the problem formulation, exposure assessment, and toxicity assessment in the HHRA. This would include identifying the sources of uncertainty in the receptors selected, identifying the sources of conservatism that address uncertainty in the exposure assumptions, including consumption rates and dietary components, as well as conservatism built into the models, and identifying the sources of uncertainty in the TRVs and the inclusion of uncertainty/safety factors.

15.2.11 Monitoring, Follow-Up, and Adaptive Management

Monitoring programs are proposed to address the uncertainties associated with the effects predictions and to evaluate the performance of mitigation. In general, monitoring is used to verify the effects predictions. Monitoring is also used to identify any unanticipated effects and to support the implementation of adaptive management to limit these effects. Typically, monitoring includes one or both of the following categories that may be applied during the Project lifespan:

- **Regulatory compliance monitoring:** monitoring activities, procedures, and programs undertaken to confirm the implementation of approved design standards, mitigation and conditions of approval, and NexGen commitments (e.g., treated effluent and environmental monitoring to meet licence conditions).
- **Follow-up monitoring:** programs designed to test the accuracy of effects predictions, reduce or address uncertainties, determine the effectiveness of mitigation, or provide appropriate feedback to operations for modifying or adopting new mitigation designs, policies, and practices (e.g., implementation of adaptive management). Results from these programs can be used to increase the certainty of effect predictions in future EAs.

Where relevant, conceptual monitoring programs would be proposed to confirm predictions and to address the uncertainties associated with the effects predictions and mitigation, and upon Project approval, would be included in the Integrated Management System.

The implementation of robust, long-term environmental testing and monitoring has also been requested by Indigenous Groups to verify protection of the environment, including community-led monitoring during Construction and Operations of the proposed Project (TSD IV: MN-S; TSD V.2: CRDN; TSD VI: YNLR).

In addition to environmental monitoring programs typically implemented for projects (i.e., as noted above), NexGen is working with local Indigenous Groups to implement independent environmental monitoring. In combination with standard Project monitoring processes, independent Indigenous monitoring would be used to verify Project performance and to determine if mitigations and controls are effective in protecting the receiving environment.

Adaptive management measures may also be proposed to address the uncertainties associated with the effects predictions and mitigation. The process for determining when, how, and where to use adaptive management would be described within the Integrated Management System Manual.

15.3 Existing Conditions

15.3.1 Baseline Concentrations of Constituents in Environmental Media

As indicated in Section 15.2.6, Existing Conditions, baseline data from several other disciplines were used to support the HHRA:

- water and sediment quality, fish tissue data for northern pike and lake whitefish, and aquatic macrophytes (Annex V.1, Aquatic Environment Baseline Report);
- air quality (Annex I, Atmospheric Baseline Report);
- soil quality (Annex VI, Terrain and Soils Baseline Report);
- blueberry and lichen quality (Annex VII.3, Vegetation Chemistry Characterization Report); and
- wildlife baseline [Annex VIII.1, Wildlife Baseline Report 1, (Mammals, Waterfowl, and Raptors); Annex VIII.2, Wildlife Baseline Report 2 (Amphibians, Birds and Bats); Annex VIII.3, Wildlife Baseline Report 3 (Bird Migration and Bats)].

The baseline data related to these disciplines are also summarized in the relevant EIS annexes as identified above.

Indigenous Groups have noted the inter-relationships between different biophysical components of the environment, and the vital role that air and water quality plays in contributing to aquatic and terrestrial environmental health, as well as to food safety and human health (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR). Qualitatively, some CRDN, BNDN, and BRDN members have commented on the clear clean waters of the Clearwater River, up to and including Patterson Lake and other lakes in the area of the Project (TSD II: BNDN; TSD V.2: CRDN; BRDN-JWG 2019b):

> This is all really clear, clean water too. Patterson's really clean. All this. Like this river, in here, like this connects Beet and all this stuff here. Right in this area here, until it gets to the Clearwater, is really really clear water . . . . It's pretty clear into here . . . . But here (tli kli na*/Where the Rivers Meet) it's all really clean clear good water. Like, Patterson, Forrest, all that, is really good water. (TSD V.2: CRDN)

> It's nice [around Patterson Lake], you know? . . . . It's a really nice area. Anywhere north is nice. It's kind of the same from Patterson, you know, west and east. A lot of sand and nice clear water. (TSD II: BNDN)

However, other Indigenous Group members from the CRDN, MN-S, and BNDN have noted a deterioration in water quality, fish health, and wildlife health in and around Patterson Lake (TSD II: BNDN; TSD IV: MN-S; TSD V.2: CRDN). Some CRDN members noted that the waters of Patterson Lake and Forrest Lake are no longer clear and clean since exploratory barge drilling began on Patterson Lake prior to 2013 (TSD V.2: CRDN).

The BNDN have reported that there have been diseased fish over the past few years in Patterson Lake (TSD II: BNDN).

The existing surface water quality and sediment quality conditions in the waterbodies in the LSA and RSA are presented in Section 10.3, Existing Conditions. Generally, concentrations of surface water constituents were below water quality thresholds (i.e., good quality) for both aquatic and terrestrial life and drinking water within the LSA waterbodies and watercourses, with some exceptions (i.e., iron, manganese, lead, nickel, and arsenic in some samples). Similarly, concentrations of sediment constituents were below sediment quality thresholds in waterbodies in the LSA and RSA, with some exceptions (i.e., arsenic, vanadium, and polonium-210 in some samples). Several constituents were measured at or below the analytical detection limit.

Some members of the BNDN, BRDN, and MN-S have noted that “clean fresh air” is one of the things they appreciate the most about where they live (BNDN-JWG 2020a; BRDN-JWG 2020; MN-S-JWG 2020). Members of the MN-S highlighted the importance of respecting the air and keeping it clean for human health and also for future generations (MN-S-JWG 2019a). However, other Indigenous Group members have indicated that they are experiencing the effects of poor air quality from existing or previous industrial developments, which they believe has affected the health of the landscape, vegetation, and wildlife (TSD II: BNDN, TSD III: BRDN, TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; CRDN-JWG 2021; BNDN-JWG 2019b; BRDN-JWG 2019a; BRDN-JWG 2019b; MN-S-JWG 2019b).

The existing air quality conditions are presented in Section 7.2.3, Existing Conditions. Baseline air quality was monitored at one location in the area where the main facilities are expected to be constructed as well as several regional air quality monitoring locations outside of the RSA, as far away as 210 km. Baseline air quality was measured for nitrogen dioxide, sulphur dioxide, sulphuric acid, carbon monoxide, $PM_{2.5}$ (particulate matter with a nominal diameter of 2.5 µm or less), PM_{10}, and TSP. Baseline studies generally showed that the existing conditions are indicative of a rural setting, relatively unaffected by outside influences on air quality. Baseline air quality was generally within the Saskatchewan Ambient Air Quality Standards or other relevant standards. Air quality conditions can generally be classified as good based on the monitoring conducted.

Baseline soil samples were collected from locations in the Project footprint and the LSA as part of the baseline monitoring program (Annex VI). Soil samples were analyzed for pH, electrical conductivity, sodium absorption ratio, soluble cations, cation exchange capacity, base saturation, particle size, and a wide range of metals and radionuclides. Results indicated that baseline soil quality was generally within the selected soil quality guidelines for protection of human and ecological health with the exception of boron, sulphur, and uranium at individual locations. The majority of the soil sample horizons were coarse textured (i.e., sand to loamy sand).

The risk estimates for the existing conditions (i.e., Base Case) for each COPC, receptor, and location are provided in the tables in Section 15.5, Risk Assessment. Risk estimates for existing conditions help provide the context to interpret the effects predicted for the Project.

15.3.2 Background Sources of Radiation and Radioactivity

Background radiation and radioactivity is present in the environment due to natural and anthropogenic (i.e., human-caused) sources. The four primary sources of natural radiation are cosmic radiation, terrestrial radiation, and intake of naturally occurring radionuclides through inhalation and ingestion (CNSC 2020b). Exposure to natural radiation can occur both indoors and outdoors.

Cosmic radiation originates from the sun and celestial events. Some of the ionizing radiation can penetrate through the Earth's atmosphere and result in an external radiation dose at the Earth's surface. Terrestrial radiation results from the natural composition of the Earth's crust such as deposits of uranium, potassium, and thorium present in soils, rocks, and building materials, which can release small amounts of ionizing radiation during the natural decay process, resulting in an external radiation dose (CNSC 2020b).

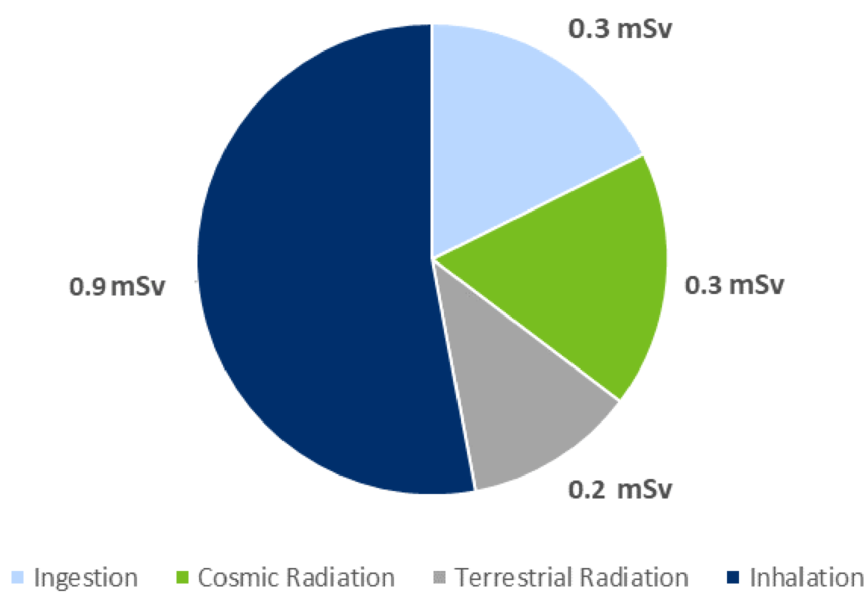
Naturally occurring radionuclides are also incorporated into plants, animals, and water from surrounding soils and rocks. Ingesting these foodstuffs and water results in an internal radiation dose due to exposure to natural radiation.

Radioactive gases can be produced from radioactive minerals found in soil and bedrock. Radon gas, a product of the decay of uranium in soil, typically disperses rapidly once it reaches the atmosphere; however, it can also accumulate inside buildings and when inhaled, contributes to an internal radiation dose.

The annual effective dose from natural background radiation is approximately 1.8 millisieverts (mSv) (Figure 15.3-1) in Canada and 2.4 mSv worldwide (CNSC 2020b). The effective dose represents the amount of energy absorbed by tissue from ionizing radiation.

There are no known existing anthropogenic sources of radiation or radioactivity in the LSA and RSA.

Figure 15.3-1: Breakdown of Doses from Natural Background Radiation in Canada



Source: CNSC 2020b.
mSv = millisievert.

15.4 Project Interactions and Mitigations

The pathways analysis identified potential adverse effects of the Project on human health, identified practicable mitigation for these potential effects, and determined whether potential effects could be sufficiently mitigated such that they are not expected to cause a residual adverse effect. As described in Section 15.2.7, the pathways analysis assigned each potential effect as:

- no pathway (i.e., mitigation results in no effect on human health);
- secondary pathway (i.e., mitigation results in a negligible effect on human health); or
- primary pathway (i.e., effect that is greater than negligible and carried forward for further assessment).

The pathways analysis is summarized in Table 15.4-1. The subsections following the table provide the rationale used to assign potential effects to the no pathway category and list primary pathways. No potential effects were classified as secondary pathways. Each Project interaction identified as a primary pathway was carried forward for detailed assessment in Section 15.5, Risk Assessment. Effects pathways apply to all Project phases unless otherwise noted.

Assessment of all exposure pathways was performed to understand the combined effects of all potential sources of COPCs on human health, as per the exposure pathways and conceptual model outlined in Section 15.2.8.3. As shown in Table 15.2-5 and Figure 15.2-5, the HHRA integrated multiple human health exposure pathways so that the assessment could evaluate the effects of the combined exposure pathways.

The environmental design features and mitigations in Table 15.4-1 represent the list of key actions used to inform the pathway analysis as part of preparing the EIS. In addition to this list of key actions, NexGen would implement the Environmental Protection Program, which would describe the processes required to monitor and characterize emissions from Project facilities and activities. This program would be used to periodically evaluate mitigation performance and identify additional mitigation, where required, and prompt potential adaptive management measures (Section 15.8, Monitoring, Follow-Up, and Adaptive Management). Where relevant, adaptive management measures may also be proposed to address uncertainties associated with effects predictions and mitigation. The process for determining when, how, and where to use adaptive management would be described within the Integrated Management System Manual.

Potential accidents and malfunctions that have the capability to influence biophysical or human environments are discussed in Section 21, Accidents and Malfunctions.

Table 15.4-1: Potential Effects Pathways for Human Health

Pathway ID	Project Components/Activities	Effects/Exposure Pathway	Environmental Design Features and Mitigation	Pathway Assessment
HH-01	Project components/activities that contribute to fugitive dust and radon emissions **during all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ process plant and underground operations ▪ handling and storage of waste rock, special waste rock, and ore ▪ site traffic ▪ transportation of personnel and materials to and from the site	**Emission and deposition of fugitive dust and radon:** ▪ Fugitive dust (e.g., metals, radionuclides) and radon emissions may adversely affect human health receptors through inhalation ▪ Radon emissions and deposition of fugitive dust (e.g., metals, radionuclides) can cause changes in soil and water quality and may adversely affect human health receptors through food ingestion (e.g., berries, fish, game meat)	▪ **Optimize haul routes** to reduce fuel consumption and emissions from equipment ▪ **Apply water and/or suppressants to site roads, access road, and airstrip**, as necessary. Use dust suppressants that minimize environmental risk and are government approved for use ▪ **Limit vehicle speed on unpaved site roads** to reduce fugitive dust during Construction and Operations ▪ Implement a Project-specific **Environmental Monitoring Plan** that includes ambient air monitoring and adaptive management based on ambient air quality standards ▪ Implement a Project-specific **Environmental Monitoring Plan** that includes water quality monitoring and adaptive management if necessary ▪ Implement a Project-specific **Environmental Protection Program**	Primary pathway
HH-02	Project components/activities that contribute to criteria air contaminant emissions **during all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ process plant and underground operations ▪ non-hazardous waste incineration ▪ power generation ▪ handling and storage of waste rock, special waste rock, and ore ▪ additional infrastructure (e.g., camp, maintenance shop, offices) ▪ site traffic ▪ transportation of personnel and materials to and from the site	**Emission and deposition of criteria air contaminants and suspended solids:** ▪ Criteria air contaminants (e.g., nitrogen, sulphur oxides) may result in changes to air quality and may adversely affect human health receptors through inhalation ▪ Deposition of suspended solids in criteria air contaminant emissions can cause changes in soil and water quality and may adversely affect human health receptors through food ingestion (e.g., berries, fish, game meat)	▪ Primarily **use liquified natural gas for power generation**, which generates lower emissions per unit of energy produced than diesel, for on-site power generation ▪ Evaluate opportunities to **reduce fuel combustion requirements** of infrastructure and equipment, to the extent practical, during detailed design ▪ Use **pollution control technology** on process plant exhaust stacks with preventative maintenance and stack testing and adaptive management, if required ▪ **Use Tier 4 diesel mobile equipment for underground operations,** whenever practical, with applicable mine ventilation airflow rates specified by Canada Centre for Mineral and Energy Technology, when available ▪ Identify and implement **procurement criteria** to confirm stationary and mobile engines meet applicable performance standards ▪ **Optimize haul routes** to reduce fuel consumption and emissions from equipment ▪ **Recover heat from the liquid natural gas power plant** exhaust and use to heat other process and ancillary buildings, if practical ▪ **Use and maintain emissions control devices** on motorized equipment ▪ Conduct **regular equipment maintenance** ▪ **Limit idling of vehicles** and equipment, to the extent practical ▪ **Maintain mobile mining equipment and vehicles** and operate the equipment within parameters for engine exhaust system design ▪ Implement a Project-specific **Effluent and Emissions Plan** ▪ Implement a Project-specific **Environmental Monitoring Plan** that includes monitoring ambient air, water quality, and aquatic organisms ▪ **Implement** a Project-specific **Environmental Protection Program**	Primary pathway
HH-03	Project components/activities that may change surface water and sediment quality through treated effluent release during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ process plant and underground operations ▪ handling and storage of waste rock, special waste rock, and ore ▪ effluent treatment ▪ additional infrastructure (e.g., roads, airstrip, camp) ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure	**Discharge of treated effluent:** ▪ Release of treated effluent (from the effluent treatment plant and sewage treatment plant) into Patterson Lake may cause changes to surface water quality (and indirectly sediment) and adversely affect human health receptors through drinking water and food ingestion (e.g., fish)	▪ **Locate proposed treated effluent diffuser** away from sensitive or unique fish habitats, to the extent practical ▪ **Install and operate an ETP and a STP** to reduce release of COPCs (e.g., major ions, metals, radionuclides) to the environment and discharge treated effluent and treated sewage to Patterson Lake ▪ **Monitor treated effluent and treated sewage** flow and quality ▪ **Collect, store, and routinely monitor contact water** to confirm discharge water meets water quality criteria appropriate for release ▪ Design the treated effluent diffuser and treated sewage outfall to **provide effective mixing and dilution of the effluent** to limit the area of the receiving environment affected by mine discharge ▪ **Design outfall(s)** such that discharged flow does not interact with sediment ▪ **Recycle and reuse process water** to reduce fresh water intake and release to Patterson Lake, to the extent practical ▪ Implement a Project-specific **Effluent Monitoring Plan** that includes monitoring the quality of treated effluent prior to release to the environment ▪ Implement a Project-specific **Environmental Monitoring Plan** that includes monitoring water and sediment quality and applying adaptive management, if necessary ▪ Implement a Project-specific **Waste Management Program** ▪ Implement a Project-specific **Environmental Protection Program** ▪ Develop and implement a **Detailed Decommissioning and Reclamation Plan** to decommission and transfer the site to the province under the Institutional Control Program	Primary pathway

Table 15.4-1: Potential Effects Pathways for Human Health

Pathway ID	Project Components/Activities	Effects/Exposure Pathway	Environmental Design Features and Mitigation	Pathway Assessment
HH-04	Project components/activities that may change surface water and sediment quality through direct site runoff during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ handling and storage of waste rock, special waste rock, and ore ▪ infrastructure (e.g., roads, airstrip, and camp, maintenance shop, offices) ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ storage of waste rock and special waste rock	**Site runoff:** ▪ Runoff from the Project footprint may cause changes to surface water quality (and indirectly sediment) and adversely affect human health receptors through food ingestion (e.g., fish)	▪ **Limit the Project footprint** to the extent practical using practices such as: o Optimize the use of cleared areas for Project activity o Use existing road infrastructure, including the existing access road and bridge crossing o Store tailings underground o Design infrastructure footprint efficiently (e.g., buildings clustered together) ▪ **Provide adequate contact water storage capacity** to manage runoff and seepage from Project infrastructure and disturbed areas ▪ **Minimize areas of vegetation clearing** and soil disturbance ▪ **Minimize steepness and length of slopes** of disturbed areas and stockpiled soils ▪ **Avoid placing soil stockpiles** near waterbodies (i.e., maintaining 150 m buffer from waterbodies), and near natural drainage features, unless required for temporary storage ▪ To the extent practical, **work in sensitive areas** (i.e., erosive soils, wetland features, and fish habitats) would be scheduled **to avoid periods that may result in high flow volumes and/or increase erosion and sedimentation** (e.g., spring freshet) ▪ **Collect and monitor contact water** to determine whether treatment is required prior to release to the environment ▪ Implement **sedimentation and erosion control** best practices and standard mitigation (e.g., temporary sediment ponds, silt curtains, sediment traps) during all Project phases ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ **Reclaim and revegetate areas** where non-permanent Project facilities have been decommissioned ▪ Perform routine inspection and maintenance of **water containment and conveyance structures** (i.e., roadside ditches and culverts) to limit the risk of road wash-out or sediment release to the environment ▪ Implement a Project-specific **Environmental Monitoring Plan** that includes monitoring water and sediment quality and applying adaptive management, if necessary ▪ Implement a Project-specific **Waste Management Program** ▪ Implement a Project-specific **Environmental Protection Program** ▪ Develop and implement **a Detailed Decommissioning and Reclamation Plan** to decommission and transfer the site to the province under the Institutional Control Program	Primary pathway
HH-05	Project components/activities that potentially change groundwater quality during **all Project phases**: ▪ handling and storage of waste rock, special waste rock, and ore	**Seepage from WRSAs causes changes to groundwater and surface water quality:** ▪ Seepage from the WRSAs may cause changes in groundwater quality and surface water quality in Patterson Lake and adversely affect human health receptors	▪ **Segregate PAG material** from NPAG material and store separately ▪ **Contain and divert runoff and seepage from** PAG waste rock, special waste rock, and ore to the effluent treatment plant ▪ Implement a Project-specific **Environmental Monitoring Plan** that includes monitoring water and sediment quality and applying adaptive management, if necessary ▪ Implement a Project-specific **Waste Management Program** ▪ Implement a Project-specific **Environmental Protection Program** ▪ Develop and implement a **Detailed Decommissioning and Reclamation Plan** to decommission and transfer the site to the province under the Institutional Control Program	Primary pathway
HH-06	Project components/activities that potentially change groundwater quality **following Closure**: ▪ WRSAs ▪ UGTMF and backfilled stopes	**Post-closure runoff and seepage from WRSAs and UGTMF:** ▪ Runoff and seepage from the WRSAs and groundwater flow from the UGTMF may affect groundwater quality and alter surface water quality in Patterson Lake after Closure, adversely affecting human health receptors	▪ Use **engineered cemented paste backfill and tailings** to control source concentrations ▪ **Apply binder** to reduce permeability in backfill and tailings ▪ Install **engineered cover system** on PAG and NPAG material during reclamation	Primary pathway

Table 15.4-1: Potential Effects Pathways for Human Health

Pathway ID	Project Components/Activities	Effects/Exposure Pathway	Environmental Design Features and Mitigation	Pathway Assessment
HH-07	Project components/activities that potentially change surface water quantity during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ process plant and underground operations ▪ handling and storage of waste rock, special waste rock, and ore ▪ ETP and treated effluent discharge ▪ additional infrastructure (e.g., roads, airstrip, camp, maintenance shop, offices) ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure	**Alteration of flows and drainage areas:** ▪ Alteration of local surface water flows and drainage areas may adversely affect human health receptors through erosion and changes in surface water quality	▪ **Limit the Project footprint** to the extent practical using practices such as: o optimizing use of cleared areas for Project activity o using existing road infrastructure, including existing access road and bridge crossing o storing tailings underground o designing an efficient infrastructure footprint (e.g., buildings clustered together) ▪ Provide **adequate contact water storage capacity** to allow controlled rate of release during both routine and non-routine operation scenarios ▪ **Minimize areas of vegetation clearing** and soil disturbance ▪ **Minimize steepness and length of slopes** of disturbed areas and stockpiled soils ▪ **Avoid placing soil stockpiles near waterbodies** (i.e., maintaining 150 m buffer from waterbodies), and near natural drainage features, unless required for temporary storage ▪ To the extent practical, **work in sensitive areas** (i.e., erosive soils, wetland features, and fish habitats) would be scheduled to **avoid periods that may result in high flow volumes and/or increase erosion and sedimentation** (e.g., spring freshet) ▪ Implement **sedimentation and erosion control** best practices and standard mitigation (e.g., temporary sediment ponds, silt curtains, sediment traps) during all Project phases ▪ Perform routine inspection and maintenance of **water containment and conveyance structures** (i.e., roadside ditches and culverts) to limit the risk of road wash-out or sediment release to the environment ▪ **Reclaim and revegetate areas** where non-permanent Project facilities have been decommissioned ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ Implement a Project-specific **Waste Management Program** ▪ Implement a Project-specific **Environmental Protection Program** ▪ Implement a Project-specific **Environmental Monitoring Plan** that includes monitoring water levels and flows and applying adaptive management, if necessary ▪ Develop a **Detailed Decommissioning and Reclamation Plan** to decommission and transfer the site to the province under the Institutional Control Program	No pathway

Bolded text represents the key topic of the environmental design features and mitigation.
WRSAs = waste rock storage areas; UGTMF = underground tailings management facility; ETP = effluent treatment plant; PAG = potentially acid generating; COPC = constituent of potential concern.

15.4.1 No Pathways

The following Project interaction was predicted to result in no pathway to human health and was not carried forward in the assessment:

HH-07: Alteration of flows and drainage areas:

- Alteration of local surface water flows and drainage areas may adversely affect human health receptors through erosion and changes in surface water quality.

Project components and activities (e.g., land clearing, site preparation, construction of facilities and infrastructure, handling and storage of waste rock and ore) during Construction and Operations, and activities associated with revegetation and removal and restoration of infrastructure and facilities during Closure can lead to altered drainage patterns and erosion of soil. This alteration can cause increased sediment loading in water that is not collected and managed on site (e.g., direct runoff from the catchment area of the Project to Patterson Lake). Altered drainage patterns and changes to water levels and flows may also affect stream channel and bank stability in the downstream environment, leading to increased sediment loading from the resulting erosion.

As further discussed in Section 10, the regional hydrological model indicates that the net discharge of water to Patterson Lake from Project activities during the Project lifespan is expected to result in small changes to annual water levels; these changes are not expected to result in a measurable change to the fluvial sediment transport regime and are not expected to affect water quality.

Surface water in the receiving environment downstream of the Project would be protected and managed through the Environmental Monitoring Plan. Site contact water would be intercepted and managed in ways to reduce effects on the surrounding environment in accordance with the Environmental Protection Program. More specifically, where possible, work required in areas of the Project footprint that may be more prone to erosion from surface water runoff and changes in surface water levels, flows, and drainage areas would be scheduled to avoid the time of year when erosion has the greatest potential (i.e., spring freshet). The rate of discharge from the ETP would be managed by having adequate surface water storage capacity to allow for controlled release rates, if required. A minimum 150 m buffer between soil stockpiles and waterbodies or drainages would be maintained (unless required for temporary storage) and all containment and conveyance structures (e.g., ditches, culverts) would be routinely inspected and maintained to limit risk of road wash-out or sediment release. Sediment and erosion control features would be implemented during Construction (e.g., temporary sediment ponds, silt curtains, sediment traps), and used as required during Operations and Closure. Progressive reclamation and revegetation would also be implemented as disturbed areas are no longer required, and non-permanent features would be restored and revegetated as they are removed. The Environmental Monitoring Plan includes monitoring surface water levels and flows and applying adaptive management, as required. During Construction and Operations, a Preliminary Decommissioning and Reclamation Plan would be developed and periodically updated to reflect changing site-specific conditions and surface water effects. Prior to transitioning to Closure, a Detailed Decommissioning and Reclamation Plan would be developed to reflect mitigations necessary to maintain protection of surface water and transfer the site to the Province under the Institutional Control Program.

Environmental design features, mitigation, and monitoring are anticipated to minimize changes in surface water levels and flows such that no adverse effects on human health receptors would be expected. Therefore, this pathway was not carried forward in the assessment.

15.4.2 Secondary Pathways

There were no Project interactions that were predicted to result in secondary pathways to human health.

15.4.3 Primary Pathways

The following Project interactions were predicted to be primary pathways to human health and were advanced for further assessment of the residual effects:

HH-01: Emission and deposition of fugitive dust and radon:

- Fugitive dust (e.g., metals, radionuclides) and radon emissions may adversely affect human health receptors through inhalation.

AND

- Radon emissions and deposition of fugitive dust (e.g., metals, radionuclides) can cause changes in soil and water quality and may adversely affect human health receptors through food ingestion (e.g., berries, fish, game meat).

HH-02: Emission and deposition of criteria air contaminants and suspended solids:

- Criteria air contaminants (e.g., nitrogen, sulphur oxides) may result in changes to air quality and may adversely affect human health receptors through inhalation.

AND

- Deposition of suspended solids in criteria air contaminant emissions can cause changes in soil and water quality and may adversely affect human health receptors through food ingestion (e.g., berries, fish, game meat).

HH-03: Release of treated effluent:

- Release of treated effluent (from the effluent treatment plant and sewage treatment plant) into Patterson Lake may cause changes to surface water quality (and indirectly sediment) and adversely affect human health receptors through drinking water and food ingestion (e.g., fish).

HH-04: Site runoff:

- Runoff from the Project footprint may cause changes to surface water quality (and indirectly sediment) and adversely affect human health receptors through food ingestion (e.g., fish).

HH-05: Seepage from WRSAs causes changes to groundwater and surface water quality:

- Seepage from the WRSAs may cause changes in groundwater quality and surface water quality in Patterson Lake and adversely affect human health receptors.

HH-06: Post-closure runoff and seepage from WRSAs and UGTMF:

- Runoff and seepage from the WRSAs and groundwater flow from the UGTMF may affect groundwater quality and alter surface water quality in Patterson Lake after Closure and adversely affect human health receptors.

As a common theme, LPA community members identified human health as a key interest and concern, and important VC (NexGen 2019). This includes concerns related to the general effects of mine waste, tailings, and surface and underground water quality, resulting in effects to environmental and human health (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; BNDN-JWG 2019b; BNDN-JWG 2020b; BNDN-JWG 2021a; BRDN-JWG 2021b; CRDN-JWG 2020a; CRDN-JWG 2020b; CRDN-JWG 2021; MN-S-JWG 2019a; NexGen 2019).

Indigenous Groups, local trappers, and LPA community members expressed concerns in general about effects of the Project on water quality in Patterson Lake or the Clearwater River watershed, and associated effects on aquatic and terrestrial health, the safety of wild foods, drinking water, and human health (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; BRDN-JWG 2019a; BRDN-JWG 2020; BRDN-JWG 2021b; CRDN-JWG 2020b; CRDN-JWG 2021; MN-S-JWG 2019b; NexGen 2019).

Concerns raised by Indigenous Groups about potential changes in air quality and effects to aquatic and terrestrial environmental health, are based, in part, on Indigenous Groups observations of air emissions and acid rain from existing or previous industrial developments, including from the Alberta oilsands region and the Cluff Lake Mine, on the environment (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; BNDN-JWG 2019a; BRDN-JWG 2019b; BRDN-JWG 2019a; CRDN-JWG 2021; MN-S-JWG 2019b). Specific concerns were raised about the effects of dust in general from Project activities on vegetation, including berry patches (TSD IV: MN-S).

Indigenous Groups raised specific concerns about radiation from Project activities affecting human health, which are based, in part, on the experiences of Indigenous Groups with previous mining developments (i.e., the Cluff Lake Mine), including the belief that the Cluff Lake Mine was not properly decommissioned (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; CRDN 2019a; CRDN 2019b; BNDN-JWG 2019b; BNDN-JWG 2020b; BRDN-JWG 2019a; BRDN-JWG 2020; CRDN-JWG 2020c; CRDN-JWG 2020b; CRDN-JWG 2021; MN-S-JWG 2019a; MN-S-JWG 2019b; NexGen 2019). For example, the CRDN and BRDN have commented that they avoid harvesting in the Cluff Lake Mine area because of concerns about the health of fish and wildlife and safety of wild foods (TSD V.2: CRDN; BRDN-JWG 2021a; CRDN-JWG 2020b; CRDN-JWG 2020c; CRDN-JWG 2021).

These pathways were considered in an integrated HHRA to determine the significance of potential effects to human health. NexGen understands the concerns raised by Indigenous Groups and recognizes the importance of implementing mitigation measures to minimize the potential Project effects to air and water quality, and associated effects to aquatic and terrestrial environmental health, as well as human health.

15.5 Risk Assessment

15.5.1 Application Case

This subsection describes the predicted results of the Application Case due to releases from the Project during the Project lifespan and the far-future projection once groundwater solutes have been released to Patterson Lake. The results are presented for the Application Case and the reasonable upper bound sensitivity scenario.

15.5.1.1 Non-carcinogens

The estimated Project HQs for cobalt, copper, molybdenum, and uranium for all human receptors at all assessed locations during the Project lifespan and far-future projection are shown in Table 15.5-1. This table shows the Base Case and the incremental risk of the Project only (i.e., without the Base Case) for both the Application Case and the reasonable upper bound sensitivity scenario.

The HQs represent the maximum HQ over the Project lifespan for the COPCs of interest, which is a conservative representation as exposure varies over the different Project phases. Hazard quotients were evaluated for the adult and the one-year-old; however, for assessment of non-carcinogens, the one-year-old is typically considered the most sensitive receptor (Health Canada 2010a).

The maximum Project HQ was predicted for uranium for the subsistence harvester (i.e., one-year-old) at the Patterson Lake South Arm. This maximum HQ would be primarily from ingestion of terrestrial animals (e.g., beaver, grouse, mallard, moose, moose organs) and is attributed to slightly elevated concentrations of uranium in soil resulting from atmospheric deposition, which then bioaccumulates in terrestrial plants. The subsistence harvester would also eat a high proportion of locally grown and harvested blueberries and Labrador tea.

All estimated Project HQs for all non-carcinogenic COPCs (i.e., cobalt, copper, molybdenum, and uranium) remain below the acceptable HQ of 0.2 per pathway for the one-year-old and adult for all human receptors in the Application Case over the Project lifespan and in the far future.

Table 15.5-1: Estimated Non-carcinogen Risk to Human Receptors – Project Lifespan and Far-Future Projection – Application Case and Upper Bound Sensitivity Scenario

	COPC	Project Lifespan Hazard Quotients								Far Future Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC	Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
Camp Worker (Patterson Lake North Arm – West Basin)		**Base Case**															
	Cobalt	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	1.15×10^{-03}	7.21×10^{-04}	1.97×10^{-02}	2.25×10^{-02}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Copper	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	8.94×10^{-04}	2.69×10^{-04}	3.89×10^{-02}	4.01×10^{-02}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Molybdenum	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	1.21×10^{-06}	1.46×10^{-04}	8.23×10^{-02}	8.25×10^{-02}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Uranium	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	3.43×10^{-03}	1.92×10^{-02}	7.29×10^{-02}	9.80×10^{-02}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Application Case — Incremental Project Risk															
	Cobalt	5.31×10^{-06}	3.03×10^{-09}	3.99×10^{-09}	$0.00 \times 10^{+00}$	9.83×10^{-05}	8.04×10^{-06}	3.37×10^{-04}	4.49×10^{-04}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Copper	2.44×10^{-08}	4.79×10^{-10}	2.10×10^{-11}	$0.00 \times 10^{+00}$	4.22×10^{-05}	1.22×10^{-06}	1.44×10^{-04}	1.87×10^{-04}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Molybdenum	1.84×10^{-07}	1.92×10^{-09}	1.64×10^{-10}	$0.00 \times 10^{+00}$	5.75×10^{-07}	5.42×10^{-06}	8.58×10^{-05}	9.20×10^{-05}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Uranium	2.55×10^{-06}	1.91×10^{-05}	8.88×10^{-09}	$0.00 \times 10^{+00}$	1.28×10^{-03}	2.14×10^{-02}	1.39×10^{-02}	3.66×10^{-02}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Upper Bound Scenario — Incremental Project Risk															
	Cobalt	5.38×10^{-06}	3.03×10^{-09}	4.03×10^{-09}	$0.00 \times 10^{+00}$	1.02×10^{-04}	8.04×10^{-06}	3.50×10^{-04}	4.66×10^{-04}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Copper	2.55×10^{-08}	4.79×10^{-10}	2.20×10^{-11}	$0.00 \times 10^{+00}$	4.34×10^{-05}	1.22×10^{-06}	1.45×10^{-04}	1.90×10^{-04}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Molybdenum	1.88×10^{-07}	1.92×10^{-09}	1.67×10^{-10}	$0.00 \times 10^{+00}$	1.76×10^{-06}	5.42×10^{-06}	1.47×10^{-04}	1.54×10^{-04}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Uranium	1.06×10^{-05}	1.91×10^{-05}	3.72×10^{-08}	$0.00 \times 10^{+00}$	3.53×10^{-03}	2.14×10^{-02}	1.45×10^{-02}	3.95×10^{-02}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Subsistence Harvester (Patterson Lake South Arm)		**Base Case**															
	Cobalt	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	2.30×10^{-03}	1.44×10^{-03}	2.44×10^{-02}	2.90×10^{-02}	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	2.30×10^{-03}	1.44×10^{-03}	2.44×10^{-02}	2.90×10^{-02}
	Copper	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	1.79×10^{-03}	5.38×10^{-04}	4.12×10^{-02}	4.35×10^{-02}	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	1.79×10^{-03}	5.38×10^{-04}	4.12×10^{-02}	4.35×10^{-02}
	Molybdenum	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	2.42×10^{-06}	2.92×10^{-04}	6.98×10^{-02}	7.02×10^{-02}	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	2.42×10^{-06}	2.92×10^{-04}	6.98×10^{-02}	7.02×10^{-02}
	Uranium	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	6.85×10^{-03}	3.84×10^{-02}	8.20×10^{-02}	1.30×10^{-01}	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	6.85×10^{-03}	3.84×10^{-02}	8.20×10^{-02}	1.30×10^{-01}
		Application Case — Incremental Project Risk															
	Cobalt	7.48×10^{-05}	1.31×10^{-09}	7.93×10^{-08}	$0.00 \times 10^{+00}$	1.96×10^{-04}	1.61×10^{-05}	6.73×10^{-04}	9.60×10^{-04}	3.77×10^{-04}	7.08×10^{-10}	4.46×10^{-07}	$0.00 \times 10^{+00}$	1.01×10^{-03}	1.13×10^{-06}	2.93×10^{-03}	4.31×10^{-03}
	Copper	1.38×10^{-06}	7.99×10^{-11}	1.71×10^{-09}	$0.00 \times 10^{+00}$	8.43×10^{-05}	2.43×10^{-06}	2.87×10^{-04}	3.75×10^{-04}	1.36×10^{-05}	5.34×10^{-12}	1.92×10^{-08}	$0.00 \times 10^{+00}$	8.32×10^{-04}	9.74×10^{-08}	7.56×10^{-04}	1.60×10^{-03}
	Molybdenum	5.26 × 10-05	3.03×10^{-10}	6.99×10^{-08}	$0.00 \times 10^{+00}$	1.15×10^{-06}	1.08×10^{-05}	1.71×10^{-04}	2.36×10^{-04}	6.70×10^{-04}	$0.00 \times 10^{+00}$	1.00×10^{-06}	$0.00 \times 10^{+00}$	1.50×10^{-05}	$0.00 \times 10^{+00}$	7.56×10^{-04}	1.44×10^{-03}
	Uranium	9.33×10^{-04}	2.61×10^{-06}	6.77×10^{-06}	$0.00 \times 10^{+00}$	2.57×10^{-03}	4.28×10^{-02}	2.78×10^{-02}	7.41×10^{-02}	3.06×10^{-03}	2.74×10^{-07}	2.79×10^{-05}	$0.00 \times 10^{+00}$	8.53×10^{-03}	1.22×10^{-03}	4.26×10^{-03}	1.71×10^{-02}
		Upper Bound Scenario — Incremental Project Risk															
	Cobalt	7.78×10^{-05}	1.31×10^{-09}	8.26×10^{-08}	$0.00 \times 10^{+00}$	2.04×10^{-04}	1.61×10^{-05}	6.98×10^{-04}	9.97×10^{-04}	5.77×10^{-04}	7.08×10^{-10}	6.83×10^{-07}	$0.00 \times 10^{+00}$	1.55×10^{-03}	1.13×10^{-06}	4.49×10^{-03}	6.62×10^{-03}
	Copper	1.42×10^{-06}	7.99×10^{-11}	1.77×10^{-09}	$0.00 \times 10^{+00}$	8.68×10^{-05}	2.43×10^{-06}	2.89×10^{-04}	3.80×10^{-04}	2.04×10^{-05}	5.34×10^{-12}	2.89×10^{-08}	$0.00 \times 10^{+00}$	1.25×10^{-03}	9.74×10^{-08}	1.14×10^{-03}	2.41×10^{-03}
	Molybdenum	1.60×10^{-04}	3.03×10^{-10}	2.17×10^{-07}	$0.00 \times 10^{+00}$	3.51×10^{-06}	1.08×10^{-05}	2.93×10^{-04}	4.68×10^{-04}	2.57×10^{-03}	$0.00 \times 10^{+00}$	3.85×10^{-06}	$0.00 \times 10^{+00}$	5.74×10^{-05}	$0.00 \times 10^{+00}$	2.92×10^{-03}	5.55×10^{-03}
	Uranium	2.56×10^{-03}	2.61×10^{-06}	1.89×10^{-05}	$0.00 \times 10^{+00}$	7.06×10^{-03}	4.28×10^{-02}	2.89×10^{-02}	8.14×10^{-02}	3.07×10^{-03}	2.74×10^{-07}	2.80×10^{-05}	$0.00 \times 10^{+00}$	8.54×10^{-03}	1.22×10^{-03}	4.26×10^{-03}	1.71×10^{-02}
Subsistence Harvester One-Year-Old (Patterson Lake South Arm)		**Base Case**															
	Cobalt	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	2.18×10^{-03}	2.84×10^{-03}	4.78×10^{-02}	5.39×10^{-02}	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	2.18×10^{-03}	2.84×10^{-03}	4.78×10^{-02}	5.39×10^{-02}
	Copper	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	1.69×10^{-03}	1.06×10^{-03}	9.70×10^{-02}	9.98×10^{-02}	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	1.69×10^{-03}	1.06×10^{-03}	9.70×10^{-02}	9.98×10^{-02}
	Molybdenum	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	2.79×10^{-06}	7.01×10^{-04}	**2.64×10^{-01}**	2.64×10^{-01}	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	2.79×10^{-06}	7.01×10^{-04}	**2.64×10^{-01}**	2.64×10^{-01}
	Uranium	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	6.49×10^{-03}	7.57×10^{-02}	1.70×10^{-01}	2.57×10^{-01}	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	6.49×10^{-03}	7.57×10^{-02}	1.70×10^{-01}	2.57×10^{-01}
		Application Case — Incremental Project Risk															
	Cobalt	8.35×10^{-05}	8.54×10^{-08}	5.18×10^{-06}	$0.00 \times 10^{+00}$	1.86×10^{-04}	2.27×10^{-05}	6.97×10^{-04}	9.95×10^{-04}	4.21×10^{-04}	4.63×10^{-08}	2.91×10^{-05}	$0.00 \times 10^{+00}$	9.56×10^{-04}	2.22×10^{-06}	3.02×10^{-03}	4.43×10^{-03}
	Copper	1.54×10^{-06}	5.22×10^{-09}	1.12×10^{-07}	$0.00 \times 10^{+00}$	7.99×10^{-05}	4.17×10^{-06}	2.89×10^{-04}	3.74×10^{-04}	1.51×10^{-05}	3.49×10^{-10}	1.25×10^{-06}	$0.00 \times 10^{+00}$	7.89×10^{-04}	1.92×10^{-07}	7.25×10^{-04}	1.53×10^{-03}
	Molybdenum	7.16×10^{-05}	2.41×10^{-08}	5.56×10^{-06}	$0.00 \times 10^{+00}$	1.33×10^{-06}	1.82×10^{-05}	2.17×10^{-04}	3.14×10^{-04}	9.11×10^{-04}	$0.00 \times 10^{+00}$	7.98×10^{-05}	$0.00 \times 10^{+00}$	1.73×10^{-05}	$0.00 \times 10^{+00}$	9.41×10^{-04}	1.95×10^{-03}
	Uranium	1.04×10^{-03}	1.71×10^{-04}	4.42×10^{-04}	$0.00 \times 10^{+00}$	2.43×10^{-03}	6.44×10^{-02}	2.02×10^{-02}	8.87×10^{-02}	3.42×10^{-03}	1.79×10^{-05}	1.83×10^{-03}	$0.00 \times 10^{+00}$	8.09×10^{-03}	2.41×10^{-03}	3.14×10^{-03}	1.89×10^{-02}
		Upper Bound Scenario — Incremental Project Risk															
	Cobalt	8.69×10^{-05}	8.54×10^{-08}	5.40×10^{-06}	$0.00 \times 10^{+00}$	1.94×10^{-04}	2.27×10^{-05}	7.24×10^{-04}	1.03×10^{-03}	6.45×10^{-04}	4.63×10^{-08}	4.46×10^{-05}	$0.00 \times 10^{+00}$	1.47×10^{-03}	2.22×10^{-06}	4.64×10^{-03}	6.80×10^{-03}
	Copper	1.58×10^{-06}	5.22×10^{-09}	1.15×10^{-07}	$0.00 \times 10^{+00}$	8.23×10^{-05}	4.17×10^{-06}	2.91×10^{-04}	3.79×10^{-04}	2.27×10^{-05}	3.49×10^{-10}	1.89×10^{-06}	$0.00 \times 10^{+00}$	1.19×10^{-03}	1.92×10^{-07}	1.09×10^{-03}	2.30×10^{-03}
	Molybdenum	2.17×10^{-04}	2.41×10^{-08}	1.73×10^{-05}	$0.00 \times 10^{+00}$	4.05×10^{-06}	1.82×10^{-05}	3.70×10^{-04}	6.27×10^{-04}	3.50×10^{-03}	$0.00 \times 10^{+00}$	3.06×10^{-04}	$0.00 \times 10^{+00}$	6.63×10^{-05}	$0.00 \times 10^{+00}$	3.63×10^{-03}	7.50×10^{-03}
	Uranium	2.86×10^{-03}	1.71×10^{-04}	1.24×10^{-03}	$0.00 \times 10^{+00}$	6.69×10^{-03}	6.44×10^{-02}	2.10×10^{-02}	9.64×10^{-02}	3.43×10^{-03}	1.79×10^{-05}	1.83×10^{-03}	$0.00 \times 10^{+00}$	8.10×10^{-03}	2.41×10^{-03}	3.14×10^{-03}	1.89×10^{-02}

Table 15.5-1: Estimated Non-carcinogen Risk to Human Receptors – Project Lifespan and Far-Future Projection – Application Case and Upper Bound Sensitivity Scenario

	COPC	Project Lifespan Hazard Quotients								Far Future Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC	Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
Subsistence Harvester (Beet Lake)		**Base Case**															
	Cobalt	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	2.30×10^{-03}	1.44×10^{-03}	2.44×10^{-02}	2.90×10^{-02}	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	2.30×10^{-03}	1.44×10^{-03}	2.44×10^{-02}	2.90×10^{-02}
	Copper	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	1.79×10^{-03}	5.38×10^{-04}	4.12×10^{-02}	4.35×10^{-02}	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	1.79×10^{-03}	5.38×10^{-04}	4.12×10^{-02}	4.35×10^{-02}
	Molybdenum	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	2.42×10^{-06}	2.92×10^{-04}	6.98×10^{-02}	7.02×10^{-02}	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	2.42×10^{-06}	2.92×10^{-04}	6.98×10^{-02}	7.02×10^{-02}
	Uranium	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	6.85×10^{-03}	3.84×10^{-02}	8.20×10^{-02}	1.30×10^{-01}	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	6.85×10^{-03}	3.84×10^{-02}	8.20×10^{-02}	1.30×10^{-01}
		Application Case — Incremental Project Risk															
	Cobalt	3.89×10^{-05}	1.31×10^{-09}	4.13×10^{-08}	$0.00 \times 10^{+00}$	1.02×10^{-04}	1.61×10^{-05}	2.28×10^{-04}	3.85×10^{-04}	1.99×10^{-04}	7.08×10^{-10}	2.36×10^{-07}	$0.00 \times 10^{+00}$	5.34×10^{-04}	1.13×10^{-06}	1.02×10^{-03}	1.76×10^{-03}
	Copper	7.07×10^{-07}	5.33×10^{-11}	8.78×10^{-10}	$0.00 \times 10^{+00}$	4.32×10^{-05}	1.62×10^{-06}	5.49×10^{-05}	1.00×10^{-04}	7.09×10^{-06}	3.56×10^{-12}	1.00×10^{-08}	$0.00 \times 10^{+00}$	4.35×10^{-04}	6.50×10^{-08}	2.76×10^{-04}	7.18×10^{-04}
	Molybdenum	2.70×10^{-05}	1.52×10^{-10}	3.58×10^{-08}	$0.00 \times 10^{+00}$	5.89×10^{-07}	5.41×10^{-06}	2.82×10^{-05}	6.12×10^{-05}	3.49×10^{-04}	$0.00 \times 10^{+00}$	5.22×10^{-07}	$0.00 \times 10^{+00}$	7.79×10^{-06}	$0.00 \times 10^{+00}$	2.71×10^{-04}	6.29×10^{-04}
	Uranium	3.43×10^{-04}	1.54×10^{-06}	2.48×10^{-06}	$0.00 \times 10^{+00}$	9.44×10^{-04}	2.52×10^{-02}	1.05×10^{-02}	3.70×10^{-02}	1.14×10^{-03}	1.62×10^{-07}	1.04×10^{-05}	$0.00 \times 10^{+00}$	3.17×10^{-03}	7.20×10^{-04}	1.44×10^{-03}	$6.48 \times 10^{-0}3$
		Upper Bound Scenario — Incremental Project Risk															
	Cobalt	4.05×10^{-05}	1.31×10^{-09}	4.30×10^{-08}	$0.00 \times 10^{+00}$	1.06×10^{-04}	1.61×10^{-05}	2.36×10^{-04}	3.99×10^{-04}	3.06×10^{-04}	7.08×10^{-10}	3.61×10^{-07}	$0.00 \times 10^{+00}$	8.18×10^{-04}	1.13×10^{-06}	1.57×10^{-03}	2.69×10^{-03}
	Copper	7.28×10^{-07}	5.33×10^{-11}	9.05×10^{-10}	$0.00 \times 10^{+00}$	4.45×10^{-05}	1.62×10^{-06}	5.56×10^{-05}	1.02×10^{-04}	1.06×10^{-05}	3.56×10^{-12}	1.51×10^{-08}	$0.00 \times 10^{+00}$	6.54×10^{-04}	6.50×10^{-08}	4.14×10^{-04}	1.08×10^{-03}
	Molybdenum	8.25×10^{-05}	1.52×10^{-10}	1.11×10^{-07}	$0.00 \times 10^{+00}$	1.81×10^{-06}	5.41×10^{-06}	6.50×10^{-05}	1.55×10^{-04}	1.34×10^{-03}	$0.00 \times 10^{+00}$	2.01×10^{-06}	$0.00 \times 10^{+00}$	2.99×10^{-05}	$0.00 \times 10^{+00}$	1.04×10^{-03}	2.41×10^{-03}
	Uranium	9.43×10^{-04}	1.54×10^{-06}	6.95×10^{-06}	$0.00 \times 10^{+00}$	2.59×10^{-03}	2.52×10^{-02}	1.08×10^{-02}	3.96×10^{-02}	1.14×10^{-03}	1.62×10^{-07}	1.04×10^{-05}	$0.00 \times 10^{+00}$	3.18×10^{-03}	7.20×10^{-04}	1.44×10^{-03}	6.48×10^{-03}
Subsistence Harvester One-Year-Old (Beet Lake)		**Base Case**															
	Cobalt	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	2.18×10^{-03}	2.84×10^{-03}	4.78×10^{-02}	5.39×10^{-02}	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	2.18×10^{-03}	2.84×10^{-03}	4.78×10^{-02}	5.39×10^{-02}
	Copper	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	1.69×10^{-03}	1.06×10^{-03}	9.70×10^{-02}	9.98×10^{-02}	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	1.69×10^{-03}	1.06×10^{-03}	9.70×10^{-02}	9.98×10^{-02}
	Molybdenum	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	2.79×10^{-06}	7.01×10^{-04}	$\mathbf{2.64 \times 10^{-01}}$	2.64×10^{-01}	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	2.79×10^{-06}	7.01×10^{-04}	$\mathbf{2.64 \times 10^{-01}}$	2.64×10^{-01}
	Uranium	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	6.49×10^{-03}	7.57×10^{-02}	1.70×10^{-01}	2.57×10^{-01}	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	6.49×10^{-03}	7.57×10^{-02}	1.70×10^{-01}	2.57×10^{-01}
		Application Case — Incremental Project Risk															
	Cobalt	4.34×10^{-05}	8.54×10^{-08}	2.70×10^{-06}	$0.00 \times 10^{+00}$	9.69×10^{-05}	2.27×10^{-05}	2.32×10^{-04}	3.98×10^{-04}	2.23×10^{-04}	4.63×10^{-08}	1.54×10^{-05}	$0.00 \times 10^{+00}$	5.06×10^{-04}	2.22×10^{-06}	1.04×10^{-03}	1.79×10^{-03}
	Copper	7.89×10^{-07}	3.48×10^{-09}	5.74×10^{-08}	$0.00 \times 10^{+00}$	4.10×10^{-05}	2.78×10^{-06}	5.16×10^{-05}	9.62×10^{-05}	7.91×10^{-06}	2.33×10^{-10}	6.56×10^{-07}	$0.00 \times 10^{+00}$	4.12×10^{-04}	1.28×10^{-07}	2.54×10^{-04}	6.75×10^{-04}
	Molybdenum	3.67×10^{-05}	1.21×10^{-08}	2.85×10^{-06}	$0.00 \times 10^{+00}$	6.80×10^{-07}	9.10×10^{-06}	3.46×10^{-05}	8.39×10^{-05}	4.74×10^{-04}	$0.00 \times 10^{+00}$	4.16×10^{-05}	$0.00 \times 10^{+00}$	8.99×10^{-06}	$0.00 \times 10^{+00}$	3.32×10^{-04}	8.57×10^{-04}
	Uranium	3.83×10^{-04}	1.01×10^{-04}	1.62×10^{-04}	$0.00 \times 10^{+00}$	8.95×10^{-04}	3.80×10^{-02}	7.40×10^{-03}	4.69×10^{-02}	1.27×10^{-03}	1.06×10^{-05}	6.79×10^{-04}	$0.00 \times 10^{+00}$	3.01×10^{-03}	1.42×10^{-03}	1.04×10^{-03}	7.43×10^{-03}
		Upper Bound Scenario — Incremental Project Risk															
	Cobalt	4.52×10^{-05}	8.54×10^{-08}	2.81×10^{-06}	$0.00 \times 10^{+00}$	1.01×10^{-04}	2.27×10^{-05}	2.40×10^{-04}	4.12×10^{-04}	3.41×10^{-04}	4.63×10^{-08}	2.36×10^{-05}	$0.00 \times 10^{+00}$	7.75×10^{-04}	2.22×10^{-06}	1.59×10^{-03}	2.73×10^{-03}
	Copper	8.13×10^{-07}	3.48×10^{-09}	5.91×10^{-08}	$0.00 \times 10^{+00}$	4.22×10^{-05}	2.78×10^{-06}	5.23×10^{-05}	9.81×10^{-05}	1.19×10^{-05}	2.33×10^{-10}	9.86×10^{-07}	$0.00 \times 10^{+00}$	6.20×10^{-04}	1.28×10^{-07}	3.82×10^{-04}	1.01×10^{-03}
	Molybdenum	1.12×10^{-04}	1.21×10^{-08}	8.86×10^{-06}	$0.00 \times 10^{+00}$	2.09×10^{-06}	9.10×10^{-06}	7.97×10^{-05}	2.12×10^{-04}	1.82×10^{-03}	$0.00 \times 10^{+00}$	1.60×10^{-04}	$0.00 \times 10^{+00}$	3.45×10^{-05}	$0.00 \times 10^{+00}$	1.28×10^{-03}	3.29×10^{-03}
	Uranium	1.05×10^{-03}	1.01×10^{-04}	4.54×10^{-04}	$0.00 \times 10^{+00}$	2.46×10^{-03}	3.80×10^{-02}	7.65×10^{-03}	4.97×10^{-02}	1.27×10^{-03}	1.06×10^{-05}	6.79×10^{-04}	$0.00 \times 10^{+00}$	3.01×10^{-03}	1.42×10^{-03}	1.04×10^{-03}	7.44×10^{-03}
Subsistence Harvester (Lloyd Lake)		**Base Case**															
	Cobalt	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	2.30×10^{-03}	1.44×10^{-03}	2.44×10^{-02}	2.90×10^{-02}	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	2.30×10^{-03}	1.44×10^{-03}	2.44×10^{-02}	2.90×10^{-02}
	Copper	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	1.79×10^{-03}	5.38×10^{-04}	4.12×10^{-02}	4.35×10^{-02}	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	1.79×10^{-03}	5.38×10^{-04}	4.12×10^{-02}	4.35×10^{-02}
	Molybdenum	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	2.42×10^{-06}	2.92×10^{-04}	6.98×10^{-02}	7.02×10^{-02}	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	2.42×10^{-06}	2.92×10^{-04}	6.98×10^{-02}	7.02×10^{-02}
	Uranium	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	6.85×10^{-03}	3.84×10^{-02}	8.20×10^{-02}	1.30×10^{-01}	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	6.85×10^{-03}	3.84×10^{-02}	8.20×10^{-02}	1.30×10^{-01}
		Application Case — Incremental Project Risk															
	Cobalt	4.05×10^{-06}	1.31×10^{-09}	4.26×10^{-09}	$0.00 \times 10^{+00}$	1.06×10^{-05}	1.61×10^{-05}	5.65×10^{-05}	8.73×10^{-05}	2.04×10^{-05}	7.08×10^{-10}	2.42×10^{-08}	$0.00 \times 10^{+00}$	5.47×10^{-05}	1.13×10^{-06}	1.10×10^{-04}	1.87×10^{-04}
	Copper	7.33×10^{-08}	2.66×10^{-11}	9.02×10^{-11}	$0.00 \times 10^{+00}$	4.48×10^{-06}	8.11×10^{-07}	1.73×10^{-05}	2.27×10^{-05}	7.23×10^{-07}	1.78×10^{-12}	1.02×10^{-09}	$0.00 \times 10^{+00}$	4.44×10^{-05}	3.25×10^{-08}	2.84×10^{-05}	7.36×10^{-05}
	Molybdenum	2.79×10^{-06}	1.52×10^{-10}	3.67×10^{-09}	$0.00 \times 10^{+00}$	6.08×10^{-08}	5.41×10^{-06}	1.22×10^{-05}	2.05×10^{-05}	3.56×10^{-05}	$0.00 \times 10^{+00}$	5.33×10^{-08}	$0.00 \times 10^{+00}$	7.94×10^{-07}	$0.00 \times 10^{+00}$	2.77×10^{-05}	6.41×10^{-05}
	Uranium	3.13×10^{-05}	5.85×10^{-08}	2.25×10^{-07}	$0.00 \times 10^{+00}$	8.61×10^{-05}	9.58×10^{-04}	4.07×10^{-04}	1.48×10^{-03}	1.03×10^{-04}	6.15×10^{-09}	9.41×10^{-07}	$0.00 \times 10^{+00}$	2.87×10^{-04}	2.74×10^{-05}	9.62×10^{-05}	5.15×10^{-04}
		Upper Bound Scenario — Incremental Project Risk															
	Cobalt	4.21×10^{-06}	1.31×10^{-09}	4.44×10^{-09}	$0.00 \times 10^{+00}$	1.10×10^{-05}	1.61×10^{-05}	5.73×10^{-05}	8.86×10^{-05}	3.13×10^{-05}	7.08×10^{-10}	3.70×10^{-08}	$0.00 \times 10^{+00}$	8.38×10^{-05}	1.13×10^{-06}	1.66×10^{-04}	2.82×10^{-04}
	Copper	7.54×10^{-08}	2.66×10^{-11}	9.29×10^{-11}	$0.00 \times 10^{+00}$	4.61×10^{-06}	8.11×10^{-07}	1.74×10^{-05}	2.29×10^{-05}	1.09×10^{-06}	1.78×10^{-12}	1.54×10^{-09}	$0.00 \times 10^{+00}$	6.67×10^{-05}	3.25×10^{-08}	4.25×10^{-05}	1.10×10^{-04}
	Molybdenum	8.51×10^{-06}	1.52×10^{-10}	1.14×10^{-08}	$0.00 \times 10^{+00}$	1.86×10^{-07}	5.41×10^{-06}	1.60×10^{-05}	3.01×10^{-05}	$1.37 \times 10^{-0}4$	$0.00 \times 10^{+00}$	2.05×10^{-07}	$0.00 \times 10^{+00}$	3.05×10^{-06}	$0.00 \times 10^{+00}$	1.06×10^{-04}	2.46×10^{-04}
	Uranium	8.67×10^{-05}	5.85×10^{-08}	6.31×10^{-07}	$0.00 \times 10^{+00}$	2.38×10^{-04}	9.58×10^{-04}	4.37×10^{-04}	1.72×10^{-03}	1.03×10^{-04}	6.15×10^{-09}	9.41×10^{-07}	$0.00 \times 10^{+00}$	2.88×10^{-04}	2.74×10^{-05}	9.62×10^{-05}	5.15×10^{-04}

Table 15.5-1: Estimated Non-carcinogen Risk to Human Receptors – Project Lifespan and Far-Future Projection – Application Case and Upper Bound Sensitivity Scenario

	COPC	Project Lifespan Hazard Quotients								Far Future Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC	Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
Subsistence Harvester One-Year-Old (Lloyd Lake)		**Base Case**															
	Cobalt	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	2.18×10^{-03}	2.84×10^{-03}	4.78×10^{-02}	5.39×10^{-02}	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	2.18×10^{-03}	2.84×10^{-03}	4.78×10^{-02}	5.39×10^{-02}
	Copper	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	1.69×10^{-03}	1.06×10^{-03}	9.70×10^{-02}	9.98×10^{-02}	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	1.69×10^{-03}	1.06×10^{-03}	9.70×10^{-02}	9.98×10^{-02}
	Molybdenum	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	2.79×10^{-06}	7.01×10^{-04}	**2.64×10^{-01}**	2.64×10^{-01}	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	2.79×10^{-06}	7.01×10^{-04}	**2.64×10^{-01}**	2.64×10^{-01}
	Uranium	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	6.49×10^{-03}	7.57×10^{-02}	1.70×10^{-01}	2.57×10^{-01}	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	6.49×10^{-03}	7.57×10^{-02}	1.70×10^{-01}	2.57×10^{-01}
		Application Case — Incremental Project Risk															
	Cobalt	4.52×10^{-06}	8.54×10^{-08}	2.78×10^{-07}	$0.00 \times 10^{+00}$	1.01×10^{-05}	2.27×10^{-05}	5.72×10^{-05}	9.49×10^{-05}	2.28×10^{-05}	4.63×10^{-08}	1.58×10^{-06}	$0.00 \times 10^{+00}$	5.19×10^{-05}	2.22×10^{-06}	1.12×10^{-04}	1.91×10^{-04}
	Copper	8.18×10^{-08}	1.74×10^{-09}	5.89×10^{-09}	$0.00 \times 10^{+00}$	4.25×10^{-06}	1.39×10^{-06}	1.63×10^{-05}	2.21×10^{-05}	8.08×10^{-07}	1.16×10^{-10}	6.70×10^{-08}	$0.00 \times 10^{+00}$	4.21×10^{-05}	6.40×10^{-08}	2.62×10^{-05}	6.93×10^{-05}
	Molybdenum	3.79×10^{-06}	1.21×10^{-08}	2.92×10^{-07}	$0.00 \times 10^{+00}$	7.01×10^{-08}	9.10×10^{-06}	1.50×10^{-05}	2.83×10^{-05}	4.84×10^{-05}	$0.00 \times 10^{+00}$	4.24×10^{-06}	$0.00 \times 10^{+00}$	9.16×10^{-07}	$0.00 \times 10^{+00}$	3.39×10^{-05}	8.74×10^{-05}
	Uranium	3.50×10^{-05}	3.82×10^{-6}	1.47×10^{-05}	$0.00 \times 10^{+00}$	8.16×10^{-05}	1.44×10^{-03}	2.89×10^{-04}	1.87×10^{-03}	1.15×10^{-04}	4.02×10^{-07}	6.15×10^{-05}	$0.00 \times 10^{+00}$	2.72×10^{-04}	5.39×10^{-05}	7.05×10^{-05}	5.74×10^{-04}
		Upper Bound Scenario — Incremental Project Risk															
	Cobalt	4.70×10^{-06}	8.54×10^{-08}	2.90×10^{-07}	$0.00 \times 10^{+00}$	1.05×10^{-05}	2.27×10^{-05}	5.80×10^{-05}	9.63×10^{-05}	3.50×10^{-05}	4.63×10^{-08}	2.42×10^{-06}	$0.00 \times 10^{+00}$	7.94×10^{-05}	2.22×10^{-06}	1.68×10^{-04}	2.87×10^{-04}
	Copper	8.42×10^{-08}	1.74×10^{-09}	6.07×10^{-09}	$0.00 \times 10^{+00}$	4.37×10^{-06}	1.39×10^{-06}	1.64×10^{-05}	2.23×10^{-05}	1.21×10^{-06}	1.16×10^{-10}	1.01×10^{-07}	$0.00 \times 10^{+00}$	6.33×10^{-05}	6.40×10^{-08}	3.92×10^{-05}	1.04×10^{-04}
	Molybdenum	1.16×10^{-05}	1.21×10^{-08}	9.09×10^{-07}	$0.00 \times 10^{+00}$	2.15×10^{-07}	9.10×10^{-06}	1.96×10^{-05}	4.14×10^{-05}	1.86×10^{-04}	$0.00 \times 10^{+00}$	1.63×10^{-05}	$0.00 \times 10^{+00}$	3.52×10^{-06}	$0.00 \times 10^{+00}$	1.30×10^{-04}	3.36×10^{-04}
	Uranium	9.68×10^{-05}	3.82×10^{-06}	4.12×10^{-05}	$0.00 \times 10^{+00}$	2.26×10^{-04}	1.44×10^{-03}	3.11×10^{-04}	2.12×10^{-03}	1.15×10^{-04}	4.02×10^{-07}	6.15×10^{-05}	$0.00 \times 10^{+00}$	2.73×10^{-04}	5.39×10^{-05}	7.05×10^{-05}	5.74×10^{-04}
Seasonal Resident (Patterson Lake South Arm)		**Base Case**															
	Cobalt	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	7.27×10^{-04}	1.13×10^{-03}	1.88×10^{-02}	2.15×10^{-02}	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	7.27×10^{-04}	1.13×10^{-03}	1.88×10^{-02}	2.15×10^{-02}
	Copper	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	5.66×10^{-04}	4.22×10^{-04}	3.86×10^{-02}	3.96×10^{-02}	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	5.66×10^{-04}	4.22×10^{-04}	3.86×10^{-02}	3.96×10^{-02}
	Molybdenum	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	7.66×10^{-07}	2.29×10^{-04}	8.60×10^{-02}	8.63×10^{-02}	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	7.66×10^{-07}	2.29×10^{-04}	8.60×10^{-02}	8.63×10^{-02}
	Uranium	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	2.17×10^{-03}	3.01×10^{-02}	6.79×10^{-02}	1.03×10^{-01}	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	2.17×10^{-03}	3.01×10^{-02}	6.79×10^{-02}	1.03×10^{-01}
		Application Case — Incremental Project Risk															
	Cobalt	4.49×10^{-05}	7.84×10^{-10}	4.76×10^{-08}	$0.00 \times 10^{+00}$	3.74×10^{-05}	4.53×10^{-06}	1.60×10^{-04}	2.47×10^{-04}	2.26×10^{-04}	4.25×10^{-10}	2.67×10^{-07}	$0.00 \times 10^{+00}$	1.92×10^{-04}	5.31×10^{-07}	7.01×10^{-04}	1.12×10^{-03}
	Copper	8.27×10^{-07}	4.80×10^{-11}	1.03×10^{-09}	$0.00 \times 10^{+00}$	1.60×10^{-05}	9.32×10^{-07}	6.70×10^{-05}	8.48×10^{-05}	8.13×10^{-06}	3.20×10^{-12}	1.15×10^{-08}	$0.00 \times 10^{+00}$	1.58×10^{-04}	4.58×10^{-08}	1.87×10^{-04}	3.53×10^{-04}
	Molybdenum	3.16×10^{-05}	1.82×10^{-10}	4.20×10^{-08}	$0.00 \times 10^{+00}$	2.19×10^{-07}	2.94×10^{-06}	4.01×10^{-05}	7.48×10^{-05}	4.02×10^{-04}	$0.00 \times 10^{+00}$	6.02×10^{-07}	$0.00 \times 10^{+00}$	2.84×10^{-06}	$0.00 \times 10^{+00}$	1.80×10^{-04}	5.86×10^{-04}
	Uranium	5.60×10^{-04}	1.57×10^{-06}	4.06×10^{-06}	$0.00 \times 10^{+00}$	4.88×10^{-04}	1.34×10^{-02}	5.17×10^{-03}	1.96×10^{-02}	1.84×10^{-03}	1.65×10^{-07}	1.68×10^{-05}	$0.00 \times 10^{+00}$	1.62×10^{-03}	5.75×10^{-04}	1.02×10^{-03}	5.08×10^{-03}
		Upper Bound Scenario — Incremental Project Risk															
	Cobalt	4.67×10^{-05}	7.84×10^{-10}	4.96×10^{-08}	$0.00 \times 10^{+00}$	3.89×10^{-05}	4.53×10^{-06}	1.66×10^{-04}	2.56×10^{-04}	3.46×10^{-04}	4.25×10^{-10}	4.10×10^{-07}	$0.00 \times 10^{+00}$	2.94×10^{-04}	5.31×10^{-07}	1.08×10^{-03}	1.72×10^{-03}
	Copper	8.51×10^{-07}	4.80×10^{-11}	1.06×10^{-09}	$0.00 \times 10^{+00}$	1.65×10^{-05}	9.32×10^{-07}	6.76×10^{-05}	8.59×10^{-05}	1.22×10^{-05}	3.20×10^{-12}	1.73×10^{-08}	$0.00 \times 10^{+00}$	2.38×10^{-04}	4.58×10^{-08}	2.80×10^{-04}	5.30×10^{-04}
	Molybdenum	9.59×10^{-05}	1.82×10^{-10}	1.30×10^{-07}	$0.00 \times 10^{+00}$	6.67×10^{-07}	2.94×10^{-06}	6.90×10^{-05}	1.69×10^{-04}	1.54×10^{-03}	$0.00 \times 10^{+00}$	2.31×10^{-06}	$0.00 \times 10^{+00}$	1.09×10^{-05}	$0.00 \times 10^{+00}$	6.94×10^{-04}	2.25×10^{-03}
	Uranium	1.54×10^{-03}	1.57×10^{-06}	1.14×10^{-05}	$0.00 \times 10^{+00}$	1.34×10^{-03}	1.34×10^{-02}	5.49×10^{-03}	2.18×10^{-02}	1.84×10^{-03}	1.65×10^{-07}	1.68×10^{-05}	$0.00 \times 10^{+00}$	1.62×10^{-03}	5.75×10^{-04}	1.02×10^{-03}	5.08×10^{-03}
Seasonal Resident One-Year-Old (Patterson Lake South Arm)		**Base Case**															
	Cobalt	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	6.89×10^{-04}	2.47×10^{-03}	4.13×10^{-02}	4.56×10^{-02}	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	6.89×10^{-04}	2.47×10^{-03}	4.13×10^{-02}	4.56×10^{-02}
	Copper	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	5.36×10^{-04}	9.22×10^{-04}	9.32×10^{-02}	9.47×10^{-02}	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	5.36×10^{-04}	9.22×10^{-04}	9.32×10^{-02}	9.47×10^{-02}
	Molybdenum	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	8.84×10^{-07}	6.10×10^{-04}	**2.77×10^{-01}**	2.78×10^{-01}	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	8.84×10^{-07}	6.10×10^{-04}	**2.77×10^{-01}**	2.78×10^{-01}
	Uranium	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	2.06×10^{-3}	6.58×10^{-02}	1.60×10^{-01}	2.33×10^{-01}	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	2.06×10^{-03}	6.58×10^{-02}	1.60×10^{-01}	2.33×10^{-01}
		Application Case — Incremental Project Risk															
	Cobalt	5.01×10^{-05}	5.12×10^{-08}	3.11×10^{-06}	$0.00 \times 10^{+00}$	3.54×10^{-05}	7.54×10^{-06}	1.66×10^{-04}	2.62×10^{-04}	2.52×10^{-04}	2.78×10^{-08}	1.75×10^{-05}	$0.00 \times 10^{+00}$	1.82×10^{-04}	1.16×10^{-06}	7.23×10^{-04}	1.18×10^{-03}
	Copper	9.24×10^{-07}	3.13×10^{-09}	6.72×10^{-08}	$0.00 \times 10^{+00}$	1.52×10^{-05}	1.87×10^{-6}	6.82×10^{-05}	8.62×10^{-05}	9.08×10^{-06}	2.09×10^{-10}	7.53×10^{-07}	$0.00 \times 10^{+00}$	1.50×10^{-04}	1.00×10^{-07}	1.77×10^{-04}	3.37×10^{-04}
	Molybdenum	4.29×10^{-05}	1.45×10^{-08}	3.34×10^{-06}	$0.00 \times 10^{+00}$	2.52×10^{-07}	5.75×10^{-06}	5.12×10^{-05}	1.04×10^{-04}	5.47×10^{-04}	$0.00 \times 10^{+00}$	4.79×10^{-05}	$0.00 \times 10^{+00}$	3.28×10^{-06}	$0.00 \times 10^{+00}$	2.24×10^{-04}	8.22×10^{-04}
	Uranium	6.25×10^{-04}	1.02×10^{-04}	2.65×10^{-04}	$0.00 \times 10^{+00}$	4.62×10^{-04}	2.40×10^{-02}	3.81×10^{-03}	2.92×10^{-02}	2.05×10^{-03}	1.08×10^{-05}	1.10×10^{-03}	$0.00 \times 10^{+00}$	1.54×10^{-03}	1.26×10^{-03}	7.49×10^{-04}	6.70×10^{-03}
		Upper Bound Scenario — Incremental Project Risk															
	Cobalt	5.21×10^{-05}	5.12×10^{-08}	3.24×10^{-06}	$0.00 \times 10^{+00}$	3.68×10^{-05}	7.54×10^{-06}	1.72×10^{-04}	2.72×10^{-04}	3.87×10^{-04}	2.78×10^{-08}	2.68×10^{-05}	$0.00 \times 10^{+00}$	2.79×10^{-04}	1.16×10^{-06}	1.11×10^{-03}	1.80×10^{-03}
	Copper	9.51×10^{-07}	3.13×10^{-09}	6.92×10^{-08}	$0.00 \times 10^{+00}$	1.56×10^{-05}	1.87×10^{-06}	6.87×10^{-05}	8.73×10^{-05}	1.36×10^{-05}	2.09×10^{-10}	1.13×10^{-06}	$0.00 \times 10^{+00}$	2.25×10^{-04}	1.00×10^{-07}	2.66×10^{-04}	5.06×10^{-04}
	Molybdenum	1.30×10^{-04}	1.45×10^{-08}	1.04×10^{-05}	$0.00 \times 10^{+00}$	7.70×10^{-07}	5.75×10^{-06}	8.76×10^{-05}	2.35×10^{-04}	2.10×10^{-03}	$0.00 \times 10^{+00}$	1.84×10^{-04}	$0.00 \times 10^{+00}$	1.26×10^{-05}	$0.00 \times 10^{+00}$	8.65×10^{-04}	3.16×10^{-03}
	Uranium	1.72×10^{-03}	1.02×10^{-04}	7.43×10^{-04}	$0.00 \times 10^{+00}$	1.27×10^{-03}	2.40×10^{-02}	4.05×10^{-03}	3.18×10^{-02}	2.06×10^{-03}	1.08×10^{-05}	1.10×10^{-03}	$0.00 \times 10^{+00}$	1.54×10^{-03}	1.26×10^{-03}	7.49×10^{-04}	6.71×10^{-03}
		Base Case															

Table 15.5-1: Estimated Non-carcinogen Risk to Human Receptors – Project Lifespan and Far-Future Projection – Application Case and Upper Bound Sensitivity Scenario

	COPC	Project Lifespan Hazard Quotients								Far Future Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC	Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
Seasonal Resident (Lloyd Lake)	**Cobalt**	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	7.27×10^{-04}	1.13×10^{-03}	1.88×10^{-02}	2.15×10^{-02}	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	7.27×10^{-04}	1.13×10^{-03}	1.88×10^{-02}	2.15×10^{-02}
	Copper	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	5.66×10^{-04}	4.22×10^{-04}	3.86×10^{-02}	3.96×10^{-02}	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	5.66×10^{-04}	4.22×10^{-04}	3.86×10^{-02}	3.96×10^{-02}
	Molybdenum	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	7.66×10^{-07}	2.29×10^{-04}	8.60×10^{-02}	8.63×10^{-02}	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	7.66×10^{-07}	2.29×10^{-04}	8.60×10^{-02}	8.63×10^{-02}
	Uranium	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	2.17×10^{-03}	3.01×10^{-02}	6.79×10^{-02}	1.03×10^{-01}	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	2.17×10^{-03}	3.01×10^{-02}	6.79×10^{-02}	1.03×10^{-01}
		Application Case — Incremental Project Risk															
	Cobalt	2.43×10^{-06}	7.84×10^{-10}	2.55×10^{-09}	$0.00 \times 10^{+00}$	3.62×10^{-06}	4.53×10^{-06}	1.30×10^{-05}	2.36×10^{-05}	1.23×10^{-05}	4.25×10^{-10}	1.45×10^{-08}	$0.00 \times 10^{+00}$	1.76×10^{-05}	5.31×10^{-07}	2.67×10^{-05}	5.70×10^{-05}
	Copper	4.40×10^{-08}	1.60×10^{-11}	5.41×10^{-11}	$0.00 \times 10^{+00}$	1.87×10^{-04}	3.11×10^{-07}	3.94×10^{-06}	1.91×10^{-04}	4.34×10^{-07}	1.07×10^{-12}	6.15×10^{-10}	$0.00 \times 10^{+00}$	2.04×10^{-04}	1.53×10^{-08}	7.19×10^{-06}	2.12×10^{-04}
	Molybdenum	1.67×10^{-06}	9.10×10^{-11}	2.20×10^{-09}	$0.00 \times 10^{+00}$	1.97×10^{-08}	1.47×10^{-06}	2.81×10^{-06}	5.97×10^{-06}	2.14×10^{-05}	$0.00 \times 10^{+00}$	3.20×10^{-08}	$0.00 \times 10^{+00}$	2.52×10^{-07}	$0.00 \times 10^{+00}$	6.65×10^{-06}	2.83×10^{-05}
	Uranium	1.88×10^{-05}	3.51×10^{-08}	1.35×10^{-07}	$0.00 \times 10^{+00}$	5.58×10^{-04}	3.00×10^{-04}	7.14×10^{-05}	9.48×10^{-04}	6.19×10^{-05}	3.69×10^{-09}	5.64×10^{-07}	$0.00 \times 10^{+00}$	6.37×10^{-04}	1.29×10^{-05}	2.51×10^{-05}	7.37×10^{-04}
		Upper Bound Scenario — Incremental Project Risk															
	Cobalt	2.53×10^{-06}	7.84×10^{-10}	2.66×10^{-09}	$0.00 \times 10^{+00}$	3.76×10^{-06}	4.53×10^{-06}	1.32×10^{-05}	2.40×10^{-05}	1.88×10^{-05}	4.25×10^{-10}	2.22×10^{-08}	$0.00 \times 10^{+00}$	2.68×10^{-05}	5.31×10^{-07}	4.01×10^{-05}	8.63×10^{-05}
	Copper	4.53×10^{-08}	1.60×10^{-11}	5.57×10^{-11}	$0.00 \times 10^{+00}$	1.87×10^{-04}	3.11×10^{-07}	3.96×10^{-06}	1.92×10^{-04}	6.52×10^{-07}	1.07×10^{-12}	9.24×10^{-10}	$0.00 \times 10^{+00}$	2.13×10^{-04}	1.53×10^{-08}	1.08×10^{-05}	2.25×10^{-04}
	Molybdenum	5.11×10^{-06}	9.10×10^{-11}	6.85×10^{-09}	$0.00 \times 10^{+00}$	5.98×10^{-08}	1.47×10^{-06}	3.70×10^{-06}	1.03×10^{-05}	8.20×10^{-05}	$0.00 \times 10^{+00}$	1.23×10^{-07}	$0.00 \times 10^{+00}$	9.66×10^{-07}	$0.00 \times 10^{+00}$	2.55×10^{-05}	1.09×10^{-04}
	Uranium	5.20×10^{-05}	3.51×10^{-08}	3.79×10^{-07}	$0.00 \times 10^{+00}$	6.18×10^{-04}	3.00×10^{-04}	8.02×10^{-05}	1.05×10^{-03}	6.19×10^{-05}	3.69×10^{-09}	5.65×10^{-07}	$0.00 \times 10^{+00}$	6.37×10^{-04}	1.29×10^{-05}	2.51×10^{-05}	7.37×10^{-04}
Seasonal Resident One-Year-Old (Lloyd Lake)		**Base Case**															
	Cobalt	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	6.89×10^{-04}	2.47×10^{-03}	4.13×10^{-02}	4.56×10^{-02}	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	6.89×10^{-04}	2.47×10^{-03}	4.13×10^{-02}	4.56×10^{-02}
	Copper	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	5.36×10^{-04}	9.22×10^{-04}	9.32×10^{-02}	9.47×10^{-02}	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	5.36×10^{-04}	9.22×10^{-04}	9.32×10^{-02}	9.47×10^{-02}
	Molybdenum	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	8.84×10^{-07}	6.10×10^{-04}	$\mathbf{2.77 \times 10^{-01}}$	2.78×10^{-01}	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	8.84×10^{-07}	6.10×10^{-04}	$\mathbf{2.77 \times 10^{-01}}$	2.78×10^{-01}
	Uranium	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	2.06×10^{-03}	6.58×10^{-02}	1.60×10^{-01}	2.33×10^{-01}	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	2.06×10^{-03}	6.58×10^{-02}	1.60×10^{-01}	2.33×10^{-01}
		Application Case — Incremental Project Risk															
	Cobalt	2.71×10^{-06}	5.12×10^{-08}	1.67×10^{-07}	$0.00 \times 10^{+00}$	1.91×10^{-06}	7.54×10^{-06}	1.33×10^{-05}	2.57×10^{-05}	1.37×10^{-05}	2.78×10^{-08}	9.47×10^{-07}	$0.00 \times 10^{+00}$	9.86×10^{-06}	1.16×10^{-06}	2.70×10^{-05}	5.26×10^{-05}
	Copper	4.91×10^{-08}	1.04×10^{-09}	3.54×10^{-09}	$0.00 \times 10^{+00}$	8.07×10^{-07}	6.24×10^{-07}	3.81×10^{-06}	5.29×10^{-06}	4.85×10^{-07}	6.98×10^{-11}	4.02×10^{-08}	$0.00 \times 10^{+00}$	8.00×10^{-06}	3.34×10^{-08}	6.53×10^{-06}	1.51×10^{-05}
	Molybdenum	2.27×10^{-06}	7.24×10^{-09}	1.75×10^{-07}	$0.00 \times 10^{+00}$	1.33×10^{-08}	2.88×10^{-06}	3.52×10^{-06}	8.86×10^{-06}	2.90×10^{-05}	$0.00 \times 10^{+00}$	2.54×10^{-06}	$0.00 \times 10^{+00}$	1.74×10^{-07}	$0.00 \times 10^{+00}$	8.14×10^{-06}	3.99×10^{-05}
	Uranium	2.10×10^{-05}	2.29×10^{-06}	8.84×10^{-06}	$0.00 \times 10^{+00}$	1.55×10^{-05}	5.37×10^{-04}	4.99×10^{-05}	6.34×10^{-04}	6.91×10^{-05}	2.41×10^{-07}	3.69×10^{-05}	$0.00 \times 10^{+00}$	5.18×10^{-05}	2.81×10^{-05}	1.80×10^{-05}	2.04×10^{-04}
		Upper Bound Scenario — Incremental Project Risk															
	Cobalt	2.82×10^{-06}	5.12×10^{-08}	1.74×10^{-07}	$0.00 \times 10^{+00}$	1.99×10^{-06}	7.54×10^{-06}	1.35×10^{-05}	2.61×10^{-05}	2.10×10^{-05}	2.78×10^{-08}	1.45×10^{-06}	$0.00 \times 10^{+00}$	1.51×10^{-05}	1.16×10^{-06}	4.06×10^{-05}	7.93×10^{-05}
	Copper	5.05×10^{-08}	1.04×10^{-09}	3.64×10^{-09}	$0.00 \times 10^{+00}$	8.31×10^{-07}	6.24×10^{-07}	3.83×10^{-06}	5.34×10^{-06}	7.28×10^{-07}	6.98×10^{-11}	6.04×10^{-08}	$0.00 \times 10^{+00}$	1.20×10^{-05}	3.34×10^{-08}	9.78×10^{-06}	2.26×10^{-05}
	Molybdenum	6.94×10^{-06}	7.24×10^{-09}	5.45×10^{-07}	$0.00 \times 10^{+00}$	4.09×10^{-08}	2.88×10^{-06}	4.62×10^{-06}	1.50×10^{-05}	1.11×10^{-04}	$0.00 \times 10^{+00}$	9.76×10^{-06}	$0.00 \times 10^{+00}$	6.69×10^{-07}	$0.00 \times 10^{+00}$	3.12×10^{-05}	1.53×10^{-04}
	Uranium	5.81×10^{-05}	2.29×10^{-06}	2.47×10^{-05}	$0.00 \times 10^{+00}$	4.30×10^{-05}	5.37×10^{-04}	5.63×10^{-05}	7.21×10^{-04}	6.92×10^{-05}	2.41×10^{-07}	3.69×10^{-05}	$0.00 \times 10^{+00}$	5.18×10^{-05}	2.81×10^{-05}	1.80×10^{-05}	2.04×10^{-04}
Permanent Resident (Patterson Lake North Arm – West Basin)		**Base Case**															
	Cobalt	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	2.30×10^{-03}	1.44×10^{-03}	2.44×10^{-02}	2.90×10^{-02}
	Copper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	1.79×10^{-03}	5.38×10^{-04}	4.12×10^{-02}	4.35×10^{-02}
	Molybdenum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	2.42×10^{-06}	2.92×10^{-04}	6.98×10^{-02}	7.02×10^{-02}
	Uranium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	6.85×10^{-03}	3.84×10^{-02}	8.20×10^{-02}	1.30×10^{-01}
		Application Case — Incremental Project Risk															
	Cobalt	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.24×10^{-03}	2.83×10^{-09}	1.47×10^{-06}	$0.00 \times 10^{+00}$	3.32×10^{-03}	4.51×10^{-06}	6.37×10^{-03}	1.09×10^{-02}
	Copper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	4.62×10^{-05}	6.05×10^{-11}	6.54×10^{-08}	$0.00 \times 10^{+00}$	2.84×10^{-03}	1.10×10^{-06}	1.81×10^{-03}	4.69×10^{-03}
	Molybdenum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.31×10^{-03}	$0.00 \times 10^{+00}$	3.46×10^{-06}	$0.00 \times 10^{+00}$	5.15×10^{-05}	$0.00 \times 10^{+00}$	1.80×10^{-03}	4.16×10^{-03}
	Uranium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.21×10^{-02}	3.84×10^{-06}	2.02×10^{-04}	$0.00 \times 10^{+00}$	6.17×10^{-02}	1.71×10^{-02}	3.07×10^{-02}	1.32×10^{-01}
		Upper Bound Scenario — Incremental Project Risk															
	Cobalt	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.90×10^{-03}	2.83×10^{-09}	2.25×10^{-06}	$0.00 \times 10^{+00}$	5.09×10^{-03}	4.51×10^{-06}	9.75×10^{-03}	1.67×10^{-02}
	Copper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	6.94×10^{-05}	6.05×10^{-11}	9.83×10^{-08}	$0.00 \times 10^{+00}$	4.26×10^{-03}	1.10×10^{-06}	2.71×10^{-03}	7.04×10^{-03}
	Molybdenum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	8.87×10^{-03}	$0.00 \times 10^{+00}$	1.33×10^{-05}	$0.00 \times 10^{+00}$	1.98×10^{-04}	$0.00 \times 10^{+00}$	6.90×10^{-03}	1.60×10^{-02}
	Uranium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.22×10^{-02}	3.84×10^{-06}	2.02×10^{-04}	$0.00 \times 10^{+00}$	6.17×10^{-02}	1.71×10^{-02}	3.07×10^{-02}	1.32×10^{-01}

Table 15.5-1: Estimated Non-carcinogen Risk to Human Receptors – Project Lifespan and Far-Future Projection – Application Case and Upper Bound Sensitivity Scenario

	COPC	Project Lifespan Hazard Quotients								Far Future Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC	Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
Permanent Resident One-Year-Old (Patterson Lake North Arm – West Basin)		**Base Case**															
	Cobalt	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	2.18×10^{-03}	2.84×10^{-03}	4.78×10^{-02}	5.39×10^{-02}
	Copper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	1.69×10^{-03}	1.06×10^{-03}	9.70×10^{-02}	9.98×10^{-02}
	Molybdenum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	2.79×10^{-06}	7.01×10^{-04}	**2.64×10^{-01}**	2.64×10^{-01}
	Uranium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	6.49×10^{-03}	7.57×10^{-02}	1.70×10^{-01}	2.57×10^{-01}
		Application Case — Incremental Project Risk															
	Cobalt	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.39×10^{-03}	1.85×10^{-07}	9.59×10^{-05}	$0.00 \times 10^{+00}$	3.15×10^{-03}	8.90×10^{-06}	6.47×10^{-03}	1.11×10^{-02}
	Copper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	5.16×10^{-05}	3.95×10^{-09}	4.28×10^{-06}	$0.00 \times 10^{+00}$	2.69×10^{-03}	2.18×10^{-06}	1.67×10^{-03}	4.41×10^{-03}
	Molybdenum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3.14×10^{-03}	$0.00 \times 10^{+00}$	2.75×10^{-04}	$0.00 \times 10^{+00}$	5.95×10^{-05}	$0.00 \times 10^{+00}$	2.20×10^{-03}	5.67×10^{-03}
	Uranium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.47×10^{-02}	2.51×10^{-04}	1.32×10^{-02}	$0.00 \times 10^{+00}$	5.85×10^{-02}	3.37×10^{-02}	2.23×10^{-02}	1.53×10^{-01}
		Upper Bound Scenario — Incremental Project Risk															
	Cobalt	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.12×10^{-03}	1.85×10^{-07}	1.47×10^{-04}	$0.00 \times 10^{+00}$	4.83×10^{-03}	8.90×10^{-06}	9.90×10^{-03}	1.70×10^{-02}
	Copper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	7.75×10^{-05}	3.95×10^{-09}	6.42×10^{-06}	$0.00 \times 10^{+00}$	4.04×10^{-03}	2.18×10^{-06}	2.50×10^{-03}	6.62×10^{-03}
	Molybdenum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.21×10^{-02}	$0.00 \times 10^{+00}$	1.06×10^{-03}	$0.00 \times 10^{+00}$	2.28×10^{-04}	$0.00 \times 10^{+00}$	8.44×10^{-03}	2.18×10^{-02}
	Uranium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.48×10^{-02}	2.51×10^{-04}	1.32×10^{-02}	$0.00 \times 10^{+00}$	5.85×10^{-02}	3.37×10^{-02}	2.23×10^{-02}	1.53×10^{-01}

Note: **Bold** indicates exceedance of HQ of 0.2.
HQ = hazard quotient; COPC = constituent of potential concern; n/a = receptor not assessed in that phase.

15.5.1.2 Carcinogens

The cancer risks (i.e., ILCRs) for arsenic for all human receptors in the Application Case and upper bound sensitivity scenario are summarized in Table 15.5-2. The cancer risks were compared against a lifetime cancer risk level of 1 in 100,000 (i.e., 0.00001). Health Canada (2021a) considers this risk level to be essentially negligible compared to the background cancer risk level in North America of approximately 5 in 10 (i.e., 0.5). Additionally, cancer risks are interpreted based on different categories of risk as shown in Figure 15.5-1, where 1 in 1,000,000 represents essentially zero risk, the range of 1 in 1,000,000 to 1 in 100,000 represents negligible or minimal risk as indicated by Health Canada (2021a), the range of 1 in 100,000 to 1 in 10,000 represents very low risk (i.e., equivalent to many healthcare interventions), the range of 1 in 10,000 to 1 in 1,000 represents low risk (i.e., equivalent to clinical procedures), and the range of 1 in 1,000 to 1 in 100 represents moderate risk (i.e., equivalent to certain types of medical procedures; Calman 1996).

The arsenic ILCR is expected to exceed the negligible cancer risk level of 1 in 100,000 for the subsistence harvester (i.e., composite receptor throughout all life stages) harvesting Traditional Foods from Patterson Lake South Arm during the Project lifespan for both the Application Case and the reasonable upper bound sensitivity scenario. The arsenic ILCR is below the negligible cancer risk level of 1 in 100,000 for all other human receptors during the Project lifespan and in the far-future scenario.

Incremental lifetime cancer risk from arsenic for the subsistence harvester at Patterson Lake South Arm was predicted to be 4 in 100,000 in both the Application Case and in upper bound scenarios. In comparison, baseline cancer risks from arsenic for the reference subsistence harvester were predicted to be 69 in 100,000 for the selected regional background conditions in the IMPACT model. The reference subsistence harvester represents an adult subsistence harvester who is exposed to baseline concentrations (i.e., existing conditions) of arsenic in foodstuffs only, without any Project-related additions. The ILCR for the human receptors from arsenic from the Project is a small portion of the existing baseline cancer risks for these receptors.

These predictions are mainly a result of the high Traditional Foods diet assumed for both receptors. The main ingestion exposure pathway for arsenic for the subsistence harvester was consumption of local terrestrial animals, including beaver, grouse, mallard, moose, and moose organs, as well as locally caught fish represented in the HHRA by lake whitefish and northern pike.

Table 15.5-2: Estimated Incremental Lifetime Cancer Risk from Arsenic to Human Receptors – Application Case and Upper Bound Sensitivity Scenario

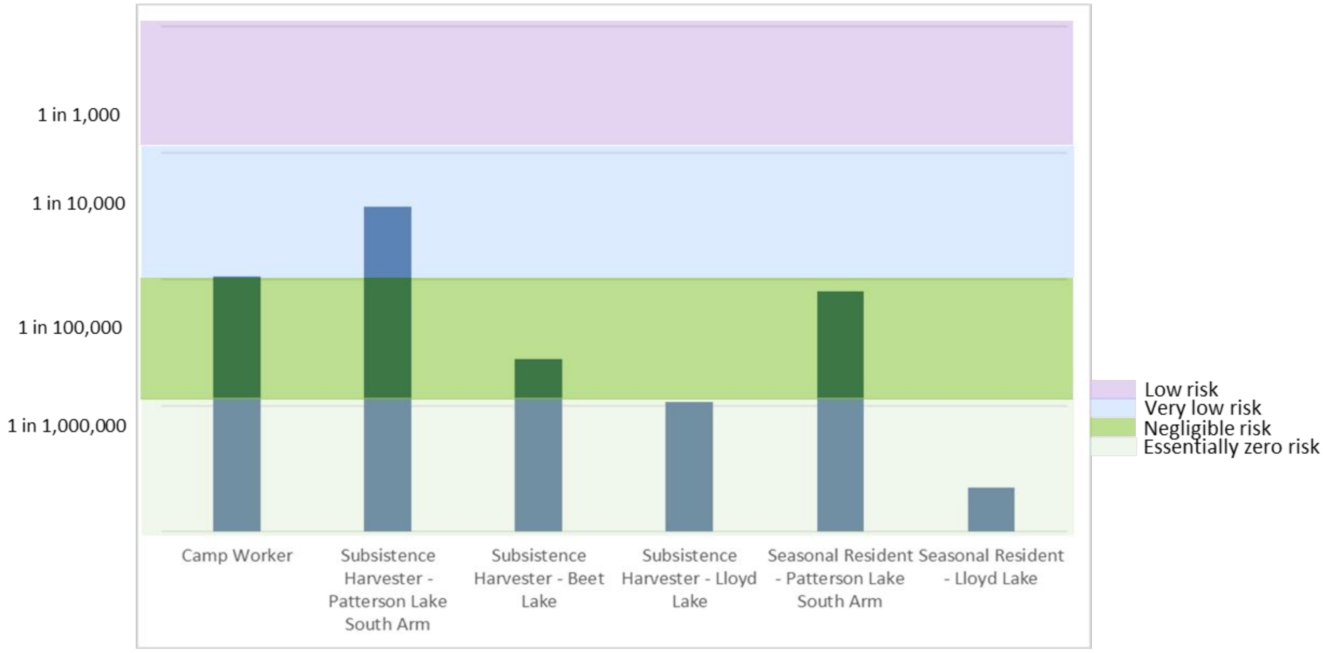
Receptor	Application Case Cancer Risk (per 100,000)		Upper Bound Scenario Cancer Risk (per 100,000)	
	Project Lifespan	Far-Future	Project Lifespan	Far-Future
Camp worker (adult)	1	n/a	1	n/a
Subsistence harvester - Patterson Lake South Arm (composite)	**4**	0.1	**4**	0.1
Subsistence harvester - Beet Lake (composite)	0.2	0.004	0.2	0.005
Subsistence harvester - Lloyd Lake (composite)	0.1	0.0002	0.1	0.0003
Seasonal resident - Patterson Lake South Arm (composite)	0.8	0.02	0.8	0.03
Seasonal resident - Lloyd Lake (composite)	0.02	0.00004	0.02	0.00007
Future permanent resident - camp location (composite)	n/a	0.5	n/a	0.8

Notes: **Bold** indicates exceedance of the negligible cancer risk level of 1 in 100,000.
Baseline cancer risks for the subsistence harvester, seasonal resident, and camp worker are 69, 50, and 27 in 100,000, respectively.
n/a = not applicable, receptor was not assessed.

Arsenic uptake by fish and maximum arsenic concentrations in fish flesh were predicted as part of the environmental pathways assessment. For Patterson Lake South Arm, where the subsistence harvester is expected to fish, the maximum predicted arsenic concentration in lake whitefish (i.e., 0.043 milligrams per kilogram fresh weight [mg/kg fw]) was within the range of background variability observed in the area of the Project (i.e., 0.011 mg/kg to 0.11 mg/kg fw; Annex V.1, Aquatic Environment Baseline Report) and within the range of tissue concentrations from lake whitefish samples as part of the Eastern Athabasca Region community monitoring program for 2011 to 2020 (i.e., 0.01 mg/kg to 0.52 mg/kg fw; CanNorth 2018). The maximum predicted concentration of arsenic in northern pike (i.e., 0.045 mg/kg fw) was also within the range of background variability measured in northern pike during baseline studies (i.e., 0.011 mg/kg to 0.36 mg/kg fw; Annex V.1) and below the range of tissue concentrations from northern pike samples as part of the Eastern Athabasca Region community monitoring program for 2011 to 2020 (i.e., 0.09 mg/kg to 0.15 mg/kg fw; CanNorth 2018) and the FNFNES sampling program for 2015 (i.e., maximum concentration of 0.1 mg/kg fw; Chan et al. 2018). Furthermore, the maximum predicted arsenic concentrations in lake whitefish and northern pike in Patterson Lake South Arm (i.e., 0.043 mg/kg fw and 0.045 mg/kg fw, respectively) for the Application Case are below the minimum of the range of concentrations measured in store-bought freshwater trout, marine haddock/cod/sole, canned tuna and salmon, and shellfish (i.e., range of 0.120 mg/kg to 8.494 mg/kg fw; geometric mean of 0.811 mg/kg fw) (Health Canada 2022). The potential for arsenic to represent health risks for consumers of Traditional Foods was assessed for the Eastern Athabasca Region and for the Boreal Shield region of Saskatchewan by CanNorth (2018) and Chan et al. (2018), respectively. Each of these HHRAs concluded that arsenic did not pose a significant risk to consumers of Traditional Foods. Since predicted incremental cancer risks from fish consumption are based on predicted arsenic concentrations in fish that are within the range of concentrations assessed for other regions of Saskatchewan, arsenic originating from the Project is not considered to be a significant health risk.

Additionally, the main contribution to the arsenic cancer risk for the human receptors is from ingestion of moose and moose organs. The ingestion rates used for moose and moose organs in the Traditional Foods diet are considered to be conservative and were based on the ingestion rates provided in the FNFNES (Chan et al. 2018). The diet is conservative in that it was based on the higher ingestion rates in the male diet for the high consumer of Traditional Foods. Arsenic concentrations in Project emissions would be monitored as part of the Effluent and Emissions Plan. The Environmental Monitoring Plan includes monitoring of water and sediment quality and applying adaptive management where necessary to minimize risk to human health, as described in Section 15.8.

Figure 15.5-1: Interpretation of Incremental Cancer Risk for Human Health Receptors – Application Case



15.5.1.3 Radionuclides and Radon

The incremental radiation doses to all human receptors during the Project lifespan and the far-future projection are below the public regulatory dose limit of 1 mSv/yr for both the Application Case and the upper bound sensitivity scenario, as shown in Table 15.5-3. The maximum dose in the Application Case was predicted for the subsistence harvester (one-year-old) who eats Traditional Foods gathered at Patterson Lake South Arm during Operations. The main contribution to the total dose is from polonium-210 from eating terrestrial animals in the Traditional Food diet, including moose (e.g., meat, organs), beaver, grouse, and mallard (Table 15.5-4).

If a dose constraint of 0.3 mSv/yr is applied, the dose to the subsistence harvester (one-year-old) is less than the dose constraint for the Application Case and for the upper bound sensitivity scenario, and well below the regulatory public dose limit.

In the far-future projection, a future permanent resident living at the location of the camp could receive a dose up to 0.07 mSv/yr, which is well below both the regulatory public dose limit and the dose constraint.

Overall, since the radiation dose estimates are below the public dose limit, no discernable health effects are anticipated due to exposure of these receptors to radioactive releases from the Project. The presence and concentrations of radionuclides in the receiving environment would be monitored and the associated radiation dose estimates would be periodically reassessed in accordance with the processes outlined in the Environmental Protection Program.

Table 15.5-3: Summary of All Radiation Doses to Human Receptors – Application Case and Upper Bound Sensitivity Scenario

Receptor	Location	Application Case		Upper Bound	
		Project Lifespan	Far-Future	Project Lifespan	Far-Future
		Dose (mSv/yr)			
Camp worker	Permanent Camp	6.50×10^{-02}	n/a	8.24×10^{-02}	n/a
Harvester	Patterson Lake South Arm	6.80×10^{-02}	4.62×10^{-03}	1.03×10^{-01}	4.62×10^{-03}
Harvester_1y	Patterson Lake South Arm	7.45×10^{-02}	5.41×10^{-03}	1.19×10^{-01}	5.41×10^{-03}
Harvester	Beet Lake	2.18×10^{-02}	1.97×10^{-03}	2.38×10^{-02}	1.97×10^{-03}
Harvester_1y	Beet Lake	2.68×10^{-02}	2.43×10^{-03}	2.94×10^{-02}	2.43×10^{-03}
Harvester	Lloyd Lake	9.53×10^{-04}	7.98×10^{-05}	1.06×10^{-03}	7.98×10^{-05}
Harvester_1y	Lloyd Lake	1.00×10^{-03}	9.12×10^{-05}	1.14×10^{-03}	9.12×10^{-05}
Seasonal Resident	Patterson Lake South Arm	1.77×10^{-02}	2.09×10^{-03}	2.60×10^{-02}	2.09×10^{-03}
Seasonal Resident_1y	Patterson Lake South Arm	2.11×10^{-02}	2.65×10^{-03}	3.20×10^{-02}	2.65×10^{-03}
Seasonal Resident	Lloyd Lake	1.55×10^{-03}	1.31×10^{-03}	1.59×10^{-03}	1.31×10^{-03}
Seasonal Resident_1y	Lloyd Lake	3.13×10^{-04}	4.91×10^{-05}	3.49×10^{-04}	4.92×10^{-05}
Permanent Resident	Permanent Camp	n/a	5.11×10^{-02}	n/a	5.12×10^{-02}
Permanent Resident_1y	Permanent Camp	n/a	6.58×10^{-02}	n/a	6.58×10^{-02}

n/a = not applicable; 1y = one-year-old; mSv/yr = millisieverts per year.

Table 15.5-4: Summary of Maximum Radiation Doses to Human Receptors – Application Case and Upper Bound Sensitivity Scenario

	Maximum Dose (mSv/yr)	Receptor	Location	Largest Contributor to Dose	% of Dose Limit
Project Lifespan					
Application Case	0.07	Subsistence Harvester (one-year-old)	Patterson Lake South Arm	Polonium-210 terrestrial animals	7%
Upper Bound Sensitivity Scenario	0.1	Subsistence Harvester (one-year-old)	Patterson Lake South Arm	Polonium-210 terrestrial animals	12%
Far-Future Projection					
Application Case	0.07	Future permanent resident (one-year-old)	Patterson Lake North Arm – West Basin	Polonium-210 terrestrial animals	7%
Upper Bound Sensitivity Scenario	0.07	Future permanent resident (one-year-old)	Patterson Lake North Arm – West Basin	Polonium-210 terrestrial animals	7%

mSv/yr = millisieverts per year.

The incremental radon dose to the camp worker was estimated to be 0.51 mSv/yr. The incremental radon dose is based on atmospheric modelling of the radon released during the maximum ore grade year (i.e., the first year of Operations). This is a conservative assumption, as radon is expected to be released at a much lower rate over the duration of the Project. Additionally, the assessment is conservative in that it assumes the camp worker spends 100% of the time indoors. Radon outdoors is expected to dissipate quickly. The total incremental dose to the camp worker from all radionuclides in the U-238 decay chain including radon would be 0.58 mSv/yr for the Application Case and 0.59 mSv/yr for the upper bound sensitivity scenario, both of which are below the dose limit for a non-nuclear energy worker of 1 mSv/yr.

15.5.2 Reasonably Foreseeable Development Case

This subsection describes the results of the RFD Case, which looks at combined effects of the Project and the Fission Patterson Lake South Property.

15.5.2.1 Non-carcinogens

With the addition of releases from the Fission Patterson Lake South Property (Section 7.2.5.3 and Section 10.5.2, Reasonably Foreseeable Development Case), the estimated Project HQs for cobalt, copper, molybdenum, and uranium for all human receptors at all assessed locations were predicted to increase slightly under the RFD Case; however, they remain below the acceptable risk level of 0.2 per pathway for the one-year-old and adult for all human receptors (Table 15.5-5). For assessment of non-carcinogens, the one-year-old is typically considered the most sensitive receptor (Health Canada 2010a). Table 15.5-5 shows the Project-only risk for the Project lifespan and for the far-future projection, as well as the Base Case risk, all for the RFD Case. These results indicate that the Project-only risks are minimal.

Table 15.5-5: Estimated Non-carcinogen Risk to Human Receptors – Project Lifespan and Far-Future Projection – Reasonably Foreseeable Development Case

	COPC	RFD Case Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
Camp Worker (Patterson Lake North Arm – West Basin)		**Base Case**							
	Cobalt	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	1.15×10^{-03}	7.21×10^{-04}	1.97×10^{-02}	2.25×10^{-02}
	Copper	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	8.94×10^{-04}	2.69×10^{-04}	3.89×10^{-02}	4.01×10^{-02}
	Molybdenum	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	1.21×10^{-06}	1.46×10^{-04}	8.23×10^{-02}	8.25×10^{-02}
	Uranium	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	3.43×10^{-03}	1.92×10^{-02}	7.29×10^{-02}	9.80×10^{-02}
		Project Lifespan - Incremental Project Risk							
	Cobalt	5.31×10^{-06}	1.72×10^{-09}	3.99×10^{-09}	$0.00 \times 10^{+00}$	1.79×10^{-04}	8.04×10^{-06}	3.32×10^{-04}	5.25×10^{-04}
	Copper	2.44×10^{-08}	4.67×10^{-10}	2.10×10^{-11}	$0.00 \times 10^{+00}$	8.64×10^{-05}	4.06×10^{-07}	1.47×10^{-04}	2.34×10^{-04}
	Molybdenum	1.84×10^{-07}	1.91×10^{-09}	1.64×10^{-10}	$0.00 \times 10^{+00}$	9.84×10^{-07}	2.71×10^{-06}	8.76×10^{-05}	9.15×10^{-05}
	Uranium	2.55×10^{-06}	1.94×10^{-05}	8.88×10^{-09}	$0.00 \times 10^{+00}$	7.17×10^{-03}	2.42×10^{-02}	1.52×10^{-02}	4.66×10^{-02}
		Far Future - Incremental Project Risk							
	Cobalt	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Copper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Molybdenum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Uranium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Subsistence Harvester (Patterson Lake South Arm)		**Base Case**							
	Cobalt	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	2.30×10^{-03}	1.44×10^{-03}	2.44×10^{-02}	2.90×10^{-02}
	Copper	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	1.79×10^{-03}	5.38×10^{-04}	4.12×10^{-02}	4.35×10^{-02}
	Molybdenum	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	2.42×10^{-06}	2.92×10^{-04}	6.98×10^{-02}	7.02×10^{-02}
	Uranium	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	6.85×10^{-03}	3.84×10^{-02}	8.20×10^{-02}	1.30×10^{-01}
		Project Lifespan - Incremental Project Risk							
	Cobalt	1.46×10^{-04}	1.31×10^{-09}	1.10×10^{-07}	$0.00 \times 10^{+00}$	3.59×10^{-04}	1.61×10^{-05}	6.63×10^{-04}	1.18×10^{-03}
	Copper	2.86×10^{-06}	2.66×10^{-11}	2.49×10^{-09}	$0.00 \times 10^{+00}$	1.73×10^{-04}	8.11×10^{-07}	2.93×10^{-04}	4.70×10^{-04}
	Molybdenum	9.60×10^{-05}	1.52×10^{-10}	9.18×10^{-08}	$0.00 \times 10^{+00}$	1.97×10^{-06}	5.41×10^{-06}	1.75×10^{-04}	2.78×10^{-04}
	Uranium	5.35×10^{-03}	2.95×10^{-06}	1.47×10^{-05}	$0.00 \times 10^{+00}$	1.43×10^{-02}	4.83×10^{-02}	3.04×10^{-02}	9.84×10^{-02}
		Far Future - Incremental Project Risk							
	Cobalt	3.77×10^{-04}	7.08×10^{-10}	4.46×10^{-07}	$0.00 \times 10^{+00}$	1.01×10^{-03}	1.13×10^{-06}	2.92×10^{-03}	4.31×10^{-03}
	Copper	1.36×10^{-05}	1.78×10^{-12}	1.92×10^{-08}	$0.00 \times 10^{+00}$	8.32×10^{-04}	3.25×10^{-08}	7.56×10^{-04}	1.60×10^{-03}
	Molybdenum	6.70×10^{-04}	$0.00 \times 10^{+00}$	1.00×10^{-06}	$0.00 \times 10^{+00}$	1.50×10^{-05}	$0.00 \times 10^{+00}$	7.56×10^{-04}	1.44×10^{-03}
	Uranium	3.06×10^{-03}	3.10×10^{-07}	2.79×10^{-05}	$0.00 \times 10^{+00}$	8.53×10^{-03}	1.38×10^{-03}	4.39×10^{-03}	1.74×10^{-02}

Table 15.5-5: Estimated Non-carcinogen Risk to Human Receptors – Project Lifespan and Far-Future Projection – Reasonably Foreseeable Development Case

	COPC	RFD Case Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
Subsistence Harvester One-Year-Old (Patterson Lake South Arm)		**Base Case**							
	Cobalt	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	2.18×10^{-03}	2.84×10^{-03}	4.78×10^{-02}	5.39×10^{-02}
	Copper	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	1.69×10^{-03}	1.06×10^{-03}	9.70×10^{-02}	9.98×10^{-02}
	Molybdenum	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	2.79×10^{-06}	7.01×10^{-04}	$\mathbf{2.64 \times 10^{-01}}$	2.64×10^{-01}
	Uranium	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	6.49×10^{-03}	7.57×10^{-02}	1.70×10^{-01}	2.57×10^{-01}
		Project Lifespan - Incremental Project Risk							
	Cobalt	1.63×10^{-04}	8.54×10^{-08}	7.19×10^{-06}	$0.00 \times 10^{+00}$	3.40×10^{-04}	2.27×10^{-05}	6.80×10^{-04}	1.21×10^{-03}
	Copper	3.19×10^{-06}	1.74×10^{-09}	1.63×10^{-07}	$0.00 \times 10^{+00}$	1.64×10^{-04}	1.39×10^{-06}	2.95×10^{-04}	4.64×10^{-04}
	Molybdenum	1.30×10^{-04}	1.21×10^{-08}	7.30×10^{-06}	$0.00 \times 10^{+00}$	2.27×10^{-06}	9.10×10^{-06}	2.21×10^{-04}	3.71×10^{-04}
	Uranium	5.97×10^{-03}	1.93×10^{-04}	9.61×10^{-04}	$0.00 \times 10^{+00}$	1.36×10^{-02}	7.27×10^{-02}	2.20×10^{-02}	1.15×10^{-01}
		Far Future - Incremental Project Risk							
	Cobalt	4.21×10^{-04}	4.63×10^{-08}	2.91×10^{-05}	$0.00 \times 10^{+00}$	9.56×10^{-04}	2.22×10^{-06}	3.01×10^{-03}	4.42×10^{-03}
	Copper	1.51×10^{-05}	1.16×10^{-10}	1.25×10^{-06}	$0.00 \times 10^{+00}$	7.89×10^{-04}	6.40×10^{-08}	7.25×10^{-04}	1.53×10^{-03}
	Molybdenum	9.11×10^{-04}	$0.00 \times 10^{+00}$	7.98×10^{-05}	$0.00 \times 10^{+00}$	1.73×10^{-05}	$0.00 \times 10^{+00}$	9.41×10^{-04}	1.95×10^{-03}
	Uranium	3.42×10^{-03}	2.03×10^{-05}	1.83×10^{-03}	$0.00 \times 10^{+00}$	8.09×10^{-03}	2.72×10^{-03}	3.23×10^{-03}	1.93×10^{-02}
Subsistence Harvester (Beet Lake)		**Base Case**							
	Cobalt	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	2.30×10^{-03}	1.44×10^{-03}	2.44×10^{-02}	2.90×10^{-02}
	Copper	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	1.79×10^{-03}	5.38×10^{-04}	4.12×10^{-02}	4.35×10^{-02}
	Molybdenum	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	2.42×10^{-06}	2.92×10^{-04}	6.98×10^{-02}	7.02×10^{-02}
	Uranium	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	6.85×10^{-03}	3.84×10^{-02}	8.20×10^{-02}	1.30×10^{-01}
		Project Lifespan - Incremental Project Risk							
	Cobalt	6.47×10^{-05}	1.31×10^{-09}	5.83×10^{-08}	$0.00 \times 10^{+00}$	1.59×10^{-04}	1.61×10^{-05}	3.21×10^{-04}	5.61×10^{-04}
	Copper	1.24×10^{-06}	2.66×10^{-11}	1.30×10^{-09}	$0.00 \times 10^{+00}$	7.51×10^{-05}	8.11×10^{-07}	5.12×10^{-05}	1.28×10^{-04}
	Molybdenum	4.28×10^{-05}	1.52×10^{-10}	4.78×10^{-08}	$0.00 \times 10^{+00}$	8.77×10^{-07}	5.41×10^{-06}	3.50×10^{-05}	8.42×10^{-05}
	Uranium	1.86×10^{-03}	1.65×10^{-06}	5.43×10^{-06}	$0.00 \times 10^{+00}$	4.97×10^{-03}	2.70×10^{-02}	1.14×10^{-02}	4.52×10^{-02}
		Far Future - Incremental Project Risk							
	Cobalt	1.99×10^{-04}	7.08×10^{-10}	2.36×10^{-07}	$0.00 \times 10^{+00}$	5.34×10^{-04}	1.13×10^{-06}	1.02×10^{-03}	1.76×10^{-03}
	Copper	7.09×10^{-06}	1.78×10^{-12}	1.00×10^{-08}	$0.00 \times 10^{+00}$	4.35×10^{-04}	3.25×10^{-08}	2.75×10^{-04}	7.18×10^{-04}
	Molybdenum	3.49×10^{-04}	$0.00 \times 10^{+00}$	5.22×10^{-07}	$0.00 \times 10^{+00}$	7.79×10^{-06}	$0.00 \times 10^{+00}$	2.71×10^{-04}	6.29×10^{-04}
	Uranium	1.14×10^{-03}	1.73×10^{-07}	1.04×10^{-05}	$0.00 \times 10^{+00}$	3.17×10^{-03}	7.71×10^{-04}	1.48×10^{-03}	6.58×10^{-03}

Table 15.5-5: Estimated Non-carcinogen Risk to Human Receptors – Project Lifespan and Far-Future Projection – Reasonably Foreseeable Development Case

	COPC	RFD Case Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
Subsistence Harvester One-Year-Old (Beet Lake)		**Base Case**							
	Cobalt	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	2.18×10^{-03}	2.84×10^{-03}	4.78×10^{-02}	5.39×10^{-02}
	Copper	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	1.69×10^{-03}	1.06×10^{-03}	9.70×10^{-02}	9.98×10^{-02}
	Molybdenum	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	2.79×10^{-06}	7.01×10^{-04}	**2.64×10^{-01}**	2.64×10^{-01}
	Uranium	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	6.49×10^{-03}	7.57×10^{-02}	1.70×10^{-01}	2.57×10^{-01}
		Project Lifespan - Incremental Project Risk							
	Cobalt	7.22×10^{-05}	8.54×10^{-08}	3.81×10^{-06}	$0.00 \times 10^{+00}$	1.51×10^{-04}	2.27×10^{-05}	3.31×10^{-04}	5.81×10^{-04}
	Copper	1.39×10^{-06}	1.74×10^{-09}	8.50×10^{-08}	$0.00 \times 10^{+00}$	7.12×10^{-05}	1.39×10^{-06}	4.76×10^{-05}	1.22×10^{-04}
	Molybdenum	5.82×10^{-05}	1.21×10^{-08}	3.80×10^{-06}	$0.00 \times 10^{+00}$	1.01×10^{-06}	9.10×10^{-06}	4.30×10^{-05}	1.15×10^{-04}
	Uranium	2.07×10^{-03}	1.08×10^{-04}	3.55×10^{-04}	$0.00 \times 10^{+00}$	4.71×10^{-03}	4.06×10^{-02}	8.06×10^{-03}	5.59×10^{-02}
		Far Future - Incremental Project Risk							
	Cobalt	2.23×10^{-04}	4.63×10^{-08}	1.54×10^{-05}	$0.00 \times 10^{+00}$	5.06×10^{-04}	2.22×10^{-06}	1.04×10^{-03}	1.79×10^{-03}
	Copper	7.91×10^{-06}	1.16×10^{-10}	6.56×10^{-07}	$0.00 \times 10^{+00}$	4.12×10^{-04}	6.40×10^{-08}	2.54×10^{-04}	6.75×10^{-04}
	Molybdenum	4.74×10^{-04}	$0.00 \times 10^{+00}$	4.16×10^{-05}	$0.00 \times 10^{+00}$	8.99×10^{-06}	$0.00 \times 10^{+00}$	3.32×10^{-04}	8.57×10^{-04}
	Uranium	1.27×10^{-03}	1.13×10^{-05}	6.79×10^{-04}	$0.00 \times 10^{+00}$	3.01×10^{-03}	1.52×10^{-03}	1.08×10^{-03}	7.57×10^{-03}
Subsistence Harvester (Lloyd Lake)		**Base Case**							
	Cobalt	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	2.30×10^{-03}	1.44×10^{-03}	2.44×10^{-02}	2.90×10^{-02}
	Copper	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	1.79×10^{-03}	5.38×10^{-04}	4.12×10^{-02}	4.35×10^{-02}
	Molybdenum	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	2.42×10^{-06}	2.92×10^{-04}	6.98×10^{-02}	7.02×10^{-02}
	Uranium	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	6.85×10^{-03}	3.84×10^{-02}	8.20×10^{-02}	1.30×10^{-01}
		Project Lifespan - Incremental Project Risk							
	Cobalt	6.56×10^{-06}	1.31×10^{-09}	6.04×10^{-09}	$0.00 \times 10^{+00}$	1.63×10^{-05}	1.61×10^{-05}	6.36×10^{-05}	1.02×10^{-04}
	Copper	1.25×10^{-07}	2.66×10^{-11}	1.34×10^{-10}	$0.00 \times 10^{+00}$	7.57×10^{-06}	8.11×10^{-07}	1.85×10^{-05}	2.70×10^{-05}
	Molybdenum	4.30×10^{-06}	1.52×10^{-10}	4.92×10^{-09}	$0.00 \times 10^{+00}$	8.86×10^{-08}	5.41×10^{-06}	1.29×10^{-05}	2.27×10^{-05}
	Uranium	1.73×10^{-04}	1.95×10^{-08}	4.97×10^{-07}	$0.00 \times 10^{+00}$	4.62×10^{-04}	3.19×10^{-04}	1.66×10^{-04}	1.12×10^{-03}
		Far Future - Incremental Project Risk							
	Cobalt	2.04×10^{-05}	7.08×10^{-10}	2.42×10^{-08}	$0.00 \times 10^{+00}$	5.47×10^{-05}	1.13×10^{-06}	1.10×10^{-04}	1.87×10^{-04}
	Copper	7.23×10^{-07}	1.78×10^{-12}	1.02×10^{-09}	$0.00 \times 10^{+00}$	4.44×10^{-05}	3.25×10^{-08}	2.84×10^{-05}	7.36×10^{-05}
	Molybdenum	3.56×10^{-05}	$0.00 \times 10^{+00}$	5.33×10^{-08}	$0.00 \times 10^{+00}$	7.94×10^{-07}	$0.00 \times 10^{+00}$	2.77×10^{-05}	6.41×10^{-05}
	Uranium	1.03×10^{-04}	2.05×10^{-09}	9.41×10^{-07}	$0.00 \times 10^{+00}$	2.87×10^{-04}	9.12×10^{-06}	7.98×10^{-05}	4.80×10^{-04}

Table 15.5-5: Estimated Non-carcinogen Risk to Human Receptors – Project Lifespan and Far-Future Projection – Reasonably Foreseeable Development Case

	COPC	RFD Case Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
Subsistence Harvester One-Year-Old (Lloyd Lake)		**Base Case**							
	Cobalt	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	2.18×10^{-03}	2.84×10^{-03}	4.78×10^{-02}	5.39×10^{-02}
	Copper	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	1.69×10^{-03}	1.06×10^{-03}	9.70×10^{-02}	9.98×10^{-02}
	Molybdenum	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	2.79×10^{-06}	7.01×10^{-04}	$\mathbf{2.64 \times 10^{-01}}$	2.64×10^{-01}
	Uranium	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	6.49×10^{-03}	7.57×10^{-02}	1.70×10^{-01}	2.57×10^{-01}
		Project Lifespan - Incremental Project Risk							
	Cobalt	7.32×10^{-06}	8.54×10^{-08}	3.95×10^{-07}	$0.00 \times 10^{+00}$	1.54×10^{-05}	2.27×10^{-05}	6.44×10^{-05}	1.10×10^{-04}
	Copper	1.40×10^{-07}	1.74×10^{-09}	8.76×10^{-09}	$0.00 \times 10^{+00}$	7.18×10^{-06}	1.39×10^{-06}	1.74×10^{-05}	2.61×10^{-05}
	Molybdenum	5.84×10^{-06}	1.21×10^{-08}	3.91×10^{-07}	$0.00 \times 10^{+00}$	1.02×10^{-07}	9.10×10^{-06}	1.59×10^{-05}	3.13×10^{-05}
	Uranium	1.93×10^{-04}	1.27×10^{-06}	3.25×10^{-05}	$0.00 \times 10^{+00}$	4.38×10^{-04}	4.80×10^{-04}	1.18×10^{-04}	1.26×10^{-03}
		Far Future - Incremental Project Risk							
	Cobalt	2.28×10^{-05}	4.63×10^{-08}	1.58×10^{-06}	$0.00 \times 10^{+00}$	5.19×10^{-05}	2.22×10^{-06}	1.12×10^{-04}	1.91×10^{-04}
	Copper	8.08×10^{-07}	1.16×10^{-10}	6.70×10^{-08}	$0.00 \times 10^{+00}$	4.21×10^{-05}	6.40×10^{-08}	2.62×10^{-05}	6.93×10^{-05}
	Molybdenum	4.84×10^{-05}	$0.00 \times 10^{+00}$	4.24×10^{-06}	$0.00 \times 10^{+00}$	9.16×10^{-07}	$0.00 \times 10^{+00}$	3.39×10^{-05}	8.74×10^{-05}
	Uranium	1.15×10^{-04}	1.34×10^{-07}	6.15×10^{-05}	$0.00 \times 10^{+00}$	2.72×10^{-04}	1.80×10^{-05}	5.89×10^{-05}	5.26×10^{-04}
Seasonal Resident (Patterson Lake South Arm)		**Base Case**							
	Cobalt	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	7.27×10^{-04}	1.13×10^{-03}	1.88×10^{-02}	2.15×10^{-02}
	Copper	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	5.66×10^{-04}	4.22×10^{-04}	3.86×10^{-02}	3.96×10^{-02}
	Molybdenum	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	7.66×10^{-07}	2.29×10^{-04}	8.60×10^{-02}	8.63×10^{-02}
	Uranium	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	2.17×10^{-03}	3.01×10^{-02}	6.79×10^{-02}	1.03×10^{-01}
		Project Lifespan - Incremental Project Risk							
	Cobalt	8.76×10^{-05}	7.84×10^{-10}	6.61×10^{-08}	$0.00 \times 10^{+00}$	6.82×10^{-05}	4.53×10^{-06}	1.59×10^{-04}	3.19×10^{-04}
	Copper	1.72×10^{-06}	1.60×10^{-11}	1.49×10^{-09}	$0.00 \times 10^{+00}$	3.28×10^{-05}	3.11×10^{-07}	6.93×10^{-05}	1.04×10^{-04}
	Molybdenum	5.76×10^{-05}	9.10×10^{-11}	5.51×10^{-08}	$0.00 \times 10^{+00}$	3.74×10^{-07}	1.47×10^{-06}	4.10×10^{-05}	1.01×10^{-04}
	Uranium	3.21×10^{-03}	1.77×10^{-06}	8.83×10^{-06}	$0.00 \times 10^{+00}$	2.72×10^{-03}	1.51×10^{-02}	5.67×10^{-03}	2.67×10^{-02}
		Far Future - Incremental Project Risk							
	Cobalt	2.26×10^{-04}	4.25×10^{-10}	2.67×10^{-07}	$0.00 \times 10^{+00}$	1.92×10^{-04}	5.31×10^{-07}	7.00×10^{-04}	1.12×10^{-03}
	Copper	8.13×10^{-06}	1.07×10^{-12}	1.15×10^{-08}	$0.00 \times 10^{+00}$	1.58×10^{-04}	1.53×10^{-08}	1.87×10^{-04}	3.53×10^{-04}
	Molybdenum	4.02×10^{-04}	$0.00 \times 10^{+00}$	6.02×10^{-07}	$0.00 \times 10^{+00}$	2.84×10^{-06}	$0.00 \times 10^{+00}$	1.80×10^{-04}	5.86×10^{-04}
	Uranium	1.84×10^{-03}	1.86×10^{-07}	1.68×10^{-05}	$0.00 \times 10^{+00}$	1.62×10^{-03}	6.49×10^{-04}	1.05×10^{-03}	5.17×10^{-03}

Table 15.5-5: Estimated Non-carcinogen Risk to Human Receptors – Project Lifespan and Far-Future Projection – Reasonably Foreseeable Development Case

	COPC	RFD Case Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
Seasonal Resident One-Year-Old (Patterson Lake South Arm)		**Base Case**							
	Cobalt	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	6.89×10^{-04}	2.47×10^{-03}	4.13×10^{-02}	4.56×10^{-02}
	Copper	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	5.36×10^{-04}	9.22×10^{-04}	9.32×10^{-02}	9.47×10^{-02}
	Molybdenum	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	8.84×10^{-07}	6.10×10^{-04}	$\mathbf{2.77 \times 10^{-01}}$	2.78×10^{-01}
	Uranium	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	2.06×10^{-03}	6.58×10^{-02}	1.60×10^{-01}	2.33×10^{-01}
		Project Lifespan - Incremental Project Risk							
	Cobalt	9.78×10^{-05}	5.12×10^{-08}	4.32×10^{-06}	$0.00 \times 10^{+00}$	6.46×10^{-05}	7.54×10^{-06}	1.63×10^{-04}	3.37×10^{-04}
	Copper	1.92×10^{-06}	1.04×10^{-09}	9.77×10^{-08}	$0.00 \times 10^{+00}$	3.11×10^{-05}	6.24×10^{-07}	7.02×10^{-05}	1.04×10^{-04}
	Molybdenum	7.83×10^{-05}	7.24×10^{-09}	4.38×10^{-06}	$0.00 \times 10^{+00}$	4.31×10^{-07}	2.88×10^{-06}	5.24×10^{-05}	1.38×10^{-04}
	Uranium	3.58×10^{-03}	1.16×10^{-04}	5.77×10^{-04}	$0.00 \times 10^{+00}$	2.58×10^{-03}	2.71×10^{-02}	4.17×10^{-03}	3.81×10^{-02}
		Far Future - Incremental Project Risk							
	Cobalt	2.52×10^{-04}	2.78×10^{-08}	1.75×10^{-05}	$0.00 \times 10^{+00}$	1.82×10^{-04}	1.16×10^{-06}	7.22×10^{-04}	1.17×10^{-03}
	Copper	9.08×10^{-06}	6.98×10^{-11}	7.53×10^{-07}	$0.00 \times 10^{+00}$	1.50×10^{-04}	3.34×10^{-08}	1.77×10^{-04}	3.37×10^{-04}
	Molybdenum	5.47×10^{-04}	$0.00 \times 10^{+00}$	4.79×10^{-05}	$0.00 \times 10^{+00}$	3.28×10^{-06}	$0.00 \times 10^{+00}$	2.24×10^{-04}	8.22×10^{-04}
	Uranium	2.05×10^{-03}	1.22×10^{-05}	1.10×10^{-03}	$0.00 \times 10^{+00}$	1.54×10^{-03}	1.42×10^{-03}	7.65×10^{-04}	6.88×10^{-03}
Seasonal Resident (Lloyd Lake)		**Base Case**							
	Cobalt	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	7.27×10^{-04}	1.13×10^{-03}	1.88×10^{-02}	2.15×10^{-02}
	Copper	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	5.66×10^{-04}	4.22×10^{-04}	3.86×10^{-02}	3.96×10^{-02}
	Molybdenum	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	7.66×10^{-07}	2.29×10^{-04}	8.60×10^{-02}	8.63×10^{-02}
	Uranium	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	2.17×10^{-03}	3.01×10^{-02}	6.79×10^{-02}	1.03×10^{-01}
		Project Lifespan - Incremental Project Risk							
	Cobalt	3.93×10^{-06}	7.84×10^{-10}	3.62×10^{-09}	$0.00 \times 10^{+00}$	5.54×10^{-06}	4.53×10^{-06}	1.47×10^{-05}	2.87×10^{-05}
	Copper	7.51×10^{-08}	1.60×10^{-11}	8.05×10^{-11}	$0.00 \times 10^{+00}$	1.88×10^{-04}	3.11×10^{-07}	4.24×10^{-06}	1.93×10^{-04}
	Molybdenum	2.58×10^{-06}	9.10×10^{-11}	2.95×10^{-09}	$0.00 \times 10^{+00}$	2.93×10^{-08}	1.47×10^{-06}	2.98×10^{-06}	7.06×10^{-06}
	Uranium	1.04×10^{-04}	1.17×10^{-08}	2.98×10^{-07}	$0.00 \times 10^{+00}$	7.09×10^{-04}	9.99×10^{-05}	3.26×10^{-05}	9.46×10^{-04}
		Far Future - Incremental Project Risk							
	Cobalt	1.23×10^{-05}	4.25×10^{-10}	1.45×10^{-08}	$0.00 \times 10^{+00}$	1.76×10^{-05}	5.31×10^{-07}	2.67×10^{-05}	5.70×10^{-05}
	Copper	4.34×10^{-07}	1.07×10^{-12}	6.15×10^{-10}	$0.00 \times 10^{+00}$	2.04×10^{-04}	1.53×10^{-08}	7.19×10^{-06}	2.12×10^{-04}
	Molybdenum	2.14×10^{-05}	$0.00 \times 10^{+00}$	3.20×10^{-08}	$0.00 \times 10^{+00}$	2.52×10^{-07}	$0.00 \times 10^{+00}$	6.65×10^{-06}	2.83×10^{-05}
	Uranium	6.19×10^{-05}	1.23×10^{-09}	5.64×10^{-07}	$0.00 \times 10^{+00}$	6.37×10^{-04}	4.29×10^{-06}	2.26×10^{-05}	7.26×10^{-04}

Table 15.5-5: Estimated Non-carcinogen Risk to Human Receptors – Project Lifespan and Far-Future Projection – Reasonably Foreseeable Development Case

	COPC	RFD Case Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
Seasonal Resident One-Year-Old (Lloyd Lake)		**Base Case**							
	Cobalt	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	6.89×10^{-04}	2.47×10^{-03}	4.13×10^{-02}	4.56×10^{-02}
	Copper	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	5.36×10^{-04}	9.22×10^{-04}	9.32×10^{-02}	9.47×10^{-02}
	Molybdenum	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	8.84×10^{-07}	6.10×10^{-04}	**2.77×10^{-01}**	2.78×10^{-01}
	Uranium	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	2.06×10^{-03}	6.58×10^{-02}	1.60×10^{-01}	2.33×10^{-01}
		Project Lifespan - Incremental Project Risk							
	Cobalt	4.39×10^{-06}	5.12×10^{-08}	2.37×10^{-07}	$0.00 \times 10^{+00}$	2.93×10^{-06}	7.54×10^{-06}	1.50×10^{-05}	3.02×10^{-05}
	Copper	8.39×10^{-08}	1.04×10^{-09}	5.26×10^{-09}	$0.00 \times 10^{+00}$	1.36×10^{-06}	6.24×10^{-07}	4.08×10^{-06}	6.15×10^{-06}
	Molybdenum	3.51×10^{-06}	7.24×10^{-09}	2.35×10^{-07}	$0.00 \times 10^{+00}$	1.94×10^{-08}	2.88×10^{-06}	3.73×10^{-06}	1.04×10^{-05}
	Uranium	1.16×10^{-04}	7.64×10^{-07}	1.95×10^{-05}	$0.00 \times 10^{+00}$	8.33×10^{-05}	1.79×10^{-04}	2.30×10^{-05}	4.21×10^{-04}
		Far Future - Incremental Project Risk							
	Cobalt	1.37×10^{-05}	2.78×10^{-08}	9.47×10^{-07}	$0.00 \times 10^{+00}$	9.86×10^{-06}	1.16×10^{-06}	2.70×10^{-05}	5.26×10^{-05}
	Copper	4.85×10^{-07}	6.98×10^{-11}	4.02×10^{-08}	$0.00 \times 10^{+00}$	8.00×10^{-06}	3.34×10^{-08}	6.53×10^{-06}	1.51×10^{-05}
	Molybdenum	2.90×10^{-05}	$0.00 \times 10^{+00}$	2.54×10^{-06}	$0.00 \times 10^{+00}$	1.74×10^{-07}	$0.00 \times 10^{+00}$	8.14×10^{-06}	3.99×10^{-05}
	Uranium	6.91×10^{-05}	8.03×10^{-08}	3.69×10^{-05}	$0.00 \times 10^{+00}$	5.18×10^{-05}	9.37×10^{-06}	1.62×10^{-05}	1.83×10^{-04}
Permanent Resident (Patterson Lake North Arm - West Basin)		**Base Case**							
	Cobalt	8.58×10^{-04}	9.04×10^{-07}	1.01×10^{-06}	$0.00 \times 10^{+00}$	2.30×10^{-03}	1.44×10^{-03}	2.44×10^{-02}	2.90×10^{-02}
	Copper	2.91×10^{-05}	2.95×10^{-08}	4.12×10^{-08}	$0.00 \times 10^{+00}$	1.79×10^{-03}	5.38×10^{-04}	4.12×10^{-02}	4.35×10^{-02}
	Molybdenum	1.08×10^{-04}	1.06×10^{-07}	1.62×10^{-07}	$0.00 \times 10^{+00}$	2.42×10^{-06}	2.92×10^{-04}	6.98×10^{-02}	7.02×10^{-02}
	Uranium	2.46×10^{-03}	8.62×10^{-06}	2.24×10^{-05}	$0.00 \times 10^{+00}$	6.85×10^{-03}	3.84×10^{-02}	8.20×10^{-02}	1.30×10^{-01}
		Base Case One-Year-Old							
	Cobalt	9.58×10^{-04}	5.91×10^{-05}	6.62×10^{-05}	$0.00 \times 10^{+00}$	2.18×10^{-03}	2.84×10^{-03}	4.78×10^{-02}	5.39×10^{-02}
	Copper	3.25×10^{-05}	1.93×10^{-06}	2.69×10^{-06}	$0.00 \times 10^{+00}$	1.69×10^{-03}	1.06×10^{-03}	9.70×10^{-02}	9.98×10^{-02}
	Molybdenum	1.47×10^{-04}	8.46×10^{-06}	1.29×10^{-05}	$0.00 \times 10^{+00}$	2.79×10^{-06}	7.01×10^{-04}	**2.64×10^{-01}**	2.64×10^{-01}
	Uranium	2.75×10^{-03}	5.64×10^{-04}	1.47×10^{-03}	$0.00 \times 10^{+00}$	6.49×10^{-03}	7.57×10^{-02}	1.70×10^{-01}	2.57×10^{-01}
		Far Future Adult - Incremental Project Risk							
	Cobalt	1.24×10^{-03}	1.42×10^{-09}	1.47×10^{-06}	$0.00 \times 10^{+00}$	3.32×10^{-03}	2.26×10^{-06}	6.36×10^{-03}	1.09×10^{-02}
	Copper	4.62×10^{-05}	6.13×10^{-11}	6.54×10^{-08}	$0.00 \times 10^{+00}$	2.84×10^{-03}	1.12×10^{-06}	1.81×10^{-03}	4.69×10^{-03}
	Molybdenum	2.31×10^{-03}	$0.00 \times 10^{+00}$	3.46×10^{-06}	$0.00 \times 10^{+00}$	5.15×10^{-05}	$0.00 \times 10^{+00}$	1.80×10^{-03}	4.16×10^{-03}
	Uranium	2.21×10^{-02}	3.88×10^{-06}	2.02×10^{-04}	$0.00 \times 10^{+00}$	6.17×10^{-02}	1.73×10^{-02}	3.09×10^{-02}	1.32×10^{-01}

Table 15.5-5: Estimated Non-carcinogen Risk to Human Receptors – Project Lifespan and Far-Future Projection – Reasonably Foreseeable Development Case

	COPC	RFD Case Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
		Far Future One-Year-Old - Incremental Project Risk							
	Cobalt	1.39×10^{-03}	9.25×10^{-08}	9.59×10^{-05}	$0.00 \times 10^{+00}$	3.15×10^{-03}	4.45×10^{-06}	6.46×10^{-03}	1.11×10^{-02}
	Copper	5.16×10^{-05}	4.00×10^{-09}	4.28×10^{-06}	$0.00 \times 10^{+00}$	2.69×10^{-03}	2.20×10^{-06}	1.67×10^{-03}	4.41×10^{-03}
	Molybdenum	3.14×10^{-03}	$0.00 \times 10^{+00}$	2.75×10^{-04}	$0.00 \times 10^{+00}$	5.95×10^{-05}	$0.00 \times 10^{+00}$	2.20×10^{-03}	5.67×10^{-03}
	Uranium	2.47×10^{-02}	2.54×10^{-04}	1.32×10^{-02}	$0.00 \times 10^{+00}$	5.85×10^{-02}	3.41×10^{-02}	2.24×10^{-02}	1.53×10^{-01}

Note: **Bold** indicates exceedance of the HQ of 0.2.
HQ = hazard quotient; COPC = constituent of potential concern; RFD = reasonably foreseeable development; n/a = receptor not applicable.

15.5.2.2 Carcinogens

The cancer risks (i.e., ILCR) were estimated using the lifetime average daily dose and the cancer slope factor. The cancer slope factor for arsenic was set by Health Canada based on cancer studies and is intended to protect the most sensitive individuals. The cancer risks (i.e., ILCRs) for all human receptors for the RFD Case are summarized in Table 15.5-6.

The cancer risks were compared against the negligible cancer risk levels described in Section 15.5.1.2.

The cancer risk (i.e., ILCR) for the RFD Case is slightly higher than the Application Case, mainly due to the additional treated effluent assumed to be released to Patterson Lake South Arm from the Fission Patterson Lake South Property. The camp worker, subsistence harvester, and seasonal resident were assumed to consume Traditional Foods from Patterson Lake South Arm.

In the far-future projection, the cancer risk for the future permanent resident at the former camp location and subsistence harvester are in the same range between the RFD Case and the Application Case. There are no expected inputs to the environment in the far-future projection from the Fission Patterson Lake South Property.

Table 15.5-6: Estimated Incremental Lifetime Cancer Risk from Arsenic to Human Receptors – Reasonably Foreseeable Development Case

Receptor	RFD Case Risk (per 100,000)	
	Project Lifespan	Far-Future
Camp worker (adult)	**3**	n/a
Subsistence harvester - Patterson Lake South Arm (composite)	**11**	0.1
Subsistence harvester - Beet Lake (composite)	0.2	0.004
Subsistence harvester - Lloyd Lake (composite)	0.1	0.0002
Seasonal resident - Patterson Lake South Arm (composite)	**2**	0.03
Seasonal resident - Lloyd Lake (composite)	0.02	0.00007
Permanent resident - Camp Location (composite)	n/a	0.5

Note: **Bold** indicates exceedance of the negligible cancer risk level of 1 in 100,000.
RFD = reasonably foreseeable development; n/a = not applicable, receptor was not assessed.

15.5.2.3 Radionuclides and Radon

With the addition of releases from the Fission Patterson Lake South Property, the incremental radiation dose (i.e., above the Base Case) to the subsistence harvester (one-year-old) who eats Traditional Foods gathered at Patterson Lake South Arm would increase from 0.07 mSv/yr (Application Case) to 0.14 mSv/yr (RFD Case). For the RFD Case, the radiation dose to all human receptors remains below the public regulatory dose limit of 1 mSv/yr and below the dose constraint of 0.3 mSv/yr (Table 15.5-7 and Table 15.5-8).

In the far-future projection, a future permanent resident living at the location of the former camp could receive a dose up to 0.07 mSv/yr, well below both the regulatory public dose limit and the dose constraint.

Overall, since the radiation dose estimates are below the public dose limit, no discernable health effects are anticipated due to exposure of these receptors to cumulative radioactive releases from both the Project and the Fission Patterson Lake South Property. The presence and concentrations of radionuclides in the receiving environment would be monitored and the associated radiation dose estimates would be periodically reassessed in accordance with the processes outlined in the Environmental Protection Program.

Table 15.5-7: Summary of All Radiation Doses to Human Receptors – Reasonably Foreseeable Development Case

Receptor	Location	RFD Case	
		Project Lifespan	Far Future
		Dose (mSv/yr)	
Camp worker	Permanent Camp	8.58×10^{-02}	n/a
Harvester	Patterson Lake South Arm	1.11×10^{-01}	5.21×10^{-03}
Harvester_1y	Patterson Lake South Arm	1.36×10^{-01}	6.17×10^{-03}
Harvester	Beet Lake	3.16×10^{-02}	2.19×10^{-03}
Harvester_1y	Beet Lake	3.90×10^{-02}	2.71×10^{-03}
Harvester	Lloyd Lake	1.84×10^{-03}	1.14×10^{-04}
Harvester_1y	Lloyd Lake	2.06×10^{-03}	1.36×10^{-04}
Seasonal Resident	Patterson Lake South Arm	2.91×10^{-02}	2.42×10^{-03}
Seasonal Resident_1y	Patterson Lake South Arm	3.75×10^{-02}	3.10×10^{-03}
Seasonal Resident	Lloyd Lake	1.84×10^{-03}	1.33×10^{-03}
Seasonal Resident_1y	Lloyd Lake	6.24×10^{-04}	7.54×10^{-05}
Permanent Resident	Permanent Camp	n/a	5.18×10^{-02}
Permanent Resident_1y	Permanent Camp	n/a	6.66×10^{-02}

1y = one-year-old; n/a = not applicable; mSv/yr = millisieverts per year; RFD = reasonably foreseeable development.

Table 15.5-8: Summary of Maximum Radiation Doses to Human Receptors – Reasonably Foreseeable Development Case

	Maximum Dose (mSv/yr)	Receptor	Location	Largest Contributor to Dose	% of Dose Limit
Project Lifespan					
RFD Case	0.1	Subsistence harvester (one-year-old)	Patterson Lake South Arm	Polonium-210 terrestrial animals	14%
Far-Future					
RFD Case	0.07	Future permanent resident (one-year-old)	Patterson Lake North Arm – West Basin	Polonium-210 terrestrial animals	7%

RFD = reasonably foreseeable development; mSv/yr = millisieverts per year.

For the RFD Case, the incremental radon dose to the camp worker from the Project and the Fission Patterson Lake South Property was estimated to be 0.57 mSv/yr. The incremental radon dose is based on atmospheric modelling of radon released during the maximum ore grade year (i.e., the first year of Operations), as well as radon releases from the Fission Patterson Lake South Property. This is a conservative assumption, as radon is expected to be released at a much lower rate over the duration of the Project. Additionally, the assessment is conservative in that it assumes that the camp worker spends 100% of the time indoors.

The total incremental dose to the camp worker for the RFD Case from all radionuclides in the U-238 decay chain including radon would be 0.66 mSv/yr, which is below the dose limit for a non-nuclear energy worker of 1 mSv/yr.

15.5.2.4 Climate Change

Section 10, Surface Water Quality and Sediment Quality evaluated a climate change sensitivity scenario on the RFD Case. The sensitivity scenario utilized the same inputs as the RFD case, except that the inputs used from hydrology were reflective of potential changes associated with climate change. The results from the RFD Case plus climate change sensitivity scenario are discussed in Section 10.5.2.1.6, Climate Change Sensitivity Scenario.

Overall, the predicted COPC concentrations within the LSA would be similar between the RFD Case and the RFD Case plus climate change sensitivity scenario. During both the Project lifespan and the far-future projection, climate change effects on surface water within the LSA would be negligible to minor relative to projections from the RFD Case. As such, the effects of climate change on the results of the human health assessment would also be negligible to minor, and no quantitative assessment was warranted.

15.6 Risk Characterization and Significance Determination

Results of the radiological dose assessment for the Application Case, upper bound sensitivity scenario, and RFD Case indicate that predicted radiation doses to human health receptors were below the CNSC public dose limit of 1 mSv/yr for the Project lifespan as well as the far-future projection. The radiation doses to human health receptors are below the dose constraint for the Project of 0.3 mSv/yr.

The Project HQs derived for COPCs including cobalt, copper, molybdenum, and uranium were below the acceptable risk level of 0.2 for all receptors, at all locations, and for all exposure pathways.

The incremental cancer risk for arsenic was predicted to exceed the negligible cancer risk level of 1 in 100,000 for the closest human receptors to the Project footprint in the Application Case and upper bound sensitivity scenario, as well as the RFD Case. This is based on the conservative assumption of high consumption of Traditional Foods including fish and terrestrial animals in the LSA.

Further characterization was conducted to determine the significance of the risk estimates based on the methods described in Section 15.2.9, including an evaluation of direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence (Table 15.6-1). For the HHRA, direction includes a description of baseline (i.e., background) values or applicable threshold values.

Table 15.6-1: Classification of Residual Effects on Human Heath Measurement Indicators for the Application Case and Reasonably Foreseeable Development Case

Measurement Indicator	Criterion	Application Case	RFD Case
Non-carcinogens (e.g., cobalt, copper, molybdenum, uranium)	Direction	▪ Negative ▪ Existing background HQs for the camp worker, subsistence harvester, and seasonal resident for cobalt, copper, molybdenum, and uranium are below 0.2 ▪ Existing background HQ for molybdenum is above 0.2 for the one-year-old subsistence harvester in Patterson Lake South Arm	▪ Negative ▪ Existing background HQs for the camp worker, subsistence harvester, and seasonal resident for cobalt, copper, molybdenum, and uranium are below 0.2 ▪ Existing background HQ for molybdenum is above 0.2 for the one-year-old subsistence harvester in Patterson Lake South Arm
	Magnitude	▪ Low magnitude: Project contribution to the HQ is small compared to existing conditions ▪ Project HQs derived for COPCs including cobalt, copper, molybdenum, and uranium were below the acceptable risk level of 0.2 for all receptors, locations, and pathways	▪ Low magnitude: Project and Fission Patterson Lake South Property contribution to the HQ is small compared to existing conditions ▪ Project and Fission Patterson Lake South Property HQs derived for COPCs including cobalt, copper, molybdenum, and uranium were below the acceptable risk level of 0.2 for all receptors, locations, and pathways
	Geographic Extent	▪ Regional: The Project HQs were below the acceptable risk level of 0.2 at all locations in the Project footprint, LSA, and RSA	▪ Regional: The Project and Fission Patterson Lake South Property HQs were below the acceptable risk level of 0.2 at all locations in the Project footprint, LSA, and RSA
	Duration	▪ Permanent	▪ Permanent
	Reversibility	▪ Irreversible	▪ Irreversible
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Unlikely: Project HQs are well below the acceptable risk level	▪ Unlikely: Project and Fission Patterson Lake South Property HQs are well below the acceptable risk level
Carcinogens (e.g., arsenic)	Direction	▪ Negative ▪ Background cancer risks from arsenic were predicted to range from 27 for the reference camp worker to 69 in 100,000 for the reference subsistence harvester (i.e., composite receptor throughout all life stages), for the selected regional background conditions in the Project IMPACT model	▪ Negative ▪ Background cancer risks from arsenic were predicted to range from 27 for the reference camp worker to 69 in 100,000 for the reference subsistence harvester (i.e., composite receptor throughout all life stages), for the selected regional background conditions in the Project IMPACT model
	Magnitude	▪ Very low (Figure 15.5-1) ▪ The arsenic ILCR would exceed the negligible cancer risk level of 1 in 100,000 for the subsistence at Patterson Lake South Arm (4 in 100,000) during the Project lifespan for the Application Case and upper bound sensitivity scenario ▪ The arsenic ILCR was below the negligible cancer risk level of 1 in 100,000 for all other human receptors during Project lifespan	▪ Low to very low ▪ The arsenic ILCR would exceed the negligible cancer risk level of 1 in 100,000 for the subsistence harvester at Patterson Lake South Arm (11 in 100,000), the seasonal resident at Patterson Lake South Arm (2 in 100,000), and the camp worker (3 in 100,000) ▪ The arsenic ILCR was below the negligible cancer risk level of 1 in 100,000 for all other human receptors
	Geographic Extent	▪ Local: the arsenic ILCR would exceed the negligible cancer risk level of 1 in 100,000 for the subsistence harvester at Patterson Lake South Arm in the LSA ▪ Cancer risk to all receptors beyond the LSA would be below the negligible cancer risk level	▪ Local: the arsenic ILCR would exceed the negligible cancer risk level of 1 in 100,000 for the camp worker and the subsistence harvester and seasonal resident at Patterson Lake South Arm in the LSA ▪ Cancer risk to all receptors beyond the LSA would be below the negligible cancer risk level
	Duration	▪ Permanent	▪ Permanent
	Reversibility	▪ Irreversible: cancer risk is not reversible	▪ Irreversible: cancer risk is not reversible
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Possible ▪ Arsenic ILCR would exceed negligible cancer risk level for the subsistence harvester at Patterson Lake South Arm ▪ The assessment incorporates conservatism in the Traditional Foods diet, as well as in the modelling assumptions and arsenic oral slope factor (Table 15.7-1)	▪ Possible ▪ Arsenic ILCR would exceed negligible cancer risk level for the subsistence harvester at Patterson Lake South Arm ▪ The assessment incorporates conservatism in the Traditional Foods diet, as well as in the modelling assumptions and arsenic oral slope factor (Table 15.7-1)
Radionuclides and radon	Direction	▪ Negative ▪ Annual effective dose from natural background radiation in Canada is approximately 1.8 mSv	▪ Negative ▪ The annual effective dose from natural background radiation in Canada is approximately 1.8 mSv
	Magnitude	▪ Low magnitude: predicted dose from the Project is a small fraction of background radiation dose (approximately 5% to 11% of background dose) ▪ Predicted radiation doses to the camp worker (including radon), subsistence harvester, seasonal resident, and future permanent resident were below the CNSC public dose limit of 1 mSv/yr for the Project lifespan, as well as the far-future projection ▪ Radiation doses to human health receptors were below the dose constraint for the Project of 0.3 mSv/yr	▪ Low magnitude: predicted dose from the Project and Fission Patterson Lake South Property is a small fraction of background radiation dose (approximately 5% to 11% of background dose) ▪ Predicted radiation doses to the camp worker (including radon), subsistence harvester, seasonal resident, and future permanent resident were below the CNSC public dose limit of 1 mSv/yr for the Project lifespan, as well as the far-future projection ▪ Radiation doses to human health receptors were below the dose constraint for the Project of 0.3 mSv/yr
	Geographic Extent	▪ Regional: the radiation doses to all human receptors were below the public dose limit at all locations in the Project footprint, LSA, and RSA	▪ Regional: the radiation doses to all human receptors were below the public dose limit at all locations in the Project footprint, LSA, and RSA
	Duration	▪ Permanent	▪ Permanent
	Reversibility	▪ Irreversible: radiation dose is not reversible	▪ Irreversible: radiation dose is not reversible
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Unlikely: radiation dose is below the public dose limit of 1 mSv/yr and dose constraint of 0.3 mSv/yr	▪ Unlikely: radiation dose is below the public dose limit of 1 mSv/yr and dose constraint of 0.3 mSv/yr

HQ = hazard quotient; ILCR = incremental lifetime cancer risk; COPC = constituent of potential concern; RFD = reasonably foreseeable development; CNSC = Canadian Nuclear Safety Commission; mSv/yr = millisieverts per year; mSv = millisievert; LSA = local study area; RSA = regional study area.

In summary, non-carcinogenic COPCs and the incremental radiation dose are predicted to be below the acceptable risk level and regulatory public dose limit, respectively (Table 15.6-1), for all human receptors in the Application Case, the reasonable upper bound sensitivity scenario, and the RFD Case. For one of the human receptor groups evaluated, the predicted cancer risks (i.e., ILCRs) would exceed the negligible cancer risk level of 1 in 100,000 in the Application Case. However, as shown in Figure 15.5-1, for all receptors in the Application Case, the predicted cancer risk would fall within the category of negligible to very low risk. Additionally, the overall risk from the Project is likely low for all human receptor groups considering the added conservatism in the assessment and the assumptions in the Traditional Foods diet. Overall, the results suggest that residual effects on the human health VC are predicted to be not significant.

15.7 Prediction Confidence and Uncertainty

The assumptions used to characterize human health receptors and develop the conceptual site model followed best industry practices. There is inherent uncertainty in the estimates, which is related to uncertainty in the input information. Where possible, site-specific information was incorporated. Where information was lacking, assumptions were made to verify conservatism was included in modelling, and that there was a high confidence that the risk was not underestimated.

Where possible, region-specific information was used to develop initial assumptions for human health receptor groups and the locations, frequency, and duration of exposures. Indigenous Groups and regulators were engaged in the process, which resulted in adjustments to the initial assumptions to better represent affected communities and increase conservatism in areas where regional information was limited. The Traditional Foods diet was augmented to reflect feedback received from JWG meetings and additional information available in IKTLU Studies. The Traditional Foods diet is considered a conservative representation of how local Indigenous Groups harvest in the LSA and RSA and was meant to represent various ways people may be harvesting and consuming Traditional Foods. Key uncertainties in the human health exposure assumptions and how they are addressed in the HHRA are summarized in Table 15.7-1.

The IMPACT model (version 5.6.0) was used to predict dose and risk to identified human receptors. The IMPACT model has been applied to ERAs at several proposed and operating uranium mines and mills including Cigar Lake Mine, Key Lake Mine, and Millennium Mine. The IMPACT model has also been used extensively by other nuclear facilities for ecological and HHRAs to support preparation of derived release limits and for annual public dose calculations. The extensive environmental database developed for northern Saskatchewan since the 1970s has gone through numerous updates and reviews as a larger available dataset has become available over time. This has helped develop more statistically rigorous relationships for COPC transfer among various environmental compartments. Details of the IMPACT model are provided in TSD XXI, Appendix A. The IMPACT model for the Project was set up to be representative of the environment it models and the transfer processes between environmental components. Where deemed applicable, field measurements were used either as inputs or as a validation of modelled values. Some model parameters were selected based on regional monitoring data and previous model calibrations to regional data for northern Saskatchewan. Model-predicted COPC concentrations for the existing conditions (i.e., Base Case) were compared to measured baseline data to confirm that model predictions were not underestimating COPC values.

There are uncertainties in the predicted releases to the aquatic and atmospheric environments. These uncertainties are discussed in the relevant sections: hydrogeology (Section 8.6, Prediction Confidence and Uncertainty), surface water quality (Section 10.6, Prediction Confidence and Uncertainty), and air quality (Section 7.2.7, Prediction Confidence and Uncertainty). Considering the conservatism in the estimated release rates, it is reasonable to conclude that doses and risks from Project activities have not been underestimated.

The uncertainties from the exposure assessment include model uncertainty and uncertainty in the exposure factors selected. The uncertainties from the toxicity assessment include conservatisms built into the radiation dose limit and dose constraint as well as the TRVs. Taken together, the approaches to exposure and toxicity assessments have confirmed that the characterization of dose and risk has been undertaken in a manner that has not underestimated dose or risk to the human health VC. Further details on the objectives and approach to evaluating confidence in assessment predictions and managing uncertainty are described in the ERA (TSD XXI).

Table 15.7-1: How Uncertainties in the Human Health Exposure Assessment are Addressed

Area of Concern	Uncertainties	Description of How the Uncertainties Have Been Addressed
Receptor selection	There are no permanent residents in the RSA, but the area is known to be used for subsistence harvesting including fishing, hunting, and gathering, and there are cabins and outfitters in the LSA that can be accessed by road. There are uncertainties on how potential receptors would realistically use the LSA and RSA (i.e., locations and residency times).	▪ Based residency and location assumptions on current understanding of how people use the Project RSA. ▪ Applied feedback from local Indigenous Groups. ▪ Assumed reasonably conservative residency times for receptors that conservatively represent receptors with shorter residency times, such as a recreational visitor. ▪ Located receptors in the LSA and RSA at locations known to be in the area of cabins, camps, and outfitters. ▪ Included two receptors located at the proposed location of the Project to cover the Project lifespan: camp worker during all phases and a family permanently residing at the decommissioned and reclaimed Project site well beyond Closure (i.e., far-future projection).
Traditional Foods diet	Detailed site-specific Traditional Foods dietary information is not currently available for the LSA and RSA.	▪ Assumed all receptors consume Traditional Foods. Receptors included a high consumer and an average consumer of Traditional Foods. ▪ Assumed that all Traditional Foods in a receptor's diet is from the LSA or RSA. ▪ Used recognized Traditional Foods survey results for relevant Saskatchewan ecozones (i.e., FNFNES) as a starting point. ▪ Applied feedback from local Indigenous Groups and regulatory bodies. ▪ Based the total food intake for male and female receptors on an adult male diet (N288.1-20 central tendency). ▪ Based the Traditional Foods diet average and high ingestion rates on the Boreal Shield Ecozone, which has higher ingestion rates than the Boreal Plain Ecozone. ▪ Adjusted the Traditional Foods diet to account for a higher ingestion rate for fruits and berries than considered in the FNFNES data.
Selection of representative ecological receptors for the IMPACT model to represent Traditional Foods receptors	Where possible, there is interest to simplify the environmental pathways model used to estimate potential health risks without leading to an underestimate of potential risk.	▪ Selected representative foods from the top three Traditional Foods items in the Boreal Shield diet. ▪ Selected representative foods from the Traditional Foods items known to be used by local Indigenous Groups Applied feedback from local Indigenous Groups and regulatory bodies. ▪ Representative foods with linkages to the aquatic environment were selected preferentially over terrestrial receptors from the same location because they have the potential to be more exposed to Project-related COPCs through atmospheric and aquatic pathways.
Exposure assumptions	Exposure concentrations vary over time.	▪ Maximum concentrations of COPCs in environmental media including water, sediment, air, soil, and Traditional Food items were estimated based on the assumption that human and ecological receptors would be exposed to the maximum exposure concentrations at their location for the Application Case, the reasonable upper bound sensitivity scenario, and the RFD Case. ▪ The radon concentration is from the air model (Appendix 7A, Air Dispersion Modelling Report), which used the predicted radon released during the maximum ore grade year (i.e., the first year of Operations). This is a conservative assumption, as radon is expected to be released at a much lower rate over the duration of the Project.
TRVs	TRVs are sufficiently conservative.	▪ The TRVs use uncertainty factors or conservative confidence levels built into the TRVs, and actual risks are lower than those estimated. The uncertainty factors for the cobalt, copper, molybdenum, and uranium TRVs are described in TSD XXI, Section 4.3.1, Project-Related Atmospheric Releases. ▪ An oral slope factor for arsenic of 1.8 per mg/kg/d was obtained from Health Canada (2021b) based on exposure to arsenic in drinking water. Using a slope factor based on drinking water ingestion likely overestimates risk from arsenic from food consumption, because arsenic in food is typically in a less toxic form (ATSDR 2007).
Bioaccessibility	To verify a more realistic interpretation of results, bioaccessibility factors are incorporated for arsenic in specific food items.	▪ The model does not consider the bioaccessibility of arsenic; the IMPACT model applies 100% bioaccessibility of arsenic. Arsenic may be present in the environment in different chemical forms such as arsenopyrite and arsenic trioxide. Some forms of arsenic can be absorbed in the gastrointestinal tract and taken up by plants, while other forms are poorly absorbed. To account for that uncertainty, and provide a more realistic interpretation of results, the model outputs were amended by incorporating the following considerations: 1) arsenic is present as 90% arsenobetaine and 10% inorganic arsenic in fish tissue; given that only the inorganic form is expected to be toxic in fish tissue consumed by humans, the exposure outputs were adjusted by a factor of 0.10; and 2) arsenic bioaccessibility was incorporated into the outputs for moose meat (59%) and moose organs (19%) using data collected as part of a study based out of British Columbia (Laird and Chan 2013). These are considered to be reasonable estimates of bioaccessibility and are expected to reduce the uncertainty associated with the risk estimates for those food types. However, 100% bioaccessibility continues to be assumed for the remaining food types (i.e., terrestrial plants, beaver, mallard, and grouse), and as such, exposure and risks for those other food types may be overestimated.

LSA = local study area; RSA = regional study area; COPC = constituent of potential concern; FNFNES = First Nations Food, Nutrition and Environment Study; RFD = reasonably foreseeable development; TRV = toxicity reference value; TSD = technical support document.

15.8 Monitoring, Follow-Up, and Adaptive Management

The HHRA was developed based on the best available information for the Project, including baseline environmental monitoring data, estimates of source terms, and Traditional Food diet (i.e., consumption rates and food types). Monitoring would focus on collecting data to verify ERA model predictions as well as provide data to improve model predictions as the Project begins. Monitoring would support NexGen's adaptive management framework with the objective of reducing uncertainty over time through an iterative process.

Air Quality: There were no exceedances of annual screening values for any constituents, indicating that unacceptable chronic effects from direct exposure to air are not expected. Therefore, no air COPCs were identified in the ERA. However, short-term exceedances, based on maximum predicted concentrations for the 24-hour averaging time, may occur within the Project footprint and at the associated boundary for nitrogen dioxide and particulate matter, including uranium in TSP and PM_{10}. Unacceptable levels of risk are not expected from infrequent, direct short-term exposures to these constituents in air. However, these constituents would be monitored as part of the Effluent and Emissions Plan.

Traditional Foods Study: The assumptions for the Traditional Food diet were initially developed from the FNFNES undertaken in Saskatchewan in 2015 (Chan et al. 2018, 2019) in combination with professional judgement. Assumptions were subsequently modified based on discussions during JWG meetings, information available from IKTLU studies, and discussions with representatives from Saskatchewan Ministry of Environment, Saskatchewan Health Authority, and the CNSC. NexGen would be working with local Indigenous Groups in an effort to complete a targeted Traditional Foods study to help validate or modify the dietary assumptions made in the HHRA.

Environmental Monitoring: NexGen would implement an Environmental Monitoring Plan consistent with requirements and guidance in CSA N288.4-19: *Environmental Monitoring Programs at Nuclear Facilities and Uranium Mines and Mills* (CSA Group 2019). Monitoring would focus on providing data to verify the predictions made by the ERA, refine the models used in the ERA, and reduce the uncertainty in the predictions made by the ERA. The Environmental Monitoring Plan would include collection of surface water, sediment, and soil samples, as well as fish tissue samples, benthic invertebrate tissue samples, and country foods such as blueberries. Monitoring locations would be focused in the area of Patterson Lake, but also extend out to the LSA and RSA to confirm predictions of the spatial extent of effects. Monitoring constituents would include those identified as COPCs in the ERA, including metals and uranium-238 series radionuclides; however, monitoring could be extended to include other constituents for other purposes, such as meeting regulatory requirements for monitoring or constituents of public interest from other uranium mines and process plants.

In addition, Environmental Committees (i.e., one per primary Indigenous Group) composed of two NexGen and two Indigenous Group representatives would be established to act in an oversight manner to monitor the environmental performance of the Project and verify the parties are implementing the regulatory and environmental commitments made in respect of the Project.

Indigenous Groups have made recommendations related to mitigating the effects of the Project on the environment, including community-led long-term environmental testing and monitoring during Construction and Operations of the proposed Project (TSD IV: MN-S; TSD V.2: CRDN; TSD VI: YNLR). NexGen has committed to provide funding for the lifespan of the Project for a full-time independent Indigenous Monitor chosen by each primary Indigenous Group; this Indigenous Monitor would have access to conduct environmental sampling for the Project, subject to the Indigenous Monitor complying with appropriate health and safety and other reasonable site-specific policies. The Indigenous Monitor would be able to report openly and without restriction to the Environmental Committee and Indigenous Group's community members on the performance of the Project. The Indigenous Monitor would also provide regular reports to the Environmental Committee.

Worker Monitoring: To keep exposures to ionizing radiation hazards as low as reasonably achievable during all phases of the Project, exposures to gamma radiation, long-lived radioactive dust, radon progeny, and radon gas would be routinely monitored for workers designated as nuclear energy workers. Personal dosimetry equipment would be provided for all workers who require it, and dose records would be maintained for each nuclear energy worker at the Project site. Effective (whole body) and equivalent (organ-specific) doses would be measured and recorded as applicable. Doses would be routinely tracked and compared to internal and external limits. The processes for classifying nuclear energy workers and for managing worker dosimetry would be included in the Radiation Protection Program.

Chemical, physical, or biological health and safety hazards encountered by workers during all phases of the Project would be monitored in accordance with established sample collection and analysis methods to quantify exposure and risk to workers and confirm the effectiveness of applicable controls. Results from personal occupational exposure and workplace monitoring would be collected, maintained, stored, communicated, and used to identify improvement opportunities, as required. The process for identifying health and safety hazards and monitoring occupational exposures would be outlined in the Health and Safety Program.

In addition, NexGen would implement the Environmental Protection Program, which would describe the processes required to monitor and characterize emissions from Project facilities and activities, to monitor and characterize the quality of the environment to assess the effectiveness of mitigations, and to continually improve environmental protection performance throughout all Project phases. Where relevant, adaptive management measures may also be proposed to address the uncertainties associated with the effects predictions and mitigation. The process for determining when, how, and where to use adaptive management would be described within the Integrated Management System Manual.

15.9 Key Findings

For the assessment of non-carcinogens, no significant adverse effect on any human receptors, as a result of releases from the Project, would be likely during the Project lifespan for the Application Case, reasonable upper bound sensitivity scenario, and RFD Case. All estimated Project HQs for all non-carcinogenic COPCs (i.e., cobalt, copper, molybdenum, and uranium) remained below the acceptable risk level of 0.2 per pathway for the one-year-old and adult for all human receptors.

For assessment of risk for carcinogens (i.e., arsenic), the ILCR was estimated and compared against the negligible cancer risk level of 1 in 100,000 recommended by Health Canada (2021a). Incremental cancer risk was predicted to exceed the negligible cancer risk level of 1 in 100,000 for the subsistence harvester at Patterson Lake South Arm just outside the Project footprint but is not expected to exceed the negligible cancer risk within the RSA farther from the Project. The predicted incremental cancer risks are in the low to very low category. These findings are based on the conservative assumption of high consumption of Traditional Foods including fish and terrestrial animals in the Project footprint and LSA. Overall, the results suggest that residual effects on the human health VC are predicted to be not significant.

The incremental radiation doses to all human receptors during the Project lifespan and the far-future projection were predicted to be below the regulatory public dose limit of 1 mSv/yr for the Application Case, the upper bound sensitivity scenario, and the RFD Case. If a dose constraint of 0.3 mSv/yr is applied, the dose to the subsistence harvester (one-year-old) would be less than the dose constraint for the Application Case, the upper bound sensitivity scenario and RFD Case, and well below the regulatory public dose limit. In the far-future projection, a future permanent resident living at the location of the camp could receive a dose up to 0.07 mSv/yr, well below the regulatory public dose limit and the dose constraint. Overall, since the radiation dose estimates are below the public dose limit, no discernable health effects are anticipated due to exposure of these receptors to radioactive releases from the Project.

Overall, considering the conservatism included in the modelling, the results of the HHRA suggest that residual effects on human health would not be greater than predicted.

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Appendix 15A Radiological and Non-Radiological Worker Effects Summary

Abbreviations and Units of Measure

Abbreviation	Definition
AcL	Action levels
ALARA	as low as reasonably achievable
ALARP	as low as reasonably practicable
CNSC	Canadian Nuclear Safety Commission
CCD	counter current decantation
DPF	diesel particulate filter
DRM	diesel particulate matter
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
HAZAN	hazard analysis
HAZOP	hazard operability
IL	Investigation levels
IMS	Integrated Management System
LHD	load-haul-dump
LLRD	long-lived radioactive dust
LLRW	low-level radioactive waste
n/a	not applicable
NEW	nuclear energy worker
NexGen	NexGen Energy Ltd.
OEL	occupational exposure limits
PPE	personal protective equipment
ppm	parts per million
RnG	radon gas
RnP	radon progeny
Project	Rook I Project
SAG	semi-autogenous grinding
SEG	similar exposure groups
TWA	time-weighted average
UGTMF	underground tailings management facility

Unit	Definition
%	percent
°	degree
°C	degrees Celsius
>	more than
<	less than
µm	micron
µg/m^3	micrograms per cubic metre
kg	kilogram
mg	milligram
mg/m^3	milligrams per cubic metre
Mlbs	million pounds
Mkg	million kilograms
mSv	millisieverts
mSv/yr	millisieverts per year
tpd	tonnes per day

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15A1 INTRODUCTION

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The proposed Project is subject to both provincial and federal Environmental Assessment (EA) processes, would be licensed as a nuclear facility by the Canadian Nuclear Safety Commission (CNSC), and would be subject to various provincial and federal permits and approvals.

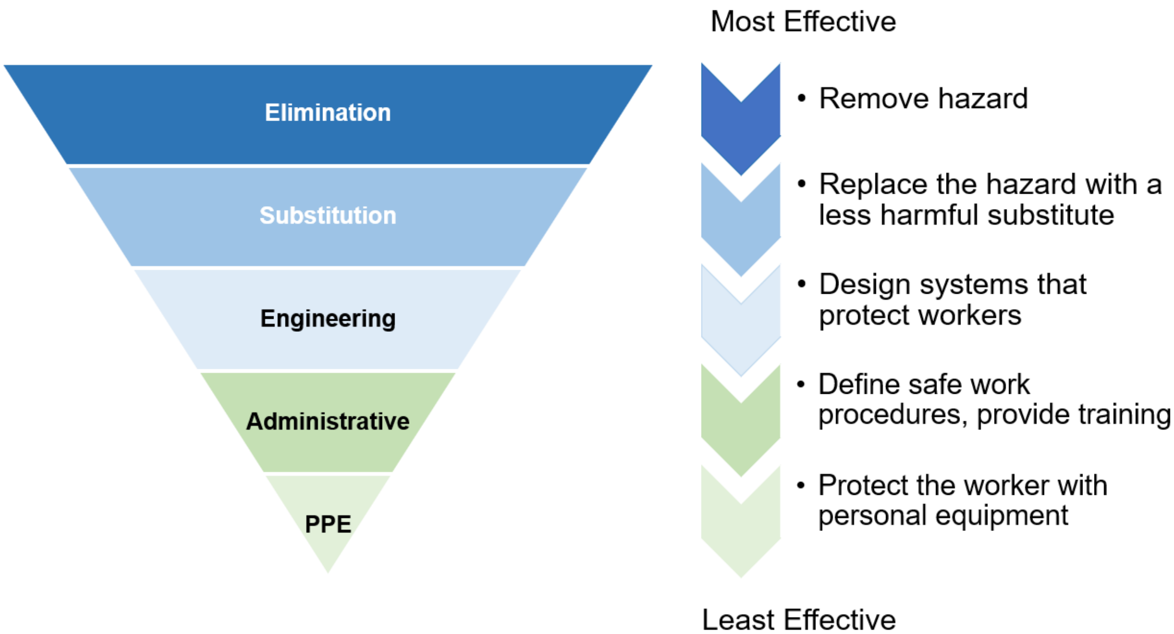
Potential radiological, chemical, physical, and biological hazards associated with Project activities that pose risks to the health and safety of workers have been, and will continue to be, systematically assessed to determine the nature, likelihood, and consequence of the potential risk; identify and implement measures to mitigate associated effects; and keep radiological and non-radiological exposures to workers as low as reasonably achievable (ALARA). Risk assessments performed for the Project specific to worker health and safety are documented in a variety of reports and studies that were used to confirm the design basis for the proposed Project. These assessments have been, and will continue to be, submitted to the CNSC and other federal and provincial regulatory agencies in support of the various Project licensing and permitting phases. The type of assessments performed are appropriate for the topic, apparent level of risk, and complexity of the activity. Examples of studies completed to date include:

- radiological exposure assessment for the underground mine, process plant, and paste processing and delivery systems;
- diesel exhaust and crystalline silica exposure assessments for the underground mine, process plant, and paste processing and delivery systems;
- hazard studies; and
- human factors assessment.

The controls identified during risk assessments are used to eliminate, prevent, or reduce the potential risk of elevated radiation exposure, injury, illness, or disease to workers, and would be implemented with consideration for the hierarchy of controls (Figure 15A1-1). The controls applied for the Project would be specific to the nature of the risk and would be documented, tracked, and periodically evaluated for effectiveness. Examples of such controls include:

- facility, equipment, and process design;
- safe work practices and training; and
- personal protective equipment (PPE).

Figure 15A1-1: Hierarchy of Controls



PPE = personal protective equipment.

In addition to these foundational studies, risks to worker health and safety would be managed throughout the lifespan of the Project in accordance with the processes that would be outlined in the Project's Integrated Management System (IMS) Manual and its supporting programs; specifically, the Health and Safety Program and the Radiation Protection Program. These management system documents would also describe the processes required to monitor and characterize workplace hazards, monitor and characterize the effectiveness of mitigations, and continually improve the protection of worker health and safety throughout all Project phases. Where uncertainty associated with potential worker health and safety hazards exists, adaptive management measures may also be proposed. The process for determining when, how, and where to use adaptive management will be described within the IMS Manual in support of licensing and approval steps.

In addition to NexGen's commitment to continually assess and improve its internal processes to maintain protection of worker health and safety, the effectiveness of IMS Manual and its supporting programs would be subject to ongoing oversight from the CNSC and provincial regulatory agencies (e.g., Labour Relations and Workplace Safety) throughout Construction, Operations, and Decommissioning and Reclamation (i.e., Closure).

The purpose of Appendix 15A is to present a summary of Project radiological and non-radiological effects to Project workers as well as present the radiological and non-radiological effects that these workers may experience through potential accidents and malfunctions. With respect to non-radiological effects, only effects that could be experienced beyond effects described for the camp worker receptor in Environmental Impact Statement (EIS) Section 15, Human Health are discussed. This appendix also presents a summary of the hazard analysis (HAZAN) study completed for the Project and the proposed approach to human factors engineering.

Further information regarding the assessments of radiological and non-radiological effects to workers is provided in the Project Application for a Licence to Prepare and Construct submitted to the CNSC, with follow-up and additional information to be provided in subsequent licensing and permitting phases.

15A2 Radiological Exposures

Radiation exposures associated with Project activities would occur in the form of ionizing radiation, which is energy that can damage cells and tissues by detaching electrons from atoms. There are three forms of ionizing radiation that would be present at the Project site (i.e., alpha, beta, and gamma), and each poses different hazards to human health. Alpha and beta radiation take the form of small, charged particles that are potentially hazardous if ingested, inhaled, or introduced via an open wound. Gamma radiation takes the form of an energy wave and can penetrate through skin and protective clothing. Sources of ionizing radiation at the proposed Project and potential exposure pathways are listed in Table 15A2-1. The potential for radiation exposure is based on multiple factors, including duration of exposure, form of hazard, and distance from the radiation source.

Table 15A2-1: Rook I Project Ionizing Radiation Sources

Type of Radiation	Exposure Pathway	Sources[a]
Gamma	External exposure	Mineralization, nuclear density gauges, aged uranium ore concentrate
Alpha/beta – radon progeny[b]	Inhalation	Mine or process water, mineralization
Alpha – radon gas	Inhalation	Mine or process water
Alpha/beta – long-lived radioactive dust	Inhalation, ingestion, wound contamination	Mineralization, uranium ore concentrate

a) Listed sources of radiation are typical of uranium mining and milling facilities and are not meant to be a comprehensive representation of any particular phase of the proposed Project.
b) Radon progeny are decay products produced from radon gas.

The CNSC Radiation Protection Regulations specify that doses to nuclear energy workers are limited to a maximum effective dose of 100 millisieverts (mSv) over a five-year dosimetry period (i.e., effectively an annual average dose limit of 20 millisieverts per year [mSv/yr]) and to a maximum dose of 50 mSv in any one-year dosimetry period. A nuclear energy worker (NEW) is a worker who has a reasonable probability to receive an occupational effective dose of radiation of 1 mSv/year or greater. The term effective dose includes the whole-body dose from credible internal and external exposure to workers, which include external radiation (i.e., gamma); inhalation of radon gas (RnG); inhalation of short-lived radon progeny (RnP); and inhalation of long-lived radioactive dust (LLRD). Although the maximum allowed effective dose is 50 mSv in any one year, in practice, the CNSC expects that the effective dose in any single year should be less than 20 mSv (i.e., 100 mSv over five years). The Radiation Protection Regulations also require licensees to establish internal action levels below the regulatory dose limits that, if reached within specified time frames, may provide an early indication of a loss of control and would trigger specific actions to be taken by the radiation department and workers to maintain control of radiation hazards and keep exposures ALARA.

Where reasonably practicable, controls are used in combination to effectively prevent or reduce the risk to workers, the public, and the environment. These controls would include minimizing time near the source, maximizing distance from the source, and using shielding where practicable. Controls are used, operated, and maintained according to their design and limitations, and require applicable training. Adherence to procedures and training are critical in preserving the effectiveness of controls.

Project radiological exposures to workers would be expected to occur in three work environments: the underground workplace, the process plant and paste tailings preparation workplace, and the low-level radioactive waste (LLRW) incinerator workplace. Radiological exposures could also potentially occur as a result of accidents and malfunctions. Radiological assessments were completed for these three work environments as well as for associated potential accidents and malfunctions.

For the underground workplace, protection measures from radiation sources would include, but not be limited to:

- **Gamma radiation:** using engineered protection (e.g., shielding), distance (e.g., possible use of remote mining methods), and managing time spent on various mining activities. For workers in the cabs of heavy equipment, there would be an intrinsic protection (i.e., shielding) provided by the steel of the vehicle itself. Shotcrete would be applied on the underground ceiling (i.e., back) and walls during mine development, as needed, and either crushed waste rock or concrete would be used to cover the development floor (i.e., sills). Waste rock and concrete would have a very low uranium content and provide shielding, with the protection factor increasing with increasing thickness.
- **RnP and RnG:** managing ventilation, managing time spent on various mining activities, and using remote-control mining equipment, as appropriate. The Project would include a push-pull ventilation system for ventilating mining stopes, where fresh air would be pulled into a working stope from a main travel way and a portion of that fresh air would be pushed toward the working face (i.e., the rock surface where the mining development is advancing). Potentially contaminated air would then be pulled from the working stope and exhausted away from any active work area.
- **LLRD:** managing ventilation and applying dust suppression measures (e.g., wet drilling).

For the process plant and paste tailings preparation workplace, protection measures from radiation sources would include, but not be limited to:

- **Gamma radiation:** using engineered protection (e.g., shielding of process vessels), distance (e.g., situating process vessels apart from routine work areas), and managing time spent on various process plant and paste tailings processing and delivery activities.
- **RnP and RnG:** using general area ventilation and source control (e.g., covered process vessels directly vented to the atmosphere).
- **LLRD:** managing ventilation and source control (e.g., capture dust and vent to the atmosphere).

For the LLRW incinerator, protection measures from radiation sources would include, but not be limited to:

- **Gamma radiation:** using engineered protection (e.g., shielding), distance (e.g., situating gamma radiation sources apart from routine work areas), and wearing appropriate PPE.
- **RnP and RnG:** exposure to RnP and RnG would not be anticipated (Section 15A2.3).
- **LLRD:** managing ventilation and wearing appropriate PPE.

The radiological exposure assessments performed as part of Project planning will be used as a planning tool to demonstrate that engineering designs are safe for workers, to identify possible engineering design optimizations to keep exposures ALARA, and to inform the development of radiation protection processes and monitoring requirements that will be implemented and continually improved throughout the Project lifespan.

To complete the assessment of radiological exposures to Project workers, the concept of similar exposure groups (SEGs) was adopted. A SEG represents a group of workers that would have the same general exposure profile for the occupational health hazard(s) anticipated or being evaluated because of the similarity, frequency, and duration of the tasks that would be performed; the materials and processes that would be utilized; and the similarity of the methods used to perform those tasks.

15A2.1 Underground Workplace

The purpose of this subsection is to summarize the predicted occupational risks to workers due to radiation exposures during the Operations Phase.

The proposed underground development and associated mining activities would include drilling, blasting, mucking (i.e., using equipment to handle ore and waste), shotcreting, development of the purpose-built underground tailings management facility (UGTMF), ore production, and backfilling mined-out stopes with cemented paste tailings. The current mineral resource model shows an average grade of 3.1% triuranium octoxide (U_3O_8); however, the annual mined grade would change from year to year.

The assessment of potential radiation dose to workers that would work in a variety of underground mining tasks was determined for each worker based on the exposure conditions in their various tasks and the amount of time workers would spend each day, and annually, performing those tasks. Annual doses were determined for the first year of operations and steady state operations.

Workers in the various underground development and associated mining activities workplaces may be exposed to four different radiation sources: gamma radiation, RnG, RnP, and LLRD. The mining activities with radiation exposure include:

- work in ore stopes;
- work in waste rock;
- work in the UGTMF;
- placement of paste tailings in the UGTMF (i.e., cemented paste tailings);
- placement of paste tailings in ore stopes (i.e., cemented paste backfill); and
- infrequent work (e.g., remuck maintenance, potential spill of ore or tailings).

The predicted dose estimates account for the implementation of engineered protection measures in the underground work environment; specifically, local push-pull ventilation in ore stopes; shotcrete on walls, floor, and back for shielding gamma radiation; intrinsic gamma radiation shield from equipment cabs for operators when they are inside vehicles; and remote-controlled operation of some equipment (e.g., loaders).

15A2.1.1 Gamma Radiation

Gamma radiation dose rates depend on the ore grade in the surfaces emitting radiation and the distance of each receptor location from these surfaces. The surfaces considered within the assessment were the back, the sills, the walls, and the working face. These surfaces were considered for each of the ore, special waste, and waste sections of the stope.

The assessment of gamma radiation shows that doses to workers arising from exposures to gamma radiation are expected to range from approximately 0.3 mSv/yr to 9.4 mSv/yr. There would be opportunities to further reduce gamma exposures through increasing intrinsic shielding provided by equipment cabs and using remote-controlled equipment for more operational tasks (e.g., drills, shotcrete application).

15A2.1.2 Radon Gas and Radon Progeny

Underground workers would be exposed to both RnP and RnG due to emission from surfaces, mucking, and mine water. Annual doses to workers from RnG and RnP would include contributions from work in underground development areas; as examples, in the development of the UGTMF and general underground mine, and occasionally, in ore sections of stopes.

The assessment of RnG and RnP radiation shows that doses to workers arising from exposures to RnG and RnP are expected to range from approximately 0.05 mSv/yr to 0.53 mSv/yr and 0.84 mSv/yr and 1.1 mSv/yr, respectively. There would be opportunities to further reduce RnG exposure through increasing local ventilation, as needed, using forced fans and to further reduce RnP exposure by selecting equipment with enclosed cabs and filtered air supply.

15A2.1.3 Long-Lived Radioactive Dust

For mine development, ore mining, and other work in waste (e.g., development of the UGTMF), sources of exposure to LLRD would include the following tasks, which were the focus of the assessment:

- drilling;
- blasting;
- mucking (including tramming);
- dumping to ore passes; and
- material handling transfer points (e.g., conveyors, chutes, grizzlies).

To minimize effects to workers associated with the potential exposure to LLRD, wet drilling would be employed and there would be a 1-hour delay after a blast before workers would be allowed to re-enter a mining area that has been blasted.

The predicted doses from LLRD would be quite low, much less than 1 mSv/yr in the first year of operations. In the following years, exposed workers would likely receive an annual dose of less than 1 mSv from LLRD; however, recognizing variability in dust levels by task and location, an annual LLRD dose of 1 mSv/yr was assumed for all underground work. There are opportunities to further reduce LLRD exposure by selecting equipment with enclosed cabs and a filtered air supply.

15A2.1.4 Underground Workplace Radiation Exposure Assessment Summary

Table 15A2-2 shows the predicted doses resulting from worker exposures to gamma radiation, RnG, RnP, and LLRD as well as the total predicted doses from all exposure types for the first year and steady state operations.

Table 15A2-2: Annual Doses for First Year and Steady State Operations Using Remote-Controlled Equipment and Enhanced Shotcrete Options

Similar Exposure Group	Annual Dose (mSv/yr)				
	Total Dose	Gamma	RnG	RnP	LLRD
First Year Operations					
Blaster	**8.1**	5.9	0.32	0.92	1
Bolter Operator	**5.0**	2.9	0.17	0.88	1
Cable Bolter Operator	**4.1**	2.1	0.16	0.88	1
Jumbo Operator	**3.6**	1.6	0.11	0.86	1
Production Driller	**5.3**	3.2	0.23	0.90	1

Table 15A2-2: Annual Doses for First Year and Steady State Operations Using Remote-Controlled Equipment and Enhanced Shotcrete Options

Similar Exposure Group	Annual Dose (mSv/yr)				
	Total Dose	Gamma	RnG	RnP	LLRD
Raisebore Operator	**10.4**	7.9	0.52	1.00	1
Scoop Operator – Development	**2.6**	0.7	0.08	0.85	1
Scoop Operator – Production	**2.2**	0.3	0.05	0.84	1
Services / Construction Worker	**6.7**	4.1	0.53	1.10	1
Shotcrete Operator	**3.8**	1.7	0.17	0.91	1
Steady State Operations					
Blaster	**9.2**	7.0	0.28	0.91	1
Bolter Operator	**4.7**	2.7	0.13	0.87	1
Cable Bolter Operator	**4.5**	2.5	0.15	0.88	1
Jumbo Operator	**3.5**	1.6	0.09	0.85	1
Production Driller	**5.9**	3.8	0.21	0.90	1
Raisebore Operator	**11.9**	9.4	0.47	1.00	1
Scoop Operator – Development	**2.6**	0.7	0.07	0.84	1
Scoop Operator – Production	**2.2**	0.4	0.05	0.84	1
Services / Construction Worker	**7.2**	4.8	0.40	1.00	1
Shotcrete Operator	**3.7**	1.7	0.13	0.89	1

Note: **Bold** indicates total dose values. Values may not add up due to rounding.
mSv/yr = millisieverts per year; RnG = radon gas; RnP = radon progeny; LLRD = long-lived radioactive dust.

The calculations presented in Table 15A2-2 demonstrate that the underground workplace environment would be safe for workers. All annual doses are below 10 mSv/yr with the exception of the raisebore operators, who may receive an annual dose of 12 mSv/yr under steady state operations.

Results of this evaluation are considered suitable for the screening of the exposure of underground workers to radiation hazards and can be used to confirm or modify design assumptions, including the design of ventilation systems and other engineering controls, time management, and radiation work planning to provide worker protection in accordance with the ALARA concept as it would be included in the Radiation Protection Program developed for the Project.

15A2.2 Process Plant and Paste Tailings Preparation Workplace

The purpose of this subsection is to summarize the predicted occupational risks to workers due to radiation exposures in the process plant and paste tailings preparation workplace during the Operations Phase.

The proposed process plant would be designed to produce up to 13.6 million kilograms (Mkg) (30 million pounds [Mlbs]) of U_3O_8 per year with a projected mine life of 24 years (based on current mineral resource estimates). The process plant would be designed with a throughput of up to 1,300 tonnes per day (tpd). The planned head grade for material sent to the process plant would be an average grade of 3.1% U_3O_8. The maximum grade processed in the process plant would be 5.0% U_3O_8.

In addition to the process plant where ore would be processed into U_3O_8, an attached paste preparation area would convert the tailings into cementitious paste, which would be disposed of underground in mined-out stopes or within the purpose-built UGTMF.

The assessment of potential radiation dose to workers in the process plant and paste tailings preparation workplace areas is based on the current design of the process plant and the predictions of quantities and radioactivity levels of the ore and tailings that would be processed and prepared for placement in underground, respectively. This assessment determined whether the proposed design and configuration of the process plant and paste tailings preparation workplace would provide reasonable assurance that radiation doses potentially received by workers would be below the regulatory limits of the CNSC and consistent with NexGen's commitment to keep radiological exposures ALARA. To provide a conservative assessment, it was assumed that basic mitigations would be implemented; however, NexGen notes that additional mitigation measures would be available and explored further as Project design proceeds.

Workers in the process plant and paste tailings preparation workplace may be exposed to three different radiation sources: gamma radiation, RnG and RnP, and LLRD. Similar exposure groups within the process plant and paste tailings preparation workplace would include process operators, maintenance personnel, and metallurgists.

15A2.2.1 Gamma Radiation

There is potential for workers to be exposed to elevated levels of gamma radiation at several areas in the process plant and paste tailings preparation workplace. The areas expected to have the highest gamma radiation fields are:

- the front end of the process plant, where ore enters the grinding circuit;
- areas proximal to process tanks containing ore slurry, leach residue, and tailings;
- areas where uranium concentrate is stored; and
- paste tailings preparation areas.

The assessment of gamma radiation shows that doses to workers arising from exposures to gamma radiation are expected to range from approximately 6 mSv/yr to 12 mSv/yr. There would be opportunities to further reduce gamma exposures through engineering design optimization (e.g., implementation of additional shielding on high gamma emitting tanks, inclusion of shielding walls between high-gamma-emitting tanks and routinely occupied areas) and consideration of work practices (e.g., consideration of task times, increased use of automation). Since elevated gamma levels would also occur in areas where aged uranium concentrate is stored, storage of uranium concentrate would be away from routinely occupied areas.

15A2.2.2 Radon and Radon Progeny

The greatest potential for release of radon to the general work areas of the process plant would be at the front end of the processing circuit, where the crushed ore is conveyed to the semi-autogenous grinding (SAG) mill. Once the ore has entered the grinding circuit, indoor tanks and equipment in the process plant and paste tailings preparation workplace would represent potential sources of RnG. These indoor tanks and equipment would be covered and have exhaust hoods, thereby actively venting fumes outside of the building.

The assessment shows that levels of exposure to RnP would be less than 10 mSv/yr through the effective control of radon at source and the design of general ventilation in the process plant and paste tailings preparation workplace. Opportunities for further optimization would include consideration of radon collection efficiency at the entry to the milling and grinding area and ventilation design optimization in the process plant and paste tailings preparation workplace to further minimize worker exposure to air potentially containing radon.

15A2.2.3 Long-Lived Radioactive Dust

Long-lived radioactive dust is generated in the dry processes such as the front end of the process plant, where crushed ore is conveyed to the SAG mill. Source control would be used at the front end of the processing circuit to capture dust that is generated, with the remaining dust mixing with process plant ventilation systems at surface. Once the ore has entered the grinding circuit, the remainder of the processing would be a wet process with minimal opportunity for dust generation. The exception to this wet process would be the drying, calcining (i.e., reduced, oxidized, or desiccated at high temperatures), and packaging circuit.

Access to the drying, calcining, and packaging areas would be strictly controlled and limited to specially trained personnel fitted with high-efficiency respirators (i.e., appropriate protection level selected based on the exposure risks) and other PPE, as required. Therefore, exposure to uranium concentrate was not assessed further. Where workers would be required to enter these areas, task-specific work and radiation plans would be developed and potential exposures would be closely monitored.

The current assessment shows that exposures to LLRD from the front end of the process plant where ore enters the circuit are expected to result in doses less than 1 mSv/yr. Within the process plant, ore and tailings would be in slurry form with all tanks and vessels exhausted outside of the process plant; therefore, there is expected to be a very low potential for worker exposure to LLRD.

15A2.2.4 Process Plant and Paste Tailings Preparation Workplace Radiation Exposure Assessment Summary

Table 15A2-3 presents the dose to each SEG by pathway, as well as the total yearly dose received. All doses predicted would be well below the CNSC yearly dose limit of 50 mSv and below the averaged annual dose limit of 20 mSv. Some of the SEGs are predicted to receive doses above the target dose of 10 mSv/yr.

Table 15A2-3: Total Dose by Similar Exposure Groups and Pathway

Similar Exposure Group	Dose by Pathway (mSv/yr)			Total Dose (mSv/yr)
	Exterior Gamma	RnP[(b)]	LLRD[(b)]	
Process Operator (Grinding Area)	10.73	1.45	<1	**13.18**
Process Operator (Leach Area)	8.36[(a)]	n/a	n/a	**8.36**
Process Operator (CCD Area)	7.35	n/a	n/a	**7.35**
Process Operator (Residue/Paste Area)	11.96	0.11	n/a	**12.07**
Maintenance	6.63	0.091	Nil (<<1)	**6.7**
Metallurgist	6.15[(a)]	0.26	Nil (<<1)	**6.4**

Note: **Bold** indicates total dose values.
a) Estimated assuming 10 cm thick reinforced concrete shielding.
b) Dose from 3.1% U_3O_8 feed grade presented for consistency.
mSv/yr = millisieverts per year; < = less than; n/a = not applicable; CCD = counter current decantation; RnP = radon progeny; LLRD = long-lived radioactive dust; << = much less than.

Further optimization of radiation protection may be available through ongoing design. As examples, the possible use of additional shielding from reinforced concrete platforms, shielding walls located adjacent to process vessels containing ore or tailings, and increased dust control efficiency at the front end of the process plant would all be expected to reduce the radiological exposure to workers.

Although there is some uncertainty in dose estimates, calculations are considered to provide reasonable estimates of dose and are likely conservative (i.e., likely overestimate the dose to a typical worker in an SEG) as limited mitigations were applied within the assessment and further mitigation opportunities would be available.

Results of this evaluation are considered suitable for the screening of the exposure of process plant and paste tailings preparation workplace workers to radiation hazards and can be used to confirm or modify design assumptions, including the design of ventilation systems and other engineering controls, time management, and radiation work planning to provide worker protection in accordance with the ALARA concept as would be included in the Radiation Protection Program developed for the Project.

15A2.3 Low-Level Radioactive Waste Incinerator

The purpose of this subsection is to summarize the predicted occupational risks to operators and maintenance staff due to radiation exposures in the LLRW incinerator during the Operations Phase.

Low-level radioactive waste would consist of conventional waste potentially contaminated by contact with radioactive materials and would be generated during the life of the Project. The LLRW would be incinerated in an LLRW incinerator in a dedicated incinerator building. The LLRW incinerator would be batch run, sized to incinerate up to 10 tonnes per batch, and include a wet-dry air pollution control system and continuous emission monitoring system to minimize the emissions of particulate matter, metals, acid gases, nitrogen, carbon monoxide, and organics, and to meet applicable emission requirements. Ash from the LLRW incinerator would be drummed for disposal underground.

The assessment of the potential radiation dose to workers from operating the LLRW incinerator is based on the current design and predictions of the quantities and radioactivity levels of LLRW that would be processed and prepared for placement underground. This assessment determined whether the proposed design and configuration of the LLRW incinerator would provide reasonable assurance that radiation doses potentially received by workers would be below the regulatory limits of the CNSC and consistent with NexGen’s commitment to keep radiological exposures ALARA. To provide a conservative assessment, it was assumed that basic mitigations would be implemented; however, NexGen notes that additional mitigation measures would be available and explored further as Project design proceeds.

Radiological exposures in the LLRW incinerator building area are expected to primarily arise from external gamma radiation and LLRD. Given the proposed ventilation design of the incinerator building and pollution controls during incineration, any radon that escapes would be diluted. Therefore, there would be very little opportunity for material exposure of workers to RnG and RnP.

Similar exposure groups working with the LLRW incinerator would include the incinerator operator and maintenance worker. Periodic maintenance of the LLRW incinerator would be required; however, maintenance tasks are not expected to generate LLRD and would be planned when waste or ash handling was not being performed. Additionally, maintenance inspections are estimated to require a maximum of 30 minutes per week. Therefore, radiological exposure to maintenance workers was not assessed as effects would be much less than (i.e., bounded by) those experienced by an LLRW incinerator operator.

Operation of the LLRW incinerator would not require 24-hour attendance; therefore, it is anticipated that LLRW incinerator operators and maintenance staff would have additional duties that could potentially expose these workers to other radiological hazards. The discussion in this subsection (Section 15A2.3, Low-Level Radioactive Waste Incinerator) focuses on exposure at the LLRW incinerator only.

15A2.3.1 Low-Level Radioactive Waste Incinerator Radiological Source Activities

There are multiple activities that would be undertaken as part of operating and maintaining the LLRW incinerator. These tasks and key assumptions are described in Table 15A2-4.

Table 15A2-4: Low-Level Radioactive Waste Incinerator Activities and Key Assumptions

Activity	Activity Description	Key Assumptions
Pre-Start Visual Inspection	Inspection of the LLRW incinerator prior to waste loading.	The incinerator and associated equipment are expected to contain minimal, if any, LLRW waste or ash, and other sources of gamma radiation would be shielded and located away from where inspections would occur.
Waste Preparation	The receipt, placement, and segregation of LLRW to provide a proper waste mixture for waste charging.	The operator would wear suitable PPE to minimize exposure to gamma radiation and LLRD.
Waste Charging	Loading of LLRW into the incinerator using a skid steer loader.	The skid steer loader operator would be exposed to gamma radiation and LLRD when moving LLRW to the primary chamber.
Starting the System	Initiating the burn cycle.	Potential gamma radiation exposure is considered within the waste preparation and waste charging.
Burn Cycle	Represents the incineration of LLRW.	The operator may be exposed to gamma radiation during the first hour of the cycle as they would be in the monitoring area. After the first hour, gamma radiation exposure would be minimal as the operator would be in the LLRW incinerator building office (i.e., at a distance and shielded from gamma radiation sources).
Cooldown Cycle	Automated cooldown following the burn cycle that would not require operator supervision.	No radiological exposure would occur during this activity.
Bottom Ash Removal	Represents the removal of larger ash particles that remain in the incinerator chamber following incineration.	An operator would manually remove ash into steel drums and would wear suitable PPE to minimize exposure to gamma radiation and LLRD.
Fly Ash Removal	Represents the removal of fine ash particles that would flow into a drum during the incineration process. Once the drum was full, an operator would remove and seal it.	The operator would wear suitable PPE to minimize exposure to gamma radiation and LLRD.
Maintenance	Periodic electrical and mechanical inspections and maintenance of the LLRW incinerator would be conducted.	Radiological exposure to a maintenance worker would be bounded by the assessment of exposures to an operator.

LLRW = low-level radioactive waste; LLRD = long-lived radioactive dust; PPE = personal protective equipment.

15A2.3.2 Low-Level Radioactive Waste Incinerator Radiation Exposure Assessment Summary

Following the descriptions and key assumptions provided in Table 15A2-4, the assessment radiation exposure risks to an operator considered the following LLRW incinerator activities: waste preparation, waste charging, burn cycle, bottom ash removal, and fly ash removal. The total annual incremental radiation dose to an operator for identified tasks is provided in Table 15A2-5.

Table 15A2-5: Total Incremental Radiation Dose to an Operator

Parameter	Annual Dose (mSv/yr)	
Task	**Base Case**	**Sensitivity Scenario**
Waste Preparation	1.37×10^{-02}	3.43×10^{-02}
Waste Charging	1.10×10^{-02}	2.76×10^{-02}
Starting the System	Included in Waste Charging	
Burn Cycle	5.53×10^{-03}	1.38×10^{-02}
Cooldown Cycle	No Exposure	
Bottom Ash Removal	7.37×10^{-02}	1.82×10^{-01}
Fly Ash Removal	3.34×10^{-03}	8.34×10^{-03}
Total Annual Dose	**1.07×10^{-01}**	**2.66×10^{-01}**

mSv/yr = millisieverts per year.

The estimated total annual incremental radiation doses for the base case and sensitivity scenario are 1.07×10^{-01} mSv/yr and 2.66×10^{-01} mSv/yr, respectively. These annual incremental doses represent approximately 0.5% to 1.3% of the annual dose limit of 20 mSv/yr and would only affect a small number of workers.

15A2.4 Accidents and Malfunctions

The purpose of this subsection is to summarize the potential Project-related accidents and malfunctions that involve potential worker exposure to radiation and radioactivity during the Operations Phase.

The assessment of accidents and malfunctions included the identification of the reasonably feasible, potential Project-related accidents and malfunctions that involve worker exposure to radiation to estimate the dose received from radiological exposure scenarios that fall outside the range of “typical” day-to-day events.

15A2.4.1 Hazard Identification

The hazard identification evaluation was used to establish a comprehensive list of potential Project-related accident and malfunction scenarios, screen these scenarios for potential risks, and based on the initial screening results, select the appropriate high- or moderate-risk scenarios as bounding scenarios. These bounding scenarios were carried forward for more detailed risk assessments. The hazard identification evaluation focused on risks to worker health.

The screening evaluation was applied to all accident and malfunction scenarios by qualitatively evaluating the likelihood (Table 15A2-6) and consequence (Table 15A2-7) to determine a risk level (Table 15A2-8).

Table 15A2-6: Likelihood Index

Rating	Likelihood	Description
1	Highly unlikely	<1 occurrence in 1,000 years
2	Unlikely	≤1 occurrence in 100 years and >1 occurrence in 1,000 years
3	Likely	≤1 occurrence in 10 years and >1 occurrence in 100 years
4	Very likely	≤1 occurrence in 1 year and >1 occurrence in 10 years
5	Almost certain	>1 occurrence in 1 year

< = less than; ≤ = less than or equal to; > = greater than.

Table 15A2-7: Consequence Index

Rating	Consequence	Description
1	None	Below IL
2	Negligible	Below AcL but above IL
3	Minor	Below 20 mSv for NEW (0.3 mSv for non-NEW) but above AcL
4	Moderate	Below 50 mSv but above 20 mSv for NEW (below 1 mSv but above 0.3 mSv for non-NEW)
5	Major	Above 50 mSv for NEW (above 1 mSv for non-NEW)

IL = Investigation levels; AcL = Action levels (exposure levels requiring notification of CNSC); mSv = millisieverts; NEW = nuclear energy worker.

Table 15A2-8: Hazard Analysis Risk Matrix

Likelihood		Consequence				
		1	2	3	4	5
		None	Negligible	Minor	Moderate	Major
5	Almost certain	Low	Moderate	Moderate	High	High
4	Very likely	Low	Low	Moderate	High	High
3	Likely	Low	Low	Moderate	Moderate	High
2	Unlikely	Low	Low	Low	Moderate	High
1	Highly unlikely	Low	Low	Low	Moderate	Moderate

A total of 22 potential hazards were identified through the hazard identification process; 12 hazards were characterized as moderate-risk scenarios with the remaining 10 hazards being characterized as low-risk scenarios. No high-risk scenarios were identified.

15A2.4.2 Bounding Scenarios

A bounding scenario is used to represent an event in which the potential effects of that event are considered to be representative of those associated with other accident and malfunction scenarios; or, alternatively, the potential effects of scenarios that are bounded by another scenario are expected to fit within the envelope of the effects associated with the bounding scenario. From the initial screening process detailed in the hazard identification, five hazard scenarios were selected as bounding scenarios for more detailed risk analysis (Table 15A2-9).

15A2.4.3 Accidents and Malfunctions Assessment Summary

The results of the risk assessment of the bounding accident scenarios are summarized in Table 15A2-9.

The results combine the analysis of both effect likelihood and effect consequence for each bounding scenario to identify an overall risk rating. The predicted dose to workers is also provided. The overall risk ratings indicate that one bounding accident scenario has a moderate risk, and four bounding accident scenarios have a low risk.

Table 15A2-9: Summary of Assessment Results for Bounding Scenarios

No.	Accident or Malfunction Scenario	Location	Likelihood	Predicted Worker Dose	Estimated Effects Consequence	Overall Risk Rating[a]
1	Vehicle accident including rollover, collision, resulting in fire and dusting	Access road	Likely	0.70 mSv	Moderate	Moderate risk
2	Process vessel including leach tanks and piping system failure	Mill processing facility	Highly unlikely	0.048 mSv	Negligible	Low risk
3	Solvent extraction fire or explosion	Solvent extraction building	Unlikely	2.17 mSv	Minor	Low risk
4	Failure of tailings / paste pipes and pumps	Paste plant and paste delivery / UGTMF	Likely	0.017 mSv	Negligible	Low risk
5	Ventilation disruption and radon accumulation in the mine	Underground mine	Unlikely	4.92 mSv[b]	Negligible	Low risk

a) Based on Table 15A2-8.
b) Conservative value provided. Values range from 0.000034 mSv to 4.92 mSv.
UGTMF = underground tailings management facility; mSv = millisievert.

The vehicle accident including rollover, collision, resulting in fire and dusting scenario was deemed to be a moderate risk. Given that the risk would be managed to be as low as reasonably practicable (ALARP) by implementation of proper emergency response plans and radiation protection plans, this risk was deemed to be tolerable, and no further mitigation was deemed necessary.

The effectiveness of designs and mitigations would continue to be assessed according to the risk management processes that would be described in the IMS Manual and the Environmental Protection Program developed for the Project, and in accordance with provincial, CNSC, and other regulatory requirements.

The results of this assessment and/or subsequent future assessments as the Project advances would be considered in planning emergency response measures.

15A3 Non-Radiological Exposures

Non-radiological exposures would include the circumstance or conditions that could cause harm to workers in the form of physical injury, illness, or disease. Following the identification of potential circumstances and conditions that could create exposures to workers, risks to worker health, safety, and the environment are assessed with consideration for a range of factors, including:

- who is affected;
- the potential injury or exposure;
- the severity of the risk exposure; and
- the frequency and duration of exposure to the hazard.

The controls identified during this risk assessment are used to eliminate, prevent, or reduce the risk of injury, illness, or disease to workers. Controls appropriate for the hazard and corresponding level of risk are selected and implemented with consideration for the hierarchy of controls (Figure 15A1-1). Examples of controls include facilities, equipment, processes, products, safe work practices, and PPE.

Where practicable and advisable, controls would be used in combination to effectively prevent or reduce worker risk. Controls would be used, operated, and maintained in accordance with their design, limitations, and applicable training and documentation.

The potential non-radiological exposures assessed for the proposed Project included worker exposure to crystalline silica dust and diesel fuel emissions.

15A3.1 Workplace Exposure to Crystalline Silica Dust and Diesel Fuel Emissions

The purpose of this subsection is to summarize the predicted occupational risks to workers due to potential exposures to airborne crystalline silica, diesel engine gaseous emissions, and diesel engine particulate matter (DPM) emissions during the Construction and Operations phases.

Potential exposure to airborne crystalline silica, diesel engine emissions (i.e., nitrogen oxides [NO_X], carbon dioxide [CO_2], carbon monoxide [CO], and sulphur dioxide [SO_2]), and DPM associated with underground development and mining and surface activities (e.g., shaft sinking, processing of paste tailings and ore in the process plant) could present potential risks to workers. The assessment of estimated exposure concentrations from crystalline silica dust, diesel engine emissions, and DPM to workers considered if proposed mining methods, development and production mining rates, and mine and surface process plant ventilation rates would adequately protect workers from the hazards of crystalline silica dust and diesel engine emissions. To evaluate these risks, estimated exposures to crystalline silica dust and diesel engine emissions were developed.

Exposure estimates of workplace concentrations were developed and compared to occupational exposure limits (OELs) adopted by NexGen for the Project to evaluate occupational risks to workers. The OELs adopted for the Project during both Construction and Operations were based on a 12-hour daily work shift, at a minimum of 7 to 14 consecutive days, with an equal number of days of rest afterwards. NexGen will meet all applicable regulatory limits and will aim to meet, based on the concept of ALARA, more stringent OELs to be established for the Project (Table 15A3-1). This approach imparts an added degree of protection to workers by adopting more stringent OELs.

Table 15A3-1: 12-hour Occupational Exposure Limits Adopted by NexGen

Contaminant	Units	12-hour Time-Weighted Average
Crystalline silica	mg/m^3	0.024
Carbon dioxide (CO_2)	ppm	2,500
Carbon monoxide (CO)	ppm	12.5
Nitrogen oxides (NO_X)	ppm	25.0
Nitrogen dioxide (NO_2)	ppm	0.134
Sulphur dioxide (SO_2)	ppm	n/a
Diesel particulate matter (DPM)	$\mu g/m^3$	80

mg/m^3 = milligrams per cubic metre; ppm = parts per million; $\mu g/m^3$ = micrograms per cubic metre; n/a = not applicable.

15A3.1.1 Crystalline Silica Dust

Crystalline silica exposure estimates considered dust generated during drilling, blasting, mucking, and underground conveying; rock breaking associated with shaft sinking; underground lateral development; development of the UGTMF; and ore extraction. Dust generated during the processing of paste tailings and ore in the surface process plant was also considered. Based on proposed operational practices, it was concluded that dust generated from blasting, underground conveying, rock breaking, and wet processing of ore would not result in significant exposure to workers; therefore, these activities did not require detailed exposure estimates. Based on estimated exposures to crystalline silica underground due to drilling and mucking activities and in the surface process plant due to the receipt and handling of ore entering the plant, it is predicted that with current proposed mining methods, development and production mining rates, and mine and surface process plant ventilation rates, workplace concentrations of crystalline silica dust would generally not exceed the established OEL of 0.024 mg/m^3, assuming 12-hour exposures (Table 15A3-2). A marginal exceedance of the OEL is predicted during shaft development when drilling through approximately 15 m to 25 m of quartz arenite sandstone located in the proposed shaft location. Task-specific personal protective equipment or increased ventilation would be implemented, if required, when drilling through this sandstone.

Table 15A3-2: Estimated Occupational Exposures to Crystalline Silica - Underground

Similar Exposure Group	Work Activity	Estimated 12-hour TWA Workplace Crystalline Silica Dust Concentration[(a)]	
		Construction and Commissioning	Operations
Driller – Shaft Sinking	Shaft sinking	0.0245 mg/m^3	n/a
Driller – Lateral	Underground lateral mine development (worst case)	0.0041 mg/m^3	0.0040 mg/m^3
Driller – UGTMF	Underground mine production (ore) (worst case)	n/a	0.0025 mg/m^3
Driller – Ore	UGTMF stope development	0.0028 mg/m^3	0.0028 mg/m^3
Material Handler – Shaft Sinking	Shaft sinking	0.0105 mg/m^3	n/a
Material Handler – Lateral	Underground lateral mine development (worst case)	0.008 mg/m^3	0.008 mg/m^3
Material Handler – UGTMF	UGTMF stope development	0.011 mg/m^3	0.011 mg/m^3
Material Handler – Ore	Underground mine production (ore)	n/a	0.006 mg/m^3

Note: Yellow shading indicates exceedance of the occupational exposure level.
a) The 12-hour OEL is 0.024 mg/m^3.
TWA = time-weighted average; UGTMF = underground tailings management facility; n/a = not applicable.

15A3.1.2 Diesel Fuel Emissions

For diesel engine emissions, SEGs selected for further analysis were operators of primary fleet vehicles where diesel power machines/equipment would be used for the majority of the work shift. Other SEGs (e.g., supervisors, maintenance personnel, radiation technicians) would be expected to have lower exposure levels due to a limited use of diesel-powered equipment and the generally lower engine power ratings for vehicles used by these SEGs. For the equipment selected as part of the Project design, it is predicted that exposures to diesel engine emission gases and DPM would be below the applicable 12-hour OELs for all contaminants assessed for all SEGs other than the material handler – haul truck operator (NO_2) and the shotcrete sprayer (NO_2 and DPM) (Table 15A3-3). Modelling indicates that DPM emissions would be adequately controlled if the Project was able to utilize a shotcrete sprayer with a Tier 4 engine, incorporate a diesel particulate filter (DPF) on the Tier 3 engine, increase ventilation rates, or reduce work cycle timing.

Table 15A3-3: 12-hour Time-Weight Average Concentrations for Diesel-Powered Emissions – No Adjustment for Productive Hours

Similar Exposure Group	EPA Tier	NO_2[a] (ppm)	NO[a] (ppm)	CO (ppm)	CO_2 (ppm)	SO_2 (ppm)	DPM[b] (µg/m³)
Material Handler – LHD Operator: Lateral Development[c]	3	0.296	2.8	2.8	2,031	0.012	635.8 95.4 w/DPF
	4	**0.108**	**1.0**	**0.2**	**1,645**	**0.011**	**3.4**
Material Handler – LHD Operator: UGTMF Mining[c]	3	0.339	3.2	3.2	2,326	0.014	728.2 109.2 w/DPF
	4	**0.123**	**1.2**	**0.2**	**1,855**	**0.012**	**3.9**
Material Handler – LHD Operator: Ore Mining[c]	3	0.103	1.0	1.0	705	0.004	220.7 33.1 w/DPF
	4	**0.037**	**0.4**	**0.1**	**571**	**0.004**	**1.2**
Material Handler – Haul Truck Operator[c]	**4**	**0.162**	**1.5**	**0.4**	**2,472**	**0.016**	**5.2**
Shotcrete Sprayer[c]	**3**	**0.152**	**1.5**	**1.4**	**1,045**	**0.007**	**481.3** **72.2 w/DPF**
	4	0.092	0.9	0.01	886	0.006	1.8
OEL – 12-hour TWA	n/a	0.134/1.0[d]	25.0	12.5	2,500	n/a	80

Note: Yellow shading indicates exceedance of the occupational exposure level.
Bold numbers indicate the engine tier selected for the Project.
a) Assumes 15% of NO_x is NO_2 (range 5% to 15%) and 95% of NO_x is NO (range 85% to 95%) (Majewski 2009). As a result, NO_2 + NO emissions exceed NO_x emissions.
b) w/DPF = Tier 3 engine equipped with a diesel particulate filter with an efficiency of 85%.
c) The diesel engine is conservatively assumed to be operating for all work hours.
d) The most stringent limit recommended by Aura (2023) is 0.134 ppm. The ALARA OEL recommended in this assessment is 1.0 ppm based on *The Mines Regulations, 2018* 8-hour TWA of 2 ppm adjusted for a 12-hour exposure period.
EPA = Environmental Protection Agency; NO_2 = nitrogen dioxide; NO = nitric oxide; CO = carbon monoxide; CO_2 = carbon dioxide; SO_2 = sulphur dioxide; DPM = diesel particulate matter; LHD = load-haul-dump; DPF = diesel particulate filter; UGTMF = underground tailings management facility; OEL = occupational exposure level; TWA = time-weighted average; n/a = not applicable.

The scenarios shown in Table 15A3-3 assume 100% productivity for a 12-hour shift. The more likely scenarios for Construction and Operations (e.g., 12-hour TWA workplace with 9.33 productive hours) predict that the concentrations for LHD and haul truck operators using equipment with Tier 4 engines and a shotcrete worker using equipment with a Tier 3 engine equipped with an aftermarket DPF would be below the applicable 12-hour OELs for all diesel-powered emissions.

15A3.1.3 Crystalline Silica Dust and Diesel Fuel Emissions Exposure Assessment Summary

The evaluation of workplace exposure to crystalline silica dust and diesel engine emissions, including DPM, considered the proposed Project mining methods, development and production mining rates, and mine and surface process plant ventilation rates.

Based on estimated exposures to crystalline silica underground due to drilling and mucking activities, and in the surface process plant due to the receipt and handling of ore entering the plant, it is predicted that workplace concentrations of crystalline silica would remain below the established OEL of 0.024 mg/m³, with one exception. A marginal exceedance of the OEL is predicted during shaft development when drilling through approximately 15 m to 25 m of quartz arenite sandstone located in the proposed shaft location. Task-specific personal protective equipment or increased ventilation would be used when drilling through this sandstone.

15A4 Hazard Analysis

A qualitative HAZAN study was completed as part of Project engineering to identify, assess, eliminate (if possible), and mitigate hazards that could affect people, the environment, or property during the operation and maintenance of the Project. Where practicable, the HAZAN study identified opportunities to modify operational hazards and/or to reduce the most significant hazards to ALARP.

The results of the HAZAN study will be considered within subsequent phases of Project design, including detailed engineering. In addition, the HAZAN study will be followed up by a comprehensive hazard operability (HAZOP) study, which will be performed during detailed engineering once process and instrumentation drawings are finalized and sufficient engineering information is available. The HAZOP study will further identify Project design and/or mitigation measures that would be implemented for the Project, where practicable, that would reduce hazards to ALARP.

15A4.1 Hazard Analysis Study Scope

The HAZAN study included reviewing the processes for the following facilities associated with the Project:

- process plant:
  - leaching;
  - solid/liquid separation;
  - paste plant and backfill system;
  - precipitation;
  - ore handling/grinding;
  - solvent extraction;
  - tailings neutralization; and
  - product drying.
- acid plant;
- process utilities;
- off-site roads;
- bulk fuel storage;
- communication tower;
- underground mine:
  - shaft sinking infrastructure;
  - mine terrace; and
  - mine ventilation.
- dewatering and material handling;
- waste rock storage areas and stockpiles;
- sewage treatment, incinerator, and fresh water buildings; and
- mill control room, and emergency response building.

15A4.2 Hazard Analysis Study Results

The HAZAN study identified and assessed 615 hazards; of this total, 21 hazards were ranked as Actionable, 179 hazards as ranked as Monitor (i.e., monitoring during Project activities would be required to determine if further action is necessary), 215 hazards were ranked as Medium, and 60 hazards were ranked as Low (Table 15A4-1). The other 140 hazards were unranked because of insufficient information, these hazards would be assessed during the HAZOP, or no further action was required (Table 15A4-1). Where insufficient information was available, further details will be acquired and the hazards will be re-assessed, if required, during future studies (e.g., HAZOP). Where possible, future controls were recommended to reduce the most significant hazards to ALARP.

Table 15A4-1: Hazard Analysis Results

Consequence Magnitude	Number of Hazards
Actionable	21
Monitor	179
Medium	215
Low	60
Not rated	140
Total	**615**

15A4.3 Hazard Analysis Next Steps

Project design features and mitigation measures proposed during the HAZAN study will be considered within future Project design phases (e.g., detailed engineering) to reduce the identified hazards to ALARP. Once the Project design has advanced, a HAZOP study will be conducted to identify any additional required Project design features or mitigation measures that would be implemented to reduce potential hazards to ALARP.

15A5 Human Factors Engineering

Human factors engineering refers to the application of psychological and physiological principles to the engineering and design of products, processes, and systems. The human factors process allows human performance issues and human-related concerns to be addressed early, effectively, and iteratively throughout Project design by facilitating compatibility between users (i.e., applicable workers), the equipment/technology/systems they use, the tasks they execute, and the environment they work in.

The means by which human factors considerations will be integrated into Project activities licensed by the CNSC are documented in the Human Factors Engineering Program Plan (Plan). The Plan provides an overview of how human factors will be integrated to derive Project design.

15A5.1 Goal of the Human Factors Engineering Program Plan

The goal of the Plan is to outline the methods for integrating human factors in the design and development of Project facilities, equipment, and processes in a manner that:

- enhances measures to protect human health, safety, and the environment;
- optimizes work environments and worker well-being;
- supports Project security; and

- improves Project operability and maintainability.

This Plan provides a consistent, risk-based approach to assessing Project facilities, equipment, and processes to include review and evaluation of user tasks, human-system interfaces, and physical work environments for compatibility with human characteristics, capabilities, and limitations.

15A5.2 Plan Scope

The Plan serves as a roadmap for integrating human factors into the design of Project facilities, equipment, and processes. The activities described in this Plan are limited to the current and future engineering design phases of the Project. Although the outcomes of this work would provide the basis for the effective integration of human factors considerations throughout the Project lifespan, this Plan does not prescribe or account for human factors assessments performed during Construction, Operations, or Closure.

All areas of the Project (e.g., mine, underground, surface processing, surface facilities) will undergo a preliminary review to determine the final scope (i.e., Project areas) that will be subject to the human factors evaluation. Human factors integration will be informed using a graded, risk-based approach that accounts for the apparent level of risk, safety significance, and complexity of facilities, equipment, or processes.

The outcomes of risk-based human factors assessments, verification, and validation executed throughout the Project would be documented in a Human Factors Engineering Summary Report.

15A5.3 Human Factors Integration Program Management

Human factors integration will be achieved through:

- accountability for human factors integration through clear roles and responsibilities;
- establishment of human factors culture within the overall Project team (e.g., design authority, responsible designer);
- consistent understanding of human factors concepts within the overall Project team (e.g., design authority, responsible designer);
- alignment of human factors needs with design workflows and stage gates;
- integration of human factors within the design review meetings, constructability reviews, and hazard studies;
- direct access by the human factors experts to the design documents and/or models; and
- direct access by the human factors experts to Project technical experts for technical support.

Human factors integration will be facilitated through development of a human factors working group; this working group will also support:

- stakeholder awareness of the Plan and human factors work activities;
- integration of human factors work activities within the responsible designer’s design timeline and schedule;
- stakeholder awareness of the status of the human factors work activities and requirements (e.g., data gathering sessions, access to Project technical experts); and
- identification of risks and proposed mitigation, if applicable.

15A5.4 Human Factors Work Activities

The human factors work activities that are planned for the Project engineering design phase include:

- operating experience review;
- function analysis;
- task analysis;
- critical task analysis;
- task-based design reviews; and
- human-system interface design.

The human factors work activities are intended to improve Project operability and maintainability as well as optimize Project work environments. A description of these activities is provided in Table 15A5-1.

Table 15A5-1: Human Factors Work Activities

Human Factor Work Activity	Description
Operating Experience Review	Uses design, operating, and maintenance experience from other mines and mills and applicable industries to identify and analyze lessons learned that should be considered during Project design.
Function Analysis	Provides an understanding of system functions by identifying and describing primary high-level activities (i.e., functions) that must be performed to satisfy system operational and maintenance requirements and objectives.
Task Analysis	Identifies the actions or cognitive processes a user must perform to achieve a function and details the performance demands on a user and requirements for successful task completion.
Critical Task Analysis	Follows a process for rating task importance and prioritizing those tasks that are critical for safe and successful goal completion for further analysis.
Task-Based Design Reviews	Uses the results of the task analysis to conduct task-based design reviews to verify Project design supports operability and maintainability.
Human-System Interface Design	Reviews the systems, equipment, technology, and graphical user interfaces (e.g., software) to maintain both design compliance to applicable human factors / design standards and guidelines support for operations and maintainability.

Human factors experts will select the most appropriate methods and tools to facilitate the human factors work activities based on their extensive experience in integrating human factors in related design projects and domains.

Human factors integration consists of three phases:

- **Development:** development of the Plan and the Human Factors Engineering Validation Plan;
- **Implementation:** human factors integration through the execution of the human factors work activities during the engineering design phases; and
- **Documentation and Traceability:** summary of results for each human factors work activity and traceability of human factors design requirements and recommendations in the Human Factors Considerations Tracking File.

The execution of the human factors work activities has been scheduled based on the overall Project design timelines and would adapt to Project schedule modifications as appropriate.

15A5.5 Related Activities

Identification of adequate staffing and job design is an important consideration during the design process to confirm that user tasks can be completed safely and efficiently for a range of operating conditions (e.g., routine, abnormal, emergency). Similarly, developing training modules and processes will support safe and efficient task completion, user interaction with human-system interfaces, and user response during abnormal and emergency events.

The results of human factors activities such as the function and task analysis, operating experience review, and validation exercises can be used to support development of staffing, job design (i.e., roles), qualifications, processes, and training. Human factors experts will highlight specific results arising from these analyses that would be considered by the design authority and shared with the relevant groups (e.g., staffing, training, process development).

15A5.6 Minimum Staff Complement

The Project staff complement would be based on operational effectiveness and planned output. Abnormal events, incidents, or emergencies could result in either modifying activities to align operations to a safe state or unplanned shutdowns of whole or partial operations. The Project staff complement would be adjusted to support these abnormal events, incidents, or emergencies.

15A5.7 Design Verification

Design verification demonstrates that the Project design conforms to human factors-related requirements, design standards, and guidelines.

15A5.7.1 Human-System Interface Design

Human-system interface designs will be reviewed and verified against human factors design standards and guidelines for compliance. Components of the design that were found non-compliant to human factors design standards and guidelines would be identified and recommendations for mitigating non-compliance will be developed, documented, and communicated to the responsible designer.

15A5.7.2 Evaluating Human-System Interfaces Against Tasks

The design of human-system interfaces would be evaluated against operational and maintenance tasks to verify that human-system interfaces provide the required support for safe execution of user tasks. Human-system interface designs that inadequately support user tasks would be identified and design recommendations to support operability and maintainability would be developed, documented, and communicated to the responsible designer.

15A5.7.3 Human Factors Requirements and Recommendations

Design requirements and recommendations arising from the human factors work activities will be reviewed to verify they have been addressed, resolved, and integrated into Project design. If there are instances where design requirements and recommendations could not be implemented, justification will be provided.

15A5.7.4 As-Built Verification

An as-built verification checklist will be developed at the end of the Project design engineering. The checklist will be based on the human factors recommendations and implemented during the as-built verification walk through completed during system commissioning.

15A5.7.5 Design Validation

Design validation is the process of determining the degree to which the design facilitates achievement of the overall goals of Project design.

A Human Factors Engineering Validation Plan will be developed documenting the planning and execution of the validation activities and will be submitted to the CNSC for review and approval. The Human Factors Engineering Validation Plan will document the test plan for executing validation exercises during detailed design and commissioning and will include information such as:

- validation scenario (may be identified from the results of the critical task analysis);
- type of analysis;
- approach and methodology;
- apparatus (e.g., model, simulation);
- participants;
- data collection tools (e.g., questionnaires, workload scales); and
- performance measures (quantitative and qualitative).

Iterative validation activities may be implemented as the design advances and more information (e.g., equipment design, human-system interface, layouts) become available.

15A6 Summary

Potential radiological, chemical, physical, and biological hazards associated with Project activities that pose risks to the health and safety of workers have been, and will continue to be, systematically assessed to determine the nature, likelihood, and consequence of the potential risk; to identify and implement measures to mitigate associated effects; and to keep radiological and non-radiological exposures to workers ALARA. Risk assessments performed for the Project specific to worker health and safety are documented in a variety of reports and studies that were used to confirm the design basis for the proposed Project. These assessments have been, and will continue to be, submitted to the CNSC and other regulatory agencies in support of the various Project licensing and permitting phases.

15A7 References

Acts and Regulations

The Mines Regulations, 2018. RRS c S-15.1 Reg 8 under The *Saskatchewan Employment Act*. Effective 6 April 2019. Available at https://www.canlii.org/en/sk/laws/regu/rrs-c-s-15.1-reg-8/latest/rrs-c-s-15.1-reg-8.html.

Radiation Protection Regulations, SOR/2000-203 under the *Nuclear Safety and Control Act*. Last amended 1 January 2021. Available at https://laws-lois.justice.gc.ca/eng/regulations/SOR-2000-203/index.html.

Literature Cited

Majewski WA. 2009. MDEC 2009, NO_2 Emissions in Mines. Available at https://mdec.ca/2010/S7P3_majewski.pdf.

Rook I Project

Environmental Impact Statement

Section 16 Cultural and Heritage Resources and Indigenous Land and Resource Use

Submitted to:
Canadian Nuclear Safety Commission
Saskatchewan Ministry of Environment

Submitted by:
NexGen Energy Ltd.
3150-1021 W Hastings St
Vancouver, BC
V6E 0C3

November 2024

Executive Summary

Section Purpose

Section 16 of the Environmental Impact Statement (EIS) provides a comprehensive assessment of potential effects of the Rook I Project (Project) on cultural and heritage resources and Indigenous land and resource use. This assessment included consideration of both potential effects from the Project and cumulative effects from the Project and other reasonably foreseeable developments (RFDs). The cultural and heritage resources and Indigenous land and resource use assessment used widely accepted scientific practices and incorporated Indigenous and Local Knowledge from a variety of sources, including Joint Working Group (JWG) meetings and Indigenous Knowledge and Traditional Land Use (IKTLU) Studies completed by First Nations and Métis Groups (collectively referred to as Indigenous Groups) for the Project.

Cultural and heritage resources and Indigenous land and resource use represented two valued components (VCs) for the Environmental Assessment (EA); the selection was based, in part, on their importance to Indigenous Groups and local community members.

The cultural and heritage resources assessment focused on heritage resources and archaeological sites that are protected under *The Heritage Property Act* of Saskatchewan.

The Indigenous land and resource use VC focused on land and resource use by the Clearwater River Dene Nation (CRDN), Métis Nation – Saskatchewan (MN-S), Birch Narrows Dene Nation (BNDN), and Buffalo River Dene Nation (BRDN). The Patterson Lake area, where the proposed Project would be located, is an important traditional land use area where these Indigenous Groups have pursued land and resource activities throughout history.

The assessment of Indigenous land and resource use was informed by the assessments completed for intermediate components (i.e., air quality, noise, hydrology, and surface water quality) and other VCs (i.e., fish and fish habitat VCs, vegetation VCs, wildlife and wildlife habitat VCs, and other land and resource use). The Indigenous land and resource use assessment provided information that was used to support other VC assessments such as other land and resource use, economy, and community well-being.

Setting

At a regional scale, the Project would be located within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system, approximately 40 km east of the Saskatchewan-Alberta border and 640 km northwest of the city of Saskatoon. The Project would reside within Treaty 8 territory and the Métis Homeland, and adjacent to Treaty 10 territory.

The spatial boundary selected for the cultural and heritage resources assessment was defined as the heritage study area and included three main areas of the maximum disturbance area: the shore area of Patterson Lake where the main Project infrastructure would be located (130 ha); a large, level upland area where the airstrip would be located (17 ha); and the shore area of Patterson Lake along the access road south of the main infrastructure (33 ha).

The Indigenous land and resource use local study area (LSA) includes the areas surrounding Patterson, Forrest, Beet, and Naomi lakes, plus the Highway 955 corridor between the Project site and La Loche. The Indigenous land and resource use regional study area (RSA) includes the fur blocks closest to the local communities and captures the broad traditional use activities and patterns of Indigenous Groups. The RSA recognizes the regional land use context, connections across the landscape, and where cumulative effects on Indigenous land and resource use may occur.

Existing Conditions (Section 16.3)

Based on defined criteria for a Heritage Resource Impact Assessment (HRIA), an HRIA was completed that assessed areas with heritage resource potential within the Project footprint and three general study areas. In total, 180 ha were assessed, and no heritage resources were identified in the survey area. Following a review of the HRIA, the Heritage Conservation Branch (Saskatchewan Ministry of Parks, Culture and Sport) confirmed that the HRIA met the requirements of Section 63 of *The Heritage Property Act*, and no further assessment was required.

Throughout the RSA, the CRDN, MN-S, BNDN, BRDN, and Athabasca Denesųłiné practise Indigenous land and resource use activities. The practised resource use activities include hunting, trapping, fishing, plant gathering, and use of cultural sites, habitation sites, and travel routes.

Indigenous land and resource use in the LSA is actively pursued by the CRDN, MN-S, and BNDN, and, to a lesser extent, the BRDN.

Within the LSA, the Patterson Lake area is an important land use area for the CRDN and MN-S. In IKTLU Studies undertaken for the Project, the CRDN described the Patterson Lake area as a key region within their primary traditional use and occupancy areas that is “historically and currently recognized as a ‘good for everything’ harvesting area which may have sustained CRDN members through time beyond living memory”. Similarly, in their IKTLU Study, the MN-S stated that the Patterson Lake area has historical and current value and is paramount to its members and their lifeblood.

The CRDN, MN-S, BNDN, and BRDN have continued to pursue land and resource activities throughout the LSA and RSA despite the expansion of industrial development and implementation of government policies that have displaced activities or discouraged their pursuit. Knowledge of the lands and waters in the Patterson Lake area has been passed down through the generations. However, Indigenous Groups are experiencing land disturbances and access restrictions associated with mining exploration and development and natural events such as forest fires. Indigenous land and resource use activities in the LSA and RSA are supported by Indigenous land-based learning programs intended to revitalize traditional activities, support community well-being, and provide opportunities for younger generations to learn traditional ways of life and connect with their culture.

Potential Effects and Proposed Mitigation (Section 16.4)

An analysis was completed to evaluate Project components and activities and associated effects pathways that could potentially affect cultural and heritage resources and Indigenous land and resource use. The evaluation also considered similar combined effects from the Fission Patterson Lake South Property, the identified RFD for the Indigenous land and resource use assessment.

Project land clearing activities would have the potential to affect cultural and heritage resources during the Project lifespan. Project activities that would have the potential to affect Indigenous land and resource use during the Project lifespan include:

- land clearing, site preparation, and construction of facilities and infrastructure;
- development of the underground mine and shafts;
- process plant and underground operations;
- handling and storage of waste rock, special waste rock, and ore;
- water intake for potable and process water;
- effluent treatment plant and treated effluent discharge;
- sewage treatment plant, water storage, and effluent monitoring ponds;
- additional infrastructure (e.g., camp, maintenance shop, offices);
- power generation;
- transportation of personnel and materials to and from the site; and
- other supporting mining construction, operation, and decommissioning and reclamation (i.e., closure) activities.

Similar activities that could affect cultural and heritage resources and Indigenous land and resource use would be expected to occur for the Fission Patterson Lake South Property.

As part of the pathways analysis, proposed environmental design features and mitigation measures were considered to determine whether effects on these two VCs could be avoided or reduced to negligible levels, thereby removing the pathway. Project environmental design features such as the underground tailings management facility and a limited Project footprint were designed to minimize the Project's effects on cultural and heritage resources and Indigenous land and resource use. NexGen Energy Ltd. (NexGen) reduced the Project footprint and corresponding maximum disturbance area (i.e., 981 ha, or four times larger than the currently anticipated Project footprint) by:

- optimizing the use of cleared areas for Project activities;
- using existing road infrastructure to the extent possible, including the existing bridge crossing;
- storing tailings underground; and
- designing an efficient infrastructure footprint (i.e., buildings clustered together).

With respect to cultural and heritage resources, as spatial overlap between the Project and the Fission Patterson Lake South Property would not exist, pathways between the projects would also not overlap; therefore, only the potential effects of the Project were considered in the subsequent steps of the assessment process.

A chance find procedure would mitigate potential effects of the Project on any unknown cultural and heritage resources, should any sites be identified during land clearing and site preparation activities. After mitigation measures were considered, the pathways analysis determined that all potentially adverse pathways from the Project to the cultural and heritage resources VC could be removed from the assessment. Therefore, no pathways were carried forward into the residual effects analysis. With respect to Indigenous land and resource use, proposed mitigation measures that would reduce effects include:

- implementation of Benefit Agreements with primary Indigenous Groups, which would include funding and human resources to support community-related initiatives and establishing an Implementation Committee;
- establishing Environmental Committees with primary Indigenous Groups;
- funding for full-time independent Indigenous Monitors;
- robust site environmental management processes;
- design of facilities and infrastructure to minimize sensory disturbance;
- implementation of progressive and final reclamation; and
- development and implementation of a Decommissioning and Reclamation Plan, Environmental Protection Program, Security Program, Caribou Mitigation and Offsetting Plan, and Indigenous and Public Engagement Program.

These mitigations have been used within the mining sector and have been proven effective. Similar mitigation and management practices would also be expected to be implemented by the Fission Patterson Lake South Property.

After mitigation measures were considered, the pathways analysis determined that many of the potential pathways from the Project to the environment (i.e., biophysical and human) could be removed from the assessment. However, it was identified that the Project could still adversely affect Indigenous land and resource use from the following pathways:

- access to, and area available for, Indigenous land and resource use;
- availability of fish, plants, and wildlife for harvesting from changes in abundance and distribution; and
- quality of the Indigenous land use experience.

Therefore, these pathways were carried forward into the residual effects analysis.

Residual Effects Analysis (Section 16.5)

A residual effects analysis was conducted to determine the potential effects on Indigenous land and resource use under two assessment cases: effects of the Project (i.e., Application Case), and combined effects of the Project and the Fission Patterson Lake South Property (i.e., RFD Case). The residual effects analysis considered three measurement indicators for the Indigenous land and resource use VC:

- access to, and area available for, Indigenous land and resource use;
- availability and quality of fish, plants, and wildlife for harvesting; and
- quality of the Indigenous land use experience.

Access to, and Area Available for, Land and Resource Use

The following are expected residual effects on access to, and area available for, Indigenous land and resource use:

- Access to traditional lands and travel routes around infrastructure would be limited for safety reasons for both the Project and the Fission Patterson Lake South Property.
- Both projects would disrupt land use as they would restrict access to a portion of the south and east shores of Patterson Lake and the Patterson Lake peninsula.
- For the Project, availability and access to lands and resources used by Indigenous Groups for traditional purposes would be reduced within the maximum disturbance area by 981 ha or 0.7% of the LSA.
- The Fission Patterson Lake South Property activities are predicted to contribute an incremental loss of 1,545 ha of land available for Indigenous land and resource use. The cumulative RFD Case loss of available land would be 2,526 ha, representing approximately 2.0% of the LSA.
- The Project is not predicted to restrict access to and between the lakes in the Indigenous land and resource use LSA. Furthermore, changes in water surface elevations would not be expected to affect open-water navigation on downstream lakes or the Clearwater River.

With mitigations, there would be continued opportunities for Indigenous land and resource use with the predicted changes in access to, and area available for, Indigenous land and resource use from the Project and the Fission Patterson Lake South Property.

Availability of Fish, Plants, and Wildlife for Harvesting

The Project would affect the availability (i.e., abundance and distribution) of fish, plant, and wildlife resources used for harvesting. Indigenous Groups use a diversity of species in the Project LSA and RSA for traditional activities including fish, large game, small game, furbearers, and traditional plants.

The results of fish and fish habitat, vegetation, and wildlife and wildlife habitat assessments were incorporated into the assessment to understand the potential for changes to the availability of fish, plants, and wildlife used for harvesting. Valued components that were considered in the assessment of Indigenous land and resource use reflect those species identified as important by Indigenous Groups through various sources including IKTLU Studies and JWG feedback. The following residual adverse effects from the Project and cumulative effects with the Fission Patterson Lake South Property were identified:

- Negligible change to the availability of fish for harvesting, localized to Patterson Lake North Arm – West Basin.
- Localized changes to the availability of traditional use plants for gathering, limited to the Project's and Fission Patterson Lake South Property's maximum disturbance areas.
- Localized changes to the availability of wildlife for harvesting, but with regional changes to wide-ranging wildlife species (e.g., moose, black bear) availability as a result changes to wildlife movements and distribution beyond the LSA and outside the Highway 955 corridor due to increased traffic and sensory disturbance.
- The local change in availability of fish, plants, and wildlife would potentially displace some Indigenous hunter and trapper activity in the LSA.

- Changes in the availability of plants in affected wetland ecosystems are conservatively assumed to be permanent; however, these changes would be small.

With mitigations, local small changes are expected in the availability of fish, plants, and wildlife for harvesting; however, there would be a continued availability of resources for Indigenous land and resource use from the Project and the Fission Patterson Lake South Property.

Quality of the Indigenous Land Use Experience

The following are expected residual effects on quality of the Indigenous land use experience for the Project and cumulative effects with the Fission Patterson Lake South Property:

- Sensory disturbances (i.e., light, noise, air quality, and aesthetics):
  - Project noise levels are predicted to be below government thresholds but could affect the aesthetics for some individual Indigenous land and resource users whose tolerance levels may differ.
  - Light trespass would be localized around infrastructure.
  - Sky glow is expected to obscure faint stars for Indigenous land and resource users in the local area.
  - Dust emissions would be highly localized.
- Visual disturbance associated with the Project and the Fission Patterson Lake South Property would be related to vegetation clearing, infrastructure development, and increased human activity associated with the projects.
- Indigenous land and resource user safety may be affected from increased traffic along the access road and adjacent highway.
- Perceptions that mine activities may adversely affect the quality of water, fish, plants, and wildlife.
- Perceptions of contamination at decommissioned facilities and the suitability of the land and resources for practising traditional activities.
- Changes to the cultural landscape for some Indigenous land and resource users as a result of changes in noise, light, air quality, traffic, and aesthetics, and perceptions of the quality of resources.

The perceived decrease in quality of resources may be considered to represent important losses of land and resource use and cultural connections for some individuals. Nonetheless, the majority of the LSA and RSA would remain intact with similar resources (i.e., water, fish, plants, and wildlife) as the Patterson Lake area, and the Project environmental protection measures would avoid contamination of the receiving environment and resources (i.e., water, fish, plants, and wildlife).

With mitigations, there would be continued levels of opportunities for Indigenous land and resource use with the predicted changes to the quality of the Indigenous land use experience from the Project and the Fission Patterson Lake South Property. Mitigations to improve perceptions on the quality of resources and cultural landscape would include the independent Indigenous monitoring program, Indigenous and Public Engagement Program to communicate results from the Project and independent environmental monitoring, and commitments contained within the Benefit Agreements such as monetary and human resources to support community-related initiatives in areas such as cultural and traditional values. These mitigations, along with those identified to mitigate noise, dust emissions, visual disturbances, and road safety, are anticipated to minimize the effects associated with changes to the quality of the Indigenous land use experience. It is reasonable to assume the

Fission Patterson Lake South Property would have similar programs and agreements in place to mitigate effects on Indigenous land and resource users.

Significance Determination (Section 16.6)

The weight of evidence from the analysis, including consideration of experiences at other uranium operations in northern Saskatchewan where multiple uses remain compatible, predicts that Indigenous land and resource use could continue in areas not affected by the Project. Indigenous land and resource use is expected to change around Patterson Lake, but overall Indigenous land and resource use in other areas of the LSA and RSA is anticipated to continue. The residual effects on the Indigenous land and resource use VC in the Application Case and the RFD Case are predicted to be **not significant**.

Despite the fact that residual adverse effects to Indigenous land and resource use are anticipated to be not significant, NexGen acknowledges that continued land and resource use activities are critical to local Indigenous Groups and communities, and necessary to maintain a social licence to operate. NexGen is committed to effectively implementing the proposed mitigations to protect land and resources, allowing independent Indigenous monitors to verify that the Project is protecting the environment and human health, continuing to build relationships and trust, and helping to maintain Indigenous connections to the land. Monitoring and follow-up measures would be a key requirement to support continued Indigenous land and resource use in the area of the Project.

Prediction Confidence and Uncertainty (Section 16.7)

Overall, there was a medium-high degree of confidence in the predictions related to the cultural and heritage resources and Indigenous land and resource use assessment. Uncertainty was primarily and appropriately addressed by making assumptions that conservatively overestimated rather than underestimated potential effects (i.e., a precautionary assessment).

Monitoring and Follow-Up (Section 16.8)

Monitoring programs would be established to confirm the mitigation effectiveness for the land and resources Indigenous Peoples rely upon, and for aspects of the Project that may affect the experience of being out on the land. The effectiveness of mitigations on the Indigenous land and resource use would be evaluated through the following:

- Long-term independent Indigenous monitoring of the effects of the Project would be conducted.
- How the objectives of the Ground Transportation Emergency Response Plan were met would be evaluated using measurable indicators and the plan would be modified as needed to foster continual improvement.
- Regular meetings would be held with potentially affected Indigenous land users, both independently and as part of the Indigenous and Public Engagement Program, to review the previous season and understand any issues or concerns that could be addressed. Follow-up would be conducted as needed.
- A Project feedback and grievance mechanism would be established to record and action issues identified by local residents. Indigenous land and resource use issues would be tracked and addressed as they arise and periodically analyzed through management reviews.
- Implementation success of the commitments made under Benefit Agreements would be tracked.
- Success of regional mitigation strategies would be monitored.

- Perception surveys would be completed to better understand local residents' thoughts and understanding of uranium mining. The perception surveys would be designed for documenting current and ongoing community perceptions of the mining in the RSA to inform future engagement and mitigation based on community issues, concerns, and opportunities.

In addition to these monitoring and follow-up programs, an Environmental Committee and Indigenous monitoring program would be established. The Environmental Committee would oversee and monitor the environmental performance of the Project. The Environmental Committee would review environmental performance reports in respect of the Project, provide feedback on environmental protection measures and monitoring programs, review and participate on environmental response measures and preventative and corrective actions, and oversee the Indigenous monitoring activities.

Monitoring programs would also be established to confirm the effectiveness of mitigation for the land and resources Indigenous Peoples rely upon. These programs are described in more detail in the relevant assessment sections:

- air quality (Section 7.2);
- noise (Section 7.3);
- fish and fish habitat (Section 11);
- vegetation (Section 13); and
- wildlife and wildlife habitat (Section 14).

Abbreviations and Units of Measure

Abbreviation	Definition
BNDN	Birch Narrows Dene Nation
BRDN	Buffalo River Dene Nation
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
CNSC	Canadian Nuclear Safety Commission
COPC	constituent of potential concern
CRDN	Clearwater River Dene Nation
EA	Environmental Assessment
EIS	Environmental Impact Statement
ENV	Saskatchewan Ministry of Environment
ETP	effluent treatment plant
GPS	global positioning system
HBC	Hudson’s Bay Company
HRIA	Heritage Resources Impact Assessment
ID	identifier
IKTLU	Indigenous Knowledge and Traditional Land Use
IR	Indian Reserve
JWG	Joint Working Group
KP	key person
LPA	local priority area
LSA	local study area
MN-S	Métis Nation – Saskatchewan
NexGen	NexGen Energy Ltd.
NR2	Northern Region 2
Project	Rook I Project
RFD	reasonably foreseeable development
RSA	regional study area
sp.	species
spp.	multiple species
ssp.	subspecies
STP	sewage treatment plant
TSD	Technical Support Document
VC	valued component
WRSA	waste rock storage area
WSE	water surface elevation
YNLR	Ya’thi Néné Lands and Resources

Unit	Definition
%	percent
dB	decibel
dBA	A-weighted decibel
ha	hectare
km	kilometre
km^2	square kilometre
m	metre
$mg/cm^2/30$ d	milligrams per square centimetre per 30 days
mg/L	milligrams per litre
mSv/yr	millisieverts per year

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16 CULTURAL AND HERITAGE RESOURCES AND INDIGENOUS LAND AND RESOURCE USE

16.1 Introduction

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The Project would be located approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the Northern Village of La Loche, and 640 km northwest of the city of Saskatoon (Figure 16.1-1). The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Patterson Lake is at the interface of the Boreal Shield and Boreal Plain ecozones. Access to the Project would be from an existing road off Highway 955 (Figure 16.1-2), with on-site worker accommodation serviced by fly-in/fly-out access.

Section 16, Cultural and Heritage Resources and Indigenous Land and Resource Use, of the Environmental Impact Statement (EIS) characterizes the potential residual effects of the Project on cultural and heritage resources and Indigenous land and resource use, which represent valued components (VCs) for the Environmental Assessment (EA).

Heritage resources and archaeological sites are protected under *The Heritage Property Act* of Saskatchewan, which requires a Heritage Resources Impact Assessment (HRIA) for developments in a heritage-sensitive area based on the presence of known heritage resources and the potential for discovering new heritage resources. Heritage resources also have spiritual and cultural importance to Indigenous Peoples and the general public. Section 5(1) of the *Canadian Environmental Assessment Act, 2012* requires an assessment of effects on "any structure, site or thing that is of historical, archaeological, paleontological or architectural significance" (Government of Canada 2015). The assessment of cultural and heritage resources was supported by the HRIA included in Annex IX, Heritage Resources Impact Assessment and Cover Letter.

Consideration of Project effects on Indigenous land and resource use for traditional purposes is also a requirement under Section 5(1) of the *Canadian Environmental Assessment Act, 2012*. Traditional activities associated with Indigenous land and resource include hunting, trapping, fishing, gathering, and other cultural activities. Occupancy and habitation are important aspects of Indigenous land and resource use and represent areas and places where Indigenous Peoples have permanently or temporarily resided (e.g., cabins, camp sites). Access and travel routes are important for understanding how lands and resources are accessed and the spiritual and cultural relationship with the broader landscape. Indigenous land and resource use also includes culturally important sites and areas that have spiritual or historical significance, such as ceremonial sites or grave sites, as well as the broader cultural landscape[1]. The pursuit of traditional activities is closely connected to the exercise of Aboriginal and Treaty Rights, which is the responsibility of the Crown to assess as identified in *Aboriginal Consultation and Accommodation – Updated Guidelines for Federal Officials to Fulfill the Duty to Consult* (Government of Canada 2011) and in compliance with Canadian Nuclear Safety Commission (CNSC) REGDOC-3.2.2 version 1.2 (CNSC 2022). Information from the EIS may be used by the Crown in fulfilling the

[1] According to the United Nations Educational, Scientific and Cultural Organization (UNESCO 2022) cultural landscapes represent the "combined works of nature and of man" designated in Article 1 of the Convention. They are illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic, and cultural forces, both external and internal. For Indigenous communities, the cultural landscape is a way to consider the relationship between Indigenous Peoples and a broader area as it considers "cultural heritage, the travel routes and spaces between them (Ehrlich 2012), the relationships between sites, and the spiritual and cultural associations that people hold with the land, often over a much larger area" (MCFN and Firelight Group 2017).

Crown's duty to consult. Section 1.3.2, Assessment of Impacts on Indigenous Rights, further discusses the duty to consult and the approach to the assessment of effects on Indigenous Rights.

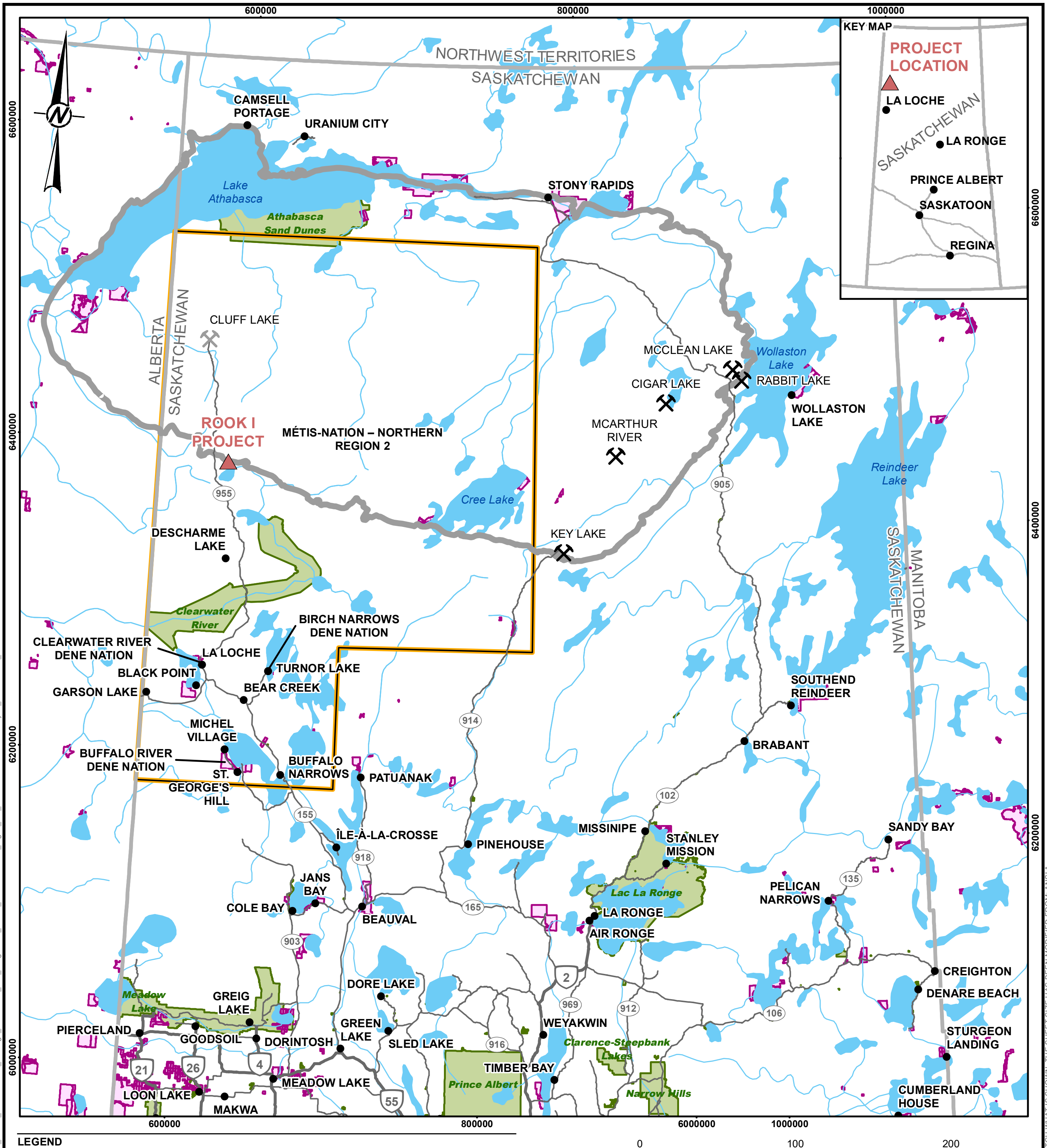
The assessment of Project effects on the Indigenous land and resource use VC was supported by assessments completed for intermediate components, other VCs, environmental risks, and sensory components:

- noise intermediate component (Section 7.3, Noise);
- air quality intermediate component (Section 7.2, Air Quality);
- fish and fish habitat VCs: northern pike / jackfish (*Esox lucius*), lake whitefish *(Coregonus clupeaformis)*, walleye *(Sander vitreus)*, and lake trout (*Salvelinus namaycush*; Section 11, Fish and Fish Habitat);
- traditional use plants VC (Section 13, Vegetation);
- American marten (*Martes americana*), through the assessment of suitable habitat (i.e., upland ecosystem VC; Section 13);
- wildlife and wildlife habitat VCs: woodland caribou (*Rangifer tarandus caribou*), moose (*Alces alces*), grey wolf (*Canis lupus*), black bear (*Ursus americanus*), beaver (*Castor canadensis*), mallard (*Anas platyrhynchos*), and common goldeneye (*Bucephala clangula*) (Section 14, Wildlife and Wildlife Habitat);
- human health VC (Section 15);
- other land and resource use VC (Section 17, Other Land and Resource Use);
- economy VC, which includes the traditional economy (Section 18, Economy);
- Environmental Risk Assessment (TSD XXI);
- Transportation Risk Assessment Report (TSD IX); and
- Light Effects Analysis Report (TSD XI).

The results from the assessment on the Indigenous land and resource use VC have informed results for:

- the traditional economy supporting the assessment of effects on the economy VC (Section 18); and
- community well-being VC (Section 19, Community Well-Being).

Several potential Project effects on cultural and heritage resources and Indigenous land and resource use were considered as part of the assessment. The removal of vegetation communities and development of Project infrastructure would have the potential to affect provincially protected heritage and archaeological resources that have high cultural value to Indigenous Peoples and communities and could alter the abundance, distribution, or availability of traditional use plants and wildlife. The Project also has the potential to cause adverse effects on Indigenous land and resource use by altering surface water quantity and quality, which could also influence fish habitat and fish productivity. Sensory disturbances, such as noise, light, air emissions, and visual resources may affect the quality of the experience for Indigenous land users around the Project, resulting in avoidance of the area. Changes in access to land and traffic patterns could alter Indigenous land user safety and potentially result in loss of use of land by Indigenous Groups. Indigenous land user concerns and perceptions about the potential health effects of fresh water and eating berries, fish, and wildlife potentially containing metals and radionuclides (constituents of potential concern [COPCs]) may decrease the use of land and resources adjacent to the Project. The Project has the potential to change the cultural landscape, including sense of place and the relationship Indigenous Peoples have with the land. A simplified linkage diagram, Figure 16.1-3, illustrates how proposed Project activities and Project effects on other VCs and intermediate components could result in a direct or indirect effect on Cultural and Heritage Resources and Indigenous land and resource use.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN BOUNDARY
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROJECT LOCATION
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

REFERENCE(S)
1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

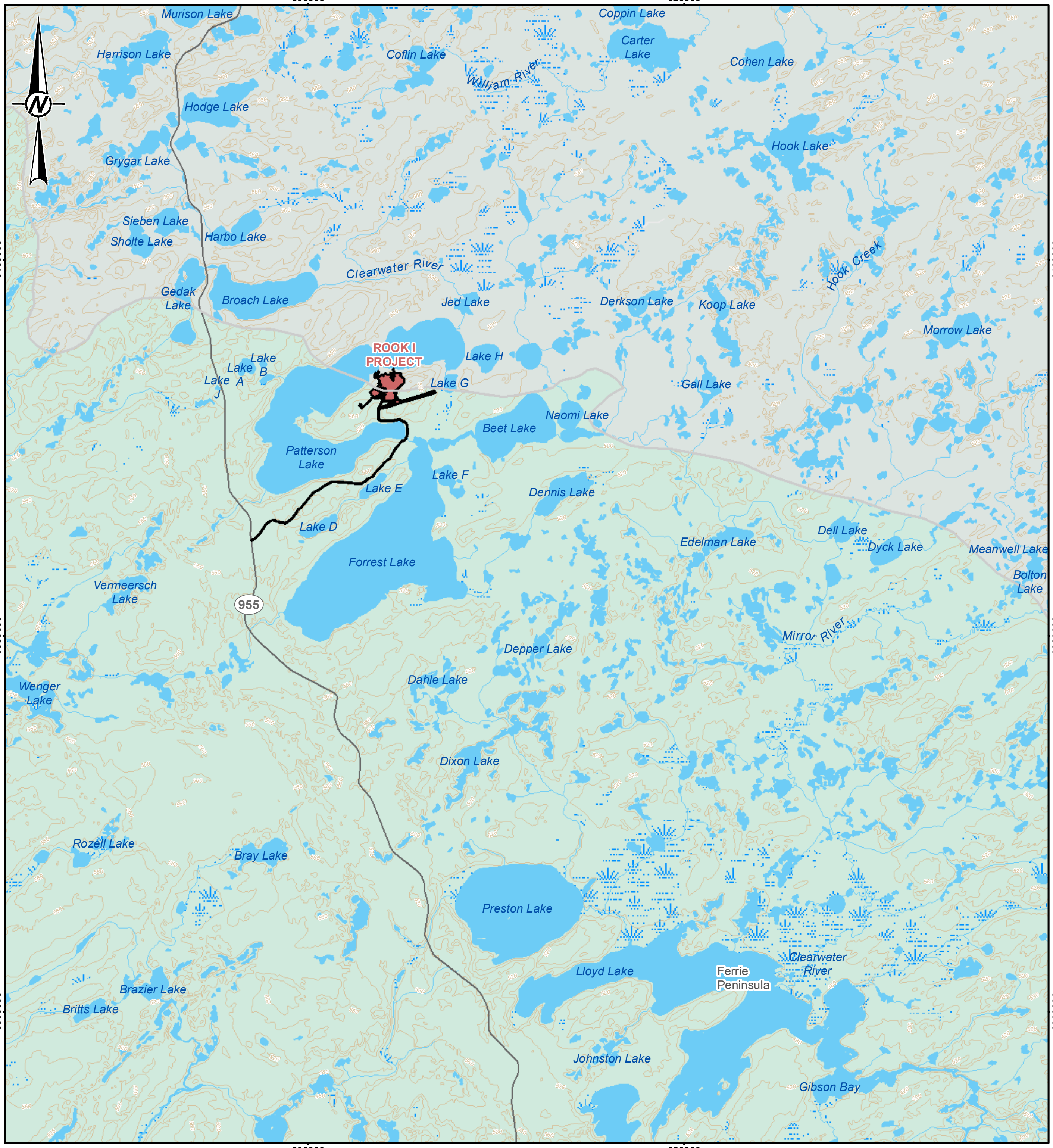
TITLE
LOCATION OF THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 16.1-1

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\16_Heritage_Resources_and_Indigenous_LRU\8_5x11\20144150_Fig16_1-1_Location-of-the-Rook-I-Project_NoTitleblock_Rev0.mxd PRINTED ON: 2023-02-09 AT: 11:36:36 AM
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A
25mm



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN
- WATERBODY
- WETLAND
- WOODED AREA
- PROPOSED PROJECT FOOTPRINT

0 5 10
1:300,000 KILOMETRES

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 16.1-2

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\16_Heritage_Resources_and_Indigenous_LRU\8_5x11\20144150_Fig16_1-2_RegionalArea_Rook_I_Project_NoTitleblock_Rev0.mxd PRINTED ON: 2023-02-09 AT: 11:37:01 AM

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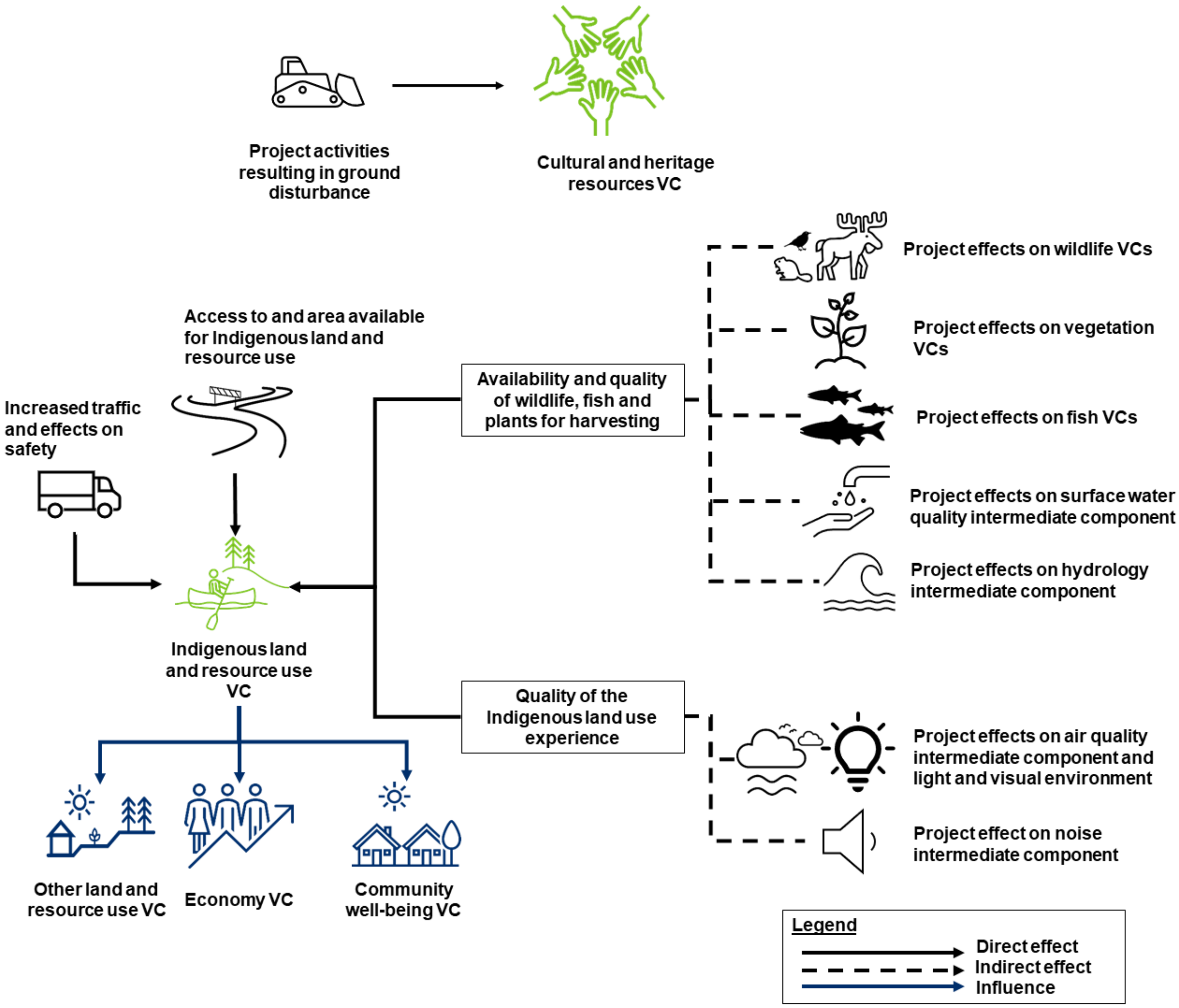
25mm 0

Figure 16.1-3: Linkage Diagram of Project Effects on Cultural and Heritage Resources and Indigenous Land and Resource Use and Influenced Valued Components



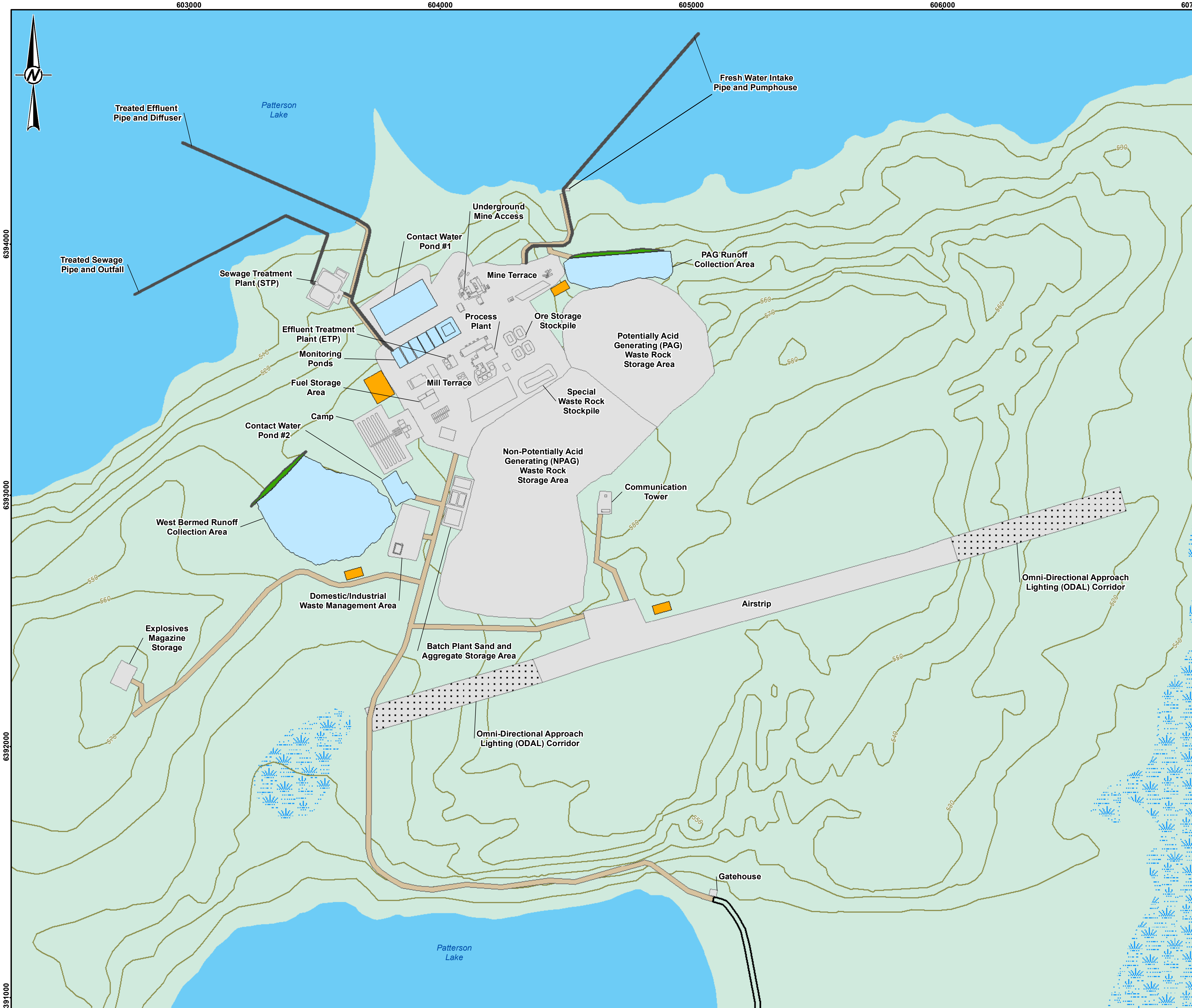
VC = valued component.

16.1.1 Project Summary

The Project would include the following key facilities to support the extraction and processing of uranium from the Arrow deposit for transportation off site (Figure 16.1-4):

- underground mine development;
- process plant buildings, including uranium concentrate packaging facilities;
- paste tailings distribution system;
- underground tailings management facility;
- potentially acid generating waste rock storage area (WRSA);
- non-potentially acid generating WRSA;
- special waste rock[2] and ore storage stockpiles;
- surface and underground water management infrastructure, including water management ponds, effluent treatment plant (ETP), and sewage treatment plant (STP);
- conventional waste management facilities and fuel storage facilities;
- ancillary infrastructure, including maintenance shop, warehouse, administration building, and camp;
- airstrip and associated infrastructure; and
- access road to Project and site roads.

[2] Special waste rock is mine rock that is mineralized with insufficient grade to be considered ore (i.e., greater than 0.03% of triuranium octoxide [U_3O_8] and less than 0.26% U_3O_8). All special waste would be temporarily stored in the special waste rock stockpile.



LEGEND

- ELEVATION CONTOUR (10 m INTERVAL)
- WATERBODY
- WETLAND
- WOODED AREA
- INTAKE OR DISCHARGE PIPE
- ACCESS ROAD
- CONTACT WATER CONTAINMENT BERM
- OMNI-DIRECTIONAL APPROACH LIGHTING (ODAL) CORRIDOR
- PROJECT INFRASTRUCTURE
- SITE ROAD
- TOPSOIL STORAGE AREA
- WATER MANAGEMENT POND

0 0.5 1

1:15,500 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021 AND UPDATED JUNE 8, 2021 .
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LAYOUT OF INFRASTRUCTURE AND FACILITIES FOR THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 16.1-4

16.1.2 Purpose and Approach to the Assessment

The purpose of Section 16 is to provide a detailed and comprehensive assessment of all potential Project specific effects and cumulative effects from the Project and other previous, existing, and reasonably foreseeable developments (RFDs), if applicable, on cultural and heritage resources and Indigenous land and resource use. This section meets the Terms of Reference for the Project submitted to the Saskatchewan Ministry of Environment (ENV) and the Canadian Nuclear Safety Commission (CNSC) *Generic Guidelines for the Preparation of an Environmental Impact Statement Pursuant to the Canadian Environmental Assessment Act, 2012* (Appendix 1A, Concordance Tables). The assessment of cultural and heritage resources and Indigenous land and resource use followed the overall EA approach and methods (Section 6, Environmental Assessment Approach and Methods) and includes the following primary steps:

Step 1 – Define the component-specific methods (Section 16.2): presents the specific approaches and methods used to measure and assess the effects of the Project on cultural and heritage resources and Indigenous land and resource as well as cumulative effects from the Project and previous, existing, and approved projects/activities, and RFDs, if applicable.

Step 2 – Characterize existing conditions (Section 16.3): describes and characterizes existing conditions to provide context and a basis for evaluating potential changes to cultural and heritage resources and Indigenous land and resource use caused by the Project.

Step 3 – Evaluate Project interactions and mitigations (Section 16.4): identifies Project components and/or activities with the potential to affect cultural and heritage resources and Indigenous land and resource use and provides mitigation policies and actions committed to by NexGen to avoid or minimize potential adverse effects. A pathways analysis was used to focus further assessment on key interactions between the Project and cultural and heritage resources and Indigenous land and resource use by evaluating the different effect pathways to determine if, after incorporation of mitigation, there is still potential to cause residual adverse effects. Primary pathways anticipated to result in residual adverse effects after incorporation of mitigation were carried forward to Step 4 for further analysis. Where potential adverse effects are adequately mitigated and thus not carried forward for further analysis (i.e., where mitigation results in a negligible effect or removes the pathway altogether), the reasons for concluding the assessment at this stage are provided.

Step 4 – Analyze residual effects (Section 16.5): evaluates and describes the potential Project effects on cultural heritage resources and Indigenous land and resource use that are anticipated to occur through the primary pathways. The residual effects analysis is presented as an integrated narrative that describes the effects of the Project over time and highlights predicted effects at the point when adverse effects of the Project are expected to be greatest. This subsection also completes an analysis of residual cumulative effects from the Project, other previous and existing projects and activities, and RFDs.

Step 5 – Classify residual effects and determine significance (Section 16.6): summarizes the results of the residual effects analysis using effects criteria (i.e., direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence). Significance was determined using the results of the residual effects analysis and classification. Significance was determined for adverse effects only and for the maximum adverse effects of the Project and the cumulative effects from the Project and previous, existing, and RFDs.

Step 6 – Describe uncertainty and define prediction confidence (Section 16.7): identifies key uncertainties and explains how these uncertainties were addressed to achieve a conservative, precautionary assessment. The implications of the approaches used to address uncertainties and the level of confidence in the residual effects analysis are discussed.

Step 7 – Identify monitoring and follow-up (Section 16.8): outlines the proposed actions to verify predicted residual effects. The purpose of these actions is to evaluate effectiveness of planned mitigation designs, policies, and practices, and address key sources of uncertainty.

16.2 Component Methods

16.2.1 Incorporation of Indigenous and Local Knowledge

Indigenous and Local Knowledge[3] related to cultural and heritage resources and Indigenous land and resource use was shared by potentially affected First Nations and Métis Groups (collectively referred to as Indigenous Groups) and local priority area (LPA) community members through the engagement process for the Project. The LPA consists of the local communities closest to the Project that would experience most of the Project effects and for which NexGen would prioritize local training, employment, and business opportunities for the Project. These communities are located along, or accessed via, Highways 155 and 955 north of the intersection of Highways 155 and 925 and include the following communities (Figure 16.2-1):

- Clearwater River Dene Nation (CRDN);
- Clearwater Clear Lake (Métis Nation – Saskatchewan [MN-S] name for Northern Region 2 [NR2]);
- La Loche (Local 39);
- Birch Narrows Dene Nation (BNDN);
- Turnor Lake (Local 40);
- Buffalo River Dene Nation (BRDN) / Dillon;
- Buffalo Narrows (Local 62);
- Bear Creek (Local 156);
- Descharme Lake;
- Garson Lake;
- Black Point (Local 162);
- Michel Village (Local 65); and
- St. George’s Hill (Local 70).

The overall approach and methods for the incorporation of Indigenous and Local Knowledge into the EA is discussed in detail in Section 3, Indigenous and Local Knowledge. Issues and concerns related to cultural and heritage resources, and Indigenous land and resource use raised by Indigenous Groups and LPA community members, and how they were addressed, are summarized in Appendix 2B, Summary of Issues and Concerns Identified by Indigenous Groups, and identified and addressed in this assessment, where applicable.

A key source of Indigenous and Local Knowledge is the Project-specific studies completed by Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, Indigenous Rights and Knowledge studies (referred to collectively as Indigenous Knowledge and Traditional

[3] Indigenous Knowledge can generally be understood as the unique and collective knowledge of a group of Indigenous People that is built up through generations of living in close contact with the land and natural environment. Local Knowledge is a more general term and, for the purposes of the EA, represents information from a citizen or community representative, but without Indigenous Group/Elder sanction. Further details on the definition and use of these terms are provided in Section 3.4, Defining Indigenous and Local Knowledge.

Land Use [IKTLU] Studies). The IKTLU Studies that were reviewed and referenced in the EIS as Technical Support Documents (TSDs) are listed below:

- TSD II (BNDN), Birch Narrows Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;
- TSD III (BRDN), Buffalo River Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;
- TSD IV (MN-S), Métis Nation – Saskatchewan Northern Region 2 Traditional Land Use & Diet Study for the NexGen Rook I Project;
- TSD V.1 (CRDN), Preliminary Identification of Issues and Concerns Related to the Proposed NexGen Energy Ltd. Rook I Project in the Patterson Lake Area; A Review; Clearwater River Dene Nation; Traditional Land Use and Occupancy Mapping Interviews; 2010 – 2016;
- TSD V.2 (CRDN), Clearwater River Dene Nation Indigenous Rights and Knowledge Survey Related to the Proposed NexGen Energy Ltd. Rook 1 Project in the Patterson Lake Area; and
- TSD VI (YNLR)[4], Provision of Athabasca Denesųłiné Traditional Knowledge, Land Use and Occupancy Information for the NexGen Rook I Project Environmental Assessment.

The CRDN provided an additional socio-economic and harvest study report and the main themes of this study were considered in Section 16. This report is referenced as:

- TSD V.3 (CRDN), Clearwater River Dene Nation Socio-economic and Harvest Study for NexGen Rook 1 Project.

Another key source of Indigenous and Local Knowledge was information shared by Indigenous Group representatives during Joint Working Group (JWG) meetings. The JWGs represent an agreed-upon primary engagement mechanism as outlined in the Study Agreements signed by each primary Indigenous Group and NexGen. More details regarding the JWGs can be found in Section 2, Indigenous, Regulatory, and Public Engagement, and Section 3, Indigenous and Local Knowledge. There are four JWGs with the Project's primary Indigenous Groups (Section 2.4.1, Identification of Indigenous Groups for Engagement):

- CRDN JWG;
- MN-S JWG representing MN-S NR2;
- BNDN JWG; and
- BRDN JWG.

The leadership of each Indigenous Group selected their JWG participants with consideration of group diversity; where possible, members included Elders, youth, different genders, a range of ages, and land users around Patterson Lake.

[4] A Study Funding Agreement was signed with Ya'thi Néné Lands and Resources (YNLR) representing the Black Lake Denesųłiné First Nation and the Fond du Lac Denesųłiné First Nation; however, this agreement was limited to funding a self-directed IKTLU Study, and not a JWG process due to the level of engagement designated to the YNLR as described in Section 2.4.1.

In addition to the IKTLU Studies and JWGs, Indigenous and Local Knowledge shared during specific engagement activities undertaken through the EA development process was incorporated into the assessment, where appropriate. These engagement activities included, but were not limited to:

- community information sessions held in four locations in 2019 (NexGen 2019);
- site tours;
- comments from the CRDN (2019a) on the Cluff Lake Mine licence renewal;
- other formal and informal meetings;
- workshops with specific groups (e.g., Fur Block N-19 trapper's workshop); and
- environmental and socio-economic baseline data collection.

Comments submitted by Indigenous Groups on the Project Description (CRDN 2019b; MN-S 2019; YNLRO 2019; ACFN 2019; CNSC 2019) were also reviewed for applicable Indigenous and Local Knowledge.

Indigenous and Local Knowledge related to cultural and heritage resources and Indigenous land and resource use was incorporated into the assessment by considering and viewing the information as complementary and influential alongside scientific information. Where possible, knowledge from each potentially affected Indigenous Group or LPA community member was described separately and cited accordingly. Where information is described for multiple potentially affected Indigenous Groups, they are collectively referred to as "Indigenous Groups" throughout the assessment.

Indigenous and Local Knowledge was included in the cultural and heritage resources and Indigenous land and resource use assessment in the following ways:

- **Component Methods – VCs:** Indigenous and Local Knowledge was considered in the selection of the cultural and heritage resources VC and the Indigenous land and resource use VC and reflects the importance of cultural resources and traditional fishing, gathering, hunting, and trapping to Indigenous Groups, including members of LPA communities, for subsistence and cultural purposes. The importance of habitation sites (e.g., cabins, camp sites), travel routes, culturally important sites (e.g., ceremonial, spiritual sites), and the cultural landscape to Indigenous land and resource use was described. The quality of resources and of the land use experience to Indigenous land users was also reflected in the assessment (Section 16.2.2, Valued Components, Measurement Indicators, and Assessment Endpoints).
- **Component Methods – Spatial Boundaries:** The spatial boundary selected for the local study area (LSA) reflects shared Indigenous and Local Knowledge regarding the locations of travel routes used to access traditional use areas, including travel routes from Highway 955, along the existing access road, and east to destinations on the Clearwater and Mirror rivers (Section 16.2.3, Spatial Boundaries).
- **Existing Conditions:** Indigenous and Local Knowledge informed the characterization of existing conditions through the identification of occupancy and travel routes, fishing, gathering, hunting, trapping, and culturally important sites in the LSA and regional study area (RSA). Indigenous and Local Knowledge was also shared about trends in the populations of moose and fish, as well as how mining and exploration activities in the Patterson Lake area have affected access and harvesting activities (Section 16.3.3, Contemporary Indigenous Land and Resource Use).

- **Project Interactions and Mitigation:** Indigenous and Local Knowledge informed the scoping of Project interactions, pathway analyses, and consideration of mitigation measures (Section 16.4, Project Interactions and Mitigation). This includes observations and experiences of Indigenous land users related to the existing and cumulative effects of mining and exploration activities on access to and area available for land and resource use and changes to the quality of the Indigenous land use experience.
- **Residual Effects Analysis:** Indigenous and Local Knowledge, including long-term observations and experiences of Indigenous land users in the Patterson Lake area, was used to inform the residual effects analysis related to changes in access and availability of land and resource use areas, availability of fish, plants, and wildlife, and the quality of the Indigenous land use experience (Section 16.5, Residual Effects Analysis).
- **Monitoring, Follow-Up, and Management:** Feedback provided by Indigenous Groups during engagement, including recommendations, was considered in the development of monitoring and follow-up activities (Section 16.8). In addition, it is planned that ongoing feedback from Indigenous Groups on the effectiveness of mitigations would be considered when updating monitoring and management plans. Independent Indigenous Monitors chosen by each primary Indigenous Group would have opportunities to participate in environmental monitoring programs for the Project.

Specific references to Indigenous and Local Knowledge, and Project comments and concerns related to cultural and heritage resources and Indigenous land and resource use raised by Indigenous Groups and LPA community members, are included in the applicable subsections of this assessment.

16.2.2 Valued Components, Measurement Indicators, and Assessment Endpoints

16.2.2.1 Valued Components

Valued components are aspects of the biophysical, cultural, and socio-economic environments that are considered to have scientific, social, cultural, economic, historical, archaeological, or aesthetic importance (Beanlands and Duinker 1983; CNSC 2021). The BNDN and BRDN define VCs as tangible biophysical resources (e.g., particular places and species) and less tangible social, economic, cultural, health, and knowledge-based values (e.g., social cohesion, place names, Indigenous language) (TSD II: BNDN; TSD III: BRDN).

Valued components were identified based on multiple considerations (Section 6.3.1, Valued Components) such as:

- potential for interaction with the Project and degree of interaction, including presence, abundance, and amount of spatial overlap of a VC with the Project;
- sensitivity of a VC to potential Project effects and level of damage or harm that could be realized should an adverse effect occur;
- species conservation status or concern (e.g., rarity, sensitivity, uniqueness);
- ecological and socio-economic/cultural value to Indigenous Groups and local communities, government agencies, and the public;
- recent experience with similar projects in Saskatchewan and other jurisdictions in Canada; and

- avoidance of redundancy with other VCs; for example, if two potential VCs represent the same attributes, mitigation actions, and potential effects from the Project, only one was evaluated as part of the assessment.

Cultural and heritage resources and Indigenous land and resource use were selected as VCs because of the potential for the Project to affect these VCs and their importance to Indigenous Groups and LPA community members. The selection of these VCs was supported by feedback provided during community information sessions for the Project in La Loche, Turnor Lake, Buffalo River, and Buffalo Narrows (Section 2 and Section 3), and consideration of other community submissions to the CNSC on the Cluff Lake Mine licence renewal.

The cultural and heritage resources VC focused on heritage resources and archaeological sites that are protected under *The Heritage Property Act* of Saskatchewan and require an HRIA. An HRIA is required for developments in a heritage sensitive area based on the presence of known heritage resources and the potential for discovering new heritage resources. The cultural and heritage resources VC effects assessment presented in Section 16 was abbreviated since the HRIA was completed as required under *The Heritage Property Act* (Section 16.3.1, Cultural and Heritage Resources).

The Indigenous land and resource use VC focused on use by the CRDN, MN-S, BNDN, and BRDN. The Patterson Lake area, where the Project would be situated, is an important traditional land use area for these Indigenous Groups. More broadly, the Fond du Lac Denesųłiné First Nation and the Black Lake Denesųłiné First Nation of the Athabasca Denesųłiné[5], are interested parties for the Project, and are represented by Ya'thi Néné Lands and Resources (YNLR). While the YNLR is not identified as a primary Indigenous Group, they have also expressed interest in the potential effects of the Project on Indigenous land and resource use.

The cultural and heritage resources and Indigenous land and resource use VCs were shared with the JWGs for their comments. The JWGs supported the selection of VCs. As the JWG processes progressed, Indigenous Groups shared the critical importance of land and resource use to their culture, well-being, and identity.

Information shared by the Indigenous Groups in the IKTLU Studies further validated the selection of VCs (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD VI: YNLR). A common theme shared in the IKTLU Studies was that access to traditional resources and land use areas and the ability to continue to participate in traditional land use activities is important for the maintenance of cultural identity and the intergenerational transmission of knowledge. For example, the CRDN stated:

> harvesting activities are of central importance to CRDN Denesųłiné, as they have been since *time immemorial*. The various harvesting activities which have been mapped to date within CRDN traditional lands include hunting, fishing, trapping, and gathering. Also represented are travel routes, staging areas, portages, camps, cabins, and meeting places – all of which are inextricably linked to harvesting activities and cultural practices integral to the distinctive identity of Denesųłiné peoples. (TSD V.1: CRDN)

[5] Note the Athabasca Denesųłiné is the collective name of Black Lake, Hatchet Lake, and Fond du Lac Denesųłiné First Nations; however, the Hatchet Lake Denesųłiné First Nation's traditional territory does not overlap the Project, and as such they were not included in the YNLR representation.

The MN-S have noted that "harvesting from Mother Earth remains an integral inherited tradition of Métis Nation . . . it is important that this tradition continues" (TSD IV: MN-S). They further stated:

> MN-S Northern Region 2 members use the land as their ancestors did: ancestral knowledge is integral to the legacy of Métis understanding and interaction with the natural world. It is crucial to the Métis way of life. (TSD IV: MN-S)

The BNDN reported that hunting and trapping "have long been at the heart of Dene culture, and they remain central to the subsistence lifeways of members of the BNDN" (TSD II: BNDN). The BNDN and BRDN stated that fishing traditions include cultural activities such as community gatherings and spending time with others while out on the land (TSD II: BNDN; TSD III: BRDN). The BNDN commented that fishing traditions have been passed down through the generations and are an important aspect of BNDN members' identities and land use (TSD II: BNDN). The YNLR reported that large game harvesting "is very important to the Athabasca Denesų̨łiné. Not only as a source of food and materials, but as foundation of a culture and way of life that is passed down through generations" (TSD VI: YNLR).

The intergenerational transmission of knowledge is often experiential, where specialized knowledge and hunting, trapping, fishing, and gathering skills are learned from Elders and relatives while out on the land and requires access to a healthy environment and abundant resources (TSD II: BNDN; TSD III: BRDN; TSD V.2: CRDN).

16.2.2.2 Measurement Indicators

Measurement indicators are used to characterize changes to attributes of the environment from the Project, other human developments, and natural factors. The changes in measurement indicators are used to predict overall effects on VCs and assessment endpoints (Section 6.3.2, Assessment Endpoints and Measurement Indicators).

One measurement indicator was identified for the cultural and heritage resources VC, and three measurement indicators were identified for the Indigenous land and resource use VC (Table 16.2-1). The measurement indicators for Indigenous land and resource use are connected to intermediate components in the EA such as air quality, noise, hydrology, and surface water quality. Accordingly, the assessments of these intermediate components are fundamental to understanding the total effects of the Project on Indigenous land and resource use (Section 6.3.3, Intermediate Components). Results from the biophysical VCs, including fish and fish habitat (Section 11), vegetation (Section 13), and wildlife and wildlife habitat (Section 14), were incorporated into the assessment of several of the measurement indicators for Indigenous land and resource use (Table 16.2-1). A description of how the indicators were used in the assessment is described further in Section 16.2.8, Residual Effects Analysis.

The measurement indicator for the cultural and heritage resources VC is defined as follows:

- **Changes to the number, quality, and significance of archaeology and heritage sites in the heritage study area:** refers to the identification of known or unknown archaeological and heritage sites identified in the heritage resources impact assessment (HRIA; Annex IX), or changes to the quality or significance of archaeology and heritage sites due to on-site construction activities. The assessment considered disturbance of legally protected sites and artifacts. Heritage sites are assumed to include historical cultural sites. Cultural resources identified by Indigenous Groups are also captured under measurement indicators for the Indigenous land and resource use VC.

The measurement indicators for the Indigenous land and resource use VC are defined as follows:

- **Changes to access to and area available for Indigenous land and resource use:** refers to changes in the ability to travel to and utilize the land base for traditional activities. Reductions in the land area available may occur because of access restrictions (e.g., gates; closing of roads, waterways, or trails) and the loss of the use within the maximum disturbance area. The assessment considered removal of areas where traditional activities are practised and also where travel to other traditional land use areas may be affected by direct disturbance to land (i.e., physical barrier to movement).
- **Changes to the availability and quality of fish, plants, and wildlife for harvesting:** refers to changes in the abundance and distribution of fish, plant, and wildlife resources that could potentially affect their availability for harvesting (i.e., fishing, gathering, hunting, and trapping) and in turn affect harvesting success. The assessment considered changes in fish, vegetation, and wildlife habitat availability (i.e., quantity and quality) and distribution (e.g., changes in the habitat or ecosystem distribution across the landscape, changes in wildlife movement), changes to wildlife and fish survival and reproduction, and changes in ecosystem condition. The assessment also considered the results from the ecological health risk assessment and the exposure of aquatic and terrestrial plant and wildlife species or receptors to chemical substances or metals (i.e., COPCs; TSD XXI, Environmental Risk Assessment).
- **Changes to the quality of the Indigenous land use experience:** refers to changes in the quality of the Indigenous land user experience related to sensory disturbances (e.g., noise, light, air quality, aesthetics), changes in safety for land users, changes to the perceptions of the quality of resources (e.g., wildlife, fish, water, plants) harvested, and changes to the cultural landscape.

16.2.2.3 Assessment Endpoints

Assessment endpoints are qualitative expressions that represent the key properties of VCs that should be protected; as such, assessment endpoints incorporate the concept of sustainability and function as significance thresholds (Section 6.3.2). The significance of effects from the Project and other human developments on cultural and heritage resources and Indigenous land and resource use is evaluated by linking changes in measurement indicators to the assessment endpoints of the protection of cultural and heritage resources and the continued ability to participate in Indigenous land and resource use activities (Table 16.2-1). Details on the application of the continued ability to participate in Indigenous land and resource use activities as a significance threshold are provided in Section 16.2.9, Residual Effects Classification and Determination of Significance. The compilation and interpretation of the results from analyzing changes in measurement indicators provides lines of evidence that collectively provide a determination of whether the assessment endpoint for cultural and heritage resources and Indigenous land and resource use is maintained or achieved (Section 6.3.2).

Table 16.2-1: Valued Components, Rationale, Measurement Indicators, and Assessment Endpoints

VCs	Rationale	Measurement Indicators	Assessment Endpoints
Cultural and heritage resources	▪ Heritage and archaeological resources have spiritual and/or cultural importance to Indigenous Peoples and communities and the public ▪ Archaeological sites are protected under *The Heritage Property Act*	▪ Number, quality, and significance of archaeology and heritage sites in the heritage study area	Protection of archaeological and heritage resources.
Indigenous land and resource use	▪ Patterson Lake is a traditional land use area for the CRDN, MN-S, BNDN, and BRDN. ▪ Plant, fish, and wildlife harvesting have cultural, social, and economic value to Indigenous Peoples ▪ Access to traditional resource and land use areas would be affected by Project activities ▪ The expression of rights and interests through land and resource use contributes to cultural expression and the intergenerational transmission of knowledge	▪ Changes to access to and area available for Indigenous land and resource use ▪ Changes to the availability and quality of fish, plants, and wildlife for harvesting ▪ Changes to the quality of the Indigenous land use experience	Continued ability to participate in Indigenous land and resource use activities.

CRDN = Clearwater River Dene Nation; MN-S = Métis Nation – Saskatchewan; BNDN = Birch Narrows Dene Nation; BRDN = Buffalo River Dene Nation; VC = valued component.

16.2.3 Spatial Boundaries

The spatial boundary selected for the cultural and heritage resources assessment was defined as the heritage study area and included three main areas of the maximum disturbance area (Annex IX, Figure 3):

- Area 1: the shore area of Patterson Lake where the main Project infrastructure would be located (130 ha);
- Area 2: a large, level upland area where the airstrip would be located (17 ha); and
- Area 3: the shore area of Patterson Lake along the access road south of the main Project infrastructure (33 ha).

The spatial boundaries selected for the Indigenous land and resource use assessment support a description of the existing environment in sufficient detail to identify, understand, and assess potential Project interactions with the Indigenous land and resource use VC, including the contribution of the Project to residual effects (Table 16.2-2). The spatial boundaries for the assessment of Indigenous land and resource use consisted of a site study area, maximum disturbance area, LSA, and RSA (Table 16.2-2; Figure 16.2-1).

The site study area is equivalent to the anticipated area of the Project footprint, which covers 228 ha and includes the access road and bridge and all proposed Project site infrastructure (Figure 16.1-4). To the degree possible, the Project footprint was minimized based on NexGen's vision and values, which are aligned with feedback from Indigenous Groups, to reduce both the area of restricted access to Indigenous land users and the potential effects on the terrestrial environment.

A maximum disturbance area was used for the assessment to address uncertainty in the final design of the Project (i.e., should certain Project components and/or infrastructure be relocated beyond the currently anticipated Project footprint through subsequent design phases) so that adverse effects on the terrestrial environment due to the Project footprint and associated activities were not underestimated (i.e., the maximum disturbance area is four times larger than the currently anticipated Project footprint). The maximum disturbance area, which covers 981 ha, represents the smallest scale of assessment and an area where the potential direct effects of the anticipated Project on soils, vegetation, and wildlife can be assessed accurately and precisely. The maximum disturbance area also represents the spatial extent of the area where Indigenous land and resource use is not anticipated to occur during the Project lifespan. The spatial boundary of the maximum disturbance area was delineated by applying buffers to the outer edges of the currently anticipated Project infrastructure (Section 6.4.1, Spatial Boundaries). The spatial boundary for terrestrial resources was also constrained to the shoreline of Patterson Lake (Figure 16.2-1). The maximum disturbance area is consistent with the maximum disturbance area for related VCs. The LSA and RSA for the Indigenous land and resource use VC were defined to include predicted effects on supporting intermediate components (e.g., noise, air quality) and VCs (e.g., fish and fish habitat, traditional use plants, and wildlife and wildlife habitat). Potential effects on supporting intermediate components and VCs included incremental and cumulative effects from the Project and other RFDs and natural factors such as climate change and wildfire, where applicable.

The LSA for supporting intermediate components and VCs contained most or all of the expected direct and many indirect effects of the Project on those VCs and intermediate components. The RSA for the supporting intermediate components and VCs provided broader context for Project-specific effects and was large enough to sufficiently capture all potential indirect effects from the Project, as well as cumulative effects from RFDs and natural factors.

More specifically, the LSA and RSA for Indigenous land and resource use were developed to reflect the spatial extent of anticipated direct and indirect Project effects on supporting intermediate components and VCs, along with known and documented land use patterns by Indigenous Groups across the landscape. Land use patterns were important to consider in defining the LSA and RSA because of the importance of Indigenous Groups' spiritual and cultural relationship with the broader landscape as reflected in habitation, travel, and access. Potential Project effects on Indigenous land and resource use may not only be specific to a location but may more broadly affect use across the landscape. Indigenous Groups have indicated the need for a large land base to successfully practise land and resource use activities such as hunting, trapping, fishing, gathering, travel, habitation, and cultural practices (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.3 CRDN).

In defining the Indigenous land and resource use LSA, it was important to consider that a Project-related indirect effect on a resource (e.g., wildlife, fish) has the potential to directly or indirectly affect Indigenous land and resource use and, as such, the geographic scope for the assessment is broader. Specifically, the RSA for supporting VCs (i.e., aquatic [Section 11], terrestrial [Section 14], and human health [Section 15]) was primarily used in defining the LSA for the Indigenous land and resource use VC because of the potential for broader direct and indirect effects on land users.

The total area of the LSA (Figure 16.2-1) is 124,670 ha (approximately 1,247 km^2), which can be sub-divided into three sub-areas:

- the Highway 955 corridor from La Loche to the Project access road turnoff: 20,350 ha (203.50 km^2);
- the maximum disturbance area, which includes the Project access road: 981 ha (9.81 km^2); and
- the remaining area 103,339 ha (1,033.39 km^2).

The Indigenous land and resource use LSA (Figure 16.2-1) incorporates:

- the Project footprint;
- the maximum disturbance area defined in the vegetation (Section 13) and wildlife (Section 14) assessments, which provides a conservative spatial estimate of the direct effects;
- the aquatic (Section 11, Figure 11.2-1), terrestrial (Section 14, Figure 14.2-2), and human health (Section 15; TSD XXI, Environmental Risk Assessment) RSAs delineated by the Clearwater River watershed boundaries where ecosystems could potentially be directly or indirectly affected by the Project, and includes Forrest Lake, Beet Lake, Naomi Lake, and the watershed east and north of the confluence of the Clearwater and Mirror rivers;
- the area of both the Project and the Fission Patterson Lake South Property boundaries, which is considered in the cumulative effects assessment for other VCs and the Indigenous land and resource use VC;
- the Highway 955 corridor north of La Loche where changes to traffic volumes and traffic disturbances may affect land use activities, which is defined as a 1,200 m wide corridor to capture road and roadside effects and includes:
  - a 100 m buffer on each side of the road centreline for the road allowance;
  - an additional 200 m buffer each side where hunting should be restricted[6];
  - an additional 300 m buffer on each side as the approximate distance that land users would commonly travel from the road to access land adjacent to the road corridor for activities such as trapping, hunting, and gathering (2019 to 2021 key person [KP] interview program); and
- destinations that require travel through Project-affected areas for Indigenous land use, which may result in avoidance from perceived risks or displacement of resource harvest activities, such as areas as far east as the junction of the Clearwater and Mirror rivers and a number of adjoining lakes east of the Project (e.g., CRDN-mapped travel routes from Highway 955, along the existing access road, and east to destinations on the Clearwater and Mirror rivers; Figure 2 in TSD V.1: CRDN; Figure 19 in TSD V.2: CRDN).

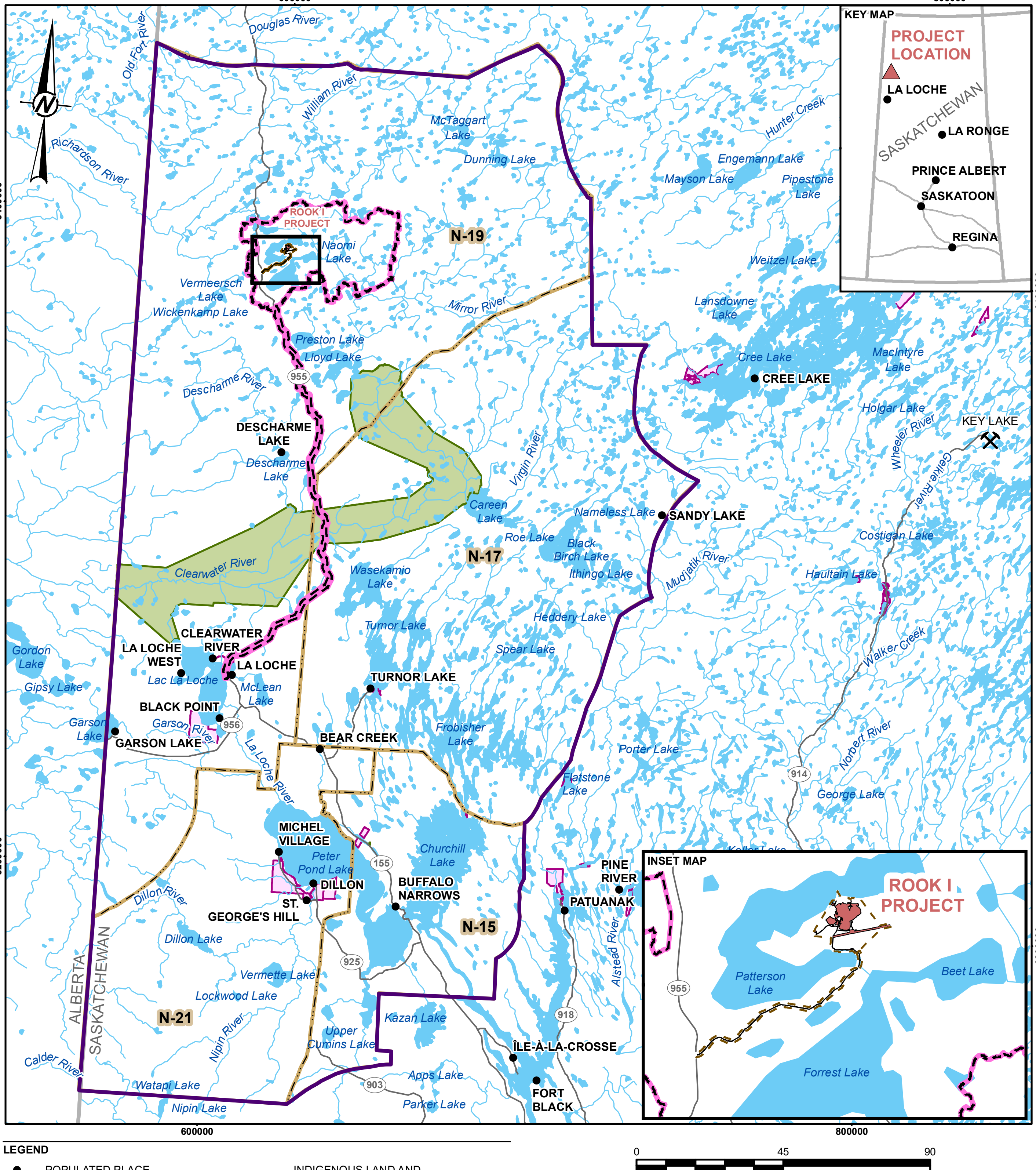
The RSA is defined as Fur Blocks N-15, N-17, N-19, and N-21 (Figure 16.2-1). These fur blocks are closest to the communities included in the LSAs for economy (Section 18) and community well-being (Section 19) and are intended to approximate the combined traditional territories of the directly affected Indigenous Groups (i.e., those with communities within the LPA), within which the Indigenous Groups express their rights and interests through land and resource use. Additional information on the traditional territories of the Indigenous Groups can be found in Section 16.3.2, Overview of Indigenous Groups, and the IKTLU Studies (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.3 CRDN). The fur blocks capture the broad traditional use activities and patterns of Indigenous Groups in recognition of the regional land use context and the connections across the landscape and are where additional cumulative effects on Indigenous land and resource use may occur. Effects at the LSA scale also have the potential to displace land users to other locations within the LSA and the RSA.

[6] In Saskatchewan, *The Wildlife Act, 1988 c. W-13.12* prohibits shooting a firearm across or along a provincial highway, provincial road, or municipal road. A no-hunting buffer distance is not specified in Saskatchewan. Bait for the purpose of big game hunting cannot be placed within 200 m of a provincial highway, provincial road, or municipal road. Distances are defined in the Wildlife Acts of Manitoba (i.e., 300 m from road centre lines) and Alberta (i.e., 365 m or 400 yards). Hunters must not discharge their firearms back towards the roadway.

Table 16.2-2: Spatial Boundaries for the Assessment of Indigenous Land and Resource Use

Spatial Boundary	Surface Area	Description
Site study area	228 ha (2.3 km^2)	▪ Equivalent to the anticipated Project footprint, which includes all proposed mine infrastructure and facilities (199 ha) and the access road (29 ha)
Maximum disturbance area	981 ha (9.8 km^2)	▪ Incorporates a level of uncertainty into the Project design so that effects are not underestimated ▪ Maximum disturbance area was selected using bounding points around the outermost components of the Project footprint
LSA	124,670 ha (1,247 km^2)	▪ The maximum disturbance area ▪ The terrestrial, aquatic, and human health RSAs where ecosystems and resources can potentially be directly or indirectly affected by the Project and experience some cumulative effects, if applicable ▪ Defined by the expected extent of the direct and indirect effects from the Project for intermediate components and supporting VCs that inform the assessment ▪ The Highway 955 corridor north of La Loche, which is defined as a 1,200 m wide corridor to account for effects on trapping, hunting, and gathering activities that may occur along the road corridor (but outside of the road allowance and where hunting is restricted) ▪ Captures travel and land use connections across the landscape since land and resource use activities are not static or independent
RSA	4,357,705 ha (43,577 km^2)	▪ Fur blocks closest to the communities included in the economy (Section 18) and community well-being (Section 19) LSAs ▪ Provides broader scale context to capture and approximates traditional territory for Indigenous Groups ▪ Provides broader scale context for assessing potential indirect Project effects and cumulative effects, if applicable ▪ Captures travel and land use connections across the landscape since land and resource use activities are not static or independent

LSA = local study area; RSA = regional study area; VC = valued component.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA
- INDIGENOUS LAND AND RESOURCE USE LOCAL STUDY AREA
- INDIGENOUS LAND AND RESOURCE USE REGONAL STUDY AREA
- FURBLOCKS

REFERENCE(S)

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2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
3. WILDLIFE MANAGEMENT, GAME BIRD DISTRICTS & GAME BIRD MANAGEMENT UNITS (GBMU), SASKATCHEWAN MINISTRY OF ENVIRONMENT, FISH AND WILDLIFE.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

INDIGENOUS LAND AND RESOURCE USE LOCAL AND REGIONAL STUDY AREAS

CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 16.2-1

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16.2.4 Temporal Boundaries

The temporal scope of the assessment focuses on the 43-year period from initial Construction to the end of Decommissioning and Reclamation (i.e., Closure) as defined by the following Project phases (Section 6.4.2, Temporal Boundaries):

- **Construction Phase (Construction):** includes site preparation; mine, process plant, and additional infrastructure development; transportation of people and materials to and from the Project; and all activities associated with commissioning the Project up until Operations commences. The duration of Construction is expected to be four years.
- **Operations Phase (Operations):** includes all activities associated with mining and processing ore; tailings management; management of waste rock, domestic waste, and hazardous materials; water management; release of treated effluent; site maintenance; progressive reclamation; and transportation of the staff and materials to and from the Project up until Decommissioning and Reclamation commences. The duration of Operations is expected to be 24 years.
- **Decommissioning and Reclamation Phase (Closure):** includes two stages expected to occur over 15 years:
    - **Active Closure Stage:** includes active decommissioning and reclamation activities the occur post-Operations, such as backfilling mine workings, removal of physical infrastructure, recontouring and revegetating disturbed areas, waste disposal and removal, and any other activities required to achieve decommissioning objectives and return the site to a safe and stable condition prior to the Transitional Monitoring Stage. The duration of the Active Closure Stage is expected to be five years.
    - **Transitional Monitoring Stage:** includes monitoring and reporting activities that occur post-Active Closure that would continue until monitoring and reporting verifies that the performance criteria have been met. Once performance criteria have been fully demonstrated, an application to be released from the CNSC licence would be submitted to the CNSC for approval. Once that is achieved, and upon Provincial approval, the land would be transferred back under Provincial management through the Institutional Control Program. The duration of the Transitional Monitoring Stage is nominally 10 years; however, NexGen acknowledges this duration would be dependent on the achievement of performance criteria.

The temporal boundaries applied to cumulative effects assessments include the duration of residual effects from previous and existing developments that overlap with residual effects from the Project and the period during which the residual effects from RFDs overlap with the Project.

16.2.5 Assessment Cases

The concept of assessment cases was applied to the cultural and heritage resources and Indigenous land and resource use assessment to estimate the incremental and cumulative effects from the Project and other developments (Section 6.5, Assessment Cases). The approach incorporated temporal boundaries for analyzing the potential effects from previous, existing, and approved projects and RFDs before, during, and after the anticipated lifespan of the Project. There are no known approved (but not yet constructed) projects in the LSA and RSA for cultural and heritage resources and Indigenous land and resource use. Assessment cases included a Base Case, Application Case, and RFD Case.

Base Case for cultural and heritage resources and Indigenous land and resource use is represented by existing conditions. The Base Case describes the existing environment in the LSA and RSA before application of the proposed Project to provide an understanding of the current conditions that may be influenced by the Project. The temporal boundary of the Base Case includes the combined effects from previous and existing human disturbances and natural factors (e.g., fire, floods, disease, insects) on the environment and cultural and heritage resources and Indigenous land and resource use. As such, existing conditions represent the cumulative effects of historical and current environmental pressures that have influenced the observed condition/patterns of cultural and heritage resources and Indigenous land and resource use (CEA Agency 2018).

Application Case for cultural and heritage resources and Indigenous land and resource use represents predictions of the combined effects of the previous and existing projects/activities and natural factors in the Base Case plus the potential effects from the proposed Project. This case was also used to identify and assess incremental, Project-specific changes that are predicted to occur to cultural and heritage resources and Indigenous land and resource use.

Reasonably Foreseeable Development Case for Indigenous land and resource use includes the Base Case, Application Case, and RFDs that have not yet been approved. Reasonably foreseeable developments are defined as projects and activities that fit any of the first three and both of the last two criteria from the following list:

- are currently under regulatory review or have officially entered a formal regulatory application process;
- have been publicly disclosed by other proponents;
- may be induced by the Project;
- have the potential to change the Project or the effects predictions; and
- occur in the spatial assessment boundary defined by Indigenous land and resource use.

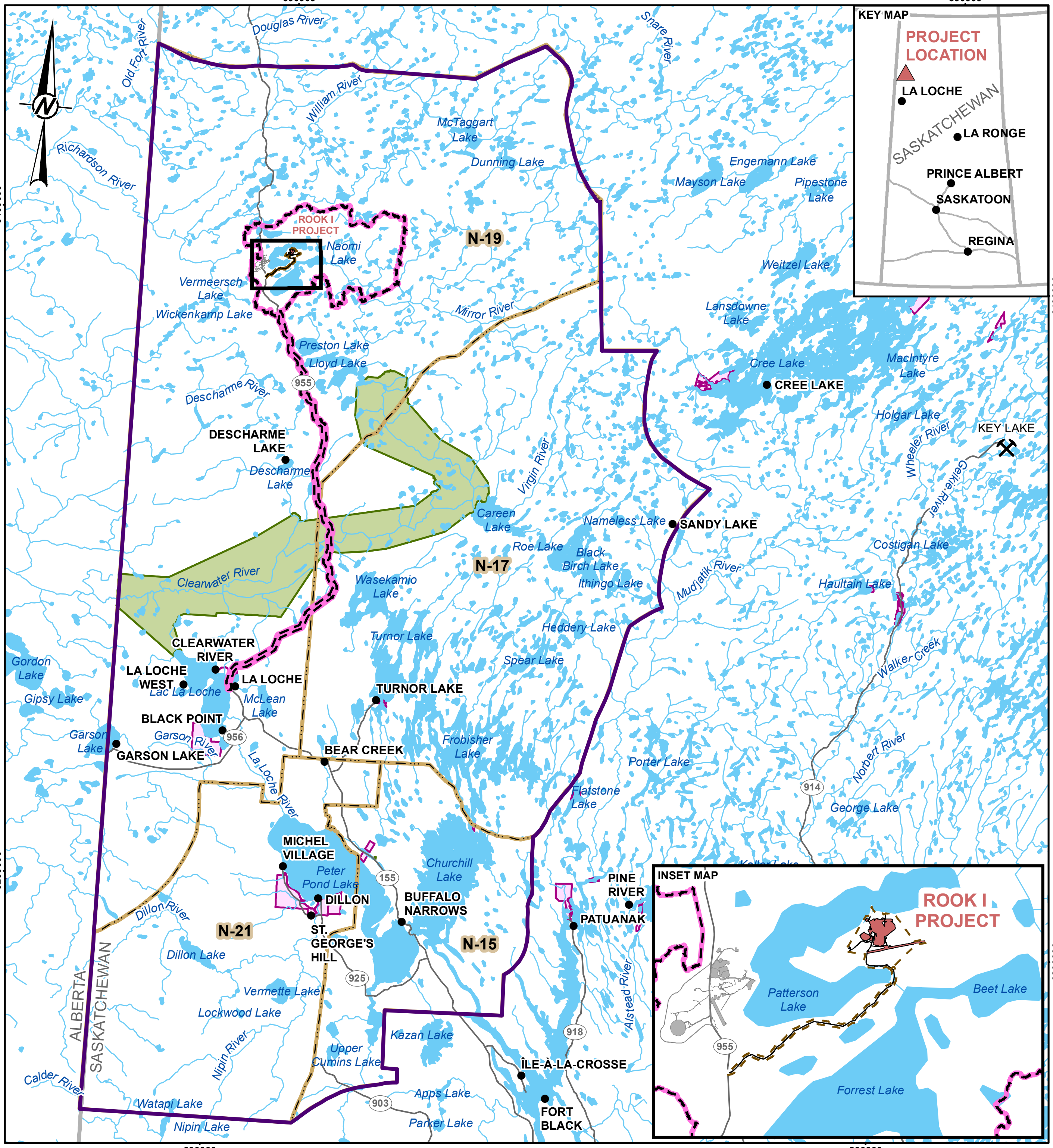
A key criterion for selecting other projects to include in the RFD Case was that the projects must cause similar effects on the Indigenous land and resource use VC influenced by the Project (Hegmann et al. 1999). The Fission Patterson Lake South Property, which is planned by Fission Uranium Corp. (Fission 2019, 2021a) was included in the RFD Case (Figure 16.2-2). Public information describes a projected three-year construction period and seven-year operating period (production and processing) (Fission 2019, 2021a). The anticipated start of construction and duration of active decommissioning at the Fission Patterson Lake South Property were not publicly available at the time this assessment was completed. For the assessment, it was assumed that the duration of active decommissioning for the Fission Patterson Lake South Property would be similar to the Active Closure Stage for the Project (i.e., five years; Section 6.5.3, Reasonably Foreseeable Development Case).

The proposed surface infrastructure layout plan (Fission 2019, 2021a) is the anticipated physical footprint of the Fission Patterson Lake South Property and includes the proposed highway bypass, airstrip, and all proposed mine site infrastructure. A hypothetical maximum disturbance area, as applied in Section 16.2.3 to the Project footprint, was also used for the Fission Patterson Lake South Property to address uncertainty in project design. The CRDN and MN-S specifically mentioned the potential for cumulative effects from the Project and the nearby proposed Fission Patterson Lake South Property (CRDN 2019b; MN-S-JWG 2020; CRDN-JWG 2021).

As a scenario within the RFD Case (where applicable), potential effects from climate change (e.g., changes in water levels), including how natural factors (e.g., fire) may be altered resulting from climate change, were considered within the assessment. Indigenous Groups indicated concerns about cumulative effects from human development, policies, and climate change (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN).

The Indigenous land and resource use assessment includes a quantitative and qualitative analysis of predicted changes on measurement indicators and associated effects from the Fission Patterson Lake South Property on Indigenous land and resource use. In addition, potential changes from natural disturbance factors and climate change drew from qualitative analyses provided in the fish and fish habitat (Section 11), vegetation (Section 13), and wildlife and wildlife habitat (Section 14) assessments.

Cultural and heritage resources were assessed for the potential effects from direct land disturbance in the maximum disturbance area due to land clearing during Construction, which can directly disturb archaeological and heritage resources protected under *The Heritage Property Act*. Details of the assessment and results are presented in Annex IX.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
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- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- INDIGENOUS LAND AND RESOURCE USE LOCAL STUDY AREA
- INDIGENOUS LAND AND RESOURCE USE REGONAL STUDY AREA
- FURBLOCKS

0 45 90

1:1,700,000 KILOMETRES

REFERENCE(S)

1. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT: NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

REASONABLY FORESEEABLE DEVELOPMENTS IN THE REGIONAL STUDY AREA

CONSULTANT: wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 16.2-2

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16.2.6 Existing Conditions

Existing conditions were characterized to provide context for the assessment of incremental and cumulative effects from the Project and other developments in the LSA and RSA. Existing conditions document the following:

- archaeological and heritage resources and land use, which include occupancy, habitation, access, and harvesting activities (e.g., hunting, trapping, fishing, gathering);
- the use of culturally important sites, areas, or landscapes;
- the importance of different traditional activities;
- locations of land use activities and culturally important areas and travel routes where available; and
- the resources harvested.

Table 16.2-3 presents how the information included in Section 16.3, Existing Conditions, is related to the measurement indicators used to assess residual effects for the Application Case and RFD Case.

Table 16.2-3: Linkage between Existing Conditions and Measurement Indicators

Measurement Indicator	Existing Conditions Information
Changes to the number, quality, and significance of archaeology and heritage sites in the heritage study area	▪ Findings are presented in the HRIA (Annex IX)
Changes to access to and area available for Indigenous land and resource use	▪ Occupancy, habitation, and access document current and historical cabins and travel routes (e.g., roads, trails, waterways), along with a general overview of important areas to the extent information was provided. Section 16.3 provides information to support the assessment of changes in physical access to lands and resources (e.g., travel routes) and changes in access to habitation sites from direct disturbance ▪ Hunting, trapping, fishing, and gathering document current and historical use patterns, including the location of activities to the extent that information was provided. Section 16.3 provides information to support the assessment of changes in access to and area available (e.g., direct disturbance) where land and resource use activities are currently practised ▪ Culturally important sites, areas, and landscapes document the importance, value, and locations, to the extent that information was provided. Section 16.3 provides information to support the assessment of changes in access to and area available to the cultural sites, areas, and landscapes from direct disturbance
Changes to the availability and quality of fish, plants, and wildlife for harvesting	▪ Hunting, trapping, fishing, and gathering document the species valued and harvested by Indigenous Groups. This information was used to support the selection of wildlife, fish, and vegetation VCs considered in the EA and to support the assessment of changes to the availability of resources for harvesting
Changes to the quality of the Indigenous land use experience	▪ Existing conditions contains information on the importance of land and resource use activities as shared by Indigenous Groups, including those aspects of the experience they value such as access to a healthy land base and resources, access to areas without sensory disturbances, the importance of sense of place, and the cultural landscape

VC = valued component; EA = Environmental Assessment; HRIA = Heritage Resources Impact Assessment.

The evaluation of existing conditions for Indigenous land and resource use relied on primary and secondary sources, including the JWG meetings, which were designed to support the inclusion of feedback and Indigenous and Local Knowledge in the assessment. The sources included:

- information presented in Annex X, Socio-economic Baseline Report;
- IKTLU Studies funded by NexGen to support the Project: Studies were completed by the CRDN, MN-S, BNDN, BRDN, and YNLR, and detailed methods are provided in each study. In general, the studies rely on primary data collection and mapping interviews to present the importance and nature of Indigenous land and resource use in proximity of the Project and the relationship Indigenous Groups have with the land;
- information provided through the JWG meetings established with the CRDN, MN-S, BNDN, and BRDN;
- information provided during a 2021 trapper's workshop, as well as KP interviews conducted by the CRDN (TSD V.3: CRDN);
- other regulatory documents, including comments from the CRDN on licence renewal for the Cluff Lake Mine and comments from the CRDN, MN-S, YNLR, and ACFN on the Project Description for the Project; and
- archival and historical documents supporting the understanding of historical use and existing effects from industrial development.

Data were validated and supplemented through several means, including discussion during JWG meetings and review of JWG meeting records. Local Knowledge relevant to Indigenous land and resource use existing conditions recorded during the 2021 trapper's workshop and results of KP interviews conducted by the CRDN were also used to validate data. The IKTLU Studies supported the integration of Indigenous and Local Knowledge into the assessment. The socio-economic variables to consider within the existing conditions subsection were confirmed from this approcah of data validation and the identification of supplemental data.

16.2.7 Project Interactions and Mitigations

Interactions (i.e., linkages) between Project components or activities, and the corresponding potential changes to measurement indicators, were identified by a pathway analysis that was then used to inform the residual effects analysis for cultural and heritage resources and Indigenous land and resource use (Section 6.7, Pathways Analysis). The first part of the analysis was to identify all potential effects pathways for all phases of the Project (Section 6.7.1, Identification of Project Interactions). Each pathway was initially assumed to have a linkage to potential effects on cultural and heritage resources and Indigenous land and resource use.

Potential pathways from Project activities to the cultural and heritage resources and Indigenous land and resource use VCs were identified using the following:

- review of the Project description (Section 5) and potential effects scoping by the project development, environmental, and socio-economic teams for the Project;
- input from Indigenous, regulatory, and public engagement (Section 2) and Indigenous and Local Knowledge (Section 3);
- scientific knowledge;
- previous experience with mining projects; and
- consideration of potential effects identified from the Terms of Reference (Section 1, Appendix 1A).

Potential adverse effects of the Project were then identified, and practicable mitigation was applied to avoid, minimize, and/or rehabilitate adverse effects on the cultural and heritage resources and Indigenous land and resource use VCs (Section 6.7.2, Identification of Mitigation). Avoidance and minimization are widely recognized as the most important approach for biodiversity conservation (BBOP 2015), which influences the availability of plants and animals to support a traditional way of life. Avoidance designs and actions integrated into the Project were developed iteratively by the Project's environmental and project development teams. Minimization techniques and technology were also identified collaboratively between Project teams.

Each potential effect pathway was evaluated using proposed mitigation to predict whether the pathway had the potential to cause residual adverse effects (Section 6.7.3, Pathway Screening). A screening-level assessment was applied using Indigenous and Local Knowledge, scientific knowledge, logic, experience with similar developments, and an understanding of the effectiveness of mitigation (i.e., level of certainty that mitigation would work) to assign each pathway to one of the following categories:

- **No pathway:** Analysis reveals that the pathway could be removed (i.e., effect is avoided) by mitigation so that the Project would result in no measurable socio-economic and/or environmental change relative to existing conditions or guideline values and, therefore, would have no residual effect on cultural and heritage resources and Indigenous land and resource use.
- **Secondary pathway:** The pathway could result in a measurable but minor socio-economic and/or environmental change relative to existing conditions or guideline values, but this change would be sufficiently small that it would have a negligible residual effect on cultural and heritage resources and Indigenous land and resource use. Therefore, the pathway is not expected to contribute to effects of RFDs to cause a significant effect.
- **Primary pathway:** The pathway is likely to result in a socio-economic and/or environmental change relative to existing conditions or guideline values and could cause a greater than negligible effect on cultural and heritage resources and Indigenous land and resource use.

Project interactions determined as no pathway or secondary pathways were not carried forward for further assessment (Section 6.7.3). Pathways that could result in changes to the environment with one or more associated measurement indicator and have the potential to cause a greater than negligible effect on cultural and heritage resources or Indigenous land and resource use were carried forward to the residual effects analysis and residual effects classification (Section 16.5).

16.2.8 Residual Effects Analysis

The residual effects analysis measures and describes the effects of the Project on the Indigenous land and resource use VCs relative to existing conditions. The residual effects analysis was conducted using the spatial boundaries (Section 16.2.3) and temporal boundaries (Section 16.2.4, Temporal Boundaries) identified for the assessment. Residual effects are described for each of the measurement indicators for the primary pathways identified for the Indigenous land and resource use VC in the LSA and RSA (Section 16.4.3, Primary Pathways). The residual effects analysis was completed for the Application Case and the RFD Case (Section 6.8, Residual Effects Analysis).

A residual effects analysis for cultural and heritage resources was not required; rationale for not including this VC in the residual effects analysis is discussed in Section 16.4.2, Secondary Pathways.

While the assessment for the Indigenous land and resource use VC focused on the activities and uses that support, but are not necessarily limited to, the expression of Aboriginal and Treaty Rights, it does not represent a description of how these changes might be experienced by each Indigenous Group. Where Indigenous Groups highlighted a specific use that could be affected, it was noted; however, because the IKTLU Studies presented information with varying degrees of detail, the assessment focused on the defined measurement indicators (Table 16.2-1).

Measurement indicators were used to describe incremental and cumulative changes from the Project and the Fission Patterson Lake South Property relative to existing conditions and focused on primary pathways, which are those pathways predicted to have greater than negligible effects that remain after mitigation. The methods for describing how changes to measurement indicators for the Indigenous land and resource use VC were assessed are presented below.

Changes to access to and area available for Indigenous land and resource use

Changes in access to and area available for Indigenous land and resource use are related to direct disturbance to the land because of the Project, resulting in the land and resources becoming unavailable for traditional activities. Changes in access and area available were identified through a qualitative comparison of reported Indigenous land and resource use areas or sites including occupancy, travel, hunting, trapping, fishing, gathering, and cultural areas or sites, and their overlap with the maximum disturbance area and associated Project infrastructure and activities (e.g., traffic on Highway 955). Temporary disturbances to access were also considered, such as the installation of in-lake infrastructure on Patterson Lake. Changes in access to areas and resources, and the quantity of land base available, may affect Indigenous land and resource use through the displacement of activities or the potential cessation of certain activities altogether.

Changes to the availability of fish, plants, and wildlife for harvesting

Changes to the availability of fish, plants, and wildlife for harvesting were identified based on the results of the following resource-specific assessments:

- wildlife and wildlife habitat VCs including woodland caribou, moose, black bear, grey wolf, beaver, common goldeneye, and mallard (Section 14), as well as American marten through consideration of suitable habitat as assessed in the vegetation assessment (Section 13);
- fish and fish habitat VCs including northern pike, lake whitefish, walleye, and lake trout (Section 11); and
- traditional use plants (Section 13).

The results of these assessments were then considered within the context of Indigenous land and resource use to determine how changes in the availability of resources harvested may affect hunting, trapping, fishing, and gathering activities. For example, Indigenous land users may decide to harvest certain species in a different area, may stop harvesting certain species altogether, or may decide to no longer engage in land and resource use activities based on where harvested species are available.

Changes to the quality of the Indigenous land use experience

Changes to the quality of the Indigenous land use experience related to sensory disturbances were assessed based on the results of the assessments for noise (Section 7.3), light (TSD XI, Light Effects Analysis Report), and air quality (Section 7.2), and a qualitative assessment of aesthetics (e.g., visual quality). Changes to safety were assessed qualitatively based on the results of the assessment for traffic (TSD IX, Transportation Risk

Assessment Report). The results are discussed within the context of Indigenous land and resource use and changes to the experience of Indigenous land users and their relationship with the land.

Changes to the perceptions of the quality of resources harvested (i.e., fish, traditional use plants, and wildlife) and water were assessed qualitatively based on the descriptions of perceived changes in harvested resources valued by Indigenous Groups. Descriptions of perceived changes in the quality of harvested resources by Indigenous Groups are provided for context, where available, and are based on their observations and experiences practising traditional activities within their territories over generations.

Perceived risks to human health from fresh water while on the land and harvesting wildlife, fish, and plants for consumption were assessed within the context of actual predicted changes to the availability (and quality) of water, fish, plants, and wildlife and how Indigenous Groups may view changes in the quality of these resources from Project activities. Indigenous land users may decide to harvest certain species in a different area, may stop harvesting certain species altogether, or may decide to no longer engage in land and resource use activities based on perceived changes to the quality of resources. Actual changes in risks to human health are evaluated by the Environmental Risk Assessment (TSD XXI) and assessed in Section 15, Human Health.

A key component of the quality of experience is the concept of the cultural landscape, which presents a more holistic understanding of the relationship between Indigenous Groups and the land that goes beyond site-specific inventories to embody the broader relationship between Indigenous Peoples and the landscape. Changes to the cultural landscape were qualitatively assessed by considering the assessment of sensory disturbances, safety, and perceptions of the quality of resources harvested combined.

16.2.9 Residual Effects Classification and Determination of Significance

The residual effects analysis uses a reasoned narrative to describe anticipated changes to each measurement indicator caused by the proposed Project and the associated effects on each VC. The residual effects analysis also considers effects from both the Project and RFDs. These narrative descriptions of anticipated effects represent the foundation for the residual effects classification and significance determination. Residual effects are summarized or classified in tabular form using effects criteria, which are intended to provide structure and comparability across VCs and intermediate components assessed for the Project (Section 6.9.1, Residual Effects Classification).

The residual effects classification uses direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence as criteria. The approach to classify each residual effect criterion is provided in Table 16.2-4.

Table 16.2-4: Definitions Applied to Effects Criteria Classifications for the Assessment of the Indigenous Land and Resource Use Valued Component

Criterion	Rating	Definition
Direction	Positive	Change in measurement indicator results in net improvement or benefit to Indigenous land and resource use
	Neutral	Change in measurement indicator results in net balance to Indigenous land and resource use
	Negative	Change in measurement indicator results in net degradation or loss to Indigenous land and resource use
Magnitude	Qualitative narrative or numeric quantification	Change in access is described by effect size (i.e., quantity of land in hectares no longer available for land use) and qualitative description of where restrictions in access are anticipated, as well as changes to intangible values, including the cultural landscape, sense of place, and loss of intergenerational transfer of knowledge
		Change in resource availability is described by effect size (i.e., quantitative or qualitative description of change in fish, plant, and wildlife VCs such as hectares of habitat loss, change in habitat distribution, and connectivity relative to existing conditions)
		Change in Indigenous land use experience is described in terms of changes to components that would affect Indigenous land use experience (i.e., light, noise, air quality, and aesthetics) and changes in the cultural and spiritual associations with the land
		Change to resource quality is a qualitative and quantitative description of potential perceived changes as expressed by Indigenous Groups
Geographic extent	Maximum disturbance area	Change in measurement indicator is confined to the maximum disturbance area, which is also used in the vegetation (Section 13) and wildlife (Section 14) assessments
	Local	Change in measurement indicator extends outside the maximum disturbance area but within the LSA
	Regional	Change in measurement indicator extends beyond the LSA but is confined to the RSA
	Beyond regional	Change in measurement indicator extends beyond the RSA
Duration	Qualitative narrative or numeric quantification	Change in measurement indicator is described by effect duration (e.g., years, decades, permanent). For Indigenous land and resource use, where possible, duration is described in terms of number of generations to capture the importance of intergenerational cultural transmission
Reversibility	Reversible	Change in measurement indicator is reversible within a clearly defined time period
	Irreversible	Change in measurement indicator is predicted to influence the component indefinitely
Frequency	Occasional	Change in measurement indicator is expected to occur rarely (e.g., once, a few times)
	Periodic	Change in measurement indicator is expected to occur consistently at regular intervals or associated with temporal events (e.g., wildfires)
	Continuous	Change in measurement indicator is expected to occur all the time
Probability of occurrence	Unlikely	Change in measurement indicator is not expected to occur, but not impossible
	Possible	Change in measurement indicator may occur but is unlikely
	Probable	Change in measurement indicator is likely to occur but is uncertain
	Certain	Change in measurement indicator will occur

LSA = local study area; RSA = regional study area; VC = valued component.

While most criteria could be assigned categorical ratings for the Indigenous land and resource use VC, predicted effect sizes were provided in specific terms (i.e., narrative or numeric quantification) in the residual effects characterization (Table 16.2-4). Similarly, duration was described in specific terms (e.g., years, number of "generations" [where possible] relative to how Indigenous Groups understand their relationship to the land). Applying a category rating to a criterion such as magnitude might lead to confusion or misinterpretation of the effects assessment or result in the criterion not being easily categorized in a meaningful way. For example, characterizing magnitude solely using an ordinal scale (i.e., low, moderate, high) for the Indigenous land and resource use VC is often not appropriate as additional context is required to properly characterize the effects, thus necessitating a more qualitative approach.

The significance of adverse residual effects on the Indigenous land and resource VC was evaluated using the assessment endpoint (i.e., continued ability to participate in Indigenous land and resource use activities) as a significance threshold and followed the approach described in Section 6.9.2, Significance Determination. This assessment endpoint is qualitatively defined by the continued ability of Indigenous Groups to participate in land-based activities based on similar availability of resources for harvesting, maintenance of access to traditional land use areas, and maintenance of quality of Indigenous land use experience, while acknowledging that traditional activities are dependent on individual preferences and experience. The classification of residual effects criteria provides the foundation for determining if the threshold for significance is exceeded.

Resilience (or societal/cultural tolerance), adaptability, and existing conditions provide important social and cultural context for the determination of significance. Existing conditions represent the combined effects of previous and current human activities and natural factors that have shaped the documented conditions and perceptions of Indigenous land and resource use in the LSA and RSA. These conditions represent the starting point for assessing Project effects and were considered as context to help define how close Indigenous land and resource use might be to its resilience limits when making the significance determination for the Project and the Fission Patterson Lake South Property. Overall, a detailed and transparent account of whether the predicted effects of the Project could be significant by causing a critical threshold to be exceeded was prepared for Indigenous land and resource use by combining Indigenous and Local Knowledge, available academic literature, data collected in the LSA and RSA, and logical reasoning (i.e., a weight of evidence or reasoned narrative approach).

Confidence in the significance prediction was identified and discussed for Indigenous land and resource use as part of the reasoned narrative. If uncertainty was high about where a threshold for a significant effect would occur in the range of potential values, and if the effect could be assessed as significant or not significant, a precautionary approach was applied, and the effect was identified as significant and additional follow-up actions to reduce uncertainty proposed.

16.2.10 Prediction Confidence and Uncertainty

The purpose of the assessment is to predict the future conditions for Indigenous land and resource use with the addition of the Project, the Fission Patterson Lake South Property, and climate change. As with all predictions of future conditions, the predictions made in this assessment embody some degree of uncertainty. The assessment applied a precautionary (i.e., conservative) approach to address uncertainty by identifying the greatest magnitude, duration, and geographic extent of potential adverse effects when a range of possible outcomes were possible. Consequently, uncertainty was addressed in a manner that increased the level of confidence that residual effects were conservatively estimated. The key uncertainties for Indigenous land and resource use and the way they were addressed are presented as part of this assessment (Section 16.7, Prediction Confidence and Uncertainty).

16.2.11 Monitoring, Follow-Up, and Adaptive Management

Monitoring programs are proposed to address the uncertainties associated with the effects predictions and to evaluate the performance of mitigation. In general, monitoring is used to verify the effects predictions. Monitoring is also used to identify any unanticipated effects and to support the implementation of adaptive management to limit these effects. Typically, monitoring includes one or more of the following categories that may be applied during the Project lifespan:

- **Regulatory compliance monitoring:** monitoring activities, procedures, and programs undertaken to confirm the implementation of approved design standards, mitigation and conditions of approval, and NexGen commitments (e.g., monitoring activities would focus on the species relied upon for Indigenous land and resource use).
- **Follow-up monitoring:** programs designed to test the accuracy of effects predictions, reduce or address uncertainties, determine the effectiveness of mitigation, or provide appropriate feedback to operations for modifying or adopting new mitigation designs, policies, and practices (e.g., implementation of adaptive management). Results from these programs can be used to increase the certainty of effect predictions in future EAs.

Where relevant, conceptual monitoring programs would be proposed to confirm predictions and to address the uncertainties associated with the effect predictions and mitigation, and upon Project approval, would be included in NexGen's Integrated Management System.

The implementation of robust, long-term environmental testing and monitoring has also been requested by Indigenous Groups to verify protection of the environment, including community-led monitoring during Construction and Operations of the proposed Project (TSD IV: MN-S; TSD V.2: CRDN; TSD VI: YNLR).

In addition to environmental monitoring programs typically implemented for projects (i.e., as noted above), NexGen is working with local Indigenous Groups to implement independent environmental monitoring. In combination with standard Project monitoring processes, independent Indigenous monitoring would be used to verify Project performance and to determine if mitigations and controls are effective in protecting the receiving environment.

Adaptive management measures may also be proposed to address the uncertainties associated with the effects predictions and mitigation. The process for determining when, how, and where to use adaptive management would be described within the Integrated Management System Manual.

16.3 Existing Conditions

This section describes the setting and characterization of the existing (i.e., Base Case) conditions in the LSA and RSA for cultural and heritage resources and Indigenous land and resource use. This section first discusses the cultural and heritage resources. The section then provides an overview of Indigenous Groups followed by contemporary Indigenous land and resource use, which is organized by the traditional activities that support Indigenous land and resource use and provides important context relative to the measurement indicators identified:

- access to and area available for Indigenous land and resource use;
- availability of wildlife, fish, and plants for harvesting; and
- quality of the Indigenous land use experience.

16.3.1 Cultural and Heritage Resources

An HRIA was completed by Canada North Environmental Services Limited Partnership for the Project from 19 June to 22 June 2018 (Annex IX). The field assessment was completed under Archaeological Resource Investigation Permit No. 18-068. A heritage study area was established that encompassed the anticipated Project footprint and three general areas based on defined criteria for an HRIA.

A total of 180 ha was assessed using a combination of pedestrian reconnaissance, post-effect inspections of disturbed areas, and the excavation of 239 subsurface shovel probes. No heritage resources were identified throughout the entire survey area. On 26 November 2018, the Heritage Conservation Branch (Saskatchewan Ministry of Parks, Culture and Sport) confirmed that the HRIA met the requirements of Section 63 of *The Heritage Property Act* and no further assessment was required (Annex IX). In February 2021, NexGen submitted an updated Project design to the Heritage Conservation Branch for review. On 25 February 2021, the Heritage Conservation branch advised NexGen that there were no further concerns with the Project proceeding as planned (Annex IX).

16.3.2 Overview of Indigenous Groups

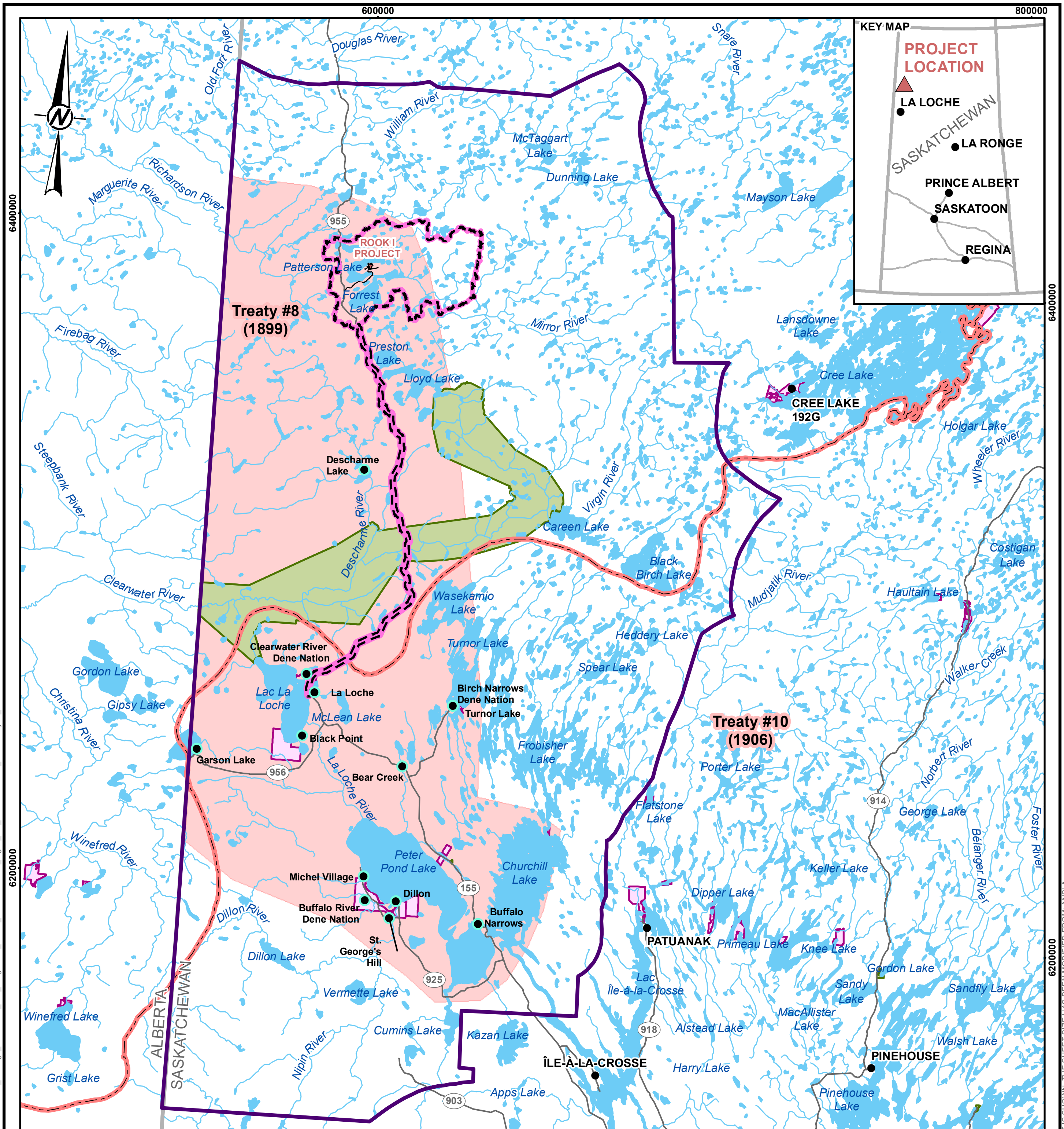
The proposed Project would be in Treaty 8 territory and within the MN-S NR2 (also known as Clearwater Clear Lake) of the Métis Homeland (Figure 16.3-1 and Figure 16.3-2). The Project would also be adjacent to Treaty 10 territory. The Indigenous Groups with land and resource use activities that may be affected by the Project are:

- CRDN, a signatory to Treaty 8 (Section 16.3.2.1.1);
- MN-S NR2 (Section 16.3.2.1.2);
- BNDN, a signatory to Treaty 10 (Section 16.3.2.1.3); and
- BRDN, a signatory to Treaty 10 (Section 16.3.2.1.4).

These primary Indigenous Groups were the focus for a detailed level of engagement, while other Indigenous Groups were offered to receive information (i.e., be informed) on the Project. A detailed discussion of how Indigenous Groups were identified for engagement is included in Section 2.4.1, Identification of Indigenous Groups for Engagement.

The traditional activities described in Section 16.3.2 include occupancy, habitation, and access; hunting, trapping, fishing, and gathering; and cultural sites, areas, and landscapes. These traditional activities are dependent on the lands and resources. The links between the information provided in existing conditions and the measurement indicators used in the assessment are presented in Table 16.2-3. A brief summary of the historical context, reserve parcels, and demographics for the Indigenous Groups is presented in Annex X, Section 5.1.1, Regional Setting. A variety of historical influences and government policies have affected Indigenous land and resource use, including the Northern Fur Conservation Area and fur conservation block system, the Saskatchewan Natural Resources Transfer Agreements, the Primrose Lake Air Weapons Base, and the uranium mining industry, among others. Information on these influences is provided in the socio-economic baseline report (Annex X, Section 5.1.1).

Section 3 provides a detailed account regarding the collection and incorporation of Indigenous and Local Knowledge into the Project EA. NexGen has entered into a Study Agreement with each of the primary Indigenous Groups (i.e., CRDN, MN-S, BNDN, BRDN) for, among other things, the sharing of Indigenous Knowledge (Section 3.5, Indigenous and Local Knowledge Sources). A Study Funding Agreement was also signed with the YNLR (on behalf of the Black Lake Denesųłiné First Nation and Fond du Lac Denesųłiné First Nation) as the YNLR identified an interest in sharing Indigenous Knowledge through an IKTLU Study.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (DECOMMISSIONED)
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROPOSED PROJECT FOOTPRINT
- SOCIO-ECONOMIC LOCAL STUDY AREA COMMUNITIES
- INDIGENOUS LAND AND RESOURCE USE LOCAL STUDY AREA
- INDIGENOUS LAND AND RESOURCE USE REGONAL STUDY AREA
- FIRST NATION TREATY BOUNDARIES
- LOCAL PRIORITY AREA

0 45 90

1:1,700,000 KILOMETRES

REFERENCE(S)
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3. WILDLIFE MANAGEMENT, GAME BIRD DISTRICTS & GAME BIRD MANAGEMENT UNITS (GBMU), SASKATCHEWAN MINISTRY OF ENVIRONMENT, FISH AND WILDLIFE.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
HISTORIC TREATIES

CONSULTANT
wsp

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FIGURE 16.3-1

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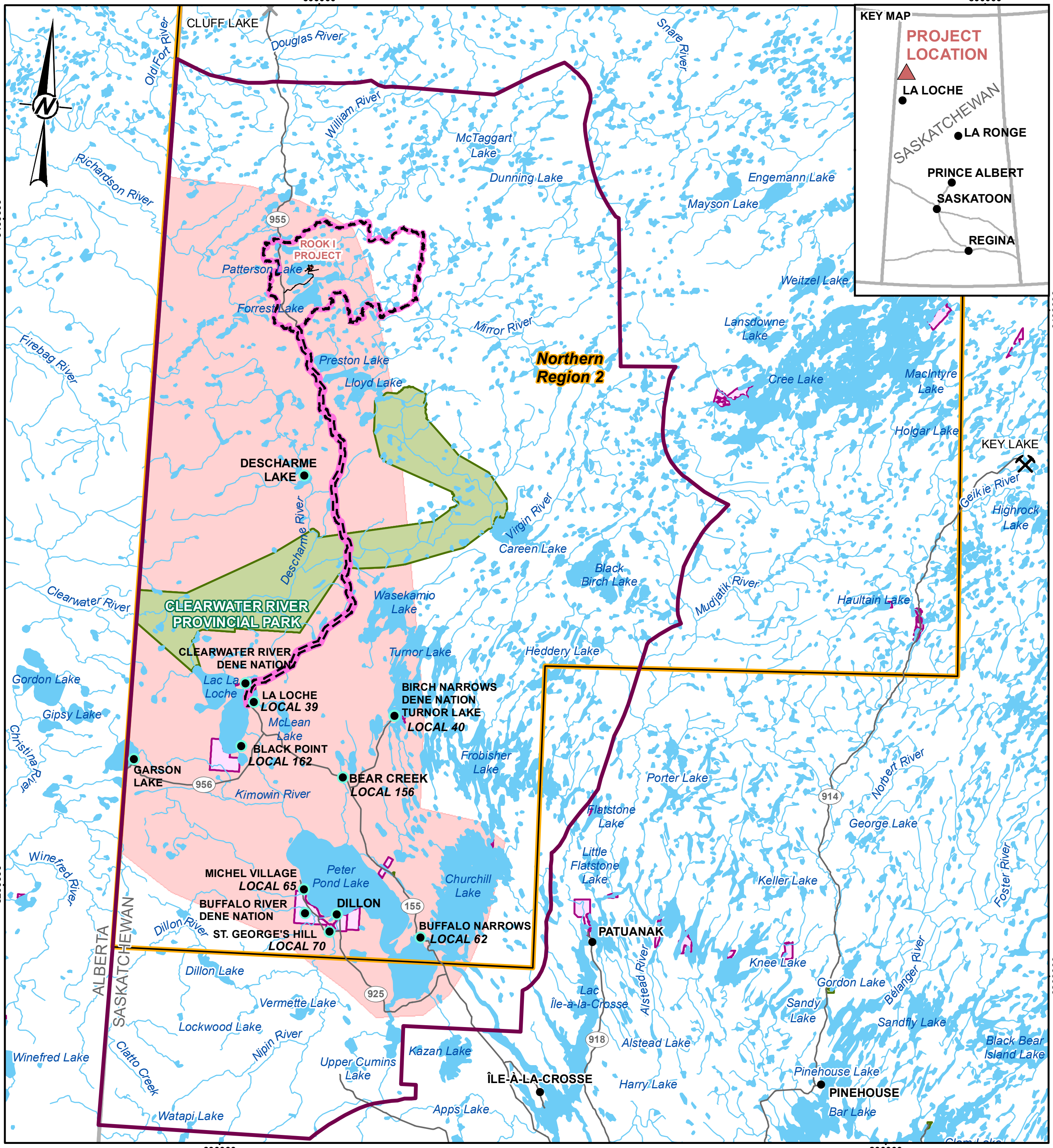

LEGEND

POPULATED PLACE	SOCIO-ECONOMIC LOCAL STUDY AREA COMMUNITIES
URANIUM MINING FACILITY (ACTIVE)	INDIGENOUS LAND AND RESOURCE USE LOCAL STUDY AREA
URANIUM MINING FACILITY (DECOMMISSIONED)	INDIGENOUS LAND AND RESOURCE USE REGONAL STUDY AREA
SECONDARY HIGHWAY	MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2
WATERCOURSE	LOCAL PRIORITY AREA
INDIAN RESERVE	
PROVINCIAL PARKS	
WATERBODY	
PROPOSED PROJECT FOOTPRINT	

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

CONSULTANT

wsp

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FIGURE 16.3-2

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16.3.2.1 Primary Indigenous Groups

This subsection provides an overview of each of the primary Indigenous Groups. As supported by the Indigenous and Local Knowledge shared with NexGen by these primary Indigenous Groups, members practise Indigenous land and resource use activities within the LSA and RSA, including hunting, trapping, fishing, plant gathering, and the use of cultural sites, habitation sites, and travel routes.

16.3.2.1.1 Clearwater River Dene Nation

The CRDN is a Dene First Nations band government with a band government that is elected for four-year terms (INAC 2019a). The CRDN maintains offices in the village of Clearwater River situated on the eastern shore of Lac La Loche. The CRDN occupies three Indian Reserves (IRs; i.e., IRs 221, 222, and 223; Figure 16.3-3) and the La Loche Indian Settlement (INAC 2019a). The CRDN reserve of Clearwater River shares its southern border with the village of La Loche. Ties between the Northern Village of La Loche and CRDN are very close and members of CRDN see them as one, which is one of the reasons why La Loche, while not a reserve, is one of the strongest Dene speaking communities in Saskatchewan (TSD V.3: CRDN). The most populous reserve is the La Loche Landing reserve located between La Loche and Buffalo Narrows, but most of its band members reside in the Northern Village of La Loche (University of Saskatchewan n.d.).

The CRDN are a community of Denesųłiné or Dene people. Traditional activities have been concentrated in the Clearwater River watershed and Patterson Lake area and areas north of Patterson Lake, including the Carswell and Old Fort rivers watersheds (CRDN 2019a,b). The traditional territory of the CRDN also extends into Alberta along the eastern shores of Lake Athabasca (TSD V.1: CRDN).

Patterns of use and occupancy have been consistent for the CRDN:

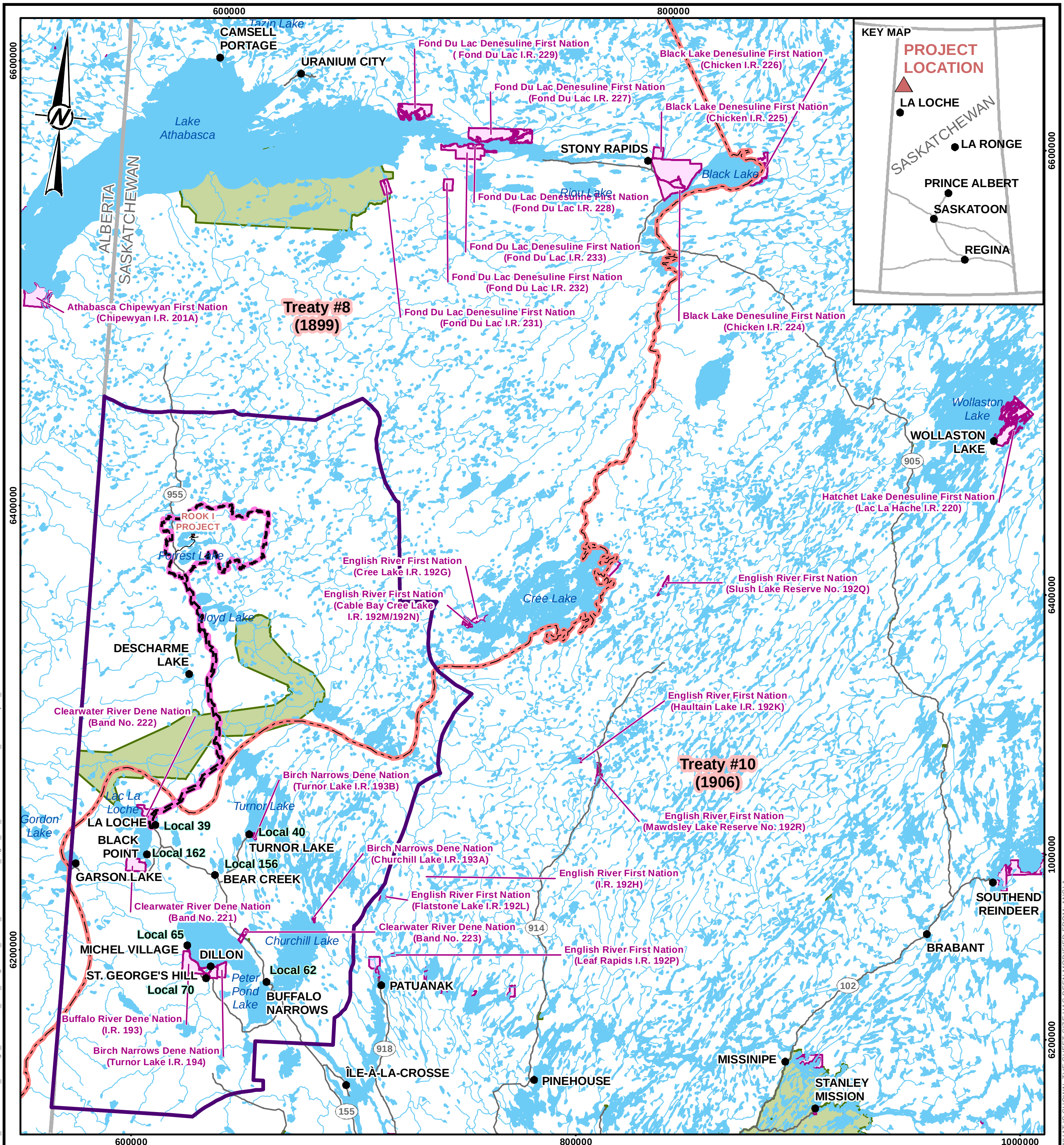
> generations beyond living memory CRDN families have lived in the La Loche and Clearwater River watersheds. In annual seasonal rounds the Nation's families moved between wintering grounds north of Des Nëtthë [Clearwater River] and west of Clos Tú [Whitefish/Garson Lake] and summer gathering camps south of Des Nëtthë [Clearwater River] on Tthį̨télaztúë [La Loche Lake], Clos Tú [Whitefish/Garson Lake], and Uldaí Tú [Jackfish/Gipsy Lake]. (TSD V.1: CRDN)

The following settlement history is sourced from the CRDN (TSD V.3: CRDN).

> The fur trade commenced in La Loche in 1778 with the arrival of Peter Pond (RCAP 1995). In 1845, the first missionary, Abbé Thibault, established a mission at La Loche that attracted local Dene families. The report by the Royal Commission for Aboriginal People in 1994 stated that by 1943, the economic rationale for a settlement in La Loche disappeared; however, the town survived.
>
> [Clearwater River Dene Nation lands are located] within the territorial boundaries of Treaty 10 (1906); however, CRDN's treaty origins date back to 1899 when Adam Boucher, a Dene leader, signed an adhesion to Treaty 8 at Fort McMurray. Boucher's people (about 50 people at the time) became known as the Portage La Loche Band [until they changed their name to the CRDN (CRDN 2019b)]. They were not at first allocated any of their treaty land entitlement and remained occupying traditional lands in both Alberta and Saskatchewan until 1970, when three parcels of reserve land were finally transferred to the Portage La Loche Band (present day CRDN; La Loche 2021a).

For a time, the “La Loche Landing” (IR 223) was being developed as a village and in 1974 it had 70 residents; however, most of the band members chose to live in the village of La Loche. The band had about 280 members living in La Loche and the La Loche Landing in 1975.

In 1979, the parcel at Palmbere Lake / Linval Lake area was traded for land bordering La Loche to the north. This area (IR 222) is now home to the village of Clearwater River. The third parcel (IR 221) is on the southwest shore of Lac La Loche. It had a few houses in the 1970s. In 1820, the trading posts of the Hudson's Bay Company (HBC) and the North West Company were located on the lake in that area.



LEGEND

- POPULATED PLACE
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROPOSED PROJECT FOOTPRINT
- INDIGENOUS LAND AND RESOURCE USE LOCAL STUDY AREA
- INDIGENOUS LAND AND RESOURCE USE REGONAL STUDY AREA
- FIRST NATION TREATY BOUNDARIES

0 60 120
1:2,500,000 KILOMETRES

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3. ABORIGINAL AFFAIRS AND NORTHERN DEVELOPMENT CANADA (AANDC) AND MEADOW LAKE TRIBAL COUNCIL, BIRCH NARROWS DENE NATION.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd
ROOK I PROJECT

TITLE
FIRST NATION RESERVES

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 16.3-3

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The CRDN are predominantly First Nations (i.e., 95.1%) with a small number of Métis (i.e., 3.7%). Clearwater River Dene Nation is the third largest LPA community with a population of 822 in 2016 (Statistics Canada 2017a). Within the last decade, CRDN has experienced the highest growth among the LPA communities with a 24.9% increase but experienced only modest growth between 2011 to 2016 (i.e., 5.4%). The CRDN has the youngest population among the LPA communities, with a median age of 23.8 years.

16.3.2.1.2 Métis Nation – Saskatchewan Northern Region 2

In the eighteenth and nineteenth centuries, prior to the establishment of what is currently Canada, the Métis emerged as a distinct nation in areas that include what is now northwest Saskatchewan (TSD IV: MN-S). Lying at the intersection of Dene and Cree territory, the Métis of the region are the result of the intermarrying of local Indigenous Peoples and those who came to the area during the fur trade (InterGroup 1982). During the late nineteenth century, after the North-West Resistance, Métis from the south, particularly the Batoche area, fled north, including to communities in the LSA, which include the northern villages of La Loche and Buffalo Narrows, along with northern hamlets and settlements. The last quarter of the nineteenth century also found Métis buffalo hunters from the southern plains moving into the area (InterGroup 1982).

The communities in the region were influenced by the fur trade, which had its beginnings in the northwest in the 1700s with the establishment of fur trade posts. For the northern regions, the only Europeans who entered the area were those involved in the fur trade and church missionaries.

The fur trade in the La Loche area began around Methye Portage, as the Northwest Company began operating in the region in 1789. The first HBC post was established along the northern portion of Methye Portage in 1819 at Clearwater River (La Loche 2021b). In 1820, the post was moved to the side of the portage nearest to Île-à-la-Crosse, at the south end of the portage along the north shore of Lac La Loche, before operations were discontinued in 1821 when the HBC joined with the Northwest Company. The post was re-established in 1853 at Portage La Loche and eventually moved to the west side of Lac La Loche by 1873 (Hudson Bay Archives 2020a). In 1895, the current site of La Loche was established as a Catholic mission. From then until 1936, both the current village site and the HBC post site on the west side of Lac La Loche were referred to as Portage La Loche. In 1936, the post burned down, and the west side settlement became known as West La Loche (Northern Village of La Loche 2018). Since 1820, people have lived in established homes around Lac La Loche, but no permanent settlement was established until the re-location of the HBC post from Methye Portage to the west side of the lake. This settlement was named Portage La Loche (Northern Village of La Loche 2018).

In 1888, an HBC outpost was established in Buffalo Narrows as a response to independent traders in the area (Hudson Bay Archives 2020b,c; Wuorinen 2019). This outpost was established almost a century after HBC set up a post in the area in Île-à-la-Crosse in 1799. Prior to the establishment of this post, HBC agents would winter in two houses loaned by the Northwest Company (Hudson Bay Archives 2020b). The post in Île-à-la-Crosse would eventually be abandoned in 1806 before being re-established in 1809. It would later burn down in 1811 and re-open in the autumn of 1814. Île-à-la-Crosse became the headquarters for the English River District in 1822. The Buffalo Narrows post would later become an outpost for the Buffalo River post in 1916 and gain full post status in 1942 to serve the commercial fishing business in the area (Hudson Bay Archives 2020c).

A small winter fishery was also located in the area near current day La Loche, with moose and caribou relied upon for meat. It was frequented by the Dene and descendants of the original Métis, many of whom settled in the area. The Dene and descendants of the original Métis also frequented Bull's House, which was located at the north end of Peter Pond Lake (Buffalo Lake at the time) and would store oxen for the summer transport system of Portage La Loche. This area was also an area with natural hay meadows where cattle grazed (MacDougall 2008).

Incorporated in 2000, the MN-S represents the interests of Métis citizens in Saskatchewan, including their rights under Section 35 of the *Constitution Act, 1982*. The MN-S NR2 is one of 12 administrative Métis regions in the province. The MN-S NR2 represents Métis citizens in northwest Saskatchewan and extends geographically from Cree Lake in the east to the Saskatchewan–Alberta border in the west and from Buffalo Narrows in the south to the south shore of Lake Athabasca in the north (Figure 16.3-2; MN-S 2021).

Métis make up a large proportion of the population in the LPA communities, with the greatest number living in Buffalo Narrows and La Loche. These two communities are the only LPA communities with Métis-majority populations. However, both communities' Métis populations have declined in recent years. In La Loche, the Métis populations decreased by 600 since 2011 (the largest population decrease among all LPA communities), and by 225 in Buffalo Narrows. Buffalo Narrows has the oldest population among LPA communities with a median age of 30.8 years, which is consistent with provincial Indigenous population characteristics where the Métis population is oldest among the Indigenous Groups (Statistics Canada 2018).

16.3.2.1.3 Birch Narrows Dene Nation

The BNDN is a community of Denesųłiné or Dene people. In 1965, members of the Clear Lake Band were relocated to the Turnor Lake area from Clear Lake (at the northern end of Churchill Lake) while others relocated to Buffalo River and English River (La Loche 2012; BNDN 2018). In 1972, the Clear Lake Band would become the BNDN and BRDN (Burnside 2017). The BNDN's current reserve parcels are Churchill Lake 193A, Turnor Lake 193B, and Turnor Lake 194 (INAC 2019b; Figure 16.3-3). Birch Narrows Dene Nation is governed by a chief and council that are elected to four-year terms (INAC 2019b).

Settlement at Turnor Lake, originally named Island Lake, began as early as 1895. Island Lake was renamed Turnor Lake in 1918 in honour of Phillip Turnor, a fur trader and surveyor who worked with the HBC (Tourism Saskatchewan Canada 2020). On 28 August 1906, the Clear Lake Band, also known as the Peter Pond Band, formally joined Treaty 10 when Chief Raphael Redshildkze signed the treaty (BNDN 2018).

> In the summer of 1906, the Dene people of English River and Clear Lake . . . entered into a treaty relationship with the Canadian government. In return for granting settlers access to nearly 220,000 square kilometres of land in northern Saskatchewan, the Cree and Dene were promised access to education, medicine, assistance in the time of need, support for the elderly, yearly annuity payments, and most importantly, that their traditional hunting, fishing and trapping ways of life would continue unimpeded. (Dodson et al. 2006)

Few other families were in the area when Treaty 10 was signed in 1906. Six or seven families were living at the lake by 1911 (La Loche 2021b), with most members of the Clear Lake Band initially living in and around Buffalo Narrows (Mease 2006).

In the 1910s and 1920s, the Clear Lake Band began to petition the Canadian government for reserves to be surveyed for them within the Treaty 10 area. A primary reason for this petition was the desire for hay lands, as they had begun cultivating them approximately 40 years prior; the Clear Lake Band was worried the already scarce lands in the region would quickly be taken up by others moving in. The surveying of the reserve lands was completed in 1923, with the southern shore of Peter Pond Lake (IR 193), a parcel of land at Churchill Lake (IR 193A), and a parcel of land at Turnor Lake (IR 193B) becoming the reserve lands (Figure 16.3-3). The Clear Lake Band had also requested Ball Island, which was not included in the survey (Dodson et al. 2006).

The BNDN population is predominantly First Nations, with a small number of Métis. In 2016, BNDN had a population of 475, a 13.4% increase from 2011, and experienced the highest growth among the LPA communities between that period (Statistics Canada 2017b). Like the other LPA communities, BNDN is relatively young, with a median age of 24.8 years, younger than the Indigenous provincial median of 24.3 years. Birch Narrows Dene Nation has a higher proportion of the population who are of retirement age (i.e., 6.3%) compared to the Indigenous provincial average (4.9%).

16.3.2.1.4 Buffalo River Dene Nation

The BRDN is a community of Denesųłiné or Dene people. Chief Raphael Redshildkze signed Treaty 10 on behalf of the Clear Lake Band. The BRDN was part of the Clear Lake Band (also called the Peter Pond Band) until 1972, when the band was divided into the BNDN and BRDN (Thompson 2021). The BRDN's current reserve parcel is BRDN 193 (INAC 2019c; Figure 16.3-3). Traditional territory for the BRDN is recognized as bordered by Lake Athabasca to the north, Ta Touie Lake to the east, Cold Lake to the south, and the Athabasca River to the west as noted in the *Buffalo River Dene Nation Band Custom Election Act*. Buffalo River Dene Nation is governed by a chief and councillor that are elected for three-year terms (INAC 2019c).

The BRDN population is predominantly First Nations (i.e., 98.1%) with a small number of Métis (i.e., 1.3%). In 2016, BRDN had a population of 785, a 2.7% increase from 2011, less than the growth rate for the Indigenous provincial average during the same period (i.e., 11.0%; Statistics Canada 2017c). Buffalo River Dene Nation has the highest proportion of working age residents compared to other LPA communities, at 63.7%, while 5.1% are of retirement age. The BRDN population is also aging faster than the other LPA communities, with the proportion of retirees increasing by 13.7% between 2011 and 2016 relative to a 6.5% decrease in the proportion of the working age population over the same period (Statistics Canada 2017c), which matches the 6.5% decrease for the Indigenous provincial average (Statistics Canada 2018).

16.3.2.2 Other Indigenous Groups

This subsection provides an overview of the other Indigenous Groups. These Indigenous Groups practise Indigenous land and resource use activities in the broader region, though do not have documented use within the LSA and are not anticipated to be directly affected by the proposed Project. NexGen has been engaging with the following other Indigenous Groups on the Project in a manner consistent with the outcomes of the approach used to define Indigenous Groups for engagement in Section 2.4.1:

- Black Lake Denesųłiné First Nation, as represented by the YNLR;
- Fond du Lac Denesųłiné First Nation, as represented by the YNLR;
- Athabasca Chipewyan First Nation; and
- English River First Nation.

16.3.2.2.1 Ya'thi Néné Lands and Resources

The YNLR is a non-profit organization established in 2016 and owned by Hatchet Lake Denesųłiné First Nation, Black Lake Denesųłiné First Nation, Fond du Lac Denesųłiné First Nation, and the municipalities of Stony Rapids, Uranium City, Wollaston Lake, and Camsell Portage (YNLRO n.d.). The administrative centre for the YNLR is located in Saskatoon, Saskatchewan. For the purposes of the EA, the YNLR represents the Athabasca Denesųłiné of Black Lake First Nation and Fond du Lac First Nation. The Black Lake First Nation's current reserve lands are Chicken 225, Chicken 226, and Chicken 224 (Figure 16.3-3) (CIRNAC 2021a), and the Fond du Lac First Nation's current reserve lands are Fond du Lac 227, Fond du Lac 228, Fond du Lac 229, Fond du Lac 231, Fond du Lac 232, and Fond du Lac 233 (Figure 16.3-3) (CIRNAC 2021b).

The Black Lake and Fond du Lac Denesųłiné First Nations, along with the Hatchet Lake First Nation, are collectively termed the Athabasca Denesųłiné. Their traditional territory is Nuhenéné. Athabasca Denesųłiné culture, history, and way of life are interwoven with the movements and health of the caribou herds.

16.3.2.2.2 Athabasca Chipewyan First Nation

The ACFN is an Athabascan-speaking Denesųłiné nation (ACFN n.d.a), with its administrative centre located in Fort Chipewyan, Alberta. The ACFN have described their core territory as extending "north, east, west, and south from the Peace Athabasca Delta in Alberta, including the Lower Athabasca River and lands to the south of Lake Athabasca, and the lands south of Fort McMurray" (ACFN n.d.b). The ACFN's homelands are mapped along the boundary of the Firebag River south of Lake Athabasca and west of the Project (ACFN n.d.c).

The ACFN's reserve lands are on the south shore of Lake Athabasca, on the Athabasca Delta, and on the Athabasca River, and include Chipewyan 201, Chipewyan 201A, Chipewyan 201B, Chipewyan 201C, Chipewyan 201D, Chipewyan 201E, Chipewyan 201F, and Chipewyan 201G (CIRNAC 2021c).

16.3.2.2.3 English River First Nation

The ERFN is based in Patuanak and composed of both Dene and Cree people (ERFN 2022). The ERFN have 19 reserves, settlements, and villages, including but not limited to La Plonge 192, Wapachewunak 192D, Ile A La Crosse 192E, Elak Base 192A, Knee Lake 192B, Dipper Rapids 192C, Cree Lake 192G, and Primeau Lake 192F (CIRNAC 2021d; MLTC 2020).

16.3.3 Contemporary Indigenous Land and Resource Use

Contemporary Indigenous land and resource use is described for each of the primary Indigenous Groups. Existing conditions are also described for the YNLR for context, noting the YNLR traditional use area does not overlap the LSA, and the YNLR is not a primary Indigenous Group as described in Section 2.4.1. However, as the YNLR identified an interest in sharing Indigenous Knowledge through an IKTLU Study, NexGen agreed to a Study Funding Agreement with the YNLR; Indigenous Knowledge provided by the YNLR has been incorporated in this subsection, as appropriate. As the ACFN and ERFN have not documented land and resource use in the area of the Project, no description of activities for these Indigenous Groups is provided.

This subsection is organized by Indigenous Group for each of the traditional activities and land uses considered in the assessment:

- **Occupancy, habitation, and access:** Occupancy describes areas and places where Indigenous Peoples have permanently or temporarily resided (e.g., cabins, camp sites). An understanding of occupancy for Indigenous Groups is important because it has the potential to represent a longstanding and intimate relationship with the land (Tobias 2009), while travel routes and access are important to understanding an Indigenous Group's spiritual and cultural relationship with the broader landscape (MCFN and Firelight 2017).
- **Fishing:** Fishing has traditionally been an important activity for Indigenous Groups for providing food. Topics discussed include the cultural importance of fishing, the species fished, fishing locations, and the seasonality, where available. Fishing for commercial or recreational purposes is covered in Section 17.3.3, Fishing.

- **Gathering:** Indigenous Groups gather plants for food, medicine, and ceremonies. Topics discussed include the cultural importance of gathering, the species of plants and berries gathered, gathering locations, and seasonality, where available.
- **Hunting:** Topics discussed include the cultural importance of hunting; harvested big game, small game, and bird species; hunting locations; and seasonality, where available.
- **Trapping:** Trapping has traditionally been an important activity for Indigenous Groups. Topics discussed include the cultural importance of trapping, furbearers trapped, trapping locations, and seasonality, where available. The species trapped can be used for sustenance, utility (e.g., pelts), and spiritual or medicinal purposes. Information on trapping for commercial purposes is included in Section 17.3.2, Commercial Trapping.
- **Culturally important sites and areas:** In addition to sites of tangible culture (e.g., traplines, kill sites, cabins), sites can also have ceremonial or spiritual importance to Indigenous Groups. The cultural landscape, which contributes to sense of place, is tied to Indigenous Peoples' relationship with the land and their spiritual and cultural associations with it. The cultural importance and value of the LSA to Indigenous Groups is also discussed.

16.3.3.1 Clearwater River Dene Nation

The CRDN notes that:

> For CRDN members, land and resource use on traditional lands according to Denesųłiné traditions, is a primary value. Irrespective of the many social changes that have taken place, hunting, fishing, and gathering activities continue to be of central importance. (TSD V.1: CRDN)

The CRDN has noted their ancestral ties with the LSA (TSD V.1: CRDN; TSD V.2: CRDN).

16.3.3.1.1 Occupancy, Habitation, and Access

Clearwater River Dene Nation members have had cabins and moved throughout the LSA and RSA to trap, hunt, fish, and maintain ties with other Dene communities. As the CRDN noted, member cabins are:

> base camps from which more extensive activities (harvesting or otherwise) originate . . . [they] are a way of exercising treaty rights to live in accordance with customary practices of land tenure and Denesųłiné traditions of mobility and freedom of movement. (TSD V.1: CRDN)

The CRDN have lived in the area around La Loche and the Clearwater River watersheds since before living memory (TSD V.1: CRDN). Historically, CRDN families used Descharme Lake as a staging area before heading north on the Cluff Lake Road, which was part of ancient Indigenous travel routes and is now Highway 955. Groups would branch off the main thoroughfare to access their preferred destinations, which included Patterson Lake (TSD V.1: CRDN; TSD V.2: CRDN).

Several travel routes mapped by the CRDN overlap with the LSA and maximum disturbance area including routes that branch east and west off of the current Highway 955 such as south of Broach Lake, north and south of Patterson Lake, intersecting Patterson Lake and Beet Lake, and to Dahle Lake (Figure 4 in TSD V.1: CRDN; Figure 19 in TSD V.2: CRDN). The upper segment of the Clearwater River from the headwaters to Lloyd Lake represents an ancestral water route and harvesting loop that continues to be well travelled by CRDN members today (TSD V.1: CRDN).

All respondents in the CRDN-conducted KP interviews had access to the use of a cabin (TSD V.3: CRDN). Cabins and camps are important for maintaining family bonds and a family's connection to the land.

> Many [CRDN cabins] are located in areas which have been occupied for generations by particular families and are recognized as such by the community at large. Cabins are commonly passed down from generation to generation. It is not unusual for proposed new cabin sites to be selected on the basis of ancestral family connections and the associated traditional hunting knowledge of that particular area. (TSD V.1: CRDN)

Cabins are also important for transmitting information between generations.

> [C]abins are the base camp "schooling" places where youngsters have the opportunity, guidance, and support of tradition-oriented parents, grandparents, and extended family members to learn and understand the values, customs, practices and traditions which are the core of Dene identity – all of which are imbedded in the Dene language. (TSD V.1: CRDN)

A cabin's state of repair is not material to its importance.

> Irrespective of the fact that many CRDN cabins have been burnt down by forest fires or are seemingly not "currently" being used, these living places and their remains are considered significant to the history and heritage of the descendant family members and to the Nation as a whole. Even if a cabin is inhabitable or completely rotted, family members commonly choose to set up camps in these locales and maintain the connection with the ancestors. (TSD V.1: CRDN)

According to the CRDN, there are numerous documented cabins in the LSA, which include "past, current and future planned structures north of the Clearwater River" (Figure 2 in TSD V.1: CRDN; Figure 17 and Figure 21 in TSD V.2: CRDN). Cabins mapped in the LSA and maximum disturbance area are at Broach Lake, Patterson Lake, Forrest Lake, Beet Lake, Dahle Lake, and along the Clearwater River. The prevalence of cabins around Patterson Lake shows that the area encompassing Patterson Lake is historically and currently recognized as a "good for everything" harvesting area that has sustained CRDN members through time beyond living memory. It is the reason why the many cabins and family living places are situated in their current locations (TSD V.1: CRDN).

The CRDN has identified camp sites and staging areas in the LSA, including camp sites around Patterson Lake and within the maximum disturbance area, Forrest Lake, Beet Lake, Broach Lake, and Dahle Lake, and staging areas with trail access southwest of the Project along an east–west travel route running between Patterson Lake and Forrest Lake (Figure 4 in TSD V.1: CRDN; Figure 17 in TSD V.2: CRDN).

Some CRDN members have commented that they can no longer access their cabins or camps because of exploration activities and private recreational camps. One CRDN member reported that he was denied access to his cabin and property at Patterson Lake in 2013 (TSD V.1: CRDN). As noted by the CRDN:

> In addition to the displacement of CRDN members from ancestral lands which arises through the erection of industry security gates, barriers and signage referred to above, there are many other displacements which have occurred that are far less visible but nonetheless noteworthy. A number of examples were provided in interview sessions where an exploration company established its base of operations on an ancestral family place, clearing and levelling the living area with complete disregard for or the outright dismissal of CRDN member's recent and ancestral presence at this same place. (TSD V.1: CRDN)

Occupancy, habitation, and access help create a sense of place or cultural landscape because they highlight not only the presence of Indigenous Peoples but also their relationship with the land. The CRDN (TSD V.1: CRDN) has an ancestral connection to the LSA; this relationship is important even when there are no physical signs of the connection (e.g., cabins). One respondent in the CRDN KP interviews described the feelings experienced when on traditional land: "being on the land is a rejuvenating experience, it's relaxing, it keeps the tradition and culture alive" (TSD V.3: CRDN). This ancestral connection is critical because it allows CRDN members to engage in land use activities, including harvesting and ceremony, but it also grounds their language and worldview, and allows for the transmission of knowledge.

16.3.3.1.2 Fishing

Clearwater River Dene Nation members fish in the LSA and RSA. Fishing, like hunting and trapping, is of central importance to maintaining Denesųłiné traditions and Dene identity (TSD V.1: CRDN; TSD V.2: CRDN). Commercial fishing is discussed in Section 17.3.3.1, and the traditional economy is discussed in Section 18.3.6.1. Species fished by the CRDN are presented in Table 16.3-1.

Table 16.3-1: Species Fished by the Clearwater River Dene Nation

Species Fished by the CRDN	
▪ Jackfish (northern pike; *Esox lucius*) ▪ Arctic grayling (*Thymallus arcticus)* ▪ Pickerel (walleye; *Sander vitreus*) ▪ Herring (cisco; *Coregonus artedi)*	▪ Ling cod (burbot; *Lota lota*) ▪ Whitefish (lake whitefish; *Coregonus clupeaformis*) ▪ Lake trout *(Salvelinus namaycush)* ▪ Suckers ▪ Minnows

Source: TSD V.1: CRDN; TSD V.2: CRDN; TSD V.3: CRDN.
CRDN = Clearwater River Dene Nation.

Lakes in the LSA that CRDN members fish include Patterson Lake, Forrest Lake, Beet Lake, Broach Lake, Gedak Lake, and Dahle Lake (Figure 4 in TSD V.1: CRDN; Figure 20 in TSD V.2: CRDN). Patterson Lake has historically been an important lake for CRDN members, including for commercial fishing. Some CRDN members have commented that there are fewer fish in the lakes in area of the proposed Project, and that fish populations in Patterson Lake and Forrest Lake have decreased during the late 1970s and 1980s and have never fully recovered (TSD V.2: CRDN). In recent years, CRDN members have either stopped fishing Patterson Lake or have expressed uncertainty around fishing the lake. In the 2014 and 2016 interviews, some CRDN members reported the abandonment of harvesting activities in the Patterson Lake area and their refusal to eat fish taken from the lake because of the exploratory uranium drilling operations. Other CRDN members reported their continuing use of the lake/area but expressed a measure of discomfort doing so: "Just not sure, you know what I mean" (TSD V.1: CRDN).

16.3.3.1.3 Gathering

Gathering is important to the CRDN. Table 16.3-2 lists species and items that CRDN members harvest and use in the LSA and RSA. Respondents to the CRDN-conducted KP interviews said that raspberries (*Rubus idaeus* ssp*. strigosus*) and blueberries (*Vaccinium myrtilloides*) were the most popular berry species and were consumed year-round, on average at least twice a week (TSD V.3: CRDN).

Table 16.3-2: Species Gathered by the Clearwater River Dene Nation

Berries	Medicines	Shrubs	Trees	Other
▪ Blueberries (*Vaccinium myrtilloides*) ▪ Bog cranberries (*Vaccinium vitis-idaea*) ▪ Low bush cranberries (*Viburnum edule*) ▪ Gooseberries (*Ribes* spp.) ▪ Saskatoon (*Amelanchier alnifolia* var. *alnifolia*) ▪ Cloudberry (*Rubus chamaemorus*) ▪ Strawberries (*Fragaria* spp.) ▪ Raspberry (*Rubus idaeus* ssp. *strigosus.)*	▪ Kinnikinnik (*Arctostaphylos uva-ursi*) ▪ Labrador tea (*Rhododendron groenlandicum*) ▪ Mint (*Mentha canadensis*) ▪ Spruce gum (*Picea* spp.) ▪ Sweet flag (rat root; *Acorus americanus*) ▪ Mushrooms	▪ Dogwood (red willow; *Cornus sericea* ssp. *sericea* ▪ Willows (*Salix* spp.)	▪ Birch (*Betula* spp.) ▪ Jack pine (*Pinus banksiana*) ▪ Poplar (*Populus* spp.) ▪ Spruce (*Picea* spp.) ▪ Tamarack (*Larix laricina*)	▪ Barks ▪ Mosses ▪ Roots ▪ Punk (i.e., rotten wood)

Source: TSD V.1: CRDN; TSD V.2: CRDN; TSD V.3: CRDN.

Clearwater River Dene Nation members gather plants in the LSA and the maximum disturbance area. Gathering areas include areas designated as "other harvesting areas" in Figure 4 in TSD V.1: CRDN and Figure 20 in TSD V.2: CRDN, and include areas south of Forrest Lake, near Dahle Lake and Depper Lake, and an area that coincides with a travel corridor that begins at Highway 955, crosses the south arm of Patterson Lake, and continues through the connecting watercourse between Patterson Lake and Beet Lake before turning south. Medicinal plant gathering areas were mapped southwest of Patterson Lake, south of Forrest Lake, and around Dahle Lake (Figure 20 in TSD V.2: CRDN). Plants are used for both sustenance as well as medicinal properties. Respondents to CRDN-conducted KP interviews said that medicinal plants are not widely used; however, this should not be taken as an indication that medicinal plants are not widely gathered (TSD V.3: CRDN).

16.3.3.1.4 Hunting

Clearwater River Dene Nation members hunt throughout their traditional territory and often use their cabins as the starting point for these activities. Hunting, along with other traditional land use activities, is important to CRDN members for multiple reasons, including providing food and encompassing "meaning and satisfaction in life as a Denesųłiné person and a community member" (TSD V.1: CRDN).

Within their traditional territory, which includes the LSA and parts of the RSA, the CRDN notes that members hunt large game, small mammals, and birds. The species traditionally hunted by the CRDN are listed in Table 16.3-3.

Table 16.3-3: Species Hunted by the Clearwater River Dene Nation

Large Mammals	Small/Medium Mammals	Birds
▪ Moose (*Alces alces*) ▪ Woodland caribou (*Rangifer tarandus caribou*) ▪ Barren-ground caribou (*Rangifer tarandus groenlandicus*) ▪ Mule deer (*Odocoileus hemionus*) ▪ White-tailed deer (*Odocoileus virginianus*) ▪ Kodiak bear (Alaskan brown bear; *Ursus arctos middendorffi*) ▪ Black bear (*Ursus americanus*)	▪ Rabbit (snowshoe hare; *Lepus americanus*) ▪ Beaver (*Castor canadensis*) ▪ River otter (*Lontra canadensis*) ▪ Muskrat (*Ondatra zibethicus*) ▪ Canada lynx (*Lynx canadensis*) ▪ Wolverine (*Gulo gulo*) ▪ American badger (*Taxidea taxus*) ▪ Weasel (*Mustela* spp.) ▪ Squirrel (*Tamiasciurus hudsonicus / Glaucomys sabrinus*) ▪ American marten (*Martes americana*) ▪ Grey wolf (*Canis lupus*) ▪ Coyote (*Canis latrans*) ▪ Red fox (*Vulpes vulpes*)	▪ Partridge ▪ Grouse spp. ▪ Goose spp. ▪ Duck spp. ▪ Swan

Source: TSD V.1: CRDN; TSD V.2: CRDN; TSD V.3: CRDN.

Responses to the CRDN KP interview program confirmed that the favourite species amongst CRDN members for large wild game was moose (TSD V.3: CRDN). Moose is consumed most commonly in the fall, or during hunting season, based on availability. Clearwater River Dene Nation KP interview respondents said that on average, moose is consumed over five times a week. In terms of large game, most CRDN respondents indicated that they only eat moose. A few respondents indicated that they have consumed caribou (*Rangifer tarandus* ssp.), but the reliance for large game is on moose. Rabbit was identified by CRDN respondents as the most popular (and often only) choice of small game, with participants stating that lynx (*Lynx canadensis*), badger (*Taxidea taxus*), coyote (*Canis latrans*), fox (*Vulpes vulpes*), wolf (*Canis lupus*), otter (*Lontra canadensis*), and squirrel (*Tamiasciurus hudsonicus / Glaucomys sabrinus*) were also trapped within the territory. One respondent traps and eats beaver “sometimes” (TSD V.3: CRDN).

Clearwater River Dene Nation members hunt in the LSA and maximum disturbance area (Figure 4 in TSD V.1: CRDN; Figure 20 in TSD V.2: CRDN). The area around Patterson Lake is referred to as a “backyard fridge” and “good for everything” area, which means that when CRDN members need food, they can access it in the LSA close to Patterson Lake, which is an area they do not consider far from the current community (TSD V.1: CRDN; TSD V.2: CRDN).

In general, CRDN members observed a decrease in wildlife populations in their traditional lands, including a decrease in moose populations in the Patterson Lake area since 2014 (TSD V.1: CRDN; TSD V.2: CRDN). Hunters have noted that they need to travel farther away to harvest moose in the RSA.

16.3.3.1.5 Trapping

In the RSA, CRDN members historically used Descharme Lake as a gathering place before dispersing for the winter to trap, travelling in groups. Travel north was typically done along what is now Highway 955, and families would branch off into the bush. The LSA and maximum disturbance area have traditionally been used for trapping activities by the CRDN, including all shores of Patterson Lake and extending north, as well as north of Forrest Lake (Figure 4 in TSD V.1: CRDN; Figure 20 in TSD V.2: CRDN). Trapping occurs in the winter. Species trapped by the CRDN are listed in Table 16.3-4.

Table 16.3-4: Species Trapped by the Clearwater River Dene Nation

Species Trapped by the CRDN		
▪ Rabbit (snowshoe hare; *Lepus americanus*) ▪ Beaver (*Castor canadensis*) ▪ River otter (*Lontra canadensis*) ▪ Muskrat (*Ondatra zibethicus*) ▪ Badger (*Taxidea taxus*)	▪ Canada lynx (*Lynx canadensis*) ▪ Weasel (*Mustela* spp.) ▪ Squirrel (*Tamiasciurus hudsonicus / Glaucomys sabrinus*) ▪ American marten (*Martes americana*)	▪ Grey wolf (*Canis lupus*) ▪ Coyote (*Canis latrans*) ▪ Red fox (*Vulpes vulpes*)

Source: TSD V.1: CRDN; TSD V.2: CRDN; TSD V.3: CRDN.
CRDN = Clearwater River Dene Nation.

While trapping has played a reduced economic role for CRDN members since the 1970s (CRDN 2019b), it remains an important cultural activity for members who continue to engage in it.

16.3.3.1.6 Culturally Important Sites and Areas

The CRDN considers the Patterson Lake area, which is in the LSA, a productive area for harvesting. Members also consider it culturally important and use it for purposes beyond harvesting.

> The cultural importance of the Patterson/Forrest [Upper and Lower Pelican] Lake area to CRDN is further confirmed by the Nation's choice to center a variety of land and water-based school curriculum activities and camps in the immediate and surrounding environs. Multi-day canoe trips regularly travel the ancestral routes in the area, including the Goráchághi Desë [Pelican River] loop which includes Patterson Lake. As well, a variety of camps and learning places have been established on neighbouring lakes (e.g., Preston, Bray and Descharme lakes). (TSD V.1: CRDN; Figure 17 in TSD V.2: CRDN)

The CRDN has identified several cultural sites (i.e., Dene place name, story, or death site) in the LSA, including at Patterson Lake, Forrest Lake, Broach Lake, Dahle Lake, and east of Beet Lake (Figure 4 in TSD V.1: CRDN).

The use of the LSA for cultural purposes by the CRDN is critical for the transmission of cultural and Indigenous Knowledge. The IKTLU Study elaborates:

> CRDN is highly committed to the maintenance, continued transmission, strengthening, and revitalization of Denesųłiné identity and heritage through school curriculums and programs offered to the Nation's children in the Dene language. Language is the principal instrument by which the Dene worldview, the wisdom of the ancestors, and the distinctive Denesųłiné ways of being are transmitted to the next generations. The Dene language cannot be divorced from the land from which it emerged; nor can the transmission of knowledge be divorced from a healthy productive land base which draws on the knowledge and experience of the ancestors, Elders, and current harvesters. (TSD V.1: CRDN)

16.3.3.2 Métis Nation – Saskatchewan

Métis Nation – Saskatchewan citizens "use the lands as their ancestors did" (TSD IV: MN-S).

> As the Métis Nation evolved, its citizens hunted, fished, and gathered plans to ensure the survival of their families. As in the past, harvesting from Mother Earth remains an integral inherited tradition to [the] Métis Nation. (TSD IV: MN-S)

16.3.3.2.1 Occupancy, Habitation, and Access

In the RSA, there are past and current cabins in a large area extending from the north shore of Patterson Lake, along both sides of Highway 955, to Messenger Lake in the north and Vermette Lake in the south (Figure B to Figure I in TSD IV: MN-S). Trails are mapped in the RSA, including a north–south trail extending south of Descharme Lake and northward to the east of Preston Lake and Patterson Lake, a north–south trail to the west of Highway 955, and an east–west trail north of Gedak and Broach lakes that connects with Hook Lake, where there are several cabins (Figure C to Figure F in TSD IV: MN-S). A canoe trail is also mapped southeast of Beet Lake. Two camping areas were identified by the MN-S in the LSA located around Broach Lake and Gedak Lake (TSD IV: MN-S).

In the LSA, the MN-S has identified past and existing cabins at Patterson Lake, outside the maximum disturbance area, and at Gedak Lake, Broach Lake, Beet Lake, Dennis Lake, Gall Lake, Forrest Lake, and Hook Creek (Figure C, Figure D, and Table 1 in TSD IV: MN-S). It is currently unknown which of these cabins are currently still being used by MN-S members.

Cabins fit within a larger context of access to and relationship with the land. For example, one MN-S citizen commented about the combined effects of the displacement of people from the land, the dying trapping industry, and forest fires contributing to the loss of knowledge and affecting the transfer of knowledge between generations (MN-S-JWG 2019a).

Métis Nation – Saskatchewan citizens are concerned about their cabins, which are important to them and their families. They see their access to land and right to build cabins as being infringed upon by government policies and industry, especially mining and exploration. The MN-S has stated that it is difficult for MN-S citizens to build traditional cabins because the government is raising lease rates and leases are typically given to industry, or cabins are being removed to make way for development (MN-S-JWG 2020).

Occupancy, habitation, and access help create a sense of place or cultural landscape because they underscore the MN-S relationship with the land, which supports their worldview and cultural transmission. The MN-S notes that the MN-S NR2 territory, in which the LSA is situated is:

> a vital source of food and traditional medicine, and a resource for shelter and recreation, all of which provides MN-S Northern Region 2 members a shared identity, sense of community and permanence. (TSD IV: MN-S)

The long-standing relationship to the area is also described by MN-S citizens: “ancestral knowledge is integral to the legacy of Métis understanding and interaction with the natural world. It is crucial to the Métis way of life” (TSD IV: MN-S).

16.3.3.2.2 Fishing

Métis Nation – Saskatchewan citizens have mentioned fishing for whitefish, jackfish, pickerel, suckers, and catfish (*Lota lota*). Species fished by the MN-S are presented in Table 16.3-5.

Table 16.3-5: Species Fished by the Métis Nation – Saskatchewan

Species Fished by the MN-S	
▪ Jackfish (northern pike) ▪ Pickerel (walleye) ▪ Trout spp. ▪ Burbot (ling cod)	▪ "Catfish" (assumed burbot) ▪ Whitefish (lake whitefish) ▪ Suckers

Source: TSD IV: MN-S; MN-S-JWG 2019a.
MN-S = Métis Nation – Saskatchewan.

Whitefish is used to make pemmican, and fish are also smoked to eat during the winter (TSD IV: MN-S). Commercial fishing is discussed in Section 17.3.3.1, and its role in the traditional economy is discussed in Section 18.3.6.1.

Along with hunting and trapping, MN-S citizens have fished the lakes, rivers, and streams in northern Saskatchewan for a long time. Fishing is integral to MN-S citizens who fish to maintain their connection with the land and to support their families financially.

> Community members rely on fishing, both personally and commercially, especially during winter or when there is no work. Members used to fish commercially all over the north. (TSD IV: MN-S)

Preston Lake was identified as an important Lake for fishing in the RSA (TSD IV: MN-S). In the LSA, the MN-S has documented fishing in Beet Lake, Dennis Lake, Clearwater River, Derkson Lake, Koops Lake, and Gall Lake, all located east of Patterson Lake, as well as three small lakes northwest of Patterson Lake (Figure C, Figure D, and Table 1 in TSD IV: MN-S). One MN-S member noted that are fewer fish in the lakes in the area of the Project in general (TSD IV: MN-S). Patterson Lake was also noted as an important place to hunt and fish, though there were concerns with recent industrial development activities affecting access (TSD IV: MN-S).

16.3.3.2.3 Gathering

Métis Nation – Saskatchewan citizens gather plants in the LSA and RSA, including medicinal plants and berries (TSD IV: MN-S). Berries are considered very important and are either eaten fresh or dried for future use (MN-S 2011; MN-S-JWG 2019a). Berry picking is also an important social activity for the MN-S as "extended families would go together in large groups to pick berries, often for days at a time" (MN-S 2011). Other plants harvested by MN-S citizens include rat root (sweet flag; *Acorus americanus)*, sweet grass (*Anthoxanthum hirtum* ssp*. Arcticum)*, medicinal plants (unspecified), teas, birch sap, and wild rice (TSD IV: MN-S). A full list of species gathered by the MN-S was not provided in the IKTLU Study.

Gathering sites identified by the MN-S in the LSA include the Patterson Lake area for medicinal plants and berries, the Gedak Lake and Dennis Lake areas for berries (Table 1 in TSD IV: MN-S). A general use area was mapped around the east shore of Forrest Lake and Beet Lake, and Forrest Lake, which overlap with the maximum disturbance area (Figure C and Figure D in TSD IV: MN-S).

16.3.3.2.4 Hunting

Métis Nation – Saskatchewan citizens engage in hunting among other harvesting activities to support their families. Hunting remains a way to maintain connection with Mother Earth, Métis ancestors, and extended family, which are all important for maintaining good health and well-being (MN-S 2011). Citizens living in the MN-S NR2, which includes the LSA, stress how resource harvesting provide citizens with "a shared identity, sense of community and permanence" (TSD IV: MN-S).

Métis Nation – Saskatchewan citizens hunt throughout the LSA and RSA. Moose is an important species for hunting. Some MN-S citizens reported that moose have moved farther away because of too much activity in the area of the proposed Project (TSD IV: MN-S). Other harvested species include deer, duck, and grouse (TSD IV: MN-S). Species traditionally hunted by MN-S citizens as specified in the IKTLU Study (TSD IV: MN-S) are listed in Table 16.3-6.

Table 16.3-6: Species Hunted by the Métis Nation – Saskatchewan

Species Hunted by the MN-S	
▪ Moose ▪ Mule deer ▪ White-tailed deer ▪ Black bear	▪ Grouse spp. ▪ Duck spp.

Source: TSD IV: MN-S.
MN-S = Métis Nation – Saskatchewan.

One citizen noted the communal aspect of harvesting in certain areas:

> One member, in fact, hunts all over northern Saskatchewan, including from La Loche to Cluff Lake. He has a trapline, but he hunts the entire area, stating that this is common practice for everyone in the community. Many community members use the area covered by his trapline for harvesting, as does he with others' traplines. (TSD IV: MN-S)

Other citizens noted the breadth of their hunting areas, which include the LSA and RSA:

> Members who hunt also noted that they hunt everywhere: around Bear Creek and Turnor Lake, Hook Lake and Patterson Lake, on both sides of Highway 955. One member said that he used to fish and hunt more often around Patterson Lake but now feels that it is too dangerous, like he is always being watched. He still uses the area around Patterson Lake, mostly to hunt moose. (TSD IV: MN-S)

Specific hunting areas located in the LSA identified by the MN-S include in the areas of Gedak Lake; Dennis Lake; Derkson, Koop, and Gall lakes; and Patterson Lake including within the maximum disturbance area (Table 1, Figure C, and Figure D in TSD IV: MN-S).

Despite the breadth of hunting areas, MN-S citizens have noted a change in all harvesting activities, including hunting, because of an increase in industrial developments, such as the Cluff Lake Mine (MN-S-JWG 2019a).

16.3.3.2.5 Trapping

Métis Nation – Saskatchewan citizens trap in the LSA and RSA. In the RSA, the MN-S has identified one trapline along the southern shore of the north arm of Lloyd Lake (TSD IV: MN-S). In the LSA, the MN-S has identified one trapline that extends towards the east from north of Patterson Lake and south of the Gedak Lake and Broach Lake area (Figure C and Table 1 in TSD IV: MN-S). Species traditionally trapped by MN-S members as specified in the IKTLU Study (TSD IV: MN-S) are listed in Table 16.3-7.

Table 16.3-7: Species Trapped by the Métis Nation – Saskatchewan

Species Trapped by the MN-S	
▪ Rabbit (snowshoe hare) ▪ Beaver ▪ River otter ▪ Muskrat ▪ Porcupine	▪ Canada lynx ▪ Grey wolf ▪ Red fox ▪ Squirrel ▪ American marten

Source: TSD IV: MN-S.
MN-S = Métis Nation – Saskatchewan.

Traplines are culturally important for MN-S citizens. They provide connection to the land and an opportunity to exercise Treaty Rights. They are also used communally and, as such, strengthen bonds among citizens.

> He [an MN-S citizen] has a trapline, but he hunts the entire area, stating that this is common practice for everyone in the community. Many community members use the area covered by his trapline for harvesting, as does he with others' traplines. This communal use of traplines and the area surrounding them is critical not only to members' ability to exercise their rights but also to their ability to monitor and ensure the region's health. (TSD IV: MN-S)

16.3.3.2.6 Culturally Important Sites and Areas

Métis Nation – Saskatchewan citizens value the LSA and consider it culturally important to their continued use of the land. They consider the area important not only for harvesting but also for its role in the larger landscape.

> Métis Nation – Saskatchewan Northern Region 2 members note that Petit Point and Patterson Lake are sites of both historic and current value, Patterson Lake being paramount to the Métis Nation – Saskatchewan Northern Region 2 members. It is their lifeblood. It feeds the lakes in the south and affects all the waterways. Spirit Creek and the Clearwater River are critical to their sustenance and traditions … (TSD IV: MN-S)

There were no cultural sites and areas identified by the MN-S in the LSA, but several were reported in the RSA, including at lakes directly north of the LSA (TSD IV: MN-S).

16.3.3.3 Birch Narrows Dene Nation

While the BNDN has documented use in the LSA, members also engage in activities closer to their home community, including at Turnor Lake, Zander Lake, and Careen Lake (TSD II: BNDN).

16.3.3.3.1 Occupancy, Habitation, and Access

According to the BNDN, there are four habitation sites in the LSA, which are cabin sites used while fishing. Two sites are located on the north shore of Patterson Lake, potentially within the maximum disturbance area, and two sites are situated on the north shore of Forrest Lake (Figure 3 in TSD II: BNDN). The area is considered excellent for fishing by BNDN members.

> . . . all the lakes . . . [have] . . . big jackfish up north. . . . 40 pounds I got [in Patterson Lake], 30 pounds . . . . Lake trout too sometimes. Thirty pounds, 40 pounds . . . (TSD II: BNDN)

The travel routes identified by the BNDN in the LSA include a transportation route that runs east–west located just south of Patterson Lake, within the maximum disturbance area (Figure 3 in TSD II: BNDN). In the RSA, the BNDN noted it is common for members to travel between Turnor Lake and Lake Athabasca. They also noted that members of the Athabasca Denesųłiné will travel south to the communities (TSD II: BNDN).

Birch Narrows Dene Nation members highlighted the importance of being able to move freely through the landscape to engage in traditional activities:

> Even today . . . I remember . . . way back when we were kids, like living in Clear Lake and going all over the place. All summer long families used to leave. All summer long, they'd go from one fish camp to the other right 'till September. We never stayed at home . . . we were nomads, they said . . . . The only time we stayed in Clear Lake was in the wintertime. Sometimes, even we'd leave in the winter too and go stay someplace. Always going from one place to the other. (TSD II: BNDN)

The BNDN also stresses the cultural importance of the area for all Dene because of the historical use and occupancy of the area by Dene people (BNDN-JWG 2019). The BNDN noted that knowledge of, and connection to, a place links generations through personal and collective memory (TSD II: BNDN). For example, one BNDN member commented about Patterson Lake:

> Around this area here, not only my dad, those old people have been trapping around this area, right to Cluff Lake and all over, the people a long time ago. That's the First Nations land. That's my land it's on. I'm a First Nation. (TSD II: BNDN)

16.3.3.3.2 Fishing

Fishing, like trapping, is important for BNDN members as a source of food and as a commercial activity (Section 17.3.3.1, Commercial Fishing, and Section 18.3.6.1). It is also important to support community bonds as Elders pass down their knowledge to younger people (TSD II: BNDN). The species BNDN members fish are presented in Table 16.3-8.

Table 16.3-8: Species Fished by the Birch Narrows Dene Nation

Species Fished by the BNDN	
▪ Jackfish (northern pike) ▪ Pickerel (walleye)	▪ Whitefish (lake whitefish) ▪ Lake trout ▪ Suckers

Source: TSD II: BNDN.
BNDN = Birch Narrows Dene Nation.

Fishing-specific values were recorded in the BNDN's IKTLU Study. The fishing values include cabin sites used for fishing; catch sites for lake trout, whitefish, jackfish, pickerel, and suckers; commercial fishing areas; net fishing areas; winter fishing sites; and trails to access fishing sites. Nineteen fishing values were identified within 250 m of the Project footprint, another 39 fishing values were within 5 km of the Project footprint, and a further 11 fishing values were identified within 25 km of the Project footprint (Table 1 in TSD II: BNDN).

Preston Lake was identified as an important Lake for fishing in the RSA (TSD II: BNDN). Some BNDN members note that, within the LSA, Patterson Lake is a waterbody with a diversity of fish species and has historically supported high quality and large fish.

> I was fishing with the old people in La Loche . . . . Went there [Patterson Lake] one summer, one winter [in the 1970s], we were fishing. Right on the lake they had a cabin on the road . . . there's all kinds of fish right there too . . . . Trout, pickerel, whitefish, mariah. (TSD II: BNDN)

However, other BNDN members are currently cautious about fishing Patterson Lake or eating fish caught there.

> Like I said, I've never seen fish like with – it's like it was just full of pimples or something. The fish from that Patterson Lake. I never – I fished there one day and the next day out there I seen those fish. I just pulled out all my nets. (TSD II: BNDN)

Birch Narrows Dene Nation members fish other lakes in the LSA, including Forrest Lake. Members also fish in several lakes in their traditional territory but outside the LSA. Fishing has typically meant moving from lake to lake through a season (TSD II: BNDN).

16.3.3.3.3 Gathering

Birch Narrows Dene Nation members harvest plants for food and medicine in the LSA and RSA. The BNDN has noted two blueberry gathering sites within 250 m of the Project footprint; one is located on the north shore of Patterson Lake, and the other is located on the south shore of Patterson Lake, potentially within the Project maximum disturbance area (Table 1 and Figure 2 in TSD II: BNDN). A full list of species gathered by the BNDN was not provided in the IKTLU Study. Birch Narrows Dene Nation members noted that the land is where their livelihoods were, as well as clothing, food, and medicines (BNDN-JWG 2019).

16.3.3.3.4 Hunting

For the BNDN, hunting is an important activity to pass on cultural memory, strengthen community bonds, and ensure healthy, affordable diets. One member shared:

> Mostly off the land instead of always having to run to the store where you spend your money on high-priced food . . . [I] hardly eat . . . from the store. I always make sure I have a lot of moose meat, fish, and rabbits and whatever I can get . . . I've been living that way for quite a while now, ever since I . . . was able to get a gun and go out and shoot . . . . And I have nets that I get people to set for me and I get fish . . . . It's very important to me [for her to get her food from the land]. (TSD II: BNDN)

Another BNDN member shared that they hunt so they could share meat with Elders who were no longer able to hunt "Hunt for the [E]lders and that all the time . . . But the ones that can't go out for themselves anymore. Yeah. So, we go through that" (TSD II: BNDN).

Hunting is an important part of Dene culture, and BNDN members hunt large and small game throughout their traditional territory, including moose, deer, and birds. Moose are considered a current staple, and BNDN members previously relied on caribou, but they have become increasingly rare. Some BNDN members noted a decrease in the populations of large game in general, including moose (TSD II: BNDN).

Species traditionally hunted by BNDN members as specified in the IKTLU Study (TSD II: BNDN) are listed in Table 16.3-9.

Table 16.3-9: Species Hunted by the Birch Narrows Dene Nation

Species Hunted by the BNDN	
▪ Moose ▪ Woodland caribou ▪ Barren-ground caribou	▪ Mule deer ▪ White-tailed deer ▪ Birds

Source: TSD II: BNDN.
BNDN = Birch Narrows Dene Nation.

Birch Narrows Dene Nation members have hunted or currently hunt in the LSA and RSA. Hunting and trapping values within 25 km of the Project (i.e., the extent of the IKTLU Study area) include temporary resting locations during moose hunts, trails for accessing hunting areas, and sites for harvesting and processing moose. Twelve hunting and trapping values were identified within 250 m of the Project footprint, which includes the maximum disturbance area; another three hunting and trapping values were within 5 km of the Project footprint; and an additional 18 hunting and trapping values were identified within 25 km of the Project footprint (TSD II: BNDN).

Moose are an important resource for BNDN members, though some also commented on the importance of caribou.

> [Discussing hunting around Lloyd Lake in the 1970s] Well we used to get about two moose, sometimes one or two . . . . Well probably at the mouth of this creek right here, right, that's where we had got two moose. (TSD II: BNDN)

> I've been there [Lloyd Lake] because I remember I went there with a partner that we went hunting and he had a camp on that point, and then we went camping around that area. That was back in 1970s some time, I forget when was that, we went hunting there . . . . And also that road, after that road was laid, it was first opened, we went hunting way down to Cluff Lake . . . .we went hunting on that road to Cluff Lake for caribou, when the mine was open already. (TSD II: BNDN)

16.3.3.3.5 Trapping

While the importance of commercial trapping has changed over time, BNDN members have continued to trap as it is an important source of food and furs for community members. The species trapped by BNDN members are presented in Table 16.3-10.

Table 16.3-10: Species Trapped by the Birch Narrows Dene Nation

Species Trapped by BNDN		
▪ American marten ▪ Canada lynx ▪ Grey wolf ▪ Mink	▪ Squirrel ▪ Fisher ▪ Beaver ▪ Muskrat	▪ Grouse spp. ▪ Rabbit (snowshoe hare)

Source: TSD II: BNDN.
BNDN = Birch Narrows Dene Nation.

Birch Narrows Dene Nation members trap in the LSA and RSA, and reported twelve hunting and trapping values within 250 m of the Project footprint, which includes the maximum disturbance area; another three hunting and trapping values within 5 km of the Project footprint; and an additional 18 hunting and trapping values within 25 km of the Project footprint (Table 1 in TSD II: BNDN). The 33 reported hunting and trapping sites within 25 km of the Project include snare sites for grouse and rabbits; trapping locations for marten, beaver, fox, mink, and lynx; and water and terrestrial trails for accessing trapping locations. The specific number of trapping locations is not reported separately from hunting locations (TSD II: BNDN).

Traplines are often organized around a cabin that trappers use throughout the season. Birch Narrows Dene Nation members have trapped in the LSA near Patterson Lake.

> [Describing how his father and others trapped in the proposed Project, around Naomi Lake, prior to 1933] That's First Nation land. They've been trapping, they've been using trapping some of them . . . . All people they used to trap like this trap around the country, the whole place there. (TSD II: BNDN)

Birch Narrows Dene Nation members have changed their trapping activities over time because of government regulation, declining pelt prices, and changes in wildlife distribution. Government regulation, which can support critical species when required, is also an impediment to subsistence harvesting.

> . . . – in the olden days, like I said, there was kind of no limit to who had the rights to fish, it was open for trapping and fishing. It was like that before, you know, so people from all over, from Buffalo, La Loche, even from Île à la Crosse, they used to fish up this area. It wasn't only La Loche or Turnor area, it was open . . . . Yeah, that was the system before, but now it's not like that. Even us right now and I think – this piece that we have, we only kind of in . . .the '70s, we were only allowed our dad trap, our grandparents trap even in that limit, and sometimes you won't believe in that little area there was about 20, 25 trappers in that area. Now it's not like that . . . . (TSD II: BNDN)

Declining fur prices make it difficult for BNDN members to recoup the costs of trapping. Birch Narrows Dene Nation members have been focused on marten and lynx because their pelts have demanded the highest prices recently, but now trapping just covers the cost of gas, according to one BNDN member (TSD II: BNDN). Another BNDN member commented that they now use their trapping cabin for summer holidays. More information on trapping and its role in the traditional economy is included in Section 17.3.2 and Section 18.3.6.1.

16.3.3.3.6 Culturally Important Sites and Areas

The IKTLU Study documents other culturally important sites in the LSA (TSD II: BNDN):

- a teaching area and portage location within 250 m of the proposed Project maximum disturbance area;
- a gathering place and collection sites for fresh water within 5 km of the proposed Project; and
- a Dene place name within 25 km of the proposed Project.

Cultural sites were mapped by the BNDN in the LSA on the north and south ends of Patterson Lake (Figure 1 and Figure 5 in TSD II: BNDN). In addition to these sites, BNDN members value the area around Patterson Lake for its historical use and connection to BNDN ancestors and for the environmental features of the area.

> It's nice [around Patterson Lake], you know? It's a lot of sand and jack pine and it's not really thick. It's, I think it's old growth, if I could remember. It's a really nice area. Anywhere north is nice. It's kind of the same from Patterson, you know, west and east. A lot of sand and nice clear water. And it's . . . where we go, sometimes if we're lucky to fly up north or even – it's the same area. I mean it's part of the same, like the bush – jack pine and – but it's a nice area though. (TSD II: BNDN)

One BNDN member noted that there is a traditional Dene gathering site in the area of the Project that was used by northern communities for gathering together during the winter months and participating in social activities such as dancing, singing, ceremony, and marriages (BNDN-JWG 2019).

16.3.3.4 Buffalo River Dene Nation

While the BRDN has documented usage in the LSA, members also use areas closer to Dillon on Peter Pond Lake and near Vermette Lake, where the BRDN have a culture camp.

16.3.3.4.1 Occupancy, Habitation, and Access

There is limited documented use by BRDN in the LSA, with most of the usage occurring in the RSA (TSD III: BRDN). According to the BRDN, Highway 955 is a travel corridor for the community, and north–south travel between the community and the communities of the Athabasca Basin has always been important.

> I hear a little bit of a talk . . . from the [E]lders. They're all gone now. People used to travel between Buffalo River, Cold Lake, Black Lake. We had our own, mostly water systems. And probably trails too. So, people – not as much as today, but you know, people still travelled in between those places . . . . But usually the main rivers like Clearwater . . .there was probably people up at Cluff Lake . . . . they got there somehow . . . . up at Uranium City and Camsell Portage and Black Lake and Stoney Rapids, Fond du Lac. They – I don't know the history and I don't know how they got there, but there was intermarriage and inter travel between these places. (TSD III: BRDN)

The BRDN has reported use of the Dyck Lake area, located in the LSA, as an important and productive trapping area where members have cabins and there is a network of high-quality trails.

> Right about there [on Dyck Lake] is where we built two cabins, right there. And from there we went to this lake and followed it to another lake way up here. And yeah we did the majority of our trapping throughout here and onto these little lakes. And from there you can get back into Turnor Lake from there. You can actually get there by snowmobile. I believe there's still trails to date. I've got friends in Turnor Lake that keep in touch where we go trapping and two of them still go up there and they trap around there. (TSD III: BRDN)

> Yeah, it's really good trapping areas [around Dyck Lake] because of the terrain, the lakes, they are close, interconnected, and you can get trails into them as you go along without really doing any kind of major trail cutting. You can get around obstacles and keep going instead of just cutting that tree down, cutting that tree down. . . . (TSD III: BRDN)

The connection between BRDN members and the land is important for maintaining and passing on their culture and strengthening intergenerational ties. A BRDN member shared,

> but here we got our own land to go hunting; I can go hunting here any time. I don't need a GPS because I know my country there. I can walk back here because my dad raised me all over for hunting. (TSD III: BRDN)

16.3.3.4.2 Fishing

Fishing is important for BRDN members for subsistence and commercial purposes. Commercial fishing is discussed in Section 17, and its role in the traditional economy is discussed in Section 18. Fishing also helps strengthen family and community bonds, either by spending time on the land with other community members or through sharing catches. Fishing by BRDN members is often carried out when they are in an area for another purpose, such as for hunting or trapping. Fish is an important part of BRDN member diets.

> Well, not [fishing] commercially but to eat . . . like I said we'll set a net there and . . . catch whitefish and then some of these lakes carry trout so we . . . [fish] that too. And the [E]lders advice, we'd take nets to that lake and then fish for trout on that lake. I believe even Dyck Lake had trout on it. (TSD III: BRDN)

Note that Dyck Lake is located in the LSA. The species BRDN members fish in the RSA are presented in Table 16.3-11.

Table 16.3-11: Species Fished by the Buffalo River Dene Nation

Species Fished by the BRDN	
▪ Jackfish (northern pike) ▪ Pickerel (walleye)	▪ Whitefish (lake whitefish) ▪ Lake trout

Source: TSD III: BRDN.
BRDN = Buffalo River Dene Nation.

Fishing-specific values were recorded in the IKTLU Study (TSD III: BRDN). The values include catch sites and travel routes used for fishing. One fishing value was identified within 250 m of the Project footprint; no additional fishing values were within 5 km of the Project footprint, and another eight fishing values were identified within 25 km of the Project footprint (TSD III: BRDN).

One BRDN member shared:

> And we had nets like this [in Preston Lake], and then where we went down about here. We had some over there . . . . But you only catch overnight, then you have to move again. . . . some lakes are like that. Pull out and then set again, reset. That's the only way you catch fish. But there were – at that time there used to be a bigger limit on it. There's pickerel and trout on that lake. (TSD III: BRDN)

Dyck Lake, located in the LSA, was also noted by a BRDN member as supporting trout (TSD III: BRDN).

16.3.3.4.3 Gathering

The BRDN notes a firewood gathering site within 25 km of the Project and in the RSA (TSD III: BRDN). Plant gathering is an important activity for BRDN members. A full list of species gathered was not provided in the IKTLU Study. Some plants are gathered for traditional medicines, which is considered special and important knowledge.

> My grandpa was a traditional medicine man . . . . [His grandfather taught him], from the bush. But he told us it's not an easy thing . . . you gotta know something and you gotta respect it. When I was young, he wanted to give it to me . . . . See a lot of things – when my grandpa used to have a spirit, it was a loon . . . . He . . . [taught] me a lot of things about medicine. How to make it, how – which one [to use] . . . (TSD III: BRDN)

> I use medicine from the ground too. And I still got it at my house, yeah. That is my culture because I use my medicine. I use it all the time and I still use it because my mom gave it to me, his dad used . . . Indian medicine and he gave it to his mom and he gave it to me and now I use it . . . . (TSD III: BRDN)

16.3.3.4.4 Hunting

Hunting is an important activity for the BRDN as it provides nutritious food for community members. Moose is the primary species hunted by BRDN members today. Species traditionally hunted by BRDN members as specified in the IKTLU Study (TSD III: BRDN) are listed in Table 16.3-12.

Table 16.3-12: Species Hunted by the Buffalo River Dene Nation

Species Hunted by the BRDN	
▪ Moose ▪ Woodland caribou ▪ Elk ▪ Mule deer	▪ White-tailed deer ▪ Black bear ▪ Rabbit (snowshoe hare)

Source: TSD III: BRDN.
BRDN = Buffalo River Dene Nation.

> Oh yeah [moose are], very, very important. Like we said, there's a lot of people using moose meat. You know, really good meat for us . . . . We know how to handle it . . . . even from the stomach . . . we get some food from out of there too. (TSD III: BRDN)

In the past, BRDN members would travel extensively to hunt moose and caribou and follow their seasonal movements. Caribou were hunted in the Patterson Lake area in the past. Now, the range for hunting is more limited. Some members will still travel north to areas near Wollaston Lake and Fond du Lac to hunt caribou, but in general, members stay closer to their home community.

Buffalo River Dene Nation members have hunted or currently hunt in the LSA and RSA. Site-specific hunting and trapping values within 25 km of the Project (i.e., the extent of the IKTLU Study area) were identified in BRDN's IKTLU Study, and include travel routes used for hunting. One hunting or trapping value was identified within 250 m of the Project footprint; no additional hunting or trapping values were identified within 5 km of the Project footprint, and another 11 hunting or trapping values were identified within 25 km of the Project footprint (Table 1 in TSD III: BRDN).

16.3.3.4.5 Trapping

Trapping is an important activity for BRDN members culturally and commercially. Trapping has brought together BRDN members and strengthens kinship bonds and broader regional bonds (TSD III: BRDN). The area around Patterson Lake has been used for trapping activities. Species trapped by BRDN members are listed in Table 16.3-13.

Table 16.3-13: Species Trapped by the Buffalo River Dene Nation

Species Trapped by the BRDN	
▪ Rabbit (snowshoe hare) ▪ Beaver ▪ Coyote ▪ Fox (red fox) ▪ Canada lynx	▪ Mink ▪ River otter ▪ American marten ▪ Grey wolf ▪ Weasel

Source: TSD III: BRDN.
BRDN = Buffalo River Dene Nation.

The distribution of hunting and trapping values are recorded in the IKTLU Study (TSD III: BRDN). One hunting or trapping value was identified within 250 m of the Project footprint; no additional hunting or trapping values were within 5 km of the Project footprint; and an additional 11 hunting or trapping values were identified within 25 km of the Project footprint (Table 1 in TSD III: BRDN). The site-specific values recorded for trapping are as follows: teaching areas for trapping; travel routes used for trapping; and trapping sites for lynx, marten, beaver, fisher (*Pekania pennanti*), muskrat (*Ondatra zibethicus*), squirrel, weasel (*Mustela* spp.), otter, and ermine (*Mustela erminea*).

The Patterson Lake area has been trapped by the BRDN in the past. Some BRDN members recalled other community members having used the area to trap and fish.

> Not that much that I remember but, he used to tell me, he used to trap from here [Patterson Lake] . . . a long time ago, there was no such thing as a [trapping] licence or anything . . . . So people used to – they used to go trapping. North, wherever. That way, on the other side of the lake here. (TSD III: BRDN)

> The only ones I know there is a Patterson Lake there. Yeah, I heard lots about that trappers and fishermen, they go there . . . . That's why they mention those lakes lots of time. (TSD III: BRDN)

The Dyck Lake area, located in the LSA, was also reported by the BRDN as an important and productive trapping area (TSD III: BRDN).

16.3.3.4.6 Culturally Important Sites and Areas

Other than cabins, which are captured under occupancy, habitation, and access above, the BRDN did not document any other culturally important sites and areas in the LSA or RSA (TSD III: BRDN).

16.3.3.5 Athabasca Denesųłiné

The Athabasca Denesųłiné way of life is interwoven with the movements of the Beverly, Ahiak, Bathurst, and Qamanirjuaq barren-ground caribou herds. "Where there are barren-ground caribou there are Athabasca Denesųłiné" (TSD VI: YNLR).

> While we talk about caribou being the lifeblood of the Athabasca Denesųłiné, it must be remembered that the range of the caribou defines the extent of their territory and it is within that area their members . . . conduct many on-the-land activities beyond the harvest of caribou. (TSD VI: YNLR)

16.3.3.5.1 Occupancy, Habitation, and Access

The Athabasca Denesųłiné have documented overnight sites, an important overnight area, and travel corridors in the RSA. Overnight sites in the RSA are on lake shores and the documented overnight site farthest south is on Hook Lake (Figure 12 in TSD VI: YNLR).

The ability to travel is important for the Athabasca Denesųłiné. One member noted:

> This is Dene land, we used the land to eat. Dene were in this area for generations, the [E]lders told me. This land travelled here, there was not trapping then, it was used only for hunting. They used all this area. (TSD VI: YNLR)

16.3.3.5.2 Fishing

The Athabasca Denesųłiné use fishing techniques that have been passed down from older generations. They often fish while doing other resource harvesting activities, such as trapping. One community member shared:

> There is fish in every lake, when you go trapping you carry a net with you. You set a net and catch fish. Mostly suckers and whitefish. Sometimes even pickerel. I set a net, I saw an otter pull a fish and he ate it. (TSD VI: YNLR)

The LSA and a portion of the RSA are considered an important area for fish. In the RSA to the northeast of the LSA is a large fish harvesting area (Figure 11 in TSD VI: YNLR).

16.3.3.5.3 Gathering

The Athabasca Denesųłiné harvest plants. Plants harvested include Ts'aili Teli (i.e., frog tail), Labrador tea, and blueberries. Plants are gathered for food and medicine. One community member shared:

> There is a lot of medicine, my dad and I use to collect them. Ts'aili Teli [Frog Tail] on the side of the road, it looks like red rose, that is medicine. They pay respect to the lake and plants when they harvested the plants . . . . He used to bring it to mom, and mom would drink it. It is good for body aches, made into tea. She mixed it with another plant, and made it into a tea. (TSD VI: YNLR)

The LSA and a portion of the RSA are considered an important plant area by the Athabasca Denesųłiné (Figure 13 in TSD VI: YNLR).

16.3.3.5.4 Hunting

The LSA is located in an area that the Athabasca Denesųłiné consider a “big game important area” and a “small game and furbearer important area” (Figures 9 and 10, TSD VI: YNLR). Northeast of the LSA and in the RSA is considered a big game harvesting area and a small game and furbearer harvesting site. Important species for the Athabasca Denesųłiné include barren-ground caribou, woodland caribou, moose, black bear, and white-tailed deer (*Odocoileus virginianus*). Harvesting large game is important because large game is a valuable food source, and the activity is fundamental to Denesųłiné culture and has been passed down between generations (TSD VI: YNLR).

16.3.3.5.5 Trapping

The LSA is considered an important area for small game and furbearers (Figure 10 in TSD VI: YNLR). A large furbearer harvesting area is located in the RSA, northeast of the LSA. According to interviews, trapping is important because it provides food, fur, and other resources (TSD VI: YNLR). Species included in the small game and furbearer category are presented in Table 16.3-14.

Table 16.3-14: Small Game and Furbearers Harvested by the Athabasca Denesųłiné

Small Game and Furbearers Harvested by the Athabasca Denesųłiné	
▪ Rabbit (snowshoe hare) ▪ Mink ▪ Beaver ▪ Fisher ▪ American marten ▪ Muskrat ▪ Fox (red fox)	▪ Grey wolf ▪ River otter ▪ Wolverine ▪ Squirrel ▪ Weasel ▪ Porcupine ▪ Bear

Source: TSD VI: YNLR.

The species named in Table 16.3-14 are both trapped and hunted. Information provided by the Athabasca Denesųłiné highlights the importance of small game in maintaining intergenerational bonds as Elders pass skills down to community youth (TSD VI: YNLR).

16.3.3.5.6 Culturally Important Sites and Areas

A large cultural area (i.e., Dene name place) is located northeast of the LSA and in the RSA. The Athabasca Denesųłiné did not document culturally important sites and areas within the LSA (TSD VI: YNLR).

16.3.3.6 Summary of Contemporary Indigenous Land and Resource Use

The CRDN, MN-S, BNDN, BRDN, and Athabasca Denesųłiné practise Indigenous land and resource use activities throughout the RSA, including hunting, trapping, fishing, and plant gathering, and use of cultural sites, habitation sites, and travel routes. Indigenous land and resource use is also actively pursued in the LSA by the CRDN, MN-S, and BNDN, and to a lesser extent the BRDN. The Athabasca Denesųłiné did not identify any specific traditional activities overlapping with the LSA. Within the LSA, the Patterson Lake area is an important land use area for the CRDN and MN-S. The CRDN described the Patterson Lake area as being “situated within the core heartland of the Nation’s primary traditional use and occupancy areas ‘Up North’” (TSD V.2: CRDN) and as “historically and currently recognized as a ‘good for everything’ harvesting area which may have sustained CRDN members through time beyond living memory” (TSD V.1: CRDN). The MN-S has stated that the Patterson Lake area has historical and current value and is paramount to its members, and their lifeblood (TSD IV: MN-S).

The CRDN, MN-S, BNDN, and BRDN have continued to pursue land and resource activities throughout the LSA and RSA despite the expansion of industrial development and implementation of government policies that have displaced activities or discouraged their pursuit. Knowledge of the lands and waters in the Patterson Lake area has been passed down through the generations. However, Indigenous Groups are experiencing land disturbances and access restrictions associated with mining exploration and development and natural events such as forest fires. Indigenous land and resource use activities in the LSA and RSA are supported by land-based learning programs by Indigenous Groups in an effort to revitalize traditional activities, support community well-being, and provide opportunities for younger generations to learn traditional ways of life and connect with their culture.

16.4 Project Interactions and Mitigations

The pathways analysis identified potential adverse effects of the Project on cultural and heritage resources and Indigenous land and resource use, identified practicable mitigation for these potential effects, and determined whether potential effects could be sufficiently mitigated such that they are not expected to cause a residual adverse effect. As described in Section 16.2.7, Project Interactions and Mitigations, the pathway analysis assigned each potential effect as:

- no pathway (i.e., mitigation results in no effect on cultural and heritage resources and Indigenous land and resource use);
- secondary pathway (i.e., mitigation results in a negligible effect on cultural and heritage resources, and Indigenous land and resource use); or
- primary pathway (i.e., effect that is greater negligible and carried forward for further assessment).

The pathway analysis is summarized in Table 16.4-1. The subsections following the table provide the rationale used to assign potential effects on the no pathway and secondary pathway categories and lists primary pathways. Both positive and negative attributes were examined, where applicable. Each Project interaction identified as a primary pathway was carried forward for detailed assessment in Section 16.4.3. Effects pathways apply to all Project phases unless otherwise noted.

The environmental design features and mitigations in Table 16.4-1 represent the list of actions used to inform the pathway analysis as part of preparing the EIS. In addition to this list of key actions, NexGen would implement the Environmental Protection Program, which would describe the processes required to monitor and characterize emissions from Project facilities and activities. This program would be used to periodically evaluate mitigation performance and identify additional mitigation, where required, and prompt potential adaptive management measures (Section 16.8, Monitoring, Follow-Up, and Adaptive Management). Where relevant, adaptive management measures may also be proposed to address uncertainties associated with effects predictions and mitigation. The process for determining when, how, and where to use adaptive management would be described within the Integrated Management System Manual.

Potential accidents and malfunctions that have the capability to influence biophysical or human environments are discussed in Section 21, Accidents and Malfunctions.

Table 16.4-1: Potential Effects Pathways for Cultural and Heritage Resources and Indigenous Land and Resource Use

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
HR-01	Land clearing during **all Project phases**	**Disturbance of heritage resources:** ▪ Land clearing could affect unknown heritage resources, which are legally protected	▪ Implement a chance find procedure during land clearing activities ▪ **Limit the Project footprint** to the extent practical using practices such as: o optimizing use of cleared areas for Project activity o using existing road infrastructure, including existing access road and bridge crossing o storing tailings underground o designing an efficient infrastructure footprint (i.e., buildings clustered together)	Secondary pathway
ILU-01	Project components/activities that contribute to disturbance of the Project footprint during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft/mine development ▪ process plant ▪ additional infrastructure (e.g., roads, airstrip, camp, maintenance shop, offices) ▪ handling and storage of waste rock, special waste rock, and ore ▪ water intakes for fresh water and process water ▪ ETP and treated effluent discharge ▪ STP and water storage and effluent monitoring ponds ▪ removal of infrastructure ▪ restoration and revegetation of facilities and infrastructure	**Changes to access to and area available for Indigenous land and resource use:** ▪ The Project footprint may restrict access and reduce the area available for or displace Indigenous land and resource use	▪ Implement **Benefit Agreements**, including: o **funding and human resources** to support community-related initiatives including but not limited to cultural and traditional values and o **the establishment of the Implementation Committee** to communicate regularly and to reach early resolution of issues and/or disputes that may arise ▪ Establish an **Environmental Committee** to monitor environmental performance of the Project ▪ Provide funding for **full-time independent Indigenous Monitors** to enable unrestricted environmental monitoring, subject to the Indigenous Monitor complying with appropriate health and safety and other reasonable site-specific requirements ▪ **Limit the Project footprint** to the extent practical using practices such as: o optimizing use of cleared areas for Project activity o using existing road infrastructure, including existing access road and bridge crossing o storing tailings underground o designing an efficient infrastructure footprint (i.e., buildings clustered together) ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ **Reclaim and revegetate** areas where non-permanent Project facilities have been decommissioned ▪ Implement a **Security Program** to provide safe and coordinated access via the access road to locations where other land and resource use is practised ▪ Develop a **Ground Transportation Emergency Response Plan** to address traffic safety on the access road, including education of workers (e.g., staff contractors) ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program	Primary pathway
ILU-02	Project components/activities that contribute to disturbance of the Project footprint, air and dust emissions and deposition, sensory disturbance (e.g., noise, light, vibrations), and presence of workforce **during all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft/mine development ▪ process plant and underground operations ▪ power generation ▪ handling and storage of waste rock, special waste rock, and ore ▪ ETP and treated effluent discharge ▪ water intakes for fresh water and process water ▪ STP and water storage and effluent monitoring ponds ▪ additional infrastructure (e.g., camp, maintenance shop, offices) ▪ removal of infrastructure ▪ restoration and revegetation of facilities and infrastructure ▪ site traffic ▪ transportation of personnel and materials to and from the site	**Changes to the availability of fish, plants, and wildlife for harvesting from changes in abundance and distribution:** ▪ The Project footprint and Project activities may alter the availability of fish, plants, and wildlife for harvesting due to Project-related effects on their abundance or distribution, thus reducing or displacing opportunities for Indigenous land and resource use	▪ Implement **Benefit Agreements** including: o **funding and human resources** to support community-related initiatives including but not limited to cultural and traditional values; and o the establishment of the **Implementation Committee** to communicate regularly and to reach early resolution of issues and/or disputes that may arise ▪ Establish an **Environmental Committee** to monitor environmental performance of the Project ▪ Provide funding for **full-time independent Indigenous Monitors** to enable unrestricted environmental monitoring, subject to the Indigenous Monitor complying with appropriate health and safety and other reasonable site-specific requirements ▪ Implement mitigations **that avoid and limit effects on fish** (Section 11.4, Project Interactions and Mitigations), **vegetation** (Section 13.4, Project Interactions and Mitigations), **and wildlife** (Section 14.4, Project Interactions and Mitigations) ▪ **Limit the Project footprint** to the extent practical using practices such as: o optimizing the use of cleared areas for Project activity o using existing road infrastructure, including existing access road and bridge crossing o storing tailings underground designing an efficient infrastructure footprint (i.e., buildings clustered together) ▪ Implement **Environmental Protection Program** and **Caribou Mitigation and Offsetting Plan** ▪ Implement **Indigenous and Public Engagement Program** to share information on Project plans and activities. The program would include a **Project feedback and grievance mechanism** to record and action issues identified by LPA residents (or other members of the public) ▪ Implement a **Security Program** to provide safe and coordinated access via the access road to locations where other land and resource use is practised	Primary pathway

Table 16.4-1: Potential Effects Pathways for Cultural and Heritage Resources and Indigenous Land and Resource Use

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
ILU-03	Project components/activities that contribute to disturbance of the Project footprint, air and dust emissions and deposition, sensory disturbance (e.g., noise, light, vibrations), and presence of workforce **during all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft/mine development ▪ process plant and underground operations ▪ power generation ▪ handling and storage of waste rock, special waste rock, and ore ▪ ETP and treated effluent discharge ▪ water intakes for fresh water and process water ▪ STP and water storage and effluent monitoring ponds ▪ additional infrastructure (e.g., camp, maintenance shop, offices) ▪ removal of infrastructure ▪ restoration and revegetation of facilities and infrastructure ▪ site traffic ▪ transportation of personnel and materials to and from the site	**Changes to the quality of the Indigenous land use experience:** ▪ Sensory disturbances (i.e., noise, light, air quality, and aesthetics) and safety concerns may change the quality of the Indigenous land use experience in the area surrounding the Project. Similarly, perceptions of the quality of water, fish, plant, and wildlife resources may adversely affect the quality of the experience and/or result in certain areas being avoided. Knowledge of the decommissioned site may change the perceived suitability of the area for Indigenous land and resource use in the future. Changes to the cultural landscape can affect sense of place and the relationship between Indigenous Groups and the land	▪ Implement mitigations **that avoid and limit effects on fish** (Section 11.4), **vegetation** (Section 13.4), **and wildlife** (Section 14.4) ▪ Implement **Benefit Agreements** with the CRDN, MN-S on behalf of the MN-S NR2 Locals, BNDN, and BRDN, each including: o **funding and human resources** to support community-related initiatives including but not limited to cultural and traditional values and o the establishment of the **Implementation Committee** to communicate regularly and to reach early resolution of issues and/or disputes that may arise ▪ Establish an **Environmental Committee** to monitor environmental performance of the Project ▪ Provide funding for **full-time independent Indigenous Monitors** to enable unrestricted environmental monitoring, subject to the Indigenous Monitor complying with appropriate health and safety and other reasonable site-specific requirements ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ **Reclaim and revegetate** areas where non-permanent Project facilities have been decommissioned ▪ Implement procedures to reduce **noise, dust, and light** levels such as: o **enclosing or dampening equipment in process buildings** where the total sound power level is expected to be more than approximately 80 dBA, where feasible o **using noise suppression (i.e., mufflers)** on vehicles and inspect regularly to make sure they are functioning properly o selecting **liquified natural gas as the primary fuel source for power generation** o **applying water and/or dust suppressants to site roads, access road, and airstrip**, as necessary o **limit vehicle speed** on unpaved site roads to reduce fugitive dust during Construction and Operation o **limiting light pollution** to the extent practicable for built infrastructure ▪ Implement **Environmental Protection Program**, **Waste Management Program** ▪ **Implement Effluent and Emissions Plan, and Environmental Monitoring Plan** ▪ Implement **Indigenous and Public Engagement Program** that includes engaging Indigenous land users to share Project information and address any issues as they arise and sharing environmental monitoring results with local communities. The program would include a **Project feedback and grievance mechanism** to record and action issues identified by LPA residents (or other members of the public) ▪ Implement a **Security Program** to provide safe and coordinated access via the access road to locations where other land and resource use is practised ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program ▪ Develop a **Ground Transportation Emergency Response Plan** to mitigate safety risks related to the transportation of materials and equipment to and from the Project site ▪ Develop a **Ground Transportation Emergency Response Plan** to address traffic safety on the access road, including education of workers (e.g., staff contractors) ▪ Develop an **Emergency Response Assistance Plan** for the transportation of uranium concentrate from the Project site	Primary pathway
ILU-04	Project components that contribute to increases in access during **all Project phases**: ▪ access road ▪ transportation of personnel and materials to and from the site	**Changes to the availability of fish, plants, and wildlife for harvesting from increased access and competition for resources:** ▪ The Project may result in changes to the availability of fish, plants, and wildlife for harvesting because of increased competition for resources important to Indigenous land and resource use through changes in access and the presence of the Project workforce during Construction and Operations	▪ **Install a gate at the site entrance** (i.e., gatehouse) to control public access ▪ **Reclaim and revegetate** areas where non-permanent Project facilities have been decommissioned ▪ **Use existing road infrastructure**, including existing access road and bridge crossing ▪ Implement a **Security Program** to provide safe and coordinated access via the access road to locations where other land and resource use is practised ▪ **Identify Indigenous land users** in **Security Program** supporting documentation and outline the process to allow continued access to areas of importance ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program	Secondary pathway

Table 16.4-1: Potential Effects Pathways for Cultural and Heritage Resources and Indigenous Land and Resource Use

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
ILU-05	Project components/activities that contribute to contaminant air criteria and dust emissions and deposition, and treated effluent release during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft/mine development ▪ process plant and underground operations ▪ power generation ▪ handling and storage of waste rock, special waste rock, and ore ▪ ETP and treated effluent discharge ▪ water intakes for fresh water and process water ▪ STP and water storage and effluent monitoring pond ▪ additional infrastructure (e.g., camp, maintenance shop, offices) ▪ removal of infrastructure ▪ restoration and revegetation of facilities and infrastructure ▪ site traffic ▪ transportation of personnel and materials to and from the site	**Changes to air or water quality:** ▪ Changes to air or water quality may result in actual contamination of fish, plants, and wildlife, changing the quality of the resources and discouraging traditional uses in proximity to the Project ▪ Changes to air or water quality may result in actual changes to human health, discouraging Indigenous land and resource uses in proximity to the Project	▪ Implement mitigations that **avoid and limit effects on fish** (Section 11.4), **vegetation** (Section 13.4), and **wildlife** (Section 14.4) ▪ Implement **Benefit Agreements** with the CRDN, MN-S on behalf of the MN-S NR2 Locals, BNDN, and BRDN, each including: o **funding and human resources** to support community-related initiatives including but not limited to cultural and traditional values o the establishment of the **Implementation Committee** to communicate regularly and to reach early resolution of issues and/or disputes that may arise ▪ Establish an **Environmental Committee** to monitor environmental performance of the Project ▪ Provide funding for **full-time independent Indigenous Monitors** to enable unrestricted environmental monitoring, subject to the Indigenous Monitor complying with appropriate health and safety and other reasonable site-specific requirements ▪ **Reclaim and revegetate** areas where non-permanent Project facilities have been decommissioned ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program ▪ Implement **Environmental Protection Program** and **Waste Management Program**, including processes for air, surface water, and groundwater monitoring and mitigation ▪ Implement **Effluent and Emissions Plan, Environmental Monitoring Plan, and Environmental Protection Program** ▪ Implement **Radiation Protection Program** to monitor and keep worker and visitor radiological exposures as low as reasonably achievable ▪ Implement **Indigenous and Public Engagement Program** that includes, among other activities, sharing monitoring results with local communities, engagement of trappers and Indigenous land users to share Project information and address any issues as they arise, and sharing of environmental monitoring results with local communities. The program would include a **Project feedback and grievance mechanism** to record and action issues identified by LPA residents (or other members of the public)	No pathway
ILU-06	Project components/activities that have potential to alter the timing and thickness of ice formation and timing of ice thaw in localized area of the Patterson Lake North Arm – West Basin during **all Project phases**: ▪ ETP and treated effluent discharge	**Safety risk from altered ice conditions:** ▪ Treated water discharged through the diffuser may change timing and thickness of ice formation and timing of ice thaw, which can increase risk of people breaking through the ice	▪ The **final treated effluent diffuser design** would avoid effects on ice cover	No pathway

Bolded text represents the key topic of the environmental design features and mitigation.
CRDN = Clearwater River Dene Nation; MN-S = Métis Nation – Saskatchewan; BNDN = Birch Narrows Dene Nation; BRDN = Birch River Dene Nation; LPA = local priority area; NR2 = Northern Region 2; ETP = effluent treatment plant; STP = sewage treatment plant; dBA = A-weighted decibel.

16.4.1 No Pathways

The following Project interactions were predicted to result in no pathway to Indigenous land and resource use and were not carried forward in the assessment.

ILU-05: Changes to air or water quality:

- Changes to air or water quality may result in contamination of fish, plants, and wildlife, changing the quality of resources harvested and discouraging Indigenous land and resource use in proximity to the Project.
- Changes to air or water quality may result in actual changes to human health, discouraging Indigenous land and resource uses in proximity to the Project.

The first pathway has been addressed through the assessments of intermediate components and VCs (Section 7.2; Section 10, Surface Water Quality and Sediment Quality; Section 11; Section 13; Section 14) and the Environmental Risk Assessment (TSD XXI) by predicting changes to the health of several ecological receptors that are of relevance to Indigenous land users, such as lake whitefish, northern pike, and moose (Table 16.4-2). The second pathway examines the changes in human health from the potential physical and chemical changes to air and water quality, and the potential for actual contamination to discourage land use. Perceived changes in resource quality are separately addressed in quality of resource use experience (pathway ILU-03, Section 16.4.3).

Activities such as land clearing, site preparation, construction of facilities, site traffic, handling of waste rock during Construction and Operations, and removal of infrastructure and revegetation during Closure would generate fugitive dust (Section 7.2). Accumulation of airborne dust produced from the Project could result in local and direct changes to vegetation (Section 13.4), which could affect wildlife habitat. Metals and radionuclides in dust could also affect plants, either indirectly through the soil (Section 12.4.2, Secondary Pathways) or directly through the surface of the plant (Section 13.4), which could affect wildlife.

An ecological risk assessment was completed as part of the Environmental Risk Assessment (TSD XXI) to determine the health risks to aquatic and terrestrial wildlife receptors from the Project air emissions, which included inhalation and ingestion (i.e., soil, sediment, water, plants, animals) exposure pathways. The risk assessment modelled exposure pathways during Operations and for an upper bound scenario (i.e., a more conservative, precautionary model). Results indicated that predicted levels of metals and radionuclides in the environment from the proposed Project for the upper bound scenario would not cause adverse effects on the health of wildlife VCs and other wildlife receptors. The ecological risk assessment also considered exposure to radon gas. All predicted radon gas emissions are well below the radiation dose benchmarks for all ecological receptors.

Following Project Closure, runoff and seepage from the WRSAs and groundwater flow from the underground tailings management facility could alter surface water quality in Patterson Lake and adversely affect the health, survival, and reproduction of wildlife. Proven engineered designs would be applied to the proposed Project to limit runoff and seepage from WRSAs, such as installing covers on the WRSAs at Closure. During Operations, potentially acid generating waste rock would be separated from non-potentially acid generating waste rock, and special waste rock would also be stored separately. The special waste rock stockpile and potentially acid generating WRSA would be lined with high density polyethylene to prevent seepage, and the potentially acid generating WRSA would be constructed with engineered layers for source control of constituents of concern

(Mine Waste Management Plan). Engineered paste tailings would be used to permanently store tailings in the underground tailings management facility to control sources of COPCs.

The far-future scenario was assessed using the regional surface water quality model and included an upper bound scenario (Section 10.2.8, Residual Effects Analysis). Most water quality parameters remained below their respective threshold values in the far-future scenario, except for cobalt and copper. In this scenario, cobalt exceedances were predicted for Patterson Lake North Arm – West Basin and Patterson Lake South Arm. Copper exceedances were predicted for Patterson Lake North Arm – West Basin (Section 10.5.1.2, Regional Surface Water Quality Model). For the upper bound scenario, cobalt exceedances were predicted for Patterson Lake North Arm – West Basin, Patterson Lake South Arm, Forrest Lake North Basin, and Beet Lake. Copper exceedances in the upper bound scenario were predicted for Patterson Lake North Arm – West Basin and Patterson Lake South Arm (Section 10.5.2.1, Regional Surface Water Quality Model).

The ecological risk assessment applied the modelled concentrations of water quality constituents as input values for exposure pathways associated with the ingestion of sediment, water, plants, and animals to determine the health risks to ecological receptors for the far-future and upper bound scenarios. The ecological risk assessment predicted that changes in surface water quality for the upper bound scenario would not cause adverse effects on the health of ecological receptors (TSD XXI).

Regarding fish, the results of the risk assessment indicated that direct toxicity from exposure to elevated copper concentrations cannot be ruled out for selected aquatic receptors (i.e., fish and fish food). An aquatic health assessment was undertaken to further evaluate the potential effects of exposure of aquatic biota in Patterson Lake to elevated copper concentrations (Appendix 11A, Aquatic Health Assessment of the Potential for Adverse Effects of Predicted Far-Future Copper Concentrations in Patterson Lake), focusing on the limited instances where concentrations exceed the minimum receptor-specific threshold of 0.002 mg/L. Predicted concentrations above the low effect threshold may result in potential adverse effects on sensitive aquatic receptors; therefore, a review of the potential magnitude of effects on sensitive species was undertaken. The results of this analysis indicated that adverse effects on aquatic biota are unlikely to occur because predicted copper concentrations are lower than the lowest “low effect” concentration for the most sensitive aquatic species.

Overall, the results of the ecological and aquatic health risk assessments indicate that there would be no adverse environmental health effects on terrestrial and aquatic receptors from Project-related air emissions and changes in water quality. Therefore, this pathway was determined to have no measurable effects on the health of the resources used by Indigenous land and resource users and was not carried forward in the assessment.

The human health risk assessment (Section 15) considered exposure to radionuclides and non-radionuclides due to direct exposure (i.e., breathing or skin contact) or consumption of water and country foods. This pathway focuses on the health of humans. The dose limit for radiation protection from radionuclides is 1 millisievert per year (mSv/yr). For non-radionuclide COPCs, a toxicity reference value was used to assess risk. There are no predicted exceedances of the public dose limit of 1 mSv/yr, and there are no predicted exceedances of the toxicity reference values (i.e., hazard quotient less than 0.2) on receptors for non-radionuclides or non-carcinogens (i.e., copper, cobalt, uranium). No significant adverse effect on any human receptors as a result of releases from the Project is likely. Therefore, this pathway was determined to have no measurable effects on the health of Indigenous land users and was not carried forward in the assessment.

To provide information to Indigenous land users on any changes to air and water quality, an Indigenous and Public Engagement Program would define activities for sharing environmental monitoring results with local communities and for engaging trappers and other Indigenous land users to share Project information, provide Project updates, and provide two-way communication opportunities to hear and address any issues or concerns. Furthermore, NexGen is committed to providing funding for full-time independent Indigenous Monitors to enable unrestricted environmental monitoring, subject to the Indigenous Monitor complying with appropriate health and safety and other reasonable site-specific policies of NexGen. The Indigenous Monitors would report directly to their respective Indigenous Group/community.

Table 16.4-2: Ecological Receptors included in the Assessment

Organism Category	Representative Species	Identified in Indigenous Group IKTLU Study or JWG
Fish	Northern pike (*Esox lucius*)	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
	Lake whitefish (*Coregonus clupeaformis*)	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
Terrestrial vegetation	Lichen	n/d
	Blueberry (*Vaccinium myrtilloides*)	CRDN MN-S BNDN Athabasca Denesųłiné
	Labrador tea (*Rhododendron groenlandicum*)	CRDN Athabasca Denesųłiné
Terrestrial mammals	Woodland caribou (*Rangifer tarandus caribou*)	CRDN BNDN BRDN Athabasca Denesųłiné
	Snowshoe hare (*Lepus americanus*)	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
	Moose (*Alces alces*)	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
	Black bear (*Ursus americanus*)	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
	Red fox (*Vulpes vulpes*)	MN-S BNDN BRDN Athabasca Denesųłiné
	Grey wolf (*Canis lupus*)	MN-S BNDN BRDN Athabasca Denesųłiné

Table 16.4-2: Ecological Receptors included in the Assessment

Organism Category	Representative Species	Identified in Indigenous Group IKTLU Study or JWG
Riparian mammals	Muskrat (*Ondatra zibethicus*)	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
	North American beaver (*Castor canadensis*)	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
	American mink (*Neovison vison*)	CRDN BNDN BRDN Athabasca Denesųłiné
Terrestrial birds	Canada goose (*Branta canadensis*)	CRDN (goose spp.) BNDN Athabasca Denesųłiné (goose spp.)
	Spruce grouse *(Falcipennis canadensis)*	CRDN MN-S BNDN Athabasca Denesųłiné
	Rusty blackbird (*Euphagus carolinus)*	n/d
Riparian birds	Mallard (*Anas platyrhynchos*)	CRDN (duck spp.) MN-S (duck spp.) BNDN (duck spp.) BRDN (duck spp.) Athabasca Denesųłiné (duck spp.)
	Common loon (*Gavia immer*)	MN-S

IKTLU = Indigenous Knowledge and Land Use; JWG = Joint Working Group; CRDN = Clearwater River Dene Nation; MN-S = Métis Nation – Saskatchewan; BNDN = Birch Narrows Dene Nation; BRDN = Birch River Dene Nation; YNLR = Ya'thi Néné Lands and Resources; n/d = no data.

ILU-06: Safety risk from altered ice conditions:

- Treated water discharged through the diffuser may change timing and thickness of ice formation and timing of ice thaw, which can increase risk of people breaking through the ice.

Treated water from the ETP for the proposed Project would be discharged through a diffuser in the Patterson Lake North Arm – West Basin. Based on evaluation of the conceptual design, operation of the diffuser is expected to increase the flow velocity at the lake water surface, which could delay ice freeze-up, reduce ice thickness if ice is formed, and advance ice break-up in a localized area around the diffuser. Project-related changes in ice conditions could increase the risk of injury or mortality if any people walking or snowmobiling over this area of Patterson Lake break through the ice. To prevent this risk, the final treated effluent diffuser design for the Project would avoid changes to ice cover relative to existing conditions; therefore, this pathway was not carried forward in the assessment.

16.4.2 Secondary Pathways

The following Project interactions were predicted to result in secondary pathways to cultural and heritage resources and Indigenous land and resource use and were not carried forward in the assessment.

HR-01: Disturbance of heritage resources:

- Land clearing could affect unknown heritage resources, which are legally protected.

As discussed in Section 16.3.1, no heritage resources were found in field studies and no further studies are required by the Heritage Conservation Branch (Annex IX). Final design would be checked with the Heritage Conservation Branch and further field studies completed prior to clearing if need be. There is a possibility that unknown heritage resources could be unearthed during land clearing even though the heritage impact assessment did not find new sites and concluded that the area should be allowed to be developed (Annex IX). Therefore, a chance find procedure would be implemented during clearing activities. Management options for any unanticipated archaeological materials or features discovered by chance during any land clearing activities for all Project phases would be developed in consultation with the Heritage Conservation Branch. The cultural and heritage resources VC was not carried forward in the assessment due to the low risk of this pathway and the negligible predicted effect on the number, quality, and/or significance of archaeology and heritage sites. Completion of the impact assessment and implementation of the chance find procedure is expected to protect archaeological and heritage resources.

ILU-04: Changes to the availability of fish, plants, and wildlife for harvesting from increased access and competition for resources:

- The Project may result in changes to the availability of fish, plants, and wildlife for harvesting because of increased competition for resources important to Indigenous land and resource use through changes in access and the presence of the Project workforce during Construction and Operations.

Indigenous Group members expressed concern about increased competition for fish, plants, and wildlife resulting from changes in Project-related access and the presence of a workforce that could potentially increase competition for resources in proximity to the Project.

Members of the CRDN indicated concerns with the potential for increased pressure on available resources associated with increased access resulting from industrial development:

> The *outsiders* are reported to have become acquainted with the beauty of CRDN traditional lands through their industrial work activities. If new cutlines and roads are built, more *outside* sports-hunters, fishermen and recreationalists are expected to further encroach on CRDN lands and food supplies. (TSD V.1: CRDN)

One BNDN member commented:

> And it's not only that area, but it's even in around closer to . . . our community because of. . . . . More trucks. More . . . activity, more people. More people coming into our immediate area – our immediate hunting area, our immediate fishing area, our immediate . . . traditional territory around our community. It's quiet now, but there's always people who look for places to fish, to set up camp, to lease out land to build cabins and – there's always that potential for a lot of other things. (TSD II: BNDN)

Buffalo River Dene Nation members are also concerned about increased competition from increased access and have seen it occur in their traditional territory:

> There's so many people there, you know not only us around from [the] community here, there's a lot of people even the down south people, they come too . . . people they come here and they hunt, they like moose meat, caribou meat, fishing, in the summertime . . . there's a lot of people here from down south. (TSD III: BRDN)

The Project could change the availability of fish, plants, and wildlife for harvesting through the potential for increased access, which could result in increased competition for resources. While the Project would not create new access, it would ease access to some areas through upgrades to the existing access road off Highway 955 (Figure 16.1-2) and through potential improvements to Highway 955, as may be deemed necessary and carried out by the Government of Saskatchewan, such as the increase of gravel surface maintenance associated proportionally with the increase in traffic. Improvements to roads in the LSA could increase hunting and trapping pressure on harvested resources from other users along Highways 155 and 955 and the access road. Project-related changes to roads and associated access conditions could also provide increased opportunities for recreational fishing on the Clearwater River and in Patterson Lake, or plant harvesting such as berry picking. The CRDN (TSD V.1: CRDN) has already noted that the area around Patterson Lake is considered a productive area for harvesting fish and wildlife, which may make it attractive to individuals from outside the LSA.

The Project could also increase competition for fish, plants, and wildlife for harvesting through increased familiarity of the area. This would be mainly expected as a result of the presence of the workers required during Construction, Operations, and the Active Closure Stage, who would be introduced to this area of northern Saskatchewan. During Construction, peak on-site employment would be 348 positions, and during Operations, peak employment would be in the second year and consist of 260 positions on site (Section 18.4.1, Beneficial Pathways). During Operations, most personnel would work a two-week-in, two-week-out rotation, on a fly-in/fly-out basis.

Increased access and familiarity with the area as a result of the proposed Project are not expected to result in measurable changes to fishing pressure (Section 11.4.2, Secondary Pathways), plant harvesting (Section 13.4.2, Secondary Pathways), or existing access for hunting and trapping (Section 14.4.2, Secondary Pathways). Existing fishing opportunities along the highway and road are limited, with the only road access to a fish-bearing waterbody or watercourse being at the existing bridge crossing of the Clearwater River downstream of the Patterson Lake outlet, which would not be modified through development of the Project. As existing roads already provide public access, improvement of the access road to the Project is unlikely to affect the harvest of traditional use plant species or wildlife. The main Project site entrance would also be gated to control public access to the Project site, which would also limit public road access to local plant harvesting and hunting opportunities and road access to Patterson Lake for fishing.

It is unlikely that resource users would start accessing the area as it is not easy to access the proposed Project from other communities in Saskatchewan (i.e., long driving distances). The Project would be located 640 km northwest of Saskatoon and 130 km north of La Loche. La Loche does not currently have accommodations where resource users from outside the LSA could stay, and the closest accommodations are in Buffalo Narrows, which is 205 km south of the proposed Project. For resource users who would like to camp, camping can occur on Crown Land or in the closest provincial park, Clearwater River Provincial Park, which is classified as a wilderness site (i.e., amenities are limited to tenting sites, primitive sites, and non-electric sites; Tourism

Saskatchewan 2021). Even if more people do frequent the area, government-regulated hunting and fishing limits would be maintained.

In addition to the challenges associated with the remoteness of the proposed Project that would discourage resource users to access the area, no hunting by employees would be permitted on the access road and the Project site. As NexGen plans to prioritize employment from local communities where possible, engagement with these communities would be undertaken to gather feedback on whether a no fishing policy applicable to NexGen workers while on work rotation is a desired mitigation to reduce effects on harvested fish populations from increased fishing pressure. Although not a Project mitigation measure, it is expected that the ENV would continue to manage sport fishing in Patterson Lake and the Clearwater River through the use of harvest restrictions, as well as the implementation of other regulations, as required (e.g., catch-and-release).

Harvesting would also be discouraged through the following Project policies that make hunting and fishing unfeasible for Project workers while on work rotation:

- the implementation of a Security Program that would prohibit hunting within the boundary of the surface lease area to protect the safety of workers and maintain orderly use of site roads (note also that no firearms or other hunting equipment would be allowed on site under the General Nuclear Safety and Control Regulations);
- transport of employees by bus to site from La Loche until the on-site airstrip is completed, after which employees would be transported to and from site by aircraft (i.e., workers would not have access to a personal vehicle for transportation off site); and
- no freezer or fridge space provided for workers to store any fish or wildlife that may be harvested.

In summary, the Project location and policies to discourage local harvesting of resources are predicted to result in a minor increase in competition for fish, plants (e.g., berries), and wildlife and have a negligible effect on Indigenous land and resource use. Therefore, this pathway was determined to be secondary and not carried forward in the assessment.

16.4.3 Primary Pathways

The following Project interactions were predicted to be primary pathways to Indigenous land and resource use and were carried forward for further assessment in the residual effects analysis (Section 16.5):

ILU-01: Changes to access to and area available for Indigenous land and resource use:

- The Project footprint may restrict access and reduce the area available for or displace Indigenous land and resource use.

ILU-02: Changes to the availability of fish, plants, and wildlife for harvesting from changes in abundance and distribution:

- The Project footprint and Project activities may alter the availability of fish, plants, and wildlife for harvesting due to Project-related effects on their abundance or distribution, thus reducing or displacing opportunities for Indigenous land and resource use.

ILU-03: Changes to the quality of the Indigenous land use experience:

- Sensory disturbances (i.e., noise, light, air emissions, and aesthetics) and safety concerns may change the quality of the Indigenous land use experience in the area surrounding the Project. Similarly, perceptions of effects on the quality of water, fish, plant, and wildlife resources may adversely affect the quality of the experience and/or result in certain areas being avoided. Knowledge of the decommissioned site may change the perceived suitability of the area for Indigenous land and resource use in the future. Changes to the cultural landscape can affect sense of place and the relationship between Indigenous Groups and the land.

16.5 Residual Effects Analysis

16.5.1 Application Case

16.5.1.1 Access to and Area Available for Indigenous Land and Resource Use

The Project would reduce access to lands and resources used by Indigenous Groups for traditional purposes through access restrictions and through the loss of land from direct disturbance. In the Base Case, Indigenous Groups are already experiencing land disturbances and access restrictions associated with mining exploration and development and natural events such as forest fires (Section 16.3). The presence of Project infrastructure (e.g., gated and controlled access to the Project footprint) and activities (e.g., construction of mine infrastructure, operation of a mine) would change access to lands and resources in the maximum disturbance area used by the CRDN, MN-S, BNDN, and BRDN for harvesting, travel, intergenerational transfer of knowledge, and living as Dene or Métis people. Traditional lands in the Project footprint beyond the gatehouse would not be accessible once Construction starts, mainly for safety purposes. Access to parts of Patterson Lake may be temporarily restricted during construction of in-lake infrastructure, but unrestricted access to the lake is expected during Operations and Closure. The Project footprint would have restricted access until the site is transferred to the Province of Saskatchewan for Institutional Control, after which time land and resource use may continue.

The maximum disturbance area is predicted to remove 981 ha of land during Construction, Operations, and the Active Closure Stage, representing 0.7% of the LSA or 0.02% of the RSA. However, the actual loss is anticipated to be less when considering the Project footprint. As part of the Project design, NexGen reduced the Project footprint and maximum disturbance area by optimizing the use of cleared areas for Project activity; using existing access road infrastructure, including the existing bridge crossing; using underground storage for tailings; and designing an efficient infrastructure footprint (e.g., buildings clustered together). After a site tour, the Métis Local President commented, “the best part I liked was the minimal disturbance and compact area. That really impressed me and the Elders I took up there. Other mining facilities I have visited have been huge” (BNDN-JWG 2021a).

While the proportion of the LSA affected by the Project would be relatively small, Indigenous Groups have stressed the importance of having unrestricted access to large swathes of land to practise traditional activities. The CRDN (TSD V.1: CRDN) and MN-S (TSD IV: MN-S; MN-S-JWG 2020) IKTLU Studies noted that some members live close to the area and consider the region to be important to their cultural practices. The CRDN IKTLU Study indicated:

> Within the immediate vicinity of Patterson Lake, the establishment of drilling operations/camps on the peninsula and north shore has displaced CRDN members from a long-standing intensively utilized harvesting corridor and area which includes trails and water routes, staging areas, and ancestral family use locales, cabins and camps. (TSD V.1: CRDN)

The BNDN shared that their traditional lifestyle requires access to large tracts of land as members travel throughout the landscape to harvest and reinforce bonds with relatives and other communities:

> Even today, . . . I remember . . . way back when we were kids, . . . living in Clear Lake and going all over the place. All summer long families used to leave. All summer long, they'd go from one fish camp to the other right 'till September. We never stayed at home. . . . we were nomads, they said. If you talk about nomads, the only time we stayed in Clear Lake was in the wintertime. Sometimes, even we'd leave in the winter too and go stay someplace. Always going from one place to the other. (TSD II: BNDN)

Changes to access and areas available for Indigenous land and resource use also have the potential to result in a loss of the relationship to and knowledge of important traditional use areas, including the cultural landscape, and can alter an individual's sense of place (TSD II: BNDN; TSD III: BRDN). The CRDN, MN-S, BNDN, and BRDN expressed the importance of sense of place as it relates to the Patterson Lake area, as well as their relationship with the land in the LSA and long-standing presence in and use of the area (TSD V.1: CRDN; TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD VI: YNLR).

While the presence of the Project would displace hunting, trapping, and gathering that may occur in the maximum disturbance area and would limit fishing on a small portion of Patterson Lake during part of Construction, it is not expected to restrict access to any currently known cabins. The closest cabins documented by the CRDN (TSD V.1: CRDN) and MN-S (TSD IV: MN-S) are on the north shore of Patterson Lake or south of the existing access road. The BNDN has also identified habitation sites (i.e., camps and cabins) located on the north shore of Patterson Lake and north shore of Forrest Lake (Section 16.3.3.3.1; Figure 3 in TSD II: BNDN). Indigenous Group members would still be able to use the documented cabins as their home base or starting point for resource use activities or spending time on the land.

There were no culturally important sites and areas identified by Indigenous Groups that overlap with the maximum disturbance area (Section 16.3.3).

The Project would affect documented travel routes that intersect with the maximum disturbance area. The CRDN identified several travel routes that intersect the maximum disturbance area, including the existing access road, along with a staging area mapped on a portion of the road outside of the maximum disturbance area that connects to Highway 955 (Section 16.3.3.1.1, Occupancy, Habitation, and Access; Figure 4 in TSD V.1: CRDN). The BNDN has also identified a transportation route south of Patterson Lake that aligns with the existing access road (Section 16.3.3.3.1).

The existing access road would be upgraded by NexGen for safety and ability to accommodate the increase in heavy equipment traffic; a Ground Transportation Emergency Response Plan would be developed to promote safety for all users.

The Ground Transportation Emergency Response Plan would contain measures to address resource user traffic safety (i.e., mitigate safety risks related to the transportation of materials and equipment) to and from the Project site, including on the access road and a Security Program within the maximum disturbance area, including the following:

- Educate Project staff on traffic safety including consideration of the safety of other non-Project users of the roads.
- Educate resource users on safe use of the access road (e.g., trappers, lodge and outfitting service providers).
- Where necessary, establish procedures for escorting resource users who are driving personal vehicles on the access road (e.g., lodge and outfitting clients).
- Conduct annual safety audits to confirm that management measures are effective in protecting safe passage of Project and other vehicular traffic.
- Evaluate annually how the objectives of the Security Program were met using measurable indicators and modify the plan as needed to foster continual improvement.

During Construction, the existing 13 km all-season access road from Highway 955 would be upgraded to allow two-way traffic and facilitate year-round vehicle and heavy equipment access to the Project (Section 5.4.18, Off-Site Infrastructure). The CRDN and BNDN would temporarily lose road access during Construction to travel routes and the staging area that align with the existing all-season road but would gain access again once the road has been upgraded.

The Project is not predicted to restrict watercourse access to and between the lakes in the Indigenous land and resource use LSA. Water surface elevations (WSEs) on Patterson Lake and on downstream lakes were assessed as part of the hydrology assessment (Section 9.6, Residual Effects Analysis). Findings predicted an approximately 1% increase in WSE on Patterson Lake, downstream on the Churchill River, and on Forrest, Beet, and Naomi lakes. These anticipated changes in WSE would not be expected to affect open-water navigation on downstream lakes or the Clearwater River. The increases in WSE would be unlikely to be measurable and would be within the range of natural variation for existing conditions.

Before the Project would be transferred to the Province under the Institutional Control Program, a Detailed Decommissioning and Reclamation Plan would be developed and implemented. NexGen is cognizant of the indication from Indigenous Groups that distrust has arisen from Indigenous Groups' experience related to decommissioning of the Cluff Lake Mine, including the level of reclamation success (CRDN 2019a; MN-S-JWG 2019b). The CRDN (2019a) shared comments on the closure of Cluff Lake Mine during the licence renewal of the Cluff Lake Mine pertaining to whether land is available for Indigenous land and resource use after mine closure:

> CRDN members continue to have concerns about the safety of harvesting food and resources from this area, and have concerns about whether this area is appropriate for the exercise of Treaty rights. This concern is exhibited through avoidance of this area, whereas CRDN's traditional use evidence indicates that the entirety of this area was once used by its members. (CRDN 2019a)

With this in mind, NexGen would continue to work to build trust and confidence in the success of the Project reclamation through integration of Indigenous land and resource use objectives in planning, progressive reclamation work, and environmental monitoring. This would include working with Indigenous Groups during the development of the Preliminary (and then Detailed) Decommissioning and Reclamation Plan to verify that its outcomes would promote future use of the Project footprint for Indigenous land and resource use activities.

In addition to standard environmental monitoring that would be completed for the Project (e.g., regulatory compliance monitoring), NexGen commits to providing funding for the life of the Project for a full-time independent Indigenous Monitor from each primary Indigenous Group, and to provide unrestricted environmental monitoring opportunities, including independent environmental sampling related to the Project, subject to the Indigenous Monitor complying with appropriate health and safety and other reasonable site-specific policies. The Indigenous Monitor would report openly and without restriction to Indigenous Group community members on the performance of the Project.

As part of its Indigenous and Public Engagement Program, NexGen would provide regular communication and information about the Project to community members by providing periodic tours of the Project and holding regular community information sessions in LPA communities on Project-related matters, including environmental and cultural protection.

To support continued access and availability of Indigenous land and resource use, NexGen has negotiated and signed Benefit Agreements with primary Indigenous Groups (i.e., CRDN, MN-S, BNDN, and BRDN). Within each Benefit Agreement, NexGen commits to provide resources, both monetary and human, to support community-related initiatives in areas such as cultural and traditional values. In negotiating these agreements, NexGen commits to working closely with Indigenous Groups to promote Indigenous resource use activities in proximity to the Project and thus the continued use of the LSA. The terms of Benefit Agreements are intended to provide the needed avoidance, mitigation, compensation, and shared benefits for the coexistence of Project development and continued Indigenous land and resource use. NexGen also commits to supporting intergenerational transfer of knowledge. Project effects on cultural transmission, which changes in access may affect with respect to community well-being, are discussed in Section 19.

Overall, the effects of the Project on existing Indigenous land and resource use due to changes in access to and area available for Indigenous land and resource uses in the LSA are expected to be small and mostly confined to the maximum disturbance area. Proposed Project mitigation measures would allow for the continued, safe access of areas outside the maximum disturbance area (e.g., travel routes along the existing access road), and commitments through the Benefit Agreements (e.g., monetary and human resources) are anticipated to support the ability to continue to access other areas for Indigenous land and resource use. While some access restrictions would be temporary during Construction, such as restrictions in access to some parts of Patterson Lake and the existing access road, access to traditional lands used in the maximum disturbance area would be lost continuously until after the Active Closure Stage and reclamation work is completed, a period of approximately 33 years (i.e., two generations). The effects are expected to be reversible in the Transitional Monitoring Stage once major closure works and land reclamation of the maximum disturbance area have been completed.

16.5.1.2 Availability of Fish, Plants, and Wildlife for Harvesting

The Project would affect the availability (i.e., abundance and distribution) of fish, plant, and wildlife resources used for harvesting. Indigenous Groups use a diversity of species in the Project LSA and RSA for traditional activities including fish, large game, small game, furbearers, and traditional plants (Section 16.3.2). The results of fish and fish habitat (Section 11), vegetation (Section 13), and wildlife and wildlife habitat (Section 14) assessments have been incorporated into the residual effects analysis to understand the potential for changes to the availability of fish, plants, and wildlife used for harvesting. Valued components that were considered in the assessment of Indigenous land and resource use and reflect those species identified as important by Indigenous Groups through various sources including IKTLU Studies and JWGs are presented in Table 16.5-1. It should be noted that even though a species may not have been identified by an Indigenous Group in their IKTLU Study or through the JWG process, the species listed below may still be important. In addition, other species identified by Indigenous Groups as important but not included in the selection of VCs are represented in the assessment through the VCs that act as indicators for other species (e.g., grey wolf is an indicator for generalist carnivores such as wolverine, red fox, and coyote; mallard is an indicator for other waterfowl).

Table 16.5-1: Valued Components by Harvesting Activity and Indigenous Group

VC	Identified in Indigenous Group IKTLU Study or JWG
Fishing	
Lake whitefish (*Coregonus clupeaformis*)	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
Northern pike (*Esox lucius*)	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
Walleye (*Sander vitreus)*	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
Lake trout (*Salvelinus namaycush*)	CRDN MN-S (trout) BNDN BRDN Athabasca Denesųłiné
Gathering	
Traditional use plants	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
Hunting and Trapping	
Woodland caribou (*Rangifer tarandus caribou*)	CRDN BNDN BRDN Athabasca Denesųłiné

Table 16.5-1: Valued Components by Harvesting Activity and Indigenous Group

VC	Identified in Indigenous Group IKTLU Study or JWG
Moose (*Alces alces*)	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
Black bear (*Ursus americanus*)	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
Grey wolf (*Canis lupus*)	MN-S BNDN BRDN Athabasca Denesųłiné
Beaver (*Castor canadensis*)	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
American marten (*Martes americana*)[(a)]	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
Mallard (*Anas platyrhynchos*)	CRDN (ducks) MN-S (ducks) BNDN (ducks) BRDN (ducks) Athabasca Denesųłiné (duck spp.)
Common goldeneye (*Bucephala clangula*)	CRDN (duck spp.) MN-S (duck spp.) BNDN (duck spp.) BRDN (duck spp.) Athabasca Denesųłiné (duck spp.)

Sources: TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD VI: YNLR.
a) Marten was not identified as a VC in the wildlife and wildlife habitat assessment; instead, in the context of Indigenous land and resource use, the potential effects of the Project on marten were assessed through consideration of suitable habitat for marten identified in the vegetation assessment (Section 13).
IKTLU = Indigenous Knowledge and Land Use; JWG = Joint Working Group; CRDN = Clearwater River Dene Nation; MN-S = Métis Nation – Saskatchewan; BNDN = Birch Narrows Dene Nation; BRDN = Buffalo River Dene Nation; VC = valued component.

16.5.1.2.1 Fishing

The Project could affect fishing for traditional purposes if changes should occur to the availability of species that Indigenous Groups fish in Patterson Lake and other lakes and streams in the LSA. Changes to the abundance and distribution of fish may occur if there are changes to fish habitat and fish survival and reproduction (Section 11.4.3, Primary Pathways). The fish and fish habitat assessment (Section 11.5, Residual Effects Analysis) included northern pike, lake whitefish, walleye, and lake trout as VC species that are fished for traditional purposes in the aquatics LSA and RSA (i.e., within the Indigenous land and resource use LSA).

Changes to habitat availability and the survival and reproduction of fish as a result of the Project would be negligible for all phases of the Project. With the implementation of effective mitigation, the Project is predicted to have negligible or low magnitude, local changes in the availability of northern pike, lake whitefish, walleye, and lake trout in Patterson Lake for harvesting purposes (Section 11.5). As presented in Section 16.4.1, No Pathways, the quality of fish is not expected to be affected by the Project by COPCs based on the Environmental Risk Assessment (TSD XXI).

16.5.1.2.2 Gathering

The Project could affect gathering for traditional purposes through changes in the availability of plant species that Indigenous Groups gather in the LSA and RSA. Changes to the abundance and distribution of plants can occur through the direct loss, alteration, and fragmentation of traditional use plant habitats. The alteration of final terrain and soil conditions and/or plant species composition could change the types of ecosystems and traditional use plants that can be reclaimed on the landscape, and adversely affect vegetation ecosystem availability, distribution, and condition (Section 13.4.3, Primary Pathways).

The vegetation assessment (Section 13.5, Residual Effects Analysis) includes traditional use plants as a VC, which captures 31 species or genera of berries, forbs, shrubs, trees, fungi, lichen, and mosses (Table 13.3-5) that are gathered for traditional purposes in the vegetation LSA and RSA (i.e., within the Indigenous land and resource use LSA). Predicted effects on traditional use plants are discussed in the paragraphs below, followed by a discussion of these changes in the context of Indigenous land and resource use and availability of resources for gathering.

The plant species used for traditional purposes that were noted by Indigenous Groups and recorded in the baseline surveys are presented in Table 16.5-2 along with the Indigenous Groups that identified them. It should be noted that species not specifically named by an Indigenous Group may still have value for them.

Table 16.5-2: Traditional Use Plant Species Gathered by Indigenous Groups

Traditional Use Plant Species[(a)]	Scientific Name[(b)]	SKCDC Common Name[(b)]	Identified by Indigenous Group
Berries	n/a	Berry spp.	CRDN MN-S BNDN BRDN Athabasca Denesųłiné
Birch	*Betula glandulosa*	Dwarf birch	CRDN MN-S BNDN
	Betula occidentalis	Paper birch	
	Betula papyrifera	Swamp birch	
Blueberry	*Vaccinium myrtilloides*	Blueberry	CRDN MN-S BNDN Athabasca Denesųłiné
Bulrushes	*Juncus nodosus* var. *nodosus*	Knotted rush	BNDN
	Schoenoplectus acutus var. *acutus*	Hard-stemmed bulrush	
Chokecherry	*Prunus virginiana* var. *viriginiana*	Chokecherry	CRDN
Cloudberry	*Rubus chamaemorus*	Cloudberry	CRDN
Cranberry	*Vaccinium oxycoccos*	Small cranberry	CRDN MN-S BNDN
Cranberry, bog	*Vaccinium vitis-idaea*	Bog cranberry	CRDN
Cranberry, low bush	*Viburnum edule*	Low bush-cranberry	CRDN
Cranberry, high bush	*Viburnum opulus* var. *americanum*	High bush-cranberry	CRDN
Dogwood	*Cornus sericea* ssp. *sericea*	Red-osier dogwood	CRDN

Table 16.5-2: Traditional Use Plant Species Gathered by Indigenous Groups

Traditional Use Plant Species[a]	Scientific Name[b]	SKCDC Common Name[b]	Identified by Indigenous Group
Frog tail	*Sarracenia purpurea* ssp. *gibbosa*	Pitcherplant	Athabasca Denesųłiné
Gooseberry	*Ribes americanum*	Wild black currant	CRDN
	Ribes glandulosum	Skunk currant	
	Ribes hudsonianum	Northern black currant	
	Ribes oxyacanthoides var. *oxyacanthoides*	Bristly gooseberry	
	Ribes triste	Swamp red currant	
Jack pine	*Pinus banksiana*	Jack pine	CRDN
Kinnikinnick	*Arctostaphylos uva-ursi*	Bearberry	CRDN
Labrador tea	*Rhododendron groenlandicum*	Common Labrador tea	CRDN Athabasca Denesųłiné
	Rhododendron tomentosum	Labrador tea	
Mint	*Mentha canadensis*	Wild mint	CRDN MN-S BNDN
Mosses[c]	n/a	n/a	CRDN
Mushrooms[c]	n/a	n/a	CRDN
Poplar	*Populus balsamifera* ssp. *balsamifera*	Balsam poplar	CRDN
	Populus tremuloides	Trembling aspen	
Raspberry	*Rubus idaeus* ssp. *strigosus*	American red raspberry	MN-S BNDN
Rat root	*Acorus americanus*	Sweet flag	CRDN MN-S
Saskatoon	*Amelanchier alnifolia* var. *alnifolia*	Saskatoon	CRDN
Spruce	*Picea glauca*	White spruce	CRDN
	Picea mariana	Black spruce	
Strawberry	*Fragaria vesca* ssp. *americana*	American wild strawberry	CRDN MN-S BNDN
	Fragaria virginiana ssp. *glauca*	Smooth wild strawberry	
Sweetgrass	*Anthoxanthum hirtum* ssp. *arcticum*	Sweet grass	CRDN MN-S
Tamarack	*Larix laricina*	Tamarack	CRDN
Willow[d]	*Salix* sp.	Willow species	CRDN

Sources: TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD VI: YNLR.
a) Pulled from IKTLU Studies.
b) SKCDC 2021.
c) Traditional use plant species name reflects broad group of plant or fungi species; therefore, the scientific name, SKCDC common name, and habitat information are not described.
d) Saskatchewan has over 40 willow species (*Salix* sp.; Harms 2017); therefore, the scientific name, SKCDC common name, and habitat information of all potential willow species are not described.
BRDN = Buffalo River Dene Nation; BNDN = Birch Narrows Dene Nation; CRDN = Clearwater River Dene Nation; MN-S = Métis Nation – Saskatchewan; IKTLU = Indigenous Knowledge and Traditional Land Use; SKCDC = Saskatchewan Conservation Data Centre.

The total amount of traditional use plant habitat is 721.6 ha in the vegetation LSA (representing 25.5% of the vegetation LSA) and 24,988 ha in the vegetation RSA (representing 23.2% of the vegetation RSA; Section 13.5.4.1.1, Habitat Availability, Table 13.5-10, Figure 13.5-10, and Figure 13.5-11). The Project would result in the direct disturbance of 282 ha (i.e., 1.1%) of traditional use plant availability in the vegetation RSA.

The largest predicted changes in availability are associated with common boreal forest plant species (i.e., jack pine [loss of 148.7 ha], mosses [loss of 51.8 ha], and blueberry [loss of 32.4 ha]). The occupancy of 24 traditional use plant species is predicted to decrease because of their removal within the maximum disturbance area due to clearing. The loss of most traditional use plants would be continuous until reclamation has re-established vegetation; however, the loss of traditional use plants in wetland habitat (e.g., pitcher plant) is considered permanent and irreversible. While the availability of traditional use plants would be reduced in the maximum disturbance area of the Project, traditional use plant habitat is predicted to remain abundant across the vegetation RSA, and incremental effects of the Project are expected to remain within the resilience and adaptability limits of traditional use plant species (Section 13.5.4.1.1). This would result in a low magnitude change in availability of traditional plants in the Indigenous land and resource use LSA.

The Project is also predicted to result in some change to the distribution of traditional use plant habitat by decreasing its connectivity and configuration through direct disturbance within the maximum disturbance area. Changes in distribution to traditional use plant species would be most common within Jack pine/lichen, Jack pine/lichen (burned), and Jack pine/feathermoss ecosites, with moderate changes also anticipated to occur in white birch/lingonberry-Labrador tea ecosites (Section 13.5.4.1.2, Habitat Distribution, Table 13.5-11). Decreased connectivity of traditional plant use habitat would be localized within the vegetation LSA and is predicted to be reversible for most ecosites (but permanent for wetlands); however, traditional plant use habitat would remain well distributed across the vegetation RSA (Section 13.5.4.1.2).

Mitigation measures planned to minimize the adverse effects of the Project on traditional use plants are described in Section 13.4, Project Interactions and Mitigations (Table 13.4-1), and include progressive reclamation. With the implementation of effective mitigation, changes to traditional use plant availability and distribution as a result of the Project are expected to be small (i.e., low magnitude) and localized, which is expected to affect the availability of traditional use plants for gathering in the maximum disturbance area.

The removal of traditional use plants in the maximum disturbance area may result in the localized displacement of existing gathering activities occurring in the Patterson Lake area, which was documented as an important area for gathering berries and medicinal plants in the LSA by the CRDN, MN-S, and BNDN (Section 16.3.2). However, while the loss of traditional use plants in the Project footprint would range from long-term to permanent depending on the habitat, traditional use plants would remain widespread in the Indigenous land and resource use LSA, and opportunities for traditional gathering could continue.

16.5.1.2.3 Hunting and Trapping

The Project could affect hunting and trapping for traditional purposes through changes to the availability (i.e., abundance and distribution) of wildlife species that Indigenous Groups hunt and trap in the LSA and RSA. Changes to the abundance and distribution of wildlife can occur through direct removal or alteration of soil and vegetation, leading to loss of wildlife habitat; alteration of final terrain and soil conditions that could change the final ecosystems that can be reclaimed on the landscape; and sensory disturbances such as the presence of people, lights, dust, smells, and noise (Section 14.4.3, Primary Pathways).

The wildlife and wildlife habitat assessment (Section 14.5, Residual Effects Analysis) includes woodland caribou, moose, black bear, grey wolf, beaver, mallard, and common goldeneye as VC species that are also hunted or trapped for traditional purposes in the wildlife LSA and RSA (i.e., within the Indigenous land and resource use LSA). American marten was also identified as a species used for traditional purposes; however, American marten was not selected as a VC in the wildlife and wildlife habitat assessment. In the context of Indigenous land and resource use, the potential effects of the Project on marten are assessed through consideration of suitable habitat identified in the vegetation assessment (Section 13). Predicted effects on the VCs and American marten are discussed in the paragraphs below.

Woodland caribou: For woodland caribou, the Project could result in a loss of 7.5 ha of high suitability habitat and 24.6 ha of moderate suitability habitat (i.e., less than 0.1% reduction of high and moderate suitability habitat in the SK2 West Caribou Administration Unit). Movement patterns for woodland caribou are expected to change within and adjacent to the Project footprint as woodland caribou would likely avoid travelling through the maximum disturbance area. This may result in woodland caribou avoiding an existing movement route at the narrows of Patterson Lake identified through Indigenous and Local Knowledge. In addition, the increased traffic expected on Highway 955 could alter movement and habitat connectivity of woodland caribou. Overall, the incremental effects of the small amount of habitat loss from the Project in the SK2 West Caribou Administration Unit are determined to range from low to high magnitude and to be significant in the Application Case because the caribou population in the Base Case in the SK2 West range already exceeds the management threshold of 65% undisturbed habitat necessary to support a self-sustaining population. NexGen is committed to reclaiming habitat disturbed by the proposed Project and offsetting the incremental loss of caribou habitat. A Caribou Mitigation and Offsetting Plan would be developed through engagement with the ENV and Indigenous Groups to meet a goal of a net increase in functional habitat for caribou.

Moose: The Project would result in a loss of 815.2 ha of low, moderate, and high suitability habitat, representing 1.0% of suitable habitat in the wildlife RSA. Changes to habitat availability are likely to have limited effects as moose habitat is abundant and widespread throughout the wildlife RSA and moose are tolerant of several types of human disturbances. Movement patterns for moose are expected to change within and adjacent to the Project footprint as they would likely avoid passing through the maximum disturbance area, including the existing movement route at the narrows of Patterson Lake. The increased traffic on Highway 955 could also affect the movement of moose that use habitats within and outside the western portion of the wildlife RSA. Remaining patches of contiguous, undisturbed habitat would remain in areas surrounding the wildlife LSA and are expected to continue to provide landscape connectivity and facilitate moose movement within the wildlife RSA. Moose display life history traits (e.g., large home ranges, high reproductive rates, ability to eat many types of plants) that allow flexibility to adapt to different types of disturbance. The Project is not expected to have a measurable effect on moose survival and reproduction.

Overall, the incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of the moose population overlapping the wildlife RSA (i.e., within the Indigenous land and resource use LSA). Moose populations are expected to remain self-sustaining and ecologically effective in the Application Case (Section 14.5.2.3.2, Significance Determination).

Black bear: The Project could result in the loss of 946.8 ha (i.e., 1.1%) and 911.0 ha (i.e., 1.0%) of available low, moderate, and high suitability spring and fall habitat in the wildlife RSA, respectively. This loss represents less than one black bear home range. Changes to bear movement and habitat connectivity are expected to be small and localized. Black bears may avoid passing through the maximum disturbance area, including the existing movement route at the narrows of Patterson Lake, and alter movement patterns within and adjacent to the Project footprint. The increased traffic on Highway 955 could also affect the movement of black bears that use habitats within and outside the western portion of the wildlife RSA. However, black bears display life history traits (e.g., diverse diet, alter time of day around human disturbance) that provide flexibility to adapt to different types of disturbances. The Project is not expected to have a measurable effect on black bear survival and reproduction as black bears are resilient to anthropogenic (i.e., human) developments and are highly mobile.

Overall, the incremental changes to bear habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of the bear population overlapping the wildlife RSA (i.e., within the Indigenous land and resource use LSA). Black bear populations are expected to remain self-sustaining and ecologically effective in the Application Case (Section 14.5.4.3.2, Significance Determination).

Grey wolf: The Project could result in the loss of 946.8 ha (i.e., 1.1%) and 846.2 ha (i.e., 1.2%) of available low, moderate, and high suitability habitat in the wildlife RSA during the snow-free period and winter, respectively. Local movement patterns of grey wolves are expected to change because of avoidance associated with high human activity (e.g., mine sites); however, wolves can move and disperse through a variety of habitat types. An increase in the number of vehicles on Highway 955 relative to existing conditions could affect the movement of wolves that use habitat within and outside the western portion of the wildlife RSA. The distribution of suitable habitat in the wildlife RSA (i.e., the Indigenous land and resource use LSA) would remain largely unchanged as a result of the Project because the maximum disturbance area is primarily located within habitat considered to be low suitability habitat for wolves due to previous fire disturbance (i.e., early- and late-stage regeneration habitats). The Project is not expected to have a measurable effect on grey wolf survival and reproduction.

Overall, the incremental changes to wolf habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within grey wolf resilience and adaptability limits. Grey wolf populations are expected to remain self-sustaining and ecologically effective in the Application Case (Section 14.5.3.3.2, Significance Determination).

Beaver: Small and localized changes to beaver habitat could result from the Project. There would be a loss of 7.4 ha (i.e., 0.5%) of high suitability beaver habitat, no loss of moderate habitat, and 28.8 ha (i.e., 0.1%) of low suitability habitat in the wildlife RSA. The distribution of suitable habitat in the wildlife RSA would remain largely unchanged. The small loss of high suitability habitat is unlikely to have a measurable effect on beaver movement within the animals' territories. Beavers are relatively tolerant of sensory disturbances associated with humans, and beaver habitat would remain well connected through wetlands, watercourses, and waterbodies in the wildlife RSA. The Project would not have a measurable effect on beaver survival and reproduction, and no measurable change to the abundance or distribution of beavers is expected in the wildlife RSA (i.e., the Indigenous land and resource use LSA). Overall, the incremental changes to beaver habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within beaver resilience and adaptability limits. Beaver populations would be expected to remain self-sustaining and ecologically effective in the Application Case (Section 14.5.5.3.2, Significance Determination).

American marten: American marten was assessed through consideration of suitable habitat identified in the vegetation assessment (Section 13). Suitable habitat for American marten in the vegetation RSA is represented by landcover types associated with mature upland deciduous, coniferous, and mixed deciduous-coniferous ecosites, which were defined in the vegetation assessment (Section 13.2.6.1.1, Upland Ecosystem Mapping, Table 13.2-3). The assessment of the vegetation upland ecosystem VC was used as an indicator for American marten (Section 14.2.2.1, Valued Components, Table 14.2-1). Subsequently, changes in the availability of mature upland ecosites from the Project (Section 13.5.1, Upland Ecosystems) were used to determine the residual effects from changes in the availability and distribution of suitable habitat for American marten. The Project could result in a loss of 112.1 ha of suitable habitat for American marten, representing 0.6% of the total suitable habitat in the wildlife RSA in the Base Case. The anticipated loss of 112.1 ha of suitable habitat represents approximately 60% of a single American marten home range using a home range size of 200 ha (Smith and Schaefer 2002) and 1.2% of a home range using the highest estimate of home range size (i.e., 9,700 ha) recorded in Smith and Shaefer (2002). American marten display life history traits (e.g., high mobility, strong dispersal ability; Buskirk and Rugiero 1994) that provide ability to adapt to different types of human development. The Project is not expected to have a measurable effect on American marten survival and reproduction.

Overall, the incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the species' resilience and adaptability limits and result in a negligible change in American marten abundance and distribution.

Mallard: The Project could result in a loss of 142.1 ha of high suitability mallard nesting habitat, representing 0.5% of available high suitability nesting habitat in the wildlife RSA. No moderate suitability nesting habitat would be affected. The remaining habitat loss would occur in areas of low habitat suitability (i.e., 0.2%). Overall, the Project would disturb 187.2 ha (i.e., 0.3%) of suitable nesting habitat in the wildlife RSA relative to the Base Case. The Project is expected to result in a small reduction in mallard reproduction in the wildlife LSA from sensory disturbance; however, these localized effects are not predicted to have broader consequences for the population occupying the wildlife RSA. Mallard is considered relatively resilient to anthropogenic disturbance, and anticipated loss of habitat is minor relative to the availability of suitable habitat elsewhere in the wildlife RSA (i.e., the Indigenous land and resource use LSA); therefore, Project effects on mallard abundance and distribution are expected to be negligible.

Overall, the incremental changes to mallard habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of the regional population. Mallard is predicted to remain self-sustaining and ecologically effective in the Application Case (Section 14.5.10.3.2, Significance Determination).

Common goldeneye: The Project could result in a loss of 3.5 ha of suitable common goldeye nesting habitat, representing less than 0.1% of suitable habitat in the wildlife RSA. Loss of suitable common goldeneye habitat is likely to have limited effects because the species is highly mobile, habitat loss would be minimal, and suitable habitat would remain largely unchanged in the wildlife LSA and RSA. The amount of habitat loss because of the Project is not expected to have a measurable effect on common goldeneye abundance. Common goldeneye may avoid the Project footprint; however, the effects of the Project are not expected to result in a measurable change in common goldeneye distribution and movement in the wildlife RSA. The Project is not expected to have a measurable effect on common goldeneye survival and reproduction.

Overall, the incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of common goldeneye populations overlapping the wildlife RSA (i.e., the Indigenous land and resource use LSA). Common goldeneye is predicted to remain self-sustaining and ecologically effective in the Application Case (Section 14.5.9.3.2, Significance Determination).

Summary

The Project would remove small amounts of high, moderate, and low suitability habitat in the wildlife RSA; however, suitable habitat for moose, black bear, grey wolf, American marten, mallard, and common goldeneye would remain largely unchanged throughout the wildlife RSA relative to existing conditions. The overall changes in wildlife habitat availability and distribution are expected to be small in the wildlife RSA and the Project is expected to have no measurable effect on survival and reproduction of wildlife. A reduction in suitable woodland caribou habitat may affect the survival and reproduction of individual woodland caribou that use the wildlife LSA, wildlife RSA, and caribou home range, but changes are expected to be non-measurable at the population level or SK2 West range. The overall effect to woodland caribou is largely attributed to existing disturbance, where the SK2 West range already exceeds the management threshold of 65% undisturbed habitat necessary to support a self-sustaining population. Implementation of a Caribou Mitigation and Offsetting Plan would have the goal of a net increase in functional caribou habitat to meet the provincial management goals for woodland caribou. Although Indigenous Groups have noted that woodland caribou is currently scarce in the Indigenous land and resource use LSA and community members self-limit harvest (CRDN-JWG 2020c; CRDN-JWG 2021) or currently do not rely on caribou for sustenance (MN-S-JWG 2019a; TSD II: BNDN; TSD III: BRDN), caribou were depended on for traditional purposes in the past and are still considered culturally important to Indigenous Groups because of their historical connections with the species and for future use.

Changes to wildlife movement and habitat connectivity from the Project would be small and localized, which may affect the distribution of wildlife and their availability in the area around Patterson Lake. However, the potential changes to distribution and availability are expected to result in negligible effects for hunting and trapping in the Indigenous land and resource use LSA and RSA. For example, wildlife movement patterns would be altered for woodland caribou, moose, black bear, and grey wolf within and adjacent to the Project footprint, including the movement route at the narrows of Patterson Lake. The increased traffic on Highway 955 could also affect the movement and habitat connectivity of woodland caribou, moose, black bear, and grey wolf that use habitats within and outside the western portion of the wildlife RSA. These changes in wildlife abundance and distribution around the Project footprint may cause a localized displacement of some existing hunting and trapping activities that have been documented by the CRDN, MN-S, BNDN, and BRDN in the Indigenous land and resource use LSA (Section 16.3.2). However, wildlife habitat is expected to remain well connected for movement throughout the rest of the wildlife RSA. Effects on wildlife availability from changes in habitat availability, habitat connectivity, and sensory disturbances would occur throughout all Project phases and extend beyond the Active Closure Stage (i.e., two generations of Indigenous land users, or 43 years, for harvesting of most species, and approaching three to four generations, or 100 years, for common goldeneye and American marten) until functional habitat is restored and sensory disturbance from traffic and Project activities is no longer expected to influence wildlife movements.

Considering the small, predicted effects (except for woodland caribou) on the abundance and distribution of species hunted and trapped by Indigenous Groups in the Indigenous land and resource use LSA, the availability of species for hunting and trapping would persist. Indigenous use of land and resources in the LSA has been resilient and has persisted through the history of changing wildlife populations, changing government policies, and industrial developments including exploration and other uranium mining projects. Overall, the Project is expected to have a small, local effect on Indigenous land and resource use through its effects on the availability of wildlife for harvest.

16.5.1.3 Quality of the Indigenous Land Use Experience

The presence of the Project may affect the quality of the Indigenous land use experience through:

- changes to noise, light, air quality, and aesthetics during Construction, Operations, and the Active Closure Stage;
- changes to Indigenous land user safety along the access road and within the Highway 955 corridor during Construction, Operations, and the Active Closure Stage;
- changes to perceptions of the quality of wildlife, fish, water, and plant resources during all Project phases, including the perceived suitability of a decommissioned site for Indigenous land and resource use; and
- changes to the cultural landscape, which could affect sense of place and the relationship between Indigenous Groups and the land.

16.5.1.3.1 Noise

Project activities would produce noise during Construction, Operations, and the Active Closure Stage. Noise was frequently mentioned by LPA communities as a key interest and concern (NexGen 2019). Most Project noise sources would be effectively continuous or steady state throughout the day and night with more irregular noise during Construction. Sources in this category include equipment associated with land clearing; site preparation and construction of facilities and infrastructure; underground shaft and mine development; ventilation fans; site traffic; power generation; and process plant and underground operations. In contrast, noise associated with the Project airstrip would be intermittent. Noise was modelled during Construction and Operations to capture maximum predicted noise effects from Project-related activities (Section 7.3.5, Residual Effects Analysis). A temporal snapshot for Closure was not included because activities during the Active Closure Stage would be similar, but less intense, relative to activities during Construction (Section 7, Air Quality, Noise, and Climate Change). The level of activities during the Transitional Monitoring Stage of Closure are expected to generate negligible noise levels relative to ambient (i.e., background) conditions.

In the absence of Saskatchewan-specific regulations or guidelines, existing noise levels were characterized in the context of thresholds from federal guidance documents from Environment and Climate Change Canada, Health Canada, and the Alberta Energy Regulator Directive 038 (Section 7.3.6, Existing Conditions). Noise was modelled to verify if Environment and Climate Change Canada thresholds for continuous daytime and nighttime noise of 55 dB and 45 dB, respectively, would be exceeded. Health Canada formulae were used to predict high annoyance and sleep disturbance noise during Construction and Operations. Analysis from the Alberta Energy Regulator measured low frequency noise in a two-part test applicable for normal operations during Operations. Model results were produced for key receptor locations provided by Indigenous Groups during Project engagement and compared to the appropriate threshold values.

Indigenous Groups have emphasized the importance of experiencing peace, quiet, and enjoyment while out on the land, and the ability to practise traditional activities in an environment without sensory disturbances (TSD V.1: CRDN; TSD II: BNDN; TSD III: BRDN). A citizen of the MN-S noted how much they love the silence of the north, and how in the wilderness you can only hear the grass rustling and the wind blowing (MN-S-JWG 2020).

Indigenous Groups have already experienced noise disturbances from increased industrial activity (e.g., exploration drilling) and the associated influx of traffic in their traditional lands and areas that were previously remote. The CRDN noted that some of their traditional activities were previously displaced from other areas because of noise, such as around the Cluff Lake Mine:

> Through 1980's and 1990's, it appears that less families from the CRDN spent time around Cluff Lake. Two CRDN members report that their families simply started to hunt, fish, camp in areas away from the mine given the level noise that seemed to come from the mine site and that there were simply "quieter and nicer places" to be. (CRDN 2019a)

Indigenous Groups expressed concerns about Project activities increasing noise because of the amount of traffic and human activity in the area, further affecting community members' enjoyment of the land and ability to practise traditional activities in some areas (TSD V.1: CRDN; TSD II: BNDN; TSD III BRDN; BRDN-JWG 2021). A CRDN member raised a concern about the effects of noise from Project facilities on both sides of Patterson Lake and community members' ability to connect with the area, particularly if they choose to bring their children to the area in the future (CRDN-JWG 2020a). The Project is expected to increase the number of vehicles on Highway 955 by 13%, 2%, and 11% during Construction, Operations, and the Active Closure Stage, respectively, relative to existing conditions (NexGen 2019).

To mitigate the effects of noise on the quality of the Indigenous land use experience, noise dampening structures would be installed on process buildings and power plant generator facilities, and mufflers would be installed on internal combustion engines. Roads would be maintained to minimize ruts and reduce noise emissions from vehicles (Section 7.3.4, Project Interactions and Mitigation, Table 7.3-8).

Project noise levels at all receptors are predicted to comply with thresholds set out in Environment and Climate Change Canada, Health Canada, and Alberta Energy Regulator guidance documents (Section 7.3). Noise levels would be monitored to prevent health and safety noise exceedances for workers or other receptors such as Indigenous land users. However, it is recognized that noise can have an effect on the aesthetics of individual resource users using the LSA, and that individuals may perceive and experience noise differently. Sensitivity to noise may be higher for some individuals, especially when they expect a quiet experience out on the land. Tolerance levels may be very different among individual Indigenous land users and are difficult to measure quantitatively. However, it is reasonable to expect that some Indigenous land users may be affected negatively and choose not to conduct harvesting activities in the LSA at some locations potentially affected by noise increases. In particular, areas experiencing the largest change in noise might be avoided. However, for both Construction and Operations, the maximum predicted change in noise levels would be small, a 3 A-weighted decibels (dBA) increase from existing conditions (Section 7, Figure 7.3-4 and Figure 7.3-5). The degree to which avoidance may occur is subject to individual sensitivities and choices.

16.5.1.3.2 Light

A light analysis was undertaken to evaluate potential effects resulting from artificial lighting anticipated for the Project (TSD XI). The Project would increase ambient light at night in the light study area (i.e., a 10-km radius around the maximum disturbance area) during Construction, Operations, and the Active Closure Stage. Quantitative light modelling focused on Construction and Operations to capture the maximum predicted light trespass and sky glow from Project-related activities. Active Closure Stage lighting was not modelled because it is expected to be less intense than during either Construction or Operations. The lighting requirements of the Project would include illuminated parking lots and roadways, and illumination for the airstrip. Project-related lighting may affect light trespass and sky glow, which are defined as follows:

- **light trespass:** the light or illuminance that strays from its intended purpose onto nearby areas where lighting may be undesirable (e.g., light in the surrounding forest); and

- **sky glow:** stray light that is scattered in the atmosphere, brightening the natural sky, and reducing star visibility (e.g., light reflecting off particles suspended in the air).

A CRDN member raised a concern about the effects of light from Project facilities on both sides of Patterson Lake and community members' ability to connect with the area, particularly if they choose to bring their children to the area in the future (CRDN-JWG 2020a).

During Construction and Operations, light trespass levels are predicted to be unchanged from existing levels at identified Indigenous land use receptor locations outside the Project footprint. The only times when light trespass would be visible is when an Indigenous land user has a direct line of sight on a light source (TSD XI).

The Project would affect sky glow in the LSA during Construction and Operations. Currently, skies in the Indigenous land and resource use LSA can be classified as an E1 zone (i.e., equivalent to a relatively uninhabited rural area). During Construction and Operations, Project-related illumination would result in skies brighter than the E1 threshold in localized areas for eight of the 16 receptors considered in the light analysis (TSD XI). The eight receptor sites would result in brighter skies classified as an E2 lighting zone (i.e., equivalent to a sparsely inhabited rural area) and are located at Broach Lake, the southern portions of Beet Lake and Naomi Lake, the south arm of Patterson Lake, and at Forrest Lake (Table 3-4 and Figure 2-1 in TSD XI).

Sky glow is expected to obscure faint stars for Indigenous land users on clear nights. The change in sky glow may affect the nighttime aesthetics and experience for Indigenous land users spending the night on the land or at a cabin in the E2 lighting zone. Overall, the change of nighttime aesthetics resulting from skyglow would be relatively minor, and changes to the star visibility are expected to be localized to the locations mentioned above.

16.5.1.3.3 Air Quality

Emissions of fugitive dust and small particles from burning gas and diesel fuel can affect air quality for Indigenous land users during all Project phases. Increased airborne dust can be caused by land clearing; site preparation and construction of facilities and infrastructure; site traffic; transportation of personnel and materials to and from the site; and handling and storage of waste rock and ore. Exposure to dust and small particles can occur through breathing, fresh water, and eating plants, fish, and wildlife. These pathways were assessed through the human health risk assessment in Section 15.

Having access to a healthy environment, including air, is critical for the practice of traditional activities, including hunting, trapping, and plant gathering, and for community well-being. For example, members of the MN-S, BNDN, and BRDN commented that clean air is one of the things they appreciate the most about where they live and is important for community well-being (BNDN-JWG 2020a; BRDN-JWG 2020; MN-S-JWG 2020). Members of the MN-S-JWG highlighted the importance of respecting the air and keeping it clean for human health and for future generations (MN-S-JWG 2019a).

Indigenous Groups expressed concerns about the effects of dust from Project activities in general, including on vegetation and berries in particular (TSD IV: MN-S). Specific concerns were expressed by Indigenous Groups related to the adverse effects of uranium dust on the environment, which is believed by some members to travel hundreds of kilometres with the wind and affect the air, water, and vegetation (MN-S-JWG 2019b; TSD II: BNDN; TSD IV: MN-S).

Air quality concerns were raised by the MN-S and BRDN related to exhaust and carbon emissions from vehicles and machinery and coming through the headframes or shafts (TSD III: BRDN; BRDN-JWG 2019b; MN-S-JWG 2019a).

> Well, my only concern is the air quality, I don't know how that's going to affect our people down this way. And also, the transportation aspect of all that industry that's being developed in the north. It looks like the only road is straight down towards La Loche and then across Buffalo area. (TSD III: BRDN)

Indigenous Groups also raised concerns about the effects of air pollution and contamination from Project activities on vegetation, wildlife, and human health (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; CRDN-JWG 2020a; CRDN-JWG 2020c; MN-S-JWG 2019b; BRDN-JWG 2021). The effects of changes in air quality from the Project on the environment and on human health were assessed in the human health risk assessment in Section 15 and are discussed in Section 16.4.1. As summarized in Section 16.4.1, the risk assessment concluded that there are no risks to ecological or human health from air emissions from the Project.

The presence of fugitive dust is likely to occur during dry spring to autumn months. Air quality modelling was completed to predict the amount and spatial extent of dust deposition and associated constituents as a result of the Project during Construction and Operations (Section 7.2; Appendix 7A, Air Dispersion Modelling Report). Results indicate that the dust deposition rate would be higher during Operations than Construction, which is a function of the type of dust and the height at which dust is released. Rates of dust deposition and accumulation would also depend on the rate of supply from the source, wind speed, precipitation events, topography, and vegetation cover (Brown and Berg 1980; Rusek and Marshall 2000).

The annual dust deposition rate during Operations is predicted to be 0.095 milligrams per square centimetre per 30 days (mg/cm^2/30 d) at the boundary of the maximum disturbance area, which is well below the Ontario human health guideline of 0.46 mg/cm^2/30 d (MECP 2020; Section 7.2; Appendix 7A). The dust deposition rate equivalent to the Ontario guideline value is predicted to occur a minimum of 314 m inside the boundary of the maximum disturbance area. Therefore, dust from the Project would be highly localized within the Indigenous land and resource use LSA. Dust is not expected to affect winter activities such as trapping and ice fishing.

Mitigation to minimize fugitive dust from Project activities includes:

- selection of liquified natural gas as the primary fuel for power generation;
- implementation of an Industrial Air Source Environmental Protection Plan, which would include ambient air monitoring and adaptive management based on ambient air quality standards;
- application of water and/or dust suppressants to site roads, access road, and airstrip, as necessary; and
- establishing and enforcing speed limits on site and access roads to reduce dust production.

Application of dust suppressants and speed limit enforcement on regional roads such as Highway 955 would be a provincial responsibility due to the public ownership of that road. The Project is expected to increase the number of vehicles on Highway 955 by 13%, 2%, and 11% during Construction, Operations, and the Active Closure Stage, respectively, relative to existing conditions (NexGen 2019), which is not expected to appreciably change dust along Highway 955.

Dust could affect the quality of the Indigenous land use experience in the LSA during Construction, Operations, and the Active Closure Stage, and potentially discourage harvesting next to the Project. Dust deposition rates are not expected to exceed guidance values outside of the maximum disturbance area. Dust deposition rates are expected to decrease further at traditional use sites farther away from the Project. As the dust deposition rate is expected to be met at a minimum distance of 314 m inside the maximum disturbance area boundary, Project dust effects would be highly localized within the LSA.

16.5.1.3.4 Aesthetics

The presence of the Project could change the quality of the experience for Indigenous land users through changes to aesthetics (i.e., visual quality) by physically altering the landscape used and valued by Indigenous Groups in the LSA. Visual disturbance associated with the Project would be related to vegetation clearing and the presence of Project infrastructure, increased human activity detectable from Patterson Lake North Arm and South Arm, development on the Patterson Lake peninsula, aircraft taking off and landing, and increased traffic on the access road and Highway 955. Visual effects are expected throughout all phases of the Project and would be permanent in areas covered by permanent features, such as WRSAs. Changes to aesthetics from visual disturbance are expected to be observed locally around the maximum disturbance area and would be greater in areas closer to the Project, but would be reduced or not observed in areas farther from the Project or in areas with flat terrain and intact forest cover where visibility is reduced because of potential screening.

NexGen has minimized the Project footprint and maximum disturbance area to the degree possible by optimizing the use of cleared areas for Project activity; using existing road infrastructure, including the existing bridge crossing; using underground storage for tailings; and designing an efficient infrastructure footprint (i.e., buildings clustered together). Efficient use of land has limited the overall Project footprint, including shoreline development.

In addition, forests can provide visual screening depending on the type of trees, understory, and successional stage, which varies around the Project. Mature jack pine in the RSA grows to a height of approximately 15 m. Project infrastructure heights would vary and the topography underlying the Project footprint would also vary with some parts of the Project higher than mature forest. The top of the finished WRSAs would tie into the hill to the south with the intention of blending in with the surrounding topography after Closure. Some infrastructure such as the headframe and communication tower may be visible from some viewpoints such as points on both Patterson Lake and the north shore of the lake during Construction and Operations prior to being decommissioned and reclaimed during the Active Closure Stage.

While permanent features of the Project (e.g., WRSAs) would be reclaimed, vegetation communities anticipated to establish on these features would likely not be representative of the terrestrial ecosites not influenced by the Project; therefore, effects are conservatively considered permanent and irreversible (Section 13.5.1.1.1, Ecosystem Availability). NexGen would undertake progressive reclamation of areas no longer required for Project activities, as well as decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. Reclamation is predicted to reverse effects on disturbed areas and restore natural ecosystems and visual aesthetics of the Project footprint; however, vegetation ecosystems or forest types would most likely differ from those present before disturbance (Section 13). This may result in a loss of aesthetic value after Closure for some Indigenous land and resource users.

16.5.1.3.5 Safety

The Project may affect the safety of Indigenous land users along the access road and Highway 955 through increased traffic volumes and increases in large vehicles (e.g., semi-trucks). Traffic and safety were frequently mentioned as a key interest and concern in LPA communities (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.2: CRDN; MN-S-JWG 2019a;). The LPA community members and trappers participating in the 2021 trapper's workshop expressed concerns about increased traffic volumes and large vehicles on the roads affecting safety, especially in consideration of road width (i.e., narrow roads), dust, and loose gravel. Road safety measures are outlined below.

16.5.1.3.5.1 Access Road

The access road to the proposed Project site is appropriate for the level of traffic during existing conditions. However, several characteristics of the existing access road may cause issues that would be exacerbated by increased traffic volumes associated with the Project:

- Steep grades and vertical crest curves may create undesirable sight distances for oncoming vehicles.
- Lighting is absent except for a small, solar-powered light at the intersection with Highway 955.
- Drainage after heavy rains or spring thaw may flood parts of the access road (NexGen 2019).

Indigenous land users have documented use of Patterson Lake, Forrest Lake, Beet Lake, Dennis Lake, Derkson Lake, Koop Lake, Gall Lake, and Dyck Lake in the LSA (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN). If the access road is used to access these lakes or cabins in these areas, there is the potential for safety conflicts. Under existing access road conditions, future shared use by over-dimensional vehicles carrying heavy loads simultaneously with untrained drivers using private vehicles (e.g., trucks) over 6 km of roadway is expected to be incompatible for safety reasons. Through development of the proposed Project, the access road would be upgraded for safety and the ability to accommodate heavy equipment, and a Ground Transportation Emergency Response Plan would be developed to promote safety for all users.

The Ground Transportation Emergency Response Plan would contain measures to address Indigenous land user traffic safety on the access road and the Security Program would contain measures within the maximum disturbance area, including the following:

- Educate Project staff and contractors on traffic safety including consideration of the safety of other non-Project users of the roads.
- Educate resource users on safe use of the access road (e.g., trappers, lodge and outfitting service providers).
- Where necessary, establish procedures for escorting resource users who are driving personal vehicles on the access road (e.g., lodge and outfitting clients).
- Conduct audits to confirm that management measures are effective in protecting safe passage of Project and other vehicular traffic.
- Evaluate annually how the objectives of the Security Program were met using measurable indicators and modify the plan as needed to foster continual improvement.

16.5.1.3.5.2 Highway 955

Highway 955 was documented by Indigenous Groups as a travel route to access traditional use areas or other communities (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN). The width of Highway 955 varies throughout the corridor and is typically between 7 m and 8 m. Road conditions were evaluated as “fair” south of the Clearwater River crossing but as “poor” north of the crossing (NexGen 2019). In the northern section, trees were observed directly adjacent to the road, leaving no pullout capability along this section of highway (NexGen 2019).

NexGen has approached the Province regarding road improvements including increasing road width, pullout frequency, and routine maintenance along Highway 955 to accommodate the increase in traffic volumes. As part of an Indigenous and Public Engagement Program, NexGen would meet with Indigenous land users on an as-needed basis to discuss access or other issues. The Ground Transportation Emergency Response Plan would contain limited measures to address Indigenous land user traffic safety on Highway 955 due to this roadway being under provincial purview; however, potential road upgrade and maintenance cost-sharing agreements would include provisions for safety such as ploughed pullouts. In addition, an Emergency Response Assistance Plan would be developed to support the response to any unplanned events that may occur along provincial roadways during the transportation of uranium concentrate from the Project site.

16.5.1.3.6 Perceptions of Water, Fish, Plant, and Wildlife Resource Quality

During Project engagement activities, Indigenous Groups emphasized the importance of having access to a healthy environment and clean natural resources, which is critical for the practice of traditional activities, including hunting, trapping, fishing, and plant gathering. Indigenous Groups have expressed concerns related to the potential contamination of the land from Project activities and subsequent effects on the quality of fish, vegetation, and wildlife resources, which in turn could affect the safety of wild foods and human health. As expressed by a member of the BNDN, “so that’s the only concern, you know . . . contaminating everything, like the land” (TSD II: BNDN).

The CRDN raised concerns about contamination to Patterson Lake from uranium and other mineral exploration activities affecting the land and food resources throughout the Clearwater River watershed; they believe that toxins could make their way up the food chain and adversely affect the health of the land and people (TSD V.1: CRDN). Similar concerns were expressed by members of the BNDN and BRDN related to the potential effects of water pollution and contamination entering the food chain, and effects on the land, plants, animals, and people (TSD II: BNDN; TSD III: BRDN).

> People come here . . . . because they know there's a lot of money there with uranium and gold. But what is uranium and gold if you're not going to have a future? . . . . Because they're going to have nothing to live on. . . . . air is going to be polluted. The water is going to be polluted. The land is going to be polluted. What are they going to have? . . . . (TSD II: BNDN)

Indigenous Groups indicated that they are already experiencing the effects of pollution and contamination from other industrial developments, including mineral exploration activities and the Cluff Lake Mine, which they believe has affected the health of the landscape (TSD V.1: CRDN; TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; CRDN-JWG 2020a; MN-S-JWG 2019b; BRDN-JWG 2021). Members of the CRDN, MN-S, and BNDN have stated that they do not believe the Cluff Lake Mine was properly decommissioned, and concerns were expressed about radioactive contamination (TSD IV: MN-S; BNDN-JWG 2019; CRDN 2019a). Some members of the CRDN have avoided using the Cluff Lake Mine area because of concerns related to the contamination of the land and radiation of resources, including perceptions that the area would remain toxic for generations despite reclamation activities (CRDN 2019a,b). Another consideration is that perceptions vary. Although Cluff Lake was perceived by many as a source of contamination, an Indigenous trapper continued to harvest in the Cluff Lake Mine area throughout the operation’s history (CNSC 2003).

A citizen of the MN-S commented that the north was pristine when they were young, but the mining industry has brought changes to environmental conditions, and they are concerned about the effects of existing pollution from mining on their children, grandchildren, and future generations (MN-S-JWG 2019a).

Fishing has been traditionally practised in Patterson Lake by the CRDN, MN-S, and BNDN; however, in more recent years, some Indigenous Group members have either stopped fishing or expressed uncertainty about fishing in Patterson Lake because of access restrictions or concerns about industry presence, including potential effects from mineral exploration activities (TSD II: BNDN; TSD IV: MN-S; TSD V.1: CRDN). The BNDN IKTLU Study noted that Patterson Lake historically supported a diversity of large fish species of high quality (TSD II: BNDN).

Perceived changes to water quality are often seen as central to changes in land and resource use as water affects fish, birds, and other wildlife (TSD IV: MN-S; MN-S-JWG 2020; TSD II: BNDN; TSD III: BRDN). As examples:

> Most important thing because we drink that water and the fish lives on water. Creatures, they drink the water. You know, like moose, caribou, everything. That's the most important thing – we drink a lot of water ourselves. (TSD II: BNDN)

> But Mother Earth is just like a sponge. It collects everything. And also, water flows. It goes wherever. . . . it connects all over the place. I mean even though it's said that it's okay, ... There's no such thing as 100 per cent guarantee for anything. Accidents happen. And the safety of our children and our grandchildren, ... I have lots of concerns. A lot of concerns for our land. A lot of concerns for our children and our grandchildren's future. (TSD III: BRDN)

From a perception study regarding the Rabbit Lake Mine in the Athabasca Basin, the Hatchet Lake Denesųłiné First Nation members appeared to be more focused on the direct effects of uranium mining on the local environment and less concerned on effects on their health through consumption of plants and animals. This response is likely due to their high level of confidence in their ability to tell whether or not their foods are contaminated (Elias et al. 1997; Elias 2001).

From ecosystem and human health perspectives in the Application Case (as described in Section 15 and summarized in Section 16.4.1), there are not expected to be changes to the quality of species harvested and Traditional Foods consumed through hunting, trapping, and fishing activities. This prediction would be confirmed through monitoring and follow-up programs, including the implementation of adaptive management, where necessary. However, existing perceptions of reduced resource quality are expected to remain for some individuals in the Application Case. To help mitigate these perceptions of the Project's potential for adverse effects on Indigenous land and resource use, NexGen would:

- implement the Project environmental protection measures designed to minimize effects to the environment;
- support an independent Indigenous monitoring program to verify that the Project is effectively protecting the environment;
- implement Benefit Agreements that support ongoing traditional land use and enhance Project benefits;
- implement the Indigenous and Public Engagement Program to communicate the results of environmental monitoring programs to verify environmental protection and build trust; and
- carry out progressive and final reclamation that considers the final land use objectives of Indigenous communities.

Project development and operation would include the environmental protection measures as presented throughout the EIS. Key environmental protection measures of the Project include minimizing the overall footprint of disturbance, storing tailings underground, source control of potential contaminants in the WRSAs, and controlling all discharges and emissions to meet permitted criteria that protect water, air, fish, plants, wildlife, and people.

To help mitigate perceived effects on the quality of harvested resources, NexGen commits to providing funding for the lifespan of the Project for full-time independent Indigenous Monitors chosen by each primary Indigenous Group, and to provide unrestricted environmental monitoring opportunities, including independent environmental sampling related to the Project, subject to the Indigenous Monitors complying with appropriate health and safety and other reasonable site-specific policies of NexGen. The Indigenous Monitors would report openly and without restriction to their Indigenous Groups and local communities. This role is anticipated to verify environmental protection and assist in increasing the level of trust in the Project and the industry. Indigenous Guardians are an example of the effectiveness of an independent Indigenous monitoring program.

The Indigenous Guardians at the Voisey's Bay Mine, a nickel mine in Labrador, have carried out an independent monitoring and communication program that has been successful at showing mining can sustainably protect land and resources (Guardians n.d.). Similar independent community participatory monitoring programs are carried out around other mines in Eastern Athabasca Regional Monitoring Program and other parts of the world for transparency and accountability (EARMP n.d.; Pareja et al. 2019).

Benefit Agreements have been negotiated and signed with each potentially affected primary Indigenous Group. Within each Benefit Agreement, NexGen commits to provide resources, both monetary and human, to support community-related initiatives in areas such as health and wellness, education, and cultural and traditional values. Project effects on cultural transmission, which may be affected by changes in perceptions of the quality of harvested resources, are discussed in Section 19.

In addition, NexGen commits to providing opportunities for communication and information about the Project to Indigenous Groups by providing periodic tours of the Project site for community members and holding annual open-houses or information sessions in LPA communities on Project-related matters, including but not limited to environmental and cultural protection. Should issues arise, mechanisms including the Implementation Committee (i.e., a component of the Benefit Agreements) would provide a forum to communicate regularly and to reach early resolution of issues and/or disputes. As part of the Indigenous and Public Engagement Program, communications with Indigenous Groups would be prepared to report on the outcomes of the human health risk assessment and ongoing monitoring of fish, plants, and wildlife resources.

Before the land is transferred to the Province under the Institutional Control Program (i.e., at the end of the Transitional Monitoring Stage), the Detailed Decommissioning and Reclamation Plan would be implemented to promote future use of the Project footprint for Indigenous land and resource use. In JWG meetings with the BNDN and BRDN, NexGen communicated that the *Northern Mine Decommissioning and Reclamation Guidelines* (ENV 2008) have a general objective to leave all disturbed areas safe for traditional land use and in good ecological condition, consistent with the surrounding physical and biological environment (BNDN-JWG 2021a; BRDN-JWG 2021). At that time, NexGen also communicated the desire to work with Indigenous Groups to develop suitable end land use objectives and the details in the Decommissioning and Reclamation Plan, both of which would evolve as the Project progresses.

Transparency is important to develop trust in the international nuclear industry. In conformance with Requirement 32 of the International Atomic Energy Agency, the CNSC's Independent Environmental Monitoring Program also makes it mandatory for independent monitoring data to be collected for all nuclear facilities in Canada and made available to the public (CNSC n.d.). Monitoring data for the Cluff Lake Mine is available online through the CNSC's Independent Environmental Monitoring Program website and 2017 independent data were consistent with the licensee's data and the closed mine poses no risk to the environment or human health (CNSC 2018). NexGen is committed to supporting the communication of results from the CNSC's programs through the Project's Indigenous and Public Engagement Program.

Communication between the government, northern Indigenous communities, and industry is also supported through the Northern Saskatchewan Environmental Quality Committee. In addition to publication of Project monitoring data on the CNSC website and to information sharing through the Northern Saskatchewan Environmental Quality Committee, the Project's Indigenous and Public Engagement Program would also communicate results of Indigenous and company monitoring, which is anticipated help reduce adverse perceptions of mining following recommendations of CNSC (CNSC n.d.) and as has been shown to work in other mining regions in Saskatchewan, Canada, and globally (Guardians n.d., EARMP n.d.; Pareja et al. 2019).

Engagement with Indigenous Groups through the JWGs and other activities has helped NexGen to develop a fuller understanding and appreciation of how important land and resources are to the Indigenous Groups. From the JWGs, NexGen has heard about the need to get information to the communities and maintain open, transparent communications.

> Let people know you're not just dumping water back into the lake; that's what they think now. They don't know that any water that touches the actual surface footprint will be treated. (BRDN-JWG 2019a)

> We used to be a trusting people, but because of historical stuff, we're more cautious in some of the decisions and approaches we take on things. But we're open to open communication, and what's best for all of us. (BNDN-JWG 2020b)

Joint Working Group members noted how much they appreciated being involved in the Project from the outset and the approach taken to understanding the perspectives of the communities and the development of Benefit Agreements (BNDN-JWG 2021a; MN-S-JWG 2021). This commitment to ongoing engagement, sharing of information, and participation in the Project is expected to help mitigate negative perceptions of the quality of the land and resources.

Without mitigation, some Indigenous land users would likely perceive high risk associated with consuming water, fish, plants, and wildlife, which could influence the user experience and, potentially, the individual choices made to avoid harvesting resources in areas near the Project. For example, perceptions that animals may be in poorer health, smaller in size, or otherwise seen as less desirable could result in certain Indigenous land and resource users reducing or avoiding traditional activities in the area of the Project. However, with mitigation, avoidance of land and resource use due to perceived risks are anticipated to be reduced.

A spatial analysis was completed to provide an indication of the extent of perceived effects on land resources. The spatial extent of indirect or perceived effects from the Project and potential avoidance or reduced traditional land and resource use surrounding the Project was assumed to be 5 km from the maximum disturbance area, which represents an area where individuals may perceive contamination to exist. A distance of 5 km from the maximum disturbance area was used as the LSA for the BNDN and BRDN IKTLU Studies to focus the assessment of traditional values surrounding the Project (TSD II: BNDN; TSD III: BRDN). Five kilometres was also selected because it represents a distance that can easily be travelled by foot, out and back, through the bush to carry out traditional activities (e.g., hunting) in a day (Candler et al. 2010). If a camp or cabin were located more than 5 km from the Project, individuals would not likely encounter the Project on a day out on the land. A 5 km distance from the Project encompasses Patterson Lake where Indigenous Groups indicated the most concern during JWG meetings. Indirect or perceived effects for the area within a 5 km distance from the Project maximum disturbance area (approximately 235 km^2) would represent approximately 19% of the Indigenous land and resource use LSA and 0.5% of the area within the Indigenous land and resource use RSA. This estimate is considered conservative since the zone of influence for direct effects from the Project on human land use was assumed in the BNDN and BRDN IKTLU Studies to be 250 m from the Project, which is based on wildlife avoidance and hunting restrictions (TSD II: BNDN; TSD III: BRDN; MSES 2010).

It is recognized that the area around Patterson Lake is part of the core use and occupancy areas for the CRDN, which encompass areas north from Buffalo Narrows to Lake Athabasca (TSD V.1: CRDN). Travel routes and use around the Patterson Lake would be expected to change from perceptions about the Project. Given the topography and distribution of lakes on the landscapes, the travel routes and cabins nearest the access road would likely be most affected, with the travel routes and cabins north of Patterson Lake likely being less affected by perceptions about the Project.

After incorporation of mitigation, a residual adverse effect is predicted for some Indigenous land users who use the LSA because of perceptions of Project effects on harvested resources. This effect is expected to extend beyond the Active Closure Stage and affect intergenerational use (i.e., beyond two generations). The level of the adverse effect depends largely on the perceptions of individuals, which are difficult to predict and, therefore, remain uncertain. The engagement completed to date and mitigation discussed above are expected to reduce the magnitude, geographic extent, and duration of the effect.

16.5.1.3.7 Cultural Landscape

The quality of the experience for Indigenous land users can be affected through changes to what can be collectively referred to as the cultural landscape, which can be altered through changes in noise, light, air quality, aesthetics, and perceptions of the quality of resources as discussed above. According to McIlwraith and Cormier (2016), “site-specific traditional use studies draw attention to particular locations on a map while minimizing the cultural value of the space between the locations”. The value of the space between sites can be captured in the concept of cultural landscapes, which considers the relationships between sites and the spiritual and cultural associations Indigenous Peoples hold with the land (MCFN and Firelight 2017). The associations with the land in the LSA that Indigenous Groups have shared include ties with other Indigenous Peoples, kinship bonds (within families and communities), and ties to ancestors. The cultural landscape also contributes to sense of place, which is “intricately connected to land and place” (TSD III: BRDN). It is tied to people’s attachment and affiliation with the land and is an expression of identity and familiarity (TSD II: BNDN; TSD III: BRDN). Sense of place “depends on particular places . . . along with their particular features (physical, social, and symbolic) and the values and activities these features foster and enable” (TSD II: BNDN).

Indigenous Groups have an inherent familiarity with the land and their traditional territories that has been developed from their long history navigating the land to access traditional use areas; this familiarity contributes to the sense of place (TSD III: BRDN). Indigenous Groups have indicated they have a strong connection to the Patterson Lake area and larger region, including the land and its physical features (i.e., topography, water features, vegetation) and cultural features. These Indigenous Groups have been using these lands for traditional activities for generations (TSD V.1: CRDN; TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD VI: YNLR).

Trails and travel routes used by Indigenous Groups to access traditional use areas in the past and today also contribute to the sense of place (TSD III: BRDN). Travel routes used in the past by Indigenous Peoples were often selected based on physical features of the landscape (e.g., frozen lakes, river valleys, ridges).

For example, a BRDN community member described the network of high-quality trails in the Dyck Lake area, located in the LSA, where the interconnected lakes facilitate travel during the winter for trapping (TSD III: BRDN).

Members of the CRDN stated that the upper segment of Clearwater River to Big Hills / Lloyd Lake is an ancestral water route and harvesting loop that continues to be well travelled today (TSD V.1: CRDN). These physical features contribute to the character of the cultural landscape. Cultural landscapes across traditional territories also play a critical role for anchoring and sharing Indigenous Knowledge and traditional practices.

Sensory disturbances and perceptions of contamination to resources can alter the landscape used and valued by Indigenous Groups by disrupting the spiritual and cultural associations with the LSA. Sensory disturbances can also affect sense of place, which is "created through personal and collective experiences-memories that become embedded in place" (TSD II: BNDN). The BNDN and BRDN have described the importance of sense of place as an intangible value related to their culture, which, along with knowledge transmission, identity, ceremonial practice, spirituality, and place names, among others, is "intricately connected to land and place, and thus largely dependent on community members' ability to access their territory and practice peaceful enjoyment of undisturbed areas of their land" (TSD III: BRDN). If the Patterson Lake area were to be avoided by some people, this could affect cultural continuity and associated transmission of knowledge for this specific area. This is because teaching and learning traditional knowledge is most often experiential. Indigenous Groups expressed concerns about sensory disturbances from Project activities in general affecting their enjoyment on the land, sense of place, and connection to their territory through disruptions to landscapes (TSD V.1: CRDN; TSD II: BNDN; TSD III: BRDN).

There is not a clear correlation between the size of the Project and the potential effect on Indigenous land and resource use as Indigenous land and resource use is more than an inventory of site-specific data and locations as noted by McIlwraith and Cormier (2016) and Mikisew Cree First Nation and Firelight (MCFN and Firelight 2017). Even localized Project effects limited to the maximum disturbance area, such as changes to air quality or aesthetics, may have an effect of the quality of the Indigenous land use experience more broadly within the LSA due to the resulting change to the cultural landscape. Nonetheless, looking at the broader area of indirect or perceived effects (i.e., using a 5 km buffer as discussed in Section 16.5.1.3.6, Perceptions of Water, Fish, Plant, and Wildlife Resource Quality) helps with understanding the connections in the broader landscape. However, effects were also considered in relation to other developments and activities across the larger traditional territories for context.

The Project has the potential to alter the cultural landscape, disrupt sense of place, and change the relationship between some Indigenous land users and the land through changes in noise, light, air quality, aesthetics, and perceptions of contamination of resources. These changes could in turn affect some Indigenous land users' spiritual and cultural associations with the land, ties to their history and ancestors, and the intergenerational transmission of knowledge. These changes can affect individual Indigenous land users differently depending on tolerances and sensitivities to changes.

The Indigenous Groups who use the LSA and RSA have adapted to changes and development over time (TSD V.1: CRDN; TSD IV: MN-S; TSD II: BNDN; TSD III: BRDN) and are expected to continue to shift in response to future changes. As a BRDN member shared:

> I want my children to live to survive, because of the way things are going now. I want them to learn how to fish. I want them to learn how to hunt. I want them to learn how to rabbit snare. Even though they know how to continue – to continue survival, to continue the knowledge and the wisdom that they have – my children and my grandchildren. To learn – to continue learning – to

> help each another. To grow with the land. I want my children and my great grandchildren to learn that. To continue that lifestyle. (TSD III: BRDN)

The importance of continued traditional practices and the commitment of Indigenous Groups to maintaining their culture despite changes experienced in their traditional territories is evident in the community-based cultural revitalization programs in which the CRDN, BNDN, and BRDN are currently involved, including Dene-language programs and land-based education (Section 19). Métis citizens in the region are also involved in the cultural revitalization programs through the schools in the La Loche and Buffalo Narrows (MN-S-JWG 2020).

Movement through the LSA and RSA could change through further fragmentation of a landscape already interrupted by exploration activities and widely staked by claims (Section 17.3.8, Mining and Exploration). Indigenous Groups have already noted being displaced from other areas, such as around the Cluff Lake Mine, which suggests the potential of the Project to result in similar disruptions to traditional activities. In comments to the CNSC from the CRDN regarding the Cluff Lake Mine licence renewal:

> Overall, there is a general perception that even though the site is being reclaimed and “looks better” it will never “be the same again” and should be “avoided in case there is risk to our family’s health and safety”. (CRDN 2019a)

In the case of the Cluff Lake Mine, CRDN members have been restricted from the use of a longstanding and productive harvesting area for approximately 40 years. Even though parts of the Cluff Lake area are now open for “Aboriginal use”, the continuity in CRDN transmission of ancestral knowledge of the area has been affected (TSD V.1: CRDN).

The mitigation discussed previously to address the potential effects of the Project on noise, light, air quality, aesthetics, and perceptions of contamination of resources would help to mitigate Project effects on the cultural landscape. As identified in Section 16.5.1.3.6, NexGen’s commitment to ongoing engagement, sharing of information, and participation of Indigenous Groups in the Project, including independent Indigenous environmental monitoring, is expected to help mitigate negative effects associated with changes to the cultural landscape. NexGen will continue to work to grow strong, positive working relationships with the Indigenous Groups to allow for mutual understandings of the effects and benefits from the Project.

Related to the cultural landscape is cultural continuity that supports well-being, as discussed in 19.5.1.1, Access Restrictions and Avoidance, and Section 19.5.2.1, Access Restrictions and Avoidance. When acquiring Mineral Surface Lease Agreements for northern mining projects, government requires uranium companies to participate in a community vitality monitoring program process. The goal of this program is to provide information and insight to Indigenous Groups and communities in the LSA so that they can actively engage in maintaining and improving the quality of life for residents of northern Saskatchewan. This program would also help preserve the cultural landscape.

To further mitigate changes to the cultural landscape, NexGen has signed four Benefit Agreements (i.e., with the CRDN, MN-S, BNDN, and BRDN). Within each Benefit Agreement, NexGen commits to provide resources to support community-related initiatives in areas such as cultural and traditional values (e.g., youth trapping training). NexGen commits to providing regular communication and information about the Project to community members including by providing periodic tours of the Project site and holding community information sessions in LPA communities on Project-related matters, including environmental and cultural protections.

16.5.2 Reasonably Foreseeable Development Case

16.5.2.1 Access to and Area Available for Indigenous Land and Resource Use

Infrastructure for the Fission Patterson Lake South Property is expected to include an underground mine, mine infrastructure and facilities, site support infrastructure, processing plant, waste rock storage facility, tailings management facility, permanent and temporary accommodation camps, mine support buildings, water management facilities, and an airstrip. Additional disturbance projected as a result of the Fission Patterson Lake South Property would include ground clearing to construct mine infrastructure and to build and relocate roads. Fission Uranium Corp. has committed to minimizing the amount of land disturbed for the Fission Patterson Lake South Property (Fission 2019, 2021a). The life of the mine is expected to include three years of construction followed by seven years of production (Section 16.2.5, Assessment Cases). Assuming that the duration of closure is the same as the Project (i.e., 15 years), the maximum overlap of direct effects to changes in access and area available for Indigenous land and resource use is 25 years (i.e., one generation) for both projects. Cumulative effects from the two projects are likely but uncertain (i.e., probable) given that the Fission Patterson Lake South Property has recently entered the formal regulatory process (Fission 2021a).

In the RFD Case, it is assumed that the Fission Patterson Lake South Property would maintain similar access restrictions as the Project, which would include an access gate and no site access for the public for the safety of on-site workers and land users. Using the same land requirement assumptions as for the Project, the Fission Patterson Lake South Property would cover approximately 1,545 ha of land, which would become unavailable for Indigenous land users. Restricted access would result in a cumulative reduction of 2,526 ha in land available for Indigenous land and resource use in the LSA; this represents 2.0% of the LSA and 0.06% of the RSA. This restricted access to land altered by the projects is expected to last until the sites are transferred to the Province of Saskatchewan for Institutional Control. The change in access from the Fission Patterson Lake South Property would also render additional shoreline segments of Patterson Lake inaccessible (i.e., in addition to the Project effects).

As noted for the Application Case, Indigenous Groups have shared their need for unrestricted access to large areas of land to engage in traditional land use activities (Section 16.5.1.1, Access to and Area Available for Indigenous Land and Resource Use). Both projects would disrupt land use as they would restrict access to a portion of the south and east shores of Patterson Lake and the peninsula. Some temporary restrictions in water access to Patterson Lake may occur if in-lake infrastructure is installed as part of the Fission Patterson Lake South Property. Access along the north side of Patterson Lake, where the CRDN (TSD V.1: CRDN), MN-S (TSD IV: MN-S), and BNDN (TSD II: BNDN) have documented cabins, camp sites, hunting and trapping sites, cultural sites, traplines, and travel routes, would remain unrestricted. However, the CRDN (TSD V.1: CRDN) has expressed concerns that increased interactions between Indigenous land users and industrial activities has already led to the voluntary withdrawal of some land users from certain locations.

Cumulatively, water surface elevations in Patterson Lake and downstream lakes are predicted to result in negligible changes (i.e., increase of 0.01 m) to Patterson Lake, Beet Lake, and Naomi Lake, with WSE change difficult to distinguish within the natural variability in existing conditions. Therefore, open-water navigation (e.g., boat access) would be unchanged.

Some loss of access would occur due to the combined effects of the Project and the Fission Patterson Lake South Property. Mitigation by NexGen for Project effects on access to and area available for Indigenous land and resource use is presented in Section 16.5.1.3, Quality of the Indigenous Land Use Experience. While it is not within the operational control of the Project to minimize the effects of another project on access, it is assumed that Fission would incorporate mitigations similar to NexGen to maintain as much access as possible for Indigenous land and resource use. There are actions NexGen may explore to help mitigate changes in access at a regional level; NexGen remains open to collaboration with Fission and Indigenous Groups on a regional scale. Despite the multiple mitigation approaches, it is acknowledged that it may not be possible to minimize or eliminate all access-related effects in an important area for some Indigenous land and resource users (e.g., some members of the CRDN and MN-S both consider the Patterson Lake area important to traditional land use).

The extent of changes to Indigenous land and resource use activities associated with climate change affecting access to or areas available for traditional land use is inherently difficult to predict. Although projected future climate extremes indicate a future that is likely to be wetter annually (Appendix 22A, Section 22A5, Future Climate), climate change is still anticipated to increase fire frequency within the RSA (Hart et al. 2019). Changes associated with fire could affect areas within the LSA; however, fire suppression activities would be enhanced according to Saskatchewan's fire suppression policies. Changes to conditions in the LSA and RSA may result in increased expense (i.e., time and effort) and decreased safety (i.e., deadfall in burnt areas) to secure resources if areas in the LSA burn. However, fire-return intervals may be limited by self-regulation as young stands burn less frequently due to fuel limitations in early successional vegetation that inhibit ignition (Hart et al. 2019). Drought and flood conditions resulting from climate change may also affect Indigenous land and resource use navigation in the open-water season. While conditions related to climate change may continue over the long term, it is reasonable to assume the resilience of Indigenous land users would enable them to adapt to and become accustomed to new conditions.

16.5.2.2 Availability of Fish, Plants, and Wildlife for Harvesting

16.5.2.2.1 Fishing

In the RFD Case, fishing for traditional purposes could be affected by changes to the availability (i.e., abundance and distribution) of fish because of the cumulative effects of the Project and the Fission Patterson Lake South Property. Changes to the abundance and distribution of fish could occur through changes to fish habitat, survival, and reproduction (Section 11.5.4, Reasonably Foreseeable Development Case).

Negligible to low magnitude effects on fish habitat availability, fish habitat distribution, and fish survival and reproduction are predicted to occur. Overall, although changes to fish habitat availability and survival and reproduction are possible in the RFD Case, the predicted incremental and cumulative effects on fish and fish habitat would be within the resilience and adaptability limits for the four fish VCs (i.e., lake trout, lake whitefish, walleye, and northern pike).

Negligible to small changes (i.e., negligible to low magnitude effects) in the availability of lake trout, lake whitefish, walleye, and northern pike for traditional fishing are expected because of the minor changes predicted in their abundance and distribution in the fish RSA (i.e., same area as the Indigenous land and resource use LSA) in the RFD Case. Effects on fish availability would be local and limited to the Patterson Lake North Arm – West Basin (Section 11.5 Fish and Fish Habitat Residual Effects Analysis; Figure 11.5-1, Table 11.5-1). Although small changes in the availability of fish in the RFD Case are predicted, the fish VCs would remain in lakes and streams throughout the Indigenous land and resource use LSA and RSA and fishing opportunities would continue.

16.5.2.2.2 Gathering

In the RFD Case, gathering for traditional purposes could be affected by changes to the availability (i.e., abundance and distribution) of plants because of the cumulative effects of the Project and the Fission Patterson Lake South Property. Changes to the abundance and distribution of plants could occur through the direct loss, alteration, and fragmentation of traditional use plant habitats (Section 13.5.4.2, Reasonably Foreseeable Development Case).

In the RFD Case, small measurable effects (i.e., low magnitude) in the availability of traditional use plants are expected because of the small changes predicted in their abundance and distribution in the vegetation RSA. Some plant gathering activities may be displaced because of the loss of traditional use plant habitat from the Project and Fission Patterson Lake South Property footprints. The availability of traditional use plant habitat in the RFD Case is predicted to decrease by approximately 732.2 ha (i.e., approximately 3.0% in the vegetation RSA [same area as the Indigenous land and resource use LSA]; Section 13.5.4.2.1, Habitat Availability, Table 13.5-12; Figure 13.5-12). The largest changes in availability were associated with common boreal forest species (i.e., jack pine [loss of 385.0 ha], mosses [loss of 125.7 ha], and blueberry [loss of 87.4 ha]). However, traditional use plant habitat is predicted to remain abundant across the vegetation RSA. The cumulative effects as a result of the Project, the Fission Patterson Lake South Property, and previous and existing developments are expected to be well within the resilience and adaptability limits of traditional use plant species. Changes to traditional plant habitat distribution in the RFD Case would result in a minor reduction of traditional use plant habitat connectivity regionally but are not predicted to affect overall connectivity in the vegetation RSA.

Changes in the availability of traditional use plants would range from long term (e.g., maximum of 95 years for the establishment of mature upland habitat) to permanent when considering the loss of wetlands. Although small changes in the availability of traditional use plants in the RFD Case is predicted, traditional plants remain widespread throughout the LSA and RSA and opportunities to gather would continue.

Climate change may alter the processes that influence the availability and distribution of traditional use plant habitat and effects would likely occur beyond the vegetation RSA; however, it is uncertain whether climate change would positively and/or negatively affect traditional use plant species. Similarly, with forest fires, some traditional use plant species adapt well to fire (e.g., jack pine and blueberry) and are anticipated to occupy newly fire-disturbed areas, which may have a positive effect on traditional use plant habitat availability and distribution. However, other traditional use plants may be negatively affected by forest fire or wetter conditions (Appendix 22, Section 22A4, Future Climate).

16.5.2.2.3 Hunting and Trapping

In the RFD Case, hunting and trapping for traditional purposes could be affected by changes to the availability (i.e., abundance and distribution) of wildlife due to the cumulative effects of the Project and the Fission Patterson Lake South Property. Changes to the abundance and distribution of wildlife can occur through direct removal or alteration of soil and vegetation leading to loss of wildlife habitat, alteration of final terrain and soil conditions that could change the final ecosystems that can be reclaimed on the landscape, and sensory disturbances such as the presence of people, lights, dust, smells, and noise (Section 14.5).

As discussed for the Application Case, the wildlife and wildlife habitat assessment (Section 14.5) includes woodland caribou, moose, black bear, grey wolf, beaver, mallard, and common goldeneye as VC species that are hunted or trapped for traditional purposes. Predicted effects on these VCs in the RFD Case are discussed below, followed by a discussion of these changes in the context of Indigenous land and resource use and availability of resources for hunting and trapping. American marten effects were not assessed in the wildlife and wildlife habitat assessment since it was not a selected VC. However, for the purposes of the Indigenous land and resource use, the potential effects in the RFD Case on marten were quantified by the changes in upland habitat from the vegetation assessment (Section 13) since mature and old growth upland habitat is highly suitable habitat for American marten.

Woodland caribou: In the RFD Case, the Project and the Fission Patterson Lake South Property would combine to reduce the amount of suitable caribou habitat by less than 0.1% of the SK2 West Caribou Administration Unit, which overlaps the Indigenous land and resource use RSA. Overall, the combined amount of high and moderate suitability habitat loss due to the Project and the Fission Patterson Lake South Property (i.e., 84.4 ha) in SK2 West is predicted to have negligible incremental effects on survival and reproduction as it accounts for much less than one caribou home range. However, the threshold of habitat loss to maintain a stable population for woodland caribou in the SK2 West range has already been exceeded without the addition of the Project and the Fission Patterson Lake South Property due to fires and existing anthropogenic disturbance. Current and future forest harvesting activities would also adversely influence caribou in the SK2 West, but timber harvest occurs south of the Indigenous land and resource use RSA.

Climate change and future fire disturbance may decrease or increase caribou habitat and alter predation risk and thus caribou survival and reproduction.

Overall, cumulative effects from the Project, the Fission Patterson Lake Property, and forest harvest activities are predicted to be significant for caribou in the RFD Case, primarily due to existing disturbance (e.g., fire). Importantly, NexGen is committed to implementing a Caribou Mitigation and Offsetting Plan to offset the incremental loss of caribou habitat from the Project. It is also anticipated that other RFDs would implement similar mitigation and offset actions to support a trajectory towards conserving woodland caribou in the SK2 range (Section 14.5.1.3.2, Significance Determination).

Moose: In the RFD Case, the Project and the Fission Patterson Lake South Property would combine to reduce the amount of suitable moose habitat in the wildlife RSA (i.e., same area as the Indigenous land and resource use LSA) by 2,450.8 ha (i.e., 2.9%), which represents about 25% of one moose home range. Approximately 81,700 ha of suitable moose habitat would remain well distributed and connected in the wildlife RSA. The Fission Patterson Lake South Property would partly overlap an area of existing disturbance, and the distribution of suitable habitat in the wildlife RSA would remain largely unchanged. Cumulative effects from the two projects are likely but uncertain given that the Fission Patterson Lake South Property has recently entered the formal regulatory process (Fission 2021b).

The Project and Fission Patterson Lake South Property are expected to increase the number of vehicles on Highway 955 relative to existing conditions, which could affect the movement of moose that use habitat within and outside the western portion of the RSA. The cumulative loss of suitable habitat in the RFD Case may possibly result in a small measurable change to the abundance and distribution of the moose around Patterson Lake.

The effects of climate change can influence moose abundance and distribution in the wildlife RSA. If wetlands are reduced, a reduction in moose habitat may occur; however, wildfires in the wildlife RSA could benefit moose populations in the region.

Overall, cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the species' resilience and adaptability limits. Moose is predicted to remain self-sustaining and ecologically effective in the RFD Case (Section 14.5.2.3.2).

Black bear: In the RFD Case, the Project and the Fission Patterson Lake South Property would reduce the availability of suitable spring habitat by 2,454.0 ha (i.e., 2.7%) in the wildlife RSA. Approximately 86,000 ha of suitable habitat would remain in the wildlife RSA. In the fall, the two projects would result in a combined loss 2,297.5 ha (i.e., 2.6%) of suitable black bear habitat. Approximately 85,000 ha of suitable habitat would remain in the wildlife RSA. The combined loss of suitable habitat represents about 31% of one female black bear home range. Habitat is predicted to remain well distributed and connected across the wildlife RSA. The Project and Fission Patterson Lake South Property are expected to increase the number of vehicles on Highway 955 relative to existing conditions, which could affect the movement of bears that use habitat within and outside the western portion of the wildlife RSA. The cumulative loss of suitable habitat in the RFD Case may possibly result in a small measurable change to the abundance and distribution of the black bear around Patterson Lake.

Climate change may influence black bear abundance and distribution in the wildlife RSA. If wetlands are reduced, a reduction in spring bear habitat may occur; however, an increase in upland habitats may cause an increase in bear habitat in seasons other than the spring. Wildfires may also increase black bear habitat because of a potential increase in the production of berries.

Overall, cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the species' resilience and adaptability limits. Black bear is predicted to remain self-sustaining and ecologically effective in the RFD Case (Section 14.5.4.3.2).

Grey wolf: In the RFD Case, the Project combined with the Fission Patterson Lake South Property are expected to alter grey wolf habitat availability and distribution in the wildlife RSA. A cumulative estimated 2,454.0 ha (i.e., 2.8%) reduction of suitable habitat during the snow-free period and a 2,139.8 ha (i.e., 3.1%) reduction of suitable habitat during the winter are predicted. These changes represent less than one territory of a wolf pack. Approximately 86,023 ha and 67,463 ha of suitable habitat would remain well distributed and connected in the wildlife RSA for the snow-free period and winter, respectively, and changes to the abundance of grey wolf are unlikely.

Changes to prey availability due to climate change may result in both positive and negative effects on grey wolf populations. Reductions in the size and occurrence of wetlands due to climate change may cause a reduction in wolf habitat because wolves select for open muskeg as primary prey (i.e., moose) occupy both bogs and wetland margins during various times of the year. Changes to wetlands in the wildlife RSA may also result in decreased beaver (i.e., wolf prey) lodge occupancy or number of active colonies. The movement of white-tailed deer into the region as a result of climate change could have positive consequences for grey wolf. The change in prey base in the wildlife RSA may cause a shift in prey selection, resulting in changes in grey wolf populations. Overall, climate change effects could be positive or negative, and the degree of changes are uncertain.

Overall, the cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the regional grey wolf population's resilience and adaptability limits. Grey wolf is predicted to remain self-sustaining and ecologically effective in the RFD Case (Section 14.5.3.3.2).

Beaver: In the RFD Case, the Project and the Fission Patterson Lake South Property would combine to reduce the amount of suitable habitat in the wildlife RSA. There would be a 203.6 ha (i.e., 0.6%) reduction in suitable beaver lodge habitat from the Project and Fission Patterson Lake South Property. Most of the habitat loss (i.e., 179.1 ha) would consist of low suitability habitat. Loss of high and moderate suitability habitat represents two to three beaver home ranges. The distribution of suitable beaver habitat in the RSA remains largely unchanged as a result of the Project and the Fission Patterson Lake South Property.

Climate change may reduce the size and occurrence of wetlands, which are important habitats for beaver; these reductions would reduce beaver habitat connectivity. Additionally, the potential for increased frequency and intensity of forest fires combined with potential effects of drought could negatively affect the abundance and distribution of beavers. The effects of climate change could also have a positive effect on beaver habitat, through the transition of coniferous dominant stands to mixedwood or deciduous-dominant stands after fires. Overall, climate change effects could be positive or negative, and the degree of changes are uncertain.

Overall, the cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the regional beaver population's resilience and adaptability limits. Beaver is predicted to remain self-sustaining and ecologically effective in the RFD Case (Section 14.5.5.3.2).

American marten: In the RFD Case, the Project and the Fission Patterson Lake Property are expected to result in a loss of 351.5 ha of suitable habitat for American marten, representing 1.8% of the total suitable habitat in the wildlife RSA in the Base Case. The loss of 351.5 ha of suitable habitat translates to between approximately 0.04 and 2 adult home ranges (Smith and Schaefer 2002), depending on the size of marten home ranges in the RSA. Movement patterns for American marten are expected to change in the area around Patterson Lake as the species would avoid open, exposed landcover and is expected to avoid areas of higher sensory disturbance on the landscape. Remaining patches of contiguous, undisturbed forested habitat would continue to provide landscape connectivity and facilitate marten movement within the wildlife RSA.

Further habitat loss and changes in connectivity may occur as a result of climate change. An increase in wildfire would decrease mature forest and the abundance and connectivity of marten habitat.

Overall, the cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the regional marten population's resilience and adaptability limits. Marten is predicted to remain self-sustaining and ecologically effective in the RFD Case.

Mallard: In the RFD Case, the Project and the Fission Patterson Lake South Property would reduce the availability of suitable nesting habitat for mallard in the wildlife RSA by 620.2 ha (i.e., 1.1%) relative to the Base Case. The RSA is characterized by abundant and widespread permanent waterbodies and wetlands that represent high suitability breeding habitat for mallard. Despite anticipated changes to habitat distribution in the RFD Case, suitable mallard habitat in the wildlife RSA is expected to remain common and connected on the landscape. Cumulative changes in habitat from the Project and Fission Patterson Lake South Property may result in a small measurable change to the abundance and distribution of mallard around Patterson Lake.

Climate change and its effect on forest fires and drought has the potential to result in additional loss of habitat availability in the RSA for mallard. Effects of climate change and habitat loss are expected to result in a small measurable reduction in mallard abundance and distribution in the RSA.

Overall, the cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the regional mallard population's resilience and adaptability limits. Mallard is predicted to remain self-sustaining and ecologically effective in the RFD Case (Section 14.5.10.3.2).

Common goldeneye: In the RFD Case, the Project and the Fission Patterson Lake South Property would combine to reduce the amount of suitable common goldeneye nesting habitat in the wildlife RSA by 114.6 ha (i.e., 0.9%). This change may affect 10 breeding territories. The loss of suitable nesting habitat is expected to result in minor changes to nesting habitat connectivity for common goldeneye in the wildlife RSA. Although the estimated loss of habitat could influence the local abundance of common goldeneye around Patterson Lake, suitable habitat would remain largely intact and available in the wildlife RSA for breeding pairs, which is expected to result in negligible effects on the population.

Climate change can negatively affect common goldeneye nesting habitat if the availability of wetlands is reduced. An increase in the intensity and frequency of wildfires could also reduce the amount of suitable nesting habitat by decreasing the availability of trees mature enough to provide suitable nest cavities.

Overall, the cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the species' resilience and adaptability limits. Common goldeneye is predicted to remain self-sustaining and ecologically effective in the RFD Case (Section 14.5.9.3.2).

Summary

Small measurable effects (i.e., primarily low magnitude) in the availability of moose, black bear, grey wolf, marten, mallard, and common goldeneye for hunting and trapping are expected because of small changes predicted in the abundance and distribution of these species in the wildlife RSA (i.e., the Indigenous land and resource use LSA) in the RFD Case. Changes in the abundance and distribution of caribou are expected to be moderate because of habitat loss due to landscape disturbance in the SK2 West, a region where caribou are not considered self-sustaining in the Base Case. Implementation of a Caribou Mitigation and Offsetting Plan would be required for both projects and would have the goal of a net increase in functional caribou habitat to meet the provincial management goals for woodland caribou. Some hunting and trapping activities may be displaced due to changes in wildlife movement and distribution resulting from the cumulative effects of the Project and the Fission Patterson Lake South Property. Changes in the availability of wildlife are expected to mainly be localized to the area around Patterson Lake, though some changes may extend farther south around Highway 955 in the wildlife RSA. The effects are expected to be approximately one generation of Indigenous land users as transfer of knowledge between generations is experiential, and long-term for availability of plants, which may take up to a maximum of 95 years (i.e., up to three generations of Indigenous land users) for establishment of mature upland ecosites depending on overlap between the Project and Fission Patterson Lake South Property. Climate change may exacerbate adverse cumulative effects, but the magnitude is uncertain.

With the small changes in the abundance and distribution of wildlife in the RFD Case, the availability of wildlife for hunting and trapping is expected to persist throughout the Indigenous land and resource use LSA and RSA.

16.5.2.3 Quality of the Indigenous Land Use Experience

In the RFD Case, the presence of the Project and the Fission Patterson Lake South Property may affect the quality of the resource use experience through:

- changes to noise, light, air quality, and aesthetics during all Project phases;
- changes to Indigenous land user safety along the Highway 955 corridor during all Project phases;
- changes to perceptions of the quality of the wildlife, fish, water, and plant resources, including the future suitability of the decommissioned sites for Indigenous land and resource use; and
- changes to the cultural landscape, which could affect sense of place and the relationship between Indigenous Groups and the land.

16.5.2.3.1 Noise

With respect to noise effects, the Fission Patterson Lake South Property would represent a similar type of development to the proposed Project and is anticipated to have comparable equipment and noise emissions.

Noise levels from the Fission Patterson Lake South Property, in combination with Project construction and operations activities, are predicted to comply with Environment and Climate Change Canada, Health Canada, and Alberta Energy Regulator guidelines at receptors in the noise RSA (Section 7.3.5), including Indigenous land use sites and cabins.

Compliance with guidelines is not the only indicator for many land users who would notice the insertion of industrial noise in an area where previously there was none. Although noise levels would be within guideline values at the receptor locations, Project and Fission Patterson Lake South Property noise could affect the experience of some Indigenous land users. Individuals may perceive and experience noise differently and have different sensitivities. Therefore, it is expected that some individuals may choose not to use the area that expands the spatial distribution of noise to effectively cover all of Patterson Lake north to Gedak Lake and from Forrest Lake to Naomi Lake (Section 7.3.6, Residual Effects Classification).

16.5.2.3.2 Light

In the RFD Case, the Project in combination with the proposed Fission Patterson Lake South Property would result in brighter skies and changes to sky glow that would occur at all receptors in the light RSA (TSD XI). Cumulative sky glow associated with Project Construction and Operations for all receptors would change from an E1 zone (i.e., a relatively uninhabited rural area) to an E2 lighting zone (i.e., a sparsely inhabited rural area), including areas such as the Patterson Lake peninsula, the northern portions of Patterson and Forrest lakes, Gedak Lake and Naomi Lake. The change in sky glow in the RFD Case is expected to slightly affect the experience of being out on the land at night due to sensory disturbance (e.g., faint stars would no longer be visible in the night sky).

16.5.2.3.3 Air Quality

In the RFD Case, the potential adverse effects of dust were considered. As an increase in dust is predicted through the addition of the Fission Patterson Lake South Property, the cumulative effects of dust may affect the quality of the Indigenous land use experience in the Patterson Lake area and discourage these activities in the area during Construction and Operations of the Project in combination with the proposed Fission Patterson Lake South Property. However, the cumulative effects of dust are expected to be limited given the highly localized nature of dust deposition; dust deposition rates are not expected to exceed guidance values outside of the Fission Patterson Lake South Property maximum disturbance boundary or maximum disturbance area for the Project. Cumulative dust deposition rates are expected to decrease at traditional use sites farther away from both developments and would be highly localized around the Patterson Lake area.

16.5.2.3.4 Aesthetics

The development of the Fission Patterson Lake South Property would likely be visible from the west shoreline of Patterson Lake and from Highway 955. The presence of the Fission Patterson Lake South Property, in combination with the Project, would change the aesthetics of the physical landscape for Indigenous land users through visual disturbance at certain locations in the Indigenous land and resource use LSA. Visual disturbance associated with the Project and the Fission Patterson Lake South Property would be related to vegetation clearing, infrastructure development, and increased human activity associated with the projects. The visibility of the projects depends on the viewpoint; however, it is likely that taller infrastructure such as headframes and communication towers may be visible from some points on Patterson Lake and the north shore of Patterson Lake during operations and construction phases, prior to being decommissioned and reclaimed during active closure stages.

As with the Project, Fission has also committed to minimizing the amount of land disturbed for the Fission Patterson Lake South Property (Fission 2019, 2021a).

Cumulative effects from the two projects are likely but uncertain (i.e., probable) given that the Fission Patterson Lake South Property has recently entered the formal regulatory application process and Fission's project description and surface infrastructure layout plan is preliminary (Fission 2021a).

Reclamation for both projects is predicted to reverse effects on disturbed areas and restore natural ecosystems and visual aesthetics; however, vegetation ecosystems or forest types would most likely differ somewhat from those present before disturbance and the establishment of some reclaimed ecosystems is predicted to occur well beyond the Active Closure Stage (Section 13).

16.5.2.3.5 Safety

In the RFD Case, changes in travel safety by land are expected. The Fission Patterson Lake South Property would have its own access road, so there should be no increase of traffic volumes on the access or site roads for the Project. Both projects would use Highway 955 for access; therefore, cumulative traffic volumes would incrementally change the nature and safety of travel to Indigenous land use areas. The Ground Transportation Emergency Response Plan would contain measures to address Indigenous land user traffic safety on the Project's access road and the Security Program would contain measures for maintaining Indigenous user traffic safety within the maximum disturbance area as listed in Section 16.5.1.3.5, Safety. It is expected that Fission Patterson Lake South Property would incorporate similar measures to protect the safety of Indigenous land users around the project and roads. While Highway 955 is under provincial purview, the mitigations proposed for the Project and comparable measures incorporated by the Fission Patterson Lake South Property would help address Indigenous land user traffic safety.

16.5.2.3.6 Perceptions of Water, Fish, Plant, and Wildlife Resource Quality

Indigenous Groups who fish, gather plants, hunt, and trap may perceive the resources harvested in the RSA as lower quality due to the cumulative effects of the Project and the Fission Patterson Lake South Property. Indigenous Groups have expressed concern about the effects of industrial development in their traditional territories, including near the former Cluff Lake Mine, mineral exploration activities, and the oil sands near Fort McMurray, which they believe have cumulatively affected the health of the landscape and resources harvested (TSD V.1: CRDN; TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; CRDN-JWG 2021; MN-S-JWG 2019b; BRDN-JWG 2021).

Some Indigenous community members have expressed concerns with the use of above-ground tailings management systems (CRDN-JWG 2020b; MN-S-JWG 2019b; BNDN-JWG 2020a; BRDN-JWG 2021) as proposed for the Fission Patterson Lake South Property due to past experiences with these tailings management systems at other sites (e.g., Cluff Lake Mine, Gunnar Mine Site). Also, the Triple R deposit, which Fission would be mining, is located under Patterson Lake, which may raise concerns about changes to water quality of Patterson Lake. For approval, the Fission Patterson Lake South Property would include design and control measures that protect the environment, and these protection measures would need to be communicated and acceptable to Indigenous Groups, the CNSC, and the ENV as part of the approval process for the Fission Patterson Lake South Property.

Some Indigenous Groups have expressed concerns about the potential for two uranium mines and mills operating on Patterson Lake and have requested that NexGen work with Fission to minimize potential effects based on the proximity of the two projects (MN-S-JWG 2020; BNDN-JWG 2021b). Concerns were expressed by the CRDN, BNDN, and BRDN related to the cumulative effects of water pollution and contamination on the health of the land and resources throughout the Clearwater River watershed due to contaminants entering the food chain and adverse effects on the health of people (TSD II: BNDN; TSD III: BRDN; TSD V.1: CRDN). The projects would be 4.8 km apart when considering the nearest distance across Patterson Lake between the Project maximum disturbance area and the Fission Patterson Lake South Property's assumed maximum disturbance area. The overlap of the areas of perceived effects could result in a perception of greater effects in the overlapping area. However, the overlap could also result in a smaller overall area of perceived effects and less fragmentation of the landscape compared to a scenario where the two projects were farther apart.

From ecosystem and human health perspectives in the RFD Case (as described in Section 15 and summarized in Section 16.5.2.2.2, Gathering), there are not expected to be noticeable changes to the quality of species harvested and Traditional Foods consumed through hunting, trapping, and fishing. However, as discussed in Section 16.5.1.3.6, perceptions of reduced resource quality are expected to exist for some individuals.

Mitigations for Project effects on the quality of harvested resources and perceptions are presented in Section 16.5.1.3.6 and are applied to the RFD Case. These mitigations include sound environmental management, independent Indigenous monitoring by primary Indigenous Groups, Benefit Agreements with primary Indigenous Groups, effective communication, and reclamation. While it is not within the operational control of the Project to minimize the effects of another project, it is reasonable to assume that Fission would implement similar mitigations as the Project to obtain approvals from regulators and support from the Indigenous Groups. Sound environmental management and reclamation are legal requirements needed for permit compliance. All air emissions and discharges are required to be designed to protect the receiving environment. It is also reasonable to assume that Fission would negotiate and sign Benefit Agreements with affected Indigenous Groups to avoid, mitigate, and compensate for effects, and share benefits of the Fission Patterson Lake South Property to the extent that there would be continued Indigenous land and resource use. Based on publicly available information, Fission is providing the CRDN with capacity funding to support community-led studies and continued engagement (Fission 2021b). It is rare in Canada that a new mine would proceed without a Benefit Agreement to indicate Indigenous support and a social licence to operate. Canada has committed to implementing the *United Nations Declaration on the Rights of Indigenous Peoples* (United Nations 2007) and enacted federal legislation to support this process.

In addition, there are actions NexGen would explore to help mitigate perceived changes in the quality of harvested resources on a regional level. Regional initiatives could include monitoring and risk communication, similar to the Eastern Athabasca Regional Monitoring Program and the Athabasca Working Group, which continues as the community-based environmental monitoring program that communicates results about the safety of Traditional Foods (EARMP 2020). The program also augments the government's permit compliance monitoring. If the Fission Patterson Lake South Property were to proceed, NexGen would commit to supporting a similar regional monitoring program for the Project in coordination with Fission, Indigenous Groups and communities in the LPA, and regulators. The development of the regional monitoring program could also consider lessons learned from other uranium mining experience in Saskatchewan to manage potential Project and cumulative effects, provide effective means of communication, and address perception concerns. Even if Fission chose not to participate in regional monitoring, standard Project monitoring and the independent Indigenous monitoring program for the Project would cover the area of potential cumulative effects around Patterson Lake. This monitoring could be expanded, if required.

Through the operation of the JWGs and other ongoing engagement with potentially affected Indigenous Groups and the LPA communities, NexGen has demonstrated a commitment to transparency and maintaining a relationship of mutual respect and understanding. The JWG members have repeatedly noted how much they appreciated being involved in the Project from the outset of early exploration activities and the approach taken to understanding the perspectives of the communities and the development of Benefit Agreements (BNDN-JWG 2021a; MN-S-JWG 2021). This commitment to ongoing engagement, sharing of information, and participation in the Project is expected to help mitigate potential negative perceptions of the quality of the land and resources near the Project.

Using the methods described in Section 16.5.1.3.6, indirect or perceived effects for the area within a 5 km distance from the Project and Fission Patterson Lake South Property (approximately 313 km^2) overlap and would represent 25% of the Indigenous land and resource use LSA and less than 0.7% of the area within the Indigenous land and resource use RSA.

The independent Indigenous monitoring program and the Indigenous and Public Engagement Program are expected to reduce perceived effects by effectively communicating the findings to Indigenous Groups and local communities through several avenues (e.g., environmental committees, annual reporting, community information sessions). The terms of the Benefit Agreements are also developed with the intent of mitigating effects such as avoidance of use from perceived effects through regular communication and information about the Project, and by resourcing community-based initiatives in areas including health and wellness, education, and cultural and traditional values. In addition, a regional strategy should prove effective as has been demonstrated in other mining regions. It is reasonable to assume the Fission Patterson Lake South Property would have similar programs and agreements.

After incorporation of mitigation, in the RFD Case, a residual adverse effect is predicted for some Indigenous land users who use the LSA because of perceived effects on harvested resources, which is expected to be more pronounced during overlapping operational periods of the Project and Fission Patterson Lake South Property. The effects would largely depend on the perceptions of individuals, which are difficult to predict and, therefore, remain uncertain. The engagement completed to date and mitigation proposed above, including Benefit Agreements, are expected to reduce the magnitude, geographic extent, and duration of the effect.

16.5.2.3.7 Cultural Landscape

The CRDN, MN-S, BNDN, and BRDN have expressed concerns about changes to the cultural landscape in the RSA, including their spiritual and cultural associations with the area around Patterson Lake (Section 16.5.1.3.7, Cultural Landscape), and have documented having to shift traditional use patterns as a result of past development projects (i.e., Cluff Lake Mine).

In the RFD Case, the presence of two uranium operations on Patterson Lake could change the quality of the Indigenous land use experience in the LSA, including changes to sense of place and cultural associations that some Indigenous Group members have with the Patterson Lake area, because of the cumulative effects of noise, light, and changes in air quality; aesthetics; perceptions of the quality of resources harvested; and knowing there are two mines in the area. Cumulative effects from the two projects are likely but uncertain (i.e., probable) given that the Fission Patterson Lake South Property has recently entered the formal regulatory application process and Fission’s project description and surface infrastructure layout plan is preliminary (Fission 2021a). The perceived suitability of the area around Patterson Lake for fishing, gathering, hunting, and trapping following decommissioning is expected to be incrementally affected by the Fission Patterson Lake South Property.

At least one Indigenous Group that could potentially be affected in the RFD Case, the CRDN, has concluded an engagement and capacity agreement with Fission. That agreement would support ongoing engagement and information sharing and fund studies to understand interactions between the Fission Patterson Lake South Property and CRDN Indigenous rights, knowledge, culture, and traditional land use. Engagement and IKTLU studies would be used in the negotiation of a Benefit Agreement between the CRDN and the Fission Patterson Lake South Property (Fission 2021b). Although the status of Fission's engagement and agreements with other Indigenous communities is not currently known through publicly available sources, negotiated agreements are assumed to meet community needs.

Mitigation to minimize Project effects on the cultural landscape is presented in Section 16.5.1.3.7. Mitigation as described in Section 16.5.2.3.6 would also mitigate effects on the cultural landscape in the RFD Case. As previously described, NexGen's commitment to ongoing engagement, sharing of information, and participation of Indigenous Groups in the Project is expected to help mitigate negative effects associated with changes to the cultural landscape. NexGen will continue to work to grow strong, positive working relationships with the Indigenous Groups for mutual understanding and benefits from the Project. Although cultural continuity is expected to be supported by the community vitality monitoring program process (Section 19.8, Monitoring, Follow-Up, and Adaptive Management) and cultural programs supported through the Benefit Agreements, avoidance of the area may be heightened for some individuals. While it is not within the operational control of the Project to minimize the effects of another project on cultural continuity, a regional approach to monitoring and mitigation is likely to help address this uncertainty and adapt approaches, as necessary. It is also reasonable to assume the Fission Patterson Lake South Property would also be exploring ways to support cultural programs through agreements with Indigenous Groups. NexGen is committed to working with local communities, Indigenous Groups, and Fission to develop regional mitigation strategies to address effects on Indigenous land use around the projects, such as supporting culture camps and other cultural programs.

16.6 Residual Effects Classification and Determination of Significance

16.6.1 Classification Summary

Residual effects were classified for the Application Case and the RFD Case after the implementation of mitigation (Table 16.6-1). Residual effects for each measurement indicator are summarized according to the direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of the effect occurring following the methods described in Section 16.2.9. Effective implementation of mitigation is summarized in Section 16.4 (Table 16.4-1), and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on Indigenous land and resource use. Following the summary of residual effects, the significance of residual effects for the Application Case and the RFD Case was determined according to the methods described in Section 16.2.9.

Table 16.6-1: Classification of Residual Effects on Indigenous Land and Resource Use Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Changes to access to and area available for Indigenous land and resource use	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Low: restrictions to land access for safety purposes within the maximum disturbance area past the gatehouse (i.e., around mine infrastructure for safety purposes) ▪ Low: assumed loss of 981 ha of land available for use, representing approximately 0.7% of the LSA	▪ Low: restrictions to land access for safety purposes within the Project maximum disturbance area past the gatehouse and the Fission Patterson Lake South Property maximum disturbance area (i.e., around mine infrastructure for safety purposes) ▪ Low: cumulative reduction of 2,526 ha of land available for use, representing approximately 2.0% of the LSA
	Geographic extent	▪ Local: maximum disturbance area of 981 ha (or approximately 0.7% of LSA) would be removed	▪ Local: Project maximum disturbance area and Fission Patterson Lake South Property hypothetical maximum disturbance area. Total of 2,526 ha (or approximately 2.0% of the LSA) would be removed
	Duration	▪ Medium-Term: 43 years (i.e., start of Construction to end of Transitional Monitoring Stage), or approximately two generations of Indigenous land users, as transfer of knowledge of an area is intergenerational	▪ Short-Term: maximum of 25 years for cumulative effects depending on the extent of temporal overlap between the Project and the Fission Patterson Lake South Property (or approximately one generation of Indigenous land users) as transfer of knowledge of an area is intergenerational ▪ Permanent: for the above-ground tailings facility
	Reversibility	▪ Reversible	▪ Reversible: reclaimed areas ▪ Irreversible: above-ground tailings facility
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain	▪ Probable (Project and Fission Patterson Lake South Property)
Changes to the availability of fish, plants, and wildlife for harvesting	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Low: small changes to the availability of wildlife (i.e., caribou, moose, black bear, grey wolf, marten, beaver, mallard, and common goldeneye) for harvesting ▪ Low: negligible to small changes to the availability of fish for harvesting ▪ Low: small changes to the availability of traditional use plants for harvesting	▪ Low: small changes to the availability of wildlife (i.e., caribou, moose, black bear, grey wolf, marten, beaver, mallard, and common goldeneye) for harvesting ▪ Low: negligible to small changes to the availability of fish for harvesting ▪ Low: small changes to the availability of traditional use plants for harvesting
	Geographic extent	▪ Local: availability of fish for harvesting, restricted to Patterson Lake North Arm – West Basin ▪ Local: availability of plants for harvesting, restricted mainly to maximum disturbance area ▪ Local: availability of wildlife for harvesting, restricted to a portion of the LSA, including the maximum disturbance area and wildlife travel route at Patterson Lake ▪ Regional: changes to wide-ranging wildlife species (e.g., moose, black bear) availability due to changes to wildlife movements and distribution beyond the LSA and outside the Highway 955 corridor from increased traffic and sensory disturbance	▪ Local: availability of fish for harvesting, restricted to Patterson Lake North Arm – West Basin ▪ Local: availability of plants for gathering (the maximum disturbance area and Fission Patterson Lake South Property) ▪ Local: availability of wildlife for harvesting, restricted to a portion of the LSA, including the Project and Fission Patterson Lake South Property maximum disturbance areas and wildlife travel route at Patterson Lake ▪ Regional: changes to wide-ranging wildlife species (e.g., moose, black bear) availability due to changes to wildlife movements and distribution beyond the LSA and outside the Highway 955 corridor from increased traffic and sensory disturbance
	Duration	▪ Medium-Term: 43 years (i.e., start of Construction to end of Transitional Monitoring Stage) for availability of wildlife and most traditional plants for harvesting or approximately two generations of Indigenous land users because transfer of knowledge between generations is experiential ▪ Long-Term: well beyond the Active Closure Stage (i.e., 60 to 80 years; total of up to 113 years; or up to five generations of Indigenous land users) for caribou, marten, goldeneye, and the availability of plants in mature upland ecosites	▪ Short-Term: maximum of 25 years for cumulative effects depending on the extent of temporal overlap between the Project and the Fission Patterson Lake South Property for wildlife harvesting or approximately one generation of Indigenous land users as transfer of knowledge between generations is experiential ▪ Long-Term: an additional generation or two for availability of plants, which may take up to a maximum of 95 years (i.e., approximately four generations of Indigenous land users) for establishment of mature upland ecosites depending on overlap between the Project and Fission Patterson Lake South Property
	Reversibility	▪ Reversible: availability of fish, wildlife, and most traditional plants in reclaimed ecosites ▪ Irreversible: availability of plants in affected wetland ecosystems	▪ Reversible: availability of fish, wildlife, and most traditional use plants ▪ Irreversible: traditional use plants in affected wetland ecosystems ▪ Irreversible: climate change effects
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain: availability of most traditional plants, fish, and wildlife species	▪ Probable (Project and Fission Patterson Lake South Property)

Table 16.6-1: Classification of Residual Effects on Indigenous Land and Resource Use Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Changes to the quality of the Indigenous land use experience	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Moderate: changes due to changes to aesthetics, perceptions of the quality of resources, and the cultural landscape, with mitigations. Small changes due to Project effects on noise, light, air quality, and safety. Some Indigenous land users in the area may change their behaviours or harvesting patterns because of perceptions of changes in the quality of harvested resources and changes to the cultural landscape. Reduced over time with mitigations	▪ Moderate: changes due to changes to aesthetics, perceptions of the quality of resources, and the cultural landscape, with mitigations. Small changes due to cumulative effects of noise, light, air quality, and safety. An increased number of Indigenous land users from the Application Case may change their behaviours or harvesting patterns because of perceptions of changes in the quality of harvested resources and changes to the cultural landscape. Reduced over time with mitigations
	Geographic extent	▪ Local: includes the maximum disturbance area, 5 km buffer for perceived effects, Patterson Lake, noise LSA, access road corridor, and Highway 955 corridor	▪ Local: cumulative changes in aesthetics, perceptions of the quality of harvested resources and the cultural landscape around Patterson Lake in the 5 km buffer for perceived effects, potentially resulting in changes in land user behaviours or harvesting patterns ▪ Local: effects on the Indigenous land use experience related to noise, light, air quality, and safety
	Duration	▪ Medium-Term: 43 years (i.e., Construction until end of Transitional Monitoring Stage) for changes to the cultural landscape, aesthetics, and perceptions of the quality of resources or approximately two generations of Indigenous land users as transfer of knowledge of an area is intergenerational ▪ Medium-Term: 43 years for effects on land use experience related to noise, air quality, and safety or approximately two generations of Indigenous land users ▪ Permanent: cultural landscape due to areas covered by permanent features (e.g., WRSAs) and perceptions for some individuals	▪ Short-Term: maximum of 25 years for cumulative effects depending on the extent of temporal overlap between the Project and the Fission Patterson Lake South Property or approximately one generation of Indigenous land users as transfer of knowledge of an area is intergenerational ▪ Permanent: changes to the cultural landscape due to areas covered by permanent features (e.g., WRSAs, above-ground tailings facility) and perceptions of some individuals
	Reversibility	▪ Reversible: changes to aesthetics and perceptions of the quality of resources, with mitigation (e.g., Indigenous monitoring) ▪ Irreversible: some perceptions related to permanent infrastructure (e.g., WRSAs), perceptions for some individuals, and cultural landscape with the changes in the history of land use ▪ Reversible: effects on land use experience related to noise, air quality, light, and safety	▪ Reversible: changes to aesthetics and perceptions of the quality of resources and the cultural landscape, with mitigation (e.g., Indigenous monitoring) ▪ Irreversible: some perceptions related to permanent infrastructure (e.g., WRSAs, above-ground tailings facility) and perceptions for some individuals ▪ Reversible: effects on land use experience related to noise, air quality, light, and safety
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Probable: changes to perceptions of the quality of resources and to the cultural landscape ▪ Certain: effects on land use experience related to noise, air quality, light, aesthetics, and safety	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (effects from climate change)

RFD = reasonably foreseeable development; LSA = local study area; RSA = regional study area; WRSAs = waste rock storage areas; COPC = constituent of potential concern.

16.6.2 Significance Determination

In determining the significance of effects on Indigenous land and resource use, consideration was given to the combination of residual effects (i.e., access to and area available for land and resource use, availability of resource, and the quality of resource use experience) combined with the overall presence of Indigenous land and resource use in the LSA as compared to the RSA.

Changes to access to and area available for Indigenous land and resource use

In the Application Case, low magnitude adverse changes are predicted for access to and area available for Indigenous land and resource use. Given limitations on access to the Project footprint from the point of the gatehouse and the potential loss of 981 ha of land in the maximum disturbance area (representing approximately 0.7% of the LSA), the geographic extent of direct effects would be limited to the maximum disturbance area and a small portion of Patterson Lake during construction of in-lake infrastructure. Changes in access and area available are likely to result in Indigenous land and resource use activities being displaced from the maximum disturbance area. The duration of effects is predicted to last for 43 years (i.e., through the Transitional Monitoring Stage), or two generations, but would be reversible. Effects are predicted to be continuous and certain.

In the RFD Case, adverse and small magnitude changes are predicted for access to and area available for Indigenous land and resource use because of the cumulative loss of 2,526 ha of land available in the LSA, representing 2.0% of the LSA, and changes in access on additional shoreline segments of Patterson Lake. The geographic extent of effects is predicted to be local and equivalent to the maximum disturbance areas of the Project and the Fission Patterson Lake South Property. The duration of cumulative effects from the projects is predicted to extend up to a maximum of 25 years (i.e., one generation), depending on the extent of temporal overlap between the Project and the Fission Patterson Lake South Property. Loss of land and resource use in the area of the proposed above-ground tailings facility for the Fission Patterson Lake South Property would be permanent. Water-based access is expected to be unrestricted except for the short-term period for installation of water-based infrastructure. The loss of access and available lands are predicted to be continuous and probable as the Fission Patterson Lake South Property recently entered the formal regulatory process (Fission 2021a).

Changes to the availability of fish, plants, and wildlife for harvesting

The Project is anticipated to create low magnitude residual adverse effects on the availability of fish, plants, and wildlife for harvesting. The geographic extent of effects on the availability of fish, plants, and wildlife is expected to be local. This change in availability would potentially displace some Indigenous hunter and trapper activity in the LSA. The duration of effects is predicted to be 43 years, or two generations, for availability of wildlife (i.e., sensory disturbance) and 43 years for many traditional plants. The duration for availability of plants and wildlife that depend on restoration of mature upland ecosites (e.g., caribou, marten, common goldeneye, jack pine) directly affected by the Project is predicted to extend well beyond the Active Closure Stage (i.e., an additional 60 years to 80 years, or an additional three to four generations). Effects would be reversible for availability of fish, most traditional plants in reclaimed ecosites, and wildlife but irreversible for traditional plants in small areas of potentially affected wetland ecosystems where effects are assumed to be permanent. Effects are predicted to be continuous and certain.

Similarly, in the RFD Case, adverse and small magnitude changes are predicted for the availability of fish, plants, and wildlife for harvesting, which is expected to result in some changes to Indigenous land and resource use. The geographic extent of effects on wildlife availability are predicted to be regional as some hunting and trapping activities may be displaced from a portion of the LSA surrounding the projects as a result of changes in wildlife distribution from the cumulative effects of the Project and the Fission Patterson Lake South Property. The geographic extent of effects on traditional plant availability and fish availability is predicted to be local. The duration of cumulative effects on Indigenous land and resource use with respect to most wildlife and traditional plants is predicted to extend up to a maximum of 25 years (i.e., one generation), depending on the extent of temporal overlap between the Project and the Fission Patterson Lake South Property. However, the duration of cumulative effects with respect to use of some plants (e.g., jack pine, white spruce) and harvesting of some wildlife (e.g., marten, common goldeneye) in mature upland ecosites may take up to a maximum of 95 years (i.e., three to four generations), depending on overlap between the Project and Fission Patterson Lake South Property. Changes in the availability of plants in affected wetland ecosystems and in the availability of wildlife and traditional use plants are conservatively assumed to be permanent; however, these areas would be small. The predicted effects are reversible through reclamation, except for wetland areas. Changes in the availability of fish, plants, and wildlife are predicted to be continuous and probable considering the Fission Patterson Lake South Property recently entered the formal regulatory process.

Changes to the quality of the Indigenous land use experience

In the Application Case, adverse and moderate magnitude residual effects are predicted for changes to the quality of the Indigenous land use experience. With respect to geographic extent, there are two scales of effects. Changes to the quality of the Indigenous land use experience associated with Project effects on noise, light, air quality, aesthetics, and safety are likely to result in activities being displaced around Patterson Lake. Changes to the quality of the Indigenous land use experience associated with perceptions of wildlife, fish, and plant resource quality and the cultural landscape have been conservatively estimated to result in activities being displaced within the maximum disturbance area and a 5 km buffer (representing 19% of the LSA and 0.5% of the RSA). Movement patterns around the south side of Patterson Lake are expected to change. These changes represent a small portion of the LSA.

For some individuals who have traditionally used Patterson Lake and the surrounding area, the perceived decrease in quality of resources may be considered to represent important losses of land and resource use and cultural connections. Nonetheless, similar resources (i.e., water, fish, plants, and wildlife) as those found in the Patterson Lake area are available throughout the LSA and RSA.

The duration of effects is predicted to extend 43 years (i.e., through the Transitional Monitoring Stage) because of changes in aesthetics, perceptions of the quality of resources harvested, and the cultural landscape, though changes in noise, air quality, light, and safety are anticipated to last for approximately 33 years (i.e., end of Active Closure Stage).

Effects are predicted to be reversible; however, perceptions associated with permanent infrastructure and the history of the cultural landscape would be irreversible for some individuals. Effects would be minimized by designing and managing the Project to high standards of environmental management and through the incorporation of mitigation. Key mitigations include independent Indigenous monitoring, Benefit Agreements with primary Indigenous Groups, the Indigenous and Public Engagement Program, and carrying out progressive and final reclamation that considers the land use objectives of Indigenous communities. Changes to the quality of the Indigenous land use experience are predicted to be continuous and probable because of changes to perceptions of the quality of resources and the cultural landscape.

In the RFD Case, adverse and moderate magnitude changes are predicted for changes to the quality of the Indigenous land use experience as a result of cumulative effects on aesthetics, perceptions of the quality of resources, and the cultural landscape; however, similar to the Application Case, only small changes are predicted for the quality of the Indigenous land use experience related to noise, light, air quality, and safety. Changes may be reflected in the species harvested, the location of activities, or in other adjustments to individual behaviour due to changes to the quality of the experience in the LSA. The geographic extent of effects from the combined effects of the Project and the Fission Patterson Lake South Property related to noise, air quality, light, and safety are expected to remain within the LSA. The geographic extent of effects for changes related to aesthetics, perceptions of the quality of harvested resources, and the cultural landscape are predicted to be local. Changes to the quality of the Indigenous land use experience associated with perceptions of wildlife, fish, and plant resource quality and the cultural landscape have been conservatively estimated to result in activities being displaced within the maximum disturbance area and a 5 km buffer around both projects (representing 25% of the LSA and 0.7% of the RSA). Movement patterns around the south and west sides of Patterson Lake are expected to change. The mitigations discussed for the Application Case would apply in the RFD Case. Additional regional Indigenous monitoring by NexGen and Fission around Patterson Lake and the projects would be expected to build trust and verify environmental protection to support continued Indigenous land and resource use in the RFD Case.

The duration of cumulative effects is predicted to extend 25 years (i.e., more than one generation), depending on the extent of temporal overlap between the Project and the Fission Patterson Lake South Property, for changes related to noise, light, air quality, and safety. Cumulative changes in the quality of the Indigenous land use experience are expected to result in changes to land use patterns around Patterson Lake and last two generations, provided the lifespan of the Fission Patterson Lake South Property overlaps with the Project. Reclamation to meet post-closure Indigenous land uses would reverse some effects; however, changes in landforms for permanent features (e.g., WRSAs, Fission Patterson Lake South Property tailings storage facility) and the history of the cultural landscape would be permanent. Effects are predicted to be continuous and probable considering the uncertainty of the Fission Patterson Lake South Property's approval.

Experience from other uranium mines in the Athabasca Basin and Labrador suggest negative views of mining activity may diminish over time as land users adapt to the change in shared land use and reassess the risk of contamination of land and resources. Mitigations to improve perceptions of the quality of resources and cultural landscape include the Indigenous and Public Engagement Program and the independent Indigenous monitoring program and further mitigations and benefits developed in the Benefit Agreements. These mitigations are also anticipated to minimize the effects associated with changes to the quality of the Indigenous land use experience.

Climate Change

The effects of climate change on the availability of fish, traditional use plants, and wildlife are difficult to predict with accuracy, but the expectation is that they are likely to occur from increases in wildfires, floods, and droughts. Effects from climate change are regional, possible (given the uncertainty in climate change predictions), and permanent. Indigenous land users are expected to incrementally adapt to climate change effects and continue to use the land and available resources.

Significance Summary

In the Application Case, when the indicators are considered collectively, Indigenous land and resource use is expected to change around Patterson Lake, but overall Indigenous land and resource use in other areas of the LSA and RSA is anticipated to continue. Changes may be reflected in the species harvested, the location of activities, or in other local adjustments to individual behaviour due to changes to the quality of the Indigenous land use experience.

The Indigenous Groups who use the LSA and RSA are resilient, have adapted to changes and development over time (TSD V.1: CRDN; MN-S-JWG 2020; TSD II: BNDN; TSD III: BRDN), and are expected to continue to shift in response to future changes. The importance of continued traditional practices and the commitment of Indigenous Groups to maintaining their culture despite changes experienced in their traditional territories is evident in the community-based cultural revitalization programs in which the CRDN, BNDN, and BRDN are currently involved, including Dene-language programs and land-based education (Section 19). Métis citizens of the MN-S in the region are also involved in the cultural revitalization programs through the schools in the La Loche and Buffalo Narrows (MN-S-JWG 2020).

In the Application Case, changes would be expected for access to and availability of lands; availability of fish, plants, and wildlife for harvesting; and quality of the Indigenous land use experience. Indirect or perceived effects are predicted to be within the 5 km buffer around the proposed mining activities, centred around the Patterson Lake area, which could affect Indigenous land and resource use activities for some individuals. The assessment endpoint (i.e., continued ability to participate in Indigenous land and resource use activities) is still expected to be supported considering mitigations of high standards of environmental management, Indigenous monitoring programs, Benefit Agreements, communication and engagement programs, and reclamation to consider end land use objectives of Indigenous communities. Benefit Agreements between mining companies and Indigenous Groups are generally predicated on obtaining Indigenous consent for projects, with the terms of the agreement providing the needed avoidance, mitigation, compensation, and shared benefits for the coexistence of Project development and continued Indigenous land and resource use. Based on the residual effects analysis, the residual adverse effects for the Application Case are predicted to be not significant.

For the RFD Case, incremental increases in effects over those described in the Application Case would be expected. In consideration of experiences at other uranium operations in northern Saskatchewan where multiple uses remain compatible, the analysis predicts that Indigenous land and resource use could continue in local areas not affected by the Project and the Fission Patterson Lake South Property. With mitigations assumed to be applied at both projects, combined with commitments to work with the local Indigenous Groups and coordinated regional mitigation, Indigenous land and resource use is expected to continue. It can reasonably be assumed that Fission would have signed Benefit Agreements prior to construction as it is rare in Canada that a new mine would proceed otherwise. Canada has committed to implementing the *United Nations Declaration on the Rights of Indigenous Peoples* (United Nations 2007) and enacted federal legislation to support this process. Benefit Agreements between mining companies and Indigenous Groups are generally predicated on obtaining Indigenous consent for projects, with the terms of the agreement providing the needed avoidance, mitigation, compensation, and shared benefits for the coexistence of Project development and continued Indigenous land and resource use. In addition, regional Indigenous monitoring programs would be supported by NexGen to verify environmental protection from cumulative effects. Based on the residual effects analysis, the residual adverse effects for the RFD Case are predicted to be not significant.

Effects of climate change on Indigenous land and resource use are likely to result from fire, flood, or drought conditions. When considering climate change in the RFD Case, effects were determined to be not significant. Regardless, climate change conditions will require Indigenous land and resource users to adopt strategies to continue to practise Indigenous land and resource use.

Despite the fact that residual adverse effects on Indigenous land and resource use are anticipated to be not significant, NexGen acknowledges that continued land and resource use activities are critical to local Indigenous

Groups and communities, and necessary to maintain a social licence to operate. NexGen is committed to effectively implementing the proposed mitigations to protect land and resources, allowing independent Indigenous Monitors to verify that the Project is protecting the environment and human health, continuing to build relationships and trust, and supporting cultural programs to maintain Indigenous connections to the land. Monitoring and follow-up, as discussed in Section 16.8, would be a key requirement to promote continued Indigenous land and resource use in the area of the Project.

16.7 Prediction Confidence and Uncertainty

Prediction confidence refers to the degree of certainty in effects assessment predictions and associated determination of significance. Scientific inference is associated with uncertainty, and prediction confidence depends on the level of uncertainty and the way it is addressed. The primary factors affecting confidence in the predictions made in the assessment for Indigenous land and resource use include:

- availability of baseline data from all potentially affected Indigenous Groups;
- availability of baseline data that identify currently used areas;
- availability of information on the understanding of potential effects by Indigenous Groups, including lessons learned from the development of the Athabasca Basin uranium mines;
- level of understanding of the strength of primary pathways (i.e., mechanisms) in terms of the effects they are likely to have on each VC (i.e., the relationship between cause and effect is clear);
- level of understanding of Indigenous perceptions is based on IKTLU Studies, comments during JWG meetings, and other perception studies, all of which may not capture the full breadth of individuals' perceptions;
- level of certainty associated with the effectiveness of proposed mitigation;
- lack of publicly available information about relationships between Fission and Indigenous Groups outside of the CRDN;
- assumptions on Fission's development of mitigations;
- Indigenous Group experience with multiple industrial developments in close proximity;
- current and future levels of participation by primary Indigenous Groups in the JWG process; and
- level of understanding of the cumulative drivers of change in measurement indicators and associated assessment endpoints.

The IKTLU Studies completed for the Project have the following limitations:

- Not all knowledge holders participated in each Indigenous Group's IKTLU Study (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1 and V.2: CRDN; TSD VI: YNLR).
- Data collected are limited by what knowledge holders are comfortable sharing (TSD II: BNDN; TSD III: BRDN). The information and level of detail presented in each IKTLU Study varies by Indigenous Group, in part, because the IKTLU Studies were self-directed.
- IKTLU Studies contain the opinions of the individuals interviewed, and do not necessarily represent the opinions all members of the Indigenous Group (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1 and V.2: CRDN; TSD VI: YNLR).

- The area shown on maps included in each respective IKTLU Study should be understood as one part of the actual area required to meaningfully practise traditional activities and Aboriginal and Treaty Rights (TSD II: BNDN; TSD III: BRDN; McIlwraith and Cormier 2016).
- The IKTLU Studies do not reflect all values in those areas, and an absence of data does not signify an absence of use or value (TSD II: BNDN; TSD III: BRDN; TSD VI: YNLR).

To address these limitations, additional information was acquired from JWG meetings, general literature about the area of the Project, and other regulatory documents.

In addition to the factors affecting uncertainty, the Indigenous land and resource use assessment partially relies on the results of other disciplines and the uncertainties, and assumptions discussed in those assessments apply to this assessment as well.

Uncertainty was managed by:

- reviewing other sources of information, including JWG meeting transcripts, historical and archival records, community websites and online information, and other regulatory filings;
- defining assessment boundaries broadly to reflect not only the presence of resources but also movement of land users across the landscape;
- incorporating Indigenous and Local Knowledge at all steps of the assessment; and
- applying assessment experience and professional judgment.

Remaining uncertainty was primarily addressed by making assumptions that overestimated rather than underestimated potential effects (i.e., a precautionary assessment). For example, the maximum disturbance area used for the Project was overestimated to address uncertainty in the size and location of Project components and infrastructure. Overall, there is a medium-high degree of confidence in the predictions related to the changes to Indigenous land and resource use during Construction, Operations, and Closure.

Climate change effects are difficult to project with certainty, as the projections depend on the assumptions of the scenarios presented (IPCC 2021). Regardless, changes from forest fires and climate change will require Indigenous land users to develop adaptation strategies to safely continue to practise Indigenous land and resource use throughout their traditional territory.

16.8 Monitoring, Follow-Up, and Adaptive Management

This subsection presents a summary of the identified monitoring and follow-up required to confirm effects predictions and address the uncertainty identified in Section 16.6, Residual Effects Classification and Determination of Significance.

Specifically, follow-up and monitoring programs would be used to:

- evaluate the effectiveness of reclamation and other mitigation actions, and modify or enhance as necessary through monitoring and developing updated mitigation measures, if needed;
- identify unanticipated negative effects, including possible accidents and malfunctions; and
- contribute to the overall continual improvement of the Project.

Monitoring programs would be established to confirm the effectiveness of mitigation for the land and resources Indigenous Peoples rely upon. These programs are described in more detail in the relevant assessment sections:

- fish and fish habitat (Section 11);
- vegetation (Section 13); and
- wildlife and wildlife habitat (Section 14).

Monitoring programs through the Environmental Protection Program and follow-up studies would also be established for aspects of the Project that may affect the experience of being out on the land, including:

- air quality (Section 7.2); and
- noise (Section 7.3).

The effectiveness of mitigations on the Indigenous land and resource use would be evaluated through the following:

- Independent Indigenous monitoring of the effects of the Project would be conducted.
- How the objectives of the Ground Transportation Emergency Response Plan were met would be evaluated using measurable indicators and the plan would be modified as needed to foster continual improvement.
- Regular meetings would be held with potentially affected Indigenous land users, as applicable, independently and as part of the Indigenous and Public Engagement Program to review the previous season and understand any issues or concerns that could be addressed. Follow-up would be conducted as needed.
- A Project feedback and grievance mechanism would be established to record and action issues identified by LPA residents. Indigenous land and resource use issues would be tracked and addressed as they arise and periodically analyzed through management reviews.
- Implementation success of the commitments made under Benefit Agreements would be tracked.
- Success of regional mitigation strategies would be monitored.
- Perception surveys would be completed to better understand LPA residents' thoughts and understanding of uranium mining. The perception surveys would be designed for documenting current and ongoing community perceptions of the mining in the RSA to inform future engagement and mitigation based on community issues, concerns, and opportunities.

In addition to these monitoring and follow-up programs, an Environmental Committee and Indigenous monitoring program would be established. The Environmental Committee would oversee and monitor the environmental performance of the Project. The Environmental Committee would review environmental performance reports in respect of the Project, provide feedback on environmental protection measures and monitoring programs, review and participate on environmental response measures and preventative and corrective actions, and oversee the Indigenous Monitor's activities.

Indigenous Monitors (funded by NexGen for the life of the Project) would be responsible for conducting long-term environmental monitoring of the Project. The Indigenous Monitors would coordinate with other Indigenous Monitors to prepare annual monitoring plans and develop mitigation strategies. Indigenous Monitors would have full access to the Project site (subject to appropriate health and safety and other reasonable site-specific policies of NexGen) for performing environmental analysis and reporting and would participate in responding to environmental occurrences. Indigenous Monitors would provide regular reports to the Environmental Committee and would be entitled to report openly and without restriction to the Indigenous Groups on all activities.

NexGen has committed in the Benefit Agreements with each primary Indigenous Group to establish an Implementation Committee. The Implementation Committee is tasked with the responsibility of facilitating an effective ongoing working relationship between NexGen and the Indigenous Groups to verify that all commitments made within the Benefit Agreements are realized.

16.9 Key Findings

The assessment of potential effects of the Project on Indigenous land and resource use incorporated information from a variety of sources, including JWG meetings and IKTLU Studies completed by Indigenous Groups for the Project. Analysis of potential effects considered information from other projects, the experiences of northern Saskatchewan communities with the uranium industry, and the perspectives and concerns of the CRDN, MN-S, BNDN, and BRDN.

The members of Indigenous Groups considered in the assessment actively pursue Indigenous land and resource use activities throughout the LSA and RSA, including hunting, trapping, fishing, plant gathering, and use of cultural sites, habitation sites, and travel routes (Section 16.3.2). These activities are supported by land-based programming and efforts by the Indigenous Groups to revitalize traditional pursuits that are key to the well-being of the communities (Section 19). The CRDN, MN-S, BNDN, and BRDN have continued to pursue land and resource activities throughout history in the LSA and RSA in response to changing government policies and industrial development that have displaced activities.

After the application of mitigation, residual Project effects on Indigenous land and resource use would result from the following pathways:

- The presence of Project infrastructure would restrict access and reduce areas available for, or displace, other land and resource users.
- The Project could change the availability of fish, plants, and wildlife for harvest.
- Sensory disturbances, changes to aesthetics, and safety concerns may change the quality of the resource use experience for some Indigenous land and resource users in the area surrounding the Project. Similarly, perceptions of effects on the quality of the fish and wildlife resources may adversely affect the quality of the experience and/or result in changes to the cultural landscape (e.g., certain areas being avoided).

Residual effects were analyzed as part of both the Application Case and the RFD Case, which considered the cumulative effects of the Fission Patterson Lake South Property. Potential effects resulting from climate change were also considered.

In summary, residual adverse effects on Indigenous land and resource use were assessed as not significant for both the Application Case and the RFD Case. Small magnitude changes in the availability of resources, access to and area available for Indigenous land and resource use, and moderate magnitude changes in the quality of the Indigenous land use experience, are expected to be centred on the Patterson Lake area. Indigenous land and resource use activities may change or be displaced but are expected to continue with the application of mitigations including the Indigenous and Public Engagement Program and Benefit Agreements. Benefit Agreements between mining companies and Indigenous Groups generally provide the needed avoidance, mitigation, compensation, and shared benefits for the coexistence of Project development and continued

Indigenous land and resource use. Development and implementation of regional strategies to address the effects on Indigenous land and resource use is also seen as an important approach to reducing the cumulative effects on the quality of the Indigenous land use experience. The extent to which effects on the quality of land use are experienced would vary by Indigenous Group and by individual land users. Mitigations would support the continued ability to participate in Indigenous land and resource use activities.

NexGen commits to working with the local communities, including Indigenous Groups and other regional groups, throughout the Project lifespan to promote the continued use of the Patterson Lake traditional use area. Monitoring and adaptive management would involve both regular communications with Indigenous Groups and evaluation.

The establishment of the Environmental Committee and hiring of an independent Indigenous Monitor would be key for Indigenous Groups to stay actively involved in monitoring of the environmental performance of the Project and to verify environmental commitments are implemented under the Benefit Agreements. NexGen would continue to engage and have ongoing communication with potentially affected Indigenous land users (independently and as part of the Indigenous and Public Engagement Program), share Project information, address issues and concerns as they arise, and share environmental monitoring results with local Indigenous Groups and communities.

NexGen has committed in the Benefit Agreements with each primary Indigenous Group to establish an Implementation Committee. The Implementation Committee is tasked with the responsibility of facilitating an effective ongoing working relationship between NexGen and the Indigenous Groups to verify that all commitments made within the Benefit Agreements are realized.

16.10 References

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Rook I Project

Environmental Impact Statement

Section 17 Other Land and Resource Use

Submitted to:
Canadian Nuclear Safety Commission
Saskatchewan Ministry of Environment

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November 2024

Executive Summary

Section Purpose

Section 17 of the Environmental Impact Statement (EIS) provides a comprehensive assessment of potential effects of the Rook I Project (Project) on other land and resource use. This assessment included consideration of both potential effects from the Project and cumulative effects from the Project and other reasonably foreseeable developments (RFDs). The other land and resource use assessment used widely accepted scientific practices and incorporated Indigenous and Local Knowledge.

Other land and resource use represented a valued component (VC) for the Environmental Assessment (EA); the selection was based on other land and resource uses being key economic activities and central features of the social setting in northern Saskatchewan. The other land and resource use assessment focused on the commercial and recreational uses that are derived from the natural environment. Commercial resource use included activities in which people from both non-Indigenous and Indigenous communities may participate: commercial fishing and trapping; lodges, outfitting and ecotourism; forestry; and mining. Recreational uses included use of parks and protected areas by Indigenous or non-Indigenous peoples, as well as fishing and hunting activities that are conducted by non-Indigenous people under provincial licences.

The assessment of other land and resource use was informed by the assessments completed for fish and fish habitat and wildlife and wildlife habitat. The other land and resource use assessment provided information that was used to support other VC assessments such as economy, Indigenous land and resource use, and community well-being.

Setting

At a regional scale, the Project would be located within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system, approximately 40 km east of the Saskatchewan-Alberta border and 640 km northwest of the city of Saskatoon. The other land and resource use local study area (LSA) includes the areas surrounding Patterson, Vermeersch, Wickenkamp, Forrest, Beet, and Naomi lakes, plus the Highway 955 corridor between the Project site and La Loche. The other land and resource use regional study area (RSA) is bounded by the N-19 trapping block.

Existing Conditions (Section 17.3)

Commercial trapping and lodge and outfitting services are the main other land and resource use activities conducted within the LSA.

For the management of big game, the Project is located within Wildlife Management Zone (WMZ) 75 and Game Bird Management Unit (GBMU) 6. Average annual harvest from WMZ 75 is five moose for 29 licensed hunters and five black bear for 12 licensed hunters (Government of Saskatchewan 2020). Harvest in GBMU 6 mainly consists of ruffed grouse, spruce grouse, sharp-tailed grouse, and ptarmigan, in order of decreasing licensed hunters and harvest numbers.

Saskatchewan fur harvest statistics from 1970 to 2020 illustrate a declining trend in the number of trappers and pelts harvested (Government of Saskatchewan 2021a). This decline was corroborated by the Birch Narrows Dene Nation (BNDN) and Buffalo River Dene Nation (BRDN), who noted trapping was the primary industry in the region up until the 1960s, and since which time it has been declining due to low fur prices and anti-fur campaigns (BNDN-JWG 2021; BRDN-JWG 2021). Trapping still provides benefits to trappers and their families, including money from fur sales, meat from certain species, and some use of furs for domestic purposes. The N-19 trapping block, whose boundaries are included in the Project's RSA, recorded 258 pelt harvests in 2019/2020 for a total value of just over $7,500 (Government of Saskatchewan 2021a).

There are approximately 10 active commercial fish harvesters from La Loche to Patterson Lake; however, over the past 20 years, Patterson Lake was only commercially fished in the 2016/2017 season.

There are three lodge and outfitting operations with allocations within or partially within the LSA: Forest Lake Outfitters, Big Bear Contracting, and Lone Wolf Camps. Kisslinger Outfitters are located within the RSA and is accessed via the Highway 955 corridor. Lloyd Lake Lodge and Bolton Lake Wilderness Retreat are remote fly-in operations also located in the RSA. The closest operation to the proposed Project is Forest Lake Outfitters, which shares the existing access road for the Project and has allocations for sports fishing on Patterson Lake and other local lakes. Lodge and outfitting services have experienced a downturn due to the COVID-19 pandemic.

For recreational users, the RSA contains all or portions of the Clearwater River Provincial Park, the Clearwater River Canadian Heritage River, the Methye Portage Historic Trail, and the Preston Lake Wildlife Refuge.

Commercial forestry activity is not conducted in the other land and resource LSA or RSA.

There are five uranium operations located in northern Saskatchewan (i.e., Cigar Lake, Key Lake Mill, McArthur River Mine, McClean Lake Mine and Mill, and Rabbit Lake Mine and Mill; CNSC n.d). However, there are no current active mines in the LSA or RSA. The Cluff Lake Mine was closed in 2002 and is located at the north end of Highway 955. Approximately 92 mineral dispositions have been granted to 12 companies that are within, or partially overlap, the LSA, including the Project's and Fission's mineral dispositions, which are proposed for development.

Potential Effects and Proposed Mitigation (Section 17.4)

An analysis was completed to evaluate Project components and activities and associated effects pathways that could potentially affect other land and resource use. The evaluation also considered similar combined effects from the Fission Patterson Lake South Property, the identified RFD for the other land and resource use assessment.

Project activities that would have the potential to affect other land and resource use during the Project lifespan include:

- land clearing, site preparation, construction of facilities and infrastructure;
- transportation of personnel and materials to and from the site;
- process plant and underground operations;
- handling and storage of waste rock, special waste rock, and ore;
- power generation;
- water intakes for potable and process water;
- effluent treatment plant and treated effluent discharge;
- sewage treatment plant and water storage and effluent monitoring ponds;
- additional infrastructure (e.g., camp, maintenance shop, offices); and
- other supporting mining construction, operation, and decommissioning and reclamation activities.

Similar activities that could affect other land and resource use would be expected to occur for the Fission Patterson Lake South Property.

As part of the pathways analysis, proposed environmental design features and mitigation measures were considered to determine whether effects on the environment could be avoided or reduced to negligible levels, thereby removing the pathway. Project environmental design features such as the underground tailings management facility and a limited Project footprint were designed to minimize the Project's effects on other land and resource use. NexGen reduced the Project footprint and corresponding maximum disturbance area (i.e., 981 ha, or four times larger than the currently anticipated Project footprint) by:

- optimizing the use of cleared areas for Project activities;
- using existing road infrastructure to the extent possible, including the existing bridge crossing;
- storing tailings underground; and
- designing an efficient infrastructure footprint (i.e., buildings clustered together).

In addition, proposed mitigation measures that would reduce effects on other land and resource use include:

- robust site environmental management processes;
- design of facilities and infrastructure to minimize sensory disturbance;
- implementation of progressive and final reclamation; and
- development and implementation of a Decommissioning and Reclamation Plan, Security Program, and Indigenous and Public Engagement Program.

These mitigations have been used within the mining sector and have been proven effective. Similar mitigation and management practices would also be expected to be implemented by the Fission Patterson Lake South Property.

After mitigation measures were considered, the pathways screening analysis determined that many of the potential pathways from the Project to the environment could be removed from the assessment. However, it was identified that the Project could still adversely affect other land and resource use from the following pathways:

- access to and area available for land and resource use; and
- quality of the resource use experience.

These pathways were carried forward into the residual effects analysis.

Residual Effects Analysis (Section 17.5)

A residual effects analysis was conducted to determine the potential effects on other land and resource use under two assessment cases: effects of the Project (i.e., Application Case), and combined effects of the Project and the Fission Patterson Lake South Property (i.e., RFD Case). The residual effects analysis considered three measurement indicators:

- access to, and area available for, land and resource use;
- availability of fish and wildlife for harvesting; and
- quality of the resources and the quality of resource use experience.

Access to, and Area Available for, Land and Resource Use

The following are expected residual effects on access to, and area available for, land and resource use:

- Access to other land and resource use around infrastructure would be limited for safety reasons for the Project and the Fission Patterson Lake South Property.
- Access would be affected by additional traffic and upgrades to the access road for the Project and the Highway 955 by-pass for the Fission Patterson Lake South Property.
- For the Project, availability of other land and resource use would be reduced within the maximum disturbance area by 981 ha or 0.7% of the LSA.
- The Fission Patterson Lake South Property activities are predicted to contribute an incremental loss of 1,545 ha of land available for other land and resource use, equivalent to 2.0% of the LSA.
- The Project and the Fission Patterson Lake South Property would not restrict small watercraft from navigation of Patterson Lake.

With mitigations, there would be continued opportunities for other land and resource use with the predicted changes in access to, and area available for, land and resource use from the Project and the Fission Patterson Lake South Property.

Quality of the Resource Use Experience

The following are expected residual effects on quality of the resource use experience for the Project and cumulative effects with the Fission Patterson Lake South Property:

- Sensory disturbances (i.e., light, noise, air quality, and aesthetics):
  - Project noise levels are predicted to be below government thresholds but could affect the aesthetics for some individual land and resource users.
  - Light trespass would be localized around infrastructure.
  - Sky glow is expected to obscure faint stars for trappers and lodge and outfitting clientele on clear nights.
  - Dust emissions would be highly localized.
- Resource user safety may be affected from increased traffic along the access road and adjacent highway.
- Perceptions that mine activities adversely affect the quality of fish and wildlife for harvest.
- Perceptions of contamination at decommissioned facilities.

With mitigations, there would be continued levels of opportunities for other land and resource use with the predicted changes to the quality of the resource use experience from the Project and the Fission Patterson Lake South Property. This includes incorporating safety mitigation measures to protect users on the access road and Highway 955. Individuals may experience different levels of effects from sensory disturbances and perceptions of effects.

Significance Determination (Section 17.6)

The weight of evidence from the analysis, including consideration of experiences at other uranium operations in northern Saskatchewan where multiple uses remain compatible, predicted that other land and resource use can continue in local areas not affected by the projects; resources equivalent in abundance and quality would continue to be available to resource users. Changes to the aesthetics of other land and resource use would be primarily dependent on proximity to the projects and individual sensitivities. The number of resource users potentially affected are limited.

Incremental and cumulative effects resulting from the Project, previous and existing developments, and the Fission Patterson Lake South Property on the other land and resource use are predicted to be **not significant**.

Prediction Confidence and Uncertainty (Section 17.7)

Overall, there was a moderate to high degree of confidence in the predictions related to the other land and resource use assessment. Uncertainty was primarily and appropriately addressed by making assumptions that conservatively overestimated rather than underestimated potential effects (i.e., a precautionary assessment).

Monitoring, Follow-Up, and Adaptive Management (Section 17.8)

Meetings would be held with community members, commercial trappers, outfitters, and other potentially affected land users, as applicable, both independently and as part of the Indigenous and Public Engagement Program. The results of the monitoring conducted by the independent Indigenous Monitors would be evaluated and modifications to monitoring plans would be made as required to support adaptive management and foster continual improvement.

Abbreviations and Units of Measure

Abbreviation	Definition
BNDN	Birch Narrows Dene Nation
BRDN	Buffalo River Dene Nation
CNSC	Canadian Nuclear Safety Commission
CRDN	Clearwater River Dene Nation
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
ENV	Saskatchewan Ministry of Environment
FFMC	Freshwater Fishing Marketing Corporation
GBMU	Game Bird Management Unit
HABISask	Hunting, Angling and Biodiversity Information of Saskatchewan
JWG	Joint Working Group
KP	key person
LPA	local priority area
LSA	local study area
MN-S	Métis Nation – Saskatchewan
NexGen	NexGen Energy Ltd.
NR2	Northern Region 2
Project	Rook I Project
RFD	reasonably foreseeable development
RSA	regional study area
IKTLU	Indigenous Knowledge and Traditional Land Use
VC	valued component
WMZ	wildlife management zone
WRSA	waste rock storage area
WSE	water surface elevation

Unit	Definition
%	percent
$	Canadian dollars unless otherwise stated
cm	centimetre
ha	hectare
km	kilometre
km^2	square kilometre
km/h	kilometres per hour
kg	kilogram
m	metre
m^3	cubic metre
$mg/cm^2/30\ d$	milligrams per square centimetre per 30 days
mSv/yr	millisieverts per year

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17 OTHER LAND AND RESOURCE USE

17.1 Introduction

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The Project would be located approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the Northern Village of La Loche, and 640 km northwest of the city of Saskatoon (Figure 17.1-1). The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Patterson Lake is at the interface of the Boreal Shield and Boreal Plain ecozones. Access to the Project would be from an existing road off Highway 955 (Figure 17.1-2), with on-site worker accommodation serviced by fly-in/fly-out access.

Section 17, Other Land and Resource Use, of the Environmental Impact Statement (EIS) characterizes the potential residual effects of the proposed Project on other land and resource use, which is an attribute or component of the human environment. Other land and resource use represents a valued component (VC) for the Environmental Assessment (EA).

The other land and resource use VC is one of two VCs that encompass land and resource use in the anticipated area of the Project; the second VC is Indigenous land and resource use. Indigenous land and resource use is described in Section 16, Cultural and Heritage Resources and Indigenous Land and Resource Use, and focuses on activities that are an expression of Aboriginal and Treaty Rights, including hunting and trapping, fishing, gathering for food and ceremonial purposes; places of occupancy such as cabins and camp sites; access and travel routes; and culturally important sites such as those with a spiritual or historical importance for traditional or cultural purposes for Indigenous Peoples. Other land and resource use focuses on the commercial and recreational uses that are derived from the natural environment. Commercial resource use includes activities in which people from both non-Indigenous and Indigenous communities may participate: commercial fishing and trapping; lodges, outfitting and ecotourism; forestry; and mining. Recreational uses include use of parks and protected areas by Indigenous or non-Indigenous peoples, as well as fishing and hunting activities that are conducted by non-Indigenous people under provincial licences. Other land and resource uses are key economic activities and central features of the social setting in northern Saskatchewan.

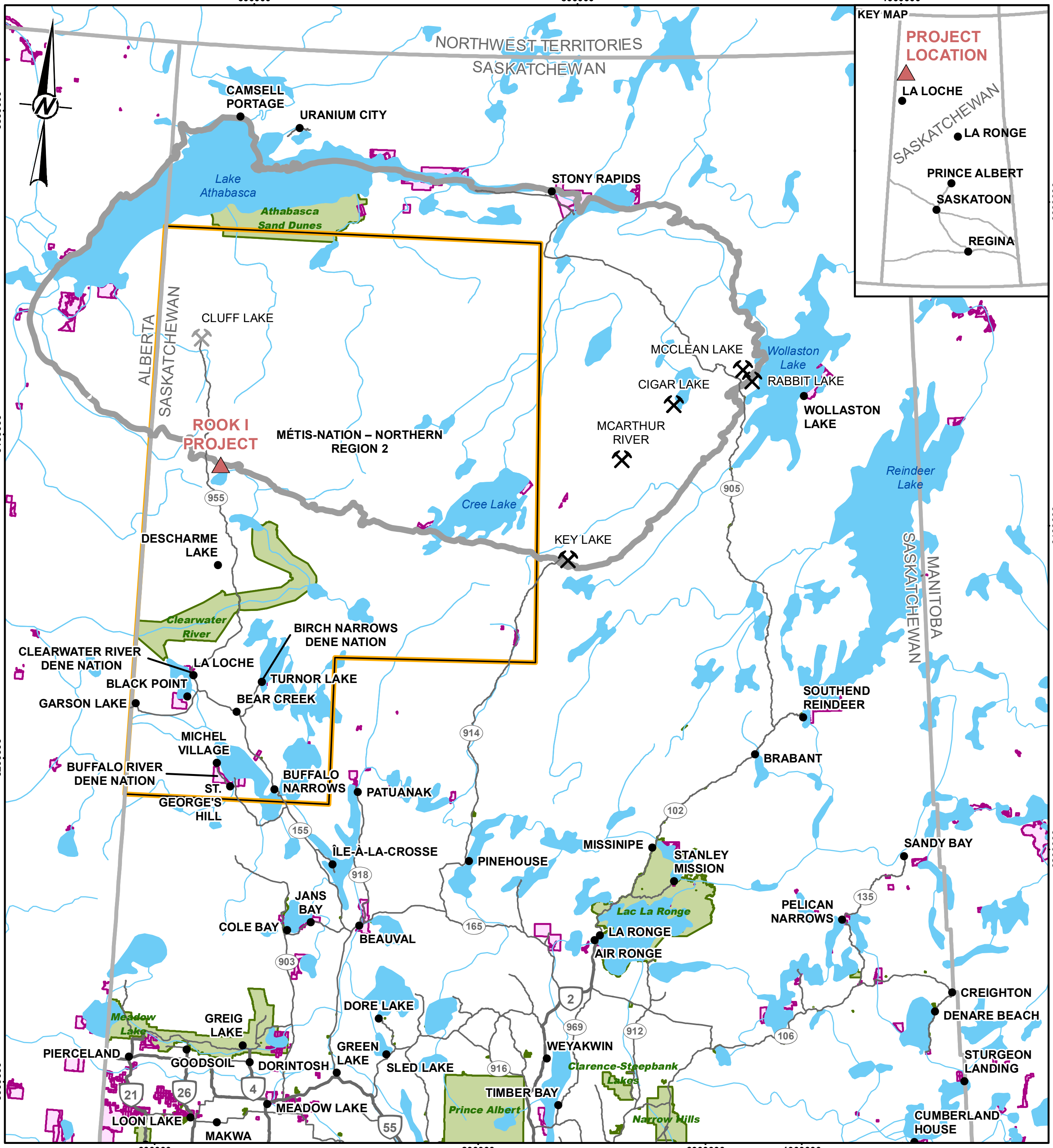
The assessment of other land and resource use incorporated findings from the fish and fish habitat (Section 11) and wildlife and wildlife habitat (Section 14) assessments, as fish and wildlife support commercial resource use activity, along with potential linkages to human health associated with the consumption of water, fish, and wildlife (Section 15). Likewise, effects on other land and resource use have linkages with the resource economy (Section 18), community well-being (Section 19), and cultural and heritage resources and Indigenous land and resource use (Section 16).

The Project has the potential to cause adverse effects on other land and resource use by:

- alteration of surface water quantity and quality, which could influence fish habitat and fish productivity;
- removal of vegetation communities and associated wildlife habitat, which could alter the abundance and distribution (or availability) of wildlife;
- noise, light, and air emissions, which could result in a decrease in the aesthetic qualities or appeal for land users of the local area around the Project;

- access restrictions, traffic patterns changes, and the presence of a large workforce, which could alter resource user safety and the aesthetics of the area around the Project; and
- land user concerns and perceptions about the potential health effects of fresh water and harvesting fish and wildlife containing metals and radionuclides, which could decrease the use of land and resources by the public adjacent to the Project.

Together, these potential changes in availability of natural resources, aesthetic quality, and potential health concerns may adversely influence recreation, tourism, and guiding opportunities for other land and resource users. A simplified linkage diagram, Figure 17.1-3, illustrates how proposed Project activities could result in a direct or indirect effect on other land and resource use, and the VCs that could be influenced through changes to other land and resource use.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN BOUNDARY
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROJECT LOCATION
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

REFERENCE(S)
1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
LOCATION OF THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 17.1-1

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\17_Non_Indigenous_LRU\8_5x11\20144150_Fig17_1-1_Location-of-the-RookI-Project_NoTitleblock_Rev0.mxd PRINTED ON: 2023-02-09 AT: 2:13:42 PM

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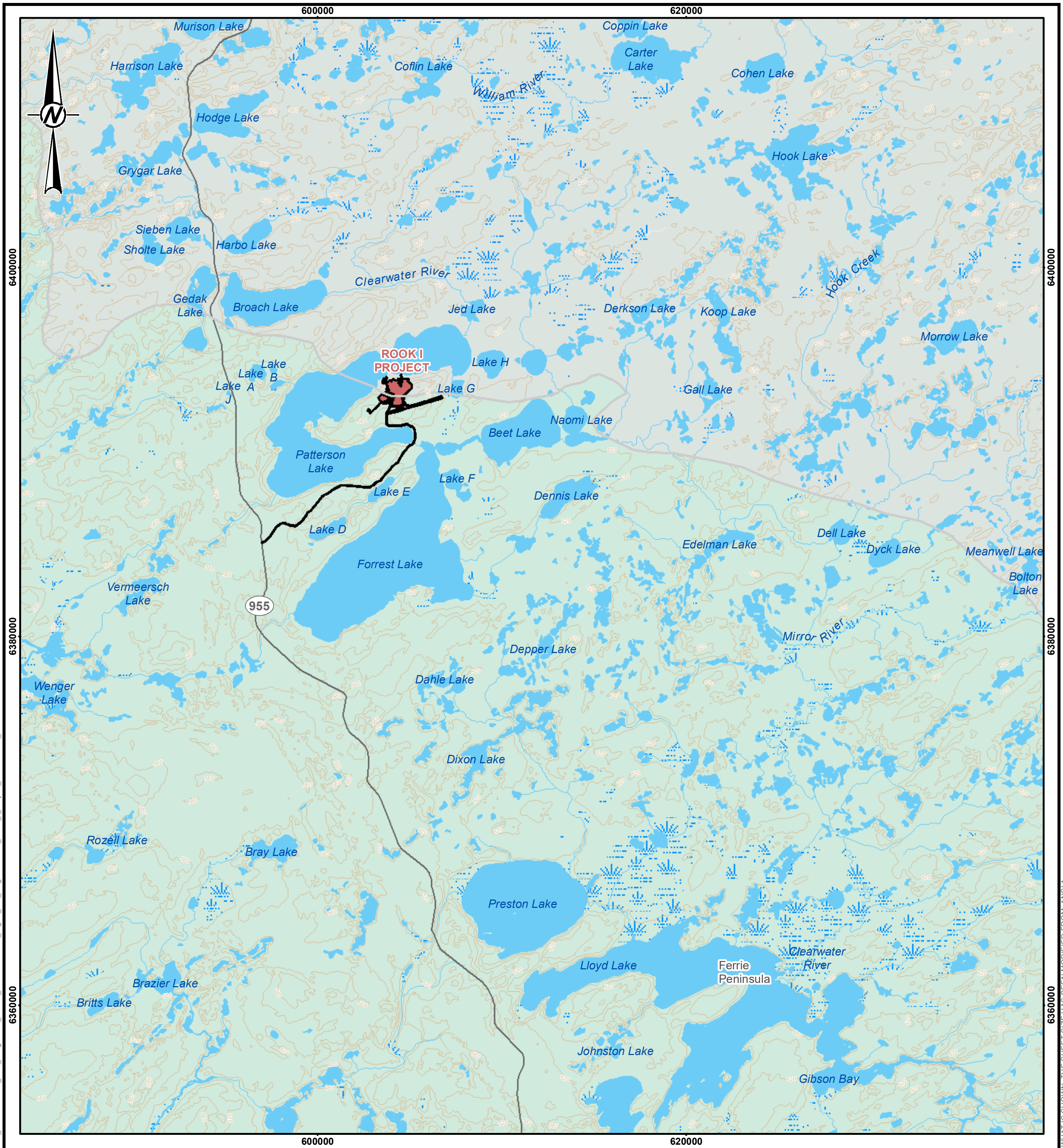

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN
- WATERBODY
- WETLAND
- WOODED AREA
- PROPOSED PROJECT FOOTPRINT

0 5 10
1:300,000 KILOMETRES

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 17.1-2

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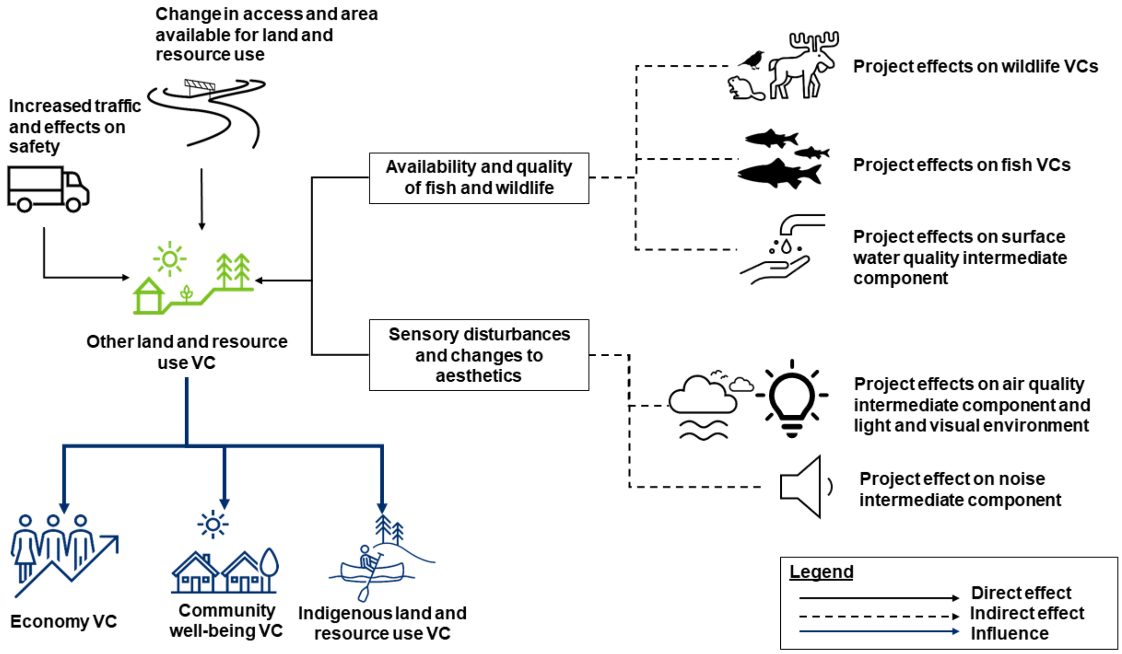
Figure 17.1-3: Linkage Diagram of Project Effects to Other Land and Resource Use and Influenced Valued Components

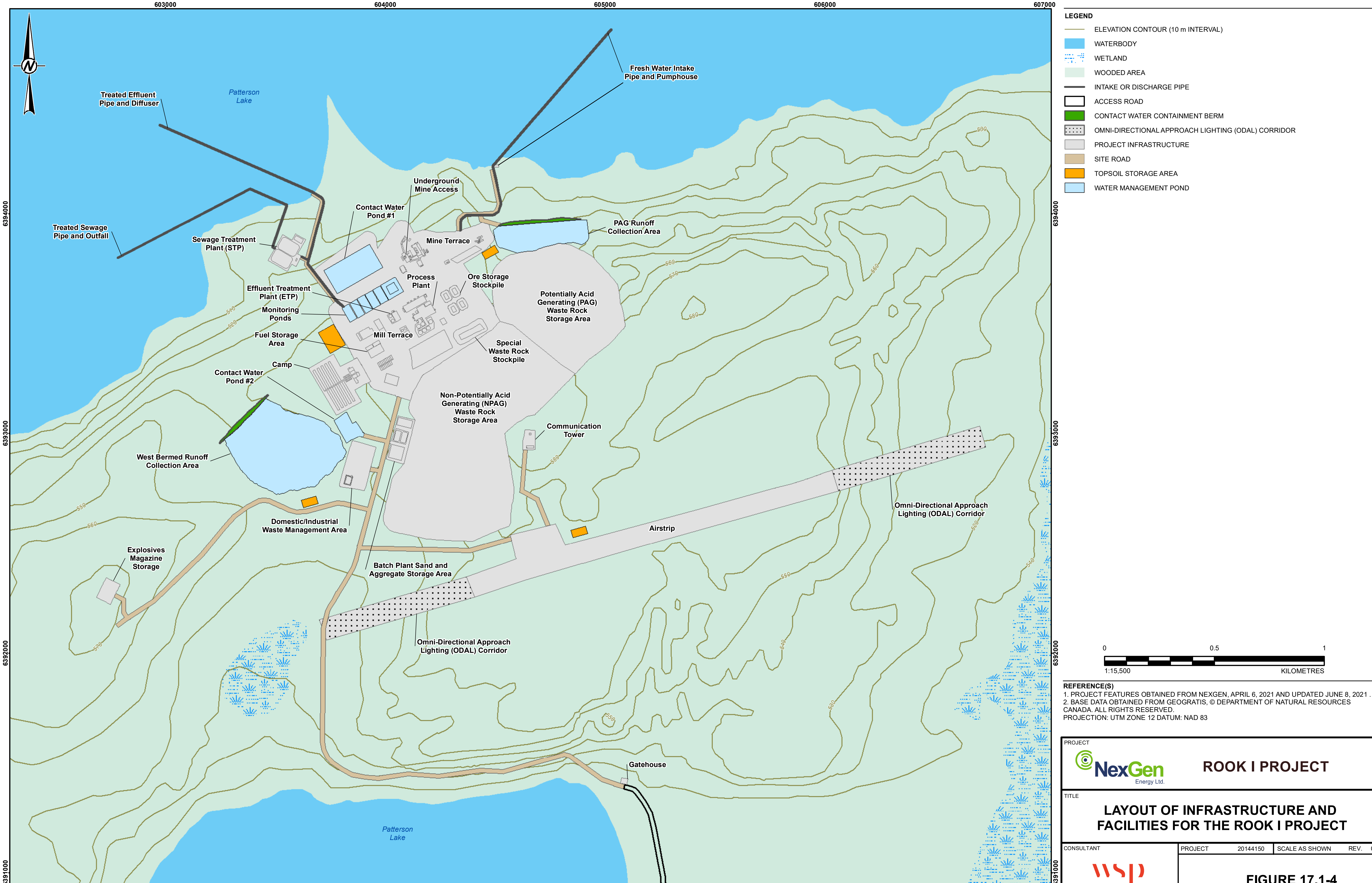


17.1.1 Project Summary

The Project would include the following key facilities to support the extraction and processing of uranium from the Arrow deposit for transportation off site (Figure 17.1-4):

- underground mine development;
- process plant buildings, including uranium concentrate packaging facilities;
- paste tailings distribution system;
- underground tailings management facility;
- potentially acid generating waste rock storage area (WRSA);
- non-potentially acid generating WRSA;
- special waste rock[1] and ore storage stockpiles;
- surface and underground water management infrastructure, including water management ponds, effluent treatment plant (ETP), and sewage treatment plant (STP);
- conventional waste management facilities and fuel storage facilities;
- ancillary infrastructure, including maintenance shop, warehouse, administration building, and camp;
- airstrip and associated infrastructure; and
- access road to Project and site roads.

[1] Special waste rock is mine rock that is mineralized with insufficient grade to be considered ore (i.e., greater than 0.03% of triuranium octoxide [U_3O_8] and less than 0.26% U_3O_8). All special waste would be temporarily stored in the special waste rock stockpile.



REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021 AND UPDATED JUNE 8, 2021 .
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
LAYOUT OF INFRASTRUCTURE AND FACILITIES FOR THE ROOK I PROJECT

CONSULTANT	PROJECT	20144150	SCALE AS SHOWN	REV. 0
wsp	FIGURE 17.1-4			

17.1.2 Purpose and Approach to the Assessment

The purpose of Section 17 is to provide a detailed and comprehensive assessment of all potential Project-specific effects and cumulative effects from the Project and other previous, existing, and reasonably foreseeable developments (RFDs), if applicable, on other land and resource use. This section meets the Terms of Reference for the Project submitted to the Saskatchewan Ministry of Environment (ENV) and the Canadian Nuclear Safety Commission (CNSC) *Generic Guidelines for the Preparation of an Environmental Impact Statement – Pursuant to the Canadian Environmental Assessment Act, 2012* (Appendix 1A, Concordance Tables). The assessment of other land and resource use followed the overall EA approach and methods (Section 6, Environmental Assessment Approach and Methods) and includes the following primary steps:

Step 1 – Define component-specific methods (Section 17.2): presents the specific approaches and methods used to measure and assess the effects of the Project on other land and resource use as well as cumulative effects from the Project, other previous and existing projects and activities, and RFDs, if applicable.

Step 2 – Characterize existing conditions (Section 17.3): describes and characterizes existing conditions to provide context and a basis for evaluating potential changes to other land and resource use caused by the Project.

Step 3 – Evaluate Project interactions and mitigations (Section 17.4): identifies Project components and/or activities with the potential to affect other land and resource use and provides environmental design features and mitigation policies and actions committed to by NexGen to avoid or minimize potential adverse effects. A pathways analysis was used to focus further assessment on key interactions between the Project and other land and resource use by evaluating the different effects pathways to determine if, after incorporation of mitigation, there is still potential to cause residual adverse effects. Primary pathways anticipated to result in residual adverse effects after incorporation of mitigation are carried forward to Step 4 for further analysis. Where potential adverse effects are adequately mitigated and thus not forwarded for further analysis (i.e., where mitigation results in negligible effects or avoids the pathway altogether), the reasons for concluding the assessment at this stage are provided.

Step 4 – Analyze residual effects (Section 17.5): evaluates and describes the potential Project effects on other land and resource use that are anticipated to occur through the primary pathways. The residual effects analysis is presented as an integrated narrative that describes the effects of the Project over time and highlights predicted effects at the point when adverse effects of the Project are expected to be greatest. This step also includes an analysis of residual cumulative effects from the Project, other previous and existing projects and activities, and RFDs.

Step 5 – Classify residual effects and determine significance (Section 17.6): summarizes the results of the residual effects analysis using effects criteria (i.e., direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence). Significance is determined using the results of the residual effects analysis and classification. Significance is determined for adverse effects only and for the maximum adverse effects of the Project and the cumulative effects from the Project, other previous and existing projects and activities, and RFDs.

Step 6 – Describe uncertainty and define prediction confidence (Section 17.7): identifies key uncertainties and explains how these uncertainties have been addressed to achieve a conservative, precautionary assessment. The implications of the approaches used to address uncertainties and the level of confidence in the residual effects analysis are discussed.

Step 7 – Identify monitoring and follow-up (Section 17.8): outlines the proposed actions to verify predicted residual effects. The purpose of these actions is to evaluate effectiveness of planned mitigation designs, policies, and practices, and address key sources of uncertainty.

17.2 Component Methods

17.2.1 Incorporation of Indigenous and Local Knowledge

Indigenous and Local Knowledge related to other land and resource use was shared by potentially affected First Nations and Métis Groups (collectively referred to as Indigenous Groups) and local priority area (LPA) community members through the engagement process for the Project and for which NexGen would prioritize local training, employment, and business opportunities for the Project. These communities are located along, or accessed via, Highways 155 and 955 north of the intersection of Highways 155 and 925 and include the following communities (Figure 17.2-1):

- Clearwater River Dene Nation;
- Clearwater Clear Lake (Métis Nation – Saskatchewan name for Northern Region 2);
- La Loche (Local 39);
- Birch Narrows Dene Nation;
- Turnor Lake (Local 40);
- BRDN / Dillon;
- Buffalo Narrows (Local 62);
- Bear Creek (Local 156);
- Descharme Lake;
- Garson Lake;
- Black Point (Local 162);
- Michel Village (Local 65); and
- St. George’s Hill (Local 70).

The overall approach and methods for the incorporation of Indigenous and Local Knowledge into the EA is discussed in detail in Section 3, Indigenous and Local Knowledge. Issues and concerns related to other land and resource use raised by Indigenous Groups and LPA community members, and how they were addressed are summarized in Appendix 2B, Summary of Issues and Concerns Identified by Indigenous Groups, and identified and addressed in this assessment, where applicable.

A key source of Indigenous and Local Knowledge is the Project-specific studies completed by Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, and Indigenous Rights and Knowledge studies (henceforth referred to collectively as Indigenous Knowledge and

Traditional Land Use [IKTLU] Studies). The IKTLU Studies that were reviewed and referenced in the EIS as technical support documents (TSDs) are listed below:

- TSD II (BNDN), Birch Narrows Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;
- TSD III (BRDN), Buffalo River Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;
- TSD IV (MN-S), Métis Nation-Saskatchewan Northern Region 2 Traditional Land Use & Diet Study for the NexGen Rook I Project;
- TSD V.1 (CRDN), Preliminary Identification of Issues and Concerns Related to the Proposed NexGen Energy Ltd. Rook I Project in the Patterson Lake Area; A Review; Clearwater River Dene Nation; Traditional Land Use and Occupancy Mapping Interviews; 2010 – 2016;
- TSD V.2 (CRDN), Clearwater River Dene Nation Indigenous Rights and Knowledge Survey Related to the Proposed NexGen Energy Ltd. Rook 1 Project in the Patterson Lake Area;
- TSD V.3 (CRDN), Socio-economic and Harvest Study; Clearwater River Dene Nation; NexGen Rook 1 Project; and
- TSD VI (YNLR), Provision of Athabasca Denesųłiné Traditional Knowledge, Land Use and Occupancy Information for the NexGen Rook I Project Environmental Assessment.

Another key source of Indigenous and Local Knowledge was information shared by Indigenous Group representatives during Joint Working Group (JWG) meetings. The JWGs represent an agreed upon primary engagement mechanism as outlined in the Study Agreements signed by each of the primary Indigenous Groups and NexGen. More details regarding the JWGs can be found in Section 2, Indigenous, Regulatory, and Public Engagement and Section 3, Indigenous and Local Knowledge. There are four JWGs with the Project's primary Indigenous Groups (Section 2.4.1, Identification of Indigenous Groups for Engagement):

- Clearwater River Dene Nation (CRDN) JWG;
- Métis Nation – Saskatchewan (MN-S) JWG representing MN-S Northern Region 2 (NR2);
- Birch Narrows Dene Nation (BNDN) JWG; and
- Buffalo River Dene Nation (BRDN) JWG.

The leadership of each Indigenous Group selected their JWG participants with consideration of group diversity; where possible, members included Elders, youth, different genders, a range of ages, and land users around Patterson Lake.

In addition to the IKTLU Studies and JWGs, Indigenous and Local Knowledge shared during specific engagement activities undertaken through the EA development process was incorporated into the assessment, where appropriate. These engagement activities included, but were not limited to:

- community information sessions held in four locations in 2019 (NexGen 2019);
- site tours;
- comments from the CRDN (2019a) on the Cluff Lake Mine licence renewal;
- other formal and informal meetings;
- workshops with specific groups (e.g., Fur Block N-19 trapper's workshop); and

- environmental and socio-economic baseline data collection.

Comments submitted by Indigenous Groups on the Project Description (CRDN 2019b; MN-S 2019; YNLRO 2019; ACFN 2019; CNSC 2019) were also reviewed for applicable Indigenous and Local Knowledge.

Indigenous and Local Knowledge related to other land and resource use was incorporated into the assessment by viewing the information as complementary and influential alongside scientific information. Where possible, knowledge from each potentially affected Indigenous Group or LPA community member was described separately and cited accordingly. Where information is described for multiple potentially affected Indigenous Groups, they are collectively referred to as "Indigenous Groups" throughout the assessment.

Indigenous and Local Knowledge was included in the other land and resource use assessment in the following ways:

- **Component Methods – VCs:** Indigenous and Local Knowledge was considered in the selection of the VC of other land and resource use and reflects the importance of commercial fishing and trapping to both Indigenous and non-Indigenous land users, including members of LPA communities, for income and supporting livelihoods and community well-being. The value of cabins, travel routes, quality of resources, and quality of the land use experience to both Indigenous and non-Indigenous land users was also reflected in the assessment for other land and resource use (Section 17.2.2).
- **Component Methods – Spatial Boundaries:** The spatial boundary selected for the local study area (LSA) reflects shared Indigenous and Local Knowledge regarding the specific locations of travel routes used to access trapping and other harvesting areas, including travel routes from Highway 955, along the existing access road, and east to destinations on the Clearwater and Mirror rivers (Section 17.2.3).
- **Existing Conditions:** Indigenous and Local Knowledge informed the characterization of existing conditions through the identification of cabin locations and travel routes, and the level of use and species targeted for commercial trapping and fishing. Indigenous and Local Knowledge was also shared about the effects of wildfires on resource use, trends in the populations of moose, furbearers, and fish, as well as how mining and exploration activities in the Patterson Lake area have affected other land and resource use (Section 17.2.6).
- **Project Interactions and Mitigation:** Indigenous and Local Knowledge informed the scoping of Project interactions, pathway analyses, and consideration of mitigation measures (Section 17.4, Project Interactions and Mitigations). This includes observations and experiences of Indigenous and non-Indigenous land users related to the existing and cumulative effects of mining and exploration activities on access to and area available for land and resource use, quality of the resource use experience, changes to air or water quality, and availability of wildlife and fish (Section 17.4).
- **Residual Effects Analysis:** Indigenous and Local Knowledge, including long-term observations and experiences of Indigenous and non-Indigenous land users in the Patterson Lake area, was used to inform the residual effects analysis related to changes in access and availability of land and resource use areas, and the quality of the resource use experience (Section 17.5.1, Application Case).
- **Monitoring, Follow-Up, and Adaptive Management:** Feedback provided by Indigenous Groups during engagement, including recommendations, was considered in the development of monitoring and follow-up activities (Section 17.8). In addition, it is planned that ongoing feedback from Indigenous Groups on the effectiveness of mitigations would be considered when updating monitoring and management plans.

Independent Indigenous Monitors chosen by each primary Indigenous Group would have opportunities to participate in environmental monitoring programs for the Project.

Specific references to Indigenous and Local Knowledge, and comments and concerns related to other land and resource use raised by Indigenous Groups and LPA community members, are included in the applicable subsections of this assessment.

17.2.2 Valued Components, Measurement Indicators, and Assessment Endpoints

17.2.2.1 Valued Components

Valued components are aspects of the biophysical, cultural, and socio-economic environments that are considered to have scientific, social, cultural, economic, historical, archaeological, or aesthetic importance (Beanlands and Duinker 1983; CNSC 2021). The BNDN and BRDN define VCs as tangible biophysical resources (e.g., particular places and species) and less tangible social, economic, cultural, health, and knowledge-based values (e.g., social cohesion, place names, Indigenous language) (TSD II: BNDN; TSD III: BRDN).

Valued components were selected based on multiple considerations (Section 6.3.1, Valued Components) such as:

- potential for interaction with the Project and degree of interaction, including presence, abundance, and amount of spatial overlap of a VC with the Project;
- sensitivity of a VC to potential Project effects and level of damage or harm that could be realized should an adverse effect occur;
- ecological and socio-economic/cultural value to Indigenous Groups and local communities, government agencies, and the public;
- recent experience with similar projects in Saskatchewan and other jurisdictions in Canada; and
- avoidance of redundancy with other VCs; for example, if two potential VCs represent the same attributes, mitigation actions, and potential effects from the Project, only one was evaluated as part of the assessment.

Selection of the other land and resource use VC was based on the history of, and reliance on, commercial trapping and fishing industries by local communities. This VC also recognizes the overall importance of lodge and outfitting services, parks and protected areas, recreational hunting and fishing activities, and cabin use to the provincial economy and recreational opportunities for Saskatchewan residents. Additional resource sector industries, such as forestry and mining, offer economic opportunity to northern Saskatchewan residents.

Although in some instances there is overlap between activities as described in cultural and heritage resources and Indigenous land and resource use (Section 16), this section focuses more narrowly on uses for commercial or recreational purposes and extends to both Indigenous and non-Indigenous users. Section 16 focuses on Indigenous land and resource use as an expression of Aboriginal and Treaty Rights. Commercial trapping and fishing, as assessed in this section, is primarily undertaken by Indigenous Peoples from the LPA communities or by other residents of northern Saskatchewan. The operation of lodges and outfitting services and use of cabins includes both Indigenous and non-Indigenous users who may or may not be residents in the LPA communities, and in some instances, are based outside of northern Saskatchewan. Recreational hunting and fishing as assessed in this section are conducted under licence primarily by non-Indigenous land and resource users. This section also includes recreational land and resource use, such as birding, wildlife viewing, hiking, canoeing, and camping, that occurs within parks and protected areas. Outside of parks and protected areas, other recreational land and resource use (e.g., snowmobiling, all-terrain vehicle [ATV] use, hiking, camping) is understood from the results of 2019 to 2021 key person (KP) interview program to be minimal and is, therefore, not included in the other land and resource use VC.

17.2.2.2 Measurement Indicators

Measurement indicators are used to characterize changes to attributes of the environment from the Project, other human developments, and natural factors. The changes in measurement indicators are used to predict overall effects on VCs and assessment endpoints (Section 6.3.2, Assessment Endpoints and Measurement Indicators). Three measurement indicators were identified and used for the other land and resource use assessment (Table 17.2-1):

- **Access to, and area available for, land and resource use:** refers to the ability to travel to and utilize the land base for other land and resource use. Reductions in the area available may occur due to travel obstructions such as closing roads, waterways, or trails for safety purposes and loss of the use of the proposed Project footprint. The assessment considers removal of areas where land and resource use is practiced and also where travel to other resource use areas may be affected.
- **Availability of fish and wildlife for harvesting:** refers to changes in the abundance and distribution of fish and wildlife species that, in turn, could affect harvest success. For example, trapping relies primarily on American marten harvests. Should the population of American marten decline or be displaced, trappers may not be as successful at harvesting this species as prior to the Project. The assessment therefore considers any effects on the availability and distribution of species harvested and subsequent potential effect on the activities of hunters, trappers, and fish harvesters.
- **Quality of the resources and the quality of resource use experience:** refers to potential changes in the resource use experience related to sensory disturbances (i.e., noise, light, and dust), disturbances from presence of a Project workforce, quality and safety of the resource use experience, and quality of the fish and wildlife resources.

17.2.2.3 Assessment Endpoints

Assessment endpoints are qualitative expressions that represent the key properties of VCs that should be protected (e.g., wildlife abundance and quality, the ability to access resource harvesting areas are maintained at a level that allows for continued opportunities for other land and resource use); as such, assessment endpoints incorporate the concept of sustainability and function as significance thresholds (Section 6.3.2). Assessment endpoints are used to guide the determination of significant effects on other land and resource use. The endpoint used in this assessment is continued level of opportunities for other land and resource use. The level of opportunity is dynamic as it is subject to factors such as markets, business fluctuations, and government policies; however, the level refers to the amount of access, the availability of resources, and the quality of resources and resource use experience.

Table 17.2-1: Valued Component, Rationale, Measurement Indicators, and Assessment Endpoints

VC	Rationale	Measurement Indicators	Assessment Endpoints
Other land and resource use	▪ Forestry, recreation, tourism, and guiding occurs in the area ▪ Fish and wildlife harvesting has social and economic value to land and resource users ▪ Access to land and resource use may be affected by Project activities	▪ Access to and area available for land and resource use ▪ Availability of fish and wildlife for harvesting ▪ Quality of the resources and the quality of resource use experience	▪ Continued level of opportunities for other land and resource use

VC = valued component.

To determine whether the assessment endpoint would be met, each of the other land and resource use activities (e.g., hunting, commercial trapping, fishing) are described in Section 17.3, Existing Conditions. Each activity was examined for linkages with supporting components such as the Project description, intermediate components (e.g., hydrology, noise, air quality), other VCs (e.g., walleye, moose), relevant TSDs (e.g., TSD IX, Transportation Risk Assessment Report), and supplemental information (e.g., KP interviews, workshops). Table 17.2-2 identifies the key linkages between the other land and resource use activities described in Existing Conditions (Section 17.3), the measurement indicators used to evaluate effects on those activities, and the supporting components which supported the assessment.

Table 17.2-2: Key Linkages between Measurement Indicators, Other Land and Resource Use Activities, and Supporting Technical Support Document, Intermediate Component, or Valued Component

Measurement Indicator	Other Land and Resource Use Activity	Relevant EA Supporting Documentation, Intermediate Components, and VCs
Access to and area available for land and resource use	▪ Hunting	▪ Project Description (Section 5)
	▪ Commercial trapping	▪ Indigenous, Regulatory, and Public Engagement (Section 2) ▪ Project Description (Section 5) ▪ TSD II: BNDN, TSD III: BRDN, TSD IV: MN-S, IV, TSD V.1: CRDN, TSD V.2: CRDN and TSD VI: YNLR
	▪ Fishing (commercial and recreational)	▪ Project Description (Section 5) ▪ Waterways navigation (Section 9, Hydrology)
	▪ Lodge and outfitting services and ecotourism	▪ Waterways navigation (Section 9, Hydrology)
	▪ Cabins, parks and protected areas, forestry, and mining and exploration	▪ Project Description (Section 5) ▪ TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN, TSD V.2: CRDN
Availability of fish and wildlife for harvesting	▪ Hunting	▪ Moose and black bear (Section 14, Wildlife and Wildlife Habitat) ▪ Human Health Risk Assessment (TSD XXI, Environmental Risk Assessment)
	▪ Commercial trapping	▪ Upland ecosystems habitat for American marten (Section 13, Vegetation) ▪ Gray wolf, beaver, and other wildlife representative of effects on furbearers (Section 14, Wildlife and Wildlife Habitat)
	▪ Fishing (commercial and recreational)	▪ Northern pike, lake whitefish, walleye, and lake trout (Section 11, Fish and Fish Habitat) ▪ Human Health Risk Assessment (TSD XXI)
Quality of the resources and the quality of resource use experience	▪ All topics	▪ Air Quality, Noise, and Climate Change (Section 7) ▪ Surface Water Quality and Sediment Quality (Section 10) ▪ Terrain and Soils (Section 12) ▪ Vegetation (Section 13) ▪ Wildlife and Wildlife Habitat (Section 14) ▪ Transportation Risk Assessment Report (TSD IX) ▪ Light Effects Analysis Report (TSD XI) ▪ Human Health Risk Assessment (TSD XXI)

VC = valued component; EA = Environmental Assessment; BNDN = Birch Narrows Dene Nation; BRDN = Buffalo River Dene Nation; CRDN = Clearwater River Dene Nation; MN-S = Métis Nation – Saskatchewan; TSD = Technical Support Document; YNLR = Ya'thi Néné Lands and Resources.

17.2.3 Spatial Boundaries

The spatial boundaries selected for the other land and resource use assessment support a description of the existing environment in sufficient detail to identify, understand, and assess potential Project interactions with the other land and resource use VC, including the contribution of the Project to residual effects and/or perceived effects. The spatial boundaries for the assessment of other land and resource use consisted of a site study area, maximum disturbance area, LSA, and regional study area (RSA; Table 17.2-3; Figure 17.2-1).

The site study area was equivalent to the anticipated area of the Project footprint, which covers 228 ha and includes the access road and bridge, and all proposed Project infrastructure (Figure 17.1-4). To the degree possible, the Project footprint was minimized based on NexGen's vision and values, which aligned with feedback from Indigenous Groups, to reduce both the area of restricted access to Indigenous and other land users and the effects on the terrestrial environment.

A maximum disturbance area was used for the assessment to address uncertainty in the final design of the Project so that adverse effects on the terrestrial environment were not underestimated (i.e., the maximum disturbance area is four times larger than the currently anticipated Project footprint). The maximum disturbance area, which covers 981 ha, represents the smallest scale of assessment and an area where the potential direct effects of the proposed Project on soils, vegetation, and wildlife can be assessed accurately and precisely. The spatial boundary of the maximum disturbance area was delineated by applying buffers to the outer edges of the currently anticipated Project infrastructure (Section 6.4.1, Spatial Boundaries). The spatial boundary for terrestrial resources was also constrained to the shoreline of Patterson Lake (Figure 17.2-1). The maximum disturbance area is consistent with the maximum disturbance area for related VCs.

The LSA and RSA for the other land and resource use VC were defined to include predicted effects on supporting intermediate components (e.g., noise, air quality) and VCs (e.g., fish and fish habitat, wildlife and wildlife habitat). Potential effects to supporting intermediate components and VCs included incremental and cumulative effects from the Project and other RFDs and natural factors such as climate change and wildfire, where applicable.

The LSA for supporting intermediate components and VCs contained most or all of the expected direct and indirect effects of the proposed Project. The RSA provided broader context for Project-specific effects and was large enough to sufficiently capture cumulative effects from RFDs and natural factors. The total area of the LSA is 125,679 ha (1,257 km^2), which can be sub-divided into three sub-areas including:

- the Highway 955 corridor from La Loche to the access road turnoff: 20,350 ha (203 km^2);
- the maximum disturbance area including the access road: 981 ha (9.81 km^2); and
- the remaining area 104,348 ha (1,043.48 km^2).

The other land and resource use LSA (Figure 17.2-1) incorporates:

- the Project footprint;
- the maximum disturbance area defined in the vegetation (Section 13) and wildlife (Section 14) assessments, which provides a conservative spatial estimate of the direct effects;
- the terrestrial, aquatic, and human health RSAs delineated by the Clearwater watershed boundaries where ecosystems could potentially be directly or indirectly affected by the Project;
- the area of both the Project and the Fission Patterson Lake Property boundaries, which is considered in the cumulative assessment for other VCs and the other land and resource use VC;
- areas where access to outfitting allocation areas may change, specifically at Vermeersch and Wickenkamp lakes and areas north of the Project and Forrest, Beet, and Naomi lakes south and east of the Project;

- the Highway 955 corridor north of La Loche where changes to traffic volumes and traffic disturbances may affect land use activities, which is defined as a 1,200 m wide corridor to capture road and roadside effects and includes:
  - a 100 m buffer on each side of the road centreline for the road allowance;
  - an additional 200 m buffer each side where hunting should be restricted[2];
  - an additional 300 m buffer on each side where land use activities may occur along the road corridor such as trapping, hunting, and outfitting (2019 to 2021 KP interview program); and
- destinations that require travel through Project-affected areas for trapping and other uses, which may result in avoidance from perceived risks or displacement of resource harvest activities, such as areas as far east as the junction of Clearwater and Mirror rivers and adjoining lakes east of the Project (e.g., CRDN-mapped travel routes from Highway 955, along the existing access road, and east to destinations on the Clearwater and Mirror rivers; TSD V.1: CRDN, Figure 2, and TSD V.2: CRDN, Figure 19).

The other land and resource use RSA was designed to provide broader context for the assessment of Project effects on VCs and the appropriate scale for the assessment of cumulative effects, if applicable (Section 6.4.1, Spatial Boundaries). The other land and resource use RSA includes the LSA plus the boundaries of the N-19 trapping block (totaling 6,499 km^2) where cumulative effects on commercial fishing and trapping may occur. While cumulative effects are not expected in most areas of the trapping block, the spatial boundaries of the trapline are a familiar reference for local Indigenous communities and capture the broad land usage patterns of local communities. The N-19 trapping block is also meaningful to use in defining the RSA because it is a defined management area with membership that is regulated by a local trapping association and generally only open to local Indigenous community residents[3].

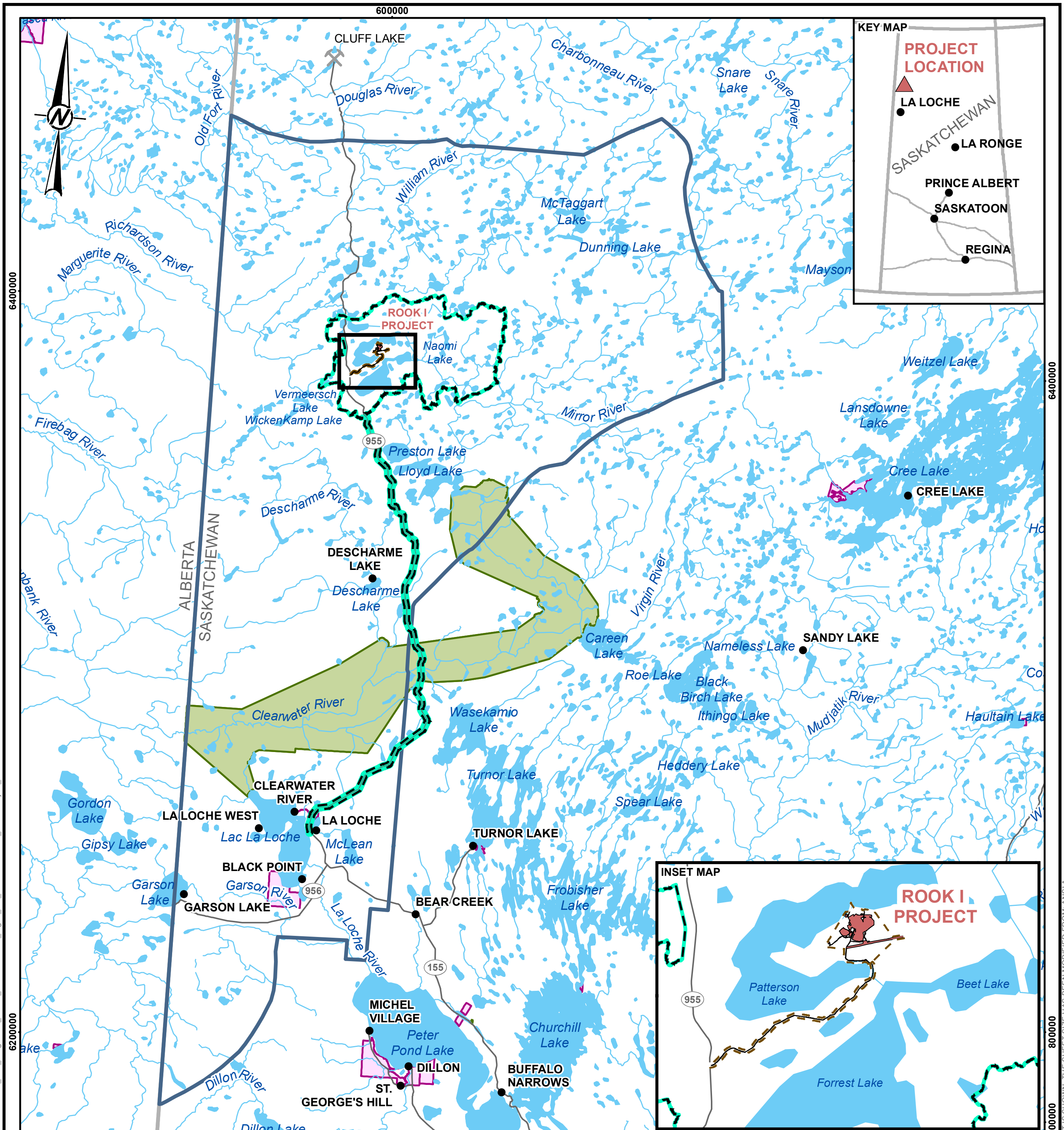
[2] In Saskatchewan, *The Wildlife Act (1988) c. W-13.12* prohibits shooting a firearm across or along a provincial highway, provincial road, or municipal road. A no hunting buffer distance is not specified in Saskatchewan. Bait for the purpose of big game hunting cannot be placed within 200 metres of a provincial highway, provincial road, or municipal road. Distances are defined in the Wildlife Acts of Manitoba (i.e., 300 m from road centre lines) and Alberta (i.e., 365 m or 400 yards). Hunters must not discharge their firearms back towards the roadway.

[3] The Northern Fur Conservation Block constitutes most of the forested area of northern Saskatchewan. This area was partitioned into 89 Fur Conservation Areas (FCAs or Trapping blocks) in 1946. The FCAs were established to allow recovery of the beaver population, and to function as the units of management whereby the fur harvest of a restricted number of trappers could be managed through an orderly trapline management system that would reduce conflicts and maintain forest trap-lines as commercial entities. Each FCA is composed of a group of registered/licenced trappers, from which a representative council of not more than five members is chosen. Each FCA membership and elected council is responsible for its own administration, organization, and operation. FCA blocks have authority on issues relevant to their membership and block administration (ENV 2012).

Table 17.2-3: Spatial Boundaries for Assessment of Other Land and Resource Use Valued Components

Spatial Boundary	Surface Area	Description
Site study area	228 ha (2.3 km^2)	Equivalent to the currently anticipated Project footprint, which includes all proposed mine infrastructure and facilities (199 ha) and the access road (29 ha).
Maximum disturbance area	981 ha (9.8 km^2)	Incorporates a level of uncertainty into the Project design so that effects are not underestimated. The maximum disturbance area was defined using bounding points offset from outermost components of the anticipated Project footprint.
LSA	125,679 ha (1,257 km^2)	▪ The maximum disturbance area. ▪ The terrestrial, aquatic and human health RSAs. where ecosystems and resources could potentially be directly or indirectly affected by the Project. ▪ Defined by the expected extent of the direct and indirect effects from the Project for intermediate components and supporting VCs that inform the assessment. ▪ Areas where access to outfitting allocation areas may change. ▪ The Highway 955 corridor north of La Loche, which is defined as a 1,200 m wide corridor to account for effects to trapping, hunting, and outfitting activities that may occur along the road corridor (but outside of the road allowance and where hunting is restricted). ▪ Destinations that require travel through Project-affected areas.
RSA	649,900 ha (6,499 km^2)	▪ The LSA plus the boundaries of the N-19 trapping block. ▪ Provides broader scale context for assessing potential indirect Project effects and cumulative effects, if applicable.

LSA = local study area; RSA = regional study area.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (DECOMMISSIONED)
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA
- OTHER LAND AND RESOURCE USE LOCAL STUDY AREA
- OTHER LAND AND RESOURCE USE REGIONAL STUDY AREA

0 40 80
1:1,500,000 KILOMETRES

REFERENCE(S)

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2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

OTHER LAND AND RESOURCE USE LOCAL AND REGIONAL STUDY AREAS

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	GE	2023-02-09	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-09	**FIGURE 17.2-1**	
CHECK	JO	2023-02-09		
REVIEW	KG	2023-02-09		

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17.2.4 Temporal Boundaries

The temporal scope of the assessment focuses on the 43-year period from initial Construction to the end of Decommissioning and Reclamation (i.e., Closure) as defined by the following Project phases (Section 6.4.2, Temporal Boundaries):

- **Construction Phase (Construction):** includes site preparation; mine, process plant, and additional infrastructure development; transportation of people and materials to and from the Project; and all activities associated with commissioning the Project up until Operations commences. The duration of Construction is expected to be four years.
- **Operations Phase (Operations):** includes all activities associated with mining and processing ore; tailings management; management of waste rock, domestic waste, and hazardous materials; water management; release of treated effluent; site maintenance; progressive reclamation; and transportation of staff and materials to and from the Project up until Decommissioning and Reclamation commences. The duration of Operations is expected to be 24 years.
- **Decommissioning and Reclamation Phase (Closure):** includes two stages expected to occur over 15 years:
  - **Active Closure Stage:** includes active decommissioning and reclamation activities that occur post-Operations, such as backfilling mine workings, removal of physical infrastructure, recontouring and revegetating disturbed areas, waste disposal and removal, and any other activities required to achieve decommissioning objectives and return the site to a safe and stable condition prior to the Transitional Monitoring Stage. The duration of the Active Closure Stage is expected to be five years.
  - **Transitional Monitoring Stage:** includes monitoring and reporting activities that occur post-Active Closure that would continue until monitoring and reporting verifies that the performance criteria have been met. Once performance criteria have been fully demonstrated, an application to be released from the CNSC licence would be submitted to the CNSC for approval. Once that is achieved, and upon Provincial approval, the land would be transferred under Provincial management through the Institutional Control Program. The duration of the Transitional Monitoring Stage is nominally 10 years; however, NexGen acknowledges this duration would be dependent on the achievement of performance criteria.

The temporal boundaries applied to the cumulative effects assessment includes the duration of residual effects from previous and existing developments that overlap with residual effects from the Project, and the period during which the residual effects from RFDs overlap with the Project.

17.2.5 Assessment Cases

The concept of assessment cases was applied to the other land and resource use assessment to estimate the incremental and cumulative effects from the Project and other developments (Section 6.5, Assessment Cases). The approach incorporated temporal boundaries for analyzing the potential effects from previous, existing, and approved projects and RFDs before, during, and after the anticipated lifespan of the Project. There are no known approved (but not yet constructed) projects in the LSA and RSA for the other land and resource use VC. Assessment cases for the Project included a Base Case, Application Case, and RFD Case.

Base Case for other land and resource use is represented by existing conditions. The Base Case describes the existing environment in the LSA before application of the proposed Project to provide an understanding of the current conditions that may be influenced by the Project. The temporal boundary of the Base Case includes the combined effects from previous and existing human disturbances and natural factors (e.g., fire, floods, disease, insects) on the environment and other land and resource use. As such, existing conditions represent the cumulative effects of historical and current environmental pressures that have influenced the observed condition and patterns of the other land and resource use VC (CEA Agency 2018).

Application Case for other land and resource use represents predictions of the combined effects of the previous and existing projects/activities and natural factors in the Base Case plus the potential effects from the proposed Project. This case was also used to identify and assess incremental, Project-specific changes that are predicted to occur to the other land and resource use VC.

Reasonably Foreseeable Development Case for other land and resource use includes the Base Case, Application Case, and RFDs that have not yet been approved. Reasonably foreseeable developments are defined as projects and activities that fit any of the first three and both of the last two criteria from the list below:

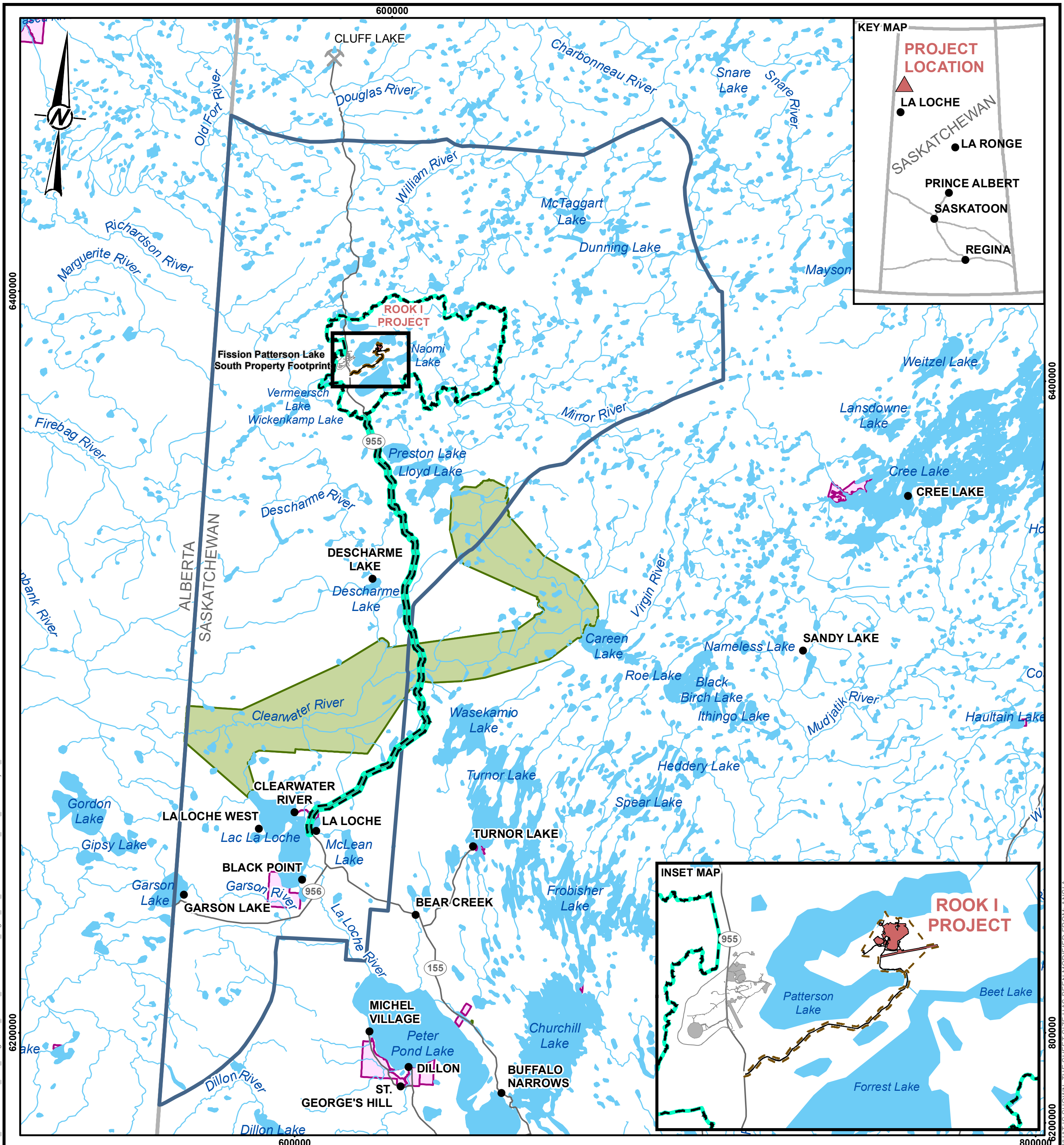
- are currently under regulatory review or have officially entered a formal regulatory application process;
- have been publicly disclosed by other proponents;
- may be induced by the Project;
- have the potential to change the Project or the effects predictions; and
- occur in the spatial assessment boundary defined for other land and resource use.

A key criterion for selecting other projects to include in the RFD Case was that the projects must cause similar effects on aspects of the other land and resource use VC influenced by the Project (Hegmann et al. 1999). The Fission Patterson Lake South Property, which is planned by Fission Uranium Corp. (Fission 2019, 2021a), was included in the RFD Case (Figure 17.2-2). Public information describes a projected three-year construction period and seven-year operating period (production and processing) (Fission 2019, 2021a). The anticipated start of construction and duration of active decommissioning at the Fission Patterson Lake South Property were not publicly available at the time this assessment was completed. For the assessment, it was assumed that the duration of active decommissioning for the Fission Patterson Lake South Property would be similar to the Active Closure Stage for the Project (i.e., five years) (Section 6.5.3, Reasonably Foreseeable Development Case).

The proposed surface infrastructure layout plan (Fission 2019, 2021a) is the anticipated physical footprint of the Fission Patterson Lake South Property and includes the proposed highway bypass, airstrip, and all proposed mine site infrastructure. A hypothetical maximum disturbance area, as applied in Section 17.2.3 to the Project footprint, was also used for the Fission Patterson Lake South Property to address uncertainty in project design. The CRDN and MN-S specifically mentioned the potential for of cumulative effects from the Project and the nearby proposed Patterson Lake South Property (CRDN 2019b; MN-S-JWG 2020; CRDN-JWG 2021).

As a scenario within the RFD Case (where applicable), potential effects from climate change, including how natural factors (e.g., fire and insects) may be altered resulting from climate change, was considered within the assessment. Indigenous Groups indicated concerns about cumulative effects from human development, policies, and climate change (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN).

The other land and resource use assessment includes a quantitative and qualitative analysis of predicted changes on measurement indicators and associated effects from the Fission Patterson Lake South Property on the other land and resource use VC. In addition, the discussion of potential changes from natural disturbance factors and climate change considered information from qualitative analyses provided in the fish and fish habitat (Section 11), vegetation (Section 13), and wildlife and wildlife habitat (Section 14) assessments.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (DECOMMISSIONED)
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- OTHER LAND AND RESOURCE USE LOCAL STUDY AREA
- OTHER LAND AND RESOURCE USE REGIONAL STUDY AREA

0 40 80

1:1,500,000 KILOMETRES

REFERENCE(S)

1. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

REASONABLY FORESEEABLE DEVELOPMENTS IN THE REGIONAL STUDY AREA

CONSULTANT

wsp

PROJECT		20144150	PHASE 3314 - 6
DESIGN	GE	2023-02-09	SCALE AS SHOWN / REV. 0
GIS	NO	2023-02-09	
CHECK	JO	2023-02-09	**FIGURE 17.2-2**
REVIEW	KG	2023-02-09	

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17.2.6 Existing Conditions

Existing conditions were characterized to provide context for the measurement indicators and the assessment of incremental and cumulative effects from the proposed Project and other RFDs in the LSA and RSA. Consideration was given to the measurement indicators and assessment end points so data in the assessment would be relevant for future mitigation and management variable monitoring. The characterization of the existing environment included review of both primary and secondary data sources. Multiple research methods were used to describe and evaluate the other land and resource use VC existing conditions.

Quantitative recreational hunting harvests and participation levels, commercial trapping production and value, and commercial fishing production by lake and by species were available from ENV databases. The data sources were retrieved by request from government officials and, in the case of fur production, from annual reports (Government of Saskatchewan 2016, 2017, 2018a, 2019a,b, 2021a). Simple statistics were generated from the data, including totals and five-year average intervals. The five-year average interval studied was selected purposely to include pre-COVID pandemic years as the pandemic has materially affected both the commercial fishing and trapping industries due to community lockdowns and fur marketing and fish processing closures (FFMC 2020; 2021 trapper's workshop).

An important source of place-based information came from Hunting, Angling and Biodiversity Information of Saskatchewan (HABISask), which is the Government of Saskatchewan's client-centred online mapping application that consolidates new information and existing applications (SKCDC 2021). Important land use boundaries, harvest regions, and management units or zones that occur in the RSA are published on HABISask, including:

- Wildlife Management Zones (WMZs);
- Game Bird Management Units (GBMUs);
- game bird districts;
- trapping fur blocks;
- recreational fishing restrictions;
- provincial parks;
- commercial forest zones, timber allocations, and Timber Supply Areas; and
- mineral dispositions.

The locations of commercial forest zones, timber allocations, and Timber Supply Areas in the Project RSA were retrieved from HABISask and then verified with the ENV provincial forester to be current. Mineral dispositions were downloaded from HABISask and overlayed with the LSA to report the number and tenure of dispositions. All dispositions were confirmed active, and therefore were included.

Existing tourism was characterized through information gained about parks, protected areas, lodges, and outfitting. National sources of data included national historic sites from Parks Canada and heritage rivers from the Canadian Heritage Rivers System. Once assembled and verified, these land use boundaries and management zones were overlayed with Project components in a geographic information system program to describe existing conditions and make predictions about potential Project interactions with various land uses. Expert interviews were conducted with Provincial staff including wildlife specialists, the fur harvest statistics coordinator, fisheries biologists, and foresters to validate the interpretation of the data.

Four sources of cabin information were used: the CRDN (TSD V.1: CRDN) provided mapped locations of cabins; local knowledge from the trapper's workshop (July 2021) produced a map of cabins; a noise receptor map (Section 7.3.2, Component Methods, Figure 7.3-2) documented where Project noise may be detected at resource cabin locations; and a map from the Saskatchewan Public Safety Agency (SPSA 2020a) illustrated communities and structures including homes, lodges, and cabins located in northern Saskatchewan.

To validate the data, cabins documented in at least two of four sources were considered for assessment. Completing this verification process improved the reliability of the data given that the presence of resource user cabins may not be known to the SPSA depending on whether cabin owners applied for Crown Land leases or not. Similarly, the CRDN noted that data are currently being refined by:

> verifying and updating the 2014 cabin data set and maps…to clearly differentiate cabins in active use from ancestral cabins, many of which have fallen into ruin or have been destroyed by the numerous forest fires that have gone through CRDN traditional lands. (TSD V.1: CRDN)

A KP interview program was undertaken to address gaps that could not be readily filled and to provide context and perspectives on interests and concerns about the Project. Interview guides were developed to learn more from land user groups such as outfitters and cabin owners. Consent was gained through a standard explanation of why the interview was being requested, the confidentiality of responses provided, the method for reporting interview results (i.e., the interview would be used in summary only), and that participation in the interview was voluntary as was the right to refuse answering any question raised. Interviewees had the opportunity to ask questions and provide their consent.

Initial KP interviews were conducted between October 2019 and March 2020 with land user groups such as outfitters and cabin owners. Key persons were selected based on their possession of knowledge and experience that could be relevant to characterizing other land and resource use. Additional KP interviews were conducted between May 2021 and July 2021. Lodge and outfitting operations that were not interviewed previously were identified through a web search and verified through consultation with the Provincial Outfitting Specialist to confirm that all local lodge and outfitting operations had the opportunity to be interviewed. These additional interviews provided a description of outfitting operations, operation areas, and resources used, though not all operators participated in an interview.

Data were validated and supplemented through several means, including discussion during JWG meetings and review of JWG meeting records. Local Knowledge was recorded in the 2021 trapper's workshop notes and 2019 community information session feedback. The 2019 to 2021 KP interview program notes were also used to validate data. The IKTLU Studies supported the integration of Indigenous and Local Knowledge into the assessment. The socio-economic variables to consider within the existing conditions subsection were confirmed from this approach of data validation and the identification of supplemental data.

17.2.7 Project Interactions and Mitigations

Interactions (i.e., linkages) between Project components or activities, and the corresponding potential changes to measurement indicators, were identified by a pathway analysis that was then used to inform the residual effects analysis for the other land and resource use VC (Section 6.7, Pathways Analysis). The first part of the analysis was to identify all potential effects pathways for all phases of the Project (Section 6.7.1, Identification of Project Interactions). Each pathway was initially assumed to have a linkage to potential effects on the other land and resource use VC.

Potential pathways from Project activities to the other land and resource use VC were identified using the following:

- review of the Project description (Section 5) and potential effect scoping by the project development, environmental, and socio-economic teams for the Project;
- input from Indigenous, regulatory, and public engagement (Section 2) and Indigenous and Local Knowledge (Section 3);
- scientific knowledge;
- previous experience with mining projects including uranium mines in northern Saskatchewan and diamond mines in the Northwest Territories (Intergroup 2013); and
- consideration of potential effects identified from the Terms of Reference (Section 1, Appendix 1A).

Potential adverse effects of the Project were then identified, and practicable mitigation was applied to avoid, minimize, and/or rehabilitate adverse effects on the other land and resource use VC (Section 6.7.2, Identification of Mitigation). Avoidance and minimization are widely recognized as the most important approach for biodiversity conservation (BBOP 2021). Avoidance designs and actions integrated into the Project were developed iteratively between the Project's environmental and project development teams. Minimization techniques and technology were also identified and implemented collaboratively between Project teams.

Each potential effect pathway was evaluated using proposed mitigation to predict whether the pathway had the potential to cause residual adverse effects (Section 6.7.3, Pathway Screening). A screening-level assessment was applied using Indigenous and Local Knowledge, scientific knowledge, logic, experience with similar developments, and an understanding of the effectiveness of mitigation (i.e., level of certainty that mitigation would work) to assign each pathway to one of the following categories:

- **No pathway:** Analysis reveals that the pathway could be removed (i.e., the effect is avoided) by mitigation so that the Project would result in no measurable socio-economic and/or environmental change relative to existing conditions or guideline values and, therefore, would have no residual effect on other land and resource use.
- **Secondary pathway:** The pathway could result in a measurable but minor socio-economic and/or environmental change relative to existing conditions or guideline values, but this change would be sufficiently small that it would have a negligible residual effect on other land and resource use. Therefore, the pathway is not expected to contribute to effects of RFDs to cause a significant effect.
- **Primary pathway:** The pathway is likely to result in a socio-economic and/or environmental change relative to existing conditions or guideline values and could cause a greater than negligible effect on other land and resource use.

Project interactions determined as no pathway or secondary pathways were not carried forward for further assessment (Section 6.7.3). Primary pathways that could result in changes to the environment with one or more associated measurement indicator and have the potential to cause a greater than negligible effect on other land and resource use were carried forward to the residual effects analysis and residual effects classification (Section 17.5).

17.2.8 Residual Effects Analysis

The residual effects analysis measures and describes the effects of the proposed Project on the other land and resource use VC relative to existing conditions. The residual effects analysis was conducted using the spatial boundaries (Section 17.2.3 Spatial Boundaries) and temporal boundaries (Section 17.2.4, Temporal Boundaries) identified for the assessment. Residual effects are described for each of the measurement indicators for the primary pathways identified for the other land and resource use VC in the LSA and RSA (Section 17.4.3, Primary Pathways). The residual effects analysis was completed for the Application Case and the RFD Case (Section 6.8, Residual Effects Analysis).

The other land and resource use VC measurement indicators were used to measure incremental change from existing conditions and to describe Project effects for primary pathways. The approach considers the following:

- Changes in access to, and the area available for, land and resource use were identified through a qualitative comparison of reported land and resource use that overlaps the maximum disturbance area and non-Project supporting infrastructure (e.g., Highway 955). Temporary disturbances to access were also considered such as the installation of in-lake infrastructure on Patterson Lake. Changes in access and the quantity of available land base may affect other land and resource use.
- Changes in the availability of fish and wildlife for harvesting were identified based on the results of resource-specific assessments such as fish and fish habitat VCs including northern pike (*Esox lucius*), lake whitefish (*Coregonus clupeaformis*), walleye (*Sander vitreus*), and lake trout (*Salvelinus namaycush*) (Section 11, Fish and Fish Habitat), and wildlife and wildlife habitat VCs including moose (*Alces alces*), black bear (*Ursus americanus*), grey wolf (*Canis lupus*), and beaver (*Castor canadensis*) (Section 14, Wildlife and Wildlife Habitat), as well as for American marten (*Martes americana*) through consideration of suitable habitat as assessed in the vegetation assessment (Section 13). The fish and fish habitat and wildlife and wildlife habitat assessments considered potential effects on the abundance and distribution of VCs at the population level. The other land and resource use, in turn, considered how effects to the animals could affect hunting, trapping, and fishing success.
- Changes in the quality of the resources and the quality of resource use experience were assessed based on the results of the noise, light, air quality, water quality, terrain, vegetation, and wildlife assessments, review of Project safety risks, the environmental risk assessment, and the human health risk assessment. A qualitative assessment was conducted on potential changes to safety, changing perceptions concerning the potential quality of country foods for consumption, disturbances from changes in the landscape, and the presence of other resource users.

17.2.9 Residual Effects Classification and Determination of Significance

The residual effects analysis uses a reasoned narrative to describe anticipated changes to each measurement indicator caused by the proposed Project and the associated effects on each VC. The residual effects analysis also considers effects from both the Project and RFDs. These narrative descriptions of anticipated effects represent the foundation for the residual effects classification and significance determination. Residual effects are summarized or classified in tabular form using effects criteria, which are intended to provide structure and comparability across VCs and intermediate components assessed for the Project (Section 6.9.1, Residual Effects Classification).

The residual effects classification uses direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence as criteria. The approach to classify each residual effect criterion for the assessment of other land and resource use is provided in Table 17.2-4.

Table 17.2-4: Definitions Applied to Effects Criteria Classifications for the Assessment of Other Land and Resource Use

Criterion	Rating	Definition
Direction	Positive	Change in measurement indicator results in net improvement or benefit to other land and resource use
	Neutral	Change in measurement indicator results in net balance to other land and resource use
	Negative	Change in measurement indicator results in net degradation or loss to other land and resource use
Magnitude	Qualitative narrative or numeric quantification	Change in measurement indicator is described by effect size (e.g., quantity of land in ha no longer available for resource use)
Geographic extent	Project footprint	Change in measurement indicator is confined to the Project footprint
	Local	Change in measurement indicator extends beyond the Project footprint but within the LSA
	Regional	Change in measurement indicator extends beyond the LSA is confined to the RSA
	Beyond regional	Change in measurement indicator extends beyond the RSA
Duration	Qualitative narrative or numeric quantification	Change in measurement indicator is described by effect duration (e.g., months, years)
Reversibility	Reversible	Change in measurement indicator is reversible within a clearly defined time period
	Irreversible	Change in measurement indicator is predicted to influence other land and resource use indefinitely
Frequency	Occasional	Change in measurement indicator is expected to occur rarely (e.g., once or a few times)
	Periodic	Change in measurement indicator is expected to occur consistently at regular intervals or associated with temporal events (e.g., during dry summers)
	Continuous	Change in measurement indicator is expected to occur all the time
Probability of occurrence	Unlikely	Change in measurement indicator is not expected to occur, but not impossible
	Possible	Change in measurement indicator may occur, but is not likely
	Probable	Change in measurement indicator is likely to occur, but is uncertain
	Certain	Change in measurement indicator will occur

RSA = regional study area; LSA = local study area.

While most criteria could be assigned categorical ratings for the other land and resource use VC, predicted effect sizes were provided in specific terms (i.e., narrative or numeric quantification) in the residual effects characterization (Table 17.2-1). Similarly, duration was described in specific terms (e.g., months or years). Applying a category rating to a criterion such as magnitude might lead to confusion or misinterpretation of the effects assessment, or result in the criterion not being easily categorized in a meaningful way. For example, characterizing magnitude solely using an ordinal scale (i.e., low, moderate, or high) in a manner meaningful for the other land and resource use VC is often not appropriate as additional context is required to properly characterize the effects. Universal effect size boundaries, such as a 20% change in a measurement indicator at the RSA or LSA scale used to define a high magnitude effect, work poorly because these size boundaries fail to consider context. Depending on the ecological and socio-economic context, and the context from the cumulative effects from previous and existing developments and activities that also interact with a VC, a 20% change from existing conditions in the study area may be required to cause a high magnitude effect on one measurement indicator, whereas a 2% change in the study area may be sufficient to cause a high magnitude effect for another measurement indicator (Section 6.9.1, Residual Effects Classification).

The significance of adverse residual effects on the other land and resource use VC was evaluated using the assessment endpoint (i.e., continued level of opportunities for other land and resource use) as a significance threshold (Section 6.9.2, Significance Determination). This assessment endpoint or threshold is qualitatively defined by the maintenance of access to a land base to perform other land and resource use activities, continued availability of fish and wildlife for harvesting, and equivalent quality of resources and resource use experience without the proposed Project. The classification of residual effects criteria provides the foundation for determining if the threshold for significance is exceeded.

Resilience (i.e., societal/cultural tolerance), adaptability, and existing conditions provide important ecological, social, and cultural context for the determination of significance on continued opportunities for other land and resource use. Existing conditions represent the combined effects of previous and current human activities and natural factors that have shaped the observed condition and patterns of the other land and resource use VC in the LSA and RSA. These conditions represent the starting point for assessing potential Project effects and were considered as context to help define how close the VC might be to its resilience limits when making the significance determination for the Project as well as the Fission Patterson Lake South Property. Overall, a detailed and transparent account of whether the predicted effects of the Project could be significant by causing the threshold to be exceeded was prepared for the other land and resource use VC by combining the available scientific literature, data collected in the LSA and RSA, and logical reasoning (i.e., a weight of evidence or reasoned narrative approach).

Confidence in the significance prediction was identified and discussed for the other land and resource use VC as part of the reasoned narrative. If uncertainty was high about where a threshold for a significant effect would occur in the range of potential values, and if the effect could be assessed as significant or not significant, a precautionary approach was applied, and the effect was identified as significant.

17.2.10 Prediction Confidence and Uncertainty

The purpose of the assessment is to predict the future conditions for other land and resource use with the addition of the Project and the Fission Patterson Lake South Property. As with all predictions of future conditions, the predictions made in this assessment embody some degree of uncertainty. The assessment applied a precautionary (i.e., conservative) approach to address uncertainty by identifying the greatest magnitude, duration, and geographic extent of potential adverse effects when a range of outcomes were possible. Consequently, uncertainty was addressed in a manner that increased the level of confidence that residual effects were conservatively estimated. The key uncertainties for other land and resource use and the way they were addressed are presented as part of this assessment (Section 17.7).

17.2.11 Monitoring, Follow-Up, and Adaptive Management

Monitoring programs are proposed to address the uncertainties associated with the effects predictions and to evaluate the performance of mitigation. In general, monitoring is used to verify the effects predictions. Monitoring is also used to identify any unanticipated effects and to support the implementation of adaptive management to limit these effects. Typically, monitoring includes one or both of the following categories that may be applied during the Project lifespan:

- **Regulatory compliance monitoring:** monitoring activities, procedures, and programs undertaken to confirm the implementation of approved design standards, mitigation and conditions of approval, and NexGen commitments (e.g., monitoring activities would focus on the species relied upon for other land and resource use).

- **Follow-up monitoring:** programs designed to test the accuracy of effects predictions, reduce or address uncertainties, determine the effectiveness of mitigation, or provide appropriate feedback to operations for modifying or adopting new mitigation designs, policies, and practices (e.g., implementation of adaptive management). Results from these programs can be used to increase the certainty of effect predictions in future EAs.

Where relevant, conceptual monitoring programs would be proposed to confirm predictions and to address the uncertainties associated with the effects predictions and mitigation, and upon Project approval, would be included in the Integrated Management System.

The implementation of robust, long-term environmental testing and monitoring has also been requested by Indigenous Groups to verify protection of the environment, including community-led monitoring during Construction and Operations of the proposed Project (TSD IV: MN-S; TSD V.2: CRDN; TSD VI: YNLR).

In addition to environmental monitoring programs typically implemented for projects (i.e., as noted above), NexGen is working with local Indigenous Groups to implement independent environmental monitoring. In combination with standard Project monitoring processes, independent Indigenous monitoring would be used to verify Project performance and to determine if mitigations and controls are effective in protecting the receiving environment.

Adaptive management measures may also be proposed to address the uncertainties associated with the effects predictions and mitigation. The process for determining when, how, and where to use adaptive management would be described within the Integrated Management System Manual.

17.3 Existing Conditions

This subsection describes the setting and characterization of the existing environment (i.e., Base Case) conditions in the LSA and RSA for the other land and resource use VC. This subsection is organized by the activities that constitute other land and resource use as important context relative to the measurement indicators identified (Table 17.2-2):

- access to and area available for land and resource use;
- availability of fish and wildlife for harvesting; and
- quality of the resources and the quality of resource use experience.

The activities described include recreational (non-Indigenous) hunting and fishing; commercial trapping; commercial fishing; lodge and outfitting services and ecotourism; cabins, parks, and protected areas; forestry and wildfire protection; and mining and exploration. These activities are dependent on the lands and resources that support them. It is important to note that, due to the Project's remote location, resource use by recreational users and commercial fishers is nominal (meaning virtually absent but not confirmed to be zero), and two resource user groups were confirmed to conduct activities in the LSA: trappers, and lodge and outfitting services.

The history of key government legislation and policy and select historic events that set the context for the management of other land and resource use, in particular hunting, commercial trapping, and fishing, is provided in Annex X, Socio-economic Baseline Report, Section 5.1.1.4, Key Government Policies. Those policies and events that are particularly important in influencing the current resource use context are also highlighted in the subsections below.

Around 2004, a committee was formed to develop a land use plan that would guide permitted development in the RSA north of La Loche. Representatives from the CRDN, La Loche, the ENV, and the Ministry of Government Relations formed a committee to complete the land use plan; however, the land use plan was never completed (Happ 2021). Land use planning is of interest to governments, communities, and developer and was the subject of a workshop facilitated in 2018 by the provincial government. A regional planning forum was held by the provincial government in 2018 that was intended for capacity building and to build networks to support land use planning processes (Government of Saskatchewan 2019c).

17.3.1 Hunting

The ENV manages the conservation and allocation of wildlife resources on behalf of all Saskatchewan residents. Many resource management tools are used to manage species abundance and reduce potential conflict between resource users. Tools include defining hunting seasons, establishing wildlife management areas, considering other land use activities, limiting firearm types, issuing licenses (e.g., hunting), and setting harvest limits. In addition to these tools, the ENV has developed a wildlife allocation policy to determine how harvestable game is allocated to hunters and to manage resource management conflicts (ENV 2017a).

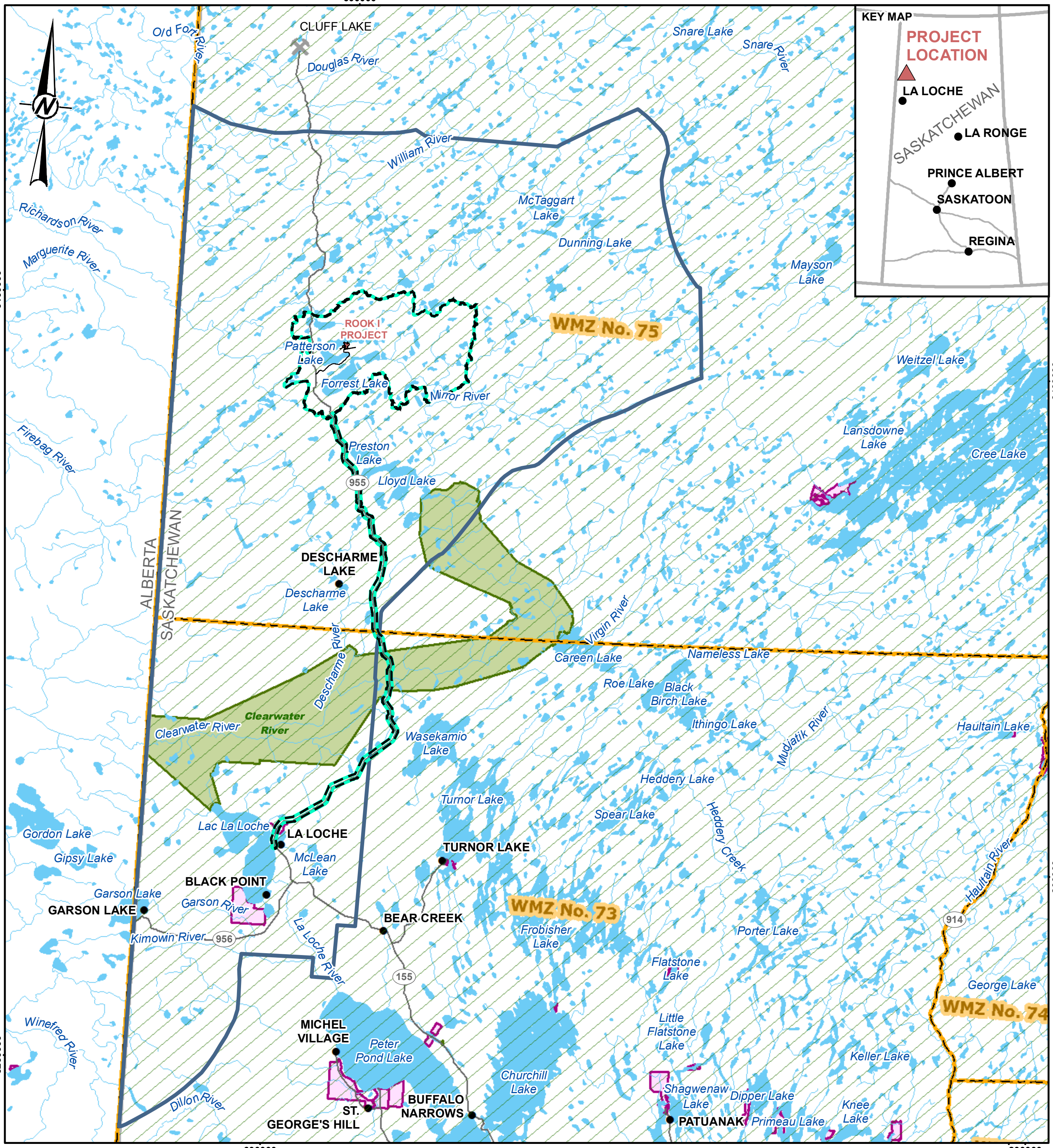
One central concept to resource management is application of the “allocation hierarchy”. The first requirement that needs to be satisfied is conservation. The second is that of Indigenous rights-holders having first right of access to game (e.g., fish and wildlife) populations for sustenance purposes, under the authority of a constitutionally protected Treaty or Aboriginal Right. Saskatchewan residents who hold a valid hunting or fishing licence are given first priority in allocation of the remaining allowable harvest and, lastly, non-residents of Saskatchewan may purchase a guided hunt through licensed outfitters or a fishing license should an allowable harvest remain (ENV 2017a).

This subsection describes licensed resident hunting and the management zones, districts, and units used to conduct wildlife management in the LSA and RSA (Figure 17.3-1). For each game species, the following is described: the maximum harvest or “bag limit” (i.e., the maximum number of fish or game animals that one person can take) and lawful hunting seasons, the number of licences allocated, and hunting success rates. Guided hunting through licensed outfitters is described in Section 17.3.4, Lodge and Outfitting Services and Ecotourism, and Indigenous Peoples’ rights-based hunting is described in Section 16.3.2, Contemporary Indigenous Land and Resource Use.

17.3.1.1 Wildlife Management Zones, Districts, and Units

The Wildlife Management Zones and Special Areas Boundaries Regulations, 1990, define WMZs as areas for managing, harvesting, controlling, or regulating wildlife. Zones are chosen based on several factors including ecosystem classification and land tenure or ownership. Wildlife Management Zones are primarily used to help with species conservation, with the goal that hunters are harvesting the surplus of a species. The ENV sets different hunting limits and seasons by zone. For the management of big game, the LSA is located within WMZ 75 and the RSA includes portions of WMZ 73 and WMZ 75 (Figure 17.3-1).

Game birds are managed under two different management units: game bird districts and GBMUs. Migratory birds such as geese, ducks, cranes, coots, and snipe are managed in two areas: the North Game Bird District and the South Game Bird District. Both the LSA and RSA are located within the North Game Bird District. For the purposes of managing upland bird harvests, there are six GBMUs in Saskatchewan (Conkin 2018). Game Bird Management Unit 6, the Forest GBMU, covers approximately the northern third of the province and contains both the LSA and RSA (Figure 17.3-1).



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (DECOMMISSIONED)
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROPOSED PROJECT FOOTPRINT
- OTHER LAND AND RESOURCE USE LOCAL STUDY AREA
- OTHER LAND AND RESOURCE USE REGIONAL STUDY AREA
- WILDLIFE MANAGEMENT ZONES

GAME BIRD MANAGEMENT UNITS

- GBMU NO. 6 (FOREST)

0 40 80

1:1,480,000 KILOMETRES

REFERENCE(S)
1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
3. WILDLIFE MANAGEMENT, GAME BIRD DISTRICTS & GAME BIRD MANAGEMENT UNITS (GBMU), SASKATCHEWAN MINISTRY OF ENVIRONMENT, FISH AND WILDLIFE.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

WILDLIFE MANAGEMENT ZONES AND GAME BIRD MANAGEMENT UNITS IN THE REGIONAL STUDY AREA

CONSULTANT

wsp

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CHECK	JO	2023-02-09	FIGURE 17.3-1	
REVIEW	KG	2023-02-09		

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17.3.1.2 Big Game Hunting

In WMZ 75, big game (e.g., moose, black bear) licences are currently made available to Saskatchewan resident hunters for a moose hunting season that extends from 1 September to 30 November. For hunters who reside elsewhere in Canada or outside Canada, guided hunts are available for one bull moose in WMZ 75 through a limited allocation of licences to licensed outfitters in the area (Section 17.3.4). Black bear licences are available to both Saskatchewan and Canadian residents for hunting in spring from 15 April to 30 June and in fall from 25 August to 14 October. Non-residents of Canada may also purchase a non-resident licence and hunt black bears through the services of a licensed outfitter using the same season dates. Harvest of one moose or bear of either sex is permitted per licence per year (Government of Saskatchewan 2021b). Other big game species such as woodland caribou (*Rangifer tarandus caribou*), white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), elk (*Cervus canadensis*), and pronghorn (*Antilocapra americana*) are not hunted by licensed hunters in WMZ 75 due to the absence or low abundance of these species (Tokaruk 2021). Wolf, though also classified as big game, is trapped by licensed trappers in this area rather than hunted (Section 17.3.2, Commercial Trapping).

The hunter harvest survey (Government of Saskatchewan 2020) is used to understand how game populations are responding to current management strategies. The hunters harvest survey was established in 2014 and was made mandatory in 2020 (Tokaruk 2021). Available data collected from the 2015 to 2020 hunting seasons are presented in Table 17.3-1 for WMZ 75 (Tokaruk 2021).

Table 17.3-1: Reported and Estimated Annual Licensed Hunter Participation and Harvest by Species in WMZ 75

Years	Moose				Black Bear			
	Reported[a]		Estimated Total[b]		Reported[a]		Estimated Total[b]	
	Licensed Hunters[c]	Harvest	Licensed Hunters	Harvest	Licensed Hunters[d]	Harvest	Licensed Hunters	Harvest
2015	n/a	n/a	19	5	n/a	n/a	n/a	n/a
2016	n/a	n/a	40	0	n/a	n/a	n/a	n/a
2017	n/a	n/a	31	4	n/a	n/a	n/a	n/a
2018	n/a	n/a	17	4	n/a	n/a	n/a	n/a
2019	9	2	42	9	4	2	14	7
2020	14	3	27	6	6	2	10	4
Average	12.5	2.5	29.3	4.6	5.0	2.0	12.0	5.5

Note: Averages are only for years with reported or estimated data.
a) Reported through annual hunting surveys for the 2019 and 2020 hunting seasons. Reported data not available (n/a) from 2015-2018.
b) Estimated total calculated from survey response rates. Estimated data not available (n/a) from 2015 to 2018 for black bear.
c) Saskatchewan residents (non-Indigenous).
d) Saskatchewan and Canadian residents (non-Indigenous).
n/a = not available.

Based on the last six years of data available at the time of assessment, the average annual estimated moose harvest by licensed hunters in WMZ 75 was approximately five moose by 29 licensed hunters, and black bear harvest from 2019 to 2020 was an average of six bears by 12 licensed hunters. Few licensed hunters travel to this area to hunt due to the long distance from major centres and the limited road access. Longer travel and limited access, in combination with lower moose densities, attracts fewer hunters to the area (Tokaruk 2021). Indigenous Knowledge shared by Indigenous Groups also suggests low densities of moose in the area of the proposed Project. The CRDN have observed declining moose populations in the area of the Project since 2014:

> It gets harder, I guess - to find a moose . . . . I'll get one in the fall, if that. But last year I got one moose and that was it for the three weeks we been there. And that's for two families; you know what I mean. . . . We got just one moose last year. Before we [got] . . . two, three. (TSD V.2: CRDN)

The MN-S also reported that moose have moved farther away because of too much activity in the area of the proposed Project (TSD IV: MN-S), and the BNDN noted a decrease in the populations of large game, including moose, reporting that exploration activities in the region and the slow rate of vegetation regrowth following wildfires are underlying causes of their declines (TSD II: BNDN).

17.3.1.3 Migratory Waterfowl Game Bird Hunting

Currently, the North Game Bird District is open for hunting from 1 September to 16 December annually. Species permitted to be harvested include: Canada, cackling, and white-fronted geese (*Branta canadensis*, *Branta hutchinsii*, *Anser albifrons*); white and blue phase snow geese and Ross's geese (*Anser caerulescens*, *Anser rossii*); sandhill cranes (*Antigone canadensis*); and ducks, coots, and snipe. Based on 2020 harvest survey results, no respondents reported harvesting in the North Game Bird District in 2019 (Tokaruk 2021). The MN-S and BRDN reported that there are fewer ducks in general compared to the past, which was attributed to reduced air and water quality, and climate change, as noted by a member of BRDN:

> Even here we used to get lots of ducks and they've dwindled down from 100 to a handful and that's a big decrease, which I notice because back when I used to go hunting for ducks on the prairie I'd be gone [for] half [an] hour and get my five, six ducks and be back. And now I'll be gone walking around all day. So . . . I see a big difference. (TSD III: BRDN)

17.3.1.4 Upland Game Bird Hunting

Upland bird species hunting is permitted from 15 September to 31 December for species such as ptarmigan, and sharp-tailed, spruce, and ruffed grouse (Government of Saskatchewan 2019a). Harvest effort and harvests of upland game birds in GBMU 6 are provided in Table 17.3-2 (Tokaruk 2021).

Table 17.3-2: 2019 Upland Game Bird Harvest and Harvest Effort in Game Bird Management Unit 6

Species / Year	Ptarmigan (*Lagopus* sp.)		Sharp-tailed grouse (*Tympanuchus phasianellus*)		Spruce grouse (*Canachites canadensis*)		Ruffed grouse (*Bonasa umbellus*)		Estimated Total	
	Licensed Hunters	Harvest	Licensed Hunters	Harvest	Licensed Hunters	Harvest	Licensed Hunters	Harvest	Licensed Hunters	Harvest
2018	8	55	30	74	170	890	277	1,505	**485**	**2,524**
2019	6	6	19	23	19	23	225	1,038	**269**	**1,090**
2020	8	48	75	146	300	1,134	497	1,579	**880**	**2,907**
Average	**7**	**36**	**41**	**81**	**163**	**682**	**333**	**1,374**	**545**	**2,174**

Note: Reported through the 2019 to 2021 annual hunting surveys for the 2018-2020 hunting seasons for GBMU 6.
GBMU = Game Bird Management Unit.

Based on harvest data from 2018-2020, spruce grouse and ruffed grouse are the most important upland birds harvested based on quantity harvested. Spruce grouse harvest appears more variable over time than ruffed grouse which is harvested in more consistent quantities over time. Harvests of all species were lowest in 2019. Conkin (2018) suggested that while there is little Saskatchewan-based research available on spruce and ruffed grouse, populations are affected by variables such as population cycles, severe weather, predators, disease, and other factors. Variability in hunting effort also influences harvests and has been documented (Conkin 2018).

17.3.2 Commercial Trapping

This subsection focuses on trapping for commercial purposes, whereas trapping for traditional purposes by Indigenous Peoples is described in Section 16.3, though it is noted that trapping for commercial purposes and for sustenance (i.e., traditional purposes) are performed concurrently.

17.3.2.1 History of Commercial Trapping

Indigenous Peoples in northern Saskatchewan have been involved in trapping fur-bearing animals for commercial purposes since the 1700s. By the twentieth century, trapping had become an important part of Indigenous livelihoods, with the fur trade introducing tools such as steel traps along with providing people with more access to European goods (Passelac-Ross 2005). Individual trappers harvested within large territories, practising a seasonal round of rotating harvesting self-regulated by local families and bands according to local fur resources. Should the resources fail in one area, they could move to a more productive region nearby. These family trapping areas were passed from generation to generation (Gulig 1997).

By the 1930s, the Great Depression had pushed many people in Saskatchewan from southern regions into the north, and the number of licensed non-Indigenous trappers approached half the number of Indigenous trappers in the north. The provincial game branch began leasing traplines in the north to anyone who wanted to purchase the rights to an area. This structure was problematic, as this introduced government-imposed regulations on a practice that had traditionally been self-regulated by local families and bands. Indigenous trappers and communities were not consulted in the establishment of these leased traplines until after non-Indigenous interests were satisfied (Gulig 1997).

A system of extensive fur conservation blocks was organized in the 1940s with the intention that communities could sustain themselves through hunting, trapping, and commercial fishing (Tough and McGregor 2007). The *Fur Act* (1953) designated "fur blocks" for the purpose of managing and conserving fur resources[4]. The northern fur block was further divided into community sections called Fur Conservation Areas. Quotas were placed on beaver and muskrat (*Ondatra zibethicus*), and these were trapped on a community basis, with the number permitted for harvest for each person dependant on population levels (Bureau of Publications for the Department of Natural Resources 1948).

Since the 1970s, the fur industry in Canada has encountered volatility in world prices followed by major setbacks on the world market. The European Union's ban on leg-hold traps and its demand that more humane methods be used to trap animals increased the cost of supplies for trappers and decreased the market and the price for furs as public interest in the product waned. Animal rights groups have also had an effect on reducing the demand for fur products, which has affected their prices (Myers and Summerville 2004). With relatively low fur prices and the high cost of accessing traplines, the number of trappers has been decreasing. Saskatchewan fur harvest statistics from 1970 to 2020 illustrate a declining trend in the number of trappers and pelts harvested (Government of Saskatchewan 2021a). This decline was corroborated by JWG discussions on traditional and wage economies with the BNDN and BRDN, who noted trapping was the primary industry in the region up until the 1960s, since which time it has been declining due to low fur prices and anti-fur campaigns (BNDN-JWG 2021; BRDN-JWG 2021). Low fur prices have resulted in trappers having to alter the species they pursue, and they cannot make enough from their traplines to recoup their costs, which include skidoos, fuel, and equipment (TSD II: BNDN). Comments from the BNDN and BRDN on the low price of furs include:

> You know, one time I remember back in the '60s – 1966, 1967, you know, the price of a lynx was $1,200 . . . . [Today] You'd be lucky if you get $22. (TSD II: BNDN)

> Well, it [trapping] was [important to me]. Right now, it's kind of low on the price. So, it's kind of – it's important to me. But it's not really going too far nowadays because you're just trapping for gas. If you don't catch much, then you're not making anything. Just buy your gas again and go again. (TSD II: BNDN)

> And then from there [a decade ago] on, the [fur] prices go down, down, down. Just about nothing now. I don't know which government we'll have to go see to get the fur price for us to bring it up; I don't know who to go to. Because . . . like a beaver, the beaver price is just down [to] nothing, just about. Maybe about five dollars, or 10 dollars. And there's lots of beaver, if the prices go – you know people walking around here, they'll be out trapping somewhere. (TSD III: BRDN)

The CRDN reported to have been very involved in mercantile trapping in the 1960s and 1980s, and during the 1960s and 1970s the Government of Saskatchewan recognized and supported CRDN trappers in their commercial trapping endeavors in the Patterson Lake area by flying trapping partners in (TSD V.2: CRDN). The CRDN have indicated that a large wildfire on CRDN traditional lands that occurred in the 1980s is "the underlying reason which precipitated the steep decline in CRDN mercantile trapping which has continued into the present day because of depressed fur market conditions" (TSD V.2: CRDN).

[4] The authority to constitute an area as a registered trapline district, a fur conservation area or a fur conservation block is now granted to the minister under *The Wildlife Act, 1998*.

Indigenous Groups have reported that furbearer populations have declined in the area of the Project and further north, which was attributed to mining and exploration activities and climate change, including the increasing frequency of wildfires in recent years. As noted by members of CRDN and BNDN:

> From that year [2013] to this year [2020], it's way different now . . . and then we used to hunt - He [husband] used to trap. He used to catch a lot of martens and lynx . . . fisher. Now not much. (TSD V.2: CRDN)

> Yeah [ability to trap has changed over time] . . . I have to switch routes once in a while or all the burns that are happening up there. Yeah. Less animals . . . . Weather is unpredictable nowadays . . . . The more activity you have up there, the less animals are on your trail . . . . There's less animals up there . . . . I had less fur last winter. (TSD II: BNDN)

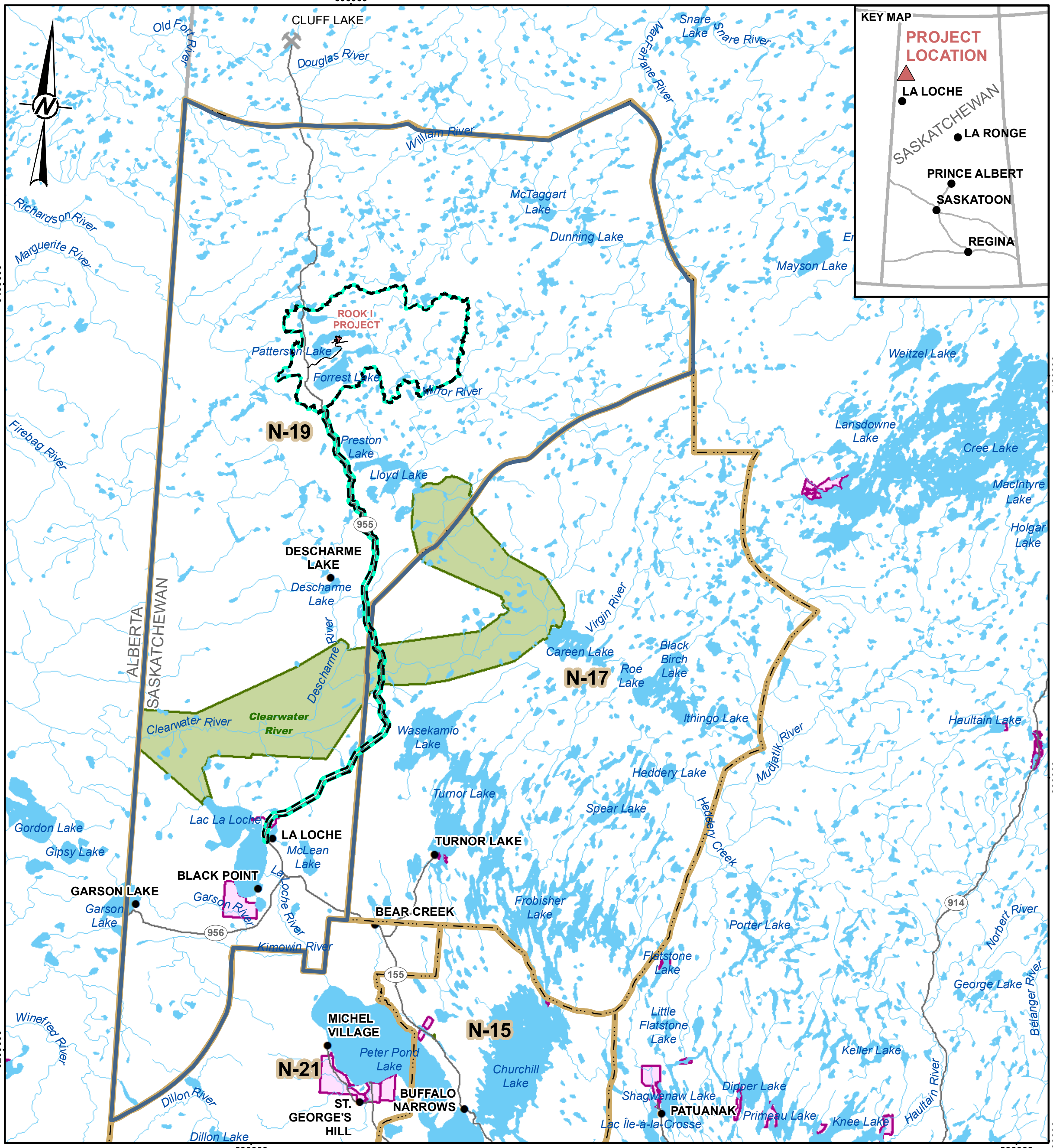
> Beaver is different. With the burnt country, they don't stay around. They move toward the green area, so the beavers are gone. (TSD II: BNDN)

17.3.2.2 Commercial Trapping in the Regional Study Area

Trapping still provides benefits to trappers and their families, including money from fur sales, meat from certain species, and some use of furs for domestic purposes, such as moccasins and gloves. Trapping continues to be a source of supplemental income for many, bringing in between $1.5 million and $6.0 million per annum for 4,500 trappers (Government of Saskatchewan 2021a). In northern Saskatchewan, the fur-bearing animals that have consistently been trapped are beaver, muskrat, squirrel, American marten, mink (*Neogale vison*), weasel (*Mustela* spp.), fox, and otter. Other fur-bearing animals that have been trapped more rarely in the northern region include wolf, lynx *(lynx canadensis*), fisher (*Pekania pennanti*), wolverine (*Gulo gulo*), and black bear (Hay 2007).

To be eligible to trap, trappers must be Saskatchewan residents and hold a Fur Conservation Area Fur Licence, which can be purchased annually for the period from 1 October to 30 September, thus covering the winter trapping season followed by time to prepare pelts for sale. Trapping is generally conducted in winter between November and March when fur is at its best or "prime" quality (2021 trapper's workshop; Government of Saskatchewan 2019b). Since trapping is conducted in winter months generally from November to March, a trapping season spans two years. The season is referenced using both years, for example, the winter season of 2019/2020.

Each fur block has a fur block chairperson, who is tasked with coordinating trappers in a fur block and participating in a co-management board with the Province. Some fur blocks have trappers assigned to zones, and other fur blocks are open, with trappers working larger areas. Trappers frequently shift their activity throughout a fur block to adjust to changes in animal density and movement and to prevent over-harvesting (2021 trapper's workshop). Figure 17.3-2 shows the N-19 trapping block that contains the LSA and the boundaries of which define the RSA.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (DECOMMISSIONED)
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROPOSED PROJECT FOOTPRINT
- OTHER LAND AND RESOURCE USE LOCAL STUDY AREA
- OTHER LAND AND RESOURCE USE REGIONAL STUDY AREA
- FUR BLOCKS

0 40 80
1:1,480,000 KILOMETRES

REFERENCE(S)
1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
3. WILDLIFE MANAGEMENT, GAME BIRD DISTRICTS & GAME BIRD MANAGEMENT UNITS (GBMU), SASKATCHEWAN MINISTRY OF ENVIRONMENT, FISH AND WILDLIFE.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
FUR BLOCKS WITHIN REGIONAL AREA

CONSULTANT
wsp

PROJECT		20144150	PHASE 3314 - 6
DESIGN	GE	2023-02-09	SCALE AS SHOWN REV. 0
GIS	NO	2023-02-09	
CHECK	JO	2023-02-09	**FIGURE 17.3-2**
REVIEW	KG	2023-02-09	

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\17_Non_Indigenous_LRU\8_5x11\20144150_Fig17_3-2_Fur-Block-N-19_Rev0.mxd PRINTED ON: 2023-02-09 AT: 2:16:33 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A 25mm

In 2019/2020, 258 pelt harvests were recorded from the N-19 trapping block for a total value of just over $7,500 (Government of Saskatchewan 2021a). American marten and lynx pelts contributed to over 90% of the income generated. The 2019/2020 pelt harvests were lower than the five-year average[5] of 418 pelts for just under $17,000 (Government of Saskatchewan 2016, 2017, 2018a, 2019b, 2021c). Industry slowdown occurred due to the COVID-19 pandemic necessitating community lockdowns and closure of fur markets (2021 trapper's workshop). In other years, a wider variety of species was harvested, such as fisher, muskrat, wolf, and others; however, lynx and American marten brought in an average of over 80% of the value of pelts sold. A BNDN trapper indicated that they target lynx and American marten "because the other ones are not really worth much" and a BRDN member suggested that "if the prices improved, a lot of people would trap because there's lots of animals over there" (TSD II: BRDN; BRDN-JWG 2020). Generally, trappers make decisions to harvest specific species based on economic returns for effort expended, personal preferences, the abundance of animals in their trapping area, the equipment available to them, and their level of experience. Wild fur harvests and cash values for the last five years for which data are available are shown in Table 17.3-3.

Table 17.3-3: Fur Block N-19 Wild Fur Harvest and Value 2014/2015 to 2019/2020

Species	2014/2015		2015/2016		2016/2017		2017/2018		2019/2020		5-Year Average	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Beaver	10	$160	n/a	n/a	5	$77	13	$187	n/a	n/a	5.6	$85
Coyote	2	$208	1	$85	n/a	n/a	11	$1,285	n/a	n/a	2.8	$315
Fisher	33	$3,124	16	$868	10	$614	18	$1,071	9	$193	17.2	$1,174
Fox – cross	6	$203	1	$17	n/a	n/a	1	$26	1	$39	1.8	$71
Fox – red	13	$273	4	$49	3	$56	15	$226	7	$62	8.4	$133
Fox – silver	n/a	n/a	n/a	n/a	n/a	n/a	2	$56	1	$53	0.8	$27
Lynx	31	$3,075	25	$1,320	17	$1,604	27	$2,172	28	$1,561	25.6	$1,946
American marten	193	$17,219	147	$9,386	127	$12,574	169	$13,836	203	$5,315	167.8	$11,666
Mink	28	$353	9	$97	6	$103	6	$100	4	$21	10.6	$135
Muskrat	254	$1,041	74	$161	56	$192	110	$356	n/a	n/a	98.8	$350
Otter	7	$321	3	$88	2	$76	4	$162	2	$43	3.6	$138
Squirrel	99	$62	121	$50	n/a	n/a	7	$3	n/a	n/a	45.4	$23
Weasel	86	$190	39	$78	6	$15	1	$2	2	$5	26.8	$58
Wolf	5	$1,657	n/a	n/a	1	$235	3	$534	n/a	n/a	1.8	$485
Wolverine	2	$597	n/a	n/a	1	$302	n/a	n/a	1	$264	0.8	$233
Total	**769**	**$28,483**	**440**	**$12,199**	**234**	**$15,849**	**387**	**$20,017**	**258**	**$7,554**	**417.6**	**$16,820**

Sources: Government of Saskatchewan 2016, 2017, 2018a, 2019b, 2021c.
Notes: 2018/2019 data were not compiled by the Province that year. A trapping season spans two years since trapping is conducted in winter months, generally from November to March.
Dollar values are total value of harvest for current for the year reported.
n/a = no harvest.

17.3.2.3 Commercial Trapping in the Local Study Area

Trapping is primarily conducted during winter months, and most trappers travel to their traplines by truck on the regional road network then snowmobile out to traps. Cabins used to support trapping activities are located both within and outside of the LSA (2021 trapper's workshop; TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; Section 17.3.5, Cabins).

[5] 2014/2015 to 2019/2020, excluding the 2018/2019 season for which harvest data are not available.

The CRDN describe the Patterson Lake area as "up north" and have historically met at Descharme Lake as a hub and branched off to other destinations from there (TSD V.1: CRDN; TSD V.2: CRDN). The Cluff Lake Road, otherwise known as Highway 955, was used to travel to destinations north of Descharme Lake, to Athabasca Lake and beyond. Patterson Lake is locally known as "Upper Pelican Lake" and is a trapping area (TSD V.1: CRDN; TSD V.2: CRDN).

Within the maximum disturbance area, the CRDN documented trapping areas between Patterson and Forrest lakes that overlap with the proposed access road and on the Patterson Lake peninsula (Figure 4, TSD V.1: CRDN).

In the LSA, several trappers use the Highway 955 corridor to trap for American marten (2021 trapper's workshop). The CRDN (TSD V.1: CRDN) documented trapping north of Patterson Lake, between Patterson and Forrest lakes and within the proposed Project footprint. Furbearers trapped by past and present CRDN members were indicated to include beaver, fisher, American marten, mink, muskrat, otter, porcupine, weasel, and wolverine (TSD V.1: CRDN, Appendix A). Recent fur production listed in Table 17.3-3 suggested a focus on American marten and lynx fur production over the past five years. CRDN describes the Patterson Lake area as "good for everything" (TSD V.1: CRDN).

The MN-S (TSD IV: MN-S) documented a trapline north of Patterson Lake but did not provide additional information on this line or the type of trapping conducted at this location. The MN-S also mapped trapping in areas north of Patterson Lake, including at Gedak Lake (Figure C, Table 1, TSD IV: MN-S). The BRDN noted historical trapping in the Patterson Lake area, but no BRDN community members reported trapping there recently in acknowledgement of CRDN community tenure within the N-19 trapping block boundaries (TSD III: BRDN). The BNDN and MN-S have also identified other trapping interests in the area of the Project, which are described in Section 16 (Cultural and Heritage Resources and Indigenous Land and Resource Use). The Ya'thi Néné Lands and Resources identified the area of the Project to be an "important furbearer area", though it is not currently used for furbearer harvesting by Ya'thi Néné Lands and Resources members (Figure 10; TSD VI: YNLR).

17.3.3 Fishing

Fishing includes consideration of commercial fishing and recreational fishing, also known as angling. Commercial fishing, by definition, is fishing for profit under a commercial fishing licence. These licences are issued to either Indigenous rights-holders or non-Indigenous individuals. Recreational fishing is fishing for sport or leisure, and though fish are consumed, they are not considered to be subsistence harvesting. Sport fishing in Saskatchewan is regulated by The Fisheries Regulations under *The Fisheries (Saskatchewan) Act, 2020.* Angling licences are required to authorize non-Indigenous people to fish. This subsection describes licensed commercial fishing and licensed angling conducted in the LSA and RSA. Rights-based fishing for food is described in Section 16.3, Existing Conditions.

17.3.3.1 Commercial Fishing

Commercial fishing is an important industry in northern Saskatchewan, though with significant variability depending on distance to markets and lake accessibility. This subsection examines the historical context, fish marketing, and commercial fishing in the LSA and RSA.

Commercial Fishing Context

Between the late 1960s and the mid-1970s, commercial fishers in northern Saskatchewan landed about 11 million pounds (approximately 500,000 kg) of fish annually, valued at nearly $2 million, from roughly 170 lakes (Environment Canada 1975). Up to the late 1980s or early 1990s, commercial fishing was an important industry for LPA communities. Fish harvesters made sufficient income to live off. Catches contributed to subsistence diets, and dried fish was sold in southern communities for extra cash income. After one lake quota was taken, fish harvesters moved on to the next lake. Commercial fishing was conducted in both winter and summer (2019 to 2021 KP interview program).

Currently, throughout Saskatchewan, there are approximately 1,200 lakes with commercial fishing quotas (Demuth 2020). Between 200 and 250 of those lakes were commercially fished in 2019 (Demuth 2020, 2021a, 2021b). Commercial fishing within the province is managed by The Fisheries Regulations. Commercial fishing predominately occurs north of Prince Albert, which is outside of the RSA. The CRDN, MN-S, BNDN, and BRDN reported that they continue to fish commercially, which is mostly practiced during the winter months; however, the locations where commercial fishing currently occurs was not provided in the IKTLU Studies (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.2: CRDN). Lake quotas are reviewed and adjusted based on assessments by the ENV. The time between assessments varies by each individual lake. Each licence has a breakdown quota per species; when the quota for one species is reached, the lake is closed. There is both a sustainability and economic benefit for fish harvesters to try to target a different fish species when one species is approaching quota to prevent lake closure (as occurs when the quota is reached). Quota limits vary by lake and are based on an estimated sustainable harvest level. Fish harvesters submit daily catch records, which the ENV has access to and manages. As the catch approaches the quota, the Province will give 48 hours' notice to all fish harvesters on that lake to pull out their nets before closing the lake. In the event that a quota is surpassed, the ENV will impose a regulation such as a reduction in the quota for the following year.

Commercial fishing is conducted primarily through fishing co-operatives. Co-operatives are established within communities, including local towns and hamlets and Indigenous communities, and their residents can obtain membership. The lakes that are selected for commercial fishing by the Province are chosen based on historical use; these lakes tend to be close to the co-operative locations. According to a 2007 economic impact study conducted by the Freshwater Fishing Marketing Corporation (FFMC), over 88% of northern Saskatchewan commercial fish harvesters and their helpers self-identified as Indigenous, inclusive of Métis (GTA 2021). The Saskatchewan Commercial Fisherman's Co-operative Federation Ltd. reports that commercial fishing is an important source of income for northern Saskatchewan families and that over 700 fish harvesters belong to local fishing co-operatives (Stewart 2006).

The ENV does not impose a maximum number of memberships per co-operative, as this is managed by each co-operative. The ENV is responsible for issuing fishing licences and setting lake quotas, fishing seasons, and allowable fishing gear (e.g., mesh sizes, how many gillnet gangs [i.e., a group of nets or panels strung together] are permitted). Market conditions also influence the commercial fishery (e.g., type and number of fish targeted due to market prices) and, more recently, the COVID-19 pandemic has also affected the fisheries.

Licences can be issued annually or every second year (i.e., pulse fisheries, which is a fisheries management technique for preventing fish stocks from being overfished by periodically permitting a cycle of fishing followed by a fallow period that allows stocks to recover). Once a licence is obtained, licensees will determine if it makes economic sense to fish that year. The decision to fish takes into consideration the following factors: access to the lake, quota, available time, market prices, fuel and other operating costs, and personal reasons.

Fish Marketing

Established in 1969, the FFMC acted as a single-desk marketer of Canada's inland fish catch under the *Freshwater Fish Marketing Act*. The FFMC's mandate was to purchase all legally caught fish, create an orderly fish market, and increase returns to fish harvesters (Government of Canada 2021). In 2012, the Saskatchewan government left the *Freshwater Fish Marketing Act*. Fisheries were no longer required to sell to the FFMC and, likewise, the FFMC was no longer obligated to purchase from them as there was now a free market approach (Government of Canada 2021). Given the choice, some fish harvesters continue to sell to the FFMC and others market their catch to small processors and for local consumption. Fish harvesters in the region currently market to either J. Waite's Fisheries in Buffalo Narrows or to the Île-à-la-Crosse Fish Company in Île-à-la-Crosse. These fish packers then sell for the best available prices on the market, whether that is to the FFMC or to other buyers.

To provide fresh, unfrozen fish to the packing companies, fish harvesters must empty their nets and drive to one of the two fish packers available (2019 to 2021 KP interview program). The distance to transport fish to the packers was stated to be a deterrent to fishing because "fish freight costs are too high, so people don't bother fishing that area" (BNDN-JWG 2020). The Île-à-la-Crosse fish processing facility has capacity for double the current commercial harvest (DMCA 2018). An opportunity has been identified for a fish collection and sorting depot in La Loche to further develop the local commercial fishing sector, although there is a current skill gap in the workforce given the decline in commercial fishing over the last decade (DMCA 2018).

In the past (assumed to be sometime during the height of commercial fishing from the late 1960s to the early 1990s), fish harvesters in the RSA depended on the value of lake whitefish, as many lakes were classified as export grade[6] fetching top dollar (2019 to 2021 KP interview program). Mixing catches from different lakes led to a downgrade in the quality rating of lake whitefish, which reduced the profitability of the fishery (2019 to 2021 KP interview program).

More recently, until the 30 April 2020 end of fiscal year, fish harvesters were receiving $3.96/kg (round weight) for walleye, locally known as pickerel, which was almost double the price received for lake whitefish (i.e., $1.94) and almost four times the price received for northern pike (i.e., $1.00; FFMC 2020). These prices made northern Saskatchewan fish harvesters heavily reliant on the pickerel catch to maintain financial viability; in 2017 for example, pickerel accounted for 63% of fish harvesters' income but only made up 23% of the catch (Financial Post 2017).

By early spring of 2020, the FFMC indicated in its annual report that the COVID-19 pandemic had begun to materially affect FFMC operations and financial results (FFMC 2020). This statement was validated in the 2019 to 2021 KP interview program, which also indicated that fish harvesters were not fishing during the 2019/2020 season as supplementary income was available from the Canadian Emergency Response Benefit (DFO 2020), which enabled fish harvesters to remain safe at home. By late April 2020, the FFMC communicated to fish harvesters that they would not buy the same volume of fish, particularly walleye, due to a glut of inventory and low demand caused by food service industry closures (CBC 2020a,b).

[6] Export grade exhibits a light-coloured flesh with low levels of parasitisation by *Triaenophorus crassus*, a muscle cyst that darkens the meat.

Commercial Fishing in the Local and Regional Study Areas

Lakes that have been active in the LSA and RSA in the last five years include Patterson Lake in the LSA and Lloyd Lake and Lac La Loche in the RSA. Patterson Lake has an annual quota of 6,250 kg of walleye, northern pike, lake whitefish, and lake trout. Lloyd Lake has an annual quota of 13,350 kg of walleye, northern pike, lake whitefish, and lake trout, and Lac La Loche has an annual quota of 76,000 kg of walleye, northern pike, and lake whitefish. Table 17.3-4 shows production in round weight (kg) by species from each of the three lakes.

Table 17.3-4: Commercial Fishery Production in Round Weight from 2015/2016 to 2019/2020

Lake Name	Year	Lake Trout (kg)	Lake Whitefish (kg)	Northern Pike (kg)	Walleye (kg)	Other (Unspecified, Mullet) (kg)	Quota Species (kg)	Total Harvest (kg)
Lac La Loche	2015/2016	n/a	19,859	40,055	77	n/a	59,991	59,991
Lac La Loche	2016/2017	n/a	26,022	48,537	6	1,659	74,565	76,224
Lac La Loche	2017/2018	n/a	16,012	47,446	94	1,672	63,552	65,223
Lac La Loche	2018/2019	n/a	4,500	11,857	171	1,585	16,527	18,112
Lac La Loche	2019/2020	n/a	1,616	4,387	360	7	6,363	6,370
Average Annual Harvest (2015/2016-2019/2020)		n/a	**13,602**	**30,456**	**141**	**1231**	**44,200**	**45,184**
Lloyd Lake	2015/2016	6	1,706	928	623	n/a	3,263	3,263
Lloyd Lake	2016/2017	n/a	2,610	587	1,840	468	5,037	5,505
Lloyd Lake	2017/2018	n/a	2,447	1,593	2,092	55	6,132	6,187
Lloyd Lake	2018/2019	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lloyd Lake	2019/2020	n/a	428	39	8	52	475	527
Average Annual Harvest (2015/2016-2019/2020)		**6**	**1,798**	**787**	**1,141**	**192**	**3,727**	**3,871**
Patterson Lake	2016/2017	127	50	13	n/a	n/a	190	190

Source: Demuth 2021a. Fish Production Data by Lake and by species (summary tables in MS Excel, pers. comm).
Averages are based on available years with harvest data.
Commercial fishery production from Patterson Lake only occurred in the 2016/2017 season from 2015 to 2020.
n/a = No harvest.

In the RSA, Lloyd Lake has been fished more consistently but is not harvested to its potential, averaging less than 4,000 kg of its 13,000 kg quota over the last five years. The distance to fish packing facilities and winter road conditions is likely deterring commercial fishing on both Patterson and Lloyd lakes (2019 to 2021 KP interview program). Currently, there are only approximately 10 active commercial fish harvesters who fish Lac La Loche and lakes north to Patterson Lake (2019 to 2021 KP interview program).

In the LSA, Patterson Lake has only been commercially fished once in the past 20 years, during 2016/2017. According to an interview, the fish harvester who used to fish Patterson Lake retired and the licence was not taken up by a new fish harvester (2019 to 2021 KP interview program). In 2010/2011, a fish harvester requested a licence to fish on Patterson Lake but did not use the allocation. A very small harvest of less than 200 kg was taken from Patterson Lake in 2016/2017.

17.3.3.2 Recreational Fishing

Waterbodies in the LSA and RSA are within the Northern Zone, a zone established by the ENV for fisheries management through establishment of recreational fishing seasons, catch limits, and other special regulations. Information pertaining to fisheries management is in the Saskatchewan Angling Guide, where fishing seasons, catch limits, and any special regulations are published (Government of Saskatchewan 2021d). The open fishing season generally lasts from the third week of May to the second week of April in the following year. Catch limits refer to the maximum number and size of fish an angler is allowed to keep or have in their possession (Government of Saskatchewan 2021d). General catch limits specify limits for all lakes where special regulations have not been established. For example, under general catch limits in the Northern Zone, northern pike and walleye have a limit of five and four fish, respectively, and not more than one fish caught can be over 75 cm in length for northern pike and not more than one over 55 cm in length for walleye (Government of Saskatchewan 2021e).

Special regulations are designated Catch and Release (CR) Waters CR1, CR2, and CR3, each of which is more restrictive on the number and size of fish caught than the previous, and all of which are more restrictive than general limits. Special regulations are in effect for one lake in the LSA: Patterson Lake, which is designated with CR1 limits (Government of Saskatchewan 2021e). The CR1 designation limits northern pike and walleye annual harvest to three and two fish, respectively. In the RSA, Lloyd Lake has a CR2 designation which restricts Arctic grayling annual harvest to one fish that must not exceed 35 cm in length.

Recreational fishing is not common in the LSA and RSA for two reasons: the remoteness of the region and the low proportion of non-Indigenous residents in the area; over 95% of residents in the region are Indigenous and, therefore, conduct rights-based fishing not requiring licensing (Section 16.3). Some Indigenous Group members and LPA community members have commented that there are fewer fish in the lakes in area of the proposed Project, which was attributed to a perception of pollution, overfishing, and overharvesting of minnows for bait (TSD IV: MN-S; TSD V.2: CRDN; NexGen 2019). The CRDN have reported that fish populations in Patterson Lake and Forrest Lake have decreased during the late 1970s and 1980s, and that fish populations in the lake have never fully recovered (TSD V.2: CRDN).

It is likely that some fishing takes place concurrently with other activities, such as hunting, camping, or canoeing in Clearwater River Provincial Park, but equivalent fishing opportunities can be found closer to larger population centres and without the time or expense of reaching the LSA and RSA. Local resource harvesters have observed self-guided family groups who fish lakes in the area that have been stocked with rainbow, brook, and lake trout (2019 to 2021 KP interview program).

Guided sport fishing opportunities are available and are described in Section 17.3.4.

17.3.4 Lodge and Outfitting Services and Ecotourism

This subsection discusses two topics: lodge and outfitting services, and ecotourism. Lodge and outfitting services have played an important role in northern economies and since 2000, with nature and adventure travel having emerged as one of the fastest-growing segments of the tourism industry (CPAWS–Wildlands League and Ontario Nature 2005). Ecotourism is also a growing industry which provides non-consumptive recreational activities for experiencing the wilderness (Reed and Mills 2007). While both industries have experienced a downturn due to the COVID-19 pandemic, a restart marketing strategy has been launched by Tourism Saskatchewan to speed recovery (Tourism Saskatchewan 2021a). Despite marketing, there are several factors that are limiting the tourism industry in the RSA. For example, La Loche region is noted to have significant challenges with respect to limited highway access, a lack of developed attractions in the region, lack of accommodations and restaurants to serve visitors, and a small and underdeveloped outfitting industry (DMCA 2018). The contribution of these services to economic effects are presented in Section 18, as applicable.

17.3.4.1 Lodge and Outfitting Services

Between 620 and 630 Saskatchewan lodge and outfitting operations are licensed each year (ENV 2017b). Outfitters offer a wide variety of hunting and angling services, and although anyone can access outfitting services, 90% of hunters using outfitting services are non-residents of the province. In 2006, it was estimated that the industry contributed over $40 million to the Saskatchewan economy (ENV 2017b).

Currently, opportunities to establish businesses for hunting big game and/or migratory birds and angling are fully allocated, making it difficult to start up any new facilities in Saskatchewan (Government of Saskatchewan 2021f). The province is known for black bear and moose hunting opportunities (Tourism Saskatchewan 2021a).

Outfitting licences are issued annually by the ENV and specify the following conditions:

- the type of fishing and/or hunting activity allowed;
- the species and amounts that may be harvested;
- where and when an outfitter or guide is authorized to provide services;
- the number of clients that can be served at one time or annually;
- the type of equipment that an outfitter can provide; and
- other terms and conditions considered appropriate for fish and wildlife management.

Outfitters can offer fishing and/or hunting services, depending on the suitability of the area in which they operate. In accordance with The Outfitter and Guide Regulations, 2004, outfitters pay a one-time application fee and annual fees based on the number of categories in which they offer services (e.g., big game such as white-tailed deer, moose, or bear; fishing; and game bird). Big-game outfitters also pay a resource allocation fee for each client. Outfitter clients are required to buy individual hunting and/or fishing licences.

Many outfitters and lodges provide guided and self-directed fishing activities during the open-water season. This service usually includes a shore lunch and eating fish at the lodge or camp. Many of the lodges follow the practice of catch and release. A few of the lodges offer services that bring clients to other nearby lakes, either by float plane or by ATV. In the northern WMZs, most of the outfitters and lodges have limited road access, relying on float planes and small private landing strips on land.

In the northern portion of the RSA, including the LSA, hunting allocations are exclusively for bear tags[7], and in the southern portion of the RSA, hunting allocations are exclusively for moose. Bear hunting seasons occur in spring and fall from 15 April to 30 June and from 25 August to 14 October, respectively. Guided moose hunts permit the harvest of one bull moose between 1 September and 30 November (Government of Saskatchewan 2020).

Kisslinger Outfitters is located in the RSA but outside of the LSA and is accessed via the Highway 955 corridor. Lloyd Lake Lodge and Bolton Lake Wilderness Retreat are remote fly-in operations also located in the RSA. There are three lodge and outfitting operations with allocations within or partially within the LSA: Forest Lake Outfitters, Big Bear Contracting, and Lone Wolf Camps. The closest operation to the proposed Project site is Forest Lake Outfitters, which shares the existing access road with NexGen and has allocations for sports fishing on Patterson Lake and other local lakes. Exact locations are not provided to protect commercial interests. Each operation is described below to the extent possible based on publicly available information and whether or not consent was provided by the operators to be interviewed.

[7] A tag authorizes the hunt to hunt the game species indicated on the tag.

Kisslinger Outfitting

In the RSA, Kisslinger Outfitting operates from a drive-up base camp located on the west side of Highway 955, just south of Clearwater River Provincial Park. Accommodations include 14 rooms for up to 20 hunters. Kisslinger Outfitters offers primarily spring bear hunts at over 25 bear bait sites along the highway (Kisslinger Outfitting 2021). About 10 days of guided hunting takes place per group. The operation is open for 24 weeks of the year from 1 May to 15 October and hosts between 50 and 60 guests annually. Guests also fish for northern pike, Arctic grayling, walleye, and lake trout on nearby lakes (2019 to 2021 KP interview program).

Lloyd Lake Lodge

In the RSA, Lloyd Lake Lodge is located on the western shores of Lloyd Lake, situated approximately 40 km south of the proposed Project site. The lodge has five guest cabins that can accommodate up to 20 guests (Lloyd Lake Lodge 2021a). This fly-in lodge offers guided fishing packages for northern pike, walleye, lake trout, and Arctic grayling (Lloyd Lake Lodge 2021b). Attempts to contact the operation for an interview to obtain additional information were not successful.

Bolton Lake Wilderness Retreat

In the RSA, Bolton Lake Wilderness Retreat is a remote fly-in facility catering to corporate retreats and resource exploration groups. The lodge is situated approximately 33 km due east of Patterson Lake. An airstrip and helipad services the lodge, and the network of surrounding trails serve exploration activity year-round. Exploration clients access the lodge by air. It is a 35-minute flight from La Loche and about 50 minutes from Fort McMurray, depending on the aircraft used. Land access to the lodge is via 55 km of winter trail accessed just north of Patterson Lake.

Under a Commercial Outfitters Licence, the lodge has an allocation area that includes Meanwell Lake, Dell Lake, Dyke Lake, Clearwater River, and Mirror River (Tourism Saskatchewan 2021b). The operation has six bear tag allocations. Bear are noted to be abundant in the area. The lodge is run year-round and has capacity for 21 people. Walleye and northern pike fishing are offered in the open water season, along with hikes and ATV trail use. Over 32 km of trail are permitted for use (2019 to 2021 KP interview program).

The Bolton Lake Wilderness Retreat was sold to new owners in May 2021. The new owners plan to maintain the existing operation as is until they are more familiar with the operation. Potential initiatives include conducting a spring bear hunt and/or river tours for tourists. A fall bear hunt was not planned for 2021 (2019 to 2021 KP interview program).

Forest Lake Outfitters

In the LSA, Forest Lake Outfitters maintains three guest cabins on the west shore of Beet Lake and an outpost camp with two cabins on Forrest Lake. Access to the facility is either by float plane to Beet Lake or by road. Driving access is via Highway 955 using the Patterson Lake turnoff, travelling the road for about 6 km, then turning right and travelling an additional 4 km to the Forest Lake outpost camp (Forest Lake Outfitters 2013). The 6 km long Patterson Lake turnoff road is the same access road used to reach the existing NexGen exploration camp facilities and proposed Project site. This road has been widened and improved for better access to the NexGen exploration camp (2019 to 2021 KP interview program). The additional 4 km roadway to Forest Lake Outfitters remains unimproved. At the terminus of this roadway is the Forest Lake outpost camp, where boat transport is provided to the main operation on Beet Lake.

The Forest Lake Outfitters operation has allocations on six interconnected lakes and one river: Patterson, Beet, Naomi, Forrest, Vermeersch, and Wickenkamp lakes, and the Clearwater River (Forest Lake Outfitters 2013). The first four lakes (i.e., Patterson Lake, Beet Lake, Naomi Lake and Forrest Lake) are accessed via interconnecting waterbodies from Beet Lake, and the latter two lakes (i.e., Vermeersch Lake and Wickenkamp Lake) are accessed via ATV along the existing access road from the Forest Lake outpost camp. Fish targeted in the lakes include walleye, northern pike, and lake trout (2019 to 2021 KP interview program).

The operation hosts an average of 45 to 60 guests annually, normally for five days for each client group. Clients are self-guided using operation-supplied boats and fuel. Clients use ATVs to access Vermeersch and Wickenkamp lakes on the opposite side of Highway 955 using 10 km of roadway, including the 6 km of roadway in common with the existing access road to the proposed Project site. Though the operation has bear tags, its focus has been exclusively on fishing (2019 to 2021 KP interview program).

Big Bear Contracting

Big Bear Contracting is located in the LSA. Little information about this outfitting operation is available from public sources. An allocation area for bear hunting located along Highway 955 from just south of Forrest Lake to about 48 km north is partially in the LSA.

Lone Wolf Camps

In the LSA and RSA, Lone Wolf Camps offers fishing from their cabins on the shores of Carswell Lake just south of Lake Athabasca. Guided bear hunting is offered on the west side of Highway 955, opposite Forrest Lake in the Wickenkamp and Wenger Lake area (2019 to 2021 KP interview program). Few details were provided in the initial interview and the operator could not be reached though follow-up calls were made to request a second KP interview.

17.3.4.2 Ecotourism

Although there is not universal agreement on the definition of ecotourism, it is generally agreed that the main tenets are conservation, sustainability, environmental education, and nature-based activities (Donahoe and Needham 2006).

One operator in the RSA conducts canoe tours down the Clearwater River from Lloyd Lake to the Saskatchewan-Alberta border. CanoeSki Discovery Company (2021) advertises a 12-day, 258 km paddle on the Clearwater River. Based on an interview with the president and chief executive officer of the business, the Clearwater Heritage Canoe Trip is not currently being offered, nor is it planned for the foreseeable future (2019 to 2021 KP interview program).

The Carswell impact structure, which is impact crater within the Athabasca Basin of the Canadian Shield in northern Saskatchewan and also known as Carswell crater, is located at the end of Highway 955 and may occasionally attract self-guiding visitors. Poor road conditions and the need to pack extra fuel may deter all but the most determined visitors. The crater is almost 40 km in diameter and the rim is still visible. The Cluff Lake Mine, now closed, is located within the crater.

No other ecotourism interests were identified in the RSA, and none occur in the LSA.

17.3.5 Cabins

As of February 2020, there were 937 remote recreational cabins and 15 remote residential sites on Crown resource land in Saskatchewan, primarily located in northern Saskatchewan (Regina Leader-Post 2020), plus an unknown number of traditional resource use cabins. Cabins provide access to recreational opportunities and shelter for resource harvesters seeking extended access to resources such as fish, meat, or fur. Remote recreational cabins and residential sites are also used as a base by Indigenous land users from which traditional activities are undertaken, to spend time with family, and they serve as educational centres where traditional ways of life and knowledge are passed down to younger generations by Elders and other adult members of an extended family (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; Section 16, Cultural and Heritage Resources and Indigenous Land and Resource Use). To build and legally occupy a cabin, permission is granted through Crown Resource Land Leases, known as a resource land disposition (Government of Saskatchewan 2021g). Examples of intended uses include:

- remote recreational cottages;
- traditional resource use cabins;
- commercial and industrial operations; and
- wild rice harvesting.

Around 2004, a committee was formed to develop a land use plan that would guide permitted development in the RSA north of La Loche. Representatives from the CRDN, La Loche, the ENV, and the Ministry of Government Relations formed a committee to complete the land use plan. At the request of CRDN Chief Roy Cheecham, the ENV implemented a development freeze or “land freeze” until the land use plan was completed. The land freeze limited land dispositions including gravel dispositions, cabin leases, and all other forms of leases except mineral exploration and development. The land use plan was never completed, and the freeze remained in effect until 2020, when by request from the CRDN, the ENV “unfroze” dispositions for traditional resource use cabins. The remainder of land dispositions remain “frozen” (Happ 2021). Available provincial data for cabins included home addresses but did not include locations of cabins in the RSA.

Four sources of information provided cabin locations in the LSA (i.e., wildfire maps, trapper’s workshop, CRDN’s IKTLU Study, and the noise receptor mapping). A map dated 22 July 2020 from the SPSA (2020a) displaying remote structures (e.g., homes, lodges, cabins) shows three cabin sites in the LSA: one on Forrest Lake, one on Beet Lake, and one west of Highway 955 near Vermeersch Lake. The first two are understood to be outfitters’ cabins (Section 17.3.4), and the latter was verified to be a resource user’s cabin (2021 trapper’s workshop). It should be noted that the presence of resource user cabins may not be known to the Provincial agencies depending on whether owners apply for leases. As of 2020, resource user cabin leases may be acquired from the Province provided they meet one of two conditions: a commercial fishing operator may apply for a cabin lease on their licensed lake or a licensed N-19 trapping block trapper may apply for a cabin lease within N-9 (Happ 2021).

The 2021 trapper’s workshop also provided the location of an additional historical cabin site northeast of Patterson Lake. The CRDN supplied locations of five additional cabins (past, current and future planned) in the LSA in Figure 2 of their IKTLU Study (TSD V.1: CRDN): one cabin on the south arm of Patterson Lake near Highway 955, two cabins on the north arm of Patterson Lake, and two cabins on Forrest Lake. The status of these cabins, whether historical, current, or planned for the future, was not available, and these locations could not be validated when cross-referenced with three other sources of information. The CRDN have commented that they are concerned about the growing number of non-Indigenous users moving into lake areas and building recreational cabins in "longstanding family spaces, without the prior knowledge or agreement of the community or CRDN families already there" (TSD V.2: CRDN).

An additional source of information for cabin identification was the noise receptor map (Section 7.3.2, Component Methods, Figure 7.3-2), which documents additional resource cabins at the east end of Gedak Lake at its outlet and the east side of Naomi Lake. The CRDN referred to Gedak Lake as "an Elders Camp" (TSD V.2: CRDN). The noise receptor map also shows three historical cabin and camp sites on the Patterson Lake peninsula and on the shores of Beet and Forrest lakes.

In summary, the LSA contains two outfitting lodge/cabin sites (i.e., one each on Forrest Lake and Beet Lake), and three resource user cabins (i.e., one each on the east side of Highway 955 near Vermeersch Lake, at the east end of Gedak Lake, and at the east end of Naomi Lake). Historical cabin or camp sites have been documented on the northeast shore of Patterson Lake, on the Patterson Lake peninsula, at the east end of Beet Lake, and on Forrest Lake. Additional sites other than the Gedak Lake camp were provided by CRDN (TSD V.2: CRDN) but could not be validated against other information sources. The CRDN reported that they were in the process of verifying the location of cabins and camps, which would be updated as available (TSD V.2: CRDN).

17.3.6 Parks and Protected Areas

Parks and protected areas include provincial parks, Canadian heritage rivers, national historic sites, and wildlife refuges. The RSA contains all or portions of the Clearwater River Provincial Park, the Clearwater River Canadian Heritage River, the Methye Portage Historic Trail, and the Preston Lake Wildlife Refuge (Figure 17.3-3). There are no parks or protected areas located in the LSA.

17.3.6.1 Provincial Parks

In the RSA, Clearwater River Provincial Park is located approximately 60 km northeast of La Loche on Highway 955 (Figure 17.3-3). The park is accessed just north of the bridge over the Clearwater River near the Warner Rapids, known as the Warner Rapids bridge. The park spans 200,000 ha and is classified as a wilderness site, meaning that amenities are limited to tenting sites, primitive (i.e., no amenities) sites, and non-electric sites (Tourism Saskatchewan 2021c). Park uses include activities such as birding, wildlife viewing, hiking, canoeing, and fishing. Because of the remoteness of the park and the expertise required to navigate the high difficulty ranked (i.e., class II to IV) rapids, it is recommended by Saskatchewan Parks that only experienced canoeists use the river system.

17.3.6.2 Canadian Heritage River

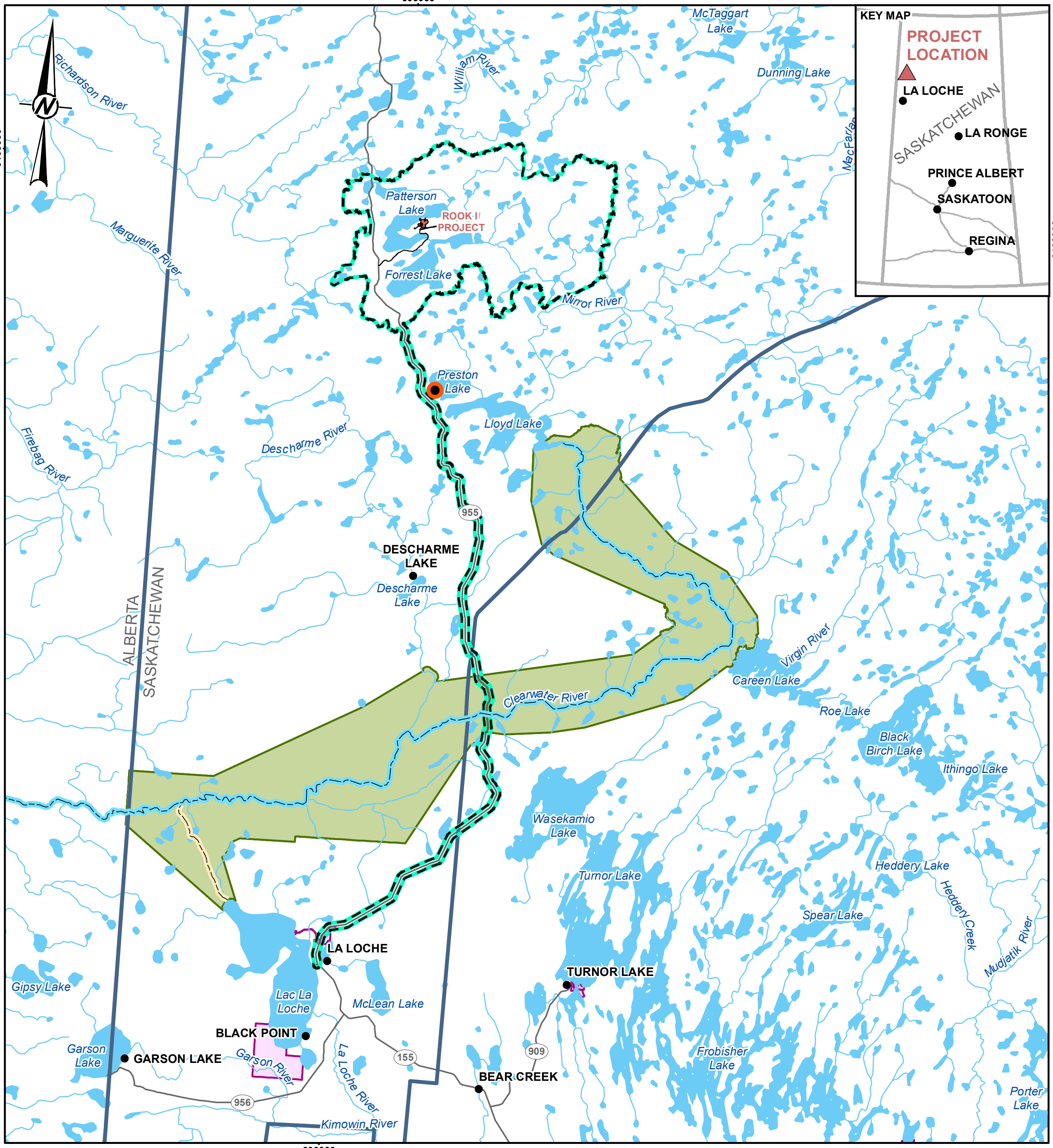
The Canadian Heritage Rivers System is Canada's national river conservation program and gives national recognition of outstanding rivers and encourages the long-term management of these rivers to conserve their natural, cultural, and recreational values. Designated in 1987, the portion of the Clearwater River in Saskatchewan, recognized for its cultural heritage dating back over 6,000 years, has been designated as part of the Canadian Heritage River Systems (CHRS 2021). The Clearwater River natural heritage values include two distinct geological areas: the Precambrian Shield in the upper portion of the river and the Interior Plains downstream. Its cultural heritage stems from a travel route for Indigenous Peoples. The Methye Portage is an approximately 20 km historical trail that spans the plateau linking the Churchill and Arctic watersheds. The Clearwater River's recreational heritage provides visitors with an extended wilderness canoe and camping experience. The Saskatchewan portion of the river falls within the Clearwater River Provincial Park, while the Clearwater River committee provides leadership for the designation in Alberta (CHRS 2017).

17.3.6.3 National Historic Site

Over 970 national historic sites commemorate unique Canadian history and culture coast to coast. Sites include sacred spaces, archaeological sites, battlefields, heritage houses, and historical districts (Parks Canada 2021a). In the RSA, the Methye Portage Historic Trail, also known as Portage La Loche, is located within the Clearwater River Provincial Park boundary and was designated a national historic site in 1933 (Parks Canada 2021b). Known for thousands of years prior, the Dene First Nations Peoples showed the route to explorer Peter Pond in 1778 (Tourism Saskatchewan 2021d). Spanning over 20 km, this trail links the east with the Athabascan and McKenzie watersheds and was the first overland trade route to the northwest (Tourism Saskatchewan 2021d). The trail is accessed by boat at the end of Wallis Bay on Lac La Loche and ends at the Clearwater River.

17.3.6.4 Wildlife Refuge

The Wildlife Management Zones and Special Areas Boundaries Regulations, 1990, define wildlife refuges as areas for protecting, propagating, managing, controlling, regulating, or enhancing wildlife or its habitat (W-13.1 Reg 45). Generally, wildlife refuges are situated where migratory bird colonies are of importance to the Province (Lees 2018). These refuges are protected areas in which no hunting is permitted and any development requires additional permits. In the RSA, there is a wildlife refuge located on a small island on Preston Lake. Like provincial parks, wildlife refuges are not required to abide by the same regulations as WMZs and have their own set of management considerations as a protected area. The refuge at on Preston Lake protects a pelican colony during its nesting and rearing period (Sidle et al. 1984). As per The Wildlife Amendment Regulations, 2018, people are prohibited from being within 100 m of this refuge between 15 April and 15 September annually. Traditional land use dispositions (i.e., either leases or permits) are not issued within a 5 km buffer around this wildlife refuge (Happ 2020).



LEGEND

- POPULATED PLACE
- PRESTON LAKE WILDLIFE REFUGE
- CANADIAN HERITAGE RIVER
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROPOSED PROJECT FOOTPRINT
- METHYE PORTAGE HISTORIC TRAIL
- OTHER LAND AND RESOURCE USE LOCAL STUDY AREA
- OTHER LAND AND RESOURCE USE REGIONAL STUDY AREA
- WILDLIFE REFUGE

0 30 60
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REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

PARKS AND PROTECTED AREAS

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
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CHECK	JO	2023-02-09	FIGURE 17.3-3	
REVIEW	KG	2023-02-09		

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17.3.7 Forestry and Wildfire Protection

This subsection discusses two topics: forestry and wildfire protection. Forests cover more than half (i.e., 34.3 million ha) of Saskatchewan, and almost one third of these forests are commercially viable (i.e., 11.7 million ha; Government of Saskatchewan 2021h). About 5.3 million ha of forested areas are considered productive enough for timber harvest, making forestry an important industry in the province. Wildfire protection is necessary in Saskatchewan due to the active wildfire regime and average of 435 fires per year in provincial forests (SPSA 2020b).

17.3.7.1 Forestry

The Forest Resources Management Regulations of Saskatchewan define forest operations as the harvesting, use, renewal, or maintenance of a forest product, and includes all related activities.

The RSA is north of the commercial forest zone; commercial forestry activity is not conducted in the LSA or RSA.

17.3.7.2 Wildfire Protection

Wildfires are unplanned fires that burn organic soil, grasses, shrubs, trees, and associated vegetative fuels (Provincial Auditor of Saskatchewan 2021). Wildfires can play a natural and beneficial role on the boreal landscape. When they do occur, wildfires can affect land use patterns for hunting, fishing, and trapping and burn cabins. The SPSA is responsible for the prevention, detection, control, suppression, and investigation of wildfires in Saskatchewan's wildfire management areas, including provincial forests (Provincial Auditor of Saskatchewan 2021). In the event of a wildfire, the SPSA assesses how to best manage the situation using a hierarchy of priority for "values-at-risk" including:

- human life;
- communities and major public industry and infrastructure;
- commercial forest; and
- other values (Dallyn 2012).

Given that there are valuable assets in areas where wildfire may occur, wildfire must be effectively managed to protect life and property. The decision to suppress (i.e., fight) a fire is made by assessing each wildfire and making decisions about how to manage it (Tymstra et al. 2020).

When there are structural values-at-risk that require wildfire protection, several strategies are used. For larger facilities, such as mine sites and similar facilities, facility workers would be trained to respond to immediate wildfire threats, and equipment to fight wildfires would be kept on site. Effective March 2015, *The Wildfire Act* (s.20) requires industrial and commercial operators operating during the wildfire season to submit wildfire prevention and preparedness plans.

Based on wildfire prevention and preparedness plans submitted, the SPSA stores information about values-at-risk in its Wildfire Management Database. Temporary values-at-risk include forestry, tree planting, and mining exploration work camps. Permanent values-at-risk include the name and location of communities, major public and industrial infrastructure, commercial timber, structures, natural resources, commercial industrial operations, cottages, and cabins (Provincial Auditor of Saskatchewan 2021).

The SPSA incorporated the ENV's Wildfire Management Branch and the Ministry of Government Relations' Emergency Management and Fire Safety in January 2019. The SPSA has fire bases, located in La Loche and

Buffalo Narrows with a Response Centre in Buffalo Narrows that oversees the Buffalo Narrows Protection Area where the Project is located. Emergency Services Officers and Protection Officers are responsible for communicating risk information concerning communities and commercial operators (SPSA n.d.). Wildfire response depends on the values-at-risk and an area that might benefit ecologically from a fire. In these areas, consideration is given to fighting fires based on a careful assessment of the values present (Dallyn 2012; Saskadapt 2021).

The CRDN are concerned that the Province's fire management approach leaves their homelands vulnerable to fire and note that their "cabins are … not protected in the event of fire" (TSD V.1: CRDN). Both the BRDN (and MN-S also stated that the fire management approach has led to cabin losses (TSD III: BRDN; TSD IV: MN-S). In addition to the loss of cabins, the CRDN and BNDN have reported that increasing wildfires in recent years has led to decreases in wildlife populations across their traditional lands in northern Saskatchewan and resulted in a loss of hunting and trapping opportunities in the long term (TSD V.1: CRDN; TSD II: BNDN).

As mentioned in Section 17.3.5, the presence of resource user cabins may not be known to the SPSA depending on whether owners apply for leases.

Fires have played a dominant role structuring landscape patterns because they account for the vast majority of the area burned within the region (Kansas et al. 2016; Skatter et al. 2017). Scientific predictions suggest that wildfire will become both more severe and frequent by the end of this century (Saskadapt 2021). Overall, the area burned in Canadian forests has increased over the past several decades because of several factors, including climate change (Gillett et al. 2004; Girardin et al. 2013). This prediction has already been observed by CRDN and BNDN members who report that fires are more frequent, tend to be bigger, and burn hotter than in earlier times (TSD II: BNDN; TSD V.1: CRDN; TSD V.2: CRDN). The MN-S and BRDN have also commented on the effects of climate change in general on the land and resources (TSD III: BRDN; TSD IV: MN-S).

17.3.8 Mining and Exploration

Under *The Crown Minerals Act*, mineral exploration is allowed on granted mineral Crown dispositions and mineral extraction is granted under Crown leases. The Project includes 32 contiguous mineral rights claims covering a total area of 35,065 ha as of 1 January 2023. These claims are part of the NexGen's larger SW2 mineral claim package comprised of 61 contiguous mineral rights claims totalling 84,651 ha (Figure 17.3-4).

The Project is located on provincial Crown Land; as the owner, the Province of Saskatchewan can grant surface rights under the authority of the *Forest Resources Management Act* and the *Provincial Lands Act*. Granting surface rights for the purpose of accessing the land to extract minerals is done by issuing a mineral surface lease subject to the Crown Resource Land Regulations. Mineral surface leases have a 33-year maximum term which may be extended, as necessary.

NexGen does not currently hold surface rights of the Project site. Surface rights are obtained after the ministerial review and approval of the EA, and the successful negotiation of a mineral surface lease agreement with the Province of Saskatchewan.

About 92 mineral dispositions have been granted to 12 companies that are within or partially overlap the LSA (Figure 17.3-4; Table 17.3-5); all 92 mineral dispositions in the LSA are considered active. Although mineral dispositions are continuous in the area, they do not necessarily lead to the development of the resource because of the many factors that come into consideration (e.g., resource geology, environment, technical and economic feasibility, markets). Currently, of the active mineral dispositions (Table 17.3-5) and in addition to the proposed

Project, only the Fission Patterson Lake South Property is in advanced exploration and proposed for development.

Table 17.3-5: Active Mineral Dispositions within or Partially within the Local Study Area

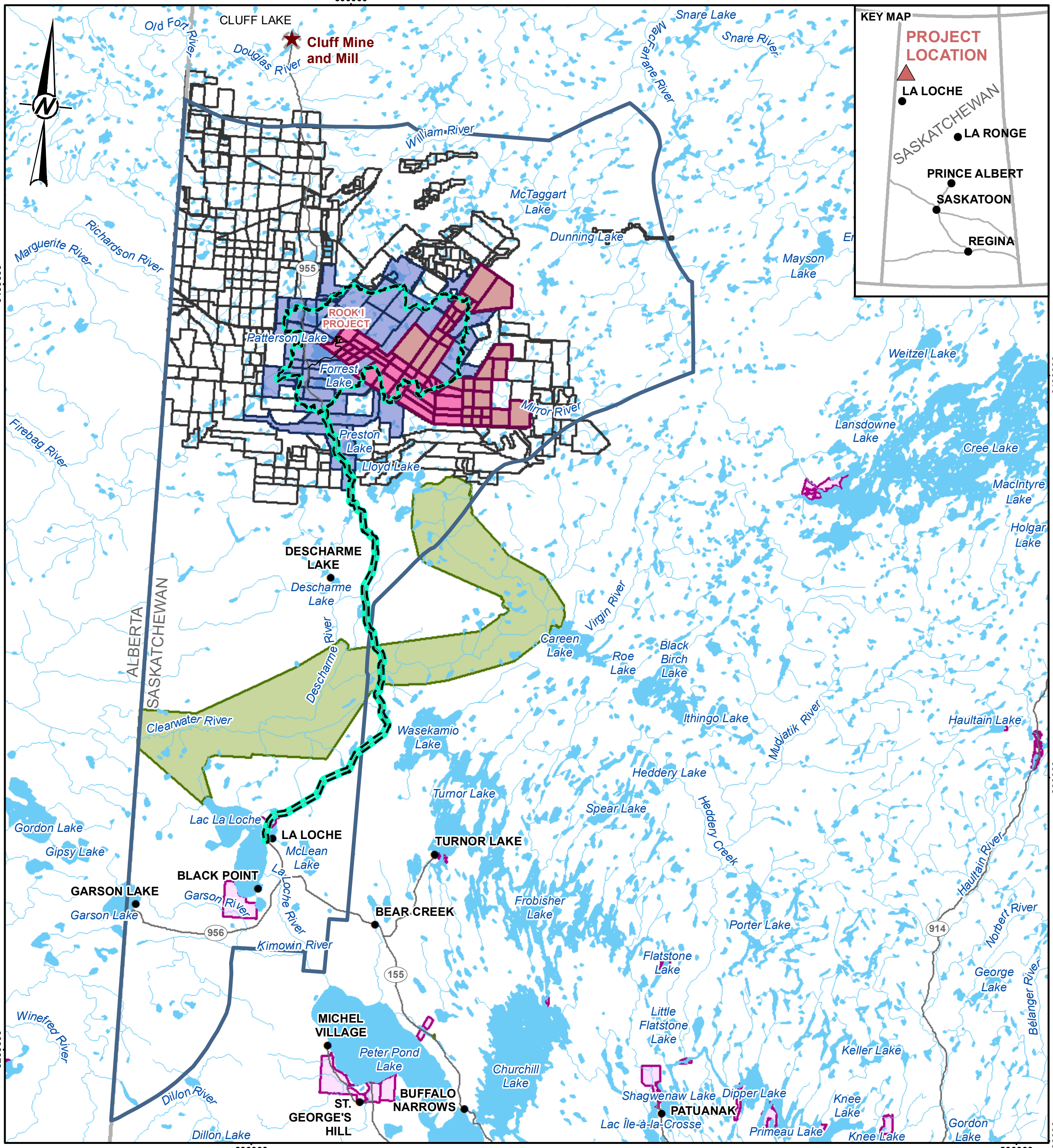
Owner	Number of Parcels
Canalaska Uranium Ltd.	2
Clean Commodities Corp.	4
Dale Resources; T. Young; M. Lederhouse; Matthew J. Mason	1
Denison Mines Corp.	5
Fission 3.0 Corp.	11
Fission Uranium Corp.	16
Forum Energy Metals Corp.	1
James Hutton	1
NexGen	38
Orano Canada Inc.	3
Purepoint Uranium Group Inc.; Cameco Corporation; Orano Canada Inc.	9
Radio Fuels Corp.	1
Total	**92**

Source: SKCDC 2021.

There are five uranium operations located in northern Saskatchewan (Cigar Lake, Key Lake Mill, McArthur River, McClean Lake, and Rabbit Lake Mine and Mill; CNSC n.d). However, there are no current active mines in the LSA or RSA. Just outside the northern portion of the RSA, the now closed Cluff Lake Mine was operated by AREVA Resources Canada Inc. (now Orano). The mine closed in 2002, was decommissioned, and is in a transitional monitoring phase, after which the Province will take responsibility for the site (Hiyate 2020). The exact date this mine will transfer to the Province is not known.

Local exploration activities on Patterson Lake have affected local resource users. In reference to drilling and exploration camps located on both the Patterson Lake peninsula (NexGen) and west shore (Fission), exploration activities occurring as early as 2014 caused CRDN members to be "much taken aback by the increased intensity of exploration activities in the Patterson Lake area (i.e., helicopter and airplane surveys and drilling camps). The drilling barges operating on Patterson Lake were shocking and particularly disturbing" (TSD V.1: CRDN). The CRDN have commented about changes to the landscape that was previously unspoiled by human activity, clean and peaceful, which is now reported to be "all cut up and fragmented" (TSD V.2: CRDN). The CRDN report that the exploration activity has already "displaced CRDN members from a long-standing intensively utilized harvesting corridor and area, which includes trails and water routes, staging areas, and ancestral family use locales, cabins and camps" (TSD V.1: CRDN). The BNDN also discussed exploration activities that led to "too many roads and lots of activity going on" and that increased human activity and traffic along Highway 955 from mineral exploration in the Patterson Lake area have affected access to hunting and fishing areas (TSD II: BNDN). These comments show that Indigenous Groups have concerns with the level of exploration activity in the Patterson Lake area.

The Project Description for the Project was accepted 16 April 2019. Fission has recently entered the formal regulatory application process with the submission of its Project Description (Fission 2021b) to ENV and issuance of a ministerial determination on 13 December 2021 that an environmental impact assessment is required.



LEGEND

- CLUFF LAKE MINE
- POPULATED PLACE
- URANIUM MINING FACILITY (DECOMMISSIONED)
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROPOSED PROJECT FOOTPRINT
- OTHER LAND AND RESOURCE USE LOCAL STUDY AREA
- OTHER LAND AND RESOURCE USE REGIONAL STUDY AREA
- NEXGEN ROOK I PROPERTY MINERAL DISPOSITIONS
- OTHER NEXGEN MINERAL DISPOSITIONS
- OTHER MINERAL DISPOSITIONS OVERLAPPING THE LOCAL STUDY AREA
- MINERAL DISPOSITIONS

0 40 80

1:1,480,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021 AND UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

ACTIVE MINERAL DISPOSITIONS WITHIN OR PARTIALLY WITHIN THE LOCAL STUDY AREA

CONSULTANT

wsp

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17.4 Project Interactions and Mitigations

The pathways analysis identified potential adverse effects of the Project on other land and resource use, identified practicable mitigation for these potential effects, and determined whether potential effects could be sufficiently mitigated such that they are not expected to cause a residual adverse effect. As described in Section 17.2.7, Project Interactions and Mitigations, the pathways analysis assigned each potential effect as:

- no pathway (i.e., mitigation results in no effect on other land and resource use);
- secondary pathway (i.e., mitigation results in a negligible effect on other land and resource use); or
- primary pathway (i.e., effect that is greater than negligible and carried forward for further assessment).

The pathway analysis is summarized in Table 17.4-1. The subsections following the table provide the rationale used to assign potential effects to the no pathway and secondary pathway categories and list primary pathways. Each Project interaction identified as a primary pathway was carried forward for detailed assessment in Section 17.4.3. Effects pathways apply to all Project phases unless otherwise noted.

Note that the mitigation measures are intended to address Indigenous and non-Indigenous land users and recognize there is considerable overlap between the two. The intent is to accommodate all, and not exclude any individuals, involved in other land and resource use. It is acknowledged that many mitigation measures outlined below (e.g., grievance mechanisms) would also overlap with mitigation measures presented in the Section 16. This approach is intended to collectively address all land users, both Indigenous and non-Indigenous, across these two sections.

The environmental design features and mitigation in Table 17.4-1 represent the list of key actions used to inform the pathway analysis as part of preparing the EIS. In addition to this list of key actions, NexGen would implement the Environmental Protection Program, which would describe the processes required to monitor and characterize emissions from Project facilities and activities. This program would be used to periodically evaluate mitigation performance and identify additional mitigation, where required, and prompt potential adaptive management measures (Section 17.8). This program would include provisions for unrestricted, independent Indigenous environmental monitoring by each of the four primary Indigenous Groups (Section 2). Where relevant, adaptive management measures may also be proposed to address uncertainties associated with effects predictions and mitigation. The process for determining when, how, and where to use adaptive management would be described within the Integrated Management System Manual.

Potential accidents and malfunctions that have the capability of influencing biophysical or human environments are assessed in Section 21, Accidents and Malfunctions.

Table 17.4-1: Potential Effects Pathways for Other Land and Resource Use

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
OLU-01	Project components or activities that contribute to the Project footprint during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ process plant ▪ handling and storage of waste rock, special waste rock, and ore ▪ STP and water storage and effluent monitoring ponds ▪ additional infrastructure (e.g., roads, airstrip, camp, maintenance shop, offices) ▪ access road upgrade ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ transportation of personnel and materials to and from the site	**<u>Access to and area available for land and resource use:</u>** ▪ Presence of Project infrastructure and activities could restrict access and reduce area available for or displace other land and resource users.	▪ **Limit the Project footprint** to the extent practical using practices such as: ○ optimizing the use of cleared areas for Project activity ○ using existing access road infrastructure, including existing bridge crossing ○ storing tailings underground ○ designing an efficient infrastructure footprint (i.e., buildings clustered together) ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ **Reclaim and revegetate areas** where non-permanent Project facilities have been decommissioned ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** ▪ Implement a **Security Program** to provide safe and coordinated access via the access road to locations where other land and resource use is practiced ▪ Develop a **Ground Transportation Emergency Response Plan** to address traffic safety on the access road, including education of workers (e.g., staff contractors) ▪ Implement **Indigenous and Public Engagement Program** to share information on Project plans and activities ▪ Establish a **Project feedback and grievance mechanism** to record and action issues identified by LPA residents (or other members of the public) ▪ Implement **Benefit Agreements**	Primary pathway
OLU-02	Project components or activities that contribute to the Project footprint, air and dust emissions and deposition, sensory disturbance (e.g., noise, lights), and presence of workforce during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ process plant and underground operations ▪ handling and storage of waste rock, special waste rock, and ore ▪ power generation ▪ ETP and treated effluent discharge ▪ STP and water storage and effluent monitoring ponds ▪ water intakes for potable and process water ▪ additional infrastructure (e.g., camp, maintenance shop, and offices) ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ transportation of personnel and materials to and from the site ▪ site and highway traffic	**<u>Quality of resource use experience:</u>** ▪ Sensory disturbances, changes to aesthetics, and safety concerns could change the quality of the resource use experience for other land and resource users in the area surrounding the Project. Similarly, perceptions of effects on the quality of the fish and wildlife resources may adversely affect the quality of the experience and/or result in certain areas being avoided. Knowledge of the decommissioned site may change the perceived suitability of the area for other land and resource use in the future.	▪ Implement mitigations **that avoid and limit effects on fish** (Section 11.4, Project Interactions and Mitigations), **vegetation** (Section 13.4, Project Interactions and Mitigations), **and wildlife** (Section 14.4, Project Interactions and Mitigations) ▪ **Enclose or dampen equipment in process buildings** where the total sound level is expected to be more than approximately 80 A-weighted[(a)] decibels, where feasible ▪ **Use noise suppression (mufflers) on vehicles** and inspect regularly to make sure they are functioning properly ▪ **Limit light pollution** to the extent practicable for built infrastructure ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ **Reclaim and revegetate areas** where non-permanent Project facilities have been decommissioned ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** ▪ **Apply water and/or suppressants to site roads, access road, and airstrip,** as necessary. Use dust suppressants that minimize environmental risk and are government approved for use ▪ **Limit vehicle speed** on unpaved site roads to reduce fugitive dust during Construction and Operations ▪ Work with local Indigenous Groups and communities to **develop fishing policies** that consider both fisheries protection and traditional use activities ▪ Implement an **Environmental Monitoring Plan** that includes monitoring ambient air and water quality and applying adaptive management, if necessary ▪ Implement a Project-specific **Waste Management Program** ▪ Implement **Radiation Protection Program** to monitor and keep worker and visitor radiological exposures as low as reasonably achievable ▪ Implement a Project-specific **Environmental Monitoring Plan** ▪ Implement a Project-specific **Effluent and Emissions Plan** ▪ Implement **Indigenous and Public Engagement Program** that includes, among other activities, sharing monitoring results with local communities, engagement of trappers and Indigenous land users to share Project information and address any issues as they arise, and sharing of environmental monitoring results with local communities ▪ Implement a **Security Program** to provide safe and coordinated access via the access road to locations where other land and resource use is practiced ▪ Develop a **Ground Transportation Emergency Response Plan** to address traffic safety on the access road, including education of workers (e.g., staff contractors) ▪ Establish a **Project feedback and grievance mechanism** to record and action issues identified by LPA residents (or other members of the public) ▪ Implement **Benefit Agreements** ▪ Develop a **Ground Transportation Emergency Response Plan** to mitigate safety risks related to the transportation of materials and equipment to and from the Project site ▪ Develop an **Emergency Response Assistance Plan** for the transportation of uranium concentrate from the Project site	Primary pathway

Table 17.4-1: Potential Effects Pathways for Other Land and Resource Use

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
OLU-03	Project components or activities that contribute to the Project footprint, air and dust emissions and deposition, sensory disturbance (e.g., noise, lights), and the presence of a workforce during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft ▪ site traffic ▪ transportation of personnel and materials to and from the site ▪ power generation ▪ process plant ▪ handling and storage of waste rock, special waste rock, and ore ▪ additional infrastructure (e.g., camp, maintenance shop, and offices) ▪ water intakes for potable and process water ▪ ETP and treated effluent discharge ▪ STP and water storage and effluent monitoring ponds ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure	<u>**Availability of wildlife and fish:**</u> ▪ Project footprint and activities may alter the availability of wildlife and fish, thus reducing or displacing opportunities for other land and resource use.	▪ **Limit the Project footprint** to the extent practical using practices such as: ○ optimizing the use of cleared areas for Project activity ○ using existing road infrastructure, including existing access road and bridge crossing ○ storing tailings underground ○ designing an efficient infrastructure footprint (i.e., buildings clustered together) ▪ Implement mitigations that **avoid and limit effects on fish and wildlife** (Section 11.4, Section 14.4) ▪ Implement a Project-specific **Environmental Monitoring Plan** ▪ Implement a Project-specific **Effluent and Emissions Plan** ▪ Implement **Indigenous and Public Engagement Program** to share information on Project plans and activities ▪ Implement a **Security Program** to provide safe and coordinated access via the access road to locations where other land and resource use is practiced ▪ Establish a **Project feedback and grievance mechanism** to record and action issues identified by LPA residents (or other members of the public) ▪ Implement **Benefit Agreements** ▪ Implement a Project-specific **Environmental Protection Program**. ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan**	Secondary pathway
OLU-04	Project components or activities that contribute to contaminant air criteria and dust emissions and deposition, and treated effluent release during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ process plant and underground operations ▪ underground tailings management facility ▪ handling and storage of waste rock, special waste rock, and ore ▪ power generation ▪ ETP and treated effluent discharge ▪ STP and water storage and effluent monitoring ponds ▪ additional infrastructure (e.g., camp, maintenance shop, and offices) ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ site traffic ▪ transportation of personnel and materials to and from the site	<u>**Changes to air or water quality:**</u> ▪ Changes to air or water quality may result in actual contamination of fish and wildlife and discourage other land and resource uses in proximity to the Project. ▪ Changes to air or water quality may result in actual changes to human health, discouraging other land and resource uses in proximity to the Project. ▪ Does not include perceived changes as addressed in pathway OLU-02, quality of resource use experience.	▪ Implement **mitigations that avoid and limit effects** on fish (Section 11.4), vegetation (Section 13.4), and wildlife (Section 14.4) ▪ **Reclaim and revegetate areas** where non-permanent Project facilities have been decommissioned ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** ▪ Implement an **Environmental Monitoring Plan** that includes monitoring ambient air and water quality and applying adaptive management, if necessary ▪ Implement a Project-specific **Waste Management Program** ▪ Implement **Radiation Protection Program** to monitor and keep worker and visitor radiological exposures as low as reasonably achievable ▪ Implement a Project-specific **Environmental Monitoring Plan** ▪ Implement a Project-specific **Effluent and Emissions Plan** ▪ Implement **Indigenous and Public Engagement Program** that includes, among other activities, sharing monitoring results with local communities, engagement of trappers and Indigenous land users to share Project information and address any issues as they arise, and sharing of environmental monitoring results with local communities ▪ Establish a **Project feedback and grievance mechanism** to record and action issues identified by LPA residents (or other members of the public) ▪ Implement **Benefit Agreements**	No pathway
OLU-05	Project components/activities that have potential to alter the timing and thickness of ice formation and timing of ice thaw in localized area of the Patterson Lake North Arm – West Basin during **all Project phases**: ▪ effluent treatment plant and treated effluent discharge	<u>**Safety risk from altered ice conditions:**</u> ▪ Treated water discharged through the diffuser may change timing and thickness of ice formation and timing of ice thaw, which could increase risk of people breaking through the ice.	▪ The final effluent treatment plant diffuser design would avoid effects to ice cover	No pathway

Bolded text represents the key topic of the environmental design features and mitigation.
(a) A-weighted decibels are an expression of the relative loudness of sounds in air as perceived by the human ear.
ETP = effluent treatment plant; STP = sewage treatment plant; BNDN = Birch Narrows Dene Narrows; BRDN = Buffalo River Dene Nation; CRDN = Clearwater River Dene Nation; MN-S = Métis Nation – Saskatchewan; NR2 = Northern Region 2; LPA = local priority area.

17.4.1 No Pathways

The following Project interactions were predicted to result in no pathway to other land and resource use and were not carried forward in the assessment.

OLU-04: Changes to air and water quality:

- Changes to air or water quality may result in actual contamination of fish and wildlife and discourage other land and resource uses in proximity to the Project.
- Changes to air or water quality may result in actual changes to human health, discouraging other land and resource uses in proximity to the Project.

This pathway has been addressed through intermediate components and VCs (Section 7.2, Air Quality; Section 10, Surface Water Quality and Sediment Quality; Section 11, Fish and Fish Habitat; Section 13, Vegetation; Section 14, Wildlife and Wildlife Habitat) and the environmental risk assessment (TSD XXI, Environmental Risk Assessment) by predicting changes to several ecological receptors, of which lake whitefish, northern pike, moose, and spruce grouse are of relevance to other land and resource users. This pathway focuses on the health of the resources relied on by resource users (e.g., fish, moose) due to potential physical and chemical changes to air and water quality, and the potential for actual contamination to discourage land use. Perceived changes in resource quality are separately addressed in quality of resource use experience (pathway OLU-02, Section 17.4.3).

Activities such as land clearing, site preparation, construction of facilities, site traffic, handling of waste rock during Construction and Operations, and removal of infrastructure and revegetation during Closure would generate fugitive dust (Section 7.2). Accumulation of airborne dust produced from the Project could result in local and direct changes to vegetation (Section 13.4), which could affect wildlife habitat. Metals and radionuclides in dust could also affect plants, either indirectly through the soil (Section 12.4.2, Secondary Pathways) or directly through the surface of the plant (Section 13.4), which could change wildlife. In addition, participants of the 2021 trapper's workshop and LPA community members commented on the potential Project effects on water quality, fish, and wildlife in the area of the Project.

An ecological risk assessment was completed to determine the health risks to aquatic and terrestrial wildlife receptors from the Project air emissions, which included inhalation and ingestion (i.e., soil, sediment, water, plants, animals) exposure pathways. The risk assessment modelled exposure pathways during Operations and an upper bound scenario (i.e., a more conservative, precautionary model). Results indicated that predicted levels of metals and radionuclides in the environment from the proposed Project for the upper bound scenario would not cause adverse effects on the health of wildlife VCs and other wildlife receptors (TSD XXI).

Following Project Closure, runoff and seepage from the WRSAs and groundwater flow from the underground tailings management facility could alter surface water quality in Patterson Lake and adversely affect the health, survival, and reproduction of wildlife. Proven engineered designs would be applied to the proposed Project to limit runoff and seepage from WRSAs such as installing covers on the WRSAs at Closure. During Operations, potentially acid generating waste rock would be separated from non-potentially acid generating waste rock, and special waste rock would also be stored separately. The special waste rock stockpile and potentially acid generating WRSA would be lined with high density polyethylene to prevent seepage (Mine Waste Management Plan). Engineered paste tailings would be used to permanently store tailings in the underground tailings management facility to control sources of COPCs.

The far-future scenario was assessed using the regional surface water quality model and included an upper bound scenario (Section 10.2.8, Residual Effects Analysis). Most water quality parameters remained below their respective threshold values in the far-future scenario, except for cobalt and copper. In this scenario, cobalt exceedances were predicted for Patterson Lake North Arm – West Basin and Patterson Lake South Arm. Copper exceedances were predicted for Patterson Lake North Arm – West Basin (Section 10.5.1.2, Regional Surface Water Quality Model). For the upper bound scenario, cobalt exceedances were predicted for Patterson Lake North Arm – West Basin, Patterson Lake South Arm, Forrest Lake North Basin, and Beet Lake. Copper exceedances in the upper bound scenario were predicted for Patterson Lake North Arm – West Basin and Patterson Lake South Arm (Section 10.5.2.1, Regional Surface Water Quality Model).

The ecological risk assessment applied the modelled concentrations of water quality constituents as input values for exposure pathways associated with the ingestion of sediment, water, plants, and animals to determine the health risks to ecological receptors for the far-future and upper bound scenarios. The ecological risk assessment predicted that changes in surface water quality for the upper bound scenario would not cause adverse effects on the health of ecological receptors (TSD XXI).

Regarding fish, the results of the risk assessment indicated that direct toxicity from exposure to elevated copper concentrations cannot be ruled out for selected aquatic receptors (i.e., fish and fish food). An aquatic health assessment was undertaken to further evaluate the potential effects of exposure of aquatic biota in Patterson Lake to elevated copper concentrations (Appendix 11A, Aquatic Health Assessment of the Potential for Adverse Effects of Predicted Far-Future Copper Concentrations in Patterson Lake), focusing on the limited instances where concentrations exceed the minimum receptor-specific threshold of 0.002 mg/L. Predicted concentrations above the low effect threshold may result in potential adverse effects on sensitive aquatic receptors. Therefore, a review of the potential magnitude of effects on sensitive species was undertaken. The results of this analysis indicated that adverse effects on aquatic biota are unlikely to occur because predicted copper concentrations are lower than the lowest low effect concentration for the most sensitive aquatic species.

The environmental risk assessment also considered exposure to radon gas. All predicted radon gas emissions are well below the radiation dose benchmarks for all ecological receptors. Overall, the results indicate that there would be no adverse environmental health effects on terrestrial and aquatic receptors from Project-related air emissions and changes in water quality. Therefore, this pathway was determined to have no measurable effects on the health of the resources used by other land and resource users and was not carried forward in the assessment.

The human health risk assessment (Section 15, Human Health; TSD XXI) considered exposure to radionuclides and non-radionuclides during Operations (i.e., identified as the highest risk period for the Project) due to direct exposure (i.e., breathing or skin contact) or consumption of water and country foods. This pathway focuses on the health of humans. The dose limit for radiation protection from radionuclides is 1 millisieverts per year (mSv/yr). For non-radionuclides constituents of potential concern, a toxicity reference value is used to assess risk. There are no predicted exceedances of the public dose limit of 1 mSv/yr, and there are no exceedances of the toxicity reference values (i.e., hazard quotient less than 0.2) for human receptors for non-radionuclides and non-carcinogens (i.e., copper, cobalt, uranium). No significant adverse effect on any human receptors as a result of releases from the Project is likely during Operations for the Application Case and RFD Case. Therefore, this pathway was determined to have no measurable effects on the health of resource users and was not carried forward in the assessment.

To provide information to land users on any changes to air and water quality, an Indigenous and Public Engagement Program defines activities for sharing environmental monitoring results with local communities and engaging trappers, outfitters, and other land users to share Project information, provide Project updates, and provide two-way communication opportunities to hear and address any issues or concerns (i.e., grievance mechanism). Also, through the Benefit Agreements there would be a commitment by NexGen to fund independent Indigenous Monitors for each of the four primary Indigenous Groups. NexGen would provide required assistance and support to the Indigenous Monitors when on-site.

OLU-05: Safety risk from altered ice conditions:

- Treated water discharged through the diffuser may change timing and thickness of ice formation and timing of ice thaw, which could increase risk of people breaking through the ice.

Treated water from the ETP for the proposed Project would be discharged through a diffuser in the Patterson Lake North Arm – West Basin. Evaluation of the conceptual design suggested that operation of the diffuser is expected to increase the flow velocity at the lake water surface, which could delay ice freeze-up, reduce ice thickness if ice is formed, and advance ice break-up in a localized area around the diffuser. Project-related changes in ice conditions could increase the risk of injury or mortality if any people walking or snowmobiling over this area of Patterson Lake break through the ice. To prevent this risk, the final ETP diffuser design for the Project would avoid changes to ice cover relative to existing conditions; therefore, this pathway was not carried forward in the assessment.

17.4.2 Secondary Pathways

OLU-03: Availability of wildlife and fish:

- Project footprint and activities may alter the availability of wildlife and fish, thus reducing or displacing opportunities for other land and resource use.

The species potentially affected by the Project and relevant to recreational hunting and trapping include moose, black bear, grey wolf, beaver, and American marten. Moose are hunted recreationally by non-Indigenous users. Black bear hunting is conducted through outfitting operations. Commercial trapping focuses on American marten, with grey wolf and beaver trapped infrequently. Changes to the distribution of wildlife would occur through direct removal or alteration of soil and vegetation leading to loss of wildlife habitat; alteration of final terrain and soil conditions that could change the final ecosystems that could be reclaimed on the landscape; and sensory disturbances such as the presence of people, lights, dust, smells, and noise (Section 14.4, Project Interactions and Mitigations). Limiting the possession of firearms to only authorized personnel on site as required by the Nuclear Safety Regulations would prevent hunting by the workforce. The Waste Management Program would be implemented to limit the attraction of wildlife to the Project (Section 14.4).

The wildlife assessment (Section 14) includes the following VC species that are hunted or trapped by resource users in the other land and resource use LSA: moose, black bear, grey wolf, and beaver. American marten was not included as a wildlife VC due to ecological and assessment redundancy with other VCs (Section 14.2.2.1, Valued Components). However, American marten was identified as preferred harvest species and was included in the assessment of other land and resource use. The assessment of effects on the upland ecosystem VC, specifically mature forest, was used to determine potential effects on American marten. While the assessment of Project effects to wildlife considered three measurement indicators for each species, the survival and reproduction indicator was most relevant to the availability of wildlife for harvesting, combined with the overall conclusions of Section 14. Survival and reproduction are tightly associated with habitat availability and distribution (the other two measurement indicators for wildlife). Based on these parameters, the Project is expected to have a negligible effect on the abundance and distribution of each of these species, as summarized below. Refer to Section 14 for the assessment details.

- **Moose:** The proposed Project is not expected to have a measurable effect on moose survival and reproduction. The calculated losses of suitable moose habitat in the RSA, which may affect survival and reproduction rates, represent 815.2 ha (1.0%) in the Application Case relative to the Base Case. These changes are expected to be well within the resilience and adaptive capacity limits of moose, which are habitat generalists and capable of utilizing a variety of land cover types. Based on a home range size of 97 km^2 (9,700 ha), the estimated loss of 815.2 ha of low, moderate, and high suitability moose habitat comprises less than one moose home range. Habitat loss caused by the Project is expected to have a negligible effect on the abundance and distribution of moose. Although moose are expected to avoid areas associated with high levels of human presence and noise (i.e., area around Patterson Lake), this avoidance is unlikely to influence survival or reproduction because suitable habitat outside of the wildlife LSA remains abundant and well connected and distributed across the wildlife RSA.
- **Black bear**: The proposed Project is not expected to have a measurable effect on black bear survival and reproduction. Sensory disturbance may affect reproductive success and survival of some individuals in close proximity to the Project as a result of denning site abandonment, early emergence from hibernation, or avoidance of areas near the Project. However, these effects are not expected due to mitigation and presence of poor-quality denning habitat under existing conditions. The calculated losses of black bear habitat in the wildlife RSA in the Application Case would be 946.8 ha (1.1%) and 911.0 ha (1.0%) of available low, moderate, and high suitability spring and fall habitat, respectively. These changes are expected to be well within the resilience and adaptive capacity limits of black bears. Using a home range size of 79.8 km^2 (7,980 ha), the estimated losses of suitable spring and fall habitat is unlikely to affect more than one individual. The anticipated loss of suitable habitat is not predicted to influence black bear survival or reproduction because suitable habitat remains abundant and well connected and distributed across the wildlife RSA. As habitat availability is not limiting, black bears would be expected to shift or alter their home ranges to exclude areas of high disturbance or use these areas less frequently when human activity levels are higher.
- **Grey wolf:** The proposed Project is not expected to have a measurable effect on grey wolf survival and reproduction. A total of 946.8 ha (1.1%) and 846.2 ha (1.2%) of available low, moderate, and high suitability habitat would be lost in the wildlife RSA in the Application Case during the snow-free period and winter, respectively. Grey wolves are highly adaptive and expected to be resilient to the small Project-related changes in availability and distribution of habitat. A change in prey availability could affect grey wolf survival and reproduction. However, large or significant changes to moose or beaver (i.e., two important prey species) abundance and distribution are not predicted. Reproductive output and survival could decrease if wolves are forced to occupy marginal or lower suitability habitat. Conservatively assuming that the entire maximum disturbance area (980.8 ha) becomes unsuitable for grey wolves, the loss of habitat would remove approximately 1.5% (981 ha of 66,000 ha) of a core wolf home range. Project-related losses to available grey wolf habitat are not expected to result in effects on the abundance and distribution of grey wolves.
- **Beaver:** Changes to beaver survival, reproduction, and abundance because of alterations to the amount, distribution, and connectivity of habitats are expected to be small because there is limited availability of suitable beaver habitat in the wildlife LSA under existing conditions. The Project would largely alter poor suitability habitat. Beavers are also relatively tolerant of sensory disturbance associated with human and

infrastructure presence. Changes to the local and regional distribution of habitats would be small and highly localized and beaver habitat should remain well connected through existing wetlands, waterbodies, and watercourses. Loss of all suitable available habitat (36.2 ha) represents about 4 home ranges and loss of available high and moderate suitability habitat (7.4 ha) represents less than one annual home range for beavers in the boreal region. Habitat loss is unlikely to have a measurable effect on the beaver population in the RSA. Habitat is not considered limiting for beavers; they can utilize different types of landscapes because they can engineer their environment. Specifically, beavers can build dams to increase the suitability of habitats.

- **American marten**: Although American Marten was not an identified as a wildlife VC, changes to the upland ecosystem VC is representative of marten habitat (Section 14.2.2.1 Valued Components; Table 14.2-1). Suitable habitat for American marten in the vegetation RSA is represented by landcover types associated with mature upland deciduous, coniferous, and mixed deciduous-coniferous ecosites, which were defined in the vegetation assessment (Section 13.2.6.1.1, Upland Ecosystem Mapping; Table 13.2-3). Subsequently, changes in the availability of mature upland ecosites from the proposed Project (Section 13.5.1, Upland Ecosystems) were used to determine the residual effects from changes in the availability and distribution of suitable habitat on American marten. The Project is expected to result in a loss of 112.1 ha of suitable habitat for American marten, representing 0.6% of the total available suitable habitat in the wildlife RSA. Based on a home range size of 200 ha, the anticipated loss of 112.1 ha of suitable habitat represents approximately 60% of a single American marten home range. A 200 ha home range size is at the low end of the recorded values for home range size in North America (Smith and Schaefer 2002). Compared to the highest value for home range size (i.e., 9,700 ha) recorded in Smith and Shaefer (2002), the 112.1 ha represents 1% of a single home range.

  American marten display life history traits (e.g., high mobility, strong dispersal ability; Buskirk and Rugiero 1994) that provide flexibility to adapt to different types of human development. The Project is not expected to have a measurable effect on American marten survival and reproduction. Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the species' resilience and adaptability limits and result in a negligible change in American marten abundance and distribution.

In total, the Project would remove 981 ha of land (the maximum disturbance area) during Construction, Operations, and the Active Closure Stage for 43 years. Regrowth of mature upland forest habitat, such as that used by American marten, would take longer than 43 years extending from 60 to 80 years after the Active Closure Stage (Section 13.5.1). As part of the Project design, NexGen optimized the use of cleared areas for Project activities by using existing road infrastructure, including the existing bridge crossing; using underground storage for tailings; and designing an efficient infrastructure footprint (i.e., buildings clustered together). Efficient use of land reduces the effect of the Project on other land and resource use. Hunting opportunities by workers on site would be limited by prohibiting firearms or other hunting equipment by unauthorized personnel on site (Nuclear Safety Regulations).

Overall, the Project would have negligible effects on moose and black bear hunting due to a low level of recreational hunting presently occurring in the other land and resource use LSA (Section 17.3.1, Hunting) and a negligible change to the abundance and distribution of these species (Section 14). Low levels of trapping in the Project footprint and negligible effects to species trapped, combined with limited geographical extents of the effect, are expected to limit the effects on trapping to a negligible level. Access to resource harvest locations may change, which is discussed in Section 17.5.1.1, Access to and Area Available for Land and Resource Use.

Overall, the Project would have negligible effects on fishing success in the LSA due to a low level of recreational fishing (Section 17.3.3, Fishing) present and negligible effects on fish and fish habitat. The use of the LSA by recreational fish harvesters has not been confirmed; however, clients of Forest Lake Outfitters fish Patterson Lake and may consume fish. The quality of fish for consumption is discussed in detail in the fish and fish habitat assessment (Section 11) and human health risk assessment (Section 15.9, Key Findings) and fish would remain safe to eat even at high consumption rates.

The Project would require in-lake infrastructure on Patterson Lake, which would include a fresh water intake, treated effluent diffuser, a treated sewage outfall, and associated pipelines (Section 5, Project Description). The installation and operation of in-lake infrastructure would result in either a direct loss or alteration of fish habitat in Patterson Lake, and turbulence from in-lake infrastructure operation may affect fish habitat in Patterson Lake, which could affect the distribution of fish. The in-lake infrastructure is not expected to have a measurable effect on the abundance of northern pike, lake whitefish, walleye, and lake trout (Section 11). The infrastructure footprint is small and would be sited away from sensitive habitat. The Project site entrance would include a gatehouse to limit public access. Potential changes in angler pressure and fish harvest levels in Saskatchewan would continue to be managed by ENV, which is the provincial government agency responsible for managing fisheries resources in the province. With respect to Construction and Operations staff on site, NexGen would gather feedback on whether a no-fishing policy is a desired mitigation to reduce effects on harvested fish populations from increased fishing pressure.

In summary, with the identified mitigation measures, the potential effect on the availability of fish and wildlife for harvesting with respect to other land and resource use is predicted to be negligible, and so this pathway was not carried forward in the assessment.

17.4.3 Primary Pathways

The following Project interactions were predicted to be primary pathways to other land and resource use and were advanced for further assessment of residual effects (Section 17.5, Residual Effects Analysis):

OLU-01: Access to and area available for land and resource use:

- The presence of Project infrastructure could restrict access and reduce area available for or displace other land and resource users.

OLU-02: Quality of resource use experience:

- Sensory disturbances, changes to aesthetics, and safety concerns could change the quality of the resource use experience for other land and resource users in the area surrounding the Project. Similarly, perceptions of effects on the quality of the fish and wildlife resources may adversely affect the quality of the experience and/or result in certain areas being avoided. Knowledge of the decommissioned site may change the perceived suitability of the area for other land and resource use in the future.

17.5 Residual Effects Analysis

17.5.1 Application Case

17.5.1.1 Access to and Area Available for Land and Resource Use

The proposed Project would be located 130 km north of the Northern Village of La Loche, and 640 km northwest of the city of Saskatoon with few overlapping industrial developments in the RSA. Therefore, the effects felt by the community would be lower than if the Project were located in closer proximity to communities and had more surrounding development (Intergroup 2013).

The presence of Project infrastructure, including management of site access, could change access for other land and resource use. The access road gatehouse and NexGen safety policies would restrict access to the surface lease area for the safety of employees and harvesters (Figure 17.1-3) and would displace all resource use activities currently occurring within the maximum disturbance area. Access to parts of Patterson Lake may be temporarily restricted during construction of in-lake infrastructure, but unrestricted access to the lake is expected during Operations and Closure. Limited access would last until the Transitional Monitoring Stage is complete and the site is transferred to the Province of Saskatchewan for Institutional Control, when it would then become available for unrestricted land use activities.

The Project would remove up to 981 ha of land (i.e., maximum disturbance area) from access by resource users during Construction, Operations, and the Active Closure Stage. As part of the Project design, NexGen reduced the Project footprint and maximum disturbance area by optimizing the use of cleared areas for Project activities; using existing road infrastructure to the extent possible, including the existing bridge crossing; using underground storage for tailings; and designing an efficient infrastructure footprint (i.e., buildings clustered together; Section 5.4, Project Components). After a site tour of the Project footprint area with Elders, a Métis Local President said, "The best part I liked was the minimal disturbance and compact area. That really impressed me and the Elders I took up there. Other mining facilities I have visited have been huge" (BNDN-JWG 2021). The maximum disturbance area is 0.7% of the other land and resource use LSA.

The Project is not predicted to restrict access to or between the lakes in the other land and resource use LSA. Water surface elevations (WSE) on Patterson Lake and on downstream lakes were assessed as part of the hydrology assessment (Section 9.6.1, Residual Effects Analysis). Findings predicted up to a 1% increase in WSE on Patterson Lake (0.8 cm), and less than 1% increases in WSEs for Forrest, Beet, and Naomi lakes (0.2 cm to 0.4 cm; Section 9, Hydrology). Changes in WSE are expected to be negligible for the duration of the Project and therefore open-water navigation on lakes or downstream is not expected to be affected. These increases in mean monthly WSEs are large enough that they may be measurable, though they are well within the range of natural variation that exist in the Base Case.

The installation or operation of the in-lake infrastructure is not expected to affect recreational fish harvesters, as the amount of fish habitat affected in Patterson Lake is small and would not meaningfully affect fish populations or fisheries productivity. If required by DFO, NexGen would develop an offsetting plan and implement offsetting measures as required by the federal *Fisheries Act* and DFO policy. The in-water infrastructure would also not interfere with lodge and outfitting clients' open-water fishing activities due to the infrastructure being submerged and the minimal footprint of the infrastructure itself.

A residual adverse effect of access to commercial trapping areas is predicted during Construction, Operations and Closure in the maximum disturbance area (981 ha) or in 0.7% of the LSA. The effect is expected to be negligible due to the currently limited amount of trapping activity occurring within the maximum disturbance area combined with other commercial trapping areas available in close proximity. This assessment was shared by one of the participants in the 2021 trapper's workshop, who noted they did not believe the Project would affect their activities to the north and south of Patterson Lake; however, if the Project did affect them, they would advise NexGen. Other uranium mining and milling operations in northern Saskatchewan have demonstrated that trapping remains a commercially viable option for trappers in proximity to existing sites. Should the Project cause a loss of income for trappers, there is a history of compensation commitments to trappers in the province. In 2018, five compensation agreements were active around five mining operations in northern Saskatchewan, $40,000 in cash payments were disbursed, and fuel valued at over $6,000 was provided to support the continuation of trapping (Government of Saskatchewan 2018b).

Throughout all phases of the Project, monitoring and communication would be key to creating good working relationships that would facilitate open communication with local resource user groups such as the N-19 Trappers Association (Section 17.8). If the Project proceeds, NexGen commits to holding an annual meeting with N-19 trappers to provide a forum to discuss and resolve Project-related issues as they arise. Provisions would also be included in the Benefit Agreements including funding and human resources to support community-related initiatives including but not limited to cultural and traditional values and land uses (e.g., trapping); the establishment of the Environmental Committee to monitor environmental performance of the Project; and funding for full-time independent Indigenous Monitors to enable unrestricted environmental monitoring subject to the Monitor complying with appropriate health and safety and other reasonable site-specific policies.

17.5.1.2 Quality of the Resource Use Experience

The presence of the Project may affect the quality of the resource use experience in the following ways:

- changes to noise, light, air quality, and aesthetics during Construction, Operations, and the Active Closure Stage;
- changes to resource user safety along the access road and within the Highway 955 corridor during Construction, Operations, and the Active Closure Stage;
- changes to perceptions of the quality of the fish and wildlife resources during all Project phases; and
- knowledge of the decommissioned site may change the perceived suitability of the area for other land and resource use in the future.

The two resource user groups that are expected to experience these changes are trappers and lodge and outfitting owners and clientele. The overall effect is discussed at the end of Section 17.5.1.2. Other groups such as recreational hunters, and recreational and commercial fish harvesters are either not active or only nominally active in the other land and resource use LSA.

Noise

Project activities would produce noise during Construction, Operations, and Active Closure Stage. Noise was frequently mentioned as a key interest and concern in LPA communities, and was noted as an important component (NexGen 2019). Noise was modelled during Construction and Operations to capture maximum predicted noise effects from Project-related activities (Section 7, Air Quality, Noise, and Climate Change). Most Project noise sources would be effectively continuous or steady state throughout day and night. Sources in this category include equipment associated with land clearing, site preparation and construction of facilities and infrastructure, underground shaft and mine development, ventilation fans, site traffic, power generation, and process plant and underground operations. In contrast, noise associated with the Project airstrip would be intermittent. A temporal snapshot for the Closure Phase was not included because activities during the Active Closure Stage would be similar, but less intense, relative to activities during Construction (Section 7). The level of activities during the Transitional Monitoring Stage of Closure are expected to generate negligible noise levels relative to ambient (i.e., background) conditions; therefore, this stage was not modelled.

In the absence of Saskatchewan-specific regulations or guidelines, existing noise levels were characterized in the context of thresholds from federal guidance documents from Environment and Climate Change Canada (ECCC) and Health Canada, and the Alberta Energy Regulator Directive (Section 7.3.3, Existing Conditions). Noise was modelled to verify if ECCC thresholds for continuous daytime and nighttime noise of 55 decibels and 45 decibels, respectively, would be exceeded. Health Canada formulas were used to predict high annoyance and sleep disturbance noise during Construction and Operations. Analysis based on guidance from the Alberta Energy Regulator measured low frequency noise in a two-part test applicable for normal operations during Operations.

Project noise levels are predicted to comply with thresholds set out in ECCC (i.e., below 55 decibels [continuous daytime] and 45 decibels [continuous nighttime]), Health Canada (i.e., high annoyance and sleep disturbance), and Alberta Energy Regulator (i.e., low frequency noise) guidance documents (Section 7). Noise levels would be measured to prevent health and safety noise exceedances for workers or other receptors such as trappers and outfitting clientele. However, it is recognized that noise could have an effect on the aesthetics of individual resource users. Individuals may perceive and experience noise differently. For example, tolerance to noise may be higher for some individuals than others, especially when there are expectations of a quiet and peaceful wilderness experience. Sensitivity levels may vary among individual resource users and are difficult to measure quantitatively. However, it is possible that some individuals may be affected negatively and choose not to conduct trapping or purchase outfitting services offered near the LSA (Section 7.3.2, Figure 7.3-2). The degree to which avoidance may occur is subject to individual sensitivities and choices.

Light

A light analysis was undertaken to evaluate potential effects resulting from artificial lighting anticipated for the Project (TSD XI, Light Effects Analysis Report). The Project would increase ambient light at night in the other land and resource use LSA during Construction, Operations, and the Active Closure Stage. Quantitative light modelling focused on the Construction and Operations phases to capture the maximum predicted light trespass and sky glow from Project-related activities. As such, Active Closure Stage lighting was not modelled because it is expected to be less intense than during either Construction or Operations. The lighting requirements of the Project include illuminated parking lots, roadways, and the airstrip, which would have intermittent requirements. Project-related lighting may affect light trespass and sky glow, which are defined as follows:

- light trespass, which is light or illuminance that strays from its intended purpose onto nearby areas where lighting may be undesirable (e.g., light in the surrounding forest); and
- sky glow, which is stray light that is scattered in the atmosphere, brightening the natural sky and reducing star visibility (e.g., light reflecting off of particles suspended in the air).

Light trespass levels are predicted to be unchanged by the Project at resource use locations outside of the Project footprint. Sky glow during Construction and Operations would result in skies brighter than the current E1 lighting zone (i.e., equivalent to a relatively uninhabited rural area), making it an E2 lighting zone (i.e., equivalent to a sparsely inhabited rural area) in localized areas such as the Patterson Lake peninsula and the northern portions of Patterson and Forrest lakes. Sky glow is expected to obscure faint stars for trappers and lodge and outfitting clientele on clear nights. This may affect area aesthetics for some trappers and outfitter clientele; however, changes to the star visibility are expected to be localized to the locations mentioned above.

Air Quality

Emissions of fugitive dust and small particles from burning gas and diesel fuel could affect air quality for resource users during all Project phases. Increased airborne dust could be caused by land clearing, site preparation and construction of facilities and infrastructure, site traffic, transportation of personnel and materials to and from the site, and handling and storage of waste rock and ore. Exposure to dust and small particles can occur through breathing, fresh water, and eating plants, fish, and wildlife. These pathways were assessed through the human health risk assessment (Section 15.4, Project Interactions and Mitigation).

Air quality was frequently mentioned as a key interest and concern in LPA communities, and was noted as an important component of the EIS (NexGen 2019). The presence of fugitive dust would be likely to occur during dry spring to autumn months and may affect the aesthetics for resource users. Air quality modelling was completed to predict the amount and spatial extent of dust deposition and associated constituents as a result of the Project during Construction and Operations (Section 7.2; Appendix 7A, Air Dispersion Modelling Report). Results indicate that the dust deposition rate would be higher during Operations than Construction, which is a function of the type of dust and the height that dust is released. Rates of dust deposition and accumulation would also depend on the rate of supply from the source, wind speed, precipitation events, topography, and vegetation cover (Brown and Berg 1980; Rusek and Marshall 2000).

The annual dust deposition rate during Operations was predicted to be 11.2 micrograms per cubic metre ($\mu g/m^3$) at the boundary of the maximum disturbance area, which is well below the Saskatchewan Ambient Air Quality Standard of 60 $\mu g/m^3$ (Section 7.2.5, Residual Effects Analysis). Therefore, dust from the Project would be highly localized within the other land and resource use LSA. Dust is not expected to affect winter activities, such as trapping and ice fishing.

Mitigation to minimize fugitive dust from the Project includes:

- implementing an Environmental Monitoring Plan that includes ambient air monitoring and adaptive management based on ambient air quality standards;
- application of water and/or dust suppressants to site roads, access road, and airstrip, as necessary;
- establishing a Project feedback and grievance mechanism to record and action issues identified by LPA residents (or other members of the public);
- funding full-time independent Indigenous Monitors to enable unrestricted environmental monitoring subject to the Monitor complying with appropriate health and safety and other reasonable site-specific policies; and
- limiting vehicle speed on unpaved site roads to reduce fugitive dust emissions.

Mitigation is expected to be effective on provincial roadways. Traffic volumes on both the access road and Highway 955 are predicted to be highest during Construction, due to transport of mining equipment, and are predicted to decline during Operations and drop further during the Active Closure Stage (TSD IX, Transportation Risk Assessment Report). Dust suppression and speed limit enforcement on regional roads such as Highway 955 would be a Provincial responsibility due to the public ownership of that road.

Aesthetics

In addition to the aesthetic aspect of changes to noise, light, and air quality, other factors that may affect the resource use experience are shoreline development and changes to the wilderness experience. Inclusion of these factors is supported by research conducted on the profitability of remote tourism, which found that the "most important features of the landscape are beauty, undeveloped shorelines, abundant fish and wildlife, and the peace and quiet associated with remote wilderness areas" (CPAWS–Wildlands League and Ontario Nature 2005). Visual aesthetics was noted as an important component in LPA communities (NexGen 2019). The proposed Project is expected to change the wilderness experience for trappers and outfitter clientele through observations of increased human activity detectable from the southern and northern arms of Patterson Lake, shoreline development on the Patterson Lake peninsula, and through observations of increased traffic on the access road and Highway 955.

NexGen has minimized the Project footprint and maximum disturbance area to the degree possible by: optimizing the use of cleared areas for Project activity; using existing road infrastructure, including the existing bridge crossing; using underground storage for tailings; and designing an efficient infrastructure footprint (i.e., buildings clustered together). Efficient use of land has limited the overall Project footprint, including shoreline development.

Safety

The Project may affect the safety of resource users along the access road and Highway 955 through increased traffic volumes, and increases in large vehicles (i.e., tracker trailers). This could affect trappers, lodge and outfitting operators, and lodge and outfitting clientele.

Traffic and safety were frequently mentioned as a key interest and concern in LPA communities, and were noted as important components (NexGen 2019). The LPA community members (NexGen 2019) and trappers participating in the 2021 workshop expressed concerns about increased traffic volumes and hauling trucks on the roads affecting safety, including from large trucks, narrow roads, dust, and loose gravel.

Effects on recreational fish harvesters or hunters are less likely due to their nominal use of the RSA. Signage would be installed to warn public of safety risks around the Project site. Road safety measures are outlined below.

Access Road

The access road to the Project site is appropriate for the level of traffic during existing conditions. However, several characteristics of the access road may cause issues that would be exacerbated by increased traffic volumes associated with the Project:

- steep grades and vertical crest curves may create undesirable sight distances for oncoming vehicles;
- lighting is absent except for a small, solar-powered light at the intersection with Highway 955; and
- drainage after heavy rains or spring thaw may flood the access road (Stantec 2019).

Access to a local outfitting operation, Forest Lake Outfitters (Section 17.3.4.1, Lodge and Outfitting Services) would involve sharing the access road with Project traffic for the first 6 km of the existing access road. This outfitter's clients use 4×4 trucks to access an outpost camp on Forrest Lake. During the summer, ATV drivers also make use of the access road to access Vermeersch and Wickenkamp lakes on the opposite side of Highway 955. Trapping has also been reported along the access road (TSD V.2: CRDN). Shared road use by over-dimensional vehicles carrying heavy loads simultaneously with untrained drivers of trucks, snowmobiles, or ATVs over 6 km of shared access road is expected to be incompatible for safety reasons, and would require that measures be taken to help protect people. The access road would be upgraded by NexGen for safety and ability to accommodate the increase in heavy equipment traffic, and a Ground Transportation Emergency Response Plan would be developed to promote safety for all users.

The Ground Transportation Emergency Response Plan would contain measures to address resource user traffic safety (i.e., mitigate safety risks related to the transportation of materials and equipment) to and from the Project site, including on the access road, and the Security Program would contain measures within the maximum disturbance area, including the following:

- Educate Project staff on traffic safety including consideration of the safety of other non-Project users of the roads.
- Provide an orientation and safety training for resource users who use the access road on a regular basis (e.g., trappers, lodge and outfitting service providers).
- Where necessary, establish procedures for escorting resource users who are driving personal vehicles on the access road (e.g., lodge and outfitting clients).
- Conduct annual safety audits to confirm that management measures are effective in protecting safe passage of Project and other vehicular traffic.
- Evaluate annually how the objectives of the Security Program were met using measurable indicators and modify the plan as needed to foster continual improvement.

Highway 955

The width of Highway 955 varies throughout the corridor and is typically between 7 m and 8 m wide. Road conditions were evaluated as ‘fair’ south of the Clearwater River crossing but as ‘poor’ north of the crossing (Stantec 2019). In the northern section, trees were observed directly adjacent to the road, leaving no pullout capability along this section of highway (Stantec 2019). Trappers also indicate that they use the Highway 955 corridor by parking on the side of the road and if the mine was approved, they believe road improvements would be necessary (2019 to 2021 KP interview program).

NexGen, has approached the Province regarding road improvements including increasing road width, increasing pullout frequency, and increasing routine maintenance along Highway 955 to accommodate the increase in traffic volumes. NexGen has committed to open and continuous dialogue with trappers that is intended to enable trappers to raise issues or concerns for discussion and resolution (2021 trapper’s workshop). As part of an Indigenous and Public Engagement Program, NexGen commits to meeting regularly with trappers on an as-needed basis to discuss access or other issues. The Security Program would contain limited measures to address resource user traffic safety on Highway 955 due to this roadway being under provincial purview; however, road upgrade and maintenance cost-sharing agreements would include provisions for safe and ploughed pullouts for trappers. In addition, an Emergency Response Assistance Plan would be developed to support the response to any unplanned events that may occur along provincial roadways during the transportation of uranium concentrate from the Project site.

Perceptions of Fish and Wildlife Resource Quality

In Section 15 and as summarized in Section 17.4.1, No Pathways, the human health risk assessment considered radionuclide and non-radionuclide exposure during Operations and determined that risk thresholds were not exceeded when compared to guidelines. It was concluded that the human health risks through exposure to contaminants of potential concern, such as through consumption of country foods, is negligible. However, land users' perceptions of the risk associated with consuming water, fish, and wildlife is also important to consider and could result in an adverse effect because of the influence this perception has on the resource use experience and, potentially, on the individual choices made to avoid land and resource use near the proposed Project. More general perceptions over the quality of country foods as potentially affected by the Project (e.g., the perception that animals may be in poorer health, smaller in size, or otherwise seen as less desirable) could also adversely affect land and resource use.

At the trapper's workshop (July 2021), individuals reported that fur-bearing species (i.e., American marten, fishers, lynx, and fox) harvested near Patterson Lake were not edible for human consumption or, in the case of lynx, not eaten (2021 trapper's workshop). Fish were not reported to be consumed either; fish harvested locally by trappers were used only to bait traps (2021 trapper's workshop). Since there is no known food produced by trappers in the Patterson Lake area, perceptions of the suitability of resources for consumption are likely not applicable to commercial trapping activities. Concerns were not raised about the health of the animals that would have bearing on trapping activity (2021 trapper's workshop). Concerns regarding the health of resources harvested for traditional purposes are discussed in Section 16.5.1.3.6, Perceptions of Wildlife, Fish, Water and Plant Resource Quality. As noted, each of the Benefit Agreements provide the option for independent Indigenous environmental monitoring opportunities, including sampling related to the Project. In addition, NexGen commits to providing opportunities for annual communication and information about the Project with trappers, and by providing periodic tours of the Project site for community members and holding annual open-houses or information sessions in Indigenous communities on Project-related matters, including but not limited to environmental and cultural protection.

Lodge and outfitting clients are understood to have a shore lunch of fish; however, given the nominal number of meals for a nominal number of fish harvesters and the lack of actual potential to affect human health, this effect is not likely to be detectable. As part of the Indigenous and Public Engagement Program, communications would be prepared for the public, including local outfitting operations and trappers, to advise on outcomes of the human health risk assessment and ongoing monitoring of the fish resource. A residual adverse effect is predicted on lodge and outfitting clients who use the LSA because of the perception of effects on fish. The extent of this effect depends largely on the perceptions of individual clients, which are difficult to predict and therefore remain uncertain. To address this uncertainty, NexGen would conduct regular meetings with local outfitters to provide Project updates and communicate on any issues and concerns as they arise in relation to the Project.

Knowledge of the Decommissioned Site

Knowledge of the decommissioned site may change the perceived suitability of the area for other land and resource use in the future; for example, this knowledge could result in some trappers avoiding the area during the Transitional Monitoring Stage and beyond due to perceived concerns of contamination. Overall, local community members, including trappers, remain uncertain about land reclamation after closure of a uranium mine. Using Cluff Lake as an example, CRDN (2019a) shared with the CNSC:

> Overall, there is a general perception that even though the site is being reclaimed and "looks better" it will never "be the same again" and should be "avoided in case there is risk to our family's health and safety".

While LPA communities have a long-standing and intimate relationship with the land and waters, outfitting clients are short-term visitors and will likely not know the local land use history. For this reason, they are less likely to have concerns about the quality of the land and waters.

Before the Project footprint is transferred to the Province of Saskatchewan, a Detailed Decommissioning and Reclamation Plan would be developed, submitted for review and approval, and implemented to promote unrestricted future use of the Project footprint for other land and resource use activities. NexGen communicated at BNDN and BRDN JWG meetings that the Northern Mines Decommissioning and Reclamation Guidelines (ENV 2008) have a general objective to leave all disturbed areas safe for traditional land use and in good ecological condition consistent with the surrounding physical and biological environment (BNDN-JWG 2021; BRDN-JWG 2021). The involvement of Indigenous communities in the development of the Detailed Decommissioning and Reclamation Plan would be key to encouraging future use of the site.

The timeframe of an altered landscape that can accommodate the resumption of resource use activities begins when the site is transferred to the Province of Saskatchewan for Institutional Control and onwards.

Overall, and considering the uncertainty associated with the potential perceptions outlined above, other land and resource use is conservatively predicted to be adversely affected in the LSA. The residual adverse effect would be limited to trappers and lodge and outfitting clientele.

17.5.2 Reasonably Foreseeable Development Case

The RFD Case considers the Fission Patterson Lake South Property in combination with the Project. Section 17.6 discusses the interaction of Project effects with climate change.

17.5.2.1 Access to and Area Available for Land and Resource Use

Infrastructure for the proposed Fission Patterson Lake South Property is expected to include an underground mine, mine infrastructure and facilities, site support infrastructure, processing plant buildings, waste rock storage facility, surface tailings management facility, permanent and temporary accommodation camps, mine support buildings, water management facilities, and an airstrip (Fission 2019, 2021a). Additional disturbance projected as a result of the Fission Patterson Lake South Property includes ground clearing to build and relocate roads. The life of the mine is expected to be three years of construction and seven years of production. Assuming that the duration of Closure is the same as the Project (i.e., 15 years), the maximum overlap of effects is 25 years for both projects.

The Fission Patterson Lake South Property has committed to minimizing the amount of land disturbed for the project (Fission 2019, 2021a). Cumulative effects from the two projects are likely but uncertain (i.e., probable) given that the Fission Patterson Lake South Property has recently entered the formal regulatory application process.

Assuming the proposed Fission Patterson Lake South Property would maintain similar access restrictions as assumed for the Project, approximately 1,545 ha of additional land would become unusable for the length of time the projects overlapped (i.e., 25 years). This restriction of access would result in a cumulative reduction of 2,526 ha (i.e., maximum disturbance area of 981 ha in addition to Fission project footprint of 1,545 ha) in land available for trapping in the LSA and changes in access and ice conditions on additional shoreline segments of Patterson Lake.

It is assumed that the Fission Patterson Lake South Property would not restrict navigation of Patterson Lake by small watercraft. This assumption would mean that access to Patterson Lake would be maintained for a local outfitting operation. Some temporary restrictions in water access may occur if in-lake infrastructure is installed as part of the Fission Patterson Lake South Property. Allocation lakes of the same outfitter on the west side of Highway 955 may be affected by the proposed Highway 955 by-pass, a surface tailings management facility, and other infrastructure (Fission 2019). Should the infrastructure layout cause a loss of use of the two allocation areas west of the highway, the effect would be adverse for this outfitting operation.

Overall, an adverse residual effect is expected on commercial trapping due to the cumulative loss of trapping area amounting to an additional 1,545 ha or a combined total of 2.0% of the LSA. Although localized, this effect is predicted to be probable if the Patterson Lake South Property receives approval.

17.5.2.2 Quality of the Resource Use Experience

In the RFD Case, the presence of the Project and the Fission Patterson Lake South Property could affect the quality of the resource use experience through:

- changes to light, noise, air quality, and aesthetics during all Project phases;
- changes to safety on Patterson Lake in winter and along the Highway 955 corridor during all Project phases;
- changes to perceptions of the quality of the fish and wildlife resources; and
- knowledge of the decommissioned site may change the perceived suitability of the area for other land and resource use in the future.

Light modelling results (TSD XI) suggest cumulative sky glow associated with Project Construction and Operations would convert portions of the other land and resource use LSA from an E1 zone, a relatively uninhabited rural area, to an E2 lighting zone (i.e., a sparsely inhabited rural area). This change in sky glow rating would occur in localized areas such as the Patterson Lake peninsula and the northern portions of Patterson and Forrest lakes. With the proposed Fission Patterson Lake South Property, brighter skies would convert all 16 receptors in the noise RSA (which is the same study area as for light) spanning from Gedak Lake to Forrest Lake to Naomi Lake to the E2 lighting zone (TSD XI).

With respect to noise effects, the Fission Patterson Lake South Property is a similar type of development to the Project and is anticipated to have comparable equipment and noise emissions. Noise levels from the Fission Patterson Lake South Property, in combination with either Project Construction or Operations activities, are predicted to comply with ECCC, Health Canada, and Alberta Energy Regulator guidelines in the noise RSA (Section 7.3.6, Residual Effects Classification). These measurement indicators (i.e., guideline thresholds) are designed to identify potential effects on the health and safety of workers at the Project site and at local receptor locations such as resource user or outfitter cabins. Project noise could have a qualitative effect on the aesthetics of resource use. Individuals may perceive and experience noise differently. For example, tolerance to noise may be higher for some individuals than others especially when there are expectations of a quiet and peaceful wilderness experience. Sensitivity levels may vary among individual resource users and are difficult to measure quantitatively. However, it is reasonable to expect that some individuals may be affected negatively and choose not to conduct trapping or purchase outfitting services offered in the RFD Case that expands the spatial distribution of noise to effectively cover all of Patterson Lake north to Gedak Lake and from Forrest Lake to Naomi Lake (Section 7.3.6).

Additional shoreline development segments relative to the Application Case would likely be visible on the west shorelines of Patterson Lake.

With respect to travel safety, traffic associated with the Fission Patterson Lake South Property would not overlap with the access road or site roads, though use of Highway 955 for project access would occur. Cumulative traffic volumes would incrementally change the nature and safety of access to trapping areas and outfitting operations. Highway 955 is under provincial purview.

As discussed in Section 17.5.1.2, at the present time, food is not a product of trapping in the Patterson Lake area, making the perception of contamination a nominal issue. Recreational hunting and fishing, other than that conducted by outfitting clientele, has not been confirmed in the LSA. Consumption of wildlife by outfitter clientele through hunting is unlikely due to black bear being the only species offered for guided hunts; consumption of fish by outfitter clientele may occur though shore lunches or evening meals. These meals would be limited. It is possible that some clientele may not be comfortable eating fish from waters near a mine and mill site because of perceptions of potential contamination. These perceptions may persist for some individuals despite predictions from the human health risk assessment (Section 15, Human Health; TSD XXI, Environmental Risk Assessment) showing that fish taken from waterbodies close to the Project site would be safe to eat (Section 17.4.1, No Pathways).

17.6 Residual Effects Classification and Determination of Significance

17.6.1 Classification Summary

Residual effects on other land and resource use from changes in access to and area available for land and resource use, and the quality of the resource use experience are summarized in Table 17.6-1 according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence following the methods described in Section 17.2.8, Residual Effects Analysis. Effective implementation of mitigation outlined in Section 17.4 is expected to reduce the magnitude of effects on other land and resource use.

Table 17.6-1: Classification of Residual Effects on Other Land and Resource Use Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Access to and area available for land and resource use	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Negligible: Restriction on access to land for safety purposes would affect few resource users; other alternative areas are locally available ▪ Nominal restrictions to small portions of Patterson Lake during Construction for installation of in-lake infrastructure	▪ Small: Reduction in access to land-based resource use; alternative areas are locally available ▪ Nominal restrictions to waterbodies for safety purposes
	Geographic extent	▪ Local: Maximum disturbance area of 981 ha (or 0.7% of LSA) would be restricted for trapping	▪ Local: Combined maximum disturbance areas of 1,545 ha and 981 ha, totalling 2,526 ha
	Duration	▪ 43 years – Construction, Operations, and Closure	▪ Maximum of 25 years, depending on the extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible	▪ Reversible (Project and Fission Patterson Lake South Property)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain (Project)	▪ Probable (Fission Patterson Lake South Property)
	Direction	▪ Negative	▪ Negative

Table 17.6-1: Classification of Residual Effects on Other Land and Resource Use Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Quality of resource use experience	Magnitude	▪ Negligible to small: Air quality and light residual effect would be difficult to detect and few resource users would experience changes ▪ Noise within guidelines for health and safety, though individual sensitivities may vary ▪ Aesthetics negligible to small though individual sensitivities may vary ▪ Travel safety: negligible ▪ Negligible to small effect on lodge and outfitting clients' perceptions of fish for consumption though individual sensitivities may vary	▪ Negligible to small: Air quality and light effects difficult to detect ▪ Negligible noise, within guidelines for health and safety, though individual sensitivities may vary ▪ Aesthetics negligible to small though individual sensitivities may vary ▪ Travel safety: negligible ▪ Negligible to small effect on lodge and outfitting clients' perceptions of fish for consumption though individual sensitivities may vary
	Geographic extent	▪ Local: Maximum disturbance area, noise LSA, access road corridor, and Highway 955 corridor	▪ Local: Cumulative altered shorelines on Patterson Lake, noise RSA, and Highway 955 corridor
	Duration	▪ 43 years – Construction, Operations, and Closure	▪ Maximum of 25 years, depending on the extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible	▪ Reversible (Project and Fission Patterson Lake South Property)
	Frequency	▪ Periodic: Changes are expected to occur consistently or at regular intervals and would vary with the use and user	▪ Periodic: Changes are expected to occur consistently or at regular intervals and would vary with the use and user
	Probability of occurrence	▪ Probable (Project)	▪ Probable (Fission Patterson Lake South Property)

LSA = local study area; RSA = regional study area; RFD = reasonably foreseeable development.

17.6.2 Significance Determination

In determining the significance of effects to other land and resource use, consideration was given to the combination of residual effects (i.e., access to and area available for land and resource use, and the quality of resource use experience) combined with the overall presence of other land and resource use in the LSA as compared to the RSA. Due to the Project's remote location, resource use for commercial and recreational purposes is nominal (meaning virtually absent but not confirmed to be zero), and only two resource user groups were identified as potentially affected: trappers, and lodge and outfitting clientele. Other groups such as recreational hunters and fish harvesters, and commercial fish harvesters are not active or nominally active in the other land and resource use LSA, and other opportunities for these uses exist throughout the RSA.

Access to and Area Available for Land and Resource Use

For the Application Case, predicted changes in access to, and area available for, land and resource use as a result of the Project is predicted to be adverse, negligible, local, for the duration of the Project (i.e., 43 years for Construction, Operations, and Closure), reversible, continuous, and certain (Table 17.6-1). The magnitude of these changes is expected to be negligible as land-based access for resource use purposes is premised on safety, meaning that access would only be restricted in a small area to maintain both the safety of the operation and of resource users in the maximum disturbance area. Experience at other uranium mine sites in northern Saskatchewan suggests that trapping and outfitting can remain compatible activities with active mining operations, so long as effective communication with resource users is maintained, and accommodation of these activities is supported in consideration of required safety measures (Intergroup 2013). Evidence from socio-economic monitoring of diamond mines in Northwest Territories indicates that, while predicted to decrease as a result of mining, trapping increased in local communities although the specific reasons for this were not explored (Intergroup 2013).

The geographic extent of changes to access for resource use is classified as local; however, the actual area restricted is the maximum disturbance area of 981 ha, representing a small portion of the LSA (0.7%). Although effects are predicted to last for the duration of the Project, they are predicted to be reversible following the Active Closure Stage as resource users are expected be able to return to the maximum disturbance area to carry out land use activities.

Other land and resource activities such as trapping and outfitting have historically been adaptable and have shifted in response to external factors such as government programs/policies and/or external market forces. Mining represents an additional external factor, but the continued presence of trapping and outfitting in proximity to other uranium operations in Saskatchewan demonstrates that these activities can remain compatible and would continue to fluctuate relative to an array of factors, such as fur prices (Intergroup 2013). Should a loss of income occur, there are remedies such as trapping compensation agreements that have been implemented successfully with trappers around five mining operations in northern Saskatchewan (Government of Saskatchewan 2018b). At this time, the trappers do not predict their activities would be affected and they have agreed to raise any issues with NexGen as they arise (2021 trapper's workshop). NexGen is committed to maintaining positive working relationships with those active in areas proximal to the Project through on-going communication and implementation of adaptive management strategies should any issues arise over the course of the Project lifespan. Thus, opportunities for other land and resource use are predicted to continue at a similar level in the Application Case relative to the Base Case.

For the RFD Case, predicted changes in access to and area available for land and resource use as a result of the Patterson Lake South Property is predicted to be probable pending project approval, adverse, small, localized (i.e., in the LSA), for a period of overlap when both projects are being constructed/operated/closed (approximately 25 years), and continuous (Table 17.6-1). Land-based access for resource use purposes would be restricted in the Project maximum disturbance area of 981 ha and in the Patterson Lake South Property area estimated at 1,545 ha representing a small area (2,526 ha) and proportion (2.0%) of the LSA. Similar to the Application case, it is reasonable to assume the effects of the Patterson Lake South Property would be reversible following the project's closure because it would be bound by the same CNSC and ENV regulatory requirements that require the site to be restored to a condition similar to its pre-Project condition. Although there are no examples from northern Saskatchewan with uranium operations as proximal as the Project and the Patterson Lake South Property (i.e., approximately 4 km apart), there are existing operations wherein the same resource users are affected by multiple operations (e.g., the Key Lake Operation and McArthur River Operation) and uses remain compatible. While it is not within the operational control of the Project to minimize the effects of another project on changes in access to resources, there are actions NexGen could potentially take to help mitigate changes in access at a regional level. Such actions could include collaboration with Fission and other land and resource users on a regional scale as may be required. Regional initiatives to mitigate access could include promotion of continued land and water use close to the Project. Such initiatives would help maintain the area as an active landscape for resource users, particularly for trappers from local Indigenous communities. However, although NexGen would explore regional initiatives, these types of initiatives have not been considered within the significance determination of the other land and resource use VC because they have not yet been developed.

Quality of the Resource Use Experience

For the Application Case, the quality of the resource use experience is predicted to be adverse, negligible to small, local (within the LSA), 43 years duration, and reversible. Light trespass would remain unchanged, but there may be an increase of sky glow (for receptors within 10 km surrounding the Project) to levels above relatively uninhabited rural areas and potentially up to levels in sparsely inhabited rural areas. The effects of light would be minimized with infrastructure design. The effects to air quality (i.e., dust) could be mitigated to a negligible magnitude with appropriate dust suppression measures. Safety for other resource users would be managed through the Security Program. Noise is predicted to be within guidelines for health and safety and could be mitigated by enforcing speed limits for traffic, enclosing noise producing equipment, prohibiting the use of engine retarder brakes, and using noise suppression (i.e., mufflers) on vehicles. Aesthetics, perceptions of the quality of fish and wildlife resources, and knowledge of the decommissioned site are subject to individual perceptions and sensitivities and proximity to the Project. These effects are likely to be negligible overall but may affect some trappers and outfitter clientele while others may not be affected at all. Effects are expected to occur in the other land and resource use LSA such as along roadways but be most detectible in the noise and light LSA.

The majority of other land and resource use occurs in areas not proximal to the Project, and not within the areas that would form the Project footprint and the maximum disturbance area. Most overlap in uses occur as trappers and outfitters travel along the access road or in the LSA to access other areas. As such, the geographic extent of effects to the resource use experience is expected to be only in a small portion of the LSA, and potential conflicts in uses such as traffic management would be managed through the Security Program. Changes would be periodic (i.e., they would occur consistently at regular intervals – which in the case of outfitting is more likely in the spring/summer months and for trapping more likely in the winter months). Effects are considered to be reversible over time and uses are expected to be sustained as resource users become accustomed to the presence of the operation. NexGen is committed to maintaining positive working relationships with those active in areas proximal to the Project and would continue to encourage those uses so long as safety permits. Thus, opportunities for other land and resource use are predicted to continue at a similar level in the Application Case relative to the Base Case.

For the RFD Case, the quality of the resource use experience is predicted to be adverse, negligible to small, local, approximately 25 years duration (i.e., the time both projects overlap), periodic, reversible, and probable. In certain ways, the proximity of the South Patterson Lake Property to the Project is advantageous relative to the experience of resource users. The location of the two developments near each other concentrates disturbance to one portion of the LSA and limits the effects on the number of resource users (i.e., influences only those who use that portion of the LSA). The remaining land and resources in the LSA would be maintained and intact.

Similar to the Application Case, aesthetics, perceptions of the quality of fish and wildlife resources, and knowledge of the decommissioned site are subject to individual perceptions and sensitivities. Although these potential effects could be compounded by a second development, the same resource users in the LSA are potentially affected by both projects. Effects would be limited to perceptions of industry in the area and minor changes to natural aesthetics based on individual sensitivities, though outfitter clientele and trappers using the Patterson Lake area do have access to local alternate fishing and trapping locations. NexGen is committed to maintaining positive working relationships with those active in areas proximal to the Project and would be open to taking a regional approach to adaptative management and mitigation, if required. Overall, continued levels of opportunities for other land and resource use are predicted in the RFD Case.

Climate Change

The extent of changes to other land and resource use activities associated with climate change is inherently difficult to predict. Although projected future climate extremes indicate a future that is likely to be wetter annually (Appendix 22A, Section 22A4, Future Climate), climate change is still anticipated to increase fire frequency within the RSA (Hart et al. 2019). Changes associated with fire could affect travel in the LSA (e.g., cutting new trails through burnt areas); however, fire suppression activities would be enhanced according to Saskatchewan's fire suppression practices due to the presence of additional values-at-risk in the area. Changes to conditions in the LSA may result in increased expense (i.e., time and effort) and decreased safety (i.e., deadfall in burnt areas) to secure resources if areas in the LSA burn. However, fire-return intervals may be limited by self-regulation as young stands of trees burn less frequently due to fuel limitations (i.e., limited fuels from vegetation available to support a fire) in early successional vegetation that inhibit ignition (Hart et al. 2019).

Drought and flood conditions may also affect resource use and navigation in the open water season. Water surface elevations on Patterson Lake and on downstream lakes are predicted to result in negligible changes (i.e., 0.01 m or less) on Patterson Lake, Beet Lake, and Naomi Lake, making WSE change difficult to distinguish from existing conditions. This negligible change means that any water access via boat is predicted to remain within current water level variations. While conditions related to climate change may continue over a long term, resource users are expected to incrementally adapt to and become accustomed to new conditions.

Given ongoing mechanisms for communication, other land and resource users would have a forum to discuss and resolve any issues, and NexGen would remain open to working with other relevant stakeholder to address issues if they arise.

Significance Summary

Overall, the weight of evidence from the analysis, including consideration of experiences at other uranium operations in northern Saskatchewan where multiple uses remain compatible, predicts that other land and resource use could continue in local areas not affected by the projects and resources equivalent in abundance and quality would continue to be available to resource users. Changes to the aesthetics of other land and resource use would be primarily dependent on proximity to the projects and individual sensitivities. The number of resource users potentially affected are limited.

Based on the residual effects analysis, the residual adverse effects for both the Application Case and the RFD Case were determined to be not significant. Opportunities for other land and resource use are expected to continue. Monitoring and follow-up are described in Section 17.8.

Effects of climate change are likely to result from fire, flood or drought conditions in a beyond-regional context which may disrupt travel, safety and require increases in effort to harvest. While additional fire protection associated with the projects may reduce the incidence or extent of burnt land and associated costs for resource users in terms of time and effort, flood or drought conditions may impact travel on a periodic and seasonal basis. Given that Project-associated WSEs would not exceed natural variation, climate change-associated flood or drought conditions are not expected to be more severe than at locations outside of the maximum disturbance area. Therefore, when considering climate change in the RFD Case, effects were determined to be not significant. Regardless, climate change conditions will require other land and resource users to adopt strategies to remain safe and continue to practice other land and resource use.

17.7 Prediction Confidence and Uncertainty

Scientific inference is associated with uncertainty and prediction confidence depends on the level of uncertainty and the way it is addressed. The primary factors affecting confidence in the predictions made in the other land and resource assessment include:

- the availability and accuracy of baseline data;
- the level of understanding of the strength of primary pathways (i.e., mechanisms) in terms of the effects they are likely to have on fish and wildlife VCs and the other land and resource use VC (e.g., the relationship between cause and effect is clear as supported further by the analyses in Section 11, Section 14, and Section 15);
- the level of certainty associated with the effectiveness of proposed mitigations, where applicable; and
- the level of understanding of the cumulative drivers of change and associated effects on fish and wildlife VCs and the other land and resource use VC.

The data sources for the baseline conditions had limitations. Large geographical management units such as the WMZs, GBMUs, fur blocks, and recreational fishing zones prevent precise descriptions of harvest activities and locations within each zone. Management units may be as large as one third of the province, and the availability of data often depends on reporting requirements. Mandatory annual hunting surveys where participation and harvest rates are reported by WMZ were instituted in 2020; data collected prior to that date estimated total harvests from a sample of voluntary responses. While trapping and commercial fishing data are more precise than hunting data due to the stringent harvest reporting requirements in both industries, there is a data gap for the 2018/2019 trapping season production as this data was not compiled by ENV that year. The COVID-19 global pandemic disrupted travel in Saskatchewan and beyond for outfitting clients, commercial fishers, and trappers alike. The pandemic affected supply chains, fuel costs, and access to fur markets; closed fish processing plants; and has virtually eliminated American tourism since 2020. Inclusion of the 2019/2020 data likely resulted in a baseline description with lower resource harvests than may have otherwise been the case. Though qualitative, the effects of the COVID-19 pandemic have been described where applicable.

The data collected from KP interviews may not be representative of the perspectives of all lodge and outfitters and trappers. Key persons were selected based on their knowledge and experience that could be relevant to characterizing the other land and resource use VC. Data presented from the KP interviews are based on the individuals' knowledge and experience, and their willingness to participate and share data openly. Where possible, information provided was verified using other sources of information such as literature, interviews with former owners, website materials, and professional experience.

Uncertainty was managed by:

- reviewing historical data and relevant studies completed in the LSA and RSA;
- completing quality assurance and quality control of baseline data;
- validation with Indigenous and Local Knowledge where possible;
- triangulating data sources for verification of precision and accuracy; and
- comparing assessment results to relevant published scientific literature.

Remaining uncertainty was primarily addressed by making assumptions that overestimated rather than underestimated potential effects (i.e., a precautionary assessment). For example, the maximum disturbance area used for the Project was conservatively sized to allow flexibility for potential future Project design changes. Also, the extents of the other land and resource use LSA were spatially inclusive (i.e., broad-based) to capture potential effects on resource users and resource use VC in recognition of the connectedness of land and resource use across the landscape. Overall, there is a medium-high degree of confidence in the predictions related to the changes to other land and resource use during Construction, Operations, and Closure.

The extent of climate change effects (e.g., future temperature increases) is difficult to project with certainty, as scientific knowledge of the processes is incomplete and the socio-economic factors that would influence the magnitude of such increases are difficult to predict (IPCC 2007). These conditions would require resource users to embrace adaptation strategies to remain safe and practice resource use.

17.8 Monitoring, Follow-Up, and Adaptive Management

This subsection presents a summary of the identified monitoring and follow-up required to confirm effects predictions and address the uncertainty identified in Section 17.7.

Specifically, follow-up and monitoring programs would be used to:

- evaluate the effectiveness of reclamation and other mitigation actions, and modify or enhance them as necessary through monitoring and developing updated mitigation measures, if required;
- identify unanticipated negative effects, including possible accidents and malfunctions; and
- contribute to the overall continual improvement of the Project.

Proposed recommendations for enhancement and monitoring are as follows:

- Include meetings with community members, commercial trappers, outfitters, and other potentially affected land users, as applicable, both independently and as part of the Indigenous and Public Engagement Program to review the previous season and understand if they experienced any issues or concerns that could be addressed. Conduct follow-up as needed.
- Conduct discussions and/or agreements with potentially affected lodge and outfitting operations and continue ongoing communications on an as-needed basis. The focus of discussions is anticipated to include access management, safety, and management of other potential interactions with the Project.
- Evaluate the results of the monitoring conducted by the independent Indigenous Monitors and suggest modifications to monitoring plans as required to conduct adaptive management and foster continuous improvement.
- Evaluate how the objectives of the Security Program were met using measurable indicators and modify the plan as needed to foster continual improvement.
- Develop and implement a Preliminary Decommissioning and Reclamation Plan.
- Meet with other mining operations active in the region to collaboratively identify concerns and develop effective responses to mitigate identified concerns.

In addition, Environmental Committees (i.e., one per primary Indigenous Group) composed of two NexGen and two Indigenous Group representatives would be established to act in an oversight manner to monitor the environmental performance of the Project and verify the parties are implementing the regulatory and environmental commitments made in respect of the Project.

Indigenous Groups have made recommendations related to mitigating the effects of the Project on the environment, including community-led long-term environmental testing and monitoring during Construction and Operations of the proposed Project (TSD IV: MN-S; TSD V.2: CRDN; YNLRO 2019). NexGen has committed to provide funding for the lifespan of the Project for a full-time independent Indigenous Monitor chosen by each primary Indigenous Group; this Indigenous Monitor would have access to conduct environmental sampling for the Project, subject to the Indigenous Monitor complying with appropriate health and safety and other reasonable site-specific policies. The Indigenous Monitor would be able to report openly and without restriction to the Environmental Committee and Indigenous Group's community members on the performance of the Project. The Indigenous Monitor would also provide regular reports to the Environmental Committee.

17.9 Key Findings

Due to the proposed Project's remote location, resource use for commercial and non-Indigenous recreational purposes (i.e., other land and resource use) is nominal, and only two resource user groups were confirmed to conduct activities in the LSA: trappers, and lodge and outfitting clientele. Other groups such as recreational hunters and fish harvesters, and commercial fish harvesters are not active or nominally active in the other land and resource use LSA; other opportunities for these uses exist throughout the RSA.

The assessment of potential effects of the proposed Project on other land and resource use incorporated information from a variety of primary and secondary sources. Analysis of potential effects considered information from other projects and the perspectives and concerns of resource users.

Many other land and resource use components did not have pathway linkages with the Project that needed to be considered for assessment. Those components included recreational hunting and fishing, commercial fishing, parks and protected areas, and forestry due to negligible levels of activity or lack of spatial overlap with the Project.

After the application of mitigation, residual Project effects on lodge and outfitting services and commercial trapping would result from the following pathways:

- The presence of Project infrastructure would restrict access and reduce area available for, or displace, other land and resource users.
- Sensory disturbances, changes to aesthetics, and safety concerns may change the quality the resource use experience for other land and resource users in the area surrounding the Project. Similarly, perceptions of effects on the quality of the fish and wildlife resources may adversely affect the quality of the experience and/or result in certain areas being avoided. Knowledge of the decommissioned site may change the perceived suitability of the area for other land and resource use in the future.

Residual effects were analyzed as part of both the Application Case and the RFD Case, which considered the cumulative effects of the Patterson Lake South Property. Potential effects resulting from climate change were also considered.

In summary, residual adverse effects on other land and resource use were assessed as not significant for both the Application and RFD Cases due to the limited number of resource users that have the potential to be affected, the negligible to small magnitude of the effects, the effects being local, and the effects being reversible.

As part of an Indigenous and Community Engagement Strategy, monitoring and adaptive management would involve regular communications with local community members, N-19 trappers, local outfitters, and other land users, as required; implementation and annual evaluation of the Security Program; and inclusion of community members such as trappers in the preparation and execution of the Detailed Decommissioning and Reclamation Plan and future iterations of the plan.

17.10 References

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Rook I Project

Environmental Impact Statement

Section 18 Economy

Submitted to:
Canadian Nuclear Safety Commission
Saskatchewan Ministry of Environment

Submitted by:
NexGen Energy Ltd.
3150-1021 W Hastings St
Vancouver, BC
V6E 0C3

November 2024

Executive Summary

Section Purpose

Section 18 of the Environmental Impact Statement (EIS) provides a comprehensive assessment of potential effects of the Rook I Project (Project) on the economy. This assessment included consideration of both potential effects from the Project and cumulative effects from the Project and other reasonably foreseeable developments (RFDs). The economy assessment used widely accepted scientific practices and incorporated Indigenous and Local Knowledge.

Economy represented a valued component (VC) in the Environmental Assessment (EA); the selection was based on the economy being a major social determinant of health in the overall well-being of individuals and communities. The selection was also informed by Indigenous and Local Knowledge obtained from Indigenous Knowledge and Traditional Land Use Studies and Joint Working Groups, and feedback received during community engagement sessions. The economy assessment provided information that was used to support the valued component assessment of community well-being.

Setting

At a regional scale, the Project would be located within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system, approximately 40 km east of the Saskatchewan-Alberta border and 640 km northwest of the city of Saskatoon.

The local study area (LSA) focused on the communities that are anticipated to experience most of the direct effects on the economy related to the Project; these effects include employment, training, and income opportunities. The regional study area (RSA) represents the area where potential cumulative effects of the Project and RFDs could occur and aligns spatially with the Northern Saskatchewan Administrative District.

Communities and Indigenous Groups in the LSA include:

- Clearwater River Dene Nation;
- Clearwater Clear Lake (Métis Nation – Saskatchewan name for Northern Region 2);
- La Loche;
- Birch Narrows Dene Nation;
- Turnor Lake;
- Birch Narrows Dene Nation / Dillon;
- Buffalo Narrows;
- Bear Creek;
- Descharme Lake;
- Garson Lake;
- Black Point;
- Michel Village; and
- St. George's Hill.

In terms of the economic setting, Saskatchewan's real gross domestic product (GDP)[1] at basic prices was $81.4 billion in 2019, with the mining and oil and gas extraction sector (i.e., the largest sector) in Saskatchewan representing $21.9 billion (26.9%) of that total. The mining, quarrying, and oil and gas sector in Northern Saskatchewan represented the fourth largest sector by employment in 2016.

The traditional economy, or subsistence economy (i.e., hunting, fishing, trapping, and gathering), is also important to supporting the livelihood of many individuals and communities in northern Saskatchewan.

Existing Conditions (Section 18.3)

The LSA is characterized by a dispersed settlement pattern of primarily small and highly remote Indigenous communities with a total population of about 6,000 in 2016. Buffalo Narrows, with an estimated population 1,110 people, and La Loche, with an estimated population 2,372, are the two urban centres in the LSA. Buffalo Narrows is located on Highway 155, approximately 200 km north of Green Lake and 100 km south of La Loche. La Loche is located at the northern terminus of Highway 155 and the southern terminus of Highway 955, 300 km north of Green Lake.

The LSA possesses limited regional connectivity, which has been identified as a challenge to economic expansion in the LSA. Highway 155 is the primary transport route that connects the LSA communities to the regional centres in southern Saskatchewan. Regional airport facilities are in Buffalo Narrows and La Loche and are primarily used by charter companies.

The LSA is economically stagnant, with a general lack of economic opportunity due to no suitably sized primary industry since the decline of the fur industry in the 1960s. Labour force participation and employment rates in communities are very low, with employment concentrated primarily in the public sector: government-funded service sectors (e.g., health, education) and Crown corporations. There are lower employment rates in common rural industries than in Saskatchewan as a whole, including agriculture, forestry, fishing and hunting, manufacturing, and retail trade. There is also limited tourism in the LSA. Fishing and commercial forestry activities contribute to the LSA economy, though to a limited scale. There are some individuals employed in mining; however, the positions are fly-in/fly-out or drive-in/drive-out to operations outside the LSA. Overall, there are insufficient employment opportunities to service the needs of the population, resulting in high unemployment.

Average personal and household incomes for the LSA are lower than for Saskatchewan as a whole, with high rates of income derived from government transfers. Participation in the traditional economy provides important opportunities to support the livelihoods of individuals and communities in addition to cultural and spiritual benefits.

Mineral exploration and investment activity in the LSA are growing. From 2008 to 2017, there were 328.3 million pounds of measured and indicated uranium resources found in the west side of the province, with more than 70% of the resources located north of La Loche. La Loche is the closest urban settlement on Highway 955 to the uranium opportunities in northwestern Saskatchewan; however, the only mining activity currently occurring in this area is exploration.

[1] The Saskatchewan Bureau of Statistics provides a definition of GDP as the total amount of productive economic activity occurring within a region during a given period of time expressed in currency units. Real GDP removes the effects of changes in prices over time and is adjusted for inflation. An industry's GDP at basic prices is the sum of its factor incomes (i.e., wages and salaries, supplementary labour income, mixed income, and other operating surplus) plus taxes on production less subsidies on production (Saskatchewan Bureau of Statistics 2019).

Project Interactions, Mitigations, and Benefit Enhancements (Section 18.4)

An analysis was completed to evaluate Project components and activities and associated effects pathways that could potentially affect economy; this analysis included consideration of both adverse and beneficial effects. The evaluation also considered similar combined effects from the Fission Patterson Lake South Property, the identified RFD for the economy assessment.

Project characteristics that have the potential to affect the economy during the Project lifespan include:

- estimated capital expenditures of $1.3 billion over the four years of Construction;
- a peak construction workforce of approximately 350 workers, with actual on-site labour requirements varying throughout Construction;
- typical annual operating spending of $167 million;
- an operations workforce, including a forecasted 486 direct jobs during the operating peak and approximately 425 direct jobs during a typical year of Operations;
- spending during Closure; and
- aspirational targets established by NexGen Energy Ltd. (NexGen) for hiring workers from LSA communities (i.e., 75%) and external spending awarded to LSA and RSA businesses (i.e., 30%).

As part of the pathways analysis, proposed mitigation measures were considered to determine whether adverse effects on the economy could be avoided or reduced to negligible levels, thereby removing the pathway. For beneficial pathways, enhancement measures and actions were also considered.

Proposed mitigation and enhancement measures, such as the delivery of certified and accredited training and recruitment programs, development of culturally sensitive employment policies, and increasing involvement of local businesses within the LSA would reduce adverse effects and enhance beneficial effects on the economy. In addition to these mitigation and enhancement measures, NexGen has negotiated and signed Benefit Agreements with all four primary Indigenous Groups in the LSA. Although details of these agreements are confidential and have not been finalized for all Indigenous Groups, they are premised on commitments including proactively engaging with local communities; supporting the economic participation of affected communities; seeking to provide opportunities resulting in sustainable, lasting benefits to local communities beyond the Project lifespan; and providing clear and timely information to those who have a direct interest in the Project. Implementation of items agreed to in Benefit Agreements is also expected to reduce adverse effects and enhance beneficial effects on the economy.

Similar mitigation, adaptive management practices, and enhancement measures would also be expected to be implemented by the Fission Patterson Lake South Property.

After mitigation measures were considered, the pathways analysis determined that all potentially adverse pathways from the Project to the environment could be removed from the assessment. Therefore, no pathways were carried forward into the residual effects analysis.

Beneficial Pathways

Overall, the proposed Project is expected to result in substantial net positive economic outcomes for the LSA and RSA, which would have cascading effects on a range of socio-economic variables, including education and training, health, and well-being.

Beneficial pathways were not carried forward for further assessment or assessed for significance; however, these pathways do provide important context for how residents and communities are likely to experience the Project.

Employment

Specific benefits from the proposed Project would include increased employment opportunities for LSA residents. During Construction, the Project could result in between 8,200 and 10,500 direct, indirect, and induced full-time equivalent (FTE) positions over the four-year period. During Operations, direct, indirect, and induced employment is estimated to range between 950 and 1,200 FTE positions during a typical operating year. Should the aspirational target of 75% local employment be achieved, an estimated 365 positions during Operations would be filled by members of the LSA. Employment would continue during Closure, but at a decreased level compared to Operations.

Income

The proposed Project would provide a substantial positive benefit through increased income opportunities, particularly for LSA residents. Construction labour costs are estimated to make up approximately $384 million, or 30% of the total capital cost of the Project. The total direct, indirect, and induced labour income for Construction could range between $730 million and $885 million. During Operations, direct labour spending is estimated to be approximately $55 million during a typical operating year. The total direct, indirect, and induced labour income for a typical operating year could range between $94 million and $112 million. Income opportunities would continue during Closure, but at a decreased level compared to Operations.

Education and Training

The Project would provide positive benefits for educational attainment in the LSA through increased education and training opportunities for local residents. NexGen would provide training opportunities for the workforce. In addition to obtaining necessary skills to acquire employment, this training could allow employees to advance to more senior and higher-income employment within the organization and improve their ability to obtain other employment in the future. Training opportunities could also result in a higher-skilled local workforce, which would have benefits for both the Project and the LSA as a whole. This benefit could extend beyond the Project lifespan.

Business and Contracting

The proposed Project would provide a positive benefit through increased business and contracting opportunities throughout Construction and Operations. Benefits would continue during Closure, but at a decreased level. NexGen would evaluate opportunities to both procure goods and services from existing sources in the LSA and develop and expand local business capacity. These opportunities are anticipated to result in new revenue sources for existing local businesses and the facilitation of new business start-ups. Local study area residents noted a strong interest in expanding local business opportunities, including ownership interests in businesses.

Broader Economic Benefits

Overall, the Project is estimated to have a direct, indirect, and induced impact on national GDP of up to $1.3 billion over the course of Construction, and up to $1.1 billion in a typical year of Operations. The Project would also generate benefits through the payment of taxes and royalties to the governments of Saskatchewan and Canada. These government revenue sources would include uranium royalties, resource surcharges, mineral surface lease payments, corporate income tax, and individual income tax. The total estimated direct payments to government for a typical operating year are estimated at $288.5 million for Saskatchewan and $103.9 million for Canada. Benefit Agreements with primary Indigenous Groups would include payments based on revenue generated throughout the life of the Project.

Residual Effects Analysis (Section 18.5)

As no pathways were required to be carried forward from the pathways analysis, a residual effects analysis for the economy VC was not required.

Significance Determination (Section 18.5)

As no pathways were required to be carried forward from the pathways analysis, the effects to the economy VC are predicted to be **not significant.**

Prediction Confidence and Uncertainty (Section 18.6)

Overall, there was a moderate degree of confidence in predictions related to the economy assessment. Uncertainty was primarily and appropriately addressed by making assumptions that conservatively overestimated rather than underestimated potential adverse effects (i.e., a precautionary assessment). In describing beneficial pathways, the precautionary approach was applied by describing the potential magnitude and distribution of benefits conservatively. This approach increases confidence that benefits are described in a way that is less likely to overstate potential benefits.

Monitoring and Follow-Up (Section 18.7)

Monitoring and follow-up would be conducted to confirm effects predictions and address potential uncertainty. Monitoring would also be performed to track progress against long-term targets and identify opportunities to further enhance outcomes. Follow-up and monitoring programs would be used to:

- monitor progress on achieving employment and contracting targets and identify opportunities to improve employment and contracting outcomes;
- maintain ongoing communication and dialogue with local communities to identify and resolve issues; and
- contribute to the overall continual improvement of the Project.

In the Benefit Agreements with Indigenous Groups, NexGen has committed to establishing an Implementation Committee that would facilitate an effective, ongoing working relationship between NexGen and the Indigenous Group and verify that all commitments made within the Benefit Agreements are realized.

Abbreviations and Units of Measure

Abbreviation	Definition
BNDN	Birch Narrows Dene Nation
BRDN	Buffalo River Dene Nation
CNSC	Canadian Nuclear Safety Commission
CRDN	Clearwater River Dene Nation
CVMPP	Community Vitality Monitoring Partnership Process
EA	Environmental Assessment
EIS	Environmental Impact Statement
ENV	Saskatchewan Ministry of Environment
FTE	full-time equivalent
GDP	gross domestic product
I/O	input/output
IKTLU	Indigenous Knowledge and Traditional Land Use
Joint Panel	Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan
JWG	Joint Working Group
KP	key person
LPA	local priority area
LSA	local study area
MN-S	Métis Nation – Saskatchewan
MPTP	Multi-Party Training Plan
MSLA	Mineral Surface Lease Agreement
NexGen	NexGen Energy Ltd.
NR	Northern Region 2
Project	Rook I Project
RCMP	Royal Canadian Mounted Police
RFD	reasonably foreseeable development
RSA	regional study area
TSD	technical support document
VC	valued component

Unit	Definition
%	percent
$	Canadian dollars unless otherwise stated
km	kilometre

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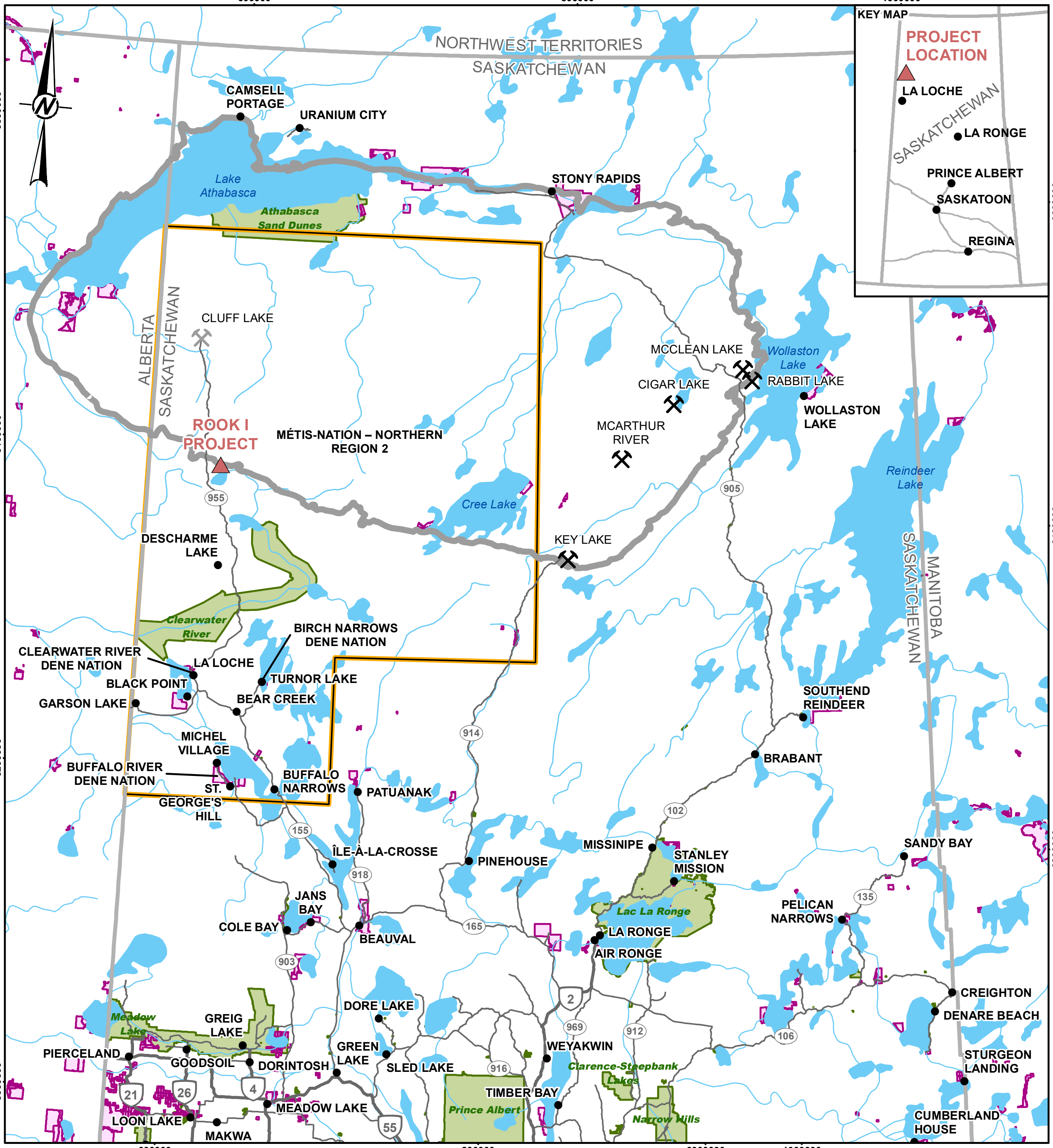
18 Economy

18.1 Introduction

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The Project would be located approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the Northern Village of La Loche, and 640 km northwest of the city of Saskatoon (Figure 18.1-1). The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Patterson Lake is at the interface of the Boreal Shield and Boreal Plain ecozones. Access to the Project would be from an existing road off Highway 955 (Figure 18.1-2), with on-site worker accommodation serviced by fly-in/fly-out access.

Section 18, Economy, of the Environmental Impact Statement (EIS) characterizes the potential residual effects of the Project on the economy, which is an attribute of the socio-economic environment. The economy represents a valued component (VC) for the Environmental Assessment (EA). The Project is predicted to create employment, contracting, and training opportunities for the local community workforce and businesses and generate taxes, royalties, and other payments that may increase the revenues of provincial and federal governments. To this end, it is anticipated that the Project would create positive economic and fiscal effects on the socio-economic conditions in the local communities, Saskatchewan, and Canada. Economic indicators are also recognized as determinants of health and well-being. Information on employment, income, education, and training opportunities associated with the Project described in this section was used to support the assessment of community well-being (Section 19). During engagement sessions, local residents expressed interest in employment, income, and business opportunities related to the Project. First Nations and Métis groups, collectively referred to as Indigenous Groups, also emphasized the importance of the traditional or subsistence economies. Detailed statistical information supporting the analysis of potential effects on the economy are presented in Appendix 18A, Socio-economic Statistical Data.

A simplified linkage diagram, Figure 18.1-3, illustrates how proposed Project activities could affect the economy VC and how the community well-being VC could be influenced through changes to the economy.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN BOUNDARY
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROJECT LOCATION
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LOCATION OF THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 18.1-1

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\18_Economy\8_5x11\20144150_Fig18_1-1_Location-of-the-Rook-I-Project_NoTitleblock_Rev0.mxd PRINTED ON: 2023-02-10 AT: 6:57:44 AM

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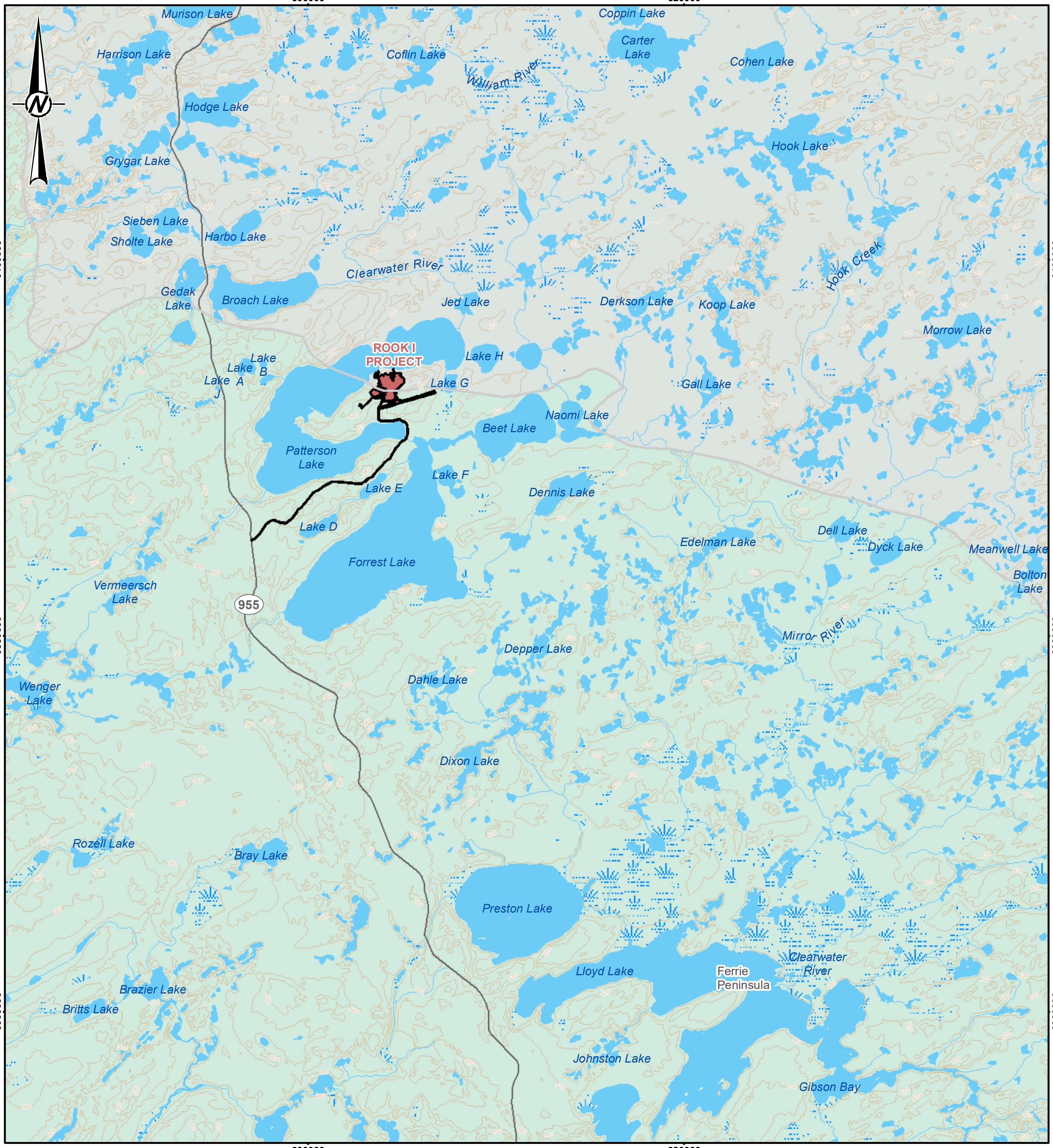

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN
- WATERBODY
- WETLAND
- WOODED AREA
- PROPOSED PROJECT FOOTPRINT

0 5 10

1:300,000 KILOMETRES

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 18.1-2

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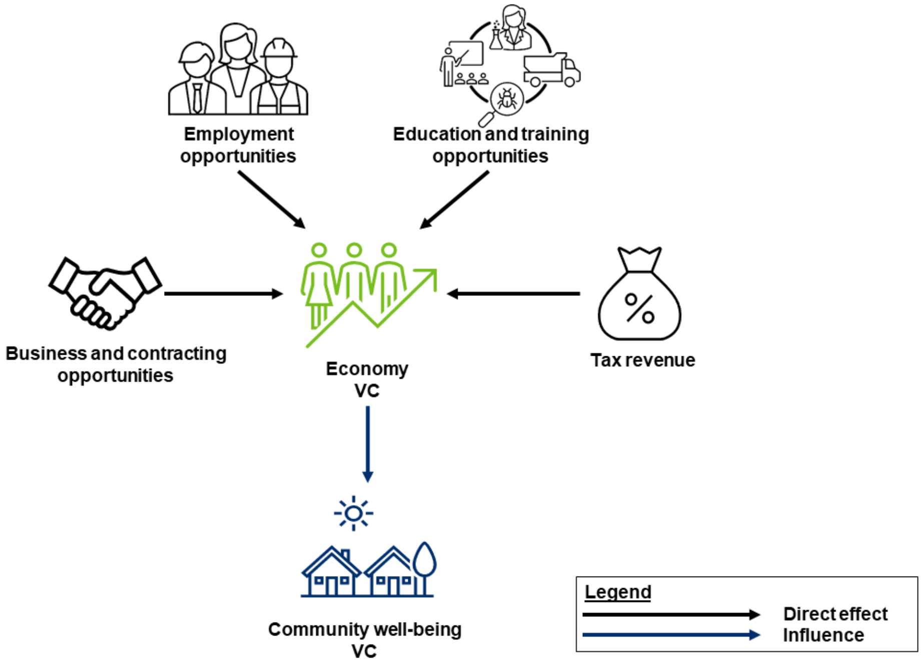
Figure 18.1-3: Linkage Diagram of Project Effects on Economy and Influenced Valued Components



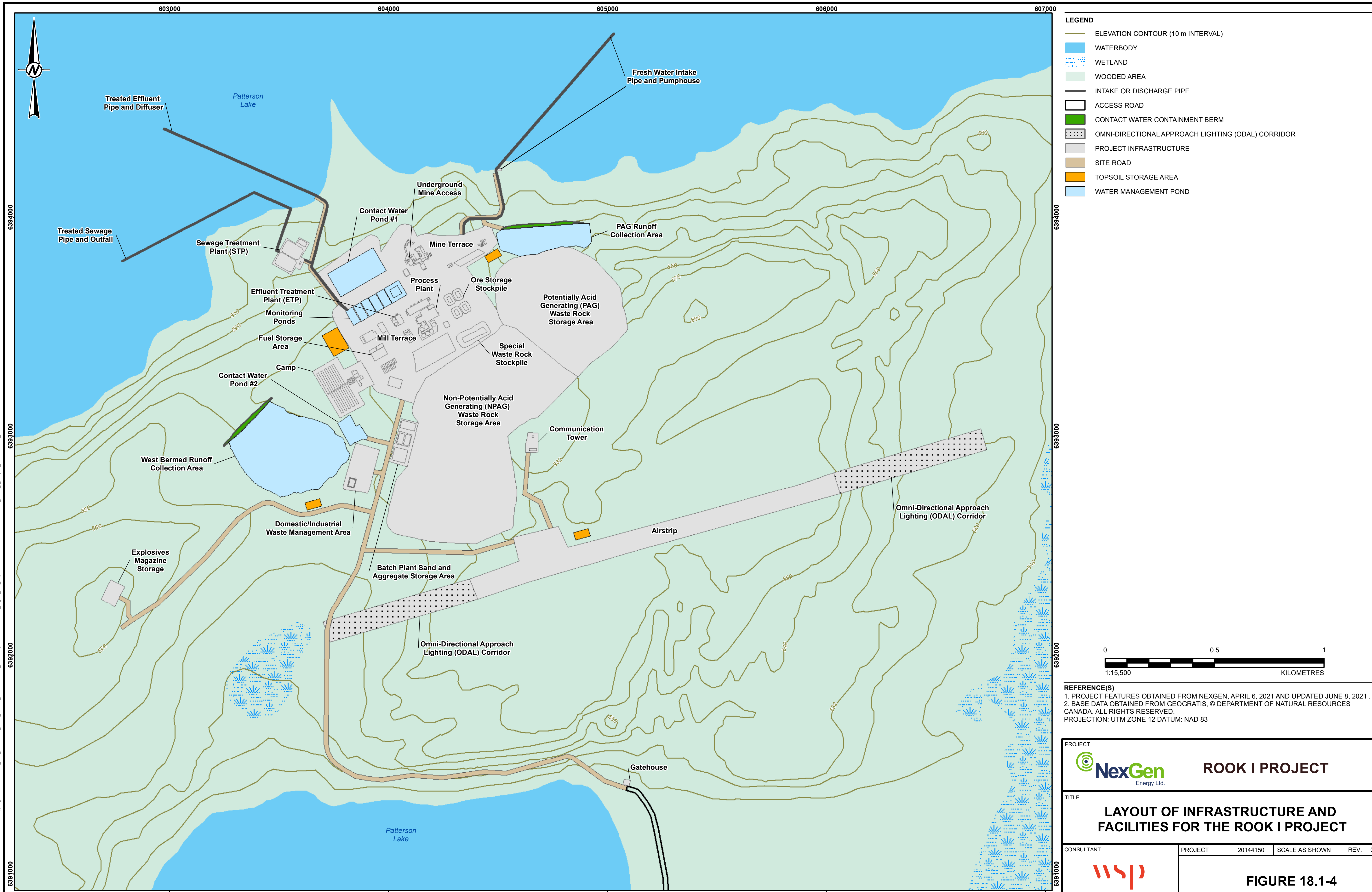
VC = valued component.

18.1.1 Project Summary

The Project would include the following key facilities to support the extraction and processing of uranium from the Arrow deposit for transportation off site (Figure 18.1-4):

- underground mine development;
- process plant buildings, including uranium concentrate packaging facilities;
- paste tailings distribution system;
- underground tailings management facility;
- potentially acid generating waste rock storage area;
- non-potentially acid generating waste rock storage area;
- special waste rock[2] and ore storage stockpiles;
- surface and underground water management infrastructure, including water management ponds, effluent treatment plant, and sewage treatment plant;
- conventional waste management facilities and fuel storage facilities;
- ancillary infrastructure, including maintenance shop, warehouse, administration building, and camp;
- airstrip and associated infrastructure; and
- access road to Project and site roads.

[2] Special waste rock is mine rock that is mineralized with insufficient grade to be considered ore (i.e., greater than 0.03% of triuranium octoxide [U_3O_8] and less than 0.26% U_3O_8). All special waste would be temporarily stored in the special waste rock stockpile.



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604000
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Patterson Lake
Treated Effluent Pipe and Diffuser
Treated Sewage Pipe and Outfall
Fresh Water Intake Pipe and Pumphouse
Underground Mine Access
Contact Water Pond #1
Sewage Treatment Plant (STP)
Mine Terrace
PAG Runoff Collection Area
Process Plant
Ore Storage Stockpile
Effluent Treatment Plant (ETP)
Potentially Acid Generating (PAG) Waste Rock Storage Area
Monitoring Ponds
Fuel Storage Area
Mill Terrace
Special Waste Rock Stockpile
Camp
Contact Water Pond #2
Non-Potentially Acid Generating (NPAG) Waste Rock Storage Area
Communication Tower
West Bermed Runoff Collection Area
Omni-Directional Approach Lighting (ODAL) Corridor
Domestic/Industrial Waste Management Area
Airstrip
Explosives Magazine Storage
Batch Plant Sand and Aggregate Storage Area
Omni-Directional Approach Lighting (ODAL) Corridor
Gatehouse
Patterson Lake
LEGEND
ELEVATION CONTOUR (10 m INTERVAL)
WATERBODY
WETLAND
WOODED AREA
INTAKE OR DISCHARGE PIPE
ACCESS ROAD
CONTACT WATER CONTAINMENT BERM
OMNI-DIRECTIONAL APPROACH LIGHTING (ODAL) CORRIDOR
PROJECT INFRASTRUCTURE
SITE ROAD
TOPSOIL STORAGE AREA
WATER MANAGEMENT POND
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REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021 AND UPDATED JUNE 8, 2021 .
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83
PROJECT
NexGen Energy Ltd.
ROOK I PROJECT
TITLE
LAYOUT OF INFRASTRUCTURE AND FACILITIES FOR THE ROOK I PROJECT
CONSULTANT
wsp
PROJECT 20144150
SCALE AS SHOWN
REV. 0
FIGURE 18.1-4

18.1.2 Purpose and Approach to the Assessment

The purpose of Section 18 is to provide a detailed and comprehensive assessment of all potential Project-specific effects and cumulative effects from the Project and other previous, existing, and reasonably foreseeable developments (RFDs), if applicable, on the economy. This section meets the Terms of Reference for the Project submitted to the Saskatchewan Ministry of Environment (ENV) and the Canadian Nuclear Safety Commission (CNSC) *Generic Guidelines for the Preparation of an Environmental Impact Statement – Pursuant to the Canadian Environmental Assessment Act, 2012* (Appendix 1A, Concordance Tables). The assessment of effects on the economy followed the overall EA approach and methods (Section 6, Environmental Assessment Approach and Methods) and includes the following primary steps:

Step 1 – Define component-specific methods (Section 18.2): presents the specific approaches and methods used to measure and assess the effects of the Project on the economy as well as cumulative effects from the Project, other previous and existing projects and activities, and RFDs, if applicable.

Step 2 – Characterize existing conditions (Section 18.3): describes and characterizes existing economic conditions to provide context and a basis for evaluating potential changes to the economy caused by the Project.

Step 3 – Evaluate Project interactions and mitigations (Section 18.4): identifies Project components and/or activities with the potential to affect the economy (both positive and adverse effects) and provides environmental design features and mitigation policies and actions committed to by NexGen to avoid or minimize potential adverse effects and enhance benefits. A pathways analysis was used to focus further assessment on key interactions between the Project and the economy by evaluating the different effects pathways to determine if, after incorporation of mitigation, there is still potential to cause residual adverse effects. Primary pathways anticipated to result in residual adverse effects after incorporation of mitigation are carried forward to Step 4 for further analysis. Where potential adverse effects are adequately mitigated and thus not forwarded for further analysis (i.e., where mitigation results in negligible effects or avoids the pathway altogether), the reasons for concluding the assessment at this stage are provided.

Step 4 – Analyze residual effects (Section 18.5): evaluates and describes the potential adverse Project effects on the economy that are anticipated to occur through the primary pathways. The residual effects analysis is presented as an integrated narrative that describes the effects of the Project over time and highlights predicted effects at the point when effects of the Project are expected to be greatest. This step also includes an analysis of residual cumulative effects from the Project, other previous and existing projects and activities, and RFDs. Potential positive effects on the economy from the Project are identified and described in Section 18.4, Project Interactions, Mitigations, and Benefit Enhancements, but are not further analyzed in Section 18.5, Residual Effects Analysis.

Step 5 – Classify residual effects and determine significance (Section 18.5): summarizes the results of the residual effects analysis using effects criteria (i.e., direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence). Significance is determined using the results of the residual effects analysis and classification. Significance is determined for adverse effects only (i.e., significance was not determined for positive effects) and for the maximum adverse effects of the Project and the cumulative effects from the Project, other previous and existing projects and activities, and RFDs.

Step 6 – Describe uncertainty and define prediction confidence (Section 18.6): identifies key uncertainties and explains how these uncertainties have been addressed to achieve a conservative, precautionary assessment. The implications of the approaches used to address uncertainties and the level of confidence in the residual effects analysis are discussed.

Step 7 – Identify monitoring and follow-up (Section 18.7): outlines the proposed actions to verify predicted residual effects. The purpose of these action is to evaluate effectiveness of planned mitigation designs, policies, and practices, and address key sources of uncertainty.

18.2 Component Methods

18.2.1 Incorporation of Indigenous and Local Knowledge

Indigenous and Local Knowledge related to economy was shared by potentially affected First Nations and Métis Groups (collectively referred to as Indigenous Groups) and local priority area (LPA) community members through the engagement process for the Project. The LPA consists of the local communities closest to the Project that would experience most of the Project effects and for which NexGen would prioritize local training, employment and business opportunities for the Project. These communities are located along, or accessed via, Highways 155 and 955 north of the intersection of Highways 155 and 925 and include the following communities (Figure 18.2-1):

- Clearwater River Dene Nation (CRDN);
- Clearwater Clear Lake (Métis Nation – Saskatchewan [MN-S] name for Northern Region 2 [NR2]);
- La Loche (Local 39);
- Birch Narrows Dene Nation (BNDN);
- Turnor Lake (Local 40);
- Buffalo River Dene Nation (BRDN) / Dillon;
- Buffalo Narrows (Local 62);
- Bear Creek (Local 156);
- Descharme Lake;
- Garson Lake;
- Black Point (Local 162);
- Michel Village (Local 65); and
- St. George's Hill (Local 70).

The overall approach and methods for the incorporation of Indigenous and Local Knowledge into the EA is discussed in detail in Section 3, Indigenous and Local Knowledge. Issues and concerns related to the economy raised by Indigenous Groups and LPA community members, and how these comments were addressed, are summarized in Appendix 2B, Summary of Issues and Concerns Identified by Indigenous Groups, and identified and addressed in this assessment, where applicable.

A key source of Indigenous and Local Knowledge is the Project-specific studies completed by Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, and Indigenous Rights and Knowledge studies (henceforth referred to collectively as Indigenous Knowledge and Traditional Land Use [IKTLU] Studies). The IKTLU Studies that were reviewed and referenced in the EIS as technical support documents (TSDs) are listed below:

- TSD II (BNDN), Birch Narrows Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;

- TSD III (BRDN), Buffalo River Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;
- TSD IV (MN-S), Métis Nation – Saskatchewan Northern Region 2 Traditional Land Use & Diet Study for the NexGen Rook I Project;
- TSD V.1 (CRDN), Preliminary Identification of Issues and Concerns Related to the Proposed NexGen Energy Ltd. Rook I Project in the Patterson Lake Area; A Review; Clearwater River Dene Nation; Traditional Land Use and Occupancy Mapping Interviews; 2010 – 2016;
- TSD V.2 (CRDN), Clearwater River Dene Nation Indigenous Rights and Knowledge Survey Related to the Proposed NexGen Energy Ltd. Rook 1 Project in the Patterson Lake Area;
- TSD V.3 (CRDN), Clearwater River Dene Nation Socio-economic and Harvest Study for the NexGen Energy Ltd. Rook 1 Project; and
- TSD VI (YNLR), Provision of Athabasca Denesųłiné Traditional Knowledge, Land Use and Occupancy Information for the NexGen Rook I Project Environmental Assessment.

Another key source of Indigenous and Local Knowledge was information shared by Indigenous Group representatives during Joint Working Group (JWG) meetings. The JWGs represent an agreed upon primary engagement mechanism as outlined in the Study Agreements signed by each of the primary Indigenous Groups and NexGen. More details regarding the JWGs can be found in Section 2, Indigenous, Regulatory, and Public Engagement and Section 3. There are four JWGs with the Project's primary Indigenous Groups (Section 2.4.1, Identification of Indigenous Groups for Engagement):

- CRDN JWG;
- MN-S JWG representing MN-S Northern Region 2 (NR2);
- BNDN JWG; and
- BRDN JWG.

The leadership of each Indigenous Group selected their JWG participants with consideration of group diversity; where possible, members included Elders, youth, different genders, a range of ages, and land users around Patterson Lake.

In addition to the IKTLU Studies and JWGs, Indigenous and Local Knowledge shared during specific engagement activities undertaken through the EA development process was incorporated into the assessment, where appropriate. These engagement activities included, but were not limited to:

- community information sessions held in four locations in 2019 (NexGen 2019a);
- site tours;
- comments from the CRDN (2019a) on the Cluff Lake Mine licence renewal;
- other formal and informal meetings;
- workshops with specific groups (e.g., Fur Block N-19 trapper's workshop); and
- environmental and socioeconomic baseline data collection.

Comments submitted by Indigenous Groups on the Project Description (CRDN 2019b; MN-S 2019; YNLRO 2019; ACFN 2019; CNSC 2019) were also reviewed for applicable Indigenous and Local Knowledge.

Indigenous and Local Knowledge related to economy was incorporated into the assessment by viewing the information as complementary and influential alongside scientific information. Where possible, knowledge from each potentially affected Indigenous Group or LPA community member was described separately and cited accordingly. Where information is described for multiple potentially affected Indigenous Groups, they are collectively referred to as "Indigenous Groups" throughout the assessment.

Indigenous and Local Knowledge was included in the economy assessment in the following ways:

- **Component Methods – VCs:** Indigenous and Local Knowledge was considered in the selection of the VC of economy and reflects the importance of the traditional economy to Indigenous Groups and LPA communities by contributing to the economic and community well-being of people and communities.
- **Existing Conditions – Economy:** Indigenous and Local Knowledge is reflected in the description of the existing economic conditions, which includes the following:
  - changes to primary industry over time;
  - the prevalence of temporary jobs (i.e., short-term work) versus the number of careers (i.e., long-term work);
  - types of industries and different employment opportunities by gender;
  - the types of traditional economic activities that are undertaken;
  - factors that influence how and when people participate in the traditional economy;
  - the understanding of participation trends in the traditional and wage economies, and how government transfers can affect participation in both;
  - how people in the local communities interact with and move between the wage economy and the traditional economy; and
  - how community members view money and savings.
- **Project Interactions and Mitigation:** Indigenous and Local Knowledge helped to inform the scoping of Project interactions, pathway analysis, and consideration of mitigation measures (Section 18.4). If required, additional mitigations would be developed with opportunities for inputs from Indigenous Groups and LPA communities to limit adverse effects on the economy and enhance the potential for positive outcomes.
- **Monitoring, Follow-Up, and Management:** Feedback provided by Indigenous Groups during engagement, including recommendations, were considered in the development of monitoring and follow-up activities (Section 18.7). In addition, it is planned that ongoing feedback from Indigenous Groups on the effectiveness of mitigations would be considered when updating monitoring programs and management plans.

Specific references to Indigenous and Local Knowledge, and Project comments and concerns related to economy raised by Indigenous Groups and LPA community members, are included in the applicable sections of this assessment.

18.2.2 Valued Components, Measurement Indicators, and Assessment Endpoints

18.2.2.1 Valued Components

Valued components are aspects of the biophysical, cultural, and socio-economic environments that are considered to have scientific, social, cultural, economic, historical, archaeological, or aesthetic importance (Beanlands and Duinker 1983; CNSC 2021). The BNDN and BRDN define VCs as tangible biophysical resources (e.g., particular places and species) and less tangible social, economic, cultural, health, and knowledge-based values (e.g., social cohesion, place names, Indigenous language) (TSD II: BNDN; TSD III: BRDN).

Valued components were identified using many factors (Section 6.3.1, Valued Components) such as:

- potential for interaction with the Project and degree of interaction, including presence, abundance, and amount of spatial overlap of a VC with the Project;
- sensitivity of a VC to potential Project effects and level of damage or harm that could be realized should an adverse effect occur;
- ecological and socio-economic/cultural value to Indigenous Groups and local communities, government agencies, and the public;
- recent experience with similar projects in Saskatchewan and other jurisdictions in Canada; and
- avoidance of redundancy with other VCs; if two potential VCs represent the same issues, mitigation actions, and potential effects from the Project, only one was evaluated as part of the assessment.

Selection of economy as a VC was informed by Indigenous and Local Knowledge obtained from information provided by IKTLU Studies (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR), feedback during community engagement sessions for the Project in La Loche, Turnor Lake, Buffalo River, and Buffalo Narrows (Section 2 and Section 3), and input from the JWGs.

Local study area (LSA) community members (Section 18.2.3, Spatial Boundaries) reported that the traditional economy makes important contributions to the economic well-being of people and communities. The CRDN noted that harvesting activities were an expression of Denesųłiné livelihood, an economic system where CRDN members are directly connected to food supplies and to the land from which the foods are derived (TSD V.2: CRDN). A BNDN member noted that at times in the past they relied on very little store-bought food as a substantial portion of their food was provided through traditional economic activities (BNDN-JWG 2021a). The BRDN members have indicated that meat obtained through hunting, trapping, and fishing are important food sources that support households and the community (TSD III: BRDN). Both the BNDN and BRDN indicated that approximately 80% of their members are active in the traditional economy (BNDN-JWG 2021a; BRDN-JWG 2021a).

Participation in the traditional economy varies by LSA community but members have estimated that the majority of community members participate in some form of traditional economy activities (BNDN-JWG 2021a; BRDN-JWG 2021a; TSD IV: MN-S). The ability to participate in the traditional economy depends on having access to a healthy land base, and availability of abundant and high-quality resources (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN).

18.2.2.2 Measurement Indicators

Measurement indicators are used to characterize changes to attributes of the environment from the Project, other human developments, and natural factors. The changes in measurement indicators are used to predict overall effects on VCs and assessment endpoints (Section 6.3.2, Assessment Endpoints and Measurement Indicators). Nine measurement indicators were identified for the economy VC (Table 18.2-1):

- local population levels:
  - Project-induced in-migration[3] and out-migration[4], and population demographic changes;
- Project-related employment:
  - labour force participation rate, labour force growth, employment/unemployment rates, and employment by industry;
- Indigenous community participation and employment in the traditional economy;
- income:
  - personal income and household income, and wage income and traditional economy income;
- training and education opportunities:
  - types of opportunities, number of positions and placement rates, and educational attainment - with each indicator measured by age cohort and gender, where possible;
- Project-related contracting opportunities;
- Project-related procurement expenditures:
  - purchase of goods and services generated by the Project, including direct expenditures, indirect expenditures (i.e., by sectors supplying goods and services to the Project), and induced expenditures, if possible (i.e., by businesses providing goods and services to satisfy consumer expenditures generated by direct and indirect employment);
- business counts (indirect and induced) in the LPA; and
- federal and provincial government revenues consisting of direct resource royalties and corporate and personal income taxes paid to the governments of Saskatchewan and Canada.

Where possible, these measurement indicators were evaluated quantitatively (e.g., direct employment opportunities with the proposed Project), though in some circumstances qualitative collection methods like surveys were necessary (e.g., induced employment and business growth). These measurement indicators align with key economic metrics identified by the CRDN (e.g., local economic and training benefits; TSD V.3: CRDN).

18.2.2.3 Assessment Endpoints

Assessment endpoints are qualitative expressions that represent the key properties of VCs that should be protected; as such, assessment endpoints incorporate the concept of sustainability and function as significance thresholds (Section 6.3.2).

[3] In-migration refers to individuals who move into a particular region.
[4] Out-migration refers to individuals who move away from a particular community or region.

The significance of effects from the Project and other human developments to the economy VC was evaluated by linking changes in measurement indicators to the influence on the assessment endpoints (Table 18.2-1). However, incremental and cumulative influences from projects on economy VCs are typically beneficial.

Table 18.2-1: Valued Component, Rationale, Measurement Indicators, and Assessment Endpoints

VC	Rationale	Measurement Indicators	Assessment Endpoints
Economy	▪ Changes in employment, business, and income opportunities may affect population in-migration and out-migration ▪ Project workforce hiring and contract opportunities may affect employment, income, training opportunities, and opportunities to participate in the traditional economy ▪ Project expenditures for supplies and services may affect opportunities for existing and new businesses ▪ Project-related payments to government may affect government revenues	▪ Local population levels ▪ Project-related employment ▪ Indigenous community participation and employment in the traditional economy ▪ Income (including both wage income and traditional economy income) ▪ Training, and educational opportunities ▪ Project-related contracting opportunities for businesses in local communities ▪ Project-related procurement expenditures ▪ Business counts ▪ Federal and provincial government revenues	▪ Enhancing the participation of local Indigenous and non-Indigenous individuals in employment, income, education, and training opportunities ▪ Enhancing Indigenous and locally owned businesses opportunities ▪ Enhancing government revenue ▪ Maintaining opportunities to participate in the traditional economy

VC = valued component.

18.2.3 Spatial Boundaries

The LSA for the assessment of effects on the economy includes the LPA communities that are either along Highway 155 or have close ties to Patterson Lake. These communities are anticipated to experience most of the direct effects on the economy related to the Project through inclusion in NexGen's LPA for employment, training, and income opportunities. Communities and Indigenous Groups in the LSA (Figure 18.2-1), include:

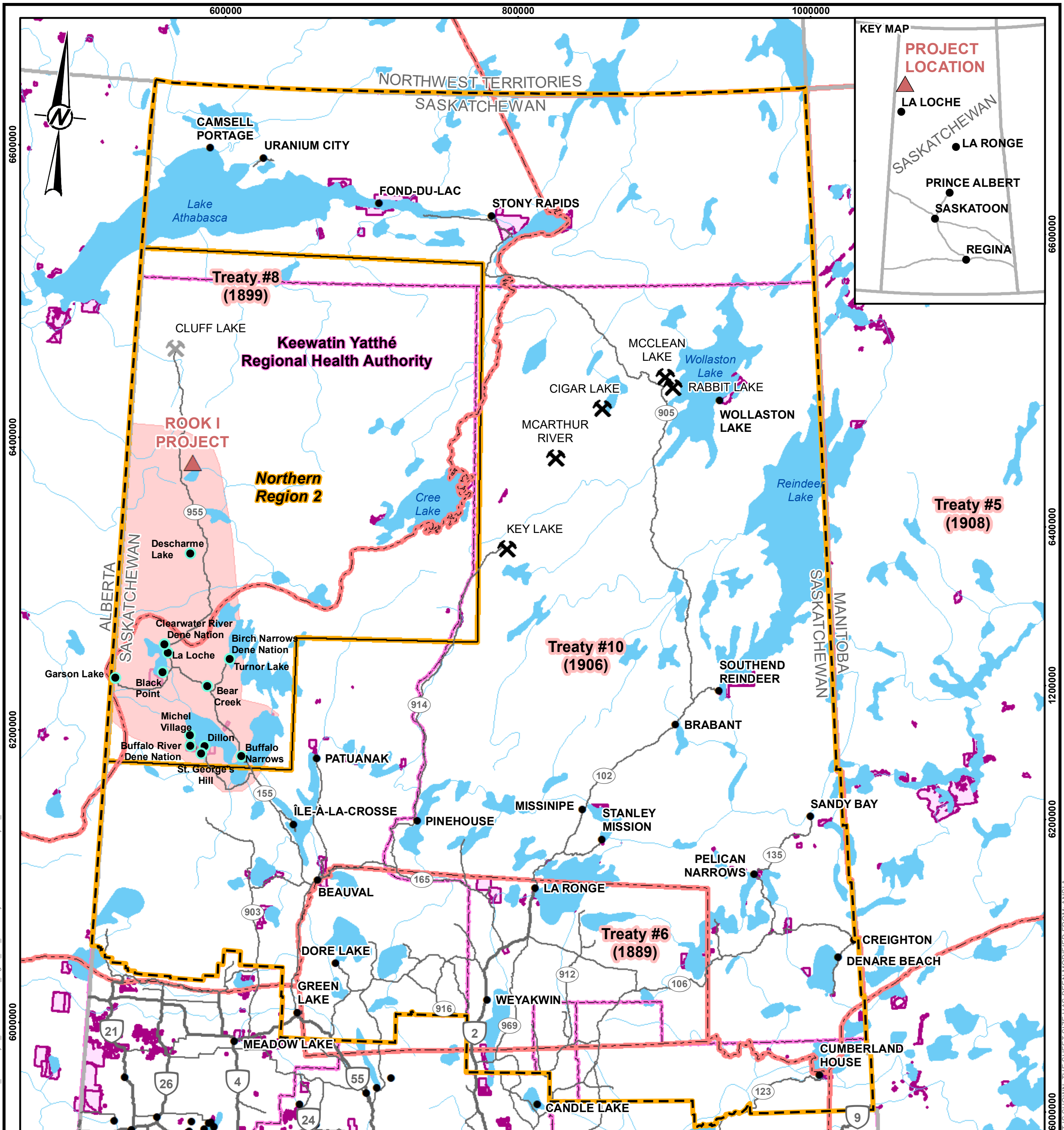
- CRDN;
- Clearwater Clear Lake (MN-S name for NR2);
- La Loche (Local 39);
- BNDN;
- Turnor Lake (Local 40);
- BRDN / Dillon;
- Buffalo Narrows (Local 62);
- Bear Creek (Local 156);
- Descharme Lake;
- Garson Lake;
- Black Point (Local 162);
- Michel Village (Local 65); and
- St. George's Hill (Local 70).

All Indigenous Groups within the LSA are reflected in the list, including the MN-S NR2, which is represented through the communities and their respective Locals within the LSA (including Clearwater Clear Lake, which is the Métis name for the area).

The regional study area (RSA; Figure 18.2-1) is the Northern Saskatchewan Administrative District as defined in *The Northern Municipalities Act, 2010* and has the same boundaries as Statistics Canada Census Division 18. The RSA was chosen primarily for two reasons:

- The proposed Project is located on Crown Land in the Northern Saskatchewan Administrative District and would therefore require a Mineral Surface Lease Agreement (MSLA) to operate (Government of Saskatchewan 2021a). It is expected the lease would include a range of provisions about land tenure, environmental protection measures, occupational health and safety, and reporting on socio-economic benefits for all residents of the Northern Saskatchewan Administrative District and be based on other MSLAs issued by the government (Government of Saskatchewan 2018). Therefore, communities and Indigenous Groups in the broader RSA are also expected to experience some direct employment, income, and training benefits from the Project. Many of these types of benefits are also contemplated as part of the Benefit Agreement processes with LSA Indigenous Groups. These are described in more detail in Section 18.4.
- The RSA represents the spatial area where cumulative direct and indirect Project effects combined with cumulative effects of any other RFDs would be experienced.

Effects on government revenues are examined at the provincial and national level (i.e., beyond RSA scale).



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- WATERBODY
- PROJECT LOCATION
- ECONOMY LOCAL STUDY AREA COMMUNITIES
- ECONOMY REGIONAL STUDY AREA
- FIRST NATION TREATY BOUNDARIES
- HEALTH REGIONS
- LOCAL PRIORITY AREA
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

ECONOMY LOCAL AND REGIONAL STUDY AREAS

CONSULTANT

wsp

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18.2.4 Temporal Boundaries

The temporal scope of the assessment focuses on the 43-year period from initial Construction to the end of Decommissioning and Reclamation (i.e., Closure) as defined by the following Project phases (Section 6.4.2, Temporal Boundaries):

- **Construction Phase (Construction):** includes site preparation; mine, process plant, and additional infrastructure development; transportation of people and materials to and from the Project; and all activities associated with commissioning the Project up until Operations commences. The duration of Construction is expected to be four years.
- **Operations Phase (Operations):** includes all activities associated with mining and processing ore; tailings management; management of waste rock, domestic waste, and hazardous materials; water management; release of treated effluent; site maintenance; progressive reclamation; and transportation of staff and materials to and from the Project up until Decommissioning and Reclamation commences. The duration of Operations is expected to be 24 years.
- **Decommissioning and Reclamation Phase (Closure):** includes two stages expected to occur over 15 years:
  - **Active Closure Stage:** includes active decommissioning and reclamation activities that occur post-Operations, such as backfilling mine workings, removal of physical infrastructure, recontouring and revegetating disturbed areas, waste disposal and removal, and any other activities required to achieve decommissioning objectives and return the site to a safe and stable condition prior to the Transitional Monitoring Stage. The duration of the Active Closure Stage is expected to be five years.
  - **Transitional Monitoring Stage:** includes monitoring and reporting activities that occur post-Active Closure that would continue until monitoring and reporting verifies that the performance criteria have been met. Once performance criteria have been fully demonstrated, an application to be released from the CNSC licence would be submitted to the CNSC for approval. Once that is achieved, and upon Provincial approval, the land would be transferred under Provincial management through the Institutional Control Program. The duration of the Transitional Monitoring Stage is nominally 10 years; however, NexGen acknowledges this duration would be dependent on the achievement of performance criteria.

For Construction, effects on the economy are described for the entire phase. For Operations, effects on the economy are described based on both the peak employment demand and for employment demand for a typical operating year (Section 5.6, Human Resources). For Closure, effects on the economy are described qualitatively and directionally (Section 18.4).

The temporal boundaries applied to cumulative effects assessments include the duration of residual effects from previous and existing developments that overlap with residual effects from the Project and the period during which the residual effects from RFDs overlap with the Project, if applicable.

18.2.5 Assessment Cases

The concept of assessment cases was applied to the economy assessment to estimate the incremental and cumulative effects from the Project and other developments (Section 6.5, Assessment Cases). The approach incorporated temporal boundaries for analyzing the potential effects from previous, existing, and approved projects and RFDs before, during, and after the anticipated lifespan of the Project. There are no known approved (but not yet constructed) projects in the LSA and RSA for the economy VC. Assessment cases for the Project included a Base Case, Application Case, and RFD Case.

Base Case for economy is represented by existing conditions. The Base Case describes the existing environment in the LSA and RSA before application of the proposed Project to provide an understanding of the current conditions that may be influenced by the Project. The temporal boundary of the Base Case includes the combined effects from previous and existing human developments and economic policies. As such, existing conditions represent the cumulative effects of past and current human developments, activities, and policies that have influenced the observed condition and patterns of the economy (CEA Agency 2018).

Application Case for economy represents predictions of the combined effects of the previous and existing projects/activities and natural factors in the Base Case plus the potential effects from the proposed Project. This case was also used to identify and assess incremental, Project-specific changes that are predicted to occur to the economy.

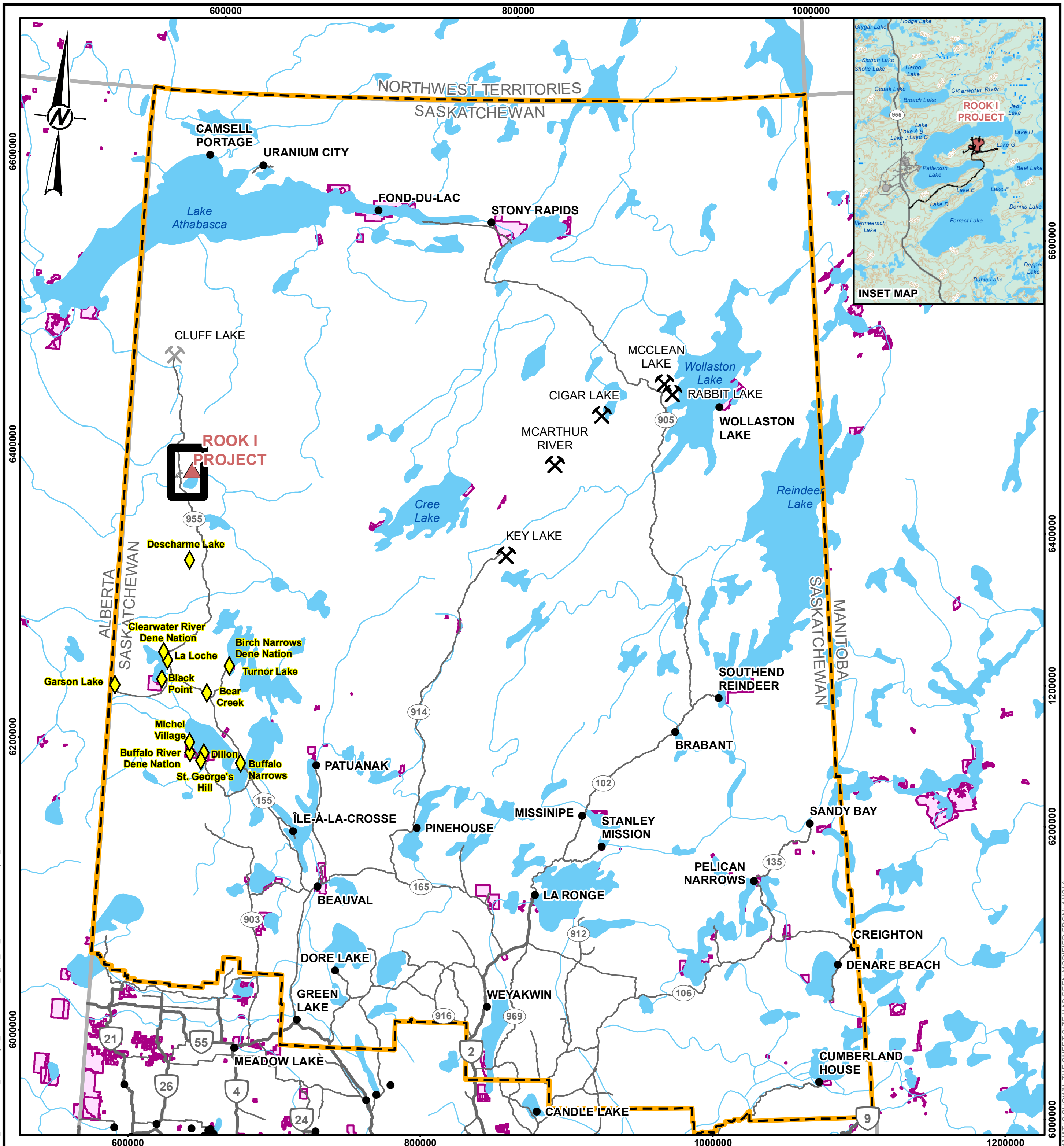
Reasonably Foreseeable Development Case for economy includes the Base Case, Application Case, and RFDs that have not yet been approved. Reasonably foreseeable developments are defined as projects and activities that fit any of the first three and both of the last two criteria from the list below:

- are currently under regulatory review or have officially entered a formal regulatory application process;
- have been publicly disclosed by other proponents;
- may be induced by the Project;
- have the potential to change the Project or the effects predictions; and
- occur in the spatial assessment boundary defined by the VCs.

A key criterion for selecting other projects to include in the RFD Case was that the projects must cause similar effects on the economy influenced by the Project (Hegmann et al. 1999). The Fission Patterson Lake South Property, which is planned by Fission Uranium Corp. (Fission 2019, 2021a), was included in the RFD Case (Figure 18.2-2). Public information describes a projected three-year construction period and seven-year operating period (production and processing) (Fission 2019, 2021a). The anticipated start of construction and duration of active decommissioning at the Fission Patterson Lake South Property were not publicly available at the time this assessment was completed. For the assessment, it was assumed that the duration of active decommissioning for the Fission Patterson Lake South Property would be similar to the Active Closure Stage for the Project (i.e., five years; Section 6.5.3, Reasonably Foreseeable Development Case).

The proposed surface infrastructure layout plan (Fission 2019, 2021a) is the anticipated physical footprint of the Fission Patterson Lake South Property and includes the proposed highway bypass, airstrip, and all proposed mine site infrastructure. The camp is expected to have 270 rooms in nine dormitories with a construction camp located nearby to accommodate a total of 400 persons across 15 dormitories. The CRDN specifically mentioned the potential for cumulative effects from the Project and the nearby proposed Patterson Lake South Property (CRDN 2019b), while JWG processes with all communities identified concerns relative to two projects existing on Patterson Lake (CRDN-JWG 2020; MN-S-JWG 2020a).

The Fission Patterson Lake South Property is currently in the feasibility study stage (Fission 2021b) and has indicated support for IKTLU Studies with local communities. As the Fission Patterson Lake South Property is located near the Project site within the LSA, and expected to draw from the same local and regional (i.e., Northern Saskatchewan) labour force, potential interactions between the Project and the Fission Patterson Lake South Property are described where applicable in the discussion of economic benefits in Section 18.4.4, Primary Pathways.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- WATERBODY
- PROJECT LOCATION
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- ECONOMY LOCAL STUDY AREA COMMUNITIES
- ECONOMY REGIONAL STUDY AREA

0 100 200

1:3,800,000 KILOMETRES

REFERENCE(S)
1. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
3. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

REASONABLY FORESEEABLE DEVELOPMENT IN THE REGIONAL STUDY AREA

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	GE	2023-02-10	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-10		
CHECK	AM	2023-02-10	FIGURE 18.2-2	
REVIEW	KG	2023-02-10		

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\18_Economy\8_5x11\20144150_Fig18_2-2_RFD-RSA-RookI-Project_Rev0.mxd PRINTED ON: 2023-02-10 AT: 6:59:33 AM

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18.2.6 Existing Conditions

The approach to characterizing the existing economic environment expands on methods used for previous uranium projects in Saskatchewan and was developed to meet or exceed both commitments made in the Project Description and regulatory requirements (CNSC 2021; NexGen 2019b). The approach also considered input from communities and Indigenous Groups in the LSA provided through JWGs (BNDN-JWG 2020; BNDN-JWG 2021a; BNDN-JWG 2021b; BRDN-JWG 2020; BRDN-JWG 2021a; CRDN-JWG 2020; MN-S-JWG 2020a) and other engagement mechanisms (Section 2). The approach to documenting the existing economic environment was designed to confirm that sufficient information was collected to describe the current conditions for the defined measurement indicators and assess potential effects of the Project. This process involved the review of:

- regulatory guidance documents;
- previous EAs, particularly for other uranium mining projects in Saskatchewan (e.g., Cluff Lake);
- reports from the Community Vitality Monitoring Partnership (i.e., those established to monitor the socio-economic effects of the uranium mining industry in northern Saskatchewan);
- information provided by LSA residents through a variety of mechanisms to select quantitative indicators;
- quantitative statistical data, as well as the analysis, from several different data sources, including Statistics Canada; and
- qualitative information from Indigenous Groups, service providers (e.g., Buffalo Narrows Economic Development Board), and LSA residents.

The characterization of the existing economic environment included both quantitative (e.g., statistics) and qualitative (e.g., discussions) data collection and analysis in line with Canadian and international best practice for environmental impact studies. Both primary (e.g., IKTLU Studies, interviews, questionnaires, observation, workshops, JWGs) and secondary (e.g., literature/reports, government statistics, organizational data) data sources were used throughout the assessment. Data collection began with a review of existing literature and databases from a variety of public sources and experience with similar projects in Saskatchewan and throughout Canada. Primary data collection was undertaken in the form of key person (KP) interviews. Key person interviews are a standard socio-economic research method that allows assessment practitioners to confirm the reasonableness of quantitative indicators and provide additional context and understanding from people with specific knowledge and experience in the LSA. Joint Working Group discussions, IKTLU Studies, and workshops (Section 2.6.1, Indigenous Engagement; Section 2.6.3, Public Engagement) assisted in identifying existing economic conditions and related community interests and concerns, as well as supported data triangulation (e.g., cross-referencing) to verify the data was accurate and representative of the communities. A JWG session in August 2021 was specifically facilitated to explore the traditional and wage economies and government transfers in detail to contextualize their composition and interconnectivity, how they changed over time, and how they influenced the communities and their residents.

Quantitative information for communities and Indigenous Groups in the LSA is presented collectively for comparison purposes with regional and provincial indicators. However, it is recognized that these communities and Indigenous Groups each have their own unique characteristics.

These differences are described quantitatively and qualitatively throughout this section. Information for each community and Indigenous Group are provided in Appendix 18A and Annex X, Socio-economic Baseline Report.

The existing economic conditions in the LSA and RSA have been influenced by a number of previous uranium projects. An overview of the history of uranium mining in northern Saskatchewan is included to provide relationship context of the existing economic conditions (Section 18.3.1.1, Overview of History of Uranium Industry in Northern Saskatchewan).

18.2.6.1 Literature Review

The review of literature and databases included the following sources:

- statistical data sources (e.g., Statistics Canada and Crown-Indigenous Relations and Northern Affairs Canada [formerly Indigenous and Northern Affairs Canada]);
- federal, provincial, and municipal government reports and data;
- regional-level documents (e.g., Northern Saskatchewan Health Indicators Report and Community Vitality Monitoring Partnership documents); and
- online sources (e.g., community websites and online business profiles).

The most recently available data from these sources were used to characterize the existing environment. As the Census of Canada is the most reliable and recent dataset available, the majority of quantitative data was sourced from this census. Data sourced from the Census of Canada are from the 2016 census year as the 2021 data had not been released at the time of the assessment.

18.2.6.1.1 Limitations of the Literature Review

Statistics Canada data, as a key source of secondary data, can contribute to developing an understanding of the LSA and RSA economies and how they have changed over time. Data was interpreted with caution because of potential comparability issues across years, confidentiality, and data quality. Time series data was reviewed for a number of indicators from the Census of Canada. In 2011, there was a shift in how the census was administered by the government of Canada, with a National Household Survey replacing the previous long-form census. One of the key differences was a shift from a mandatory to an optional response requirement, which potentially resulted in a reduction in the total number of survey respondents.

As the census is conducted once every five years, the census data may not accurately reflect the most current socio-economic conditions. In particular, changes in the local, regional, and national economy arising from the COVID-19 pandemic are not captured in the 2016 census data.

In JWG discussions, some individuals noted that Statistics Canada data may not always be representative of their communities, due in part to low participation in census surveys; however, they acknowledged the economic data did seem to accurately represent the community (BRDN-JWG 2021a). Statistics Canada notes that:

> published census data go through a variety of automated and manual processes to determine whether the data need to be suppressed. This is done primarily for two reasons: (1) to ensure that the identity and characteristics of respondents is not disclosed (which will subsequently be referred to as confidentiality) and (2) to limit the dissemination of data of unacceptable quality (which will subsequently be referred to as data quality). (Statistics Canada 2016; Guide to the Census of Population, 2016, Chapter 11 – Dissemination)

Census data were consistently available for the larger LSA communities. However, a number of indicators were not available for small communities in the LSA such as Bear Creek, Black Point, Descharme Lake, Garson Lake, Turnor Lake, St. George's Hill, and Michel Village.

Other data sets used in the assessment have limitations related to differing survey methods, differing geographic parameters (i.e., not aligned to the LSA or RSA), and saturation of data (i.e., no ability to isolate LSA community data) within larger datasets (i.e., datasets that also include communities outside the LSA or RSA). These limitations are noted throughout the assessment subsections, where applicable. Other literature, while relevant to examining topics in greater detail, and often in the context of northern Saskatchewan, may not be specific to the LSA community context.

To address these limitations, key trends or findings were confirmed where possible through KP interviews, through triangulation of multiple sources, and discussion with the JWGs.

18.2.6.2 Key Person Interview Program

A KP interview program is a widely accepted approach to qualitative data collection and analysis for understanding communities in effects assessments in Saskatchewan, in Canada, and globally. It is an effective means for soliciting relevant community profile information from service providers, community/opinion leaders, and informed members of the communities. Information gathered through a KP interview program can strengthen the understanding of the existing environment when used in combination with other primary and secondary data sources and can be used in data triangulation to confirm accuracy and applicability.

A KP interview program was undertaken as part of the characterization of the existing economic environment to confirm trends observed in quantitative data, address gaps that could not be readily filled by secondary sources and provide context and perspectives on community interests and concerns. Interview guides were developed to address gaps in information and provide local context. Topics covered during KP interviews included health, education, economic development, social services, and community well-being. Research for the economic assessment was completed in conjunction with community well-being (Section 19), cultural and heritage resources and Indigenous land and resource use (Section 16), and other land and resource use (Section 17). Key person interviews were conducted between October 2019 and July 2021. A total of 73 interviews were conducted with community members, including business owners, principals and staff of schools, housing clerks, health care directors, band councillors, and the RCMP. Details on the KP interview program can be found in Section 2.6.3.1.6, Summary of Key Person Interview Research Program.

Interviews were conducted with the consent of individual interview participants and community leadership. Community Coordinators were hired and trained to assist in identifying participants in the KP interview program. Interviews were conducted in La Loche (20 interviews), BNDN / Turnor Lake (9 interviews), BRDN (16 interviews), Buffalo Narrows (24 interviews), other hamlets and villages (3 interviews), and the Meadow Lake Tribal Council (1 interview). The CRDN indicated a desire to undertake KP interviews for their community independently, and NexGen provided the KP interview guide and directions for interviewers. The CRDN subsequently provided the Clearwater River Dene Nation Socio-economic and Harvest Study for the Rook 1 Project, which contained information from the KP interviews completed by the CRDN (TSD V.3: CRDN). Following receipt, this information was considered in the EA.

18.2.6.2.1 Limitations of Key Person Interviews

The data collected from KP interviews are not necessarily representative of the perspectives of all community members. Key persons were selected based on their knowledge and experience that could be relevant to characterizing the socio-economic baseline of the community, consistent with industry good practice. Collaboration was sought with Indigenous Groups to assist in identifying KP interviewees. As a result, some participants in the KP interview program were identified with the assistance of Community Coordinators who live in the communities.

All KP interviews were conducted by the same interview team with the exception of those interviews conducted for the CRDN (Section 18.2.6.2, Key Person Interview Program). Using a different interviewer and approach may result in different information being solicited or obtained from the other interviews. Although the KP interviews have a specific set of questions, interviewers may probe certain responses differently, which could produce slightly different results. Additionally, verification of information provided by other interviewers is challenging. Information provided was verified using the results of multiple interviews and other sources of information such as literature and professional experience.

Data presented from the KP interviews are based on the interviewed community member's knowledge and experience, and their willingness to participate and share data openly.

18.2.6.3 Other Sources of Information

Indigenous and Local Knowledge was incorporated into the description of the existing environment as described in Section 18.2.1, Incorporation of Indigenous and Local Knowledge. Information from several sources was incorporated, including community information sessions (Section 2.6.3.1.2, Summary of Community Information Sessions), JWG meetings (Section 2.6.1.1.1, Joint Working Group Activities), and other workshops, including a Youth Workshop (Section 2.6.3.1.5, Summary of Youth Workshop) and a Trappers Workshop (Section 2.6.3.1.8, Summary of Trappers Workshop). A planned workshop with women was postponed due to COVID-19 and was later adjusted to a series of individual interviews with women (Section 2.6.3.1.7, Women's Interviews) who had direct or indirect experience with participation in mining employment, as identified by each Indigenous Group. Joint Working Group meetings in August 2021 with the BNDN JWG and the BRDN JWG were dedicated to discussing the traditional and wage economies and government transfers, and how these economies and transfers are interrelated within the LPA communities. These JWGs were used to inform the assessment. Invitations to participate in this JWG topic were provided to the CRDN JWG and MN-S JWG, but the CRDN and MN-S JWGs were unable to meet prior to completion of the assessment. Key topics discussed at the JWGs included:

- key aspects of the traditional and wage economies;
- changes in community participation in the traditional and wage economies;
- gender differences in participation in the traditional and the wage economies;
- the effects of government transfers and subsidies on participation in the traditional and wage economies; and
- discussions on the challenges and opportunities for future participation in the traditional and wage economies.

Input/output (I/O) modelling was prepared to help understand potential direct, indirect, and induced effects of the Project. Appendix 18B, Rook I Project Economic Impact Modelling Results, summarizes the results of the I/O modelling and the cautions and limitations associated with the modelling.

18.2.7 Project Interactions, Mitigations, and Benefit Enhancements

Interactions (i.e., linkages) between Project components or activities, and the corresponding potential changes to measurement indicators, were identified by a pathway analysis that was then used to focus the residual effects assessment for the economy (Section 6.7, Pathways Analysis). The first part of the analysis was to identify all potential effects pathways for all phases of the Project (Section 6.7.1, Identification of Project Interactions). Each pathway was initially considered to have a linkage to potential effects on the economy.

Potential pathways from Project activities to the economy VC were identified using the following:

- review of the Project description (Section 5) and potential effects scoping by the project development, environmental, and socio-economic teams for the Project;
- input from Indigenous, regulatory, and public engagement (Section 2) and Indigenous and Local Knowledge (Section 3);
- scientific knowledge;
- previous experience with mining projects; and
- consideration of potential effects identified from the Terms of Reference (Section 1, Appendix 1A).

Through a hierarchy of controls approach, potential effects of the Project were then identified, and practicable mitigation was applied to avoid, minimize, and/or compensate for negative effects, while the potential positive effects were examined to develop, support, and/or enhance sustainable beneficial measures to the economy VC (Section 6.7.2, Identification of Mitigation).

Each potential effect pathway was evaluated using proposed mitigation to predict whether the pathway had the potential to cause residual adverse effects (Section 6.7.3, Pathway Screening). A screening-level assessment was applied using Indigenous and Local Knowledge, scientific knowledge, logic, experience with similar developments, and an understanding of the effectiveness of mitigation (i.e., level of certainty that mitigation would work) to assign each pathway to one of the following categories:

- **Beneficial pathway:** The pathway is likely to result in a potential beneficial effect. Project design features or enhancement measures that may be available to enhance beneficial effects are described.
- **No pathway:** Analysis reveals that the pathway could be removed (i.e., the effect is avoided) by mitigation so that the Project would result in no measurable change relative to existing conditions or guideline values and, therefore, would have no residual effect on the economy.
- **Secondary pathway:** The pathway could result in a measurable but minor change relative to existing conditions or guideline values, but this change would be sufficiently small that it would have a negligible residual effect on the economy. Therefore, the pathway is not expected to contribute to effects of other existing and approved projects/activities or RFDs to cause a significant effect.
- **Primary pathway:** The pathway is likely to result in a change relative to existing conditions or guideline values that could cause a greater than negligible effect on the economy.

Project interactions determined as no pathway, secondary pathways, or beneficial pathways were not carried forward for further assessment (Section 6.7.3). Primary pathways that could result in changes to the socio-economic environment with one or more associated measurement indicator and have the potential to cause a greater than negligible adverse effect on the economy were carried forward to the residual effects analysis and residual effects classification (Section 18.5).

The primary objective of pathway analysis was to complete a screening level assessment of potential adverse effects from the Project on VCs and intermediate components (Section 6.7.3). Because economic opportunities from the Project primarily result in beneficial effects on individuals and local communities, positive outcomes or beneficial pathways were identified and discussed in Section 18.4, Project Interactions, Mitigations, and Benefit Enhancements. However, these pathways were not assessed for significance (Section 6.7.3). Reporting the positive outcomes of a project is necessary to provide additional context for people to understand and assess both the adverse effects and benefits (i.e., positive effects) to the social-ecological system or how residents and communities are likely to experience the full effects of the Project.

NexGen recognizes that increases in employment, income, business opportunities, and a potential influx of workers into the local communities from the economic benefits of the Project, can result in unintended negative effects on people and families (e.g., stress) or the potential amplification of existing negative issues in communities (e.g., substance abuse). These adverse effects from positive changes in local economic conditions are identified in this subsection and are considered and analyzed in more detail in the assessment of the community well-being VC (Section 19).

18.2.8 Residual Effects Analysis

A residual effects analysis measures and describes the effects of a project on the economy VC relative to existing conditions. If required, a residual effects analysis is conducted using the spatial boundaries (Section 18.2.3) and temporal boundaries (Section 18.2.4) identified for the assessment. If necessary, residual effects are described for each of the measurement indicators for the primary pathways identified in the LSA and RSA (Section 18.4.4). If required, a residual effects analysis is completed for the Application Case and the RFD Case (Section 6.8, Residual Effects Analysis).

18.2.9 Residual Effects Classification and Determination of Significance

The residual effects analysis uses a reasoned narrative to describe anticipated changes to each measurement indicator caused by the proposed Project and the associated effects on each VC. The residual effects analysis also considers effects from both the Project and RFDs. These narrative descriptions of anticipated effects represents the foundation for the residual effects classification and significance determination. Residual effects are summarized or classified in tabular form using effects criteria, which is intended to provide structure and comparability across VCs and intermediate components assessed for the Project (Section 6.9.1, Residual Effects Classification).

If a residual effects analysis is required, the residual effects classification uses direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence as criteria. Should a residual effects analysis be required, the approach to classify each residual effect criterion for the economy VC would follow the criteria provided in Table 18.2-2.

Table 18.2-2: Definitions Applied to Effects Criteria Classifications for the Assessment of the Economy

Criterion	Rating	Definition
Direction	Positive	Change in measurement indicator results in net improvement or benefit to the economy
	Neutral	Change in measurement indicator results in net balance to the economy
	Negative	Change in measurement indicator results in net degradation or loss to the economy
Magnitude	Qualitative narrative or numeric quantification	Change in measurement indicator is described by effect size (e.g., changes in direct employment)
Geographic extent	Project footprint	Change in measurement indicator is confined to the Project footprint
	Local	Change in measurement indicator extends outside the Project footprint but within the LSA
	Regional	Change in measurement indicator extends beyond the LSA but is confined to the RSA (i.e., Northern Saskatchewan Administrative District)
	Beyond regional	Change in measurement indicator extends beyond the RSA
Duration	Qualitative narrative or numeric quantification	Change in measurement indicator is described by effect duration (e.g., months, years, decades, or permanent)
Reversibility	Reversible	Change in measurement indicator is reversible within a clearly defined time period (e.g., end of Closure)
	Irreversible	Change in measurement indicator is predicted to influence the economy indefinitely
Frequency	Occasional	Change in measurement indicator is expected to occur rarely (e.g., once or a few times)
	Periodic	Change in measurement indicator is expected to occur consistently at regular intervals or associated with temporal events (e.g., seasonal maintenance or supply periods)
	Continuous	Change in measurement indicator is expected to occur all the time
Probability of occurrence	Unlikely	Change in measurement indicator is not expected to occur, but not impossible
	Possible	Change in measurement indicator may occur, but is not likely
	Probable	Change in measurement indicator is likely to occur, but is uncertain
	Certain	Change in measurement indicator will occur

LSA = local study area; RSA = regional study area.

While most criteria can be assigned categorical ratings for the economy VC, predicted effect sizes would be provided in specific terms (i.e., narrative or numeric quantification) in the residual effects characterization (Table 18.2-2). Similarly, duration would be described in specific terms (e.g., years). Applying a category rating to a criterion such as magnitude might lead to confusion or misinterpretation of the effects assessment, or result in the criterion not being easily categorized in a meaningful way. For example, characterizing magnitude solely using an ordinal scale (i.e., low, moderate, or high) in a manner meaningful for the economy VC is often not appropriate as additional context is required to properly characterize the effects. Universal effect size boundaries, such as a 20% change in a measurement indicator at the RSA or LSA scale used to define a high-magnitude effect, work poorly because these size boundaries fail to consider context. Depending on the context from the cumulative effects from previous and existing developments and activities that also interact with a VC, a 20% change from existing conditions in the study area may be required to cause a high magnitude effect on one VC, whereas a 2% change in the study area may be sufficient to cause a high magnitude effect for another VC (Section 6.9.1).

If a residual effects analysis is required, the significance of adverse residual effects on the economy is evaluated using the assessment endpoints as significance thresholds defined in Section 18.2.2.3, Assessment Endpoints. However, if no primary pathways between the Project and the economy VC are present and a residual effects analysis and a residual effects classification are not required, the Project would not be expected to create greater-than-negligible adverse effects. Therefore, a classification of not significant will be applied. Resilience, societal/cultural tolerance or adaptability, and existing conditions provide important social and cultural context for the determination of significance. The classification of residual effects criteria provides the foundation for determining if the threshold for significance (i.e., assessment endpoints) is exceeded. If required, confidence in the significance prediction is identified and discussed as part of the reasoned narrative. If uncertainty is high about where a threshold for a significant effect would occur in the range of potential values, and if the effect could be assessed as significant or not significant, a precautionary (i.e., conservative) approach is applied, and the effect is identified as significant.

18.2.10 Prediction Confidence and Uncertainty

The purpose of the assessment is to predict the future conditions for economy with the addition of the Project and the Fission Patterson Lake South Property. As with all predictions of future conditions, the predictions made in this assessment embody some degree of uncertainty. The assessment applied a precautionary (i.e., conservative) approach to address uncertainty by identifying the greatest magnitude, duration, and geographic extent of potential adverse effects when a range of outcomes were possible. Consequently, uncertainty was addressed in a manner that increased the level of confidence that residual effects were conservatively estimated. The key uncertainties for economy and the way they were addressed are presented as part of this assessment (Section 18.6, Prediction Confidence and Uncertainty).

In describing beneficial pathways, the precautionary approach was applied by describing the potential magnitude and distribution of benefits conservatively. This approach increases confidence that benefits are described in a way that is less likely to overstate potential benefits.

18.2.11 Monitoring, Follow-Up, and Adaptive Management

Monitoring programs are proposed to address the uncertainties associated with the effects predictions and to evaluate the performance of mitigation. In general, monitoring is used to verify the effects predictions. Monitoring is also used to identify any unanticipated effects and to support the implementation of adaptive management to limit these effects. Typically, monitoring includes one or both of the following categories that may be applied during the Project lifespan:

- **Regulatory compliance monitoring:** monitoring activities, procedures, and programs undertaken to confirm the implementation of approved design standards, mitigation and conditions of approval, and NexGen commitments (e.g., monitoring local employment and contracting outcomes may be committed to as part of MSLA or other agreements).
- **Follow-up monitoring:** programs designed to test the accuracy of effects predictions, reduce or address uncertainties, determine the effectiveness of mitigation, or provide appropriate feedback to operations for modifying or adopting new mitigation designs, policies, and practices (e.g., implementation of adaptive management). Results from these programs can be used to increase the certainty of effect predictions in future EAs.

Where relevant, conceptual monitoring programs would be proposed to confirm predictions and to address the uncertainties associated with the effects predictions and mitigation, and upon Project approval, would be included in the Integrated Management System.

In addition, monitoring and management plans can examine ways to enhance opportunities. NexGen has a demonstrated commitment to working with Indigenous Groups and local communities and to realize the potential economic benefits the Project can bring to the LSA and RSA. As such, NexGen has included plans and policies aimed at realistically and sustainably achieving these positive effects.

Adaptive management measures may also be proposed to address the uncertainties associated with the effects predictions and mitigation. The process for determining when, how, and where to use adaptive management would be described within the Integrated Management System Manual.

18.3 Existing Conditions

18.3.1 Overview of Provincial and Northern Saskatchewan Economies

Gross domestic product (GDP) is a common measure of the value of goods and services produced in a jurisdiction over a particular time period. Saskatchewan's real GDP[5] at basic prices was $81.4 billion in 2019 (Saskatchewan Bureau of Statistics 2019). This value represents a decrease in GDP compared to the 2018 real GDP of $82.1 billion. The real GDP of the mining and oil and gas extraction sector in Saskatchewan (i.e., the largest sector) was $21.9 billion in 2019. The next largest sectors in 2019 were real estate and rental and leasing (i.e., $7.7 billion GDP in 2019) and agriculture (i.e., $7.1 billion in 2019). The real GDP for all three sectors was reasonably stable from 2017 to 2019.

Saskatchewan employee wages and salaries in 2019 totaled $28.9 billion in nominal (i.e., current) rather than real (i.e., inflation-adjusted) dollars, an increase over 2017 ($27.5 billion) and 2018 ($27.7 billion). The mining and oil and gas extraction sector contributed $2.5 billion in employee wages and salaries (i.e., 9% of the provincial total), which represented an increase from approximately $2.3 billion in each of 2017 and 2018, and 8% of the provincial total in each year (Saskatchewan Bureau of Statistics 2021a).

In its 2020/2021 mid-year economic report, the Government of Saskatchewan (2021b) noted the provincial economy was affected by both the COVID-19 pandemic and the fall in global oil prices. At the mid-point of the 2020/2021 fiscal year (1 April to 31 March [Government of Saskatchewan 2021b]), the economy was noted to have performed better than originally anticipated in the 2020 budget. Employment recovery was noted to be uneven across industries, with employment in accommodation and food services in October 2020 still well below pre-pandemic levels while employment in construction and wholesale and retail trade had rebounded. Equivalent employment information for the mining and oil and gas sector was not provided in the mid-year economic report. The 2020/2021 mid-year economic report noted no material changes to the medium-term economic outlook compared to previous Government of Saskatchewan economic reports, which showed provincial revenues rebounding and reductions in provincial deficits through 2024/2025. This lack of material changes was driven in part by substantial growth in non-renewable resource revenues, though resource revenues were not forecast to recover to 2019/2020 levels until 2023/2024 (Government of Saskatchewan 2020a).

The economy of northern Saskatchewan is notably different than the province overall. Mining, quarrying, and oil and gas extraction; educational services; public administration; and health care and social assistance accounted for a larger proportion of employment in northern Saskatchewan in 2016 compared to the province (Figure 18.3-13). Agriculture, forestry, fishing and hunting, manufacturing, and retail trade comprised a lower percentage of total employment in northern Saskatchewan compared to the province. Quantitative indicators used throughout this subsection contrast northern Saskatchewan with the province where data are available. The traditional economy, or subsistence economy, is also important to supporting the livelihood of many individuals and

[5] The Saskatchewan Bureau of Statistics provides a definition of GDP as the total amount of productive economic activity occurring within a region during a given period of time expressed in currency units. Real GDP removes the effects of changes in prices over time and is adjusted for inflation. An industry's GDP at basic prices is the sum of its factor incomes (i.e., wages and salaries, supplementary labour income, mixed income, and other operating surplus) plus taxes on production less subsidies on production (Saskatchewan Bureau of Statistics 2019).

communities in northern Saskatchewan. The traditional economy refers to activities such as hunting, fishing, trapping, and gathering that takes place outside of the wage or market economy. More information on the traditional economy is provided in Section 18.3.6.1, Traditional Economy Participation and Income.

18.3.1.1 Overview of History of Uranium Industry in Northern Saskatchewan

The uranium industry has been active in northern Saskatchewan for more than 70 years and the evolution of industry practices provide important context for understanding the existing economic environment in the LSA and RSA. Uranium mining and milling in northern Saskatchewan began in the 1950s with the Gunnar, Lorado, and Beaverlodge mines/mills located near Lake Athabasca and serviced through Uranium City. Several smaller mine sites also operated in the vicinity of Uranium City, the majority of which delivered ore to the Beaverlodge mill for processing. The Gunnar and Lorado mines/mills ceased operations in the 1960s while the Beaverlodge mine continued operating until the 1980s (Clement and Stenson 2002). Since the 1970s, a number of new uranium mining operations have been developed in northern Saskatchewan, including two mine and mill operations, Cluff Lake and Rabbit Lake; two mill operations, Key Lake and McClean Lake; and two mining operations, McArthur River and Cigar Lake. Milling for McArthur River and Cigar Lake ore currently utilizes Key Lake and McClean Lake facilities, respectively (Figure 18.2-1; Cameco 2021a,b).

Cluff Lake was the only uranium mine and mill in the LSA and was operated by Orano from 1980 to 2002. It was located approximately 235 km north of the Northern Village of La Loche on Highway 955 (Figure 18.2-1). Decommissioning of the site began in 2004, with most of the decommissioning work completed by the end of 2006. The site has been available for public access since 2013. Since decommissioning, the mine has been subject to a comprehensive environmental monitoring program (Orano 2020). Rabbit Lake transitioned to care and maintenance in 2016 (Cameco 2021c), and McArthur River mine and Key Lake mill transitioned to care and maintenance in 2018 (Cameco 2021b); however, in February 2022, Cameco expressed intent to reopen the McArthur River mine. Cigar Lake is still in operation as of December 2021 (Cameco 2021a).

The mining workforce in northern Saskatchewan totalled about 1,600 jobs in 2018 compared to about 3,900 at its peak in 2012. Despite layoffs over the past two years, mining continues to be the largest private-sector employer in the north (Government of Saskatchewan 2018). During KP interviews, several LSA residents noted they felt left out of participating in the economic benefits of the uranium industry. They felt mines in the Athabasca Basin (northcentral part of Saskatchewan) tended to focus on the communities nearest to the uranium mines and that employment and business opportunities from those mines did not benefit communities in the northwest to the extent that should have occurred. Despite this sentiment, many residents of the LSA communities have expressed interest in employment opportunities closer to home, including employment in the mining sector (CVMPP 2013; 2019 to 2021 KP interview program; Appendix 2D, Summary of Public Engagement Activities; BNDN-JWG 2021d; BRDN-JWG 2021a; TSD V.3: CRDN).

Communities in the LSA have historically had lower employment rates in the uranium mining industry compared to other communities in the RSA. For example, employment rates in uranium mining in 2006 for LSA communities were 2.6% for La Loche and CRDN, 5.2% for Buffalo Narrows, and 4.3% for Turnor Lake in comparison to select communities in the RSA (i.e., 11.4% for Wollaston Lake, 11.7% for Air Ronge, and 9.2% for La Ronge; CVMPP 2013; 2006 data were the most recent available at the time research for the 2013 Community Vitality Monitoring Partnership Process [CVMPP] report was undertaken). This lower employment rate was attributed to the considerable distance between the LSA communities and the current uranium mines in northeastern Saskatchewan; however, this lower rate could also be a result of other operations'

Human Resource Development Agreements (required as a condition of MSLAs) that prioritize hiring in proximity to the respective sites.

Lack of education and training opportunities has been cited by residents in the LSA as a barrier to employment in the uranium sector. Local study area residents have commented that positions that require higher education and skill levels are often not filled by local employees.

Some LSA residents commented that when various mines in the RSA that employed residents closed, some employees were not provided the opportunity to obtain their formal trade tickets while working at the mine, despite training and relevant work experience that they felt should have allowed them to meet the qualification requirements. Therefore, these workers faced barriers in gaining other employment following mine closure (2019 to 2021 KP interview program).

The Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan (Joint Panel) noted uranium mining produces a boom-bust economic cycle. The Joint Panel observed that employment and business opportunities created by operating mines and mills are not permanent, but the benefits of training and work experience can produce more enduring benefits (IAAC 2016a). The Joint Panel indicated its view that the continuation of initiatives, such as the Multi-Party Training Plan (MPTP)[6], are necessary to provide opportunities for northerners in the uranium mining industry. Further information about the MPTP is provided in Section 18.3.5, Employment by Sector.

The Joint Panel also indicated the inclusion of appropriate objectives in the Human Resource Development Agreements that form part of surface leases is an effective way to certify employment and business opportunities are available to northerners (IAAC 2016b). In 2013, the CVMPP[7] reviewed the socio-economic effects of the modern era of uranium mining in northern Saskatchewan and noted that initiatives like the MPTP contributed to increased education levels and, in particular, post-secondary training relevant to the mining sector. Based on the review, the CVMPP made a number of recommendations to further improve northern participation in economic benefits from the uranium sector, including the following:

- Multi-stakeholder approaches (e.g., provincial government, federal government, tribal councils, school boards, and communities) should:
  - discuss how to place more effort on early childhood development; and
  - provide support for bridging programs between high schools and colleges/universities.
- Uranium mining companies should target some education efforts and donations to invest in early childhood development.
- Uranium mining companies should explore ways for small northern companies to participate more in mine contract opportunities (CVMPP 2013).

[6] The MPTP was a multi-stakeholder partnership between public, private, and non-profit organizations. It enabled mining companies to pool their labour projections and other partners to combine resources in linking training directly to the mineral sector's demand.

[7] The CVMPP was initiated in 1998 as an outcome of the Joint Federal-Provincial Panel on Uranium Mining in northern Saskatchewan. The goal of the CVMPP is to provide information and insight to stakeholders so that they can actively engage in maintaining and improving the quality of life for residents of northern Saskatchewan.

18.3.2 Overview of Local Study Area Economy

This subsection provides an overview of the LSA economy with specific reference to regional connectivity, key centres, and economic vitality.

The LSA is characterized by a dispersed settlement pattern of primarily small and highly remote Indigenous communities (i.e., less than 1,000 people; Appendix 18A, Table 18A-1b). Buffalo Narrows (estimated population 1,110 people) and La Loche (estimated population 2,372) are the only urban centres in the LSA. Buffalo Narrows is located on Highway 155, approximately 200 km north of Green Lake and 100 km south of La Loche. La Loche is located at the northern terminus of Highway 155 and the southern terminus of Highway 955, 300 km north of Green Lake (Figure 18.2-1).

Despite its smaller population, Buffalo Narrows has developed as a regional services centre for Saskatchewan, with services encompassing the LSA / LPA communities, and subsequently supporting a considerably stronger economy (measured through income, labour market dynamics, and economic vitality) than La Loche. These economic indicators are discussed in Section 18.3.4, Labour Force Characteristics, and Section 18.3.6, Income. Additional discussion on service provision is provided in Section 19.3.2.2, Social Services.

The LSA is remote with limited regional connectivity. Highway 155 is the primary transport route that connects the LSA communities to the regional centres in southern Saskatchewan and has been identified by numerous sources as in need of substantial repairs in multiple locations (Saskatchewan Government Insurance 2018; Wagner 2018; 2019 to 2021 KP interview program). Highway 955 was built for the Cluff Lake Mine and provides access to the northwestern area of the province. It is the only access to the uranium opportunities recently identified in the northwest (Wagner 2018). Regional commercial airport facilities are located in both Buffalo Narrows and La Loche, with North Country Air operating charter flights out of La Loche (North County Air Service n.d.) and Voyage Air operating charter flights out of Buffalo Narrows (Voyage Air 2002). However, regional connectivity is identified as a challenge to economic expansion in the LSA (BNDN-JWG 2020). Additional discussion on transportation infrastructure is provided in Section 19.3.3.4, Road Transportation Infrastructure, and Section 19.3.3.5, Air Transportation Infrastructure.

Labour force participation and employment rates in communities are low, with employment concentrated primarily in government-funded service sectors and Crown corporations (DMCA 2018). There are lower employment rates in common rural sectors including agriculture, forestry, fishing and hunting, manufacturing, and retail trade than in the province overall (Appendix 18A, Table 18A-17a). Government transfers and subsidies make up a large amount of community income. Employment by sector, income, and participation rates are discussed in Section 18.3.4, Section 18.3.5, Employment by Sector, and Section 18.3.6.

There is limited tourism industry or infrastructure in the LSA, as well as limited manufacturing. Fishing and commercial forestry activities contribute to the LSA economy, though to a limited scale (2019 to 2021 KP interview program). Mineral exploration and investment activity in the LSA is growing. From 2008 to 2017 there were 328.3 million pounds of measured and indicated uranium resources found in the west side of the province, with more than 70% of the resources located north of La Loche (DMCA 2018). La Loche is the closest urban settlement on Highway 955 to the uranium opportunities in northwestern Saskatchewan; however, the only mining activity currently occurring in this area is exploration. Mineral exploration opportunities in and adjoining the LSA are discussed in Section 17.3.8, Mining and Exploration.

18.3.3 Population

This subsection describes the historical, current, and potential future populations of the communities in the LSA based on Statistics Canada data. Information for the RSA (i.e., Census Division No. 18, which includes all of northern Saskatchewan) and the Province of Saskatchewan are provided for comparative purposes.

18.3.3.1 Population Change

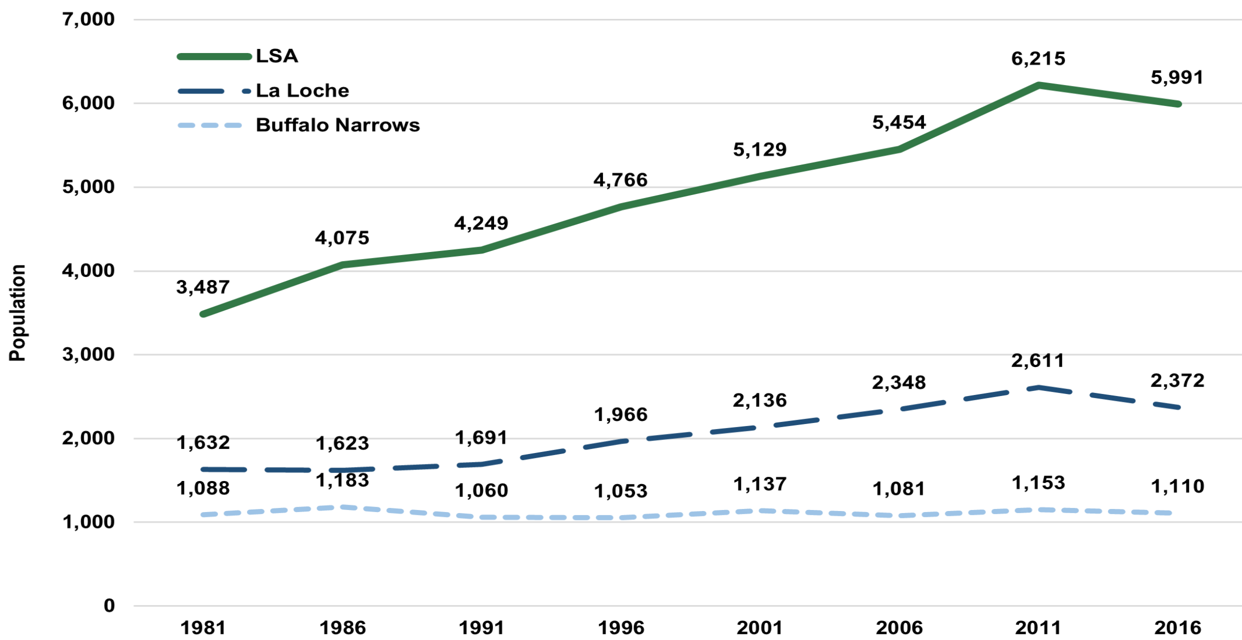
Figure 18.3-1 shows the population of the LSA from 1981 to 2016 as reported in the Census of Canada for each five-year census period as well as the populations for the largest communities in the LSA (i.e., La Loche and Buffalo Narrows). Figure 18.3-2 shows the population for the remaining communities in the LSA over the same period. Data from the 2016 Census of Canada are the most recently released from Statistics Canada (Section 18.2.6.1, Literature Review). In 2016, the LSA population was 5,991.

The 2016 populations for communities in the LSA range in size from 2,372 people (i.e., La Loche) to 10 or fewer people (i.e., Descharme Lake and Garson Lake, individually; Appendix 18A, Table 18A-1b). The LSA population increased from 3,487 people in 1981 to 6,215 in 2011 and was followed by a decline to 5,991 people in 2016 (Appendix 18A, Table 18A-1b)[8]. The LSA population decline from 2011 to 2016 was primarily a consequence of the population decrease in La Loche; this decrease was specifically observed in the population younger than 50 years of age (Appendix 18A, Table 18A-4). However, an economic analysis completed for La Loche noted the community did not show the typical signs of population loss and there remained a housing shortage despite several new builds (DMCA 2018). The KP interview program participants indicated that the reasons some residents moved away from La Loche included the need to pursue employment and education opportunities elsewhere or because of a lack of housing availability locally.

For comparison, the RSA population increased from 25,304 in 1981 to 37,064 in 2016, and the population of Saskatchewan increased from 968,313 in 1981 to 1,098,352 in 2016 (Appendix 18A, Table 18A-1a).

[8] The LSA includes Bear Creek, BNDN (Turnor Lake 193B), Black Point, Buffalo Narrows, BRDN 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data were not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake for 1981 to 2006.

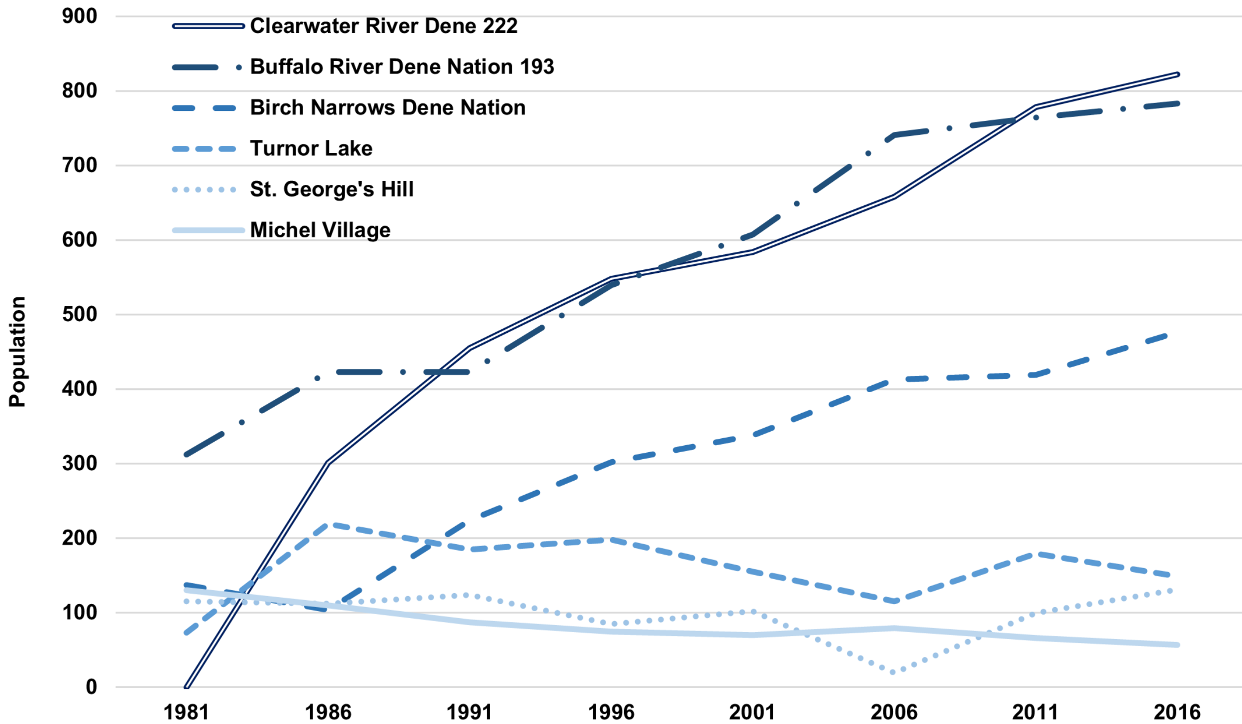
Figure 18.3-1: Local Study Area Population, 1981 to 2016



Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.
Note: Population numbers for 2011 and 2016 include four northern settlements (i.e., Bear Creek, Black Point, Descharme Lake, and Garson Lake) for which data were not available in previous Census Profiles.
LSA = local study area.

Figure 18.3-2 illustrates the population of the LSA communities from 1981 to 2016 for smaller communities, where data are available, as reported in the Census of Canada for each five-year census period (Appendix 18A, Table 18A-1b).

Figure 18.3-2: Local Study Area Selected Communities Population, 1981 to 2016



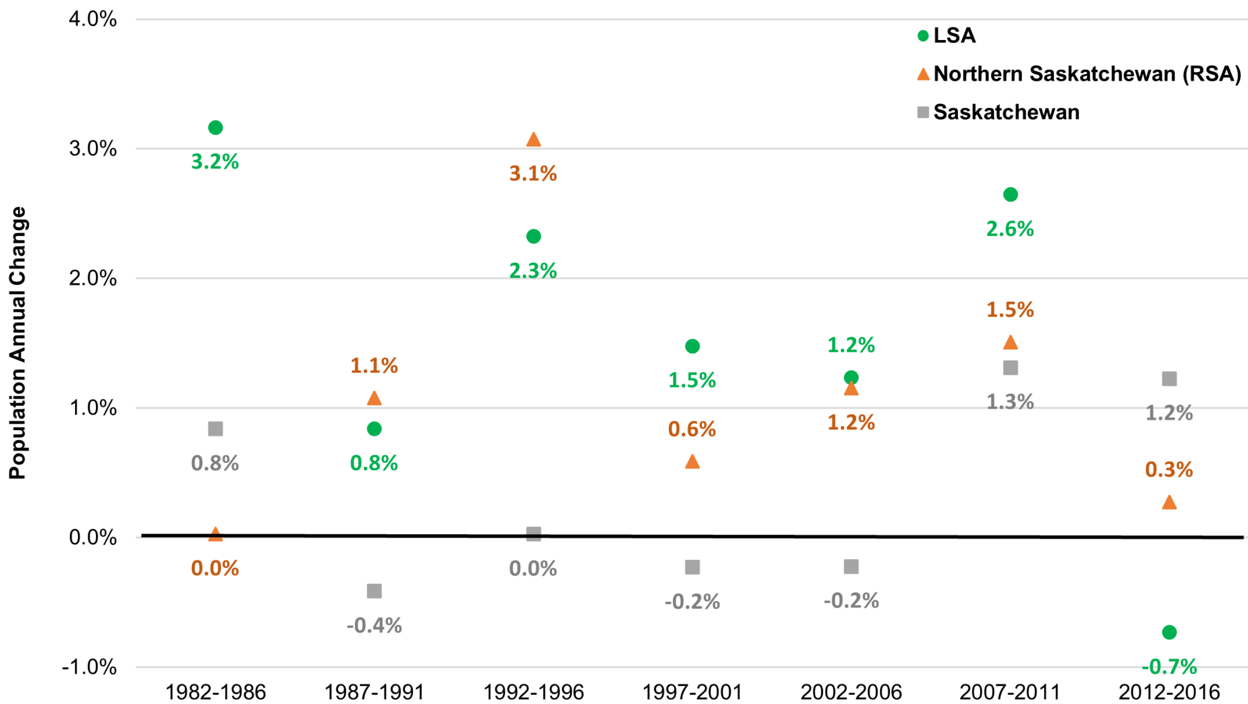
Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.
Average annual percentage population changes calculated by InterGroup Consultants Ltd.
Note: The figure does not include four northern settlements (i.e., Bear Creek, Black Point, Descharme Lake, and Garson Lake) for which population numbers were available only for 2011 and 2016 were not available in previous Census Profiles.

Figure 18.3-3 shows the average annual population change for the LSA, the RSA, and Saskatchewan from 1982 to 2016 (Appendix 18A, Table 18A-1a). Both the LSA and RSA experienced higher average annual population growth than the province from 1987 to 2011. The higher growth rates in the LSA and RSA may be attributed in part to a younger age structure and higher birth rates, though other factors including in-migration and out-migration can also affect population growth rates and these factors may affect individual communities differently. The LSA and RSA population growth is consistent with a nationally observed trend in higher population growth rates for Indigenous Peoples in Canada due to factors including a younger age structure and higher birth rates (Statistics Canada 2015).

Individual communities in the LSA experienced a range of population growth rates. For example, BNDN had among the most variation in population changes with a 5.4% average annual decline from 1982 to 1986 and a 16.6% average annual increase from 1987 to 1991 (Appendix 18A, Table 18A-1b). Based on information provided by community members, this increase could have been due to several factors, including changes in definitions to Treaty Rights or movement of people around the region. For the 1986 to 2016 time period, the highest annual average growth rates in the LSA occurred in the smaller communities of BNDN and CRDN (5.2% and 3.4%, respectively). These communities experienced population growth rates substantially higher than the LSA population growth rate over the same period. The two largest communities in the LSA (i.e., Buffalo Narrows and La Loche) experienced a decline and very low rate of population growth (-0.2% and 1.3%) across the same time period (Appendix 18A, Table 18A-1b). Further analysis of population growth rates in the LSA is presented in Annex X, Socio-economic Baseline Report and Section 19, Community Well-Being.

From 2011 to 2016, the LSA experienced an average annual population decline of 0.7% compared to an average annual increase of 1.2% for Saskatchewan. The LSA population decline from 2011 to 2016 was primarily a result of the population decrease in La Loche as discussed previously in this subsection.

Figure 18.3-3: Average Annual Population Change for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 1982 to 2016



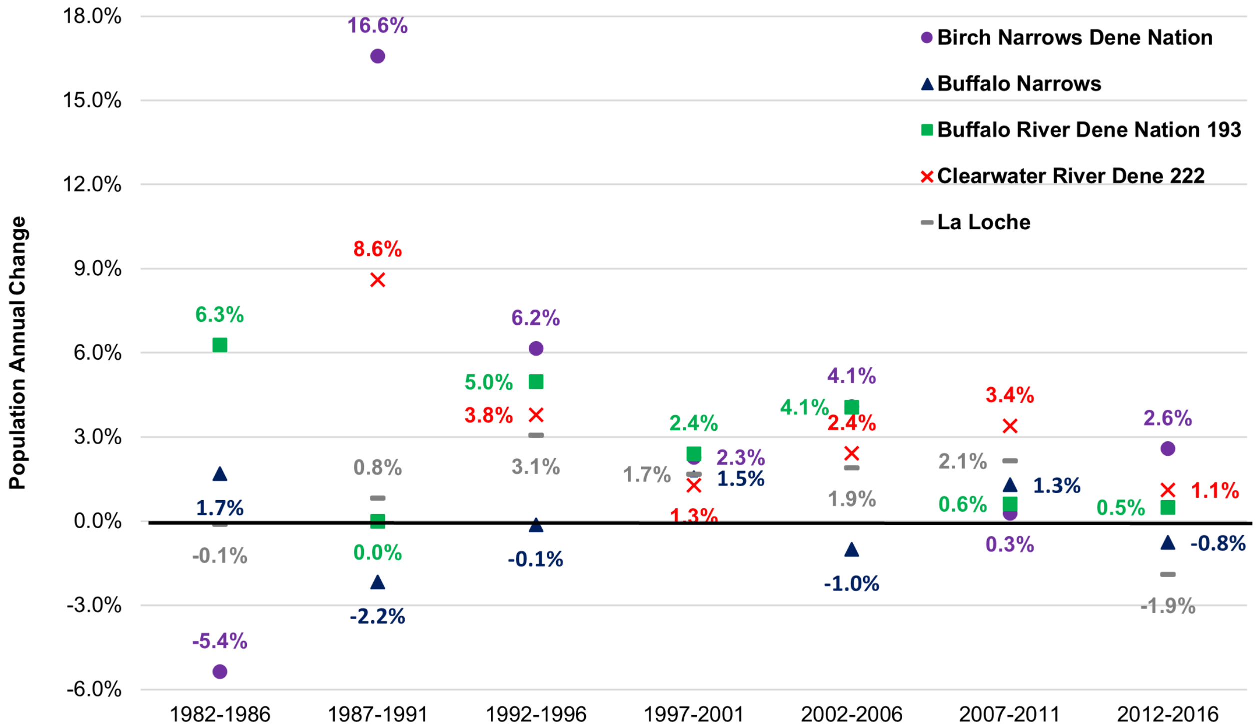
Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.
Average annual percentage population changes calculated by InterGroup Consultants Ltd.
Note: Population numbers for 2011 and 2016 include four northern settlements (i.e., Bear Creek, Black Point, Descharme Lake, and Garson Lake) for which data were not available in previous Census Profiles.
LSA = local study area; RSA = regional study area.

Figure 18.3-4 presents the average annual population change LSA communities where data are available from 1982 to 2016 (Appendix 18A, Table 18A-1b)[9].

- BNDN experienced the lowest (i.e., -5.4% during 1982 to 1986) and the highest (i.e., 16.6% during 1987 to 1991) average annual population changes among the communities.
- Buffalo Narrows did not experience material average annual population changes from 1982 to 2016.

[9] To minimize rounding error and due to data unavailability, LSA communities with less than 400 population as of the 2016 Census were not included in this comparison.

Figure 18.3-4: Average Population Change for Local Study Area Communities, 1982 to 2016



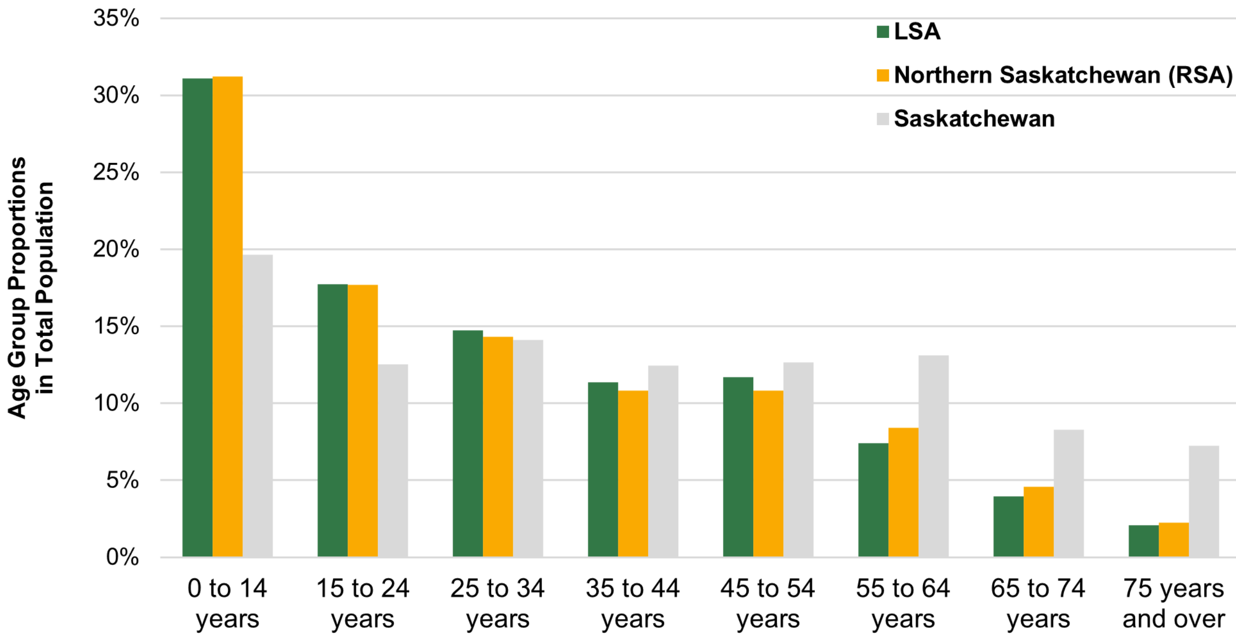
Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.

18.3.3.2 Age and Gender Distribution

Figure 18.3-5 shows the distribution of the population by age category for the LSA, the RSA, and Saskatchewan for 2016 (Appendix 18A, Table 18A-2a). The pattern of population distribution by age cohort in the LSA is very similar to the RSA, with certain age cohorts in both LSA and RSA significantly different to Saskatchewan. Both the LSA and RSA have a higher proportion of the population aged 24 and younger and a lower proportion of the population aged 55 and older when compared to the total population of Saskatchewan. This pattern may be reflective of populations with higher-than-average birth rates and out-migration[10] of post-secondary and working-aged people to pursue education, social, and employment opportunities as many of the LSA communities noted during KP interviews (2019 to 2021 KP interview program). For communities in the LSA, CRDN has the youngest population, with a majority of the 2016 population (i.e., 53%) under 25 years old and less than 10% aged 55 years or older; Buffalo Narrows has the oldest population with 42.3% under 25 years old and 21.2% aged 55 years or older (Appendix 18A, Table 18A-2b)[11].

[10] Out-migration refers to individuals who move away from a particular community or region.
[11] To minimize rounding error and due to data unavailability, LSA communities with less than 400 population as of the 2016 Census were not included in this comparison.

Figure 18.3-5: Population Distribution by Age Group for the Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016

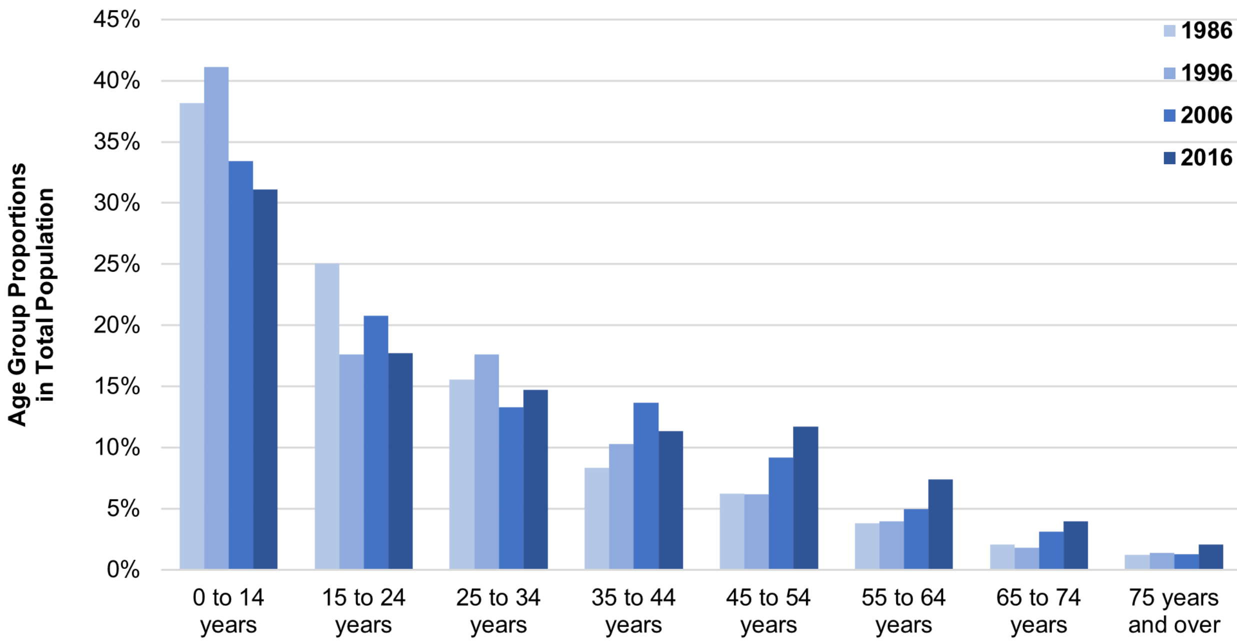


Source: Statistics Canada 2017a.
Note: Data were not available for Bear Creek, Descharme Lake, and Garson Lake.
LSA = local study area; RSA = regional study area.

Figure 18.3-6 shows the change in the age distribution of the LSA population from 1986 to 2016 (Appendix 18A, Table 18A-3a). The LSA population has historically been younger compared to Saskatchewan; however, the proportion of the population that is 24 years of age or younger has steadily decreased between 1986 (i.e., 63.3%) and 2016 (i.e., 48.8%). Among LSA communities, the sharpest decline was observed in BRDN where the proportion of the population that is 24 years of age or younger has decreased from 65.5% in 1986 to 45.9% in 2016 (Appendix 18A, Table 18A-3c)[12]. This trend could likely be higher, as some LSA residents have noted younger people may not want to leave their home community for reasons including anxiety about moving away from family and the culture shock from moving to a different city (2019 to 2021 KP interview program; BNDN-JWG 2021a). Proportional increases are observed across all age cohorts older than 45 years, indicating an aging population and corroborates the observation of increasing out-migration among younger cohorts. A similar trend is observed in the RSA population, with a decline in the proportion of the RSA population that is 24 years of age or younger from 59.6% in 1986 to 48.9% in 2016. By comparison, the proportion of the population of Saskatchewan that is 24 years of age or younger was 40.9% in 1986 and 32.2% in 2016 (Appendix 18A, Table 18A-3b).

[12] To minimize rounding error and due to data unavailability, LSA communities with less than 400 population as of the 2016 Census were not included in this comparison.

Figure 18.3-6: Population Distribution by Age Group for the Local Study Area, 1986 to 2016



Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.
Note: Data were not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake.

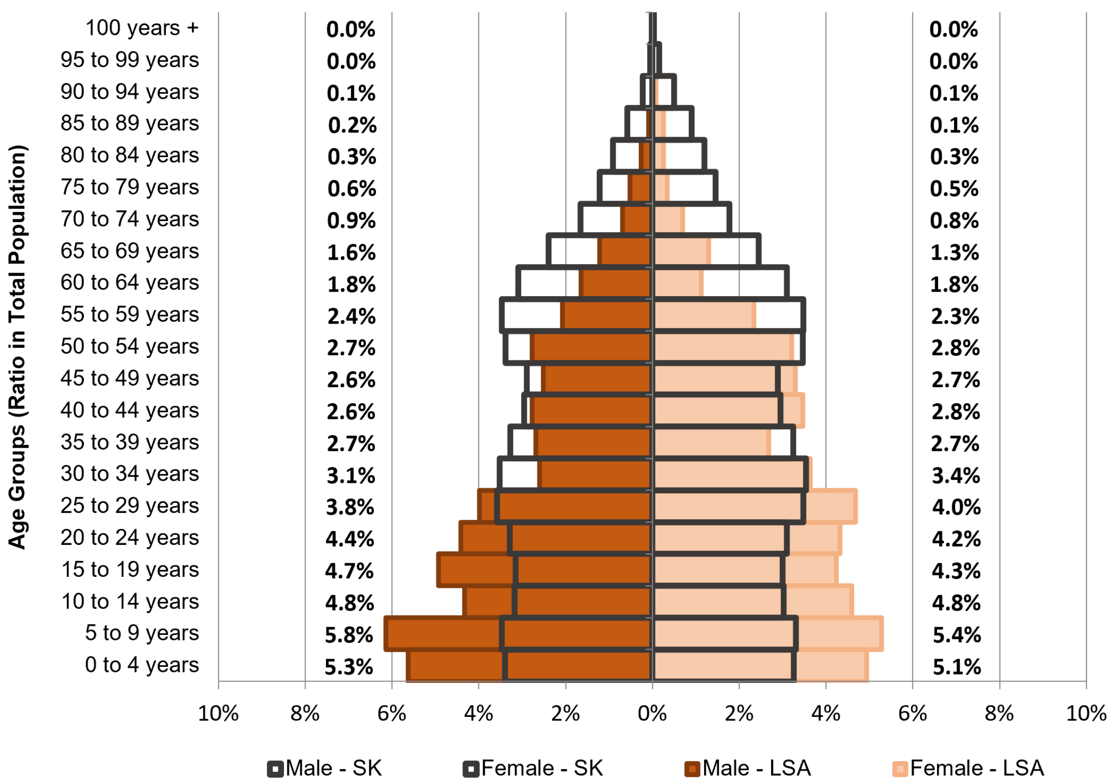
Figure 18.3-7 shows the 2016 population for the LSA and Saskatchewan by sex and age cohort. With respect to gender balance, females make up a slightly higher proportion (i.e., 51.2%) of the total population than males. Among LSA communities, the highest female proportion (i.e., 53.7%) was in BRDN and the lowest (i.e., 49.5%) in Buffalo Narrows. By comparison, the populations of the RSA and Saskatchewan are more evenly split between females and males (i.e., 49.7% and 50.3% female portion for the RSA and Saskatchewan, respectively) (Appendix 18A, Table 18A-5b)[13].

The age structure of the LSA population in 2016 was similar to the RSA and younger than the Saskatchewan population (Appendix 18A, Table 18A-5a). Median ages in the LSA in 2016 ranged between 23.8 years in CRDN and 30.8 years in Buffalo Narrows. This compares to median ages of 25.7 years in the RSA and 37.8 years in Saskatchewan as a whole. Median age by gender in the LSA was similar, except in the communities of La Loche, Buffalo Narrows and Michel Village. In La Loche, the median age of males was 21.8 years compared to 26.3 years for females, and in Buffalo Narrows the median age of males was 29.4 years compared to 33.3 years for females (Appendix 18A, Table 18A-5b)[14]. In the community of Michel Village, the median age of males was 50.0 years compared to 31.8 years for females. In 2016, females in both La Loche and Buffalo Narrows had higher employment rates than males (Appendix 18A; Table-13a), which may be reflective of the employment opportunities available locally, may result in more working-age females remaining in those communities, and may contribute to the overall higher median ages for females observed in those communities.

[13] To minimize rounding error and due to data unavailability, LSA communities with less than 400 population as of the 2016 Census were not included in this comparison.
[14] To minimize rounding error and due to data unavailability, LSA communities with less than 400 population as of the 2016 Census were not included in this comparison.

Overall, the data reflects the higher proportions of youth, and the contraction of young working-aged cohorts, particularly males over 30. The contraction of male cohorts may be attributed to the lack of economic opportunities, which are explored further in Section 18.3.4, Labour Force Characteristics. Correspondingly, the data shows higher proportions of working-aged females in the 25 to 34 years age cohorts. This aligns with labour force analysis (Section 18.3.4) which notes the main industries in the LSA are traditionally female orientated (e.g., service industries). This analysis was corroborated in discussions with the JWGs in August 2021 (BRDN-JWG 2021a; BNDN-JWG 2021a). Although out-migration for educational, social and employment reasons are generally higher for females in rural areas, this is likely reversed in the LPA because of the lack of customary economic opportunities for males (i.e., there are no/limited predominantly male industries active in the LPA). Discussions with community members identified situations where one partner (generally the female) worked in the wage economy and the other in the traditional (non-wage) economy.

Figure 18.3-7: Population Age Structure by Sex for the Local Study Area and Saskatchewan, 2016



Ratio numbers in the chart are for LSA male (left) and female (right) population

Source: Statistics Canada 2017a.
Note: Data were not available for Bear Creek, Black Point, Descharme Lake, Garson Lake, and St. George's Hill.
SK = Saskatchewan; LSA = local study area.

The data also shows the proportions of older age cohorts in the LSA significantly below the Saskatchewan data, which highlights the challenges of northern rural living on aged residents. The CRDN indicated their population is relatively young with the largest proportion of the population, by age breakdown, in the group aged 20-24 years according to Statistics Canada data. For the age group 0-14 years, CRDN has 31.1% of their population in this group, compared to Saskatchewan at 19%.

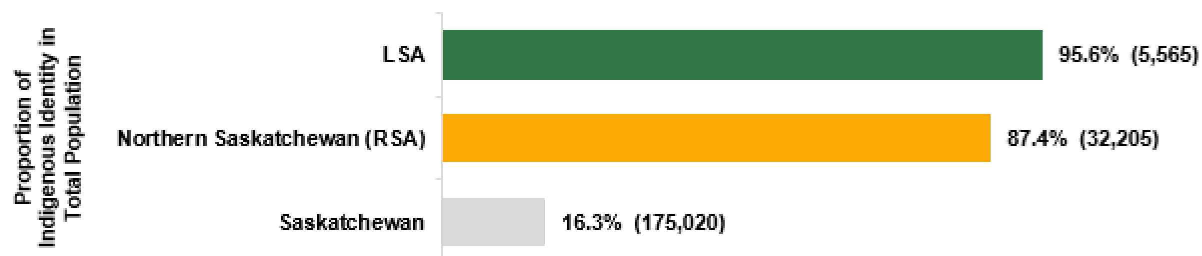
The average age of the population of CRDN in 2016 was 27.1 years. The population characteristics of the Northern Village of La Loche, where many CRDN members reside, has a similar population distribution to that of the CRDN reserve (TSD V.3 CRDN).

Communities with higher proportions of younger residents can experience more economic pressures on the working-aged population to support children and families. Younger populations may also place additional demands on health, education, and other social services (Irvine et al. 2011). Additional discussion on demands for health, education, and social services is provided in Section 19.3, Existing Conditions.

18.3.3.3 Indigenous Identity

Figure 18.3-8 shows the proportion of the 2016 population that identifies as Indigenous for the LSA, the RSA, and Saskatchewan as a whole (Appendix 18A, Table 18A-6a). The communities in the LSA are predominantly Indigenous (i.e., 95.6%). Within the LSA, Buffalo Narrows has the lowest proportion of population that identifies as Indigenous (i.e., 87.5% in 2016). This may be because Buffalo Narrows is the regional centre for many provincial government services and Crown corporations due to its centralized location in relation to the other communities in the LSA (has been this regional centre since the mid-1970s). For all other communities where data were available, over 96% of the population in 2016 identified as Indigenous (Appendix 18A, Table 18A-6c)[15]. Of the 2016 Indigenous population in the LSA, 61.6% identified as First Nations, 38.1% identified as Métis, and 0.4% identified as having Multiple Indigenous[16] identities (Appendix 18A, Table 18A-6b). A majority (i.e., 53.1%) of members of First Nations in the LSA reported living off-reserve in 2021 (Appendix 18A, Table 18A-7). A detailed breakdown of Indigenous identity is provided in Appendix 18A, Table 18A-6b and Table 18A-6c.

Figure 18.3-8: Proportion of Population Identifying as Indigenous for the Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016



Source: Statistics Canada 2017a.
Note: Data were not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake.
LSA = local study area; RSA = regional study area.

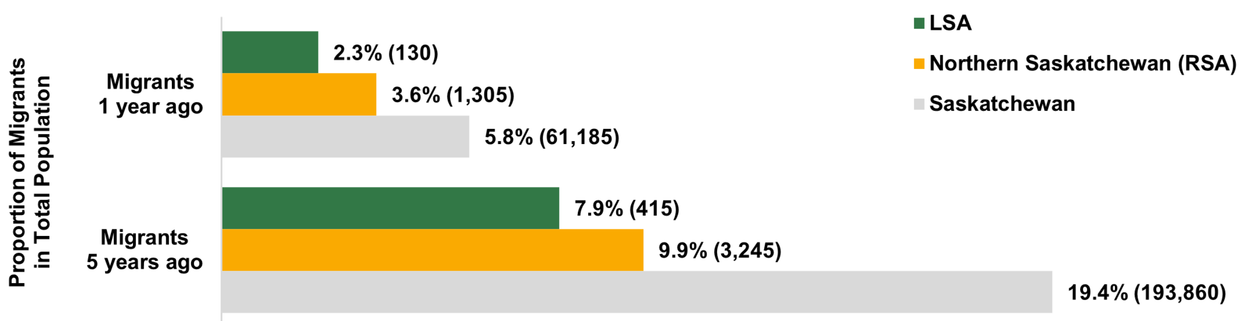
[15] To minimize rounding error and due to data unavailability, LSA communities with less than 400 population as of 2016 Census were not included in this comparison.
[16] According to Statistics Canada 2016, “Multiple Aboriginal [Indigenous] responses” includes persons who are any two or all three of the following: First Nations (North American Indian), Métis, or Inuk (Inuit).

18.3.3.4 Migration

Statistics Canada surveys population mobility as part of the census. Population mobility can be a key driver of population changes. People may move for a variety of reasons, including access to employment and education opportunities or to be closer to family. Migrants are people who relocated into a new census subdivision and include both internal migrants who moved to a different city, town, township, village, or Indian Reserve within Canada, and external migrants who lived outside Canada at an earlier date. Migrants do not include people who moved within the same census subdivision (Statistics Canada 2017b)[17]. Figure 18.3-9 shows the proportion of the LSA, RSA, and Saskatchewan population who migrated within the last year (i.e., 2016) and the last five years (i.e., 2011 to 2016; Appendix 18A, Table 18A-9a). A smaller proportion of the LSA population are migrants within the last year and last five years compared to the RSA and Saskatchewan as a whole. For communities within the LSA, La Loche had the lowest migration rate within 1 year (i.e., 1.1%) and within the last 5 years (i.e., 3.8%). Buffalo Narrows had the highest migration rate within 1 year (i.e., 4.3%), likely due to service sector workers and Crown corporation staff rotating into positions, while BRDN had the highest migration rate within the last 5 years (i.e., 13.1%; Appendix 18A, Table 18A-9b)[18].

Some common reasons for migration stated by LSA residents include attending school, limited housing availability within a community, and limited availability of employment. Residents of smaller communities within the LSA often move to larger communities such as Buffalo Narrows or La Loche for schooling and housing. Some LSA residents commented that people who leave the community for schooling often do not return as they seek further education or employment opportunities elsewhere (2019 to 2021 KP interview program).

Figure 18.3-9: Proportion of Population Who Were Migrants 1 Year and 5 Years Ago, 2016



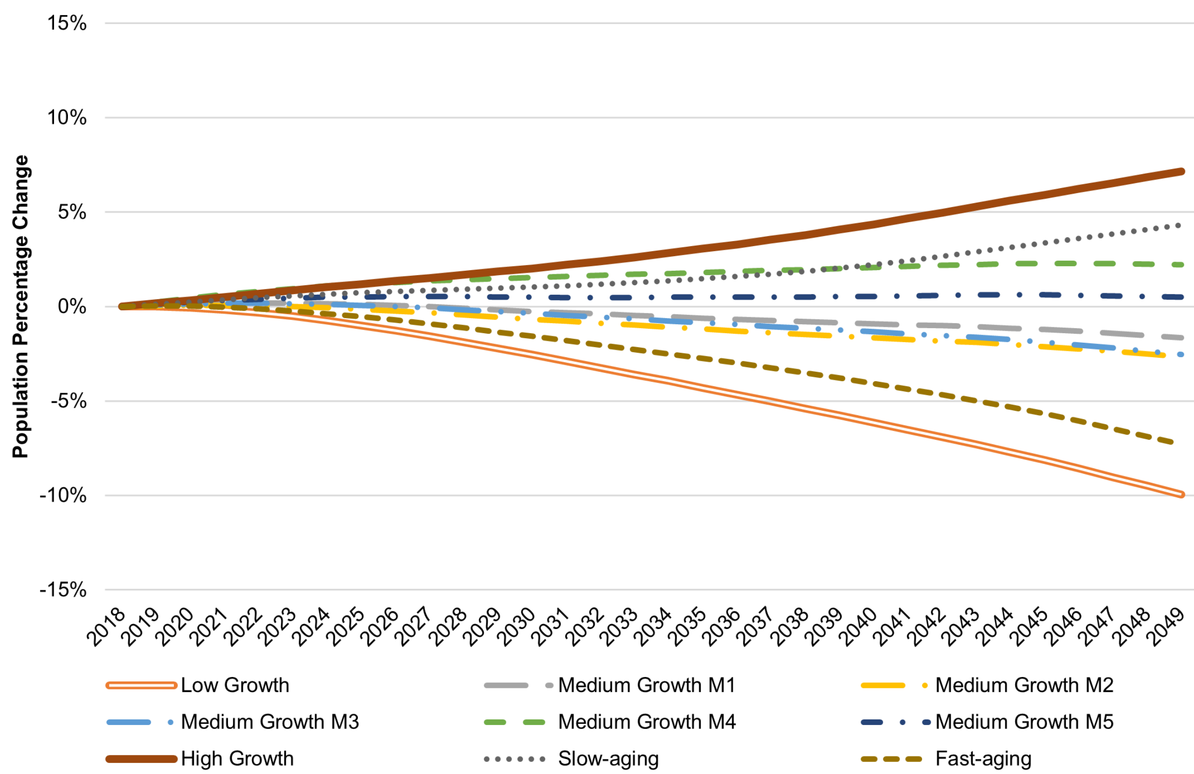
Source: Statistics Canada 2017a.
Note: Data were not available for Bear Creek, Descharme Lake, and Garson Lake.
LSA = local study area; RSA = regional study area.

[17] Statistics Canada defines non-migrant movers as those who moved within the same census subdivision. Migrants are defined as those who do not live in the same census subdivision as they did in the last reference period.
[18] To minimize rounding error and due to data unavailability, LSA communities with less than 400 population as of the 2016 Census were not included in this comparison.

18.3.3.5 *Population Projections*

Statistics Canada prepares population projection scenarios by health region[19]. The projections are not available at the individual community level. The projections are developed considering trends in birth rate, mortality, and migration, and in discussion with experts (Chagnon et al. 2020). Additional detail on assumptions related to each scenario are provided in Appendix 18A, Table 18A-10a and Table 18A-10b. The projections include low-, medium-, and high-growth, as well as slow- and fast-aging scenarios. The Northwest Region of the Saskatchewan Health Authority (previously the Keewatin Yatthé Health Region) includes the communities in the LSA (i.e., population of 5,991 in 2016) as well as other communities. The Northwest Region had a total population of approximately 11,000 in 2018 (Appendix 18A, Table 18A-10a). Figure 18.3-10 shows the range of cumulative percent changes in population for the Northwest Region from 2018 forecasted to 2049 based on nine different scenarios. The cumulative percentage changes were calculated by dividing the forecast population in each year by the population in 2018, which was the year these future forecasts were projected from (i.e., the base year). Projections should be interpreted with caution due to the small population size of the health region and are intended to show a range of potential future population scenarios.

Figure 18.3-10: Cumulative Forecast Percentage Population Change by Scenario for the Northwest Health Region, 2018 to 2049



Source: Statistics Canada, Custom projections for Health Regions in Canada (2018 to 2049). Raw data and discussions of assumptions presented in Appendix 18A, Table 18A-10a and Table 18A-10b.

[19] Statistics Canada refers to health regions as administrative areas defined by the provincial ministries of health.

Figure 18.3-10 shows a range of potential outcomes for the population of the Northwest Region from a cumulative increase of approximately 7% from 2018 to 2049 in the high growth scenario to a decrease of approximately 10% in the low growth scenario for the same period. Applying these increases and decreases to the LSA would result in a population range of approximately 5,400 to 6,400 for the LSA by 2049 and average annual population changes ranging from a decrease of 0.34% to an increase of 0.22%. By contrast, Statistics Canada projects average annual population increases for Saskatchewan of between 0.84% and 1.72% for the period from 2018 to 2043 (Statistics Canada 2019; Appendix 18A, Table 18A-10b). This variability in the LSA data is consistent with past population trends (Figure 18.3-1 and Figure 18.3-2).

18.3.3.6 Population Summary

The population of the LSA has grown from approximately 3,500 people in 1981 to approximately 6,000 in 2016, with almost 40% (i.e., 2,372 people) of the 2016 population residing in La Loche. Since 1981, the larger LSA communities of La Loche and Buffalo Narrows have typically experienced lower annual average population growth rates than the smaller communities of the LSA (i.e., BNDN, BRDN, and CRDN). A large majority of LSA residents identify as Indigenous. The LSA population is, on average, younger than the Province of Saskatchewan. This younger population has implications for labour force participation, employment rates, and education and training needs. Demands on services resulting from a younger population are described in more detail in Section 19.3.6, Community Well-Being Index.

18.3.4 Labour Force Characteristics

Statistics Canada defines the labour force as the total number of persons who are employed or unemployed in a reference period (Statistics Canada 2017b). Labour force characteristics for the market or wage economy can be described by a number of indicators, including the following:

- **Employment rate:** Statistics Canada defines an employed person as someone who completed paid work as either an employee for a company or through self-employment; someone who completed unpaid family work contributing directly to the operation of a business owned and operated by a related member of the same household; or someone who had a job but was not at work as a result of illness, family responsibilities, or other factors (Statistics Canada 2017c). Statistics Canada calculates the employment rate as the number of persons employed in the reference period expressed as a percentage of the total population aged 15 years and over.
- **Unemployment rate:** Statistics Canada defines an unemployed person as someone who was without paid work or self-employment work, were available for work and had actively looked for paid work in the past four weeks, were on temporary lay-off and expected to return to their job, or had definite arrangements to start a new job in four weeks or less. The unemployment rate is the number of unemployed people expressed as a percentage of the total labour force (Statistics Canada 2017b).
- **Persons not in the labour force:** People who are not in the labour force are those who are aged 15 or older but not employed or unemployed. This can include people who are permanently unable to work, retired, full-time students, and discouraged[20] workers (OECD 2003; Gilmore and LaRochelle-Côté 2011).
- **Participation rate:** the total number of employed and unemployed people in a reference period expressed as a percentage of the population aged 15 years and over (Statistics Canada 2017c).

[20] The Organisation for Economic Co-operation and Development (OECD) defines a discouraged worker as someone who, while willing and able to engage in a job, is not seeking work or has ceased to seek work because they believe there are no suitable available jobs.

The 2016 estimated labour force of the LSA was 1,805 people, with the largest labour pools located in La Loche (i.e., 525 people, or 29%) and Buffalo Narrows (i.e., 475 people, or 26%). Figure 18.3-11 shows the employment rate, unemployment rate, percentage of people not in the labour force, and the participation rate for the LSA, RSA, and Saskatchewan from 1986 to 2016 (Appendix 18A, Table 18A-11). The presented information suggests that the labour market of the LSA and RSA operate relatively independently of each other, and both operate independently of the Saskatchewan labour market. Activities occurring more broadly in the RSA and Saskatchewan have little to no effect on the labour market of the LSA. The data also show that the participation rate and employment rate for the LSA and RSA have consistently been lower than for Saskatchewan. Conversely, the unemployment rate and percentage of people not in the labour force have been consistently higher in the LSA and RSA than in Saskatchewan. Of note, in 2016, more people in the LSA aged 15 years and over were not in the labour force than were in the labour force (i.e., 2,220 compared with 1,805). The participation rate, employment rate, and unemployment rate vary among LSA communities (Appendix 18A, Table 18A-13b)[21].

- The employment rate in 2016 in the LSA was 32.5%. The highest employment rate (i.e., 54.2%) was in Buffalo Narrows, which is likely because Buffalo Narrows is the regional centre for many provincial government services and Crown corporations. The lowest employment rate (i.e., 24.0%) was in La Loche, which has the largest concentration of both population and labour force in the LSA due to limited available employment outside mining and the public sector, with employment often limited to seasonal (2019 to 2021 KP interview program). It was noted during a JWG meeting that Buffalo Narrows is a pick-up point for current mining operations (BRDN-JWG 2021a) in the Athabasca Basin. The employment rate in 2016 for Saskatchewan was 63.5%.
- The unemployment rate in 2016 in the LSA was 28.0%; the highest (i.e., 44.4%) was for the CRDN, and the lowest (i.e., 13.7%) was in Buffalo Narrows. The unemployment rate in 2016 for Saskatchewan was 7.1%.
- The participation rate in 2016 in the LSA was 44.8%; the highest (i.e., 62.1%) was in Buffalo Narrows, and the lowest (i.e., 33.1%) was in La Loche. The participation rate in 2016 for Saskatchewan was 68.3%.

The proportion of population not in the labour force varies considerably between communities of the LSA. In 2016, the average proportion of LSA population not in the labour force was 55.2%, the highest (i.e., 66.9%) was in La Loche, and the lowest (i.e., 37.3%) was in Birch Narrows (Appendix 18A, Table 18A-14b). In Saskatchewan as a whole, proportion of population not in the labour force in 2016 was 31.7% (Appendix 18A, Table 18A-14a). The proportion of population not in the labour force also varies by age group. For instance, in La Loche, the proportion of population not in the labour force in 2016 was 80.9% for the age group of 15 to 24 years, and 49.1% for age group of 35 to 44 years (Appendix 18A, Table 18A-14b). Based on information collected from KP interviews and JWGs, there may be a substantial portion of the population that is currently disengaged from the labour force due to the persistent lack of employment opportunities (i.e., discouraged worker) or because they are receiving a government transfer. This population may choose to participate in the labour force if there were more employment opportunities available locally (KP interviews Program; MN-S-JWG 2020b; BRDN-JWG 2020; BNDN-JWG 2021a; DMCA 2018).

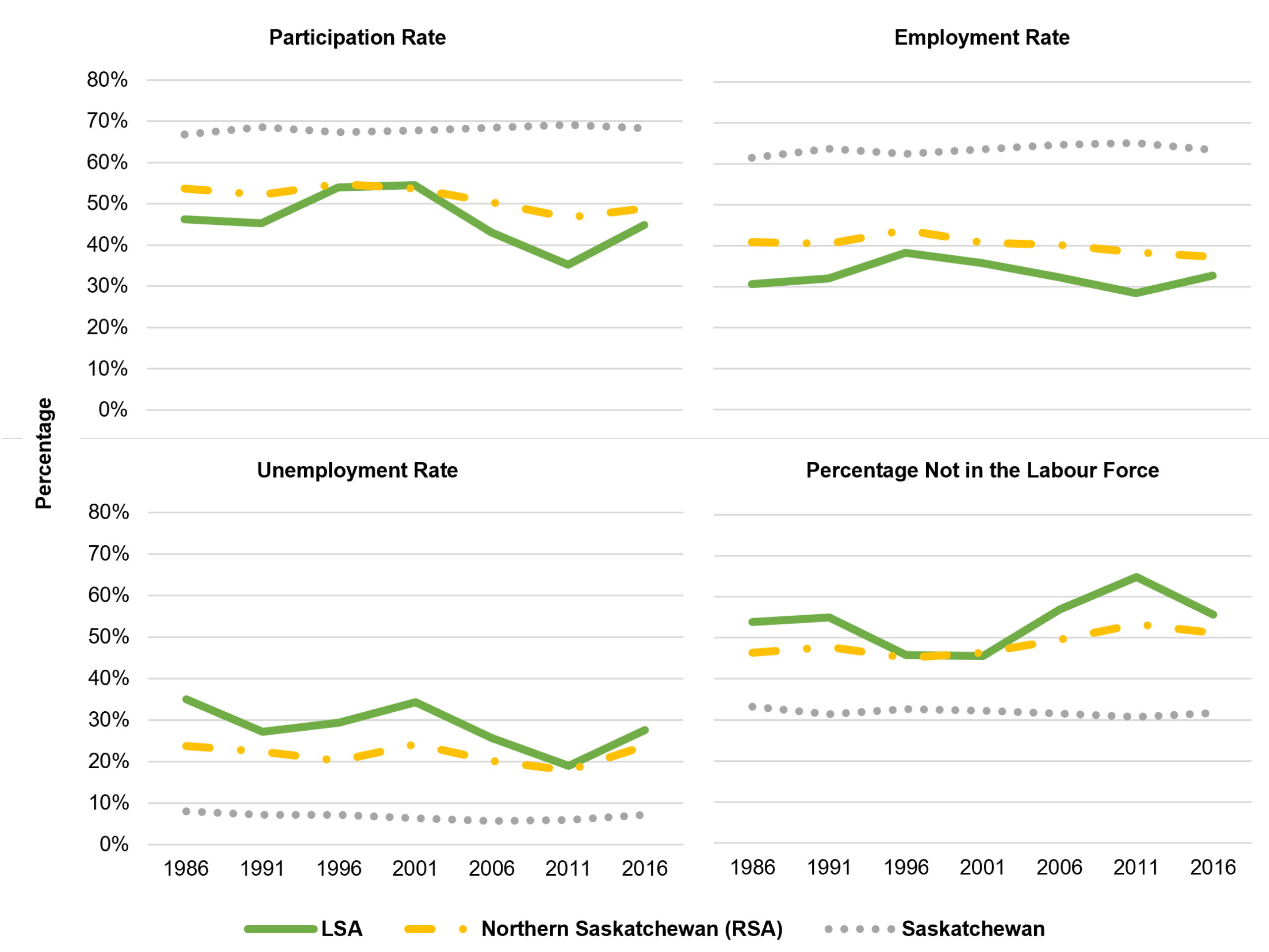
Trends in the data, particularly related to the 2011 National Household Survey, should be interpreted with caution due to a shift from a mandatory to an optional response survey in that year (Section 18.2.6.1.1, Limitations of the Literature Review). The variability in the LSA data may reflect the smaller population size relative to the RSA and Saskatchewan.

[21] Data were not available for Bear Creek, Black Point, Descharme Lake, or Garson Lake.

A 2013 review of the socio-economic impacts of uranium mining in northern Saskatchewan noted that the total number of RSA residents participating in the workforce increased from 5,924 in 1976 to 11,272 in 2006. Despite this increase, employment and unemployment rates in the RSA remained relatively stable from 1976 to 2006 due to concurrent population growth (CVMPP 2013). In July 2021, the Saskatchewan Bureau of Statistics (2021b) reported the provincial unemployment rate was 7.3%, which is slightly higher than the 2016 Census value of 7.1% but lower than the July 2020 provincial unemployment rate of 9.3%.

During the JWG on economies in August 2021, a BRDN participant commented that they expected the unemployment rate for their community was higher in 2021 as a result of the COVID-19 pandemic (BRDN-JWG 2021a).

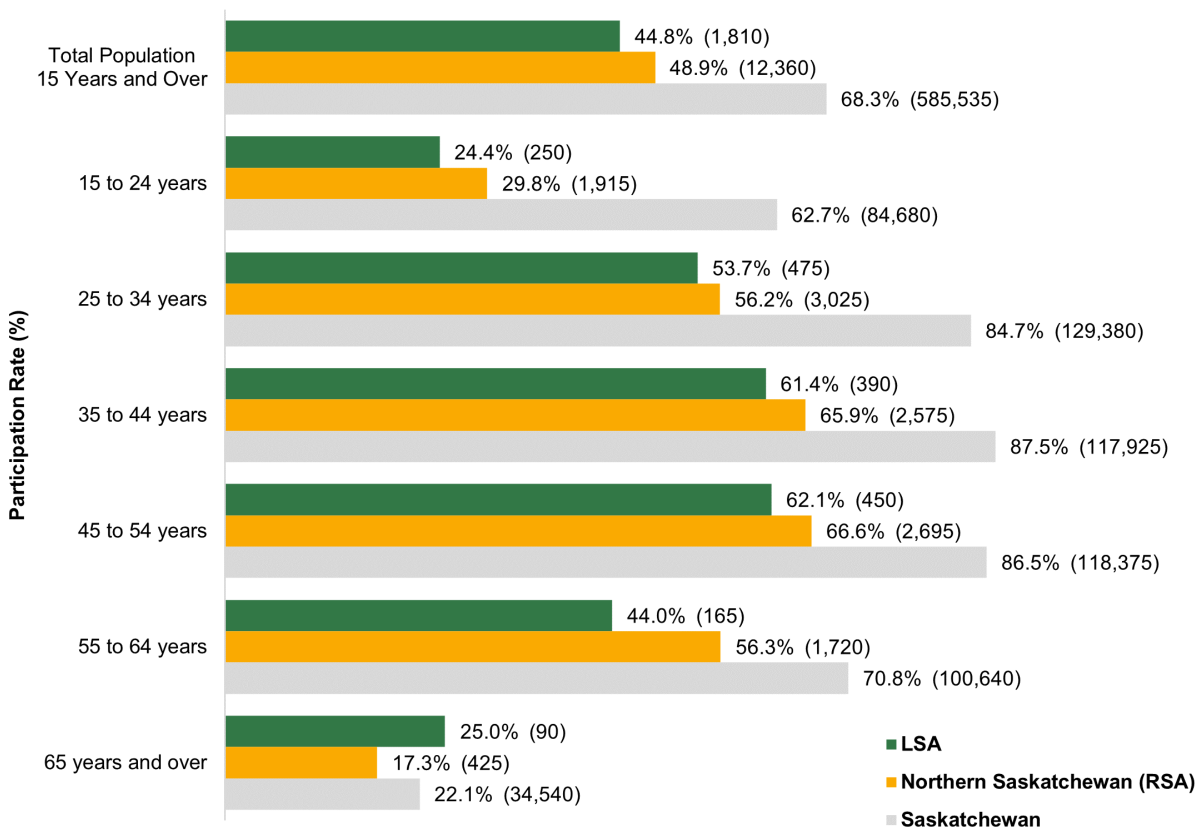
Figure 18.3-11: Participation Rate, Employment Rate, Unemployment Rate, and Percentage of People Not in the Labour Force for the Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 1986 to 2016



Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.
Note: Data were not available for all years for Bear Creek, Black Point (except 2016), Descharme Lake, Garson Lake. Data from 2011 were not available for the BNDN (Turnor Lake 193B) or Turnor Lake.
LSA = local study area; RSA = regional study area; BNDN = Birch Narrows Dene Nation.

Figure 18.3-12 shows the 2016 participation rate for the LSA, RSA, and Saskatchewan by age cohort (Appendix 18A, Table 18A-14a). Both the LSA and RSA have participation rates substantially lower than Saskatchewan for all age cohorts, with the exception of the 65 and older cohort, where the LSA has a higher participation rate (i.e., 25.0%) than both the RSA (i.e., 17.3%) and Saskatchewan (i.e., 22.1%). Lower participation rates can reflect a number of factors, including but not limited to a lack of local employment opportunities that results in discouragement for potential workers or preferences for engagement in the traditional or non-market economy (2019 to 2021 KP interview program).

Figure 18.3-12: Participation Rate by Age Cohort for the Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016



Source: Statistics Canada 2017a.
Note: Data were not available for Bear Creek, Black Point, Descharme Lake, or Garson Lake.
LSA = local study area; RSA = regional study area.

For the LSA, RSA, and Saskatchewan, the participation rate for those aged 15 to 24 and those over 65 is consistently lower than the participation rate for the total population of each region. The lower participation rates in these age cohorts reflects the significant proportion of each cohort that is not in the labour force due to reasons potentially including pursuing education and training opportunities (and therefore not available to work), particularly for those aged 15 to 24, and retirement for those aged 65 and older, as is commonly observed for larger populations like the RSA and Saskatchewan and confirmed for the LSA (2019 to 2021 KP interview program). The participation rates for population between the ages of 25 to 64 are either the same as or higher than the participation rates for the total population. Similar trends are noted for the 2016 employment rate by age cohort (Appendix 18A, Table 18A-14a). A larger proportion of those aged 15 to 24 and those over 65 were not in the labour force in 2016 compared to those between the ages of 25 to 64. This suggests the core labour force is composed of people between the ages of 25 to 64. These findings are consistent across communities in the LSA for 2016 (Appendix 18A, Table 18A-14b)[22].

In the LSA in 2016, the participation rate was somewhat higher for males (i.e., 47.0%) than females (i.e., 42.3%) which is common among LSA communities , though both were low compared to the RSA and very low compared to Saskatchewan (Appendix 18A, Table 18A-13a). Buffalo Narrows had the highest participation rates in 2016 for both males (i.e., 61.1%) and females (i.e., 65.0%) while La Loche had the lowest participation rates for both males (i.e., 36.7%) and females (i.e., 30.0%), which is likely linked to the employment and unemployment rates discussed below. The CRDN 2016 participation rate was 48.3% for males and 45.0% for females (TSD V.3: CRDN). A greater proportion of females were not in the labour force compared to males in the LSA in 2016, which is consistent with the RSA and Saskatchewan. An economic study of CRDN and La Loche found that despite training initiatives in the La Loche region, participation rates in the labour force for both CRDN and La Loche have dropped between the ten-year study period of 2006 to 2016 (DMCA 2018).

In 2016, males in the LSA had lower employment rates than females (i.e., 29.9% compared to 33.9% respectively) and higher unemployment rates (i.e., 35.4% compared to 21.0% respectively). Buffalo Narrows had the highest 2016 employment rates (i.e., 48.6% for males; 60.0% for females) and lowest unemployment rates (i.e., 18.2% for males; 7.7% for females). The CRDN had the lowest employment rate for males (i.e., 21.4%) and an employment rate of 31.0% for females. Michel Village had the highest unemployment rate for males (66.7%) and an unemployment rate of 66.7% for females, noting that the total population aged 15 years and over in Michel Village is very small (i.e., 50 persons). The CRDN had an unemployment rate of 53.6% for males, and the highest unemployment rate for females (i.e., 34.6%). La Loche had and an employment rate of 23.8% for males and the lowest employment rate (i.e., 24.1%) for females (Appendix 18A, Table 18A-13b). Males in La Loche had higher unemployment rates than females (i.e., 33.3% and 19.6%, respectively).

Higher employment rates for females in the LSA reflect the gender imbalance of employment in key sectors in the LSA economy. Two of the largest employment sectors in the LSA in 2016 (i.e., educational services and health care and social assistance or the government sector [DMCA 2018]) predominantly employ females (i.e., 73% and 85%, respectively; Figure 18.3-15). The CRDN indicated that the majority of their members who are in the workforce are employed in the health and education services and the majority of those are females (TSD V.3 CRDN). The employment and unemployment data corroborates observational data and discussions from the August 2021 JWGs (BRDN-JWG 2021a; BNDN-JWG 2021a), which also noted a lack of employment opportunities in predominantly male industries (e.g., farming, mining, oil and gas, forestry, construction), common in rural areas like the LSA and RSA, and a higher-than-normal proportion of predominantly female industries (e.g., education, healthcare, social services). This data is supported by the La Loche Economic Development Strategic Plan from 2017, which found that the main industries driving the La Loche economy are educational services (7.3%), health care and social services (4.8%), and other services (6.1%; LLEDC 2017). As a result, there are significantly more employment opportunities in industries more commonly associated with female employment than male, which is reflected in the employment and unemployment rates. However, there are still fewer employment opportunities for LSA residents than people seeking employment, which is why unemployment is high, and partially explains why participation rates are low (i.e., people are not looking for employment opportunities they believe do not exist).

[22] To minimize rounding error and due to data unavailability, LSA communities with less than 400 population as of the 2016 Census were not included in this comparison.

Comments made during JWG meetings indicated that lower levels of educational attainment are a barrier to some employment opportunities; for example, a BNDN member stated, "more professional people come into our communities until we can develop our own at the local level" (BNDN-JWG 2020). A BNDN representative also noted difficulty retaining teachers in 2021 (BNDN-JWG 2021b). Local study area residents confirmed during KP interviews that many local employment opportunities are seasonal and that seasonal employment opportunities, such as fire fighting, outfitting, and construction, are more often filled by men (2019 to 2021 KP interview program). It was also noted that many of these opportunities are more jobs (i.e., short-term work) than careers (i.e., long-term work), which can also affect employment/unemployment and participation rates.

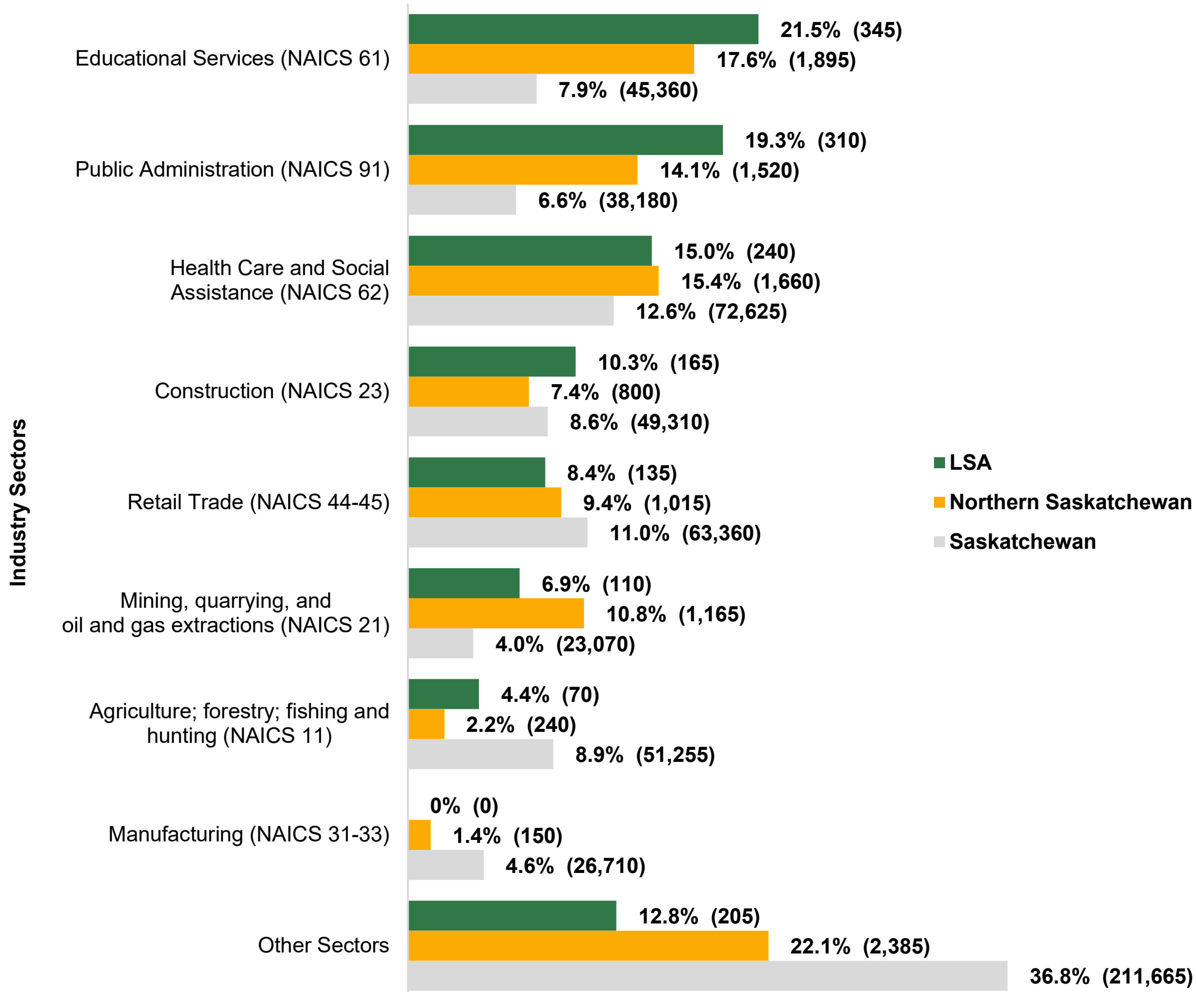
Residents noted that online employment application processes can make it difficult to obtain employment as many people do not have access to a computer or internet in their homes or have limited or no experience with such processes. Distance to employment was noted as a barrier to employment in the mining sector, particularly for women, generally due to family and childcare responsibilities. Some LSA residents noted women may be more likely to enter the industry if employment opportunities in mining were more proximal to their homes. It was also noted this would benefit family units in general, particularly in the ability to respond to family emergencies (2019 to 2021 KP interview program). A number of these barriers to employment have also been identified as being broadly applicable to the RSA, including lower levels of educational attainment, limited job and work experience opportunities in smaller communities, and the short-term or seasonal nature of many jobs (NLMC et al. 2011).

18.3.5 Employment by Sector

Figure 18.3-13 shows the percentage of employment by sector for 2016 for the LSA, the RSA, and Saskatchewan (Appendix 18A, Table 18A-17a). The sectors with the highest employment rates in the LSA and RSA are educational services, public administration, and health care and social services. Females make up the majority of employees in the educational services and health care and social services sectors in the LSA (Figure 18.3-15), which contributes to the higher employment rates for females in the LSA compared to males. The data indicate that employment in the LSA and RSA is particularly concentrated in government-funded service sectors with lower employment rates in sectors including agriculture, forestry, fishing and hunting, manufacturing, and retail trade than in Saskatchewan as a whole. During JWG meetings, it was noted that government services represent a large portion of employment, with comparatively little private business employment opportunities (BNDN-JWG 2021b; BRDN-JWG 2020). This trend was also noted for CRDN and La Loche economies, where the private sector made up only 20% of employment compared to 45% in the provincial economy (DMCA 2018).

The construction sector is also a large employer in many LSA communities, and for people living on reserve at the CRDN; for the on-reserve CRDN, the construction sector was the second highest employer after educational services (Appendix 18A, Table 18A-17a and Table 18A-17b). The LSA residents noted that many employment opportunities in the construction sector are cyclical or intermittent and often depend on the availability of government funding for infrastructure projects (2019 to 2021 KP interview program).

Figure 18.3-13: Employment by Industry Sector for the Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016



Source: Statistics Canada 2017a.
Note: Data were not available for Bear Creek, Descharme Lake, or Garson Lake.
LSA = local study area; NAICS = North American Industry Classification System.

Employment in the mining, quarrying, and oil and gas extraction sectors peaked in 2011 in LSA communities (i.e., 11.2% of total employment) followed by a decline in 2016 (i.e., 6.9% of total employment), though caution should be used interpreting trends, particularly in consideration of the change in survey methods for 2011 (Appendix 18A, Table 18A-18a; Figure 18.3-14). Employment in mining, quarrying, and oil and gas extraction was higher in 2016 in the LSA (6.9%) and RSA (10.8%) compared to Saskatchewan as a whole (4.0%). However, employment in other primary industries such as agriculture, forestry, fishing, and hunting was lower in the LSA (4.4%) and RSA (2.2%) than in all of Saskatchewan (8.9%). In Saskatchewan as a whole, construction, retail trade, agriculture, forestry, fishing, and hunting (28.5%) accounted for a larger share of employment than public administration, educational services, or health care and social assistance (27.1%) (Appendix 18A, Table 18A-17a).

Public administration, educational services, and health care and social assistance have consistently provided the highest share of employment in the LSA since 2001. Community members confirmed major employers in the LSA include the health district, the government, and schools (2019 to 2021 KP interview program). Other sectors, such as the following, have at times been substantial employers in individual LSA communities (Appendix 18A, Table 18A-18b)[23].

- In CRDN in 2016, the construction sector was the second-highest employer (19.0%) after educational services (21.4%).
- In Buffalo Narrows in 2011, the mining, quarrying, and oil and gas extraction sector was the second-highest employer (13.3%) after public administration (41.0%).
- In BRDN in 2011, the retail trade sector was the second-highest employer (15.0%) after public administration (25.0%); in 2001, the manufacturing sector was the third-highest employer (15.8%) after public administration (23.7%) and educational services (18.4%).

Government service sectors were noted to be the sectors typically most likely to employ LSA residents and to provide the most access to local employment opportunities (2019 to 2021 KP interview program). As indicated in Figure 18.3-13, employment in other primary industries such as agriculture, forestry, fishing, and hunting, and in sectors such as manufacturing and retail trade, is lower in the LSA and RSA than in Saskatchewan. As a result, employment opportunities in the LSA are reliant to a large degree on government-funded service sectors. A 2018 economic analysis completed for the La Loche region confirmed government services accounted for the majority of employment (60.7%) with comparatively few employment opportunities in the private sector (greater than 20%; DMCA 2018).

Community members noted the mining and oil and gas sectors are considered important sources of employment because they provide steady employment and good wages (2019 to 2021 KP interview program). Employment in the mining, quarrying, and oil and gas extraction sectors has ranged between 2.5% in 2001 and 11.2% in 2011 (Figure 18.3-14 and Appendix 18A, Table 18A-18a)[24]. During KP interviews, community members commented that there has been an increased awareness and opportunity for LSA residents to pursue employment opportunities in the oil and gas or mining sector outside of their home communities. More recent estimates indicated approximately 200 LSA residents have experience in the mining, quarrying, or oil and gas sector and represent a potential workforce for the Project; however, this value also likely included seasonal quarry workers and others with less transferable skills (BRDN-JWG 2021a). Members of CRDN have expressed wariness regarding economic and employment benefits from exploration projects as they have failed to materialize in the past (TSD V.2: CRDN). Clearwater River Dene Members reported that based on previous experience with the Cluff Lake Mine and the Oilsands Quest exploration activities, local residents were initially hired for oil and gas and mining projects but were soon replaced by workers from southern Saskatchewan (TSD V.2: CRDN). Overall, many CRDN KP interview respondents expressed interest in Project employment potential for community members but had concerns about the types of opportunities (i.e., low paying versus professional careers), whether CRDN members would have access to mine jobs, the prospect that southern workers would get most of the jobs, and the challenges balancing jobs, money, and quality of life

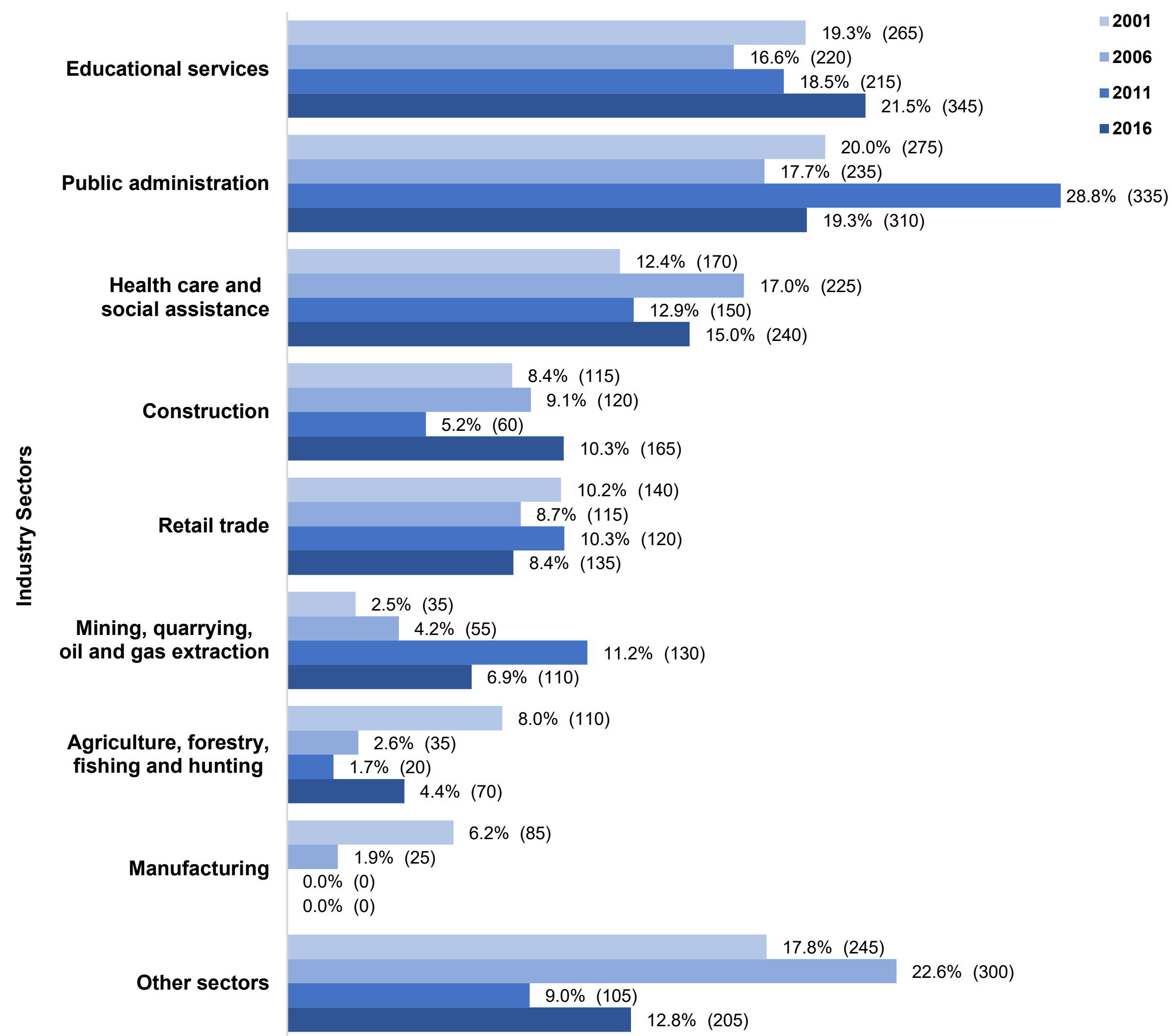
[23] To minimize rounding error and due to data unavailability, LSA communities with less than 400 population as of the 2016 Census were not included in this comparison.

[24] According to Mining Industry Human Resources Council report on Saskatchewan Mining Industry Hiring Requirements and Available Talent Forecasts, 2014, Figure 8 on page 14, employment in the Saskatchewan mining industry peaked between 2005 and 2008 (MIHRC 2015).

(TSD V.3: CRDN). This aligned with similar interest and concerns by the other Indigenous Groups (2019 to 2021 KP interview program; MN-S-JWG 2019a, MN-S-JWG 2020a, BNDN-JWG 2021a; BRDN-JWG 2021a).

Many community members that work in mining or the oil and gas sector still reside within the LSA while working a rotation elsewhere such as Fort McMurray, Cold Lake, the potash mines in central Saskatchewan, or the uranium mines in northeastern Saskatchewan. It was noted that those working in Alberta commute longer distances between the worksite and home depending on the rotation schedule while those working in the uranium industry in Saskatchewan are able to utilize pick-up points in Buffalo Narrows, Beauval, and Prince Albert (BRDN-JWG 2021a; 2019 to 2021 KP interview program). Similar to the LSA, public administration, educational services, and health care and social assistance accounted for the highest share of employment in 2016 in the RSA. However, in Saskatchewan as a whole, the three sectors contributing to the highest share of employment were health care and social assistance (i.e., 12.6%), retail trade (i.e., 11.0%), and agriculture, forestry, fishing, and hunting (i.e., 8.9%) (Appendix 18A, Table 18A-17a).

Figure 18.3-14: Proportion of Employment by Industry Sector for the Local Study Area, 2001 to 2016



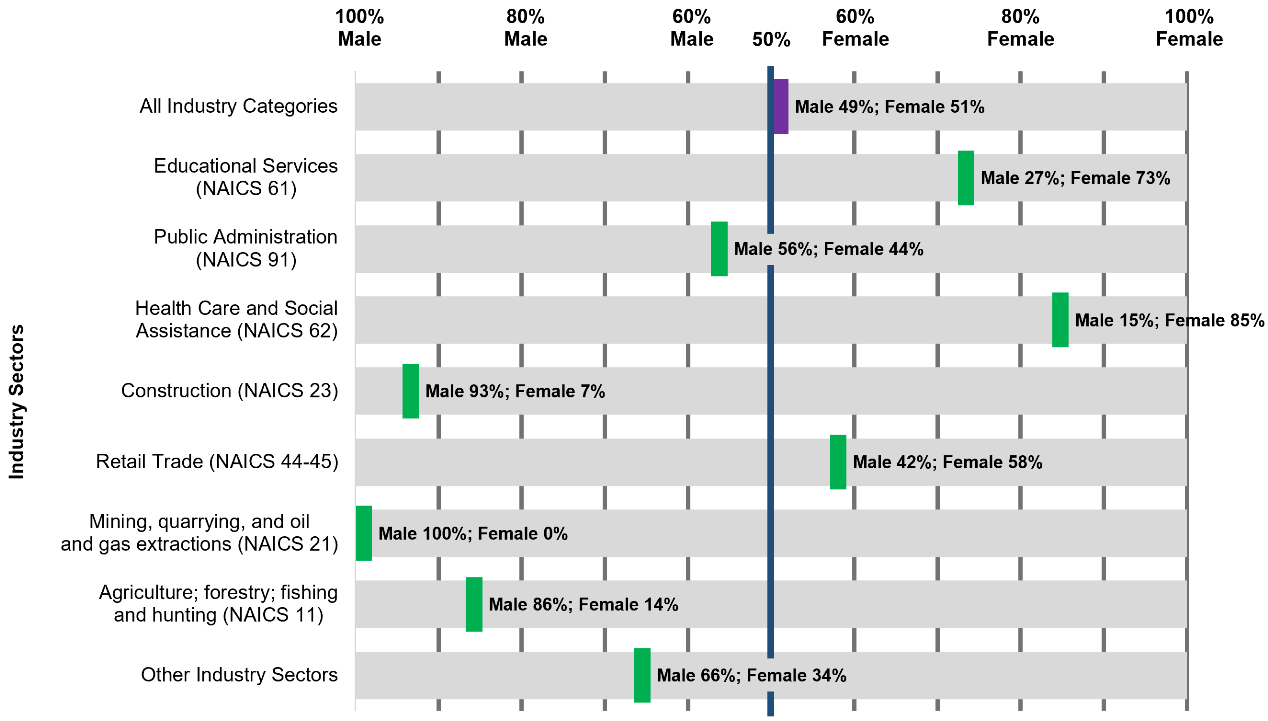
Source: Statistics Canada 2002, 2007, 2012, 2017.
Note: Data were not available for Bear Creek, Black Point, Descharme Lake, or Garson Lake.

Local study area residents noted during KP interviews that people may have to leave their home community (i.e., out-migrate) to obtain work and only return when local job opportunities are available, which may be a contributing factor to the decline in population from 2011 to 2016 (Figure 18.3-1). Employment opportunities in the LSA are more common in health care and education, and interview participants noted workers in these fields are more likely to be able to return to their home communities for employment. These sectors also predominantly employ females, which contributes to the generally higher employment rates for females in the LSA (Figure 18.3-15 and Appendix 18A, Table 18A-17a). Those seeking work in other sectors may not be able to find local employment that matches their skills and interests as easily. While some LSA residents continue to work in the mining sector, other mine workers do not have credentials that are easily transferable to employment in other sectors (2019 to 2021 KP interview program).

Figure 18.3-15 shows the distribution of employment by sector and sex in the LSA from the 2016 Census (Appendix 18A, Table 18A-17a). Females accounted for a larger proportion of employment in health care and social assistance (i.e., 85%) and educational services (i.e., 73%). Males accounted for a higher proportion of employment in public administration (i.e., 56%). The construction sector and mining, quarrying, and oil and gas extraction sector were predominantly male (i.e., 93% and 100%, respectively). The Construction Sector Council (CSC 2010) has noted a number of barriers to employment for women in the construction sector including barriers related to recruitment, access to education, training and employment opportunities, and workplace environment. A 2010 report on the status of women in the mining and exploration sector also noted that the need for flexible working arrangements was a key issue for women (Women in Mining Canada 2010). Reasons for flexible working arrangements include childcare and being able to attend to family (2019 to 2021 KP interview program). In the RSA and Saskatchewan, distribution of employment by sector and sex in 2016 were similar with the LSA, except the mining, quarrying, and oil and gas extraction sectors, where approximately 13% of employees were females (Appendix 18A, Table 18A-17a). For communities in the LSA, the highest proportion of employment by females is observed in Buffalo Narrows (i.e., 55.4%) and the lowest is in BNDN (i.e., 46.9%; Appendix 18A, Table 18A-17b)[25].

[25] To minimize rounding error and due to data unavailability, LSA communities with less than 400 population as of the 2016 Census were not included in this comparison.

Figure 18.3-15: Employment by Industry Sector and by Sex for the Local Study Area, 2016



Source: Statistics Canada 2017a.
Note: Data were not available for Bear Creek, Black Point, Descharme Lake, or Garson Lake.
NAICS = North American Industry Classification System.

18.3.6 Income

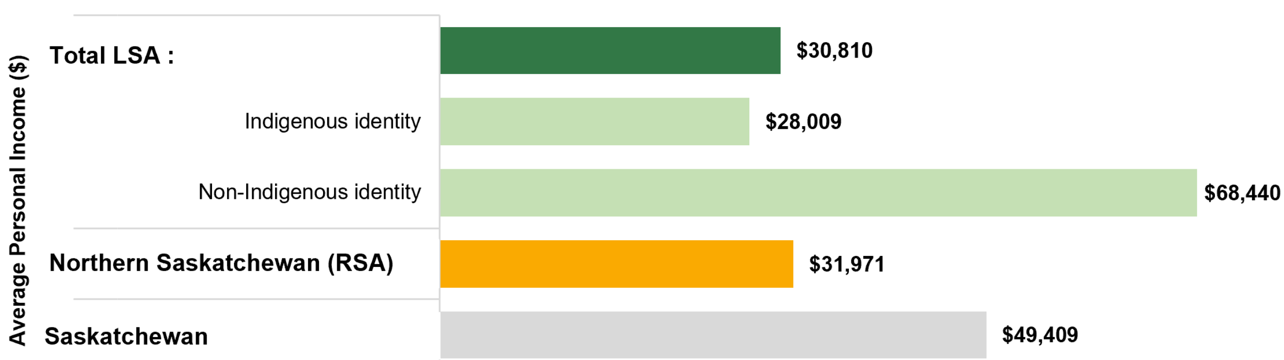
Effects on income are characterized considering both wage or market income (e.g., employment income, income from trapping or commercial fishing) and traditional economy income. The traditional economy, or subsistence economy, refers to activities such as hunting, fishing (non-commercial), trapping, plant harvesting, and crafting that take place outside of the market or wage economy (Section 18.3.6.1). These activities provide food and other necessities of life that either support people and communities through personal use or are given to, exchanged with, or bartered with other members of the community but are not purchased with cash. Participation in the traditional economy also facilitates the transmission of social norms and cultural values across generations (Marks 1977; Usher et al. 2003; Duhaime et al. 2004). The IKTLU Studies completed by the BNDN, BRDN, CRDN, and MN-S all confirm the importance of participation in the traditional economy to community members in the LSA (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN, TSD V.2: CRDN). An IKTLU Study provided by the Ya'thi Néné Lands and Resources also provides context of the importance of these activities within the RSA (TSD VI: YNLR).

Usher et al. (2003) have noted that a mixed economy that integrates the market and traditional economies typically exists in Indigenous communities across the north in Canada. People can participate in both the wage or market economy and the traditional economy to meet their needs (Tough 1996; Myers 1996). Many types of traditional economy activities are largely seasonal, though traditional economy activities can be conducted year-round with the nature of the activity changing with the season. Where traditional economic opportunities are reduced, other sources of income are often required. Residents of the LSA that do not participate in the wage economy often turn to the traditional economy to meet their needs while those who have consistent employment in the wage economy may participate less frequently (BNDN-JWG 2021b; BRDN-JWG 2021a).

Participation in the traditional economy is typically not captured in Statistics Canada labour force and income statistics. For example, BRDN members described people in their community who are farmers, wild rice harvesters, and loggers, but these people would not be captured in census employment statistics (BRDN-JWG 2021a). Economic activities associated with the traditional economy (Section 18.3.6.1, Traditional Economy Participation and Income) are described based on IKTLU Studies prepared for the Project, literature, and findings from KP interviews throughout this section to capture the importance of the traditional economy in supporting individuals and communities in the LSA. Further information on Indigenous land and resource use can be found in Section 16.

Figure 18.3-16 shows the average personal income in 2015 for the LSA, the RSA, and Saskatchewan (Appendix 18A, Table 18A-19a). Personal income, or total income, refers to the total money income received during the calendar year prior to the census year, and includes farming income, fishing income, and income from unincorporated business or professional practice. Average personal incomes for the LSA and RSA are similar, and both are substantially lower than the average personal income for Saskatchewan. The 2015 average personal income in the LSA ranged between $43,901 in Buffalo Narrows, $24,473 for people living on-reserve at CRDN (Appendix 18A, Table 18A-19b), and $29,030 for La Loche. Average personal incomes for Indigenous people in the LSA (i.e., $28,009) are lower than for non-Indigenous people in the LSA (i.e., $68,440) and lower than the averages for the RSA (i.e., $31,971) and Saskatchewan (i.e., $49,409; Figure 18.3-15 and Appendix 18A, Table 18A-19a).

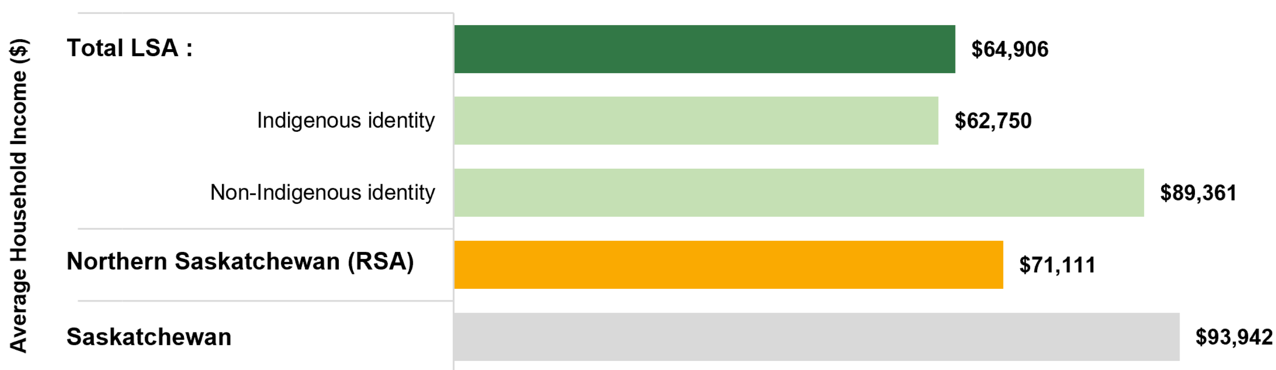
Figure 18.3-16: Average Personal Income for the Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2015



Source: Statistics Canada 2017a.
Note: Data were not available for Bear Creek, Black Point, Descharme Lake, Garson Lake, Michel Village, St. George's Hill, and Turnor Lake.
LSA = local study area; RSA = regional study area.

Figure 18.3-17 shows the average household income in 2015 for the LSA, the RSA, and Saskatchewan (Appendix 18A, Table 18A-20a). The average household income for the LSA is lower than average household incomes for both the RSA and Saskatchewan. The 2015 average household income in the LSA ranged between $79,638 for Buffalo Narrows and $52,534 for BRDN (Appendix 18A, Table 18A-20b). Other notable average household income values in the LSA are $62,036 for La Loche, $63,786 for CRDN and $58,296 for BNDN. Average incomes for Indigenous households in the LSA (i.e., $62,750) are lower than the average households in the LSA (i.e., $64,906), while average household incomes for non-Indigenous people in the LSA (i.e., $89,361) are substantially higher than the average households in the LSA. Average incomes for Indigenous households in the LSA are also lower than the averages for the RSA (i.e., $71,111) and Saskatchewan (i.e., $93,942). Average household incomes for non-Indigenous people in the LSA (i.e., $89,361) are noticeably higher than the average for the RSA (i.e., $71,111); however, they are slightly lower than for Saskatchewan as a whole (i.e., $93,942). The large majority of the population in the LSA identifies as Indigenous (Figure 18.3-8) and, as a result, the average incomes reported for non-Indigenous LSA residents represent relatively few workers, some having relocated to the LSA to fill jobs requiring a specific skill set or profession (Appendix 18A, Table 18A-19a). Recruiting for higher paying employment opportunities from outside the LSA communities may contribute to the higher average employment incomes for non-Indigenous workers in the LSA.

Figure 18.3-17: Average Household Income for the Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2015

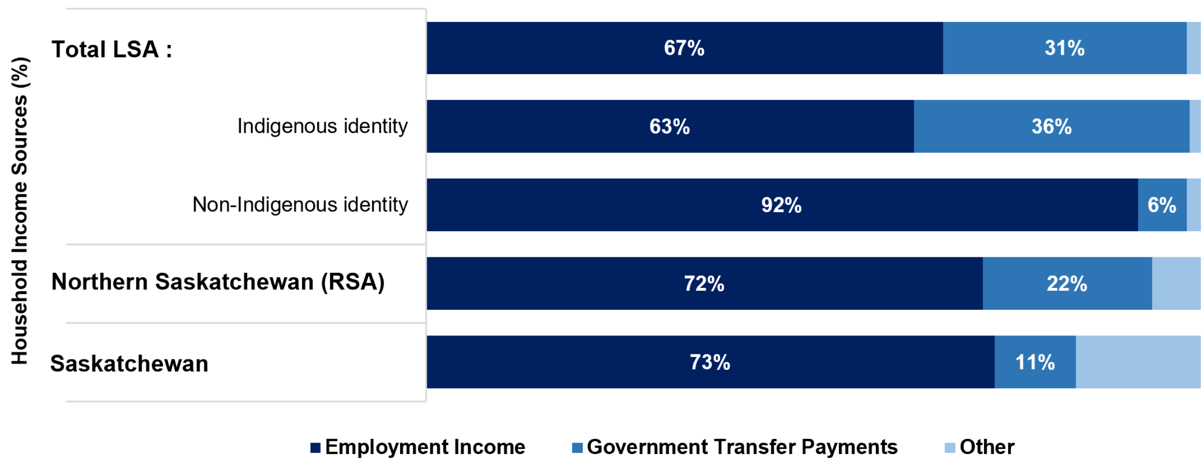


Source: Statistics Canada 2017a.
Note: Data were not available for Bear Creek, Black Point, Descharme Lake, Garson Lake, Michel Village, St. George's Hill, and Turnor Lake.
LSA = local study area; RSA = regional study area.

Figure 18.3-18 shows the sources of household income in 2015 for the LSA, the RSA, and Saskatchewan (Appendix 18A, Table 18A-21a). Government transfer payments[26] make up a larger share of average household income for people in the LSA (i.e., 31%) than for the RSA (i.e., 22%) and Saskatchewan (i.e., 11%). For communities in the LSA, the proportion of household income from government transfers was highest in La Loche (i.e., 41%) and lowest in Buffalo Narrows (i.e., 17%; Appendix 18A, Table 18A-21b). For Indigenous residents of the LSA, the share of household income from government transfer payments is higher than the average for the LSA, and also higher than the averages for the RSA and Saskatchewan. During JWGs, some LSA residents also noted payments related to settlement agreements (e.g., the Air Weapons Range settlement and Cows and Plows process) can represent one-time sources of income for community members (BNDN-JWG 2021c; BNDN-JWG 2021d; BRDN-JWG 2021b).

[26] According to Statistics Canada Census 2016, "Government transfers are all cash benefits received from federal, provincial, territorial, or municipal governments during the reference period. It includes: Old Age Security pension, Guaranteed Income Supplement Allowance or Allowance for the Survivor; Retirement disability and survivor benefits from Canada Pension Plan and Québec Pension Plan; Benefits from Employment Insurance and Québec parental insurance plan; Child benefits from federal and provincial programs; Social assistance benefits; Workers' compensation benefits; Working income tax benefit; Goods and services tax credit and harmonized sales tax credit; Other income from government sources."

Figure 18.3-18: Household Income Sources for the Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2015



Source: Statistics Canada 2017a.
Note: Data were not available for Bear Creek, Black Point, Descharme Lake, Garson Lake, Michel Village, St. George's Hill, or Turnor Lake.
LSA = local study area; RSA = regional study area.

Although mining and oil and gas is not one of the main employment sectors in the LSA, residents noted that they are considered high-value employment opportunities. Statistics Canada data for 2020 indicate average hourly wage rates in Saskatchewan for the forestry, fishing, and mining, quarrying, and oil and gas industries were approximately 46% higher than for employees across all industries (Statistics Canada 2021a)[27]. During KP interviews, some LSA residents confirmed mining and resource sector wages and income opportunities are higher than other industries and those with experience in those industries may not be willing to accept lower paying employment (2019 to 2021 KP interview program).

18.3.6.1 Traditional Economy Participation and Income

Participation in the traditional economy is important to Indigenous people in Canada. At the national level, the Aboriginal Peoples Survey (Budinski et al. 2017) surveyed approximately 43,000 First Nations people living off reserve, Métis, and Inuit with a response rate of approximately 76% (Vongdara et al. 2018). Survey results indicated 59.8% of respondents engaged in some form of hunting, fishing, trapping, gathering wild plants, or making clothing, footwear, or artwork at least once in the previous 12 months across Canada. Survey results indicated 35.4% of respondents participated in hunting, fishing, or trapping in the previous 12 months; 28.9% gathered wild plants; 9.1% made clothing or footwear; and 24.3% made carvings, drawings, jewelry, or other kinds of artwork. Participation in both the labour force and other activities including hunting, fishing, trapping, gathering wild plants, and making clothing, arts and crafts was common, with 41.6% of respondents indicating they participated in both the labour force and traditional economy activities in the past 12 months. The First Nations Information Governance Centre has a mandate to oversee data collection on First Nations reserves and in northern communities on behalf of all First Nations.

[27] $42.47 compared to $29.13 for all industries. Both full- and part-time employees.

The First Nations Regional Health Survey completed by the First Nations Information Governance Centre found 22.5% of Indigenous adults reported fishing in the three months prior to the survey, 18.3% reported hunting or trapping, and 16.8% reported berry picking or other food gathering (FNIGC 2018).

In Saskatchewan, Traditional Food harvesting (hunting, fishing, and gathering of wild plants), is an important part of the Traditional Food systems and food security of First Nations communities (Chan et al. 2018). The First Nations Food Nutrition and Environment Study (Chan et al. 2018) found that almost all Indigenous adults in Saskatchewan (i.e., 94%) reported eating Traditional Foods as part of their diet. Of the population included in the survey, Indigenous adults in Saskatchewan ate land mammals (i.e., 83%), berries (i.e., 78%), fish (i.e., 51%), wild birds (i.e., 46%), and wild plant foods and teas (i.e., 43%) (Chan et al. 2018). As described by tradition-oriented CRDN members, there are no practical and affordable nutritious (e.g., non-processed and nutrient-dense) food replacements available to them through outside sources such as the local Northern store (TSD V.2: CRDN). Furthermore, these food replacements are neither desired nor considered culturally appropriate.

> Mostly we live on that [wild meat], we don't use store meat actually. The only thing we use is dry goods from the store, and for the meat it's wild food only. (TSD V.2: CRDN)

> We don't want to live off of store food. Because that's all manufactured stuff you know. Like we go out in the bush, we get a moose. Nobody gave it antibiotics or injections, like, to make it grow really fast, you know. It's all natural. But in the store, that's where all these diseases come. They do that to mass produce. (TSD V.2: CRDN)

Local Study Area community members noted the traditional economy makes important contributions to the economic well-being of people and communities. They also noted that participation in the traditional economy varied by individual. People with stable employment in the wage economy may spend less time harvesting but still may include Traditional Foods in their diet (BRDN-JWG 2021a). Wage-employed CRDN hunters engaged in shift-work outside of communities indicated that they schedule their harvesting activities accordingly and would spend more time hunting if schedules allowed (TSD V.2: CRDN).

The traditional economy has been described as a "sponge" that absorbs labour when formal labour (i.e., wage economy) opportunities decline, and releases it when opportunities arise (Usher et al. 2003). This labour consists of many skills learned through kinship ties and operates at the household level. Butchering, skinning, net mending, mechanical repairs, and many other skills and specialized knowledge support the traditional economy (Usher et al. 2003). These specialized skills and knowledge are often learned experientially and passed down to younger generations, including prime harvesting locations, harvesting techniques, how to process and store meat, and how to assess the health of wildlife and fish harvested (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.2: CRDN; TSD VI: YNLR; MN-S-JWG 2020b). An LSA resident commented that it takes a lot of skill and work to make garments from hides and furs (N-19 trappers workshop). People can move between the wage economy and the traditional economy depending on the availability of opportunities as well as their own personal preferences (Usher et al. 2003; BRDN-JWG 2021a). An LSA resident commented that trapping is a way of life as well as a hobby and fulfills a love of being outside (N-19 trappers workshop). Other residents have noticed many youth showing interest in learning trapping and fishing (N-19 trappers workshop). An increase in youth interest may be supported by the increase in traditional land-based teaching in the schools within the LSA. Students are taught how to snare game, such as rabbits, and how to prepare the game (BNDN-JWG 2021b; BRDN-JWG 2021a; 2019 to 2021 KP interview program).

Access to land and water is also essential to the traditional economy. This can be affected by downturns in the commercial fishing and trapping industries that would otherwise help support travel to harvest areas, or regional industrial development may reduce the land base or resources upon which the traditional economy depends. Reductions in harvests can lead to increased costs from having to purchase food and other necessities from the market economy, and subsequently to increased impoverishment (Parlee 2015). A potential for increased commercial fishing in the region has been flagged as an opportunity for La Loche based on the increased demand for fish products that had occurred (DMCA 2018).

Traditional land and resource use is important for Indigenous people throughout the LSA, as many LSA residents participate in the traditional economy. For those participating in both economies, their increased level of activity in one often corresponds to a decreased level of activity in the other. This interaction between the traditional and wage economies enables some residents to maintain living standards when incomes levels are lower, including for seasonal workers. Additional information on traditional land and resource use is provided in Section 16. Information on participation in the traditional economy for each of the Indigenous Groups in the LSA is provided below.

Traditional land and resource use is a primary value for CRDN members that extends beyond economic considerations (TSD V.1: CRDN; TSD V.2: CRDN). The CRDN reported that sustenance harvesting activities are for the purposes of "providing, in whole or in part, the nutrition, livelihood, shelter, clothing, and fuel needs of individuals, households, extended families, and the community at large" (TSD V.2: CRDN). Clearwater River Dene Nation members have described the Patterson Lake area as a "backyard fridge" (TSD V.2: CRDN) where harvesters know where to go to get the foods they need:

> To this day, our families depend on our ancient lands for a range of cultural, sustenance, livelihood, spiritual and socio-economic purposes. Our ability to depend and rely on our lands is still critical to our community. Our families generally face high levels of unemployment and must continue to depend on the land to put food on the table. Any impact, disruption or diminution of our community's ability to rely on our wildlife, fish, berries, plants, forests and water resources can result in serious impacts and ramifications. (CRDN 2019b)

Any diminishment in opportunities to secure food has a substantial negative economic effect on CRDN community families (TSD V.1: CRDN). Clearwater River Dene Nation members have noted their ability to access harvesting sites has been constrained by industrial development; as examples, development of the Cluff Lake Mine as well as by exploration drilling operations and camps in the immediate vicinity of Patterson Lake, which has prevented CRDN members from access to and use of longstanding high-quality harvesting areas (TSD V.1: CRDN; TSD V.2: CRDN). Clearwater River Dene Nation's IKTLU Study report states that:

> a number of harvesters specifically described how wage-based jobs (individual or within the extended family) financially support the imperatives to live as Denesųłiné people engaged in land-based activities and the provision of food. (TSD V.1: CRDN)

Members of CRDN also expressed concern that increased access from outside hunters and the resulting competition would result in scarcer CRDN food supplies (TSD V.2: CRDN). Clearwater River Dene Nation members have stated that, in their view, their traditional hunting, trapping, and fishing activities have been affected by provincial land management policies and practices and industrial development activities (including access restrictions, abandoned waste from exploration activities, sensory disturbance, increased use by non-Indigenous resource users, and increased traffic volume; TSD V.2: CRDN). The CRDN JWG did not meet to discuss the economies JWG topic in August 2021.

Birch Narrows Dene Nation community members have estimated 80% or more of the people in the community participate in some form of traditional economic activity (BNDN-JWG 2021a). Birch Narrows Dene Nation members have described the importance of harvesting wild foods in feeding family members and supporting households and the broader community by sharing food with Elders and other community members (TSD II). At times in the past, a BNDN member noted they relied on very little store-bought food (BNDN-JWG 2021a). Income from commercial trapping and fishing (TSD II) has been noted to be important for BNDN members. A BNDN member commented that:

> because you're working in a mine doesn't mean you are going to discontinue [traditional activities]. In fact, because you have income, you're able to create that ability to be out there and to build cabins. (BNDN-JWG 2021a)

Hunting, trapping, fishing, and other traditional economy activities are recognized by BNDN members as requiring considerable skill and practice (TSD II; BNDN-JWG 2020; BNDN-JWG 2021a). Birch Narrows Dene Nation members have stated that, in their view, their traditional hunting, trapping, and fishing activities have been affected by industrial development, and disturbances related to the resource sector, including changes to animal quantities and migration patterns and decreased access to historically used areas (TSD II: BNDN). A BNDN member noted some youths are becoming more involved with traditional arts and crafts: "It's coming back. With Covid, with our roads blocked, people needed something to do. It brought a lot of artistic abilities in some of our young ladies, and some of the older ladies too" (BNDN-JWG 2021a). It was also noted that some BNDN residents relied on selling clothing and crafts for cash income to supplement lost income during the COVID-19 pandemic (BNDN-JWG 2021a).

Similar to the BNDN estimate, a BRDN community member estimated approximately 80% of community members participate in some form of traditional economy activities (BRDN-JWG 2021a). Buffalo River Dene Nation members have indicated that meat obtained through hunting, trapping, and fishing are important food sources that support households and the community (TSD III: BRDN). Wood harvesting, communal gardening, berry picking, and wild rice harvesting have also been noted as important traditional economy activities (BRDN-JWG 2021a). Commercial fishing remains important to the livelihood of BRDN members but declines in fur prices have made commercial trapping a less practical occupation (TSD III: BRDN). Buffalo River Dene Nation members have indicated traditional hunting, fishing, and trapping require experience and skills not only in harvesting animals but also in processing and preserving the meat (TSD III: BRDN). Buffalo River Dene Nation members have indicated that, in their view, traditional hunting, trapping, and fishing have been affected by climate change, industrial development, and pollution; increased use by non-Indigenous resource users; and institutional changes including the introduction of fur conservation areas (TSD III: BRDN). It was noted during women's interviews (2019 to 2021 KP interview program) that both partners in several BRDN families participate in the traditional economy including hunting, gathering, and fishing. Buffalo River Dene Nation members also noted participation in the traditional economy can ebb and flow depending on the availability of employment in the wage economy. People may only be able to participate in the traditional economy on weekends or holidays when they are employed in the wage economy but may increase their traditional economic activities during periods when wage employment is not available. The BRDN members attributed a recent increase in participation in the traditional economy in part to an increase in traditional teachings provided in school (BRDN-JWG 2021a).

Métis Nation – Saskatchewan citizens have noted that hunting, trapping, fishing, and plant gathering has helped preserve the survival of families and that the land is an integral part of their livelihoods. Métis Nation – Saskatchewan members provided estimates that, on average, 70% of their food comes from hunting, trapping, fishing, and gathering (TSD IV: MN-S). Fishing is noted as an activity that supports both personal and commercial economic activity. Métis Nation – Saskatchewan members have noted that access to Patterson Lake for hunting and fishing has been impeded by drilling activity and the barge on Patterson Lake (TSD IV: MN-S). Métis Nation – Saskatchewan members have also noted that, in their view, there have been global warming and pollution effects on the land and wildlife and a decline in quality of meat and pelts (TSD IV: MN-S). The MN-S JWG did not meet to discuss the economies JWG topic in August 2021.

In the RSA, a IKTLU Study prepared by the Ya'thi Néné Lands and Resources noted that traditional harvesting is very important to the Athabasca Denesųłiné, not only for providing food and materials, but also as the foundation of a culture and way of life passed down through generations. A variety of wildlife, plants, and resources have been noted as being important to Athabasca Denesųłiné, with barren-ground caribou[28] (*Rangifer tarandus groenlandicus*) central to both harvesting activities and the community's cultural identity (TSD VI: YNLR).

The labour or market economy supplies capital needed to participate in the traditional economy. For example, funds earned in the labour market support equipment and supply purchases such as snowmobiles, ammunition, and fuel (Tough 1996). As a result, a household that is successful in the traditional economy is often also successful in the wage or market economy as cash income can be used to purchase harvesting equipment and cover expenses (Usher et al. 2003). This was also observed by Indigenous Groups, who noted increased access to traditional lands (i.e., roads, particularly Highway 955) and equipment (e.g., trucks, ATVs, snowmobiles, boats) has resulted in more community members participating in the traditional economy, to varying degrees (BNDN-JWG 2021a; BRDN-JWG 2021a).

18.3.6.2 Labour Force, Employment, and Income Summary

Participation rates and employment rates for the LSA were consistently lower than for Saskatchewan as a whole for the 30-year period from 1986 to 2016 (Figure 18.3-11). Females in the LSA typically have higher employment rates than males, which may reflect greater participation in the educational, health care, and social services sectors.

Analysis of the LSA communities shows significant differences in the labour force, employment, and income characteristics of Buffalo Narrows compared to La Loche and other communities of the LSA. Relative to other LSA communities, Buffalo Narrows had higher participation and employment rates, higher personal and household income levels, and lower rates of government transfer dependency in 2016 (Annex X).

Average personal and household incomes for the LSA are lower than for Saskatchewan as a whole. Local Study Area residents noted participation in the traditional economy provides important opportunities to support the livelihoods of individuals and communities in addition to cultural and spiritual benefits. The relationship between the traditional and wage economies enables some residents to supplement a decrease in wage income with an increase in the traditional economy (e.g., when seasonal employment opportunities are out of season). Most smaller community residents are active in the traditional economy, though the extent varies by individual.

[28] Traditional knowledge collected on the Beverly and Qamairjuaq caribou indicate that barren-ground caribou ranges extended to areas south of the Project. Telemetry data from 1993 to 2012 indicate that the ranges of collared female barren-ground caribou were largely north of the Athabasca Denesųłiné communities; however, non-collared barren-ground caribou may still occur in more southern areas (TSD VI: YLNR).

Many elements of employment and income characteristics in the LSA reflect that wage employment is particularly concentrated in government-funded service sectors with lower employment rates in sectors including agriculture, forestry, fishing and hunting, mining, oil and gas, manufacturing, and retail trade than in Saskatchewan as a whole. These government-funded service sectors typically employ more females than males, and this is reflected in the LSA data.

18.3.7 Education and Training

This subsection summarizes education and training facilities and programs available in the LSA and where LSA residents access education and training opportunities that are not available locally. An overview of educational attainment for LSA residents is also provided.

18.3.7.1 Educational Facilities and Programs

This subsection describes the primary, secondary and post-secondary facilities and programs available in the LSA.

18.3.7.1.1 Primary and Secondary Education

The Ducharme School in La Loche is a kindergarten to grade 6 school that provides education for approximately 500 students from La Loche and the surrounding areas. Dene High School in La Loche provides grade 7 to 12 education and has supporting programs including a breakfast and lunch program for students and a wellness centre. Dene High School can accommodate approximately 500 students and has seen enrollment fluctuate between 350 and 450 students between 2015 and 2019. Students from the CRDN attend Dene High School based on available programing, while students from Black Point are bussed to La Loche for both high school and elementary school by the Northern Lights School Division. Dene High School has traditional education programs that provide outdoor education opportunities for children including a modular farm from President's Choice Children's Charity. Dene High School also offers trades courses in construction and carpentry, as well as an Adult 12 program. Adult 12 is an educational program designed for adult learners (18 years of age and older) to achieve a Saskatchewan Grade 12 standing (Northlands College 2018). Students in the Adult 12 program are integrated into other classes, as Adult 12 class sizes are often too small to have their own lessons and because of limited teaching staff and classroom space. Key person interview participants noted that there is limited time or resources to offer many courses outside the standard high school-level courses (2019 to 2021 KP interview program). The Dene High School in La Loche has an average graduating class of 25 students with approximately 5% to 10% of students pursuing post-secondary education. Interview program participants noted some students work for a period of time before pursuing post-secondary education as moving from the community can be stressful (2019 to 2021 KP interview program).

The Clearwater River School in CRDN is a kindergarten to grade 12 school with a capacity of 260 students. Average enrollment is 220 students, though current enrollment is 170 students, which is largely attributed to the effects associated with COVID-19 (TSD V.3: CRDN). Typically, attendance starts to drop at grade 7, with high school attendance becoming low; the general belief is that this is a result of formal education not being reinforced by local parents (TSD V.3: CRDN). The Clearwater River School also offers an Adult 12 program, with students in this program taking classes with the students from the regular grade 12 program. In addition, the school offers a driver's education program and courses for several industry-related safety tickets, which is part of the overall goal to provide education requirements for trade school or university (TSD V.3: CRDN). Overall graduation rates are consistent at approximately 45%. Twin Lakes Community School in Buffalo Narrows offers kindergarten through grade 12 for approximately 300 children from Buffalo Narrows and the surrounding area. In addition to core school subjects (e.g., math and English), Twin Lakes Community School offers welding, carpentry, commercial cooking, and drafting. The school offers Adult 12 up to the age of 21, after which students would have to transfer to Northlands College (2019 to 2021 KP interview program). At Twin Lakes Community School, the graduation rate is approximately 58% of the graduating class. Typically, out of 10 graduating students, five pursue post-secondary education with two or three students completing this education. Interview participants cited reasons for starting but not completing post-secondary education include culture shock and financial stress (2019 to 2021 KP interview program).

Buffalo River School in Dillon offers kindergarten to grade 12 for approximately 300 students. For Adult 12 education, the nearest campus is Northlands College in Buffalo Narrows. Students from Michel Village and St. George's Hill are bussed to Buffalo River School for high school programs, while those in kindergarten to grade 8 attend school in St. George's Hill (2019 to 2021 KP interview program). Between 6 and 12 students at Birch Narrows School in BNDN graduate annually. Key person interview participants noted that students who pursue post-secondary education often have to upgrade their academic marks, which often occurs through Northlands College in Buffalo Narrows (2019 to 2021 KP interview program; BNDN-JWG 2021a). Students who plan on pursuing post-secondary education and want to use band funding must go through an application process. In recent years, more students have applied for post-secondary education band funding than there are funds available (2019 to 2021 KP interview program). Common areas of study include education, nursing, and office management (BNDN-JWG 2021a).

Birch Narrows School, located in BNDN, serves students from both BNDN and Turnor Lake and can accommodate up to 350 students. In the 2019 to 2020 year, there were 206 students enrolled. Adult students are integrated into the classroom and are allowed to attend until age 21, after which they would have to pursue adult education elsewhere, such as in Buffalo Narrows or La Loche (2019 to 2021 KP interview program). Buffalo River School in Dillon sees an average of 6 to 10 graduates a year. The school also includes a small post-secondary upgrading classroom (BRDN-JWG 2021a). Key person interview participants noted many students who pursue post-secondary education return to the community before completing the program. Students often go to Buffalo Narrows to take post-secondary education at Northlands College (2019 to 2021 KP interview program). Those that travel farther for education to locations (e.g., Saskatchewan Polytechnic) can experience issues including culture shock and difficulty accessing childcare (BRDN-JWG 2021a).

18.3.7.1.2 Post-Secondary Education

There are two post-secondary education institutions represented in the LSA: Gabriel Dumont Institute and Northlands College. Local study area residents have noted students within the LSA often have to move to a different community to access post-secondary education opportunities. Students from smaller communities in particular may have to relocate to La Loche to take courses at Gabriel Dumont Institute or to Buffalo Narrows to take courses at Northlands College (2019 to 2021 KP interview program; MN-S-JWG 2020b; BNDN-JWG 2021a). Comments made during JWG meetings also noted a general lack of local education and training opportunities for youth (BRDN-JWG 2020).

Gabriel Dumont Institute has a campus in La Loche. Programs offered include programs to support adults to upgrade their education (including Adult 12), various post-secondary courses, as well as industry-recognized training and programs leading into an apprenticeship (Gabriel Dumont Institute 2021). Training courses that have been offered include the following:

- industrial mechanic (i.e., millwright);
- multi-sector safety ticket training;

- enhanced introduction to carpentry;
- construction trades training;
- heavy equipment operator; and
- heavy equipment and truck and transport technician (Gabriel Dumont Institute 2021).

Training courses vary depending on labour market conditions, and the Gabriel Dumont Institute meets regularly with northern companies to determine which programs are needed for current employment needs. The La Loche campus has requested mental health and addictions awareness courses as well as driving courses for the near future, though Class 5 driving lessons were offered in Buffalo Narrows and Beauval in 2020 and 2021. There is a waitlist for programs offered at the La Loche location for every program as enrollment is higher than available seats (2019 to 2021 KP interview program; Gabriel Dumont Institute 2021).

The Gabriel Dumont Institute in La Loche also offers Adult Basic Education levels 1 to 4 to community members. These programs provide a range of educational skills from literacy to interpersonal skills to lifelong learning skills. The Northern Economic Development Intern Program offered through the Gabriel Dumont Institute offers online distance learning with a paid internship that involves data management, mapping, and workplace skill development (Gabriel Dumont Institute 2021; 2019 to 2021 KP interview program).

Northlands College has a campus in Buffalo Narrows with a smaller satellite campus in La Loche located at Dene High School. Northlands College in Buffalo Narrows offers post-secondary education to approximately 80 students from Buffalo Narrows as well as surrounding communities including La Loche, Turnor Lake, Dillon, Île-à-la-Crosse, Beauval, Pinehouse, and others. Learning programs include nursing, institutional cooking, Bachelor of Arts, and Bachelor of Social Work as well as other certificate and diploma programs. Northlands College offers Adult 12 as well as a variety of university-level courses. To access further training from Northlands College, including mining-specific training, students have to travel to La Ronge (MN-S-JWG 2020a). The Buffalo Narrows campus has less capacity (i.e., available enrollment places) than the La Ronge campus (2019 to 2021 KP interview program).

Currently, there are no post-secondary programs offered in Birch Narrows or in Dillon (2019 to 2021 KP interview program). A BNDN member commented that they would like to see more training offered in the community: “I believe in bringing the training to our community rather than the students travelling out” (BNDN-JWG 2021a). While some courses are available at the La Loche satellite location by distance education, many students must travel out of La Loche to complete their training if courses are not offered (2019 to 2021 KP interview program).

The CRDN KP interviews identified several challenges to accessing post-secondary education in communities, including the types of courses offered, low demand for certain courses, and limited opportunities for quality or skilled jobs, not just manual labour (TSD V3: CRDN). Similar issues were raised by the MN-S, BNDN, and BRDN during JWG discussions (MN-S-JWG 2020a; BNDN-JWG 2020; BRDN-JWG 2021a). Issues also exist with training off-reserve and the logistical and family challenges with travel to other communities, as well as the culture shock to students who travelled to larger communities outside the LSA (TSD V.3: CRDN; BNDN-JWG 2020; BRDN-JWG 2021a).

18.3.7.1.3 Mining-Specific Training

The uranium sector has historically provided a number of training opportunities for northern workers including student work placements and partnerships with Northern Career Quest to offer training programs (Government of Saskatchewan 2018). The MPTP was a collaborative effort developed by government, industry, and local public and Indigenous communities to maximize training and advancement opportunities in the uranium sector. The MPTP coordinated programs include education upgrading, apprenticeship training, workplace preparation, and technical skills training. During the first three phases (i.e., Phase I, 1993 to 1998; Phase II, 1998 to 2003; and Phase III, 2003 to 2008), a total of 4,933 residents in the RSA enrolled in the programs, with the many enrolling during the second phase (i.e., 2,109 enrollments). Total enrollment included 1,947 (i.e., 39.5%) enrollments for workplace education, 1,149 (23.3%) enrollments for basic education, 1,132 (22.9%) enrollments for skills training, 414 (8.4%) enrollments for apprenticeship training, and 291 (5.9%) enrollments for technical training (CVMPP 2013).

The MPTP has focused on funding training initiatives for the RSA workforce, including mining-specific training. A fourth and final five-year term for the MPTP was signed in 2010. The MPTP brought governments, industry, agencies, and Indigenous partners together to provide funding to train and assist northern residents in accessing employment opportunities. Programs were planned by the Mineral Sector Steering Committee to meet current skill needs. The types of programs offered included underground mining, mill operator, chemical technician, mineral exploration technician, and academic upgrading (NLMC et al. 2011). The Joint Panel (Section 18.3.1.1, Overview of History of Uranium Industry in Northern Saskatchewan) noted programs such as the MPTP were important to make sure RSA residents can continue to access economic opportunities in the uranium sector (IAAC 2016b).

Community members from Birch Narrows, Turnor Lake, BRDN, La Loche, and CRDN can access mining-specific training from the Northern Career Quest Partnership, which is targeted towards long-term, full-time mining employment in the RSA (Northlands College 2018). This training is offered on site at mines for employees of companies such as Orano, Cameco Corporation, and Athabasca Basin Security (Northern Career Quest 2021). Residents from Clearwater, La Loche, Birch Narrows, Turnor Lake, Dillon, and Buffalo Narrows are noted to have participated from 2008 to 2012 (Northern Career Quest 2013). Additionally, Aggressive Drilling provides training and employment for community members in partnership with Northern Career Quest Partnership and NexGen (NexGen 2021a). Between 2008 and 2017, Northern Career Quest saw a total of 3,834 graduates from various communities in the RSA (Northern Career Quest 2021).

NexGen (2021b) initiated a summer student internship program in 2016 for both high school and post-secondary students. Since 2016, 70 students have gone through the program. High school students from the La Loche area experience opportunities in areas including geology, surveying, camp maintenance, and industrial cooking. Post-secondary students receive hands-on work experience. A summer student mentorship program brings participants who have completed the high school program back to mentor new students. NexGen also currently provides bursaries to support students pursuing post-secondary education (NexGen 2021b; NexGen 2019b).

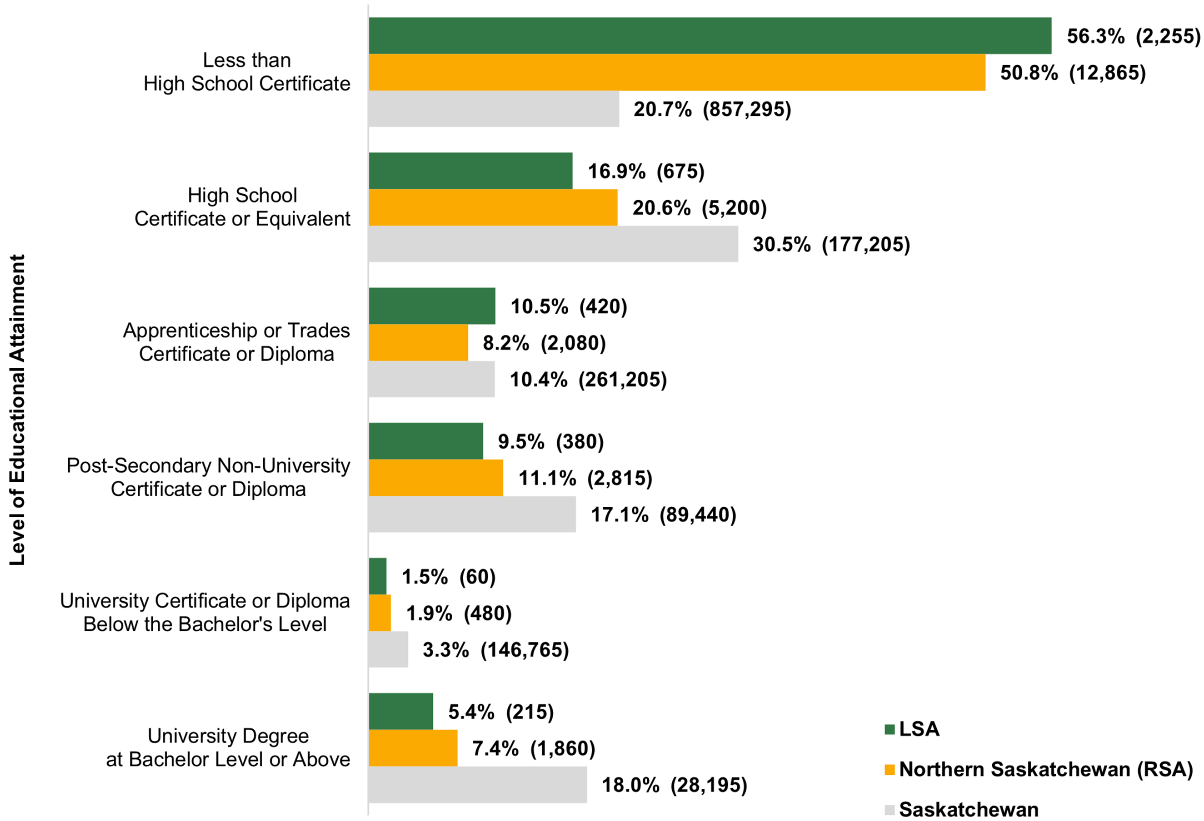
18.3.7.2 Educational Attainment

Educational attainment has been shown to improve employment and income opportunities as well as lead to better health (Public Health in Canada 2008). Figure 18.3-19 shows the highest levels of educational attainment in 2016 for the population aged 15 years of age or older in the LSA, the RSA, and Saskatchewan (Appendix 18A, Table 18A-22a). The majority of the population in the LSA (i.e., 56.3%) and RSA (i.e., 50.8%) have less than a high school certificate, compared to approximately 20% of the Province of Saskatchewan. This reflects in part the overall younger population in the LSA and RSA compared to Saskatchewan, but also other challenges. A 2013 study on the socio-economic effects of uranium mining in the RSA noted that fewer educational programs in communities, lower levels of funding, low rates of attendance, and high drop-out rates were all challenges to educational attainment for the RSA residents (CVMPP 2013). Indigenous residents in the LSA were much more likely to have less than a high school certificate and much less likely to have a university degree than non-Indigenous LSA residents (Appendix 18A, Table 18A-22a). Among LSA communities, the highest proportion of the population aged 15 years or older with less than a high school certificate in 2016 was in La Loche (i.e., 67.2%) and the lowest was in Buffalo Narrows (i.e., 32.2%; Appendix 18A, Table 18A-22b); the reason behind this difference is not known but likely complex and due to a number of factors. Buffalo Narrows has the highest share of population aged 15 years or older with a post-secondary non-university certificate or diploma (i.e., 17.1%), a university certificate or diploma below the bachelor’s level (i.e., 3.9%), and a university degree at bachelor level or above (i.e., 11.2%) among communities in the LSA. This aligns with the higher labour force participation rate, higher personal and household incomes, and lower rates of government transfer dependency in the Buffalo Narrows population as described in Section 18.3.4 and Section 18.3.6.

Participants in JWG sessions noted concerns about not enough training facilities for both youth and adults, not enough students taking maths and sciences in high school, and the frequent need for students to leave the community to pursue further education (MN-S-JWG 2020b; BRDN-JWG 2020; BNDN-JWG 2020). The CRDN also noted limited opportunities for training though acknowledged some successes, including a member completing heavy equipment training leading to a career in the field (TSD V.3: CRDN).

The proportion of the population over 15 years of age with an apprenticeship, trades certificate, or diploma in the LSA in 2016 is similar to the proportion for Saskatchewan as a whole (i.e., 10.5% and 10.4%, respectively). A previous study on socio-economic effects of the uranium industry noted the proportion of the population of the RSA residents with apprenticeship or trades certificates or diplomas increased substantially between 1981 and 2006 (CVMPP 2013). In 2018, the government of Saskatchewan noted education benefits from mining operations in the RSA, including contributions to scholarships for students and outreach to schools to increase career awareness and promote future opportunities in mining (Government of Saskatchewan 2018).

Figure 18.3-19: Educational Attainment for the Population 15 Years of Age and Older in the Local Study Area, Regional Study Area (Northern Saskatchewan), and Saskatchewan, 2016



Source: Statistics Canada 2016.
Note: Data were not available for Bear Creek, Black Point, Descharme Lake, or Garson Lake.
LSA = local study area; RSA = regional study area.

18.3.7.3 Education and Training Summary

Local study area residents frequently noted that post-secondary educational opportunities in the local communities can be limited. In particular, students frequently need to leave their home communities in order to pursue post-secondary education. Students who leave their home communities to pursue education may not return as they seek employment opportunities elsewhere upon completing their studies (BNDN-JWG 2020; 2019 to 2021 KP interview program).

Educational attainment is generally lower in LSA communities than in the RSA or Saskatchewan, with a majority of the population aged 15 years and older having less than a high school certificate (Figure 18.3-19). Lower levels of educational attainment can limit future employment and income opportunities. It can also result in the need for employers to recruit workers from outside the LSA to fill jobs that require higher levels of education or training.

18.3.8 Local Business

The number and diversity of businesses providing goods and services to the LSA communities is limited and reflective of the population size of the communities and the structure of their economies (i.e., the predominance of government-funded services). Businesses and services available in the LSA are described below.

Clearwater River Dene Nation owns a convenience store with gas and catering services located on-reserve (CRDN 2013). Clearwater River Dene Nation also owns several businesses located off-reserve including RobWel constructors (in Meadow Lake), IWL Steel Fabricators (in Saskatoon and Martensville), Clearwater River Enviro Limited Partnership, and Clearwater Pipe Rentals Limited Partnership. The CRDN also have business investments through the Meadow Lake Tribal Council, one of which is NorSask Forest Products Inc. (RobWel 2018). The CRDN data on community-owned businesses or businesses owned by CRDN members has not been made available for 2021. In 2016, there was only one mining company in the CRDN / La Loche region, no utility companies or manufacturing companies, one accommodation and food service business, and one construction company; retail trade was the strongest sector (TSD V.3: CRDN). For context, Table 18.3-1 shows CRDN / La Loche population and business data compared with La Ronge; La Ronge is a northern community with proximity to an operating mine (DMCA 2018). As indicated by the data shown in Table 18.3-1, local business is relatively under-developed in the CRDN / La Ronge region.

Table 18.3-1: Population and Business Data for Clearwater River Dene Nation / La Loche and La Ronge Regions

	CRDN / La Loche Region	La Ronge Region
Population	3,194	6,416
Private sector services	17	90
Mining, forestry, construction, manufacturing	2	18
Health, education, government	4	17
Total businesses	23	125
Population per business	138.87	51.33

Source: DMCA 2018.
CRDN = Clearwater River Dene Nation.

La Loche has an economic development corporation and a strategic plan to own community-based businesses and develop partnerships. Local businesses and services available in La Loche include the following (Northern Business Directory 2017):

- gas bars and other automotive services and maintenance (e.g., Clearwater Store, Junction Fuel, La Loche Fuel Bar, La Loche Towing, P.R. Service);
- construction and trucking services (e.g., Methy Construction & Maintenance, Gibbons Enterprises [2019 to 2021 KP interview program]);
- restaurants and taverns (e.g., Chester Fried Chicken, Trapper’s Cabin);
- lumber and hardware supply stores (e.g., Northern Store, ValuMaster Hardware, Saskatchewan Government Insurance); and
- grocery and convenience stores (e.g., Lakeshore Express, Northern Store, Rocky & Bea Enterprises Ltd., Centerpoint Grocery and Pharmacy [2019 to 2021 KP interview program]).

Various outfitting establishments outside the community also provide seasonal income to residents. Businesses in La Loche hire local employees and report low staff turnover. Currently, there are no motels or temporary accommodations in La Loche (2019 to 2021 KP interview program).

Local businesses in Birch Narrows and Turnor Lake include Anne's C-Store, a convenience store that provides groceries and gas; a taxi service; and a fisherman's cooperative. The Birch Narrows band also runs Birch Narrows Fishing and Adventure Lodge, a tourist outfitters operation northeast of Turnor Lake (BNDN 2013).

Buffalo River Dene Nation has two retail and services businesses: Buffalo River Mini Mart, which provides gas, groceries, First Nation Bank, postal service, and takeout food; and Maries Fast Food (Northern Business Directory 2016).

A variety of businesses and services are available in Buffalo Narrows including the following (BNEDC 2021a):

- a gas bar and other automotive services and maintenance (e.g., Buffalo Narrows Service Centre, Kinekt Auto, MacDonald Way Motors, Squeeky Clean Car Wash & Gas);
- construction and trucking services (e.g., Garry LaPrise Enterprises, Ron Pedersen Enterprise Ltd., Whitekrow Construction, Seright Electrical Contracting);
- fabrication and welding services (e.g., NW Fabricators and Precision Welding);
- restaurants and taverns (e.g., Lil Izzy's Family Restaurant, Pelican Tavern, The Burger Bus);
- lumber and hardware supply stores (e.g., Petit's Lumber & Home Hardware);
- taxi services;
- outfitting and tourism services (e.g., Tinker's Camp, Hay Island Lodge, R Hansen Fishing Camp);
- financial and insurance services (e.g., North West Agencies, Innovation Credit Union); and
- grocery and convenience stores (e.g., Hudson's Snack Shack, Northern Store).

Temporary accommodations available in Buffalo Narrows include the Waterfront Inn and Krow Nest Inn as well as lodges, guest houses, and campgrounds (BNEDC 2021b). All staff are local with low turnover rates reported (2019 to 2021 KP interview program).

Birch Narrows Dene Nation, BRDN, and CRDN have access to business planning and economic development support services as member nations of the Meadow Lake Tribal Council (MLTC 2021). Key person interview participants noted that a number of local businesses in Buffalo Narrows and La Loche have experienced some growth in recent years due to mineral exploration in the area. Other customers include local residents, governments, government employees, the Royal Canadian Mounted Police (RCMP), and hospitals. Centerpoint Grocery and Pharmacy and P.R. Service in La Loche have been working with NexGen to provide food and fuel for the current exploration camp located at Patterson Lake (2019 to 2021 KP interview program).

Northern business participation in the uranium sector initially focused on business opportunities that required limited capital investment and technical expertise, including security services, catering, and light construction work. Over time, northern businesses servicing the uranium sector expanded their scope of goods and services to include heavy construction services, transportation, and bulk commodities as well as the customer base for their existing services (CVMPP 2013). Northern Resource Trucking Limited Partnership is a joint venture between a number of communities including CRDN and BNDN. The company is based in Saskatoon but focuses on long-distance hauling between mine sites in the RSA (CVMPP 2013). A study on the socio-economic effects of uranium mining on the RSA noted that the size of contracts and the administrative requirements of managing uranium sector contracts are barriers to participation by northern-owned businesses (CVMPP 2013). During JWG meetings, local residents noted that it is difficult for small northern businesses to successfully bid for government contracts due to insufficient capacity (MN-S-JWG 2019). In addition, residents stated that economic development and contracting with local businesses is a priority for their communities, with a BRDN member stating, “we want to own the company, to be the contractor in a meaningful partnership – a huge percentage of the company” (BRDN-JWG 2020). Residents also indicated a need for planning that would result in long-term success and capacity building for businesses beyond uranium mining (MN-S-JWG 2019). Residents indicated that businesses created to support the uranium industry would be negatively affected in the event of a downturn in the uranium sector and referred to the closure of Cameco mines that resulted in substantial job loss in northern communities.

In summary, LSA residents have generally noted the limited number of locally owned businesses and that goods and services must often be sourced from outside the local communities. Residents have expressed a strong interest in expanding local business opportunities including exploring partnerships between communities. In particular, LSA residents have commented that they see substantial value not just in expanding employment opportunities but also ownership interests in businesses (BNDN-JWG 2021b; BRDN-JWG 2020).

18.3.9 Government Revenues

There are a number of provincial and federal sources of revenue that can be affected by the uranium sector. The following are the primary sources of government revenue that could be affected by the Project:

- uranium royalties;
- resource surcharges;
- mineral surface lease payments;
- corporate income tax; and
- individual income tax.

18.3.9.1 Uranium Royalties

Uranium royalties in Saskatchewan are payable in accordance with The Crown Mineral Royalty Regulations pursuant to *The Crown Minerals Act*. The Saskatchewan uranium royalty system has three components (Government of Saskatchewan 2017):

- a basic royalty of 5% of gross revenue;
- the Saskatchewan Resource Credit, typically applied as a 0.75% credit against the basic royalty such that the effective basic royalty is 4.25% of gross revenue; and
- a profit royalty with tiers that increase from 10% to 15% as net profit increases.

The Government of Saskatchewan reported total non-renewable resource revenues for Saskatchewan from all sources, including oil and gas, potash, and other non-renewable resources, of $1.750 billion in 2019/20 and $1.735 billion in 2018/19.

The Saskatchewan Ministry of Energy and Resources reported uranium resource revenues of $53 million in 2019/20 (Saskatchewan Ministry of Energy and Resources 2020) and $28 million in 2018/19 (Saskatchewan Ministry of Energy and Resources 2019). The resource revenues include both basic royalty and profit royalty, as well as any interest, penalty, or other amounts that may be payable pursuant to the Crown Mineral Royalty Regulations.

18.3.9.2 Resource Surcharge

Resource corporations in Saskatchewan are subject to the Corporation Capital Tax Resource Surcharge pursuant to *The Corporation Capital Tax Act, 1980.* A tax rate of 3.0% is applied to the value of resource sales (Ministry of Finance 2021).

Total resource surcharge revenues reported by the provincial government were $413 million in 2020 and $394 million in 2019 (Government of Saskatchewan 2020b). The resource surcharge revenues include revenues from the 3.0% tax on the value of sales of uranium produced in Saskatchewan.

18.3.9.3 Mineral Surface Lease Agreements

Section 5-16 of The Crown Resource Land Regulations, 2019 under *The Provincial Lands Act, 2016* enables the minister responsible for the administration of *The Forest Resources Management Act* to issue a mineral surface lease to access Crown resource land for mineral extraction. Mineral Surface Lease Agreements apply to mines operating on Crown Land in the Northern Saskatchewan Administration District. The Government Relations and Environment ministries administer MSLAs to provide long-term land rental (Government of Saskatchewan 2021a). Fees associated with MSLAs are set out in section 6-3 of The Crown Resource Land Regulations, 2019.

18.3.9.4 Corporate Income Tax

Federal corporate income taxes are payable to the Government of Canada pursuant to the *Income Tax Act* (Canada). The 2021 corporate tax rate after the general tax reduction was 15%. The Government of Canada reported corporate income tax revenues of $50.060 billion in 2019/2020 and $50.368 billion in 2018/19.

Provincial corporate income taxes are payable to the Government of Saskatchewan pursuant to *The Income Tax Act, 2000* (Saskatchewan). The 2021 corporate income tax rate in Saskatchewan was 12% according to Section 56(1) of the *Income Tax Act*. The Government of Saskatchewan (2020b) reported corporation income tax revenues of $787 million in 2020 and $586 million in 2019.

18.3.9.5 Individual Income Tax

Federal individual income taxes are payable to the Government of Canada pursuant to the *Income Tax Act*. The 2021 individual income tax rates ranged from 15% to 33% depending on the tax bracket. The Government of Canada (2019; 2021) reported individual income tax revenues of $167.576 billion in 2019/2020 and $163.881 billion in 2018/2019.

Provincial personal income taxes are payable to the Government of Saskatchewan pursuant to *The Income Tax Act, 2000* (Saskatchewan). The 2021 personal income tax rates in Saskatchewan ranged from 10.5% to 14.5% depending on the tax bracket. The Government of Saskatchewan (2020b) reported individual income tax revenues of $2.629 billion in 2020 and $2.340 billion in 2019.

18.4 Project Interactions, Mitigations, and Benefit Enhancements

The pathways analysis identified potential beneficial and adverse effects of the Project on the economy, identified practicable mitigation for potential adverse effects and enhancement for potential beneficial effects, and determined whether potential adverse effects could be sufficiently mitigated such that they are not expected to cause a residual adverse effect. Mitigations would be developed with opportunities for inputs from Indigenous Groups and LPA communities to limit adverse effects on the economy and enhance the potential for positive outcomes.

Key Project characteristics that contribute to potential effects on the economy include the following:

- estimated capital expenditures of $1,300 million over the four-year Construction phase;
- a peak Construction workforce of approximately 350 workers, with actual on-site labour requirements varying throughout the Construction period;
- an Operations workforce, including a forecasted 486 direct jobs during the operating peak and an estimated 456 direct jobs during a typical operating year. Workers would travel to the site by plane and reside at the Project site during their shift period;
- spending on supplies and services during Operations;
- spending during Closure;
- transportation of goods and materials during all Project phases, including transport on Provincial Highways 155 and 955; and
- targets established by NexGen for hiring workers and procurement of goods and services from LSA communities.

Additional information on Project workforce rotations is provided in Section 19.4.3, Secondary Pathways. Project interactions that affect the economy can also have related effects on other elements of the human environment. These are described in more detail in Section 16 (Cultural and Heritage Resources and Indigenous Land and Resource Use), Section 17 (Other Land and Resource Use), and Section 19 (Community Well-Being).

As described in Section 18.2.7, Project Interactions, Mitigations, and Benefit Enhancements, the pathway analysis assigned each potential effect as:

- beneficial pathway (effects are positive or beneficial);
- no pathway (mitigation results in no effect on the economy);
- secondary pathway (mitigation results in a negligible adverse effect on the economy); or
- primary pathway (adverse effect that is greater than negligible and carried forward for further assessment of effects on the economy).

The pathway analysis for economy is summarized in Table 18.4-1. The subsections following the table provide the rationale used to assign potential effects to the beneficial pathway, no pathway, and secondary pathway categories and list primary pathways. Each Project interaction identified as a primary pathway, if any, was carried forward for detailed assessment. Positive interactions for the economy were classified as beneficial pathways (Section 18.2.7) and were not carried forward for further assessment (Section 6.7.3). Effects pathways apply to all Project phases unless otherwise noted.

The mitigations and enhancements in Table 18.4-1 represent the list of key actions used to inform the pathway analysis as part of preparing the EIS.

Table 18.4-1: Potential Effects Pathways for Economy

Pathway ID	Project Components/Activities	Effects Pathway	Mitigation and Benefit Enhancement Policies and Actions	Pathway Assessment
E-01	Project components/activities that contribute to workforce requirements during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft/mine development ▪ processing facilities and underground operations ▪ handling of waste rock, special waste rock, and ore ▪ effluent treatment plant ▪ power generation ▪ removal of infrastructure ▪ restoration and revegetation of facilities and infrastructure ▪ food, housekeeping, maintenance, and environmental monitoring services ▪ transportation of personnel and materials to and from the site	**Employment, income, and training opportunities:** ▪ Workforce requirements may increase employment and related wage income in local communities during Construction, Operations, and Closure, relative to existing conditions ▪ Project development may create indirect and induced employment and wage income opportunities during Construction, Operations, and Closure ▪ Workforce requirements may increase education and training opportunities in local communities during Construction and Operations ▪ Employment and income opportunities would be reduced during Closure, relative to Operations ▪ Education and training opportunities would be reduced during Closure, relative to Operations	▪ Provide **dedicated space for Elders** to be available to support employees to assist with employee retention ▪ Implement a tailored **local workforce recruitment strategy** to confirm that LSA residents are fully aware of and understand access to Project employment opportunities ▪ Work with relevant training institutions to facilitate delivery of **certified and accredited training and recruitment programs for construction and mining-related skills** targeted at employment opportunities for LSA residents and continue to provide scholarship and summer student opportunities ▪ Work with local communities to **develop culturally sensitive employment policies** to address both recruitment and retention barriers ▪ Use best efforts to provide qualified local residents with a **first preference for employment and training opportunities** ▪ Establish a **mentoring program** to support long-term participation of LSA residents in the Project workforce ▪ Prioritize **advancement** of qualified local residents into increasingly senior positions ▪ Set a long-term aspirational target of **75% of the Project's workforce** being composed of LSA residents ▪ **Maintain ongoing communication with employees and contractors** about future workforce and contracting needs and the schedule for Closure ▪ Implement a **workforce transition plan** to address reduction in employment and training opportunities during Closure. NexGen will consider slowdowns or shutdowns associated with care and maintenance in the development of the workforce transition plan ▪ Implement provisions of **Benefit Agreements** related to employment and training	▪ Beneficial pathway (Construction, Operations) ▪ Secondary pathway (Closure)
E-02	Project components/activities that contribute to the Project expenditures during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft/mine development ▪ processing facilities and underground operations ▪ handling of waste rock, special waste rock, and ore ▪ effluent treatment plant ▪ power generation ▪ additional infrastructure (e.g., roads, airstrip, camp, maintenance shop, and offices) ▪ removal of infrastructure ▪ restoration and revegetation of facilities and infrastructure ▪ site traffic ▪ transportation of personnel and materials to and from the site	**Business and contracting opportunities:** ▪ Expenditures for supplies and services may increase existing and new business and contracting opportunities in local communities and northern Saskatchewan during Construction, Operations, and Closure, relative to existing conditions ▪ Direct and indirect employment and business activity results in induced employment and business opportunities ▪ Reductions in business and contracting opportunities during Closure, relative to Operations	▪ Develop and maintain a **business opportunities workplan** that describes the steps NexGen and each primary Indigenous Group would take to achieve the desired outcomes of the respective **Benefit Agreement** ▪ Provide **advance notice** of business opportunities ▪ Work with local communities to **maintain a local business registry** ▪ **Pre-qualify** each Indigenous business listed in the business registry and provide feedback to any Indigenous business that does not successfully pre-qualify ▪ Develop and implement a **single source process and a preferred competitive bid process** to facilitate the success of capable and suitably qualified Indigenous businesses ▪ Establish a long-term aspirational target of **30% of external spending** being awarded to LSA and RSA businesses ▪ Implement provisions of **Benefit Agreements** related to employment, training, and economic development	▪ Beneficial pathway (Construction and Operations) ▪ Secondary pathway (Closure)
E-03	Project components/activities that contribute to workforce requirements during **Construction and Operations**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft/mine development ▪ processing facilities and underground operations ▪ handling of waste rock, special waste rock, and ore ▪ effluent treatment plant ▪ power generation ▪ food, housekeeping, maintenance, and environmental monitoring services ▪ transportation of personnel and materials to and from the site	**Participation and employment in the traditional economy:** ▪ Workforce requirements may increase employment and related wage income and affect participation in the traditional economy in local communities during Construction, Operations, and Closure	▪ Work with local communities to **develop culturally sensitive employment policies** to address both recruitment and retention barriers ▪ Support and promote Indigenous community **participation and employment** in the traditional economy ▪ Implement provisions of **Benefit Agreements** related to employment and training	▪ Beneficial pathway (economy); social and cultural considerations are discussed in Section 19.4.3

Table 18.4-1: Potential Effects Pathways for Economy

Pathway ID	Project Components/Activities	Effects Pathway	Mitigation and Benefit Enhancement Policies and Actions	Pathway Assessment
E-04	Project components/activities that contribute to provincial and federal revenues during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft/mine development ▪ processing facilities and underground operations ▪ handling of waste rock, special waste rock, and ore ▪ effluent treatment plant ▪ power generation ▪ removal of infrastructure ▪ restoration and revegetation of facilities and infrastructure ▪ food, housekeeping, maintenance, and environmental monitoring services ▪ transportation of personnel and materials to and from the site	**Provincial and federal tax revenue and payments to Indigenous Groups:** ▪ Project payments (i.e., taxes, royalties, and surface lease payments) may increase the revenues of the governments of Saskatchewan and Canada during Operations ▪ Benefit Agreements include payments to Indigenous Groups based on revenue generated throughout the life of the Project	▪ None required	▪ Beneficial pathway
E-05	Project components/activities that contribute to workforce requirements during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft/mine development ▪ processing facilities and underground operations ▪ handling of waste rock, special waste rock, and ore ▪ effluent treatment plant ▪ power generation ▪ removal of infrastructure ▪ restoration and revegetation of facilities and infrastructure ▪ food, housekeeping, maintenance, and environmental monitoring services ▪ transportation of personnel and materials to and from the site	**Population migration:** ▪ Changes in employment, business, and income opportunities may affect population in-migration and out-migration	▪ Provide **dedicated space for Elders** to be available to support Indigenous employees to assist with employee retention ▪ Work with relevant training institutions to facilitate delivery of **certified and accredited training and recruitment programs for construction and mining-related skills** targeted at employment opportunities for LSA residents and continue to provide scholarship and summer student opportunities ▪ Work with local communities to **develop culturally sensitive employment policies** to address both recruitment and retention barriers ▪ Use best efforts to provide qualified local residents with a **first preference for employment and training opportunities** ▪ Prioritize **advancement** of qualified local residents into increasingly senior positions ▪ Set a long-term aspirational target of **75% of the Project's workforce** being composed of LSA residents ▪ Implement provisions of **Benefit Agreements** related to employment and training	▪ Secondary pathway

Bolded text represents the key topic of the environmental design features and mitigation.
LSA = local study area.

18.4.1 Beneficial Pathways

The following Project interactions were predicted to result in beneficial pathways to the economy. Beneficial pathways were not analyzed for residual effects and assessed for significance (Section 18.5) but do provide important context for how residents and communities are likely to experience the Project. Overall, the Project is estimated to have a direct, indirect, and induced impact on national GDP of up to $1.3 billion over the course of Construction and up to $1.1 billion in a typical year of Operations (Appendix 18B; Table 18B-1 and Table 18B-2). The analysis of beneficial effects on the economy considers that NexGen has negotiated and signed Benefit Agreements with all four primary Indigenous Groups in the LSA. Although details of these agreements are confidential and have not been finalized for all Indigenous Groups, they are premised on commitments described in NexGen's Integrated Management System Policy including proactively engaging with local communities; supporting the economic participation of affected communities; seeking to provide opportunities resulting in sustainable, lasting benefits to local communities beyond the Project lifespan; and providing clear and timely information to those who have a direct interest in the Project.

E-01: Employment, income, and training opportunities:

- Project development and workforce requirements may increase employment, income, and training opportunities in local communities during Construction, Operations and Closure.

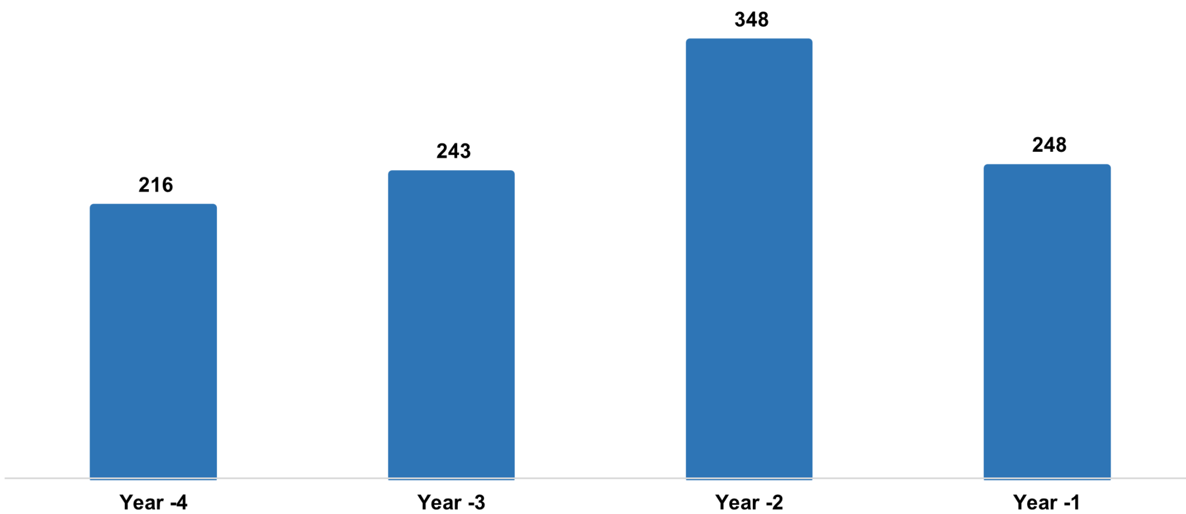
Maximizing and prioritizing access to employment, income, education, and training opportunities for local residents has been frequently raised as a key area of interest by LSA residents during Project engagement. In particular, LSA residents have indicated that they want confirmation that local workers are prioritized for hiring over people from other regions, that access to education and training opportunities is available for LSA residents who want to obtain employment with the Project and more skilled employment levels, and that workers receive training and certifications that can be transferred to employment in other sectors, particularly once Project operations cease (2019 to 2021 KP interview program; TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD V3: CRDN; TSD VI: YNLR). The promotion of local employment, income, education, and training within the LPA communities is in alignment with the CRDN recommendations (TSD V.3: CRDN).

Employment opportunities

The Project would provide a positive benefit through increased employment opportunities for LSA residents. These benefits would vary by Project phase. The Project is anticipated to create a substantial number of jobs during Construction and Operations. Some Project employment opportunities would continue during Closure. These jobs would primarily be created in the LSA, which experiences lower than average employment rates (Figure 18.3-11; Appendix 18A, Table 18A-11) compared to the RSA and Saskatchewan.

During Construction, which has an estimated duration of four years, on-site labour is expected to peak at approximately 350 workers on site, including labour associated with surface and underground construction, supervision, staff, maintenance, general and administration positions, the integrated execution team, and visitors, consultants, and contractors. Actual on-site labour requirements would vary throughout Construction. Figure 18.4-1 shows the distribution of peak on-site labour by year (Appendix 18A, Table 18A-23b).

Figure 18.4-1: Annual Peak On-Site Labour for the Rook I Project during Construction



Source: NexGen 2021c.
Note: Annual peaks during Construction include visitors, contractors, and consultants.

Analysis prepared using the Statistics Canada Interprovincial I/O model estimated labour income associated with the direct (i.e., employed by the Project) construction workforce at approximately $532 million[29] or 41% of the total construction capital cost of $1,300 million (Appendix 18B, Table 18B-1). Input/output modelling estimates that this labour spending across the four-year construction period[30] would result in approximately 730 direct full-time equivalent (FTE)[31] positions through capital expenditure, 4,870 direct FTE positions through industry input expenditure in Saskatchewan, and 5,870 direct FTE positions across Canada (Appendix 18B, Table 18B-1). These are estimates prepared based on I/O modelling and anticipated labour spending and not based on detailed human resource plans. The actual number of positions created would vary throughout Construction, depending on the specific work requirements. NexGen would make best efforts to recruit LSA residents; however, due to the specialized nature of some of the construction work and the associated technical employment qualification requirements, a substantial portion of the Construction workforce is anticipated to be sourced from outside the LSA. As noted in Figure 18.3-15, employment in the construction sector is typically predominantly male and this may represent an opportunity for males in the LSA who typically have a lower average employment rate than females (Section 18.3.5). In addition, the four-year Construction period may provide an opportunity for education and training to improve the ability of LSA residents to obtain employment during the Operations period.

[29] Note that the labour income includes the value of the worker benefits program and other components and is not equivalent to the wage or salary payment received.
[30] Full Time Equivalents are reported as calculated by an analysis prepared using the Statistics Canada I/O model based on the overall average full-time hours worked in the relevant business or government sectors.
[31] Estimates include an allocation of budget contingencies to labour costs.

In addition to direct employment effects, the Project is also expected to have positive indirect (i.e., employed in sectors supplying goods and services to the Project), and induced (i.e., employed as a result of consumer expenditures generated by direct and indirect employment) employment effects (Statistics Canada 2021c)[32]. The I/O model estimated that the total Canada-wide direct, indirect, and induced employment could represent between approximately 8,200 and 10,500 FTE positions across the four-year construction period, of which up to 7,900 of these FTE positions could be in Saskatchewan (Appendix 18B, Table 18B-1). The distribution of construction employment for Saskatchewan compared to other regions of Canada or outside of Canada would depend on a number of factors, including the specific skills required and the availability of labour.

The I/O modelling was undertaken to provide an illustration of the range of potential outcomes. Actual outcomes would vary depending on a number of factors. There are a number of assumptions and limitations to the I/O analysis, including the assumption of fixed technological coefficients and that it does not take into account economies of scale, constraint capacities, technological change, externalities, or price changes. This makes the analysis less accurate for long-term and large effects as companies adjust their production technology and may themselves have an influence on the structure and functioning of the economy.

During Operations, peak employment is expected to comprise a total of 486 positions on payroll (i.e., direct employment) as shown in Table 18.4-2. Of the total 486 positions, 260 people are expected to be on site at any one time at peak employment. Most personnel would work a two-week-in, two-week-out rotation, on a fly-in and fly-out basis. Effects of the work rotation on community well-being are discussed in Section 19.4, Project Interactions and Mitigations.

Some senior staff would work a rotation of four days on site and three days off site without a cross shift (NexGen 2021c). During the first two years of Operations, it is expected there would also continue to be some underground contractors, surface construction workers, and workers from the integrated execution team (NexGen 2021c, Table 10-17). A detailed breakdown of anticipated positions at peak employment during Operations is provided in Appendix 18A, Table 18A-25.

Table 18.4-2: Peak Positions (On Site and Payroll) During Operations

Labour Category	On-Site Positions	Payroll Positions
Mine labour	167	332
Process plant / paste plant labour	64	125
General and administration labour	29	29
Total	**260**	**486**

Source: NexGen 2021c.

[32] Direct effects measure the initial requirements for an extra dollar's worth of output of a given industry. Indirect effects measure the changes due to inter-industry purchases as they respond to the new demands of the directly affected industries. Induced effects measure the changes in the production of goods and services in response to consumer expenditures induced by additional household income (i.e., wages) generated by the production of the direct and indirect requirements.

Most of the positions during Operations would require some form of training such as on-the-job training, a university or college diploma or certificate, trades training, or a university degree. Table 18.4-3 summarizes anticipated education and training requirements for Operations jobs at peak demand which occurs in year 2 of Operations. Education requirements shown in Table 18.4-3 are the highest level of training anticipated to be necessary for each position, consistent with a conservative approach to estimating the potential for Project employment. Some combination of training and experience may also be accepted for certain positions. In certain cases, lower levels of education and training may be accepted for some positions. A detailed breakdown of anticipated workforce educational requirements at peak employment during Operations is provided in Appendix 18A, Table 18A-24.

Table 18.4-3: Anticipated Education and Training Requirements

Labour Category	Total Positions at Peak (Year 2)
High school, on-the-job training, university or college certificate or diploma	295
Trades	146
University degree	45
Total	**486**

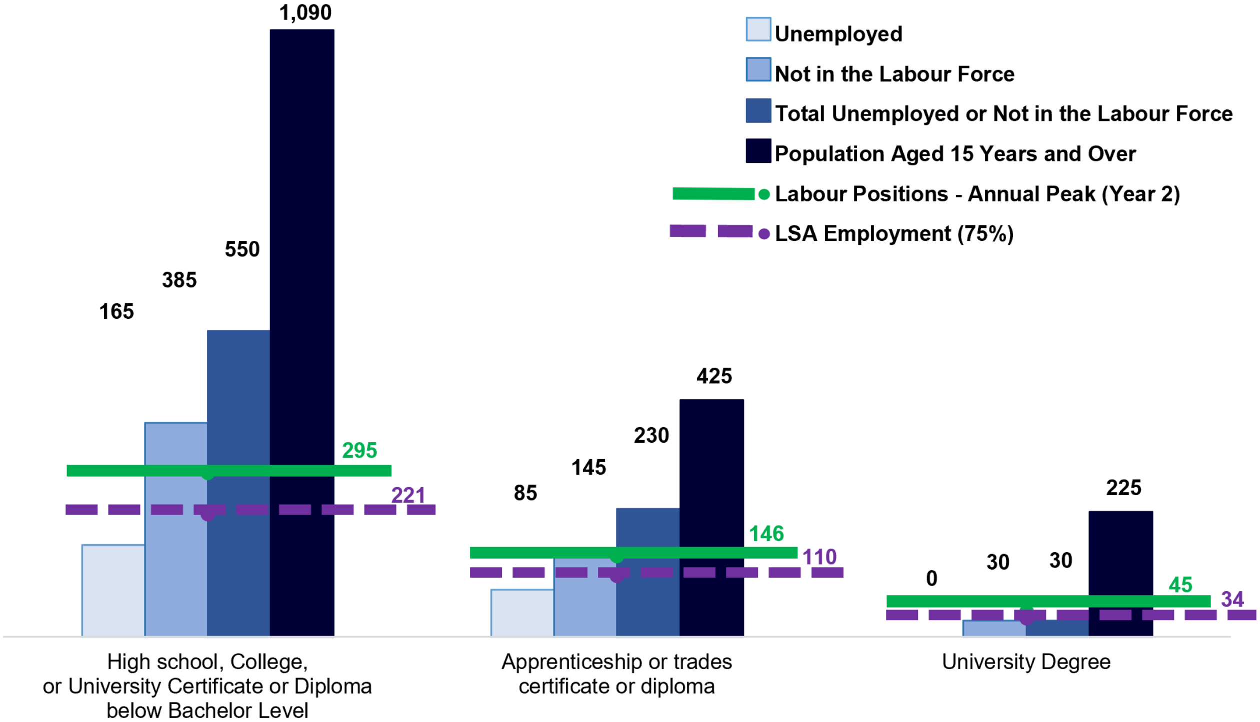
Source: Halliday 2021a; Oakes 2021.

Operations would present greater employment opportunities for LSA residents compared to Construction. This is due to the long-term nature of Operations employment as well as recruitment, education, and training plans implemented to progress toward NexGen's aspirational LSA resident employment target of 75% as described in the Benefit Agreements. Figure 18.4-2 compares the anticipated peak job requirements in Table 18.4-3 with the LSA population 15 years of age or older in 2016 who have obtained the following:

- a high school diploma or a university or college certificate or diploma;
- an apprenticeship or trades certificate or diploma; or
- a university degree.

Figure 18.4-2 also shows the proportion of the 2016 LSA population over the age of 15 who were unemployed or not in the labour force by those educational categories (Appendix 18A, Table 18A-23a).

Figure 18.4-2: 2016 Local Study Area Population over 15 Years of Age by Educational Attainment and 2016 Labour Force Status Compared to Operations Period Peak Labour Requirements



Source: Number of positions (payroll) based on the data provided by NexGen Energy Ltd. Rook I Project Feasibility Study Workbook (Oakes 2021.) and remaining data from Statistics Canada 2016.
LSA = local study area.

The information in Figure 18.4-2 indicates filling 75% of the peak (year 2) operating jobs in each education category may require hiring 40% of the 2016 LSA population over the age of 15 with a high school, college, or university certificate who were unemployed or not in the labour force in 2016 (i.e., 221 positions out of 550 people) and 48% of the LSA population over the age of 15 with an apprenticeship or trades certificate or diploma who were unemployed or not in the labour force in 2016 (i.e., 110 positions out of 230 people). It should be noted that not everyone currently absent from the labour force would be able to work and there are many existing barriers to employment. People not in the labour force includes those who are permanently unable to work due to illness or injury and those who are retired (Section 18.3.4). Those who are able to work may prefer work in other sectors or may have limitations on their availability due to family, education, or other commitments, or may prefer to rely on other sources of income including government transfers or non-wage income obtained through the traditional economy. As discussed in Section 18.3.7.2, a substantial portion of the LSA population has less than a high school diploma (Figure 18.3-19), and programs to assist that segment of the population to obtain the necessary education levels could help expand the available workforce in the LSA for the Project.

Based on these considerations, it is likely the long-term target of 75% of the workforce being residents of the LSA would not be achieved in the early stages of Project Operations. This is consistent with previous experience in the mining sector in the RSA. The Province of Saskatchewan reported in 2018 that employment at mines in the RSA were composed of 47% of residents of northern Saskatchewan compared to a long-term target of 67% (Government of Saskatchewan 2018). A collaborative effort between NexGen, communities, and the provincial and federal governments would likely improve the ability to achieve the long-term target for employment and be consistent with the shared responsibilities of these parties. Previous studies and reviews have identified programs such as the MPTP, bridging supports between high school and post-secondary education, and investments in early education as important measures for improving employment readiness and access to employment opportunities for RSA residents (CVMPP 2013). The Joint Panel noted programs such as the MPTP were important to make sure RSA residents can continue to access economic opportunities in the uranium sector (IAAC 2016b). Local study area residents also commented that programs like the MPTP, Northern Career Quest, and other training that focused on specific employment skills and job opportunities were successful (BNDN-JWG 2021a). Education, training, and recruitment programs developed and implemented jointly between NexGen and the LSA communities, with involvement from other interested stakeholders (e.g., educational institutions), where appropriate, has been initiated with the intent of expanding the number of qualified workers from the LSA over time.

Employment in a typical year during the Operations period is anticipated to be somewhat lower than the Year 2 peak. Statistics Canada I/O modelling based on labour spending in a typical Operations year estimated approximately 456 direct jobs (Appendix 18B, Table 18B-2). Actual employment is expected to vary year by year, but the results of the I/O modelling are provided to illustrate the estimated employment for a typical year over the Operations period.

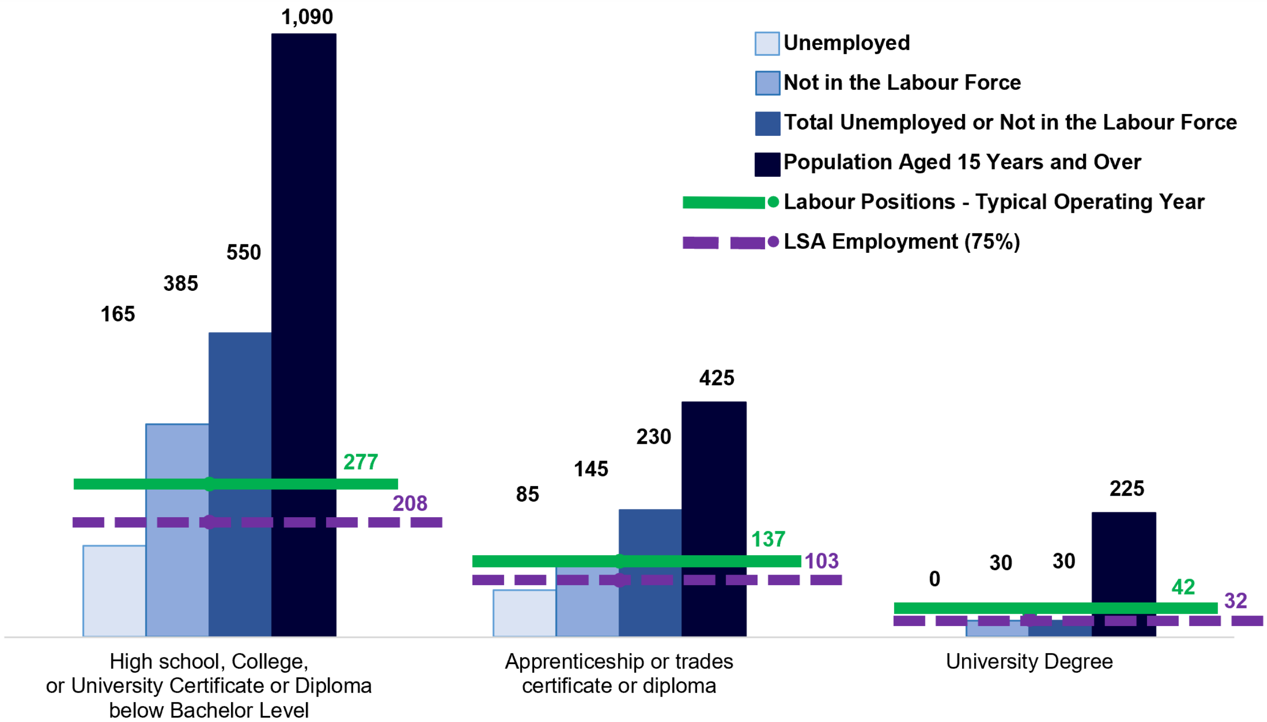
Figure 18.4-3 provides an illustration of the potential typical Operations year labour requirements (Appendix 18A, Table 18A-24) with the proportion of the 2016 LSA population over the age of 15 who were unemployed or not in the labour force by educational category (Appendix 18A, Table 18A-23a). Education requirements in Figure 18.4-3 assume the same proportion of jobs in a typical Operations year would require each type of education or training level as for the peak employment period. The information in Figure 18.4-3 indicates filling 75% of the peak illustrative average peak operating jobs in each education category may require hiring 38% of the 2016 LSA population over the age of 15 with a high school, college, or university certificate who were unemployed or not in the labour force in 2016 (i.e., 208 positions out of 550 people) and 45% of the LSA population over the age of 15 with an apprenticeship or trades certificate or diploma who were unemployed or not in the labour force in 2016 (i.e., 103 positions out of 230 people).

Figure 18.4-4 to Figure 18.4-6 illustrate employment scenarios that achieve LSA employment levels of 75%, 50%, and 25% for the Operations peak (Year 2) and estimated typical Operations period for context (Appendix 18A, Table 18A-24). The scenarios provide an illustration of the range of LSA employment outcomes that may be achieved, especially early in Project Operations when the aspirational LSA employment target of 75% may not yet be achievable.

It is likely that if the Fission Patterson Lake South Property proceeds, it would require employees with similar skills and draw from the same LSA and RSA for employees. The Fission Patterson Lake South Property is estimated to employ approximately 320 people during operations (Fission 2021b). As a result, the opportunity to employ residents of the LSA on the Project may be reduced in the event the Fission Patterson Lake South Property proceeded due to competition for workers and the limited number of qualified personnel from which to draw on (i.e., high demand, low supply). However, another operating mining project may create additional education and training opportunities that could also be of benefit to LSA residents and may further stimulate interest in the industry among residents.

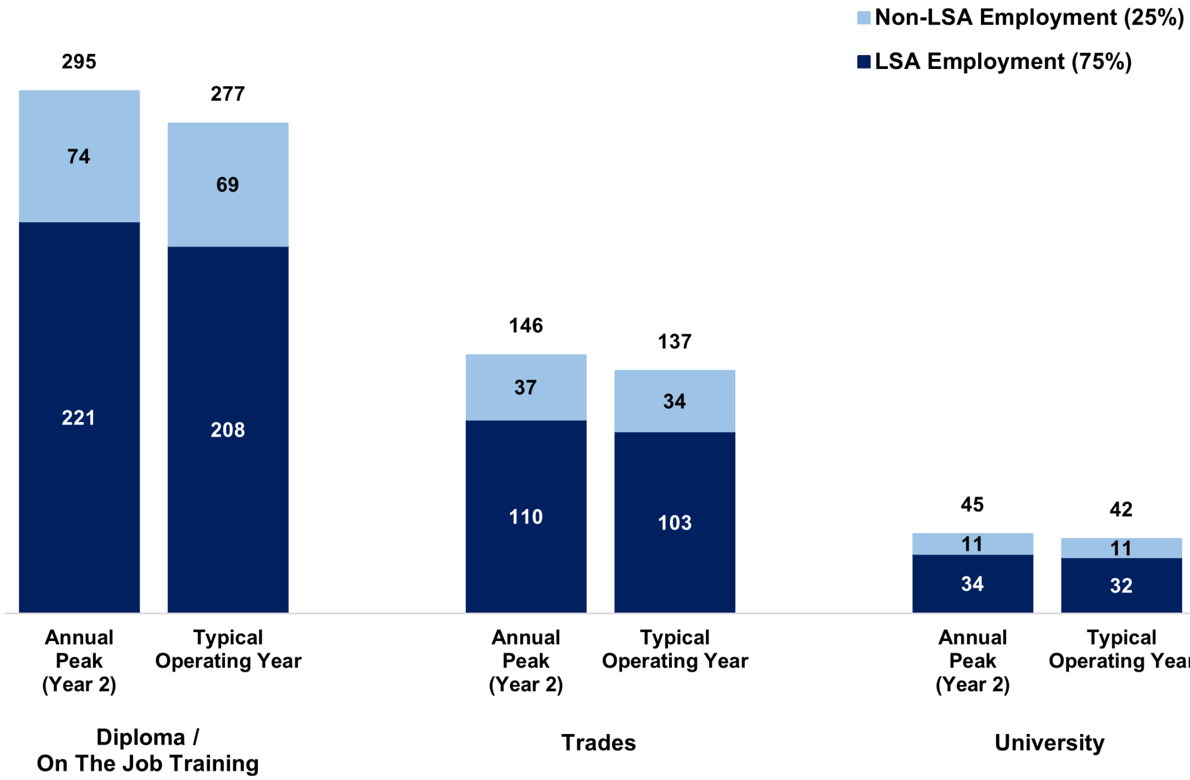
In addition to direct employment effects during Operations, I/O modelling estimates that the Project is expected to have positive indirect and induced employment effects. During a typical operating year, the estimated total Canada-wide direct, indirect, and induced employment could range between 950 and up to approximately 1,200 FTE positions, including up to approximately 650 FTE positions in the province (Appendix 18B, Table 18B-2).

Figure 18.4-3: 2016 Local Study Area Population over 15 Years of Age by Educational Attainment and 2016 Labour Force Status Compared to Estimated Typical Operations Labour Requirements



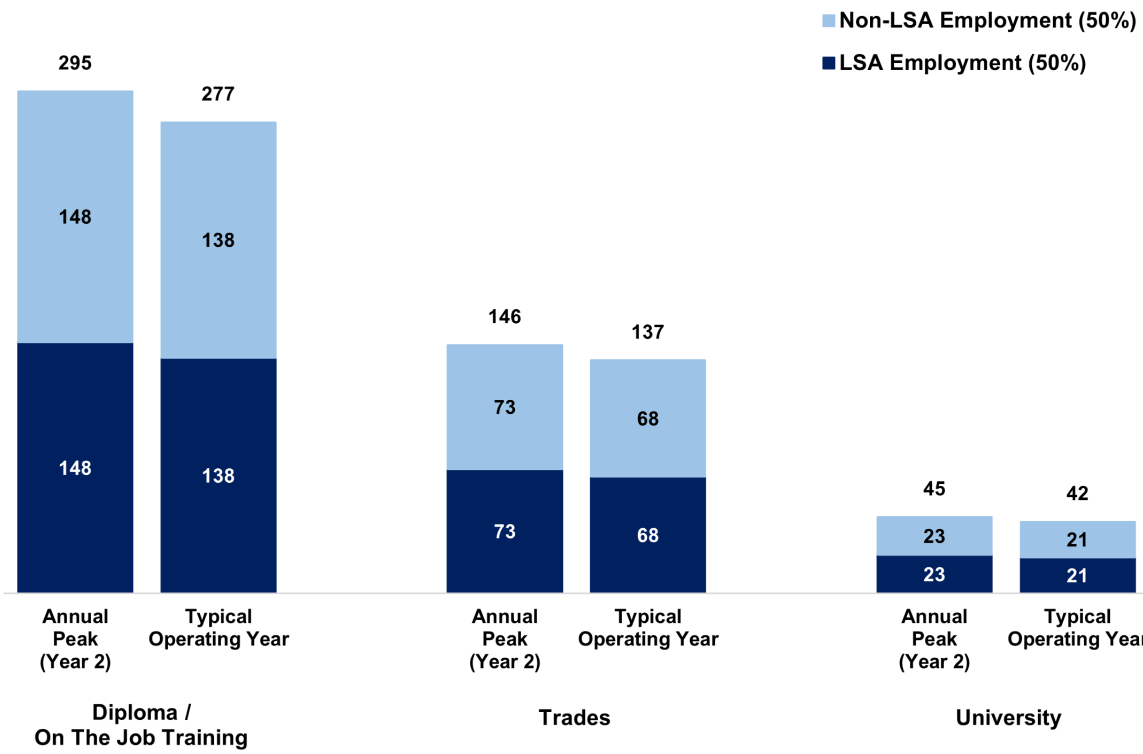
Note: Typical operating year positions (payroll) are calculated by InterGroup Consultants Ltd. Based on Statistics Canada I/O modelling and the number of positions (payroll) from NexGen Energy Ltd. Rook I Project Feasibility Study Workbook (Oakes 2021), and remaining data from Statistics Canada (2016).
LSA = local study area; I/O = input/output.

Figure 18.4-4: Operations Peak (Year 2) and Estimated Typical Operations Labour Requirements – 75% Local Study Area Employment Scenario



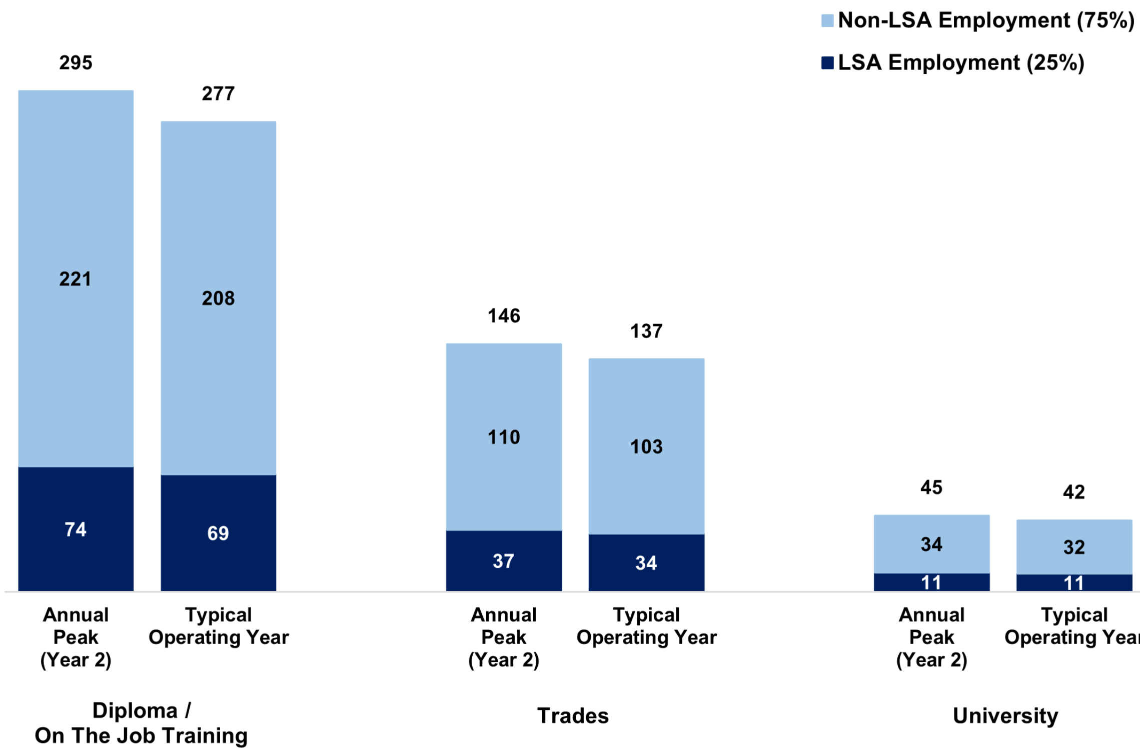
Source: Number of positions is based on the data provided by NexGen Energy Ltd. Rook I Project Feasibility Study Workbook (Oakes 2021). Labour positions in payroll allocated into three groups and average operations peak calculated by InterGroup Consultants Ltd.
Note: Typical operations phase estimated based on Statistics Canada I/O modelling. Education requirement for typical operations phase is calculated based on the proportion from the Year 2 annual peak allocation.
LSA = local study area; I/O = input/output.

Figure 18.4-5: Operations Peak (Year 2) and Estimated Typical Operations Labour Requirements – 50% Local Study Area Employment Scenario



Source: Number of positions in based on the data provided by NexGen Energy Ltd. Rook I Project Feasibility Study Workbook (Oakes K. 2021). Labour positions in payroll allocated into three groups and average operations peak calculated by InterGroup Consultants Ltd.
Note: Typical operations phase estimated based on Statistics Canada I/O modelling. Education requirement for typical operations phase is calculated based on the proportion from the Year 2 annual peak allocation.
LSA = local study area; I/O = input/output.

Figure 18.4-6: Operations Peak (Year 2) and Estimated Typical Operations Labour Requirements – 25% Local Study Area Employment Scenario



Source: Number of positions in based on the data provided by NexGen Energy Ltd. Rook I Project Feasibility Study Workbook (Oakes K. 2021). Labour positions in payroll allocated into three groups and average operations peak calculated by InterGroup Consultants Ltd.
Note: Typical operations phase estimated based on Statistics Canada I/O modelling. Education requirement for typical operations phase is calculated based on the proportion from the Year 2 annual peak allocation.
LSA = local study area; I/O = input/output.

Work rotations are necessary based on the travel distance to the Project and have been used on other uranium projects in Saskatchewan (CVMPP 2013). Effects of commuter work schedules on community well-being are discussed in Section 19.4. Working with local communities to develop culturally sensitive employment policies, such as providing space and access for Elders on site, has been cited as an important way to contribute to recruitment and retention of Indigenous employees. For example, a 2019 report prepared by the Conference Board of Canada (2019) examined Indigenous recruitment and retention in Canada's northern and remote regions cited cultural awareness training and flexible work arrangements to accommodate important cultural activities as methods that can support the creation of an inclusive, accepting work environment for Indigenous employees. NexGen has committed to measures such as the following that would enhance employment opportunities, including in Benefit Agreements:

- Work with local communities to develop culturally sensitive employment policies including addressing recruitment and retention barriers.
- Implement a tailored local workforce recruitment strategy to confirm that LSA residents are fully aware of and understand how to access Project employment opportunities.
- Provide dedicated space for Elders to be available to support Indigenous employees and assist with employee retention.

- Have an aspirational target of 75% of the Project's workforce being composed of LSA residents.
- Use best efforts to provide qualified local residents with a first preference for employment and training opportunities.
- Work with relevant training institutions to facilitate the delivery of certified and accredited training and recruitment programs for construction and mining-related skills targeted at employment opportunities for LSA residents and continue to provide scholarship and summer student opportunities.
- Prioritize advancement for qualified local residents into increasingly senior positions.
- Establish a mentoring program to support long-term participation of LSA residents in the Project workforce.

There can also be negative effects associated with employment including stress on individuals and families. These potential effects are analyzed in the assessment of the community well-being VC (Section 19). Effects during Closure are described in Section 18.4.3, Secondary Pathways.

Income opportunities

The Project would provide a positive benefit through increased income opportunities for local residents. These benefits would occur in an area where average incomes are typically lower than for Saskatchewan overall (Figure 18.3-16). These benefits vary by Project phase.

The estimated labour income associated with the Construction workforce would be approximately $532 million (Appendix 18B, Table18B-1)[33]. Surface contractor labour rates were estimated based on Saskatchewan construction trade agreements (NexGen 2021c). In addition to direct income opportunities (i.e., income for Project employees), the Project is expected to have positive indirect and induced income effects (e.g., income for employees of businesses that provide supplies and services to the Project, increased income for local retail and hospitality workers as a result of Project employees having more disposable income and spending it locally). Input/output modelling estimated the total direct, indirect, and induced labour income across Canada for Construction could be between approximately $730 million and up to $885 million including up to $672 million for Saskatchewan (Appendix 18B, Table 18B-1). Increased disposable income can have benefits by increasing purchasing power and improving the ability to save and adapt to changing economic circumstances, which can influence community well-being (Section 19). Increased wage income can also improve the ability for individuals and communities to participate in the traditional economy by purchasing equipment to increase accessibility (e.g., boat) and tools (e.g., firearms; Section 18.3.6.1; BRDN-JWG 2021a; BNDN-JWG 2021a). It is acknowledged that access to increased income can also have a detrimental effect on community well-being due a range of factors including inappropriate spending and increased income disparity between households (Section 19.4.3).

During a typical year of Operations, direct labour income is estimated to be approximately $55 million (Appendix 18B, Table 18B-2). The compensation structure would include a base salary, benefits and bonuses, and incentives (NexGen 2021c). Compensation would be competitive with other Saskatchewan employers, particularly those in the uranium industry. In 2020, average weekly earnings in the mining, quarrying, and oil and gas extraction industry in Saskatchewan were $1,917 compared to an aggregate across all industries of $1,092 (Statistics Canada 2021c). It should also be noted average incomes in the LSA in 2016 were lower than in the RSA and Saskatchewan (Figure 18.3-16); therefore, higher-income employment opportunities could be

[33] Note that the labour income includes the value of the worker benefits program and other components and is not equivalent to the wage or salary payment received. It also includes an allocation of contingencies to labour.

particularly beneficial to LSA residents. For context, an estimated illustrative annual average Project employee income (i.e., approximately $100,000 based on a weekly income of $1,917, as noted above) is $69,000 higher than the LSA average personal income and $35,000 higher than the LSA average household income. Actual income would vary by position. In 2016, there were 85 households in the LSA with incomes of $90,000 – $99,999, and 450 households with incomes of more than $90,000. If 365 LSA residents were employed on the Project (i.e., based on the 75% aspirational target) and each received an average annual income of $99,684 then this could result in a four-fold increase in households with incomes of $90,000 – $99,999 and an 80% increase in the number of households with incomes above $90,000.

In addition to direct income opportunities, the Project is expected to have positive indirect and induced income effects. An analysis prepared using the Statistics Canada Interprovincial I/O model estimated the total direct, indirect, and induced labour income for a typical operating year could be between approximately $94 million and up to $112 million for Canada, including up to approximately $62 million for Saskatchewan (Appendix 18B, Table 18B-2). These figures would be somewhat higher if sustaining capital expenditures were included, as described in Appendix 18B, Table 18B-3. Commitments made in Benefit Agreements and those described in Table 18.4-1 would help enhance income opportunities for LSA residents.

Effects during Closure are described in Section 18.4.3.

Education and training opportunities

The Project would provide a positive benefit for educational attainment in the LSA through increased education and training opportunities for local residents. These opportunities would occur in an area with lower levels of educational attainment than the RSA and Saskatchewan as a whole (Figure 18.3-19). These benefits would vary by Project phase. NexGen would continue to provide training opportunities for their workforce. This training could allow employees to advance to more senior and higher-income employment within the organization and improve their ability to obtain other employment in the future. Training opportunities could also result in a higher-skilled local workforce. In 2016, more than 50% of the population aged 15 years and older in the LSA did not have a high school diploma (Figure 18.3-19). Comments made during JWG meetings also noted a general lack of local education and training opportunities for youth (BRDN-JWG 2020).

NexGen (2021c) initiated a summer student internship program in 2016 for both high school and post-secondary students and also operates a summer student mentorship program.

NexGen also currently provides bursaries to support students pursuing post-secondary education (NexGen 2021b). It is anticipated these programs would continue during Construction and Operations.

The Project would enter into an MSLA with the Province of Saskatchewan that provides “the foundation for the development of support relationships between northern communities, mining operations, and the Government of Saskatchewan” (Government of Saskatchewan 2021a). Each lease requires the operator to have a Human Resource Development Agreement that focuses on the priorities for northern training, employment, and job advancement. Human Resource Development Plans become the annual tool to achieve the agreement’s objectives. NexGen’s Human Resources Management Plan would define responsibilities for Project roles and required training and development. NexGen would prepare detailed operator training that includes classroom training, field training, and on-the-job training to help prepare the Operations workforce.

Métis Nation – Saskatchewan members have noted that they want to participate in the economic opportunities created by the Project and that financial support for training, including training in traditional culture and environmental management, is important (TSD IV). Advanced preparation for training opportunities was also noted to be important, with a BNDN member stating:

> Groups like ours need as much warning as possible to get people started on the 2-3-4-year programs. We want to get past that short-term hiring for labourers etc. We'd like to get more people involved in trades certification and so on, so the timing is important. (BNDN-JWG 2020)

Key person interview participants noted concerns that some residents with experience in the mining and resource sector do not have formal training and certifications that are recognized outside of the mining and resource sector and that this may constrain income opportunities, particularly during mining shutdowns or closures (2019 to 2021 KP interview program). NexGen recognizes the importance of these points and is working with Indigenous Groups to create suitable and timely education and training opportunities.

Working with local communities to enhance employment and training opportunities could include continuing to provide scholarship and summer student opportunities to help prepare students for future employment opportunities and developing and implementing education and training opportunities to prioritize and support the advancement of qualified local residents into more senior positions. Assisting employees to obtain certifications and credentials that are transferable to other employment can help make sure education and training continue to enhance employment opportunities even during periods of mine closures or decommissioning.

In addition to priorities established within the LPA, the Benefit Agreements include the following commitments related to training and employment:

- **A training and recruitment program:** NexGen would continue to operate training and recruitment programs for construction- and mining-related skills targeted at employment opportunities for the Project for individuals residing within the LPA (i.e., LSA). In addition, NexGen would require all Project contractors and its other contractors to adhere to the same conditions.
- **Scholarships:** NexGen would continue to provide annual scholarships for at least four students residing within the LPA and attending post-secondary programs.
- **Student mentorship:** NexGen would continue to provide a summer-student mentorship program consistent with past practice for students residing within the LPA.
- **Traditional Activities:** NexGen would work cooperatively to protect traditional activities and cultural values potentially effected by the Project.

E-02: Business and contracting opportunities:

- Expenditures for supplies and services may increase existing and new business and contracting opportunities in local communities and Northern Saskatchewan during Construction, Operations, and Closure.

The Project would provide a positive benefit through increased business and contracting opportunities throughout Construction and Operations. Benefits would continue during Closure, relative to existing conditions. This can result in new revenue sources for existing local businesses and presents opportunities for new business start-ups. These opportunities would occur in an area where the majority of the local employment is a result of government spending and opportunities for local businesses are currently limited (Section 18.3.6, Income).

Potential effects related to commercial fishing, trapping, outfitting, and eco-tourism are described in Section 17.4, Project Interactions and Mitigations.

Local study area residents have noted that there are a limited number of locally owned businesses, and that goods and services must often be sourced from outside the local communities. Residents noted a strong interest in expanding local business opportunities including exploring partnerships between communities. In particular, LSA residents have commented that they see substantial value not just in expanding employment opportunities, but also ownership interests in businesses (Section 18.3.6). NexGen evaluates its supply chain for opportunities to procure goods and services from existing sources in the LSA as well as opportunities to develop and expand local capacity (NexGen 2021a).

Métis Nation – Saskatchewan members have expressed concerns that local business people are not getting contracting opportunities and have suggested development of a collaboration agreement, a contracting association, and an overarching company to allow one-stop services to address this concern. Access to specific lists of contract opportunities, timelines, values, and contract requirements were also noted as being required to improve the opportunities for local contractors. Clearwater River Dene Nation members have noted an interest in knowing what business and contracting opportunities are needed (CRDN-JWG 2020). The CRDN have noted concerns with the inequitable distribution of economic benefits from previous projects including the Cluff Lake Mine and a proposed oilsands project (TSD V.1: CRDN). A BRDN member noted the desire to have locally owned businesses benefit from contracting opportunities (BRDN-JWG 2020). A BNDN representative noted concerns about benefits flowing more to southern communities (BNDN-JWG 2020).

NexGen has an aspirational long-term target of 30% of the Project's external spend being awarded to LSA and RSA businesses. Achieving this aspirational target would be facilitated through NexGen programs and engagement within the LPA, including through the Benefits Agreements with the primary Indigenous Groups. The Benefit Agreements would include the following commitments:

- develop and maintain a business opportunities workplan that describes the steps each Party would take to achieve the desired outcomes;
- establish and maintain a local business registry;
- provide advance notice of business opportunities;
- pre-qualify each Indigenous business listed in the business registry and provide feedback to any Indigenous business that does not successfully pre-qualify; and
- develop and implement preferred bid processes to facilitate the success of capable and suitably qualified Indigenous businesses.

NexGen is also committed to providing annual reporting that provides the total value and number of contracts awarded in relation to the Project, and the total value and number of contracts awarded to Indigenous or locally owned businesses from the Project, whether directly or as subcontractors to other Project contractors.

Working with local communities to maintain a business registry, identifying gaps in locally available services, and developing options to build capacity and capability in those areas would assist with procurement planning and understanding the current capabilities of local businesses. Other commitments and annual reporting would provide the opportunity for ongoing feedback and adaptation to make progress toward the local procurement target.

If the proposed Fission Patterson Lake South Property proceeds, it would draw from the LSA and RSA for supplies and contractors. There may be economies of scale for local businesses in servicing two mining operations. For example, some specialized equipment or specialized training may become more economical if there are more mining projects in the area. NexGen intends to work with the proponents of the Fission Patterson Lake South Property to collaborate on mitigation and benefit enhancement where appropriate and to work with businesses in the region to collaboratively manage cumulative effects on the economy.

Effects during Closure are described in Section 18.4.3.

E-03: Participation and employment in the traditional economy:

- Workforce requirements may increase employment and related wage income and affect participation in the traditional economy in local communities during Construction, Operations, and Closure.

The traditional economy provides important non-cash income to many LSA residents. Effects on the ability to participate in the traditional economy as a result of Project-related wage employment and participation in a commuter rotation system are anticipated to be beneficial but may have an overall neutral effect. Local study area residents have noted that participation in the traditional economy can ebb and flow depending on the availability of wage employment. Participation in the wage economy can be a deterrent to spending longer periods on the land (BNDN-JWG 2021a; BRDN-JWG 2021a); however, income earned in the market (i.e., wage) economy can also contribute to success in traditional economy activities as market (i.e., wage) income can be used to purchase supplies and equipment needed for traditional economy activities. A study of the effects of the fly-in / fly-out commuter rotation system in the RSA found that participation in a work rotation did not limit an individual's ability to participate in traditional activities, and in some ways, enabled people to spend more time on the land as the rotation provided an equal period at home in which those activities could occur (CVMPP 2005).

Participation in the traditional economy often occurs sequentially and simultaneously with activities related to Other Land and Resource Use (Section 17) and Cultural and Heritage Resources and Indigenous Land and Resource Use (Section 16), and the effects related to those environmental components are addressed in those sections. Mitigation and enhancement measures described relative to those activities also support participation in the traditional economy. Further, NexGen would work with local communities to develop culturally sensitive employment policies that facilitate the ability to participate in both the wage economy and traditional economy.

On balance, while wage employment may reduce activity in the traditional economy for some participants, the effects of increased wage income on the ability to purchase equipment and supplies, combined with employment policies that facilitate participation in the traditional economy is expected to result in a positive benefit to the ability to participate in the traditional economy.

E-04: Provincial and federal tax revenue and payments to Indigenous Groups:

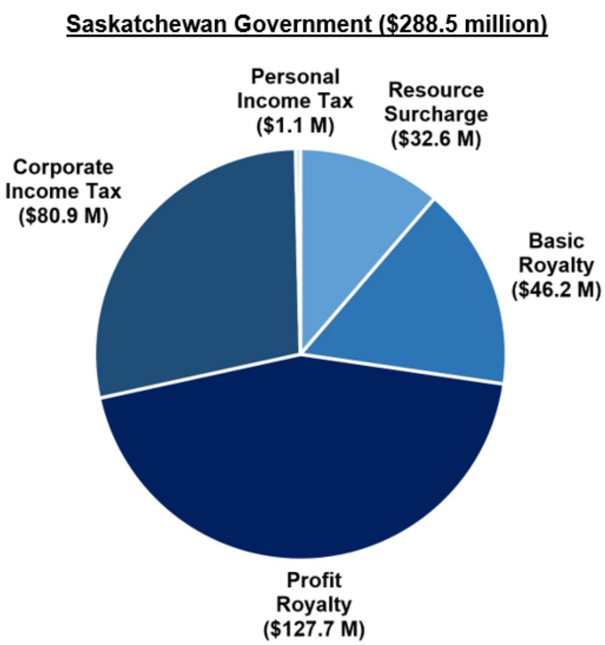
- Project payments (i.e., taxes, royalties, and surface lease payments) may increase the revenues of the governments of Saskatchewan and Canada during Operations. Benefit Agreements include payments to Indigenous Groups based on revenue generated throughout the life of the Project.

The Project would generate payments to the governments of Saskatchewan and Canada through royalties, personal and corporate income taxes, and mineral surface leases. This would provide increased revenues to support government spending. Figure 18.4-7 sets out the estimated payments for a typical year during Operations. Estimates of federal and provincial personal income taxes were calculated based on median effective tax rates reported by Statistics Canada (Appendix 18B, Table 18B-4 and Table 18B-5).

Estimates of resource surcharge, basic royalties, profit royalties, and corporate income tax were prepared as part of the Project Feasibility Study. Estimated direct payments to governments do not include payments that may be made pursuant to an MSLA. NexGen does not currently hold surface rights for the proposed Project footprint. Surface rights would be negotiated as part of an MSLA with the Province of Saskatchewan following review and approval of the EA, if received.

The estimated payments of $288.5 million would be approximately 2.2% of the $12.9 billion in total revenue reported by the Government of Saskatchewan for the fiscal year ending in 2020 (Government of Saskatchewan 2020b).

Figure 18.4-7: Estimated Direct Payments to Government for a Typical Operating Year, 2020



Note: Estimates of federal and provincial personal income taxes were calculated based on median effective tax rates reported by Statistics Canada.
M = millions.

In addition to payments to the provincial and federal governments, the Benefit Agreements include payments to Indigenous Groups based on revenue generated throughout the Project lifespan. The Benefit Agreements are negotiated agreements between each primary Indigenous Group and NexGen, the contents of which are confidential.

18.4.2 No Pathways

There were no Project interactions identified that were predicted to result in no pathway to the economy.

18.4.3 Secondary Pathways

The following Project interactions were predicted to result in secondary pathways to the economy and were not carried forward in the assessment.

E-01: Employment, income, and training opportunities:

- Project-related employment, income, and training opportunities would decrease during Closure relative to Operations.

During Construction and Operations, there would be increases in employment, income, and training opportunities (Section 18.4.4). During Closure, activities such as backfilling mine workings, removal of physical infrastructure, and recontouring and revegetating disturbed areas that are necessary to achieve decommissioning objectives and return the site to a safe and stable condition would continue for some time.

The transition from Operations to Closure would result in decreases to employment, income, and training opportunities in the LSA relative to Operations. However, compared to existing conditions without the proposed Project, this work experience and training is anticipated to result in a more experienced and qualified local labour force, which represents a residual benefit in the ability to obtain other employment and income opportunities. The ability of this skilled workforce to obtain employment in the LSA appropriate for their skills and experience is uncertain because it would depend on the economic conditions and activity at the time of Closure.

Local study area residents have noted concerns with respect to the loss of economic opportunities associated with other mine closures (2019 to 2021 KP interview program). A workforce transition plan, as part of overall closure planning, and maintaining ongoing communication with employees and local communities is anticipated to help workers transition to other employment and mitigate the decreases in employment, income, and training opportunities during Closure. NexGen will also consider slowdowns or shutdowns associated with care and maintenance in the development of the workforce transition plan. On balance, considering the residual benefits of work experience and training, and the availability of mitigation including a workforce transition plan, the effects on the economy during Closure are expected to be negligible compared to existing conditions. Therefore, the pathway was not carried forward for further assessment.

E-02: Business and contracting opportunities:

- Project-related business and contracting opportunities would decrease during Closure relative to Operations.

During Construction and Operations, there would be increases in business and contracting opportunities (Section 18.4.4). The transition from Operations to Closure would result in reductions in spending on supplies and services over time and decrease local business and contracting opportunities. However, compared to existing conditions, the experience gained by local businesses is anticipated to result in more experienced and diverse local businesses, which represents a residual benefit in the local economy.

Ongoing communication with contractors and suppliers to provide information on decommissioning and reclamation plans could help businesses plan for changes. On balance, considering the residual benefits of a more experienced and diverse local business sector, the effects on the economy during Closure are expected to be negligible compared to the potential future economy without the Project. Therefore, the pathway was not carried forward for further assessment.

E-05: Population migration:

- Changes in employment, business, and income opportunities may affect population in-migration and out-migration.

The increased availability of local employment opportunities may provide an incentive for people to move to the LSA. This could include both former residents, who move back to the LSA when employment opportunities increase, and newcomers to the LSA. Increased income may also enable local residents to move either within the LSA or outside the LSA to pursue improved housing or other amenities not available locally. Population migration (both in-migration and out-migration) would also be influenced by Project-specific commuter transportation arrangements. Local study area residents have noted that while there are people who work outside of their home community, many prefer not to have to leave their communities for extended periods (2019 to 2021 KP interview program; BNDN-JWG 2021b).

Census data have shown modest decreases in population in the LSA in recent years, though the LSA has previously experienced faster population growth both year over year and compared to the rate of population growth in the RSA and Saskatchewan Population changes vary by community (Appendix 18A, Table 18A-1b). Population growth rates have been somewhat higher than in the RSA (Figure 18.3-1; BNDN-JWG 2021b). Current population projections for the Northwest Health Region in which the LSA is located range from a cumulative increase of approximately 7% from 2018 to 2049 in the High Growth scenario to a decrease of approximately 10% in the low growth scenario (Figure 18.3-10); however, it is noted that projecting population changes for small populations has a high degree of uncertainty.

Local study area residents have noted during interviews that a number of factors influence migration decisions, including access to employment, education, housing, and other amenities. Often, LSA residents relocate to the surrounding communities, such as Buffalo Narrows, for educational training (BNDN-JWG 2021a; 2019 to 2021 KP interview program). Previous research has also indicated many RSA residents have a strong sense of home and connection to the northern region and return if they can find employment (BNDN-JWG 2021a; Anderson Fast & Associates 2000). Local study area residents who obtain employment on the Project may choose to relocate to southern centres to access education and other amenities and commute to the Project site depending on the availability of commuter transportation. On balance, migration decisions reflect highly personal consideration of a number of factors.

During JWG meetings, a BNDN member noted concerns about potential future population growth in the LSA and related issues to changes in land use (BNDN-JWG 2019). This is not predicted to be an issue given the limited economic (Section 19.3.5, Economic Well-Being), educational (Section 19.3.4, Educational Well-Being), and social (Section 19.3.6, Community Well-Being Index) opportunities in the region and because most, if not all, in-migration would be anticipated to be former residents, which would be viewed by most as a positive outcome (i.e., relatives returning home). However, to limit the potential for negative effects from unmanageable in-migration, particularly from people without connections to the LSA, mitigation to reduce the incentive to relocate to the LSA from other jurisdictions could include providing a variety of pick-up points for fly-in / fly-out workers throughout Saskatchewan. For a couple of key reasons, having multiple pick-up points for workers is being considered. First, the anticipated Project workforce demand is expected to exceed the currently available labour force in the LSA. Second, the Project would require a number of highly skilled positions that require levels of experience that may not be currently available within the LSA labour force. Outside of the LSA, pick-up points are anticipated for Saskatoon and Prince Albert, though changes could occur based on the general residency locations of the future workforce. Additional locations would likely also be required; this may include a pick-up point within the LSA. During Closure, the decline in employment opportunities relative to Operations would reduce or eliminate incentives to relocate.

In addition, working with LSA communities to develop hiring policies and commuter transportation options that provide flexibility for workers to maintain employment, specifically if they choose to relocate south to larger communities (e.g., Saskatoon) to access education or other amenities for themselves or family members, could help with the planning and management of any in-migration and out-migration pressures. Potential effects of commuter transportation on community well-being are provided in Sections 19.4.3 and 19.4.4.

Increases in employment and income opportunities may affect either in-migration or out-migration decisions based on individual circumstances. Providing commuter options from locations outside the LSA is anticipated to reduce the incentive for people to relocate to the LSA communities, which may limit both returning residents and new arrivals. Considering the changes in employment and income opportunities could influence both in-migration and out-migration and the availability of commuter transportation to mitigate in-migration pressures, potential population changes related to the Project are considered to have negligible residual effects on the economy. Therefore, the pathway was not carried forward for further assessment.

18.4.4 Primary Pathways

There were no adverse Project interactions identified that were predicted to result in primary pathways to the economy.

18.5 Residual Effects Analysis

The review of Project interactions did not identify any adverse primary pathways. Therefore, a residual effects analysis was not completed (Section 6.7.3). Residual effects of the Project from employment and income on community well-being including effects on community cohesion are described in Section 19.4.4, Primary Pathways.

18.5.1 Application Case

The review of Project interactions did not identify any adverse primary pathways. Therefore, a residual effects analysis was not completed (Section 6.7.3).

18.5.2 Reasonably Foreseeable Development Case

The review of Project interactions did not identify any adverse primary pathways. Therefore, a residual effects analysis was not completed (Section 6.7.3).

18.5.3 Residual Effects Classification and Determination of Significance

There are no predicted primary pathways from the Project to the economy; therefore, the Project would not be expected to create greater-than-negligible adverse effects. For this reason, effects to the economy VC are predicted to be **not significant** (Section 18.2.9, Residual Effects Classification and Determination of Significance).

18.6 Prediction Confidence and Uncertainty

Factors affecting confidence in the predictions made in the assessment of effects on the economy include the following:

- availability and accuracy of baseline data as discussed in Section 18.2.6;
- level of detail currently available on specific employment, contracting, and education and training opportunities, plans, and programs;
- limitations of I/O modelling as discussed in Section 18.4.1, Beneficial Pathways, and Appendix 18B, Section 18B2.2, Cautions and Limitations; and
- level of certainty associated with the effectiveness of proposed mitigation and enhancement measures.

Uncertainty was managed through the following:

- reviewing historical data and relevant studies completed in the LSA and RSA;
- completing quality assurance and quality control of baseline data;
- conducting primary data collection including interviews with knowledgeable local residents about potential effects on the economy;
- providing a range for I/O model indirect and induced results based on the open and closed models, consistent with guidance from Statistics Canada;
- discussing relevant topics and findings with JWGs; and
- applying reasonable conservativeness in professional judgment based on knowledge or past industry experience in the RSA.

Remaining uncertainty was primarily addressed by making assumptions that are likely to understate rather than overestimate the economic benefits of the Project and using ranges of possible outcomes to describe potential benefits. Overall, there is a moderate degree of confidence in predictions related to the assessment of economy.

18.7 Monitoring, Follow-Up, and Adaptive Management

This subsection presents a summary of the identified monitoring and follow-up required to confirm effects predictions and address the uncertainty identified in Section 18.6. Monitoring is also recommended for economic benefits to track progress against long-term targets and identify opportunities to further enhance outcomes. Follow-up and monitoring programs would be used to:

- monitor progress on achieving employment and contracting targets and identify opportunities to improve employment and contracting outcomes;
- maintain ongoing communication and dialogue with local communities to identify and resolve issues; and
- contribute to the overall continual improvement of the Project.

It is anticipated the Project's MSLA would include a Human Resources Development Agreement and a rolling Annual Human Resources Development Plan that would require reporting on efforts to meet socio-economic commitments. Typically, mining operations report to the province on indicators including the following:

- total employment and employment of residents of the RSA;

- employment by sex and Indigenous identity;
- total wages (i.e., in dollars) and percentage of the total wages for residents of the RSA;
- external training partnerships and in-house employee development;
- northern procurement volumes (i.e., in dollars) and percentages of total procurement; and
- community involvement including school awards, scholarships, outreach, and information sharing with northern residents (Government of Saskatchewan 2018).

In addition to this reporting, NexGen has committed in the Benefit Agreements with each primary Indigenous Group to establish an Implementation Committee composed of four representatives (i.e., two from the Indigenous Group and two from NexGen). The Implementation Committee is tasked with the responsibility of facilitating an effective ongoing working relationship between the Parties and to confirm that all commitments made within the Benefit Agreements are realized. The Implementation Committee provides a forum for regular communication and information exchange between the Parties, effective management of the commitments, and the early resolution of issues and/or disputes that may arise.

Each Implementation Committee is required, or expected to require, to provide an annual written report on all activities identified within the Benefit Agreement. In addition, the Implementation Committee is required, or is expected to be required, to organize and host an annual community meeting to, among other things, provide a summary of the activities undertaken to address the commitments in the Benefit Agreements, including a summary of the environmental, cultural, economic, training, employment, and business development initiatives undertaken.

NexGen is committed to working with Indigenous Groups and local communities to sustainably maximize training and employment opportunities within the LPA throughout the Project lifespan.

18.8 Key Findings

The objectives of Section 18 were to provide a detailed and comprehensive assessment of all potential Project-specific effects and cumulative effects with RFDs on the economy. This section meets the Terms of Reference for the Project submitted to the ENV and CNSC (Section 1, Introduction; Terms of Reference from ENV and the CNSC Generic Guidelines for the Preparation of an EIS Pursuant to *Canadian Environmental Assessment Act, 2012* [Appendix 1A, Concordance Tables]). The assessment has considered both adverse and beneficial effects of the Project on the economy.

Overall, the Project is expected to result in substantial net positive economic outcomes for the LSA and RSA, which would have flow-on effects on a range of socio-economic variables including health and well-being (Section 19).

Realized employment and business opportunities in the LSA and RSA created by the Project during Construction, Operations, and Closure would have a positive effect on labour force indicators within local communities where participation rates and employment rates have been, on average, lower than in Saskatchewan as a whole (Figure 18.3-11).

Sustainable economic opportunities associated with the Project also form part of the signed Benefit Agreements with Indigenous Groups.

Specific economic benefits include the following (Section 18.4.1):

- The Project would provide a substantial positive benefit through increased employment opportunities for LSA residents.
  - For Construction, the peak construction workforce is expected to be approximately 350 on-site workers, and the Project could result in between approximately 8,200 and 10,500 direct, indirect, and induced FTE positions across Canada over the four-year Construction period.
  - During Operations, the peak employment is expected to total 486 direct positions which, if aspirational targets (75%) are achieved, could include 365 positions hired from the LSA. Employment during a typical Operating year is estimated to be approximately 456 direct positions. There are a number of challenges and barriers to achieving the aspirational employment targets that would require collaboration between NexGen, Indigenous Groups and federal and provincial governments. Direct, indirect, and induced employment is estimated to range between 950 and 1,200 FTE positions across Canada during a typical operating year.
  - During Closure, some level of employment would continue, though it would decrease relative to Operations.
- The Project would provide a substantial positive benefit through increased income opportunities for LSA residents.
  - For Construction, labour costs are estimated to make up approximately $532 million or 41% of the total capital cost of $1,300 million. The total direct, indirect, and induced labour income across Canada for Construction could range between $730 million and $885 million.
  - During Operations, direct labour spending is estimated to be approximately $55 million during a typical operating year. Peak employment is expected to comprise a total of 486 positions on payroll. The total direct, indirect, and induced labour income for a typical operating year could range between $94 million and $112 million. For context, an estimated illustrative annual average Project employee income (based on average weekly earnings in the mining, quarrying, and oil and gas extraction industry in Saskatchewan) of approximately $100,000 is $69,000 higher than the LSA average personal income and $35,000 higher than the LSA average household income. Actual income would vary by position.
  - During Closure, some level of income opportunities would continue, though these would decrease relative to Operations.

Commitments made in Benefit Agreements and programs developed and implemented jointly between NexGen and the LSA communities, with involvement from other interested stakeholders where appropriate, could help enhance income opportunities for LSA residents.

- The Project would provide a substantial positive benefit through increased education and training opportunities for local residents.
- The Project would provide a positive benefit through expenditures for supplies and services leading to increased business and contracting opportunities throughout Construction, Operations, and Closure.
- The Project would provide a positive benefit to the ability to participate in the traditional economy. While wage employment may reduce activity in the traditional economy for some participants, the effects of increased wage income on the ability to purchase equipment and supplies, combined with employment policies that facilitate participation in the traditional economy is expected to result in a net positive benefit.

- The Project would generate benefits through payments to the governments of Saskatchewan and Canada through taxes and royalties; the total estimated direct payments to government for a typical operating year were estimated at $288.5 million for Saskatchewan and $103.9 million for Canada.
- In addition to payments to the provincial and federal governments, the Benefit Agreements include payments to Indigenous Groups based on revenue generated throughout the Project lifespan.

Mitigation, enhancement, and monitoring are proposed to sustainably maximize economic opportunities; these include (Section 18.4):

- Working with local communities to develop culturally sensitive employment policies including addressing potential barriers to employment.
- Providing a dedicated space for Elders to be available to support Indigenous employees.
- Using best efforts to provide qualified local residents with a first preference for employment and training opportunities to achieve a long-term aspirational target of 75% of the Project's workforce being composed of residents of the LSA.
- Operating training and recruitment programs for construction and mining-related skills targeted at employment opportunities for LSA residents and continue to provide scholarship and summer student opportunities.
- Prioritizing advancement for qualified local residents into increasingly senior positions.
- Setting a long-term aspirational target of 30% of the Project's external spend being awarded to LSA and RSA businesses.
- Working with local communities to establish and maintain a business registry for local businesses.

All adverse Project interactions identified were predicted to result in secondary pathways to the economy and hence anticipated to have minimal effect. The following is a summary of key findings for potential adverse effects of the Project on the LSA economy (Section 18.4.3):

- Project-related employment, income, and training opportunities would decrease during Closure. However, work experience and training obtained during Operations should result in a more experienced and qualified local labour force, which represents a residual benefit in the ability to obtain other employment and income opportunities.
- The transition from Operations to Closure would result in reductions in spending on supplies and services over time and decrease local business and contracting opportunities. However, the experience gained by local businesses could result in more experienced and diverse local businesses, which represents a residual benefit in the local economy.
- Employment and income opportunities created by the Project, particularly during Operations, may affect population in-migration and out-migration in the LSA and RSA. However, mitigation measures that would be implemented by the Project are considered to result in negligible residual effects on the economy, and sustainable in-migration from former residents could produce a net positive outcome for the LSA.

The economy is a major determinant in the overall well-being of individuals and communities. Employment, income, education and training, and business opportunities from the Project are substantially positive and are expected to make strong contributions to the economic development of the LSA communities and creation of a positive legacy.

18.9 References

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Appendix 18A Socio-Economic Statistical Data

List of Tables

Table18A-1a: Population of Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 1981 to 2016

Region	Population							
	1981	1986	1991	1996	2001	2006	2011	2016
LSA[(a,b,c)]	3,487	4,075	4,249	4,766	5,129	5,454	6,215	5,991
Northern Saskatchewan[(a,b,d)]	25,304	25,340	26,735	31,104	32,029	33,919	36,557	37,064
Saskatchewan[(a,b)]	968,313	1,009,613	988,928	990,237	978,933	968,157	1,033,381	1,098,352

Region	Average Annual Change in Population (%)[(e)]						
	1982 to 1986	1987 to 1991	1992 to 1996	1997 to 2001	2002 to 2006	2007 to 2011	2012 to 2016
LSA	3.2%	0.8%	2.3%	1.5%	1.2%	2.6%	-0.7%
Northern Saskatchewan	0.0%	1.1%	3.1%	0.6%	1.2%	1.5%	0.3%
Saskatchewan	0.8%	-0.4%	0.0%	-0.2%	-0.2%	1.3%	1.2%

Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake for 1981 to 2006.

d) North Saskatchewan is defined as Census Division No.18.

e) Average annual percentage population changes calculated by InterGroup Consultants Ltd.

LSA = local study area.

Table 18A-1b: Population of Local Study Area Communities, 1981 to 2016

Community	Population[a,b]							
	1981	1986	1991	1996	2001	2006	2011	2016
Bear Creek	n/d	n/d	n/d	n/d	n/d	n/d	55	33
Birch Narrows Dene Nation	137	104	224	302	338	413	419	476
Black Point	n/d	n/d	n/d	n/d	n/d	n/d	80	43
Buffalo Narrows	1,088	1,183	1,060	1,053	1,137	1,081	1,153	1,110
Buffalo River Dene Nation 193	312	423	423	539	607	741	764	783
Clearwater River Dene 222	0	301	455	548	584	658	778	822
Descharme Lake	n/d	n/d	n/d	n/d	n/d	n/d	10	5
Garson Lake	n/d	n/d	n/d	n/d	n/d	n/d	0	10
La Loche	1,632	1,623	1,691	1,966	2,136	2,348	2,611	2,372
Michel Village	130	110	87	75	70	79	66	57
St. George's Hill	115	112	124	85	102	19	100	131
Turnor Lake	73	219	185	198	155	115	179	149
LSA Total[c]	**3,487**	**4,075**	**4,249**	**4,766**	**5,129**	**5,454**	**6,215**	**5,991**

Community	Average Annual Change in Population (%)[d]						
	1982 to 1986	1987 to 1991	1992 to 1996	1997 to 2001	2002 to 2006	2007 to 2011	2012 to 2016
Bear Creek	n/d	n/d	n/d	n/d	n/d	n/d	-9.7%
Birch Narrows Dene Nation	-5.4%	16.6%	6.2%	2.3%	4.1%	0.3%	2.6%
Black Point	n/d	n/d	n/d	n/d	n/d	n/d	-11.7%
Buffalo Narrows	1.7%	-2.2%	-0.1%	1.5%	-1.0%	1.3%	-0.8%
Buffalo River Dene Nation 193	6.3%	0.0%	5.0%	2.4%	4.1%	0.6%	0.5%
Clearwater River Dene 222	n/d	8.6%	3.8%	1.3%	2.4%	3.4%	1.1%
Descharme Lake	n/d	n/d	n/d	n/d	n/d	n/d	-12.9%
Garson Lake	n/d	n/d	n/d	n/d	n/d	n/d	n/d
La Loche	-0.1%	0.8%	3.1%	1.7%	1.9%	2.1%	-1.9%
Michel Village	-3.3%	-4.6%	-2.9%	-1.4%	2.4%	-3.5%	-2.9%
St. George's Hill	-0.5%	2.1%	-7.3%	3.7%	-28.5%	39.4%	5.5%
Turnor Lake	24.6%	-3.3%	1.4%	-4.8%	-5.8%	9.3%	-3.6%
LSA Total[c]	**3.2%**	**0.8%**	**2.3%**	**1.5%**	**1.2%**	**2.6%**	**-0.7%**

Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake for 1981 to 2006.

d) Average annual percentage population changes calculated by InterGroup Consultants Ltd.

LSA = local study area; n/d = no data available.

Table 18A-2a: Population Distribution by Age Group for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016

Age Group	Population[a,b]			Age Group Proportions[e]		
	LSA[c]	Northern Saskatchewan (RSA)[d]	Saskatchewan	LSA	Northern Saskatchewan (RSA)	Saskatchewan
Total - Population in private households	**5,805**	**37,065**	**1,098,350**	**100.0%**	**100.0%**	**100.0%**
0 to 14 years	1,805	11,565	215,685	31.1%	31.2%	19.6%
15 to 24 years	1,030	6,550	137,720	17.7%	17.7%	12.5%
25 to 34 years	855	5,310	155,045	14.7%	14.3%	14.1%
35 to 44 years	660	4,005	136,540	11.4%	10.8%	12.4%
45 to 54 years	680	4,005	138,825	11.7%	10.8%	12.6%
55 to 64 years	430	3,115	144,110	7.4%	8.4%	13.1%
65 to 74 years	230	1,690	90,970	4.0%	4.6%	8.3%
75 years and over	120	835	79,455	2.1%	2.3%	7.2%

Source: Statistics Canada 2017a.
a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.
b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.
c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Descharme Lake, and Garson Lake.
d) Northern Saskatchewan (RSA) is defined as Census Division No.18.
e) Age group proportions calculated by InterGroup Consultants Ltd.
LSA = local study area; RSA = regional study area.

Table 18A-2b: Population Distribution by Age Group for Local Study Area Communities, 2016

Age Group	Population[a,b]								
	Birch Narrows Dene Nation - Turnor Lake 193B	Black Point	Buffalo Narrows	Buffalo River Dene Nation 193 (Peter Pond Lake 193)	Clearwater River Dene 222	La Loche	Michel Village	Turnor Lake	LSA Total[c]
Total - Population in private households	**475**	**45**	**1,110**	**785**	**820**	**2,370**	**55**	**145**	**5,805**
0 to 14 years	165	10	295	235	255	780	10	55	1,805
15 to 24 years	80	0	175	125	180	440	10	20	1,030
25 to 34 years	100	5	120	125	125	355	5	20	855
35 to 44 years	45	5	130	80	110	275	0	15	660
45 to 54 years	40	10	140	115	70	265	20	20	680
55 to 64 years	30	5	130	55	50	145	5	10	430
65 to 74 years	10	5	70	30	25	75	10	5	230
75 years and over	20	5	35	15	5	35	0	5	120
Age distribution[d]									
0 to 24	51.6%	n/c	42.3%	45.9%	53.0%	51.5%	n/c	n/c	n/c
25 to 54	38.9%	n/c	35.1%	40.8%	37.2%	37.8%	n/c	n/c	n/c
55+	12.6%	n/c	21.2%	12.7%	9.8%	10.8%	n/c	n/c	n/c

Source: Statistics Canada 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Descharme Lake, and Garson Lake.

d) Age distribution percentages calculated by InterGroup Consultants Ltd.

LSA = local study area, n/c = not calculated due to lack of data.

Table 18A-3a: Local Study Area Population Distribution by Age Group for 1986 through 2016

Age Group	Population in the LSA [a,b,c]						
	1986	1991	1996	2001	2006	2011	2016
Total - Population in private households	**4,075**	**4,240**	**4,765**	**5,125**	**5,445**	**5,885**	**5,805**
0 to 14 years	1,555	1,695	1,960	2,010	1,820	1,835	1,805
15 to 24 years	1,020	920	840	865	1,130	1,245	1,030
25 to 34 years	635	730	840	840	725	770	855
35 to 44 years	340	385	490	640	745	805	660
45 to 54 years	255	250	295	375	500	630	680
55 to 64 years	155	185	190	240	270	355	430
65 to 74 years	85	85	85	100	170	175	230
75 years and over	50	45	65	65	70	80	120

Age Group	Age Group Proportions in LSA [d]						
	1986	1991	1996	2001	2006	2011	2016
0 to 14 years	38.2%	40.0%	41.1%	39.2%	33.4%	31.2%	31.1%
15 to 24 years	25.0%	21.7%	17.6%	16.9%	20.8%	21.2%	17.7%
25 to 34 years	15.6%	17.2%	17.6%	16.4%	13.3%	13.1%	14.7%
35 to 44 years	8.3%	9.1%	10.3%	12.5%	13.7%	13.7%	11.4%
45 to 54 years	6.3%	5.9%	6.2%	7.3%	9.2%	10.7%	11.7%
55 to 64 years	3.8%	4.4%	4.0%	4.7%	5.0%	6.0%	7.4%
65 to 74 years	2.1%	2.0%	1.8%	2.0%	3.1%	3.0%	4.0%
75 years and over	1.2%	1.1%	1.4%	1.3%	1.3%	1.4%	2.1%

Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Descharme Lake, and Garson Lake for all Census years, Black Point for 1986 to 2011, St. George's Hill for 2006 and 2016, and Turnor Lake for 2011.

d) Age group proportions calculated by InterGroup Consultants Ltd.

LSA = local study area.

Table 18A-3b: Population Distribution by Age Group for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 1986 and 2016

Age Group	Number of Population					
	LSA[a,b,c]		Northern Saskatchewan (RSA)[a,b,d]		Saskatchewan[a,b]	
	1986	2016	1986	2016	1986	2016
Total - Population in private households	**4,075**	**5,805**	**25,340**	**37,065**	**1,009,610**	**1,098,350**
0 to 14 years	1,555	1,805	9,795	11,565	245,715	215,685
15 to 24 years	1,020	1,030	5,300	6,550	167,515	137,720
25 to 34 years	635	855	3,985	5,310	170,505	155,045
35 to 44 years	340	660	2,430	4,005	118,160	136,540
45 to 54 years	255	680	1,600	4,005	89,010	138,825
55 to 64 years	155	430	1,155	3,115	90,105	144,110
65 to 74 years	85	230	720	1,690	75,545	90,970
75 years and over	50	120	350	835	53,050	79,455

Age Group	Age Group Proportions[e]					
	LSA		Northern Saskatchewan (RSA)		Saskatchewan	
	1986	2016	1986	2016	1986	2016
0 to 14 years	38.2%	31.1%	38.7%	31.2%	24.3%	19.6%
15 to 24 years	25.0%	17.7%	20.9%	17.7%	16.6%	12.5%
25 to 34 years	15.6%	14.7%	15.7%	14.3%	16.9%	14.1%
35 to 44 years	8.3%	11.4%	9.6%	10.8%	11.7%	12.4%
45 to 54 years	6.3%	11.7%	6.3%	10.8%	8.8%	12.6%
55 to 64 years	3.8%	7.4%	4.6%	8.4%	8.9%	13.1%
65 to 74 years	2.1%	4.0%	2.8%	4.6%	7.5%	8.3%
75 years and over	1.2%	2.1%	1.4%	2.3%	5.3%	7.2%

Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake for 1986 and St. George's Hill for 2016.

d) Northern Saskatchewan (RSA) is defined as Census Division No.18.

e) Age group proportions calculated by InterGroup Consultants Ltd.

LSA = local study area; RSA = regional study area.

Table 18A-3c: Population Distribution by Age Group for Local Study Area Communities, 1986 and 2016

Number of Population[a,b]

Age Group	Birch Narrows Dene Nation		Black Point		Buffalo Narrows		Buffalo River Dene Nation 193		Clearwater River Dene 222		La Loche		Michel Village		St. George's Hill		Turnor Lake		LSA[c]	
	1986	2016	1986	2016	1986	2016	1986	2016	1986	2016	1986	2016	1986	2016	1986	2016	1986	2016	1986	2016
Total - Population in private households	**105**	**475**	**n/d**	**45**	**1,185**	**1,110**	**420**	**785**	**300**	**820**	**1,625**	**2,370**	**110**	**55**	**110**	**n/d**	**220**	**145**	**4,075**	**5,805**
0 to 14 years	40	165	n/d	10	410	295	145	235	135	255	665	780	40	10	35	n/d	85	55	1,555	1,805
15 to 24 years	25	80	n/d	0	235	175	130	125	80	180	420	440	30	10	45	n/d	55	20	1,020	1,030
25 to 34 years	10	100	n/d	5	245	120	55	125	35	125	245	355	10	5	10	n/d	25	20	635	855
35 to 44 years	10	45	n/d	5	115	130	25	80	25	110	120	275	5	0	10	n/d	30	15	340	660
45 to 54 years	10	40	n/d	10	85	140	25	115	25	70	80	265	10	20	5	n/d	15	20	255	680
55 to 64 years	10	30	n/d	5	50	130	20	55	10	50	60	145	5	5	0	n/d	0	10	155	430
65 to 74 years	0	10	n/d	5	35	70	15	30	0	25	30	75	5	10	0	n/d	0	5	85	230
75 years and over	0	20	n/d	5	20	35	10	15	0	5	15	35	0	0	0	n/d	5	5	50	120

Age Group Proportions[d]

Age Group	Birch Narrows Dene Nation		Black Point		Buffalo Narrows		Buffalo River Dene Nation 193		Clearwater River Dene 222		La Loche		Michel Village		St. George's Hill		Turnor Lake		LSA[c]	
	1986	2016	1986	2016	1986	2016	1986	2016	1986	2016	1986	2016	1986	2016	1986	2016	1986	2016	1986	2016
0 to 14 years	38.1%	34.7%	n/d	22.2%	34.6%	26.6%	34.5%	29.9%	45.0%	31.1%	40.9%	32.9%	36.4%	18.2%	31.8%	n/d	38.6%	37.9%	38.2%	31.1%
15 to 24 years	23.8%	16.8%	n/d	0.0%	19.8%	15.8%	31.0%	15.9%	26.7%	22.0%	25.8%	18.6%	27.3%	18.2%	40.9%	n/d	25.0%	13.8%	25.0%	17.7%
25 to 34 years	9.5%	21.1%	n/d	11.1%	20.7%	10.8%	13.1%	15.9%	11.7%	15.2%	15.1%	15.0%	9.1%	9.1%	9.1%	n/d	11.4%	13.8%	15.6%	14.7%
35 to 44 years	9.5%	9.5%	n/d	11.1%	9.7%	11.7%	6.0%	10.2%	8.3%	13.4%	7.4%	11.6%	4.5%	0.0%	9.1%	n/d	13.6%	10.3%	8.3%	11.4%
45 to 54 years	9.5%	8.4%	n/d	22.2%	7.2%	12.6%	6.0%	14.6%	8.3%	8.5%	4.9%	11.2%	9.1%	36.4%	4.5%	n/d	6.8%	13.8%	6.3%	11.7%
55 to 64 years	9.5%	6.3%	n/d	11.1%	4.2%	11.7%	4.8%	7.0%	3.3%	6.1%	3.7%	6.1%	4.5%	9.1%	0.0%	n/d	0.0%	6.9%	3.8%	7.4%
65 to 74 years	0.0%	2.1%	n/d	11.1%	3.0%	6.3%	3.6%	3.8%	0.0%	3.0%	1.8%	3.2%	4.5%	18.2%	0.0%	n/d	0.0%	3.4%	2.1%	4.0%
75 years and over	0.0%	4.2%	n/d	11.1%	1.7%	3.2%	2.4%	1.9%	0.0%	0.6%	0.9%	1.5%	0.0%	0.0%	0.0%	n/d	2.3%	3.4%	1.2%	2.1%

Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake for 1986 and St. George's Hill for 2016.

d) Age group proportions calculated by InterGroup Consultants Ltd.

LSA = local study area, n/d = no data or guideline available.

Table 18A-4: Local Study Area and La Loche Population Change from 2011 to 2016

Age Group	La Loche			LSA[a,b,c]		
	2011	2016	Change	2011	2016	Change
Total - Population in private households	**2,610**	**2,370**	**(240)**	**5,885**	**5,805**	**(80)**
0 to 49 years	2,295	1,985	(310)	5,015	4,690	(325)
50 years and over	310	385	75	880	1,115	235

Source: Statistics Canada 2012, 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, Garson Lake, and Turnor Lake for 2011, for Bear Creek, Descharme Lake, Garson Lake, and St. George's Hill for 2016.

LSA = local study area; (#) = negative change.

Table 18A-5a: Population Age Structure by Sex, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016

Age Group[e]	LSA[a,b,c]					Northern Saskatchewan (RSA)[a,b,d]					Saskatchewan[a,b]				
	Total	Male – LSA	Female – LSA	% Male	% Female	Total	Male – RSA	Female – RSA	% Male	% Female	Total	Male – SK	Female – SK	% Male	% Female
Total Population	**5,775**	**2,810**	**2,955**	**n/c**	**n/c**	**37,065**	**18,640**	**18,425**	**n/c**	**n/c**	**1,098,355**	**545,785**	**552,565**	**n/c**	**n/c**
0 to 4 years	615	325	285	-5.63	4.94	3,850	1,960	1,890	-5.29	5.10	73,130	37,335	35,795	-3.40	3.26
5 to 9 years	680	355	305	-6.15	5.28	4,165	2,165	1,995	-5.84	5.38	74,460	38,150	36,305	-3.47	3.31
10 to 14 years	510	250	265	-4.33	4.59	3,555	1,785	1,775	-4.82	4.79	68,095	34,920	33,175	-3.18	3.02
15 to 19 years	525	285	245	-4.94	4.24	3,345	1,725	1,610	-4.65	4.34	67,655	34,680	32,980	-3.16	3.00
20 to 24 years	510	255	250	-4.42	4.33	3,210	1,635	1,575	-4.41	4.25	70,060	36,070	33,990	-3.28	3.09
25 to 29 years	510	230	270	-3.98	4.68	2,900	1,425	1,475	-3.84	3.98	77,525	39,290	38,235	-3.58	3.48
30 to 34 years	355	150	210	-2.60	3.64	2,410	1,140	1,270	-3.08	3.43	77,520	38,610	38,915	-3.52	3.54
35 to 39 years	300	155	155	-2.68	2.68	2,005	990	1,015	-2.67	2.74	71,590	35,940	35,650	-3.27	3.25
40 to 44 years	340	160	200	-2.77	3.46	2,000	960	1,040	-2.59	2.81	64,950	32,510	32,440	-2.96	2.95
45 to 49 years	335	145	190	-2.51	3.29	1,965	950	1,010	-2.56	2.72	63,575	31,780	31,795	-2.89	2.89
50 to 54 years	350	160	185	-2.77	3.20	2,040	985	1,050	-2.66	2.83	75,245	37,230	38,015	-3.39	3.46
55 to 59 years	250	120	135	-2.08	2.34	1,750	890	860	-2.40	2.32	76,195	38,070	38,130	-3.47	3.47
60 to 64 years	170	95	65	-1.65	1.13	1,365	685	675	-1.85	1.82	67,915	33,935	33,985	-3.09	3.09
65 to 69 years	150	70	75	-1.21	1.30	1,060	585	480	-1.58	1.30	53,230	26,285	26,945	-2.39	2.45
70 to 74 years	90	40	40	-0.69	0.69	630	325	305	-0.88	0.82	37,740	18,225	19,510	-1.66	1.78
75 to 79 years	60	30	20	-0.52	0.35	425	225	200	-0.61	0.54	29,400	13,410	15,985	-1.22	1.46
80 to 84 years	30	15	15	-0.26	0.26	250	125	120	-0.34	0.32	23,120	9,950	13,170	-0.91	1.20
85 to 89 years	10	5	15	-0.09	0.26	110	60	55	-0.16	0.15	16,280	6,305	9,975	-0.57	0.91
90 to 94 years	0	0	5	0.00	0.09	40	20	25	-0.05	0.07	8,005	2,510	5,485	-0.23	0.50
95 to 99 years	0	0	0	0.00	0.00	0	0	0	0.00	0.00	2,290	525	1,760	-0.05	0.16
100 years +	0	0	0	0.00	0.00	5	0	0	0.00	0.00	370	50	325	0.00	0.03

Source: Statistics Canada 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, Garson Lake, and St. George's Hill.

d) Northern Saskatchewan (RSA) is defined as Census Division No.18.

e) Male and female proportions by age groups calculated by InterGroup Consultants Ltd.

LSA = local study area; RSA = regional study area; SK = Saskatchewan; n/c = not calculated.

Table 18A-5b: Proportion of Population by Sex, Average and Median Ages of Population, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016

Metric[e]	Birch Narrows Dene Nation[a,b]	Black Point[a,b]	Buffalo Narrows[a,b]	Buffalo River Dene Nation 193[a,b]	Clearwater River Dene 222[a,b]	La Loche[a,b]	Michel Village[a,b]	Turnor Lake[a,b]	LSA[a,b,c]	Northern Saskatchewan (RSA) [a,b,d]	Saskatchewan [a,b]
Total - Age groups and average age of the population - 100% data	**475**	**45**	**1,110**	**785**	**820**	**2,370**	**55**	**145**	**5,805**	**37,065**	**1,098,350**
Male	225	20	560	390	415	1,135	20	70	2,835	18,640	545,785
Female	255	20	550	390	410	1,235	30	85	2,975	18,425	552,565
Proportions by sex											
Male	47.4%	44.4%	50.5%	49.7%	50.6%	47.9%	36.4%	48.3%	48.8%	50.3%	49.7%
Female	53.7%	44.4%	49.5%	49.7%	50.0%	52.1%	54.5%	58.6%	51.2%	49.7%	50.3%
Average age of the population	**27.8**	**38.1**	**34.0**	**29.7**	**27.1**	**27.6**	**38.8**	**27.2**	**29.2**	**29.7**	**39.1**
Male	28.0	39.0	33.1	30.5	26.7	26.5	44.2	23.8	28.6	29.6	38.2
Female	27.7	37.2	35.0	29.0	27.5	28.5	34.8	30.0	29.7	29.9	40.0
Median age of the population	**24.6**	**39.8**	**30.8**	**26.8**	**23.8**	**24.0**	**40.8**	**23.4**	**n/c**	**25.7**	**37.8**
Male	23.4	39.8	29.4	27.6	23.1	21.8	50.0	21.3	n/c	25.1	36.9
Female	25.4	38.5	33.3	26.2	24.1	26.3	31.8	23.9	n/c	26.2	38.7

Source: Statistics Canada 2017a.
a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.
b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.
c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Descharme Lake, Garson Lake, and St. George's Hill.
d) Northern Saskatchewan (RSA) is defined as Census Division No.18.
e) Proportions by sex calculated by InterGroup Consultants Ltd.
LSA = local study area; RSA = regional study area; n/c = not calculated.

Table 18A-6a: Proportion of Population Identifying as Indigenous, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016

Age Group[e]	LSA[a,b,c]									Northern Saskatchewan (RSA)[a,b,d]									Saskatchewan[a,b]								
	Total			Indigenous Identity			Non-Indigenous Identity			Total			Indigenous Identity			Non-Indigenous Identity			Total			Indigenous Identity			Non-Indigenous Identity		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total - Population in private households - 25% sample data	**5,820**	**2,840**	**3,050**	**5,565**	**2,700**	**2,915**	**255**	**130**	**135**	**36,850**	**18,515**	**18,335**	**32,205**	**16,035**	**16,165**	**4,650**	**2,480**	**2,165**	**1,070,560**	**533,385**	**537,170**	**175,020**	**84,730**	**90,290**	**895,535**	**448,655**	**446,885**
0 to 14 years	1,800	940	890	1,785	915	875	30	10	10	11,555	5,900	5,650	10,955	5,615	5,345	600	290	310	213,260	109,120	104,140	57,690	29,085	28,605	155,570	80,035	75,540
15 to 24 years	1,015	535	490	1,015	520	500	20	n/d	10	6,435	3,305	3,135	6,000	3,060	2,935	440	240	200	135,065	68,855	66,205	31,810	15,900	15,910	103,250	52,960	50,295
25 to 34 years	890	395	505	805	365	455	90	50	50	5,385	2,575	2,810	4,670	2,225	2,440	715	350	370	152,675	76,695	75,975	25,630	11,820	13,805	127,045	64,875	62,170
35 to 44 years	635	280	345	595	275	320	60	10	25	3,915	1,920	1,995	3,325	1,600	1,725	590	315	270	134,695	67,290	67,405	19,770	9,065	10,705	114,925	58,230	56,695
45 to 54 years	740	305	430	700	275	410	35	20	30	4,045	1,935	2,115	3,385	1,605	1,780	665	325	340	136,815	67,860	68,955	18,535	8,600	9,935	118,270	59,265	59,010
55 to 64 years	390	215	190	350	200	175	10	25	10	3,055	1,560	1,490	2,180	1,070	1,105	875	495	385	142,065	70,665	71,405	13,005	6,235	6,770	129,060	64,430	64,630
65 years and over	380	200	180	340	165	185	35	35	10	2,460	1,315	1,145	1,695	855	840	765	460	305	155,985	72,895	83,095	8,580	4,025	4,550	147,410	68,865	78,545
Proportion																											
0 to 14 years	31%	33%	29%	32%	34%	30%	12%	8%	7%	31%	32%	31%	34%	35%	33%	13%	12%	14%	20%	20%	19%	33%	34%	32%	17%	18%	17%
15 to 24 years	17%	19%	16%	18%	19%	17%	8%	0%	7%	17%	18%	17%	19%	19%	18%	9%	10%	9%	13%	13%	12%	18%	19%	18%	12%	12%	11%
25 to 34 years	15%	14%	17%	14%	14%	16%	35%	38%	37%	15%	14%	15%	15%	14%	15%	15%	14%	17%	14%	14%	14%	15%	14%	15%	14%	14%	14%
35 to 44 years	11%	10%	11%	11%	10%	11%	24%	8%	19%	11%	10%	11%	10%	10%	11%	13%	13%	12%	13%	13%	13%	11%	11%	12%	13%	13%	13%
45 to 54 years	13%	11%	14%	13%	10%	14%	14%	15%	22%	11%	10%	12%	11%	10%	11%	14%	13%	16%	13%	13%	13%	11%	10%	11%	13%	13%	13%
55 to 64 years	7%	8%	6%	6%	7%	6%	4%	19%	7%	8%	8%	8%	7%	7%	7%	19%	20%	18%	13%	13%	13%	7%	7%	7%	14%	14%	14%
65 years and over	7%	7%	6%	6%	6%	6%	14%	27%	7%	7%	7%	6%	5%	5%	5%	16%	19%	14%	15%	14%	15%	5%	5%	5%	16%	15%	18%

Source: Statistics Canada 2017a.
a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.
b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.
c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake.
d) Northern Saskatchewan (RSA) is defined as Census Division No.18.
e) Proportions by age groups calculated by InterGroup Consultants Ltd.
LSA = local study area; RSA = regional study area; n/d = no data available.

Table 18A-6b: Proportion of Population Identifying as Indigenous, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016

Metric	LSA[a,b,c]									Northern Saskatchewan (RSA)[a,b,d]									Saskatchewan[a,b]								
	Total Identity[e]	Aboriginal Identity, total[f]	Single Aboriginal Responses, total[g]	First Nations[h]	Métis	Inuk (Inuit)	Multiple Aboriginal Responses[i]	Aboriginal Responses NIE[g]	Non-Aboriginal Identity	Total Identity[e]	Aboriginal Identity, total[f]	Single Aboriginal Responses, total[j]	First Nations[h]	Métis	Inuk (Inuit)	Multiple Aboriginal Responses[i]	Aboriginal Responses NIE[g]	Non-Aboriginal Identity	Total Identity[e]	Aboriginal Identity, total[f]	Single Aboriginal Responses, total[g]	First Nations[h]	Métis	Inuk (Inuit)	Multiple Aboriginal Responses[i]	Aboriginal Responses NIE[g]	Non-Aboriginal Identity
Population																											
Total - both sex	**5,820**	**5,565**	**5,550**	**3,430**	**2,120**	**0**	**20**	**0**	**255**	**36,850**	**32,205**	**32,010**	**25,575**	**6,435**	**10**	**135**	**50**	**4,650**	**1,070,560**	**175,020**	**172,810**	**114,565**	**57,880**	**360**	**1,300**	**905**	**895,535**
Male	2,840	2,700	2,710	1,720	995	0	10	0	130	18,515	16,035	15,945	12,730	3,215	10	60	25	2,480	533,385	84,730	83,750	55,275	28,330	150	600	380	448,655
Female	2,985	2,850	2,850	1,710	1,125	0	n/d	0	135	18,335	16,165	16,065	12,845	3,220	0	70	30	2,165	537,170	90,290	89,055	59,290	29,555	215	705	530	446,885
Ratio in Total Population[k]																											
Total - both sex	**100.0%**	**95.6%**	**95.4%**	**58.9%**	**36.4%**	**0.0%**	**0.3%**	**0.0%**	**4.4%**	**100.0%**	**87.4%**	**86.9%**	**69.4%**	**17.5%**	**0.0%**	**0.4%**	**0.1%**	**12.6%**	**100.0%**	**16.3%**	**16.1%**	**10.7%**	**5.4%**	**0.0%**	**0.1%**	**0.1%**	**83.7%**
Male	100.0%	95.1%	95.4%	60.6%	35.0%	0.0%	0.4%	0.0%	4.6%	100.0%	86.6%	86.1%	68.8%	17.4%	0.1%	0.3%	0.1%	13.4%	100.0%	15.9%	15.7%	10.4%	5.3%	0.0%	0.1%	0.1%	84.1%
Female	100.0%	95.5%	95.5%	57.3%	37.7%	0.0%	0.0%	0.0%	4.5%	100.0%	88.2%	87.6%	70.1%	17.6%	0.0%	0.4%	0.2%	11.8%	100.0%	16.8%	16.6%	11.0%	5.5%	0.0%	0.1%	0.1%	83.2%
Ratio in Total Aboriginal Identity[k]																											
Total - both sex	**n/c**	**100.0%**	**99.7%**	**61.6%**	**38.1%**	**0.0%**	**0.4%**	**0.0%**	**n/c**	**n/c**	**100.0%**	**99.4%**	**79.4%**	**20.0%**	**0.0%**	**0.4%**	**0.2%**	**n/c**	**n/c**	**100.0%**	**98.7%**	**65.5%**	**33.1%**	**0.2%**	**0.7%**	**0.5%**	**n/c**
Male	n/c	100.0%	100.4%	63.7%	36.9%	0.0%	0.4%	0.0%	n/c	n/c	100.0%	99.4%	79.4%	20.0%	0.1%	0.4%	0.2%	n/c	n/c	100.0%	98.8%	65.2%	33.4%	0.2%	0.7%	0.4%	n/c
Female	n/c	100.0%	100.0%	60.0%	39.5%	0.0%	0.0%	0.0%	n/c	n/c	100.0%	99.4%	79.5%	19.9%	0.0%	0.4%	0.2%	n/c	n/c	100.0%	98.6%	65.7%	32.7%	0.2%	0.8%	0.6%	n/c

Source: Statistics Canada 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake.

d) Northern Saskatchewan (RSA) is defined as Census Division No.18.

e) Users should be aware that the estimates associated with this variable are more affected than most by the incomplete enumeration of certain Indian reserves and Indian settlements in the 2016 Census of Population. For more information on Aboriginal variables including information on their classifications the questions from which they are derived data quality and their comparability with other sources of data refer to the Aboriginal Peoples Reference Guide Census of Population 2016 (Statistics Canada 2017c) and the Aboriginal Peoples Technical Report Census of Population 2016 (Statistics Canada 2019a).

f) 'Aboriginal identity' includes persons who are First Nations (North American Indian) Métis or Inuk (Inuit) and/or those who are Registered or Treaty Indians (that is registered under the Indian Act of Canada) and/or those who have membership in a First Nation or Indian band. Aboriginal peoples of Canada are defined in the *Constitution Act 1982* section 35 (2) as including the Indian Inuit and Métis peoples of Canada (Statistics Canada 2017c).

g) 'Single Aboriginal responses' includes persons who are in only one Aboriginal group that is First Nations (North American Indian) Métis or Inuk (Inuit).

h) Users should be aware that the estimates associated with this variable are more affected than most by the incomplete enumeration of certain Indian reserves and Indian settlements in the 2016 Census of Population (Statistics Canada 2017a). For additional information refer to the Aboriginal Peoples Reference Guide Census of Population 2016 (Statistics Canada 2017c).

i) 'Multiple Aboriginal responses' includes persons who are any two or all three of the following: First Nations (North American Indian) Métis or Inuk (Inuit).

j) 'Aboriginal responses not included elsewhere' includes persons who are not First Nations (North American Indian) Métis or Inuk (Inuit) but who have Registered or Treaty Indian status and/or Membership in a First Nation or Indian band.

k) Ratios in total population and total Aboriginal identity, including by sex, calculated by InterGroup Consultants Ltd.

LSA = local study area; RSA = regional study area; n/c = not calculated.

Table 18A-6c: Proportion of Population Identifying as Indigenous, for Local Study Area Communities, 2016

Identity	Birch Narrows Dene Nation[(a,b)]	Buffalo Narrows[(a,b)]	Buffalo River Dene Nation 193[(a,b)]	Clearwater River Dene 222[(a,b)]	La Loche[(a,b)]	Michel Village[(a,b)]	St. George's Hill[(a,b)]	Turnor Lake[(a,b)]	LSA Total[(c)]
Total identity[(d)]	**475**	**1,040**	**780**	**820**	**2,365**	**60**	**130**	**150**	**5,820**
Aboriginal identity[(e)]	460	910	770	810	2,280	60	130	145	**5,565**
Single Aboriginal responses[(f)]	465	905	770	810	2,280	55	120	145	**5,550**
First Nations[(g)]	440	180	755	780	1,095	20	100	60	**3,430**
Métis	20	730	10	30	1,185	35	20	90	**2,120**
Inuk (Inuit)	0	0	0	0	0	0	0	0	**0**
Multiple Aboriginal responses[(h)]	0	0	0	0	10	0	10	0	**20**
Aboriginal responses not included elsewhere[(i)]	0	0	0	0	0	0	0	0	**0**
Non-Aboriginal identity	15	135	10	10	85	0	0	0	**255**
Proportions of Aboriginal and Non-Aboriginal identity[(j)]									
Aboriginal identity	96.8%	87.5%	98.7%	98.8%	96.4%	100.0%	100.0%	96.7%	95.6%
Non-Aboriginal identity	3.2%	13.0%	1.3%	1.2%	3.6%	0.0%	0.0%	0.0%	4.4%
Proportions of Aboriginal identity groups[(j)]									
Single Aboriginal responses	101.1%	99.5%	100.0%	100.0%	100.0%	91.7%	92.3%	100.0%	99.7%
First Nations	95.7%	19.8%	98.1%	96.3%	48.0%	33.3%	76.9%	41.4%	61.6%
Métis	4.3%	80.2%	1.3%	3.7%	52.0%	58.3%	15.4%	62.1%	38.1%
Inuk (Inuit)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Multiple Aboriginal responses	0.0%	0.0%	0.0%	0.0%	0.4%	0.0%	7.7%	0.0%	0.4%
Aboriginal responses not included elsewhere	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Source: Statistics Canada 2017a.
a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.
b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.
c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake.
d) Users should be aware that the estimates associated with this variable are more affected than most by the incomplete enumeration of certain Indian reserves and Indian settlements in the 2016 Census of Population. For more information on Aboriginal variables including information on their classifications the questions from which they are derived data quality and their comparability with other sources of data refer to the Aboriginal Peoples Reference Guide Census of Population 2016 (Statistics Canada 2017c) and the Aboriginal Peoples Technical Report Census of Population 2016 (Statistics Canada 2019a).
e) 'Aboriginal identity' includes persons who are First Nations (North American Indian) Métis or Inuk (Inuit) and/or those who are Registered or Treaty Indians (that is registered under the *Indian Act* of Canada) and/or those who have membership in a First Nation or Indian band. Aboriginal peoples of Canada are defined in the *Constitution Act, 1982* section 35 (2) as including the Indian Inuit and Métis peoples of Canada.
f) 'Single Aboriginal responses' includes persons who are in only one Aboriginal group that is First Nations (North American Indian) Métis or Inuk (Inuit).
g) Users should be aware that the estimates associated with this variable are more affected than most by the incomplete enumeration of certain Indian reserves and Indian settlements in the 2016 Census of Population. For additional information refer to the Aboriginal Peoples Reference Guide Census of Population 2016 (Statistics Canada 2017c).
h) 'Multiple Aboriginal responses' includes persons who are any two or all three of the following: First Nations (North American Indian) Métis or Inuk (Inuit).
i) 'Aboriginal responses not included elsewhere' includes persons who are not First Nations (North American Indian) Métis or Inuk (Inuit) but who have Registered or Treaty Indian status and/or Membership in a First Nation or Indian band.
j) Proportions of Aboriginal and non-Aboriginal identity, and proportions of Aboriginal identity groups calculated by InterGroup Consultants Ltd.
LSA = local study area.

Table 18A-7: Local Study Area First Nation Communities Registered Population as of June, 2021

Residency	Number of People				Ratio in Total			
	Clearwater River Dene	Buffalo River Dene Nation	Birch Narrows First Nation	Total	Clearwater River Dene	Buffalo River Dene Nation	Birch Narrows First Nation	Total
Registered on own reserve	1,049	794	448	**2,291**	38.0%	51.7%	51.5%	**44.3%**
Registered on other reserves	39	46	42	**127**	1.4%	3.0%	4.8%	**2.5%**
Registered on own Crown Land	0	0	0	**0**	0.0%	0.0%	0.0%	**0.0%**
Registered on other band Crown Land	0	0	0	**0**	0.0%	0.0%	0.0%	**0.0%**
Registered on no band Crown Land	7	0	0	**7**	0.3%	0.0%	0.0%	**0.1%**
Registered off reserve	1,669	696	380	**2,745**	60.4%	45.3%	43.7%	**53.1%**
Total registered population	**2,764**	**1,536**	**870**	**5,170**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: INAC 2021.
Note: Ratios in total calculated by InterGroup Consultants Ltd.

Table 18A-8: Persons Who Were Eligible for Saskatchewan Health Insurance Benefits

Community	Health Coverage Report							Health Coverage Report Region
	2015	2016	2017	2018	2019	2020	2021	
Buffalo Narrows	1,421	1,443	1,428	1,374	1,369	1,426	1,379	Keewatin Yatthé
Clearwater River Dene Band Indian Reserve	661	716	733	765	796	806	830	Keewatin Yatthé
Dillon (for Buffalo River Dene Nation 193 [Peter Pond Lake 193])	958	986	994	995	1,022	1,022	1,027	Keewatin Yatthé
La Loche	3,270	3,302	3,308	3,176	3,270	3,359	3,289	Keewatin Yatthé
Turnor Lake	676	688	695	682	688	690	713	Keewatin Yatthé
Total	**6,986**	**7,135**	**7,158**	**6,992**	**7,145**	**7,303**	**7,238**	

Source: eHealthSaskatchewan n.d.
Note: The Saskatchewan Health Coverage Report is a count of persons who were eligible for Saskatchewan health insurance benefits as of 30 June of the year. The Saskatchewan Health Coverage Report is not a population census and should not be used as such. Coverage for an individual begins on the first day of the third month following their arrival to Saskatchewan. Residents with at least one day of coverage in the month of June are counted. Residents leaving the province remain eligible for coverage for this same period. In the case of death, people who had coverage any time in June are included. Coverage is available to residents temporarily living outside of the province (i.e., students, contract employees). For these cases, addresses from outside of Saskatchewan are acceptable. In the event that only the out-of-province address is available, the person is counted in the Out-of-Province category. In previous years, individuals were distributed into residence codes based on the address hierarchy explained above. Reporting starting in 2010 will now present distribution based on the community locations provided by Person Health Registration System. The correspondence address is the only address that is mandatory for collection in Person Health Registration System. In cases where the correspondence address is different from the residence, this may result in inaccuracies in the distribution. This appendix table was included to provide an information on population from a different source to see if the population change has similar trend with Statistics Canada data.

Table 18A-9a: Proportion of Population who are Migrants within 1-year and 5-years, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016

Metric	LSA[a,b,c]			Northern Saskatchewan (RSA)[a,b,d]			Saskatchewan[a,b]		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total - Mobility status 1 year ago - 25% sample data[e]	**5,755**	**2,800**	**2,950**	**36,110**	**18,140**	**17,970**	**1,055,820**	**525,975**	**529,850**
Non-movers	5,280	2,565	2,705	32,390	16,310	16,080	905,630	451,665	453,965
Movers	475	230	245	3,720	1,825	1,885	150,195	74,310	75,880
Non-migrants	345	180	170	2,415	1,160	1,260	89,005	43,990	45,015
Migrants	130	85	60	1,305	670	630	61,185	30,320	30,865
Internal migrants	150	55	70	1,275	660	620	49,930	24,855	25,075
Intraprovincial migrants	95	55	75	1,040	525	520	35,965	17,690	18,275
Interprovincial migrants	30	20	10	235	135	105	13,970	7,165	6,805
External migrants	0	0	0	25	15	15	11,255	5,465	5,790
Proportion[g]									
Non-movers	91.7%	91.6%	91.7%	89.7%	89.9%	89.5%	85.8%	85.9%	85.7%
Movers	8.3%	8.2%	8.3%	10.3%	10.1%	10.5%	14.2%	14.1%	14.3%
Non-migrants	6.0%	6.4%	5.8%	6.7%	6.4%	7.0%	8.4%	8.4%	8.5%
Migrants	2.3%	3.0%	2.0%	3.6%	3.7%	3.5%	5.8%	5.8%	5.8%
Internal migrants	2.6%	2.0%	2.4%	3.5%	3.6%	3.5%	4.7%	4.7%	4.7%
Intraprovincial migrants	1.7%	2.0%	2.5%	2.9%	2.9%	2.9%	3.4%	3.4%	3.4%
Interprovincial migrants	0.5%	0.7%	0.3%	0.7%	0.7%	0.6%	1.3%	1.4%	1.3%
External migrants	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	1.1%	1.0%	1.1%
Total - Mobility status 5 years ago - 25% sample data[f]	**5,255**	**2,545**	**2,710**	**32,915**	**16,490**	**16,430**	**998,200**	**496,505**	**501,695**
Non-movers	3,880	1,885	1,985	23,980	12,180	11,800	602,890	300,715	302,175
Movers	1,380	650	745	8,940	4,315	4,630	395,310	195,790	199,520
Non-migrants	975	460	510	5,700	2,760	2,935	201,450	99,955	101,495
Migrants	415	195	220	3,245	1,550	1,690	193,860	95,835	98,025
Internal migrants	410	190	240	3,130	1,490	1,645	147,360	72,815	74,540
Intraprovincial migrants	295	135	170	2,375	1,085	1,295	98,780	47,825	50,950
Interprovincial migrants	85	55	50	755	405	350	48,585	24,995	23,590
External migrants	20	20	20	115	65	50	46,500	23,015	23,485
Proportion[g]									
Non-movers	73.8%	74.1%	73.2%	72.9%	73.9%	71.8%	60.4%	60.6%	60.2%
Movers	26.3%	25.5%	27.5%	27.2%	26.2%	28.2%	39.6%	39.4%	39.8%
Non-migrants	18.6%	18.1%	18.8%	17.3%	16.7%	17.9%	20.2%	20.1%	20.2%
Migrants	7.9%	7.7%	8.1%	9.9%	9.4%	10.3%	19.4%	19.3%	19.5%
Internal migrants	7.8%	7.5%	8.9%	9.5%	9.0%	10.0%	14.8%	14.7%	14.9%
Intraprovincial migrants	5.6%	5.3%	6.3%	7.2%	6.6%	7.9%	9.9%	9.6%	10.2%
Interprovincial migrants	1.6%	2.2%	1.8%	2.3%	2.5%	2.1%	4.9%	5.0%	4.7%
External migrants	0.4%	0.8%	0.7%	0.3%	0.4%	0.3%	4.7%	4.6%	4.7%

Source: Statistics Canada 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Descharme Lake, and Garson Lake.

d) Northern Saskatchewan (RSA) is defined as Census Division No.18.

e) Refers to the status of a person with regard to the place of residence on the reference day 10 May 2016 in relation to the place of residence on the same date one year earlier at the provincial level. Persons who have not moved are referred to as non-movers and persons who have moved from one residence to another are referred to as movers. Movers include non-migrants and migrants. Non-migrants are persons who did move but remained in the same city town township village or Indian reserve. Migrants include internal migrants who moved to a different city town township village or Indian reserve within Canada. External migrants include persons who lived outside Canada at the earlier reference date.

f) Refers to the status of a person with regard to the place of residence on the reference day 10 May 2016 in relation to the place of residence on the same date five years earlier at the provincial level. Persons who have not moved are referred to as non-movers and persons who have moved from one residence to another are referred to as movers. Movers include non-migrants and migrants. Non-migrants are persons who did move but remained in the same city town township village or Indian reserve. Migrants include internal migrants who moved to a different city town township village or Indian reserve within Canada. External migrants include persons who lived outside Canada at the earlier reference date.

g) Proportions of mobility status by groups calculated by InterGroup Consultants Ltd.

LSA = local study area; RSA = regional study area.

Table 18A-9b: Proportion of Population who are Migrants within 1-year and 5-years, for Local Study Area Communities, 2016

Community	1 Year Ago(a,b,c)			5 Years Ago(a,b,d)		
	Total	Migrants	%	Total	Migrants	%
Birch Narrows Dene Nation	465	15	3.2%	420	55	13.1%
Black Point	40	10	25.0%	40	10	25.0%
Buffalo Narrows	1,040	45	4.3%	955	120	12.6%
Buffalo River Dene Nation 193	760	10	1.3%	710	55	7.7%
Clearwater River Dene 222	805	15	1.9%	730	50	6.8%
La Loche	2,315	25	1.1%	2,090	80	3.8%
Michel Village	60	0	0.0%	55	0	0.0%
St. George’s Hill	125	0	0.0%	120	20	16.7%
Turnor Lake	145	10	6.9%	135	25	18.5%
LSA Total(e)	**5,755**	**130**	**2.3%**	**5,255**	**415**	**7.9%**

Source: Statistics Canada 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) Refers to the status of a person with regard to the place of residence on the reference day 10 May 2016 in relation to the place of residence on the same date one year earlier at the provincial level. Persons who have not moved are referred to as non-movers and persons who have moved from one residence to another are referred to as movers. Movers include non-migrants and migrants. Non-migrants are persons who did move but remained in the same city town township village or Indian reserve. Migrants include internal migrants who moved to a different city town township village or Indian reserve within Canada. External migrants include persons who lived outside Canada at the earlier reference date.

d) Refers to the status of a person with regard to the place of residence on the reference day 10 May 2016 in relation to the place of residence on the same date five years earlier at the provincial level. Persons who have not moved are referred to as non-movers and persons who have moved from one residence to another are referred to as movers. Movers include non-migrants and migrants. Non-migrants are persons who did move but remained in the same city town township village or Indian reserve. Migrants include internal migrants who moved to a different city town township village or Indian reserve within Canada. External migrants include persons who lived outside Canada at the earlier reference date.

e) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George’s Hill, and Turnor Lake. However, data are not available for Bear Creek, Descharme Lake, and Garson Lake.

LSA = local study area.

Table 18A-10a: Population Projection for Saskatchewan Keewatin Yatthé Regional Health Authority for 2018 to 2049

Years	Projection[a]								
	Low Growth	Medium Growth M1[b]	Medium Growth M2[b]	Medium Growth M3[b]	Medium Growth M4[b]	Medium Growth M5[b]	High Growth	Slow Aging	Fast Aging
2018	11,139	11,139	11,139	11,139	11,139	11,139	11,139	11,139	11,139
2019	11,139	11,148	11,144	11,149	11,166	11,154	11,158	11,154	11,143
2020	11,132	11,154	11,147	11,154	11,189	11,166	11,177	11,167	11,141
2021	11,120	11,158	11,146	11,158	11,210	11,175	11,196	11,180	11,135
2022	11,103	11,159	11,143	11,158	11,229	11,183	11,215	11,192	11,126
2023	11,082	11,159	11,139	11,157	11,246	11,190	11,235	11,203	11,114
2024	11,057	11,156	11,132	11,153	11,260	11,194	11,253	11,212	11,098
2025	11,028	11,151	11,123	11,147	11,271	11,196	11,271	11,220	11,079
2026	10,998	11,145	11,114	11,140	11,282	11,198	11,290	11,228	11,060
2027	10,965	11,138	11,103	11,131	11,291	11,198	11,308	11,234	11,038
2028	10,929	11,129	11,091	11,121	11,298	11,197	11,326	11,241	11,014
2029	10,892	11,120	11,078	11,110	11,304	11,195	11,345	11,247	10,989
2030	10,855	11,111	11,065	11,099	11,310	11,194	11,364	11,254	10,964
2031	10,816	11,103	11,053	11,088	11,316	11,193	11,385	11,261	10,939
2032	10,778	11,095	11,041	11,077	11,322	11,193	11,407	11,270	10,913
2033	10,739	11,086	11,029	11,066	11,329	11,193	11,430	11,280	10,887
2034	10,700	11,079	11,018	11,055	11,335	11,194	11,455	11,291	10,861
2035	10,660	11,071	11,007	11,044	11,341	11,194	11,480	11,303	10,834
2036	10,619	11,064	10,996	11,033	11,347	11,195	11,506	11,316	10,806
2037	10,579	11,057	10,985	11,022	11,353	11,196	11,534	11,331	10,777
2038	10,537	11,049	10,975	11,011	11,358	11,196	11,562	11,347	10,747
2039	10,496	11,043	10,964	11,000	11,364	11,197	11,592	11,365	10,717
2040	10,454	11,037	10,955	10,990	11,370	11,199	11,624	11,386	10,685
2041	10,412	11,031	10,946	10,979	11,376	11,202	11,658	11,409	10,653
2042	10,369	11,026	10,936	10,968	11,382	11,205	11,692	11,434	10,619
2043	10,326	11,020	10,927	10,957	11,387	11,207	11,729	11,461	10,584
2044	10,280	11,012	10,916	10,944	11,391	11,208	11,764	11,487	10,546
2045	10,233	11,003	10,903	10,930	11,393	11,208	11,799	11,514	10,506
2046	10,184	10,993	10,890	10,913	11,393	11,206	11,834	11,540	10,463
2047	10,133	10,982	10,875	10,896	11,392	11,203	11,868	11,567	10,419
2048	10,082	10,969	10,858	10,877	11,389	11,199	11,902	11,593	10,374
2049	10,029	10,956	10,842	10,857	11,385	11,195	11,936	11,620	10,327
Average Annual Population Change[c]	-0.34%	-0.05%	-0.09%	-0.08%	0.07%	0.02%	0.22%	0.14%	-0.24%
Cumulative Population Change[c]	-9.96%	-1.64%	-2.67%	-2.53%	2.21%	0.50%	7.16%	4.32%	-7.29%

Source: Statistics Canada 2021a.

a) These projections use the same methodology, assumptions and scenarios as in Statistics Canada (2020) The methods combine the use of historical data and the opinion of experts for each component of growth to develop future trajectories specific to each Health Regions. Generally, the same method has been used for all Health Regions. However, in Health Regions with small populations, where the counts of demographic events recorded annually are usually small, the past trends are often noisy, being very affected by random fluctuations. For this reason, some compromises were made in the less populated Health Regions (including Keewatin Yatthé), such as using the trends of both sex together instead of doing it for each sex separately, or keeping the age structure constant over time (for the projected changes in a given component of growth).

b) To account for the high uncertainty associated with internal migration projection, five assumptions are proposed, each based on a distinct reference period, and constituting the basis for a distinct scenario. Together, these assumptions demonstrate the high volatility of this component over time. Assumption M1, which can be considered an average scenario to some extent, is based on the longest period for which data are available for all provinces and territories (after the creation of Nunavut), from 1991/1992 to 2016/2017. Assumptions M2 to M5 reflect shorter intervals within the aforementioned period. Reference periods were selected so that each province and territory has at least one past period of relatively favourable net interprovincial migration, and another past period of relatively unfavourable net interprovincial migration.

c) Average annual population change and cumulative population change calculated by InterGroup Consultants Ltd.

Table 18A-10b: Population Projection for Saskatchewan for 2018 to 2043

Years	Projection								
	Low Growth[b]	Medium Growth M1[c]	Medium Growth M2[d]	Medium Growth M3[e]	Medium Growth M4[f]	Medium Growth M5[g]	High Growth[h]	Slow Aging[i]	Fast Aging[j]
2018[a]	1,162	1,162	1,162	1,162	1,162	1,162	1,162	1,162	1,162
2019	1,176	1,178	1,178	1,179	1,181	1,177	1,181	1,180	1,177
2020	1,191	1,195	1,195	1,198	1,200	1,194	1,200	1,199	1,192
2021	1,205	1,213	1,212	1,217	1,221	1,211	1,221	1,219	1,207
2022	1,219	1,231	1,230	1,236	1,242	1,228	1,243	1,240	1,222
2023	1,234	1,250	1,248	1,256	1,263	1,246	1,266	1,262	1,237
2024	1,247	1,268	1,266	1,277	1,285	1,264	1,289	1,284	1,252
2025	1,261	1,287	1,285	1,297	1,306	1,282	1,313	1,307	1,267
2026	1,274	1,306	1,303	1,317	1,328	1,300	1,338	1,330	1,282
2027	1,287	1,325	1,322	1,338	1,350	1,318	1,363	1,354	1,296
2028	1,300	1,343	1,340	1,358	1,372	1,336	1,389	1,378	1,310
2029	1,312	1,362	1,358	1,378	1,394	1,354	1,414	1,402	1,324
2030	1,324	1,380	1,376	1,398	1,416	1,372	1,441	1,427	1,337
2031	1,335	1,399	1,394	1,418	1,438	1,390	1,467	1,451	1,350
2032	1,346	1,417	1,412	1,438	1,460	1,407	1,493	1,475	1,363
2033	1,356	1,434	1,429	1,457	1,482	1,425	1,520	1,500	1,375
2034	1,366	1,452	1,446	1,476	1,503	1,442	1,546	1,524	1,387
2035	1,375	1,469	1,462	1,495	1,524	1,458	1,573	1,549	1,398
2036	1,384	1,486	1,479	1,514	1,545	1,475	1,600	1,573	1,409
2037	1,392	1,502	1,494	1,532	1,566	1,491	1,626	1,597	1,419
2038	1,400	1,518	1,510	1,550	1,586	1,507	1,652	1,622	1,429
2039	1,407	1,534	1,525	1,567	1,606	1,522	1,678	1,646	1,438
2040	1,414	1,549	1,539	1,584	1,626	1,537	1,704	1,669	1,446
2041	1,421	1,563	1,553	1,600	1,645	1,552	1,730	1,693	1,455
2042	1,426	1,578	1,567	1,616	1,664	1,566	1,755	1,716	1,462
2043	1,432	1,591	1,580	1,632	1,683	1,580	1,780	1,739	1,469

Table 18A-10b: Population Projection for Saskatchewan for 2018 to 2043

Years	Projection								
	Low Growth(b)	Medium Growth M1(c)	Medium Growth M2(d)	Medium Growth M3(e)	Medium Growth M4(f)	Medium Growth M5(g)	High Growth(h)	Slow Aging(i)	Fast Aging(j)
Average annual population change(k)	0.84%	1.26%	1.24%	1.37%	1.49%	1.24%	1.72%	1.62%	0.94%
Cumulative population change(k)	23.20%	36.92%	35.94%	40.41%	44.80%	35.93%	53.19%	49.63%	26.41%

Source: Statistics Canada 2019b.

a) The base population for these projections is derived from the official preliminary postcensal estimates of the population for Canada, provinces and territories as of 1 July 2018. In all scenarios, the population is projected until 2043 for the provinces and territories, and until 2068 for Canada as a whole. For more detail on the assumptions and scenarios, please refer to the projection report (catalogue 91-520) and the technical report (catalogue 91-620). Because of rounding, counts within tables may differ from the totals.

b) The low-growth scenario contains the following assumptions at the Canada level: the total fertility rate reaches 1.40 children per woman in 2042/2043 and remains constant thereafter; life expectancy at birth reaches 85.6 years for males and 88.8 years for females in 2067/2068; interprovincial migration is based on the trends observed between 1991/1992 and 2016/2017; the immigration rate reaches 0.65% in 2042/2043 and remains constant thereafter; the annual number of non-permanent residents reaches 1,080,910 in 2043 and remains constant thereafter; the net emigration rate reaches 0.18% in 2042/2043 and remains constant thereafter.

c) The medium-growth (M1) scenario contains the following assumptions at the Canada level: the total fertility rate reaches 1.59 children per woman in 2042/2043 and remains constant thereafter; life expectancy at birth reaches 87.0 years for males and 89.0 years for females in 2067/2068; interprovincial migration is based on the trends observed between 1991/1992 and 2016/2017; the immigration rate reaches 0.83% in 2042/2043 and remains constant thereafter; the annual number of non-permanent residents reaches 1,397,060 in 2043 and remains constant thereafter; the net emigration rate reaches 0.15% in 2042/2043 and remains constant thereafter.

d) The medium-growth (M2) scenario contains the following assumptions at the Canada level: the total fertility rate reaches 1.59 children per woman in 2042/2043 and remains constant thereafter; life expectancy at birth reaches 87.0 years for males and 89.0 years for females in 2067/2068; interprovincial migration is based on the trends observed between 1995/1996 and 2010/2011; the immigration rate reaches 0.83% in 2042/2043 and remains constant thereafter; the annual number of non-permanent residents reaches 1,397,060 in 2043 and remains constant thereafter; the net emigration rate reaches 0.15% in 2042/2043 and remains constant thereafter.

e) The medium-growth (M3) scenario contains the following assumptions at the Canada level: the total fertility rate reaches 1.59 children per woman in 2042/2043 and remains constant thereafter; life expectancy at birth reaches 87.0 years for males and 89.0 years for females in 2067/2068; interprovincial migration is based on the trends observed between 2003/2004 and 2008/2009; the immigration rate reaches 0.83% in 2042/2043 and remains constant thereafter; the annual number of non-permanent residents reaches 1,397,060 in 2043 and remains constant thereafter; the net emigration rate reaches 0.15% in 2042/2043 and remains constant thereafter.

f) The medium-growth (M4) scenario contains the following assumptions at the Canada level: the total fertility rate reaches 1.59 children per woman in 2042/2043 and remains constant thereafter; life expectancy at birth reaches 87.0 years for males and 89.0 years for females in 2067/2068; interprovincial migration is based on the trends observed between 2009/2010 and 2016/2017; the immigration rate reaches 0.83% in 2042/2043 and remains constant thereafter; the annual number of non-permanent residents reaches 1,397,060 in 2043 and remains constant thereafter; the net emigration rate reaches 0.15% in 2042/2043 and remains constant thereafter.

g) The medium-growth (M5) scenario contains the following assumptions at the Canada level: the total fertility rate reaches 1.59 children per woman in 2042/2043 and remains constant thereafter; life expectancy at birth reaches 87.0 years for males and 89.0 years for females in 2067/2068; interprovincial migration is based on the trends observed between 2014/2015 and 2016/2017; the immigration rate reaches 0.83% in 2042/2043 and remains constant thereafter; the annual number of non-permanent residents reaches 1,397,060 in 2043 and remains constant thereafter; the net emigration rate reaches 0.15% in 2042/2043 and remains constant thereafter.

h) The high-growth scenario contains the following assumptions at the Canada level: the total fertility rate reaches 1.79 children per woman in 2042/2043 and remains constant thereafter; life expectancy at birth reaches 88.0 years for males and 91.3 years for females in 2067/2068; interprovincial migration is based on the trends observed between 1991/1992 and 2016/2017; the immigration rate reaches 1.08% in 2042/2043 and remains constant thereafter; the annual number of non-permanent residents reaches 1,944,400 in 2043 and remains constant thereafter; the net emigration rate reaches 0.13% in 2042/2043 and remains constant thereafter.

i) The slow-aging scenario contains the following assumptions at the Canada level: the total fertility rate reaches 1.79 children per woman in 2042/2043 and remains constant thereafter; life expectancy at birth reaches 85.6 years for males and 88.8 years for females in 2067/2068; interprovincial migration is based on the trends observed between 1991/1992 and 2016/2017; the immigration rate reaches 1.08% in 2042/2043 and remains constant thereafter; the annual number of non-permanent residents reaches 1,944,400 in 2043 and remains constant thereafter; the net emigration rate reaches 0.13% in 2042/2043 and remains constant thereafter.

j) The fast-aging scenario contains the following assumptions at the Canada level: the total fertility rate reaches 1.40 children per woman in 2042/2043 and remains constant thereafter; life expectancy at birth reaches 88.0 years for males and 91.3 years for females in 2067/2068; interprovincial migration is based on the trends observed between 1991/1992 and 2016/2017; the immigration rate reaches 0.65% in 2042/2043 and remains constant thereafter; the annual number of non-permanent residents reaches 1,080,910 in 2043 and remains constant thereafter; the net emigration rate reaches 0.18% in 2042/2043 and remains constant thereafter.

k) Average annual population change, and cumulative population change calculated by InterGroup Consultants Ltd.

Table 18A-11: Labour Force Status Change, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 1986 to 2016

Metric	LSA[a,b,c]							Northern Saskatchewan (RSA)[a,b,d]							Saskatchewan[a,b]						
	1986	1991	1996	2001	2006	2011	2016	1986	1991	1996	2001	2006	2011	2016	1986	1991	1996	2001	2006	20–1	2016
Total - Population aged 15 years and over[e]	**2,500**	**2,565**	**2,805**	**3,095**	**3,605**	**3,735**	**4,045**	**15,500**	**16,360**	**19,035**	**20,105**	**22,365**	**24,795**	**25,295**	**751,090**	**738,680**	**748,135**	**755,520**	**766,230**	**812,505**	**857,295**
In the labour force[e]	1,155	1,160	1,515	1,690	1,555	1,315	1,815	8,315	8,545	10,445	10,785	11,280	11,585	12,355	501,750	506,295	503,500	512,240	524,305	562,310	585,540
Employed[f]	765	820	1,075	1,105	1,165	1,060	1,320	6,345	6,630	8,330	8,180	9,005	9,520	9,420	461,515	470,475	467,285	479,735	494,900	529,100	544,095
Unemployed[g]	405	315	445	580	400	250	500	1,975	1,915	2,110	2,610	2,275	2,070	2,935	40,225	35,820	36,215	32,505	29,400	33,210	41,445
Not in the labour force[h]	1,345	1,410	1,285	1,410	2,050	2,420	2,250	7,185	7,815	8,590	9,320	11,085	13,205	12,940	249,340	232,380	244,630	243,285	241,930	250,190	271,760
Participation rate[i]	46.2%	45.2%	54.0%	54.6%	43.1%	35.2%	44.9%	53.6%	52.2%	54.9%	53.6%	50.4%	46.7%	48.8%	66.8%	68.5%	67.3%	67.8%	68.4%	69.2%	68.3%
Employment rate[j]	30.6%	32.0%	38.3%	35.7%	32.3%	28.4%	32.6%	40.9%	40.5%	43.8%	40.7%	40.3%	38.4%	37.2%	61.4%	63.7%	62.5%	63.5%	64.6%	65.1%	63.5%
Unemployment rate[k]	35.1%	27.2%	29.4%	34.3%	25.7%	19.0%	27.5%	23.8%	22.4%	20.2%	24.2%	20.2%	17.9%	23.8%	8.0%	7.1%	7.2%	6.3%	5.6%	5.9%	7.1%

Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available: for all years for Bear Creek, Black Point (except 2016), Descharme Lake, and Garson Lake; for 2011 for Birch Narrows Dene Nation - Turnor Lake 193B and Turnor Lake.

d) Northern Saskatchewan (RSA) is defined as Census Division No.18.

e) Refers to whether a person aged 15 years and over was employed unemployed or not in the labour force during the week of Sunday 1 May to Saturday 7 May 2016.

f) Employed refers to persons 15 years and over, excluding institutional residents who, during the week prior to Census Day: 1) did any work at all at a job or business, that is, paid work in the context of an employer-employee relationship, or self-employment. This also includes persons who did unpaid family work, which is defined as unpaid work contributing directly to the operation of a farm, business, or professional practice owned and operated by a related member of the same household; or 2) had a job but were not at work due to factors such as their own illness or disability, personal or family responsibilities, vacation, or a labour dispute. This category excludes persons not at work because they were on layoff or between casual jobs, and those who did not then have a job (even if they had a job to start at a future date; Statistics Canada 2017b).

g) Unemployed refers to persons who, during the week of Sunday 1 May to Saturday 7 May 2016, were without paid work or without self-employment work and were available for work and either: 1) had actively looked for paid work in the past four weeks; or 2) were on temporary lay-off and expected to return to their job; or 3) had definite arrangements to start a new job in four weeks or less (Statistics Canada 2017b).

h) Not in the labour force refers to persons who, during the week of Sunday 1 May to Saturday 7 May 2016, were neither employed nor unemployed. It includes students, homemakers, retired workers, seasonal workers in an off season who were not looking for work, and persons who could not work because of a long-term illness or disability (Statistics Canada 2017b).

i) The participation rate refers to the number of people in the labour force in the week of Sunday 1 May to Saturday 7 May 2016, as a percentage of the population 15 years and over (Statistics Canada 2017).

j) The employment rate refers to the number of people employed in the week of Sunday 1 May to Saturday 7 May 2016 as a percentage of the total population 15 years and over (Statistics Canada 2017b).

k) The unemployment rate refers to the number of people unemployed in the week of Sunday 1 May to Saturday 7 May 2016 expressed as a percentage of the population in the labour force (Statistics Canada 2017b).

LSA = local study area; RSA = regional study area.

Table 18A-12: Labour Force Survey Estimates for Census Division No. 17 and 18, and Saskatchewan, for 2015/2016 to 2019/2020

Metric	Census Division No. 17 and 18[a]					Saskatchewan[a]				
	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020
Participation rate[b]	74.0%	74.6%	73.3%	71.0%	67.8%	69.5%	68.9%	68.3%	68.3%	67.6%
Employment rate[c]	65.8%	67.5%	67.8%	65.6%	62.0%	65.5%	64.5%	64.0%	64.3%	62.9%
Unemployment rate[d]	11.1%	9.6%	7.4%	7.3%	8.5%	5.7%	6.4%	6.3%	5.9%	7.0%

Source: Statistics Canada 2022.

a) Labour force survey estimates with two-year moving averages.

b) The “Participation Rate” is the number of labour force participants expressed as a percentage of the population 15 years of age and over. The participation rate for a particular group (age, sex and marital status) is the number of labour force participants in that group expressed as a percentage of the population for that group. Estimates are percentages, rounded to the nearest tenth.

c) The “Employment Rate” (formerly the employment and population ratio) is the number of persons employed expressed as a percentage of the population 15 years of age and over. The employment rate for a particular group (age, sex and marital status) is the number employed in that group expressed as a percentage of the population for that group. Estimates are percentages, rounded to the nearest tenth.

d) The “Unemployment Rate” is the number of unemployed persons expressed as a percentage of the labour force. The unemployment rate for a particular group (age, sex and marital status) is the number unemployed in that group expressed as a percentage of the labour force for that group. Estimates are percentages, rounded to the nearest tenth.

Table 18A-13a: Labour Force Status, for Local Study Area, 1986 to 2016

Metric	LSA[a,b,c]																				
	1986			1991			1996			2001			2006			2011			2016		
	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female
Total Population 15 Years and Over[d]	**2,500**	**1,330**	**1,170**	**2,565**	**1,285**	**1,275**	**2,805**	**1,370**	**1,440**	**3,095**	**1,475**	**1,625**	**3,605**	**1,755**	**1,850**	**3,735**	**1,780**	**1,940**	**4,045**	**1,925**	**2,140**
In the labour force[d]	1,155	775	380	1,160	705	455	1,515	840	675	1,690	920	775	1,555	830	730	1,315	655	655	1,815	905	905
Employed[e]	765	470	295	820	465	380	1,075	575	495	1,105	555	550	1,165	585	570	1,060	490	555	1,320	575	725
Unemployed[f]	405	320	85	315	235	85	445	275	170	580	355	215	400	235	150	250	160	85	500	320	190
Not in the labour force[g]	1,345	555	790	1,410	595	800	1,285	525	775	1,410	570	845	2,050	925	1,125	2,420	1,120	1,295	2,250	1,025	1,235
Participation rate[h]	46.2%	58.3%	32.5%	45.2%	54.9%	35.7%	54.0%	61.3%	46.9%	54.6%	62.4%	47.7%	43.1%	47.3%	39.5%	35.2%	36.8%	33.8%	44.9%	47.0%	42.3%
Employment rate[i]	30.6%	35.3%	25.2%	32.0%	36.2%	29.8%	38.3%	42.0%	34.4%	35.7%	37.6%	33.8%	32.3%	33.3%	30.8%	28.4%	27.5%	28.6%	32.6%	29.9%	33.9%
Unemployment rate[j]	35.1%	41.3%	22.4%	27.2%	33.3%	18.7%	29.4%	32.7%	25.2%	34.3%	38.6%	27.7%	25.7%	28.3%	20.5%	19.0%	24.4%	13.0%	27.5%	35.4%	21.0%

Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available: for all years for Bear Creek, Black Point (except 2016), Descharme Lake, and Garson Lake; for 2011 for Birch Narrows Dene Nation - Turnor Lake 193B and Turnor Lake.

d) Refers to whether a person aged 15 years and over was employed unemployed or not in the labour force during the week of Sunday 1 May to Saturday 7 May 2016.

e) Employed refers to persons 15 years and over, excluding institutional residents who, during the week prior to Census Day: 1) did any work at all at a job or business, that is, paid work in the context of an employer-employee relationship, or self-employment. This also includes persons who did unpaid family work, which is defined as unpaid work contributing directly to the operation of a farm, business, or professional practice owned and operated by a related member of the same household; or 2) had a job but were not at work due to factors such as their own illness or disability, personal or family responsibilities, vacation, or a labour dispute. This category excludes persons not at work because they were on layoff or between casual jobs, and those who did not then have a job (even if they had a job to start at a future date; Statistics Canada 2017).

f) Unemployed refers to persons who, during the week of Sunday 1 May to Saturday 7 May 2016, were without paid work or without self-employment work and were available for work and either: 1) had actively looked for paid work in the past four weeks; or 2) were on temporary lay-off and expected to return to their job; or 3) had definite arrangements to start a new job in four weeks or less (Statistics Canada 2017b).

g) Not in the labour force refers to persons who, during the week of Sunday 1 May to Saturday 7 May 2016, were neither employed nor unemployed. It includes students, homemakers, retired workers, seasonal workers in an off season who were not looking for work, and persons who could not work because of a long-term illness or disability (Statistics Canada 2017b).

h) The participation rate refers to the number of people in the labour force in the week of Sunday 1 May to Saturday 7 May 2016, as a percentage of the population 15 years and over (Statistics Canada 2017b).

i) The employment rate refers to the number of people employed in the week of Sunday 1 May to Saturday 7 May 2016 as a percentage of the total population 15 years and over (Statistics Canada 2017b).

j) The unemployment rate refers to the number of people unemployed in the week of Sunday 1 May to Saturday 7 May 2016 expressed as a percentage of the population in the labour force (Statistics Canada 2017b).

LSA = local study area.

Table 18A-13b: Labour Force Characteristics for Local Study Area Communities, 2016

Metric	LSA[a,b,c]																										
	Birch Narrows Dene Nation			Buffalo Narrows			Buffalo River Dene Nation 193			Clearwater River Dene 222			La Loche			Michel Village			St. George's Hill			Turnor Lake			LSA Total		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total Population 15 Years and Over by Labour Force Activity[d]	**315**	**150**	**165**	**765**	**360**	**400**	**545**	**270**	**275**	**570**	**280**	**290**	**1,585**	**735**	**850**	**50**	**20**	**25**	**100**	**50**	**50**	**95**	**35**	**55**	**4,025**	**1,900**	**2,110**
In the Labour Force[d]	165	90	75	475	220	260	260	135	120	270	140	130	525	270	255	30	15	15	35	25	15	45	20	25	1,805	915	895
Employed[e]	115	50	60	415	175	240	175	85	90	150	60	90	380	175	205	20	0	15	30	15	10	25	15	10	1,310	575	720
Unemployed[f]	55	35	15	65	40	20	85	55	35	120	75	45	145	90	50	10	10	10	10	10	0	15	10	10	505	325	185
Not in the Labour Force[g]	150	60	85	285	140	145	290	135	150	300	145	155	1,060	470	590	20	0	10	60	30	35	55	15	30	2,220	995	1,200
Participation Rate[h]	52.4%	60.0%	45.5%	62.1%	61.1%	65.0%	47.7%	50.0%	43.6%	47.4%	50.0%	44.8%	33.1%	36.7%	30.0%	60.0%	75.0%	60.0%	35.0%	50.0%	30.0%	47.4%	57.1%	45.5%	44.8%	48.2%	42.4%
Employment Rate[i]	36.5%	33.3%	36.4%	54.2%	48.6%	60.0%	32.1%	31.5%	32.7%	26.3%	21.4%	31.0%	24.0%	23.8%	24.1%	40.0%	0.0%	60.0%	30.0%	30.0%	20.0%	26.3%	42.9%	18.2%	32.5%	30.3%	34.1%
Unemployment Rate[j]	33.3%	38.9%	20.0%	13.7%	18.2%	7.7%	32.7%	40.7%	29.2%	44.4%	53.6%	34.6%	27.6%	33.3%	19.6%	33.3%	66.7%	66.7%	28.6%	40.0%	0.0%	33.3%	50.0%	40.0%	28.0%	35.5%	20.7%

Source: Statistics Canada 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake.

d) Refers to whether a person aged 15 years and over was employed unemployed or not in the labour force during the week of Sunday 1 May to Saturday 7 May 2016.

e) Employed refers to persons 15 years and over, excluding institutional residents who, during the week prior to Census Day: 1) did any work at all at a job or business, that is, paid work in the context of an employer-employee relationship, or self-employment. This also includes persons who did unpaid family work, which is defined as unpaid work contributing directly to the operation of a farm, business, or professional practice owned and operated by a related member of the same household; or 2) had a job but were not at work due to factors such as their own illness or disability, personal or family responsibilities, vacation, or a labour dispute. This category excludes persons not at work because they were on layoff or between casual jobs, and those who did not then have a job (even if they had a job to start at a future date; Statistics Canada 2017b).

f) Unemployed refers to persons who, during the week of Sunday 1 May to Saturday 7 May 2016, were without paid work or without self-employment work and were available for work and either: 1) had actively looked for paid work in the past four weeks; or 2) were on temporary lay-off and expected to return to their job; or 3) had definite arrangements to start a new job in four weeks or less (Statistics Canada 2017b).

g) Not in the labour force refers to persons who, during the week of Sunday 1 May to Saturday 7 May 2016, were neither employed nor unemployed. It includes students, homemakers, retired workers, seasonal workers in an off season who were not looking for work, and persons who could not work because of a long-term illness or disability (Statistics Canada 2017b).

h) The participation rate refers to the number of people in the labour force in the week of Sunday 1 May to Saturday 7 May 2016, as a percentage of the population 15 years and over (Statistics Canada 2017b).

i) The employment rate refers to the number of people employed in the week of Sunday 1 May to Saturday 7 May 2016 as a percentage of the total population 15 years and over (Statistics Canada 2017b).

j) The unemployment rate refers to the number of people unemployed in the week of Sunday 1 May to Saturday 7 May 2016 expressed as a percentage of the population in the labour force (Statistics Canada 2017b).

LSA = local study area.

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Table 18A-14a: Labour Force Characteristics by Age Groups, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016

Metric	LSA[a,b,c]			Northern Saskatchewan (RSA)[a,b,d]			Saskatchewan[a,b]		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total Population 15 Years and Over Labour Force Activity[e]	**4,025**	**1,900**	**2,110**	**25,295**	**12,610**	**12,685**	**857,300**	**424,260**	**433,035**
In the Labour Force[e]	1,805	915	895	12,360	6,540	5,820	585,535	311,105	274,430
Employed[f]	1,310	575	720	9,415	4,665	4,755	544,090	286,330	257,760
Unemployed[g]	505	325	185	2,935	1,875	1,060	41,445	24,775	16,665
Not in the Labour Force[h]	2,220	995	1,200	12,940	6,070	6,870	271,760	113,155	158,605
Participation Rate[i]									
Total Population 15 Years and Over	44.8%	48.2%	42.4%	48.9%	51.9%	45.9%	68.3%	73.3%	63.4%
15 to 24 years	24.4%	27.4%	19.2%	29.8%	32.7%	26.6%	62.7%	64.0%	61.3%
25 to 34 years	53.7%	56.6%	49.5%	56.2%	62.1%	50.7%	84.7%	90.1%	79.3%
35 to 44 years	61.4%	66.1%	50.0%	65.9%	68.8%	62.9%	87.5%	91.9%	83.2%
45 to 54 years	62.1%	62.9%	58.4%	66.6%	69.3%	64.2%	86.5%	89.3%	83.8%
55 to 64 years	44.0%	48.7%	50.0%	56.3%	60.4%	52.3%	70.8%	76.5%	65.2%
65 years and over	25.0%	20.5%	25.7%	17.3%	20.2%	14.4%	22.1%	29.4%	15.8%
Employment Rate[j]									
Total Population 15 Years and Over	32.5%	30.3%	34.1%	37.2%	37.0%	37.5%	63.5%	67.5%	59.5%
15 to 24 years	11.7%	10.4%	16.2%	17.7%	17.7%	17.9%	54.0%	54.3%	53.7%
25 to 34 years	36.2%	34.2%	37.1%	38.5%	39.6%	37.5%	77.8%	82.5%	73.0%
35 to 44 years	46.5%	49.2%	39.7%	52.3%	51.0%	53.4%	82.4%	85.8%	79.0%
45 to 54 years	53.1%	43.5%	51.7%	56.2%	55.6%	57.1%	82.3%	83.9%	80.7%
55 to 64 years	37.3%	25.6%	36.1%	49.3%	49.5%	49.0%	67.4%	71.6%	63.2%
65 years and over	12.5%	15.4%	8.6%	15.5%	17.9%	12.7%	21.2%	28.0%	15.3%
Unemployment Rate[k]									
Total Population 15 Years and Over	28.0%	35.5%	20.7%	23.7%	28.7%	18.2%	7.1%	8.0%	6.1%
15 to 24 years	54.0%	62.1%	42.1%	40.2%	46.3%	32.3%	13.8%	15.1%	12.3%
25 to 34 years	33.7%	44.2%	27.1%	31.4%	36.2%	26.0%	8.2%	8.5%	7.9%
35 to 44 years	23.1%	35.9%	17.6%	20.6%	25.8%	15.1%	5.9%	6.6%	5.0%
45 to 54 years	20.0%	23.1%	11.5%	15.6%	20.1%	11.4%	4.9%	6.0%	3.7%
55 to 64 years	6.1%	10.5%	0.0%	12.8%	16.9%	7.1%	4.9%	6.4%	3.2%
65 years and over	11.1%	75.0%	0.0%	10.6%	9.4%	9.1%	4.2%	4.7%	3.4%

Table 18A-14a: Labour Force Characteristics by Age Groups, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016

Metric	LSA[a,b,c]			Northern Saskatchewan (RSA)[a,b,d]			Saskatchewan[a,b]		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Not in the Labour Force Ratio[l]									
Total Population 15 Years and Over	55.2%	52.4%	56.9%	51.2%	48.1%	54.2%	31.7%	26.7%	36.6%
15 to 24 years	74.6%	70.8%	77.8%	70.2%	67.3%	73.2%	37.3%	36.0%	38.7%
25 to 34 years	46.3%	46.1%	50.5%	43.9%	38.1%	49.3%	15.3%	9.9%	20.7%
35 to 44 years	40.2%	32.2%	48.5%	34.1%	31.3%	37.1%	12.5%	8.1%	16.8%
45 to 54 years	37.9%	35.5%	40.4%	33.5%	30.7%	35.8%	13.5%	10.7%	16.2%
55 to 64 years	57.3%	53.8%	58.3%	43.5%	39.6%	47.7%	29.2%	23.5%	34.7%
65 years and over	83.3%	82.1%	71.4%	82.9%	79.8%	86.0%	77.9%	70.7%	84.2%

Source: Statistics Canada 2017a.
a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.
b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.
c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake.
d) Northern Saskatchewan (RSA) is defined as Census Division No.18.
e) Refers to whether a person aged 15 years and over was employed unemployed or not in the labour force during the week of Sunday 1 May to Saturday 7 May 2016.
f) Employed refers to persons 15 years and over, excluding institutional residents who, during the week prior to Census Day: 1) did any work at all at a job or business, that is, paid work in the context of an employer-employee relationship, or self-employment. This also includes persons who did unpaid family work, which is defined as unpaid work contributing directly to the operation of a farm, business, or professional practice owned and operated by a related member of the same household; or 2) had a job but were not at work due to factors such as their own illness or disability, personal or family responsibilities, vacation, or a labour dispute. This category excludes persons not at work because they were on layoff or between casual jobs, and those who did not then have a job (even if they had a job to start at a future date; Statistics Canada 2017b).
g) Unemployed refers to persons who, during the week of Sunday 1 May to Saturday 7 May 2016, were without paid work or without self-employment work and were available for work and either: 1) had actively looked for paid work in the past four weeks; or 2) were on temporary lay-off and expected to return to their job; or 3) had definite arrangements to start a new job in four weeks or less (Statistics Canada 2017b).
h) Not in the labour force refers to persons who, during the week of Sunday 1 May to Saturday 7 May 2016, were neither employed nor unemployed. It includes students, homemakers, retired workers, seasonal workers in an off season who were not looking for work, and persons who could not work because of a long-term illness or disability (Statistics Canada 2017b).
i) The participation rate refers to the number of people in the labour force in the week of Sunday 1 May to Saturday 7 May 2016, as a percentage of the population 15 years and over (Statistics Canada 2017b).
j) The employment rate refers to the number of people employed in the week of Sunday 1 May to Saturday 7 May 2016 as a percentage of the total population 15 years and over (Statistics Canada 2017b).
k) The unemployment rate refers to the number of people unemployed in the week of Sunday 1 May to Saturday 7 May 2016 expressed as a percentage of the population in the labour force (Statistics Canada 2017b).
l) Not in the labour force ratios calculated by InterGroup Consultants Ltd.
LSA = local study area; RSA = regional study area.

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Table 18A-14b: Labour Force Characteristics by Age Groups for Local Study Area Communities, 2016

Metric	Birch Narrows Dene Nation[a,b]			Buffalo Narrows[a,b]			Buffalo River Dene Nation 193[a,b]			Clearwater River Dene 222[a,b]			La Loche[a,b]			Michel Village[a,b]			St. George's Hill[a,b]			Turnor Lake[a,b]			LSA[a,b,c]		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total Population 15 Years and Over by Labour Force Activity[d]	**315**	**150**	**165**	**765**	**360**	**400**	**545**	**270**	**275**	**570**	**280**	**290**	**1,585**	**735**	**850**	**50**	**20**	**25**	**100**	**50**	**50**	**95**	**35**	**55**	**4,025**	**1,900**	**2,110**
In the Labour Force[d]	165	90	75	475	220	260	260	135	120	270	140	130	525	270	255	30	15	15	35	25	15	45	20	25	1,805	915	895
Employed[e]	115	50	60	415	175	240	175	85	90	150	60	90	380	175	205	20	0	15	30	15	10	25	15	10	1,310	575	720
Unemployed[f]	55	35	15	65	40	20	85	55	35	120	75	45	145	90	50	10	10	10	10	10	0	15	10	10	505	325	185
Not in the Labour Force[g]	150	60	85	285	140	145	290	135	150	300	145	155	1,060	470	590	20	0	10	60	30	35	55	15	30	2,220	995	1,200
Participation Rate[h]																											
Total Population 15 Years and Over	52.4%	60.0%	45.5%	62.1%	61.1%	65.0%	47.7%	50.0%	43.6%	47.4%	50.0%	44.8%	33.1%	36.7%	30.0%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	44.8%	48.2%	42.4%
15 to 24 years	31.2%	44.4%	28.6%	34.6%	28.6%	45.5%	19.2%	23.1%	23.1%	27.8%	29.4%	15.8%	19.1%	22.9%	14.6%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	24.4%	27.4%	19.2%
25 to 34 years	68.4%	77.8%	54.5%	71.4%	69.2%	78.6%	57.7%	63.6%	57.1%	64.0%	58.3%	61.5%	38.6%	44.8%	36.6%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	53.7%	56.6%	49.5%
35 to 44 years	87.5%	75.0%	75.0%	75.0%	88.9%	72.7%	66.7%	85.7%	57.1%	66.7%	72.7%	54.5%	50.9%	58.3%	41.9%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	61.4%	66.1%	50.0%
45 to 54 years	55.6%	66.7%	50.0%	83.8%	84.6%	80.0%	65.2%	66.7%	58.3%	64.3%	50.0%	71.4%	43.4%	47.6%	39.4%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	62.1%	62.9%	58.4%
55 to 64 years	60.0%	66.7%	66.7%	64.7%	60.0%	83.3%	45.5%	50.0%	40.0%	44.4%	50.0%	60.0%	27.6%	28.6%	26.7%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	44.0%	48.7%	50.0%
65 years and over	0.0%	0.0%	0.0%	38.5%	42.9%	41.7%	22.2%	0.0%	0.0%	33.3%	0.0%	66.7%	20.0%	16.7%	22.2%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	25.0%	20.5%	25.7%
Employment Rate[i]																											
Total Population 15 Years and Over	36.5%	33.3%	36.4%	54.2%	48.6%	60.0%	32.1%	31.5%	32.7%	26.3%	21.4%	31.0%	24.0%	23.8%	24.1%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	32.5%	30.3%	34.1%
15 to 24 years	18.8%	22.2%	28.6%	15.4%	0.0%	36.4%	7.7%	15.4%	15.4%	5.6%	11.8%	10.5%	10.1%	10.4%	9.8%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	11.7%	10.4%	16.2%
25 to 34 years	42.1%	55.6%	36.4%	57.1%	53.8%	64.3%	30.8%	27.3%	42.9%	36.0%	25.0%	46.2%	27.1%	27.6%	26.8%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	36.2%	34.2%	37.1%
35 to 44 years	50.0%	75.0%	50.0%	75.0%	77.8%	63.6%	40.0%	57.1%	42.9%	38.1%	36.4%	36.4%	40.0%	45.8%	35.5%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	46.5%	49.2%	39.7%
45 to 54 years	44.4%	0.0%	50.0%	81.1%	76.9%	80.0%	52.2%	50.0%	58.3%	42.9%	25.0%	42.9%	34.0%	33.3%	33.3%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	53.1%	43.5%	51.7%
55 to 64 years	60.0%	0.0%	66.7%	58.8%	50.0%	66.7%	27.3%	33.3%	40.0%	44.4%	0.0%	40.0%	20.7%	21.4%	20.0%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	37.3%	25.6%	36.1%
65 years and over	0.0%	0.0%	0.0%	34.6%	28.6%	25.0%	0.0%	40.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	12.5%	15.4%	8.6%
Unemployment Rate[j]																											
Total Population 15 Years and Over	33.3%	38.9%	20.0%	13.7%	18.2%	7.7%	32.7%	40.7%	29.2%	44.4%	53.6%	34.6%	27.6%	33.3%	19.6%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	28.0%	35.5%	20.7%
15 to 24 years	60.0%	50.0%	0.0%	44.4%	75.0%	40.0%	60.0%	66.7%	66.7%	70.0%	100.0%	66.7%	47.1%	54.5%	33.3%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	54.0%	62.1%	42.1%
25 to 34 years	30.8%	42.9%	33.3%	25.0%	22.2%	27.3%	46.7%	57.1%	25.0%	43.8%	71.4%	25.0%	33.3%	38.5%	26.7%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	33.7%	44.2%	27.1%
35 to 44 years	28.6%	66.7%	0.0%	0.0%	0.0%	0.0%	30.0%	33.3%	50.0%	35.7%	50.0%	33.3%	21.4%	28.6%	15.4%	n/d	n;/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	23.1%	35.9%	17.6%
45 to 54 years	40.0%	0.0%	66.7%	0.0%	18.2%	0.0%	20.0%	25.0%	0.0%	44.4%	50.0%	40.0%	21.7%	30.0%	15.4%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	20.0%	23.1%	11.5%
55 to 64 years	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	25.0%	50.0%	0.0%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	6.1%	10.5%	0.0%
65 years and over	0.0%	0.0%	0.0%	0.0%	66.7%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	11.1%	75.0%	0.0%
Not in the Labour Force Ratio[j,k]																											
Total Population 15 Years and Over	47.6%	40.0%	51.5%	37.3%	38.9%	36.3%	53.2%	50.0%	54.5%	52.6%	51.8%	53.4%	66.9%	63.9%	69.4%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	55.2%	52.4%	56.9%
15 to 24 years	62.5%	55.6%	71.4%	65.4%	71.4%	63.6%	76.9%	69.2%	76.9%	72.2%	70.6%	78.9%	80.9%	77.1%	85.4%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	74.6%	70.8%	77.8%
25 to 34 years	36.8%	22.2%	45.5%	28.6%	30.8%	28.6%	38.5%	36.4%	42.9%	36.0%	41.7%	38.5%	61.4%	55.2%	65.9%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	46.3%	46.1%	50.5%
35 to 44 years	25.0%	50.0%	50.0%	15.0%	0.0%	27.3%	40.0%	28.6%	42.9%	42.9%	27.3%	45.5%	49.1%	41.7%	58.1%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	40.2%	32.2%	48.5%
45 to 54 years	33.3%	66.7%	33.3%	18.9%	15.4%	20.0%	34.8%	33.3%	41.7%	35.7%	37.5%	28.6%	56.6%	52.4%	60.6%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	37.9%	35.5%	40.4%
55 to 64 years	60.0%	66.7%	66.7%	35.3%	40.0%	33.3%	63.6%	50.0%	80.0%	44.4%	50.0%	40.0%	72.4%	71.4%	73.3%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	57.3%	53.8%	58.3%
65 years and over	100.0%	100.0%	100.0%	57.7%	50.0%	66.7%	77.8%	60.0%	66.7%	116.7%	125.0%	66.7%	100.0%	91.7%	100.0%	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	83.3%	82.1%	71.4%

Source: Statistics Canada 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake.

d) Refers to whether a person aged 15 years and over was employed unemployed or not in the labour force during the week of Sunday 1 May to Saturday 7 May 2016.

e) Employed refers to persons 15 years and over, excluding institutional residents who, during the week prior to Census Day: 1) did any work at all at a job or business, that is, paid work in the context of an employer-employee relationship, or self-employment. This also includes persons who did unpaid family work, which is defined as unpaid work contributing directly to the operation of a farm, business, or professional practice owned and operated by a related member of the same household; or 2) had a job but were not at work due to factors such as their own illness or disability, personal or family responsibilities, vacation, or a labour dispute. This category excludes persons not at work because they were on layoff or between casual jobs, and those who did not then have a job (even if they had a job to start at a future date; Statistics Canada 2017).

f) Unemployed refers to persons who, during the week of Sunday 1 May to Saturday 7 May 2016, were without paid work or without self-employment work and were available for work and either: 1) had actively looked for paid work in the past four weeks; or 2) were on temporary lay-off and expected to return to their job; or 3) had definite arrangements to start a new job in four weeks or less (Statistics Canada 2017b).

g) Not in the labour force refers to persons who, during the week of Sunday 1 May to Saturday 7 May 2016, were neither employed nor unemployed. It includes students, homemakers, retired workers, seasonal workers in an off season who were not looking for work, and persons who could not work because of a long-term illness or disability (Statistics Canada 2017b).

h) The participation rate refers to the number of people in the labour force in the week of Sunday 1 May to Saturday 7 May 2016, as a percentage of the population 15 years and over (Statistics Canada 2017b).

i) The employment rate refers to the number of people employed in the week of Sunday 1 May to Saturday 7 May 2016 as a percentage of the total population 15 years and over (Statistics Canada 2017b).

j) The unemployment rate refers to the number of people unemployed in the week of Sunday 1 May to Saturday 7 May 2016 expressed as a percentage of the population in the labour force (Statistics Canada 2017b).

k) Not in the labour force ratios calculated by InterGroup Consultants Ltd.

LSA = local study area; n/d = no data available.

Table 18A-15: Full-Time and Part-Time Workers, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016

Metric	LSA[a,b,c]			Northern Saskatchewan (RSA)[a,b,d]			Saskatchewan[a,b]		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total - Work activity during the reference year for the population aged 15 years and over in private households - 25% sample data[e]	**4,015**	**1,905**	**2,110**	**25,295**	**12,610**	**12,685**	**857,295**	**424,265**	**433,030**
Did not work[f]	**2,255**	**1,025**	**1,225**	**13,490**	**6,460**	**7,030**	**242,835**	**100,140**	**142,700**
Worked	**1,765**	**900**	**880**	**11,805**	**6,150**	**5,655**	**614,465**	**324,125**	**290,335**
Worked full time[g]	1,510	750	750	9,800	5,260	4,540	479,940	277,490	202,455
Worked full time 40+ weeks	1,000	420	575	6,710	3,275	3,435	394,230	226,780	167,450
Worked full time not all year	500	310	170	3,095	1,985	1,110	85,720	50,710	35,000
Worked part time[h]	270	130	150	2,005	885	1,115	134,515	46,635	87,885
Worked part time 40+ weeks	75	30	45	695	265	425	64,720	19,830	44,890
Worked part time not all year	185	100	85	1,300	625	685	69,800	26,800	42,985
Proportion of Full and Part Time[i]									
Worked full time	85.6%	83.3%	85.2%	83.0%	85.5%	80.3%	78.1%	85.6%	69.7%
Worked full time 40+ weeks	56.7%	46.7%	65.3%	56.8%	53.3%	60.7%	64.2%	70.0%	57.7%
Worked full time not all year	28.3%	34.4%	19.3%	26.2%	32.3%	19.6%	14.0%	15.6%	12.1%
Worked part time	15.3%	14.4%	17.0%	17.0%	14.4%	19.7%	21.9%	14.4%	30.3%
Worked part time 40+ weeks	4.2%	3.3%	5.1%	5.9%	4.3%	7.5%	10.5%	6.1%	15.5%
Worked part time not all year	10.5%	11.1%	9.7%	11.0%	10.2%	12.1%	11.4%	8.3%	14.8%

Source: Statistics Canada 2017a.
a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.
b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.
c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake.
d) Northern Saskatchewan (RSA) is defined as Census Division No.18.
e) Refers to the number of weeks in which a person worked for pay or in self-employment in 2015 at all jobs held even if only for a few hours and whether these weeks were mostly full time (30 hours or more per week) or mostly part time (less than 30 hours per week).
f) Includes persons aged 15 years and over who never worked persons who worked prior to 2015 persons who worked in 2016 but not in 2015.
g) Full time is 30 hours or more per week.
h) Part time is less than 30 hours per week.
i) Proportion of full and part time workers calculated by InterGroup Consultants Ltd.
LSA = local study area; RSA = regional study area.

Table 18A-16: Labour Force Characteristics by Educational Attainment, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016

Metric	LSA[a,b,c]						Northern Saskatchewan (RSA)[a,b,d]						Saskatchewan [a,b]					
	Total - Population Aged 15 Years and Over	No Certificate, Diploma, or Degree	Secondary (High) School Diploma or Equivalency Certificate	Apprenticeship or Trades Certificate or Diploma	College, CEGEP, or University Certificate or Diploma below Bachelor Level	University Certificate, Diploma, or Degree at Bachelor Level or Above	Total - Population Aged 15 Years and Over	No Certificate, Diploma, or Degree	Secondary (High) School Diploma or Equivalency Certificate	Apprenticeship or Trades Certificate or Diploma	College, CEGEP or Certificate, or Diploma below Bachelor Level	University Certificate, Diploma, or Degree at Bachelor Level or Above	Total - Population Aged 15 Years and Over	No Certificate, Diploma, or Degree	Secondary (High) School Diploma or Equivalency Certificate	Apprenticeship or Trades Certificate or Diploma	College, CEGEP or Certificate, or Diploma below Bachelor Level	University Certificate, Diploma, or Degree at Bachelor Level or Above
Total Population 15 Years and Over by Labour Force Activity[e]	**4,015**	**2,255**	**670**	**425**	**420**	**225**	**25,295**	**12,865**	**5,200**	**2,080**	**3,290**	**1,860**	**857,300**	**177,210**	**261,205**	**89,440**	**174,965**	**154,480**
In the labour force[e]	1,795	615	345	280	360	195	12,355	3,990	2,895	1,415	2,445	1,610	585,535	73,960	187,530	67,280	130,800	125,960
Employed[f]	1,300	360	265	180	290	210	9,420	2,435	2,215	1,140	2,095	1,545	544,095	63,675	172,750	62,570	124,335	120,765
Unemployed[g]	500	250	100	85	65	0	2,935	1,560	685	280	350	65	41,445	10,290	14,785	4,705	6,470	5,200
Not in the labour force[h]	2,220	1,645	325	145	90	10	12,935	8,875	2,305	665	845	250	271,760	103,245	73,675	22,160	44,165	28,515
Participation rate[i,l]	44.7%	27.3%	51.5%	65.9%	85.7%	86.7%	48.8%	31.0%	55.7%	68.0%	74.3%	86.6%	68.3%	41.7%	71.8%	75.2%	74.8%	81.5%
Employment rate[j,l]	32.4%	16.0%	39.6%	42.4%	69.0%	93.3%	37.2%	18.9%	42.6%	54.8%	63.7%	83.1%	63.5%	35.9%	66.1%	70.0%	71.1%	78.2%
Unemployment rate[k,l]	27.9%	40.7%	29.0%	30.4%	18.1%	0.0%	23.8%	39.1%	23.7%	19.8%	14.3%	4.0%	7.1%	13.9%	7.9%	7.0%	4.9%	4.1%

Source: Statistics Canada 2017a.
a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals may not add-up due to rounding.
b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.
c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake.
d) Northern Saskatchewan (RSA) is defined as Census Division No.18.
e) Refers to whether a person aged 15 years and over was employed unemployed or not in the labour force during the week of Sunday 1 May to Saturday 7 May 2016.
f) Employed refers to persons 15 years and over, excluding institutional residents who, during the week prior to Census Day: 1) did any work at all at a job or business, that is, paid work in the context of an employer-employee relationship, or self-employment. This also includes persons who did unpaid family work, which is defined as unpaid work contributing directly to the operation of a farm, business, or professional practice owned and operated by a related member of the same household; or 2) had a job but were not at work due to factors such as their own illness or disability, personal or family responsibilities, vacation, or a labour dispute. This category excludes persons not at work because they were on layoff or between casual jobs, and those who did not then have a job (even if they had a job to start at a future date; Statistics Canada 2017b).
g) Unemployed refers to persons who, during the week of Sunday 1 May to Saturday 7 May 2016, were without paid work or without self-employment work and were available for work and either: 1) had actively looked for paid work in the past four weeks; or 2) were on temporary lay-off and expected to return to their job; or 3) had definite arrangements to start a new job in four weeks or less (Statistics Canada 2017b).
h) Not in the labour force refers to persons who, during the week of Sunday 1 May to Saturday 7 May 2016, were neither employed nor unemployed. It includes students, homemakers, retired workers, seasonal workers in an off season who were not looking for work, and persons who could not work because of a long-term illness or disability (Statistics Canada 2017b).
i) The participation rate refers to the number of people in the labour force in the week of Sunday 1 May to Saturday 7 May 2016, as a percentage of the population 15 years and over (Statistics Canada 2017b).
j) The employment rate refers to the number of people employed in the week of Sunday 1 May to Saturday 7 May 2016 as a percentage of the total population 15 years and over (Statistics Canada 2017b).
k) The unemployment rate refers to the number of people unemployed in the week of Sunday 1 May to Saturday 7 May 2016 expressed as a percentage of the population in the labour force (Statistics Canada 2017b).
l) Participation, employment, and unemployment rates calculated by InterGroup Consultants Ltd.
LSA = local study area; RSA = regional study area; CEGEP = Collège d'enseignement général et professionnel.

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Table 18A-17a: Employment by Industry Sector, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016

Metric	Employment									Percentage of Employment by Sector									Distribution of Employment by Sector and Sex[h]					
	LSA[a,b,c]			Northern Saskatchewan (RSA)[a,b,d]			Saskatchewan[a,b]			LSA[a,b,c]			Northern Saskatchewan (RSA)[a,b,d]			Saskatchewan[a,b]			LSA[a,b,c]		Northern Saskatchewan (RSA)[a,b,d]		Saskatchewan[a,b]	
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Male	Female	Male	Female	Male	Female
Total labour force population aged 15 years and over by Industry - NAICS[e]	**1,815**	**905**	**905**	**12,360**	**6,540**	**5,820**	**585,535**	**311,110**	**274,430**	**n/c**	**n/c**	**n/c**	**n/c**	**n/c**	**n/c**	**n/c**	**n/c**	**n/c**	**n/c**	**n/c**	**n/c**	**n/c**	**n/c**	**n/c**
Industry - not applicable[f]	205	115	75	1,570	910	655	10,225	5,200	5,020	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/d	n/c	n/c
All industry categories[g]	**1,605**	**785**	**820**	**10,790**	**5,630**	**5,160**	**575,310**	**305,905**	**269,410**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**48.9%**	**51.1%**	**52.2%**	**47.8%**	**53.2%**	**46.8%**
Agriculture, forestry, fishing and hunting (NAICS 11)	70	60	10	240	220	20	51,255	36,820	14,440	4.4%	7.6%	1.2%	2.2%	3.9%	0.4%	8.9%	12.0%	5.4%	85.7%	14.3%	91.7%	8.3%	71.8%	28.2%
Mining, quarrying, and oil and gas extractions (NAICS 21)	110	105	0	1,165	1,025	145	23,070	20,040	3,025	6.9%	13.4%	0.0%	10.8%	18.2%	2.8%	4.0%	6.6%	1.1%	100.0%	0.0%	87.6%	12.4%	86.9%	13.1%
Construction (NAICS 23)	165	140	10	800	735	70	49,310	43,460	5,850	10.3%	17.8%	1.2%	7.4%	13.1%	1.4%	8.6%	14.2%	2.2%	93.3%	6.7%	91.3%	8.7%	88.1%	11.9%
Manufacturing (NAICS 31-33)	0	10	0	150	120	30	26,710	21,000	5,710	0.0%	1.3%	0.0%	1.4%	2.1%	0.6%	4.6%	6.9%	2.1%	100.0%	0.0%	80.0%	20.0%	78.6%	21.4%
Retail trade (NAICS 44-45)	135	65	90	1,015	455	555	63,360	30,185	33,180	8.4%	8.3%	11.0%	9.4%	8.1%	10.8%	11.0%	9.9%	12.3%	41.9%	58.1%	45.0%	55.0%	47.6%	52.4%
Transportation and warehousing (NAICS 48-49)	55	50	15	445	325	120	24,755	19,385	5,370	3.4%	6.4%	1.8%	4.1%	5.8%	2.3%	4.3%	6.3%	2.0%	76.9%	23.1%	73.0%	27.0%	78.3%	21.7%
Educational services (NAICS 61)	345	85	235	1,895	530	1,365	45,360	13,670	31,690	21.5%	10.8%	28.7%	17.6%	9.4%	26.5%	7.9%	4.5%	11.8%	26.6%	73.4%	28.0%	72.0%	30.1%	69.9%
Health care and social assistance (NAICS 62)	240	35	195	1,660	290	1,370	72,625	11,285	61,335	15.0%	4.5%	23.8%	15.4%	5.2%	26.6%	12.6%	3.7%	22.8%	15.2%	84.8%	17.5%	82.5%	15.5%	84.5%
Accommodation and food services (NAICS 72)	55	20	45	585	270	310	37,785	14,295	23,490	3.4%	2.5%	5.5%	5.4%	4.8%	6.0%	6.6%	4.7%	8.7%	30.8%	69.2%	46.6%	53.4%	37.8%	62.2%
Other services (except public administration) (NAICS 81)	20	40	0	250	135	115	25,680	12,590	13,090	1.2%	5.1%	0.0%	2.3%	2.4%	2.2%	4.5%	4.1%	4.9%	100.0%	0.0%	54.0%	46.0%	49.0%	51.0%
Public administration (NAICS 91)	310	180	140	1,520	955	570	38,180	19,640	18,535	19.3%	22.9%	17.1%	14.1%	17.0%	11.0%	6.6%	6.4%	6.9%	56.3%	43.8%	62.6%	37.4%	51.4%	48.6%
Other industry categories not included above (NAICS 22, 31-33, 41, 51, 52, 53, 54, 55, 56, 71)	75	70	40	1,105	630	475	123,445	69,200	54,230	4.7%	8.9%	4.9%	10.2%	11.2%	9.2%	21.5%	22.6%	20.1%	63.6%	36.4%	57.0%	43.0%	56.1%	43.9%

Source: Statistics Canada 2017a.
a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases 10. Totals may not add up due to rounding.
b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.
c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Descharme Lake, and Garson Lake.
d) Northern Saskatchewan (RSA) is defined as Census Division No.18.
e) Includes the experienced labour force, which refers to persons aged 15 years and over who during the Census were employed and the unemployed who had last worked for pay or in self-employment prior to the Census.
f) Includes unemployed persons aged 15 years and over who have never worked for pay or in self-employment or who had last worked prior to 1 January 2015.
g) Refers to the general nature of the business carried out in the establishment where the person worked. The data are produced according to the NAICS 2012.
h) Percentages of employment by sector and distribution of employment by sector and sex calculated by InterGroup Consultants Ltd.
LSA = local study area; RSA = regional study area; NAICS = North American Industry Classification System; n/c = not calculated.

Table 18A-17b: Employment by Industry Sector for Local Study Area Communities, 2016

Industry Sector	Birch Narrows Dene Nation[(a,b)]			Black Point[(a,b)]			Buffalo Narrows[(a,b)]			Buffalo River Dene Nation 193[(a,b)]			Clearwater River Dene 222[(a,b)]			La Loche[(a,b)]			Michel Village[(a,b)]			St. George's Hill[(a,b)]			Turnor Lake[(a,b)]			LSA[(a,b,c)]		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total labour force population aged 15 years and over by Industry – NAICS[(d)]	**165**	**90**	**80**	**10**	**0**	**0**	**475**	**220**	**260**	**260**	**135**	**125**	**270**	**140**	**130**	**525**	**270**	**255**	**30**	**15**	**15**	**40**	**20**	**15**	**40**	**15**	**25**	**1,815**	**905**	**905**
Industry – not applicable[(e)]	10	0	0	0	0	0	15	10	0	30	20	10	55	35	20	75	40	35	0	0	0	10	0	0	10	10	10	205	115	75
All industry categories[(f)]	160	85	75	10	0	0	460	205	255	230	120	110	210	100	110	455	230	225	25	10	15	30	20	15	25	15	15	1,605	785	820
Agriculture, forestry, fishing and hunting (NAICS 11)	10	10	0	0	0	0	30	25	0	20	15	10	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	70	60	10
Mining, quarrying, and oil and gas extractions (NAICS 21)	10	10	0	0	0	0	25	25	0	15	15	0	15	10	0	35	35	0-	0	0	0	0	0	0	10	10	0	110	105	0
Construction (NAICS 23)	10	15	0	0	0	0	25	25	0	25	25	0	40	35	0	45	40	10	10	0	0	10	0	0	0	0	0	165	140	10
Manufacturing (NAICS 31-33)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	10	0
Retail trade (NAICS 44-45)	15	10	10	0	0	0	30	10	25	15	10	10	20	10	15	55	25	30	0	0	0	0	0	0	0	0	0	135	65	90
Transportation and warehousing (NAICS 48-49)	0	10	0	0	0	0	25	10	15	15	10	0	0	0	0	15	10	0	0	0	0	0	0	0	0	10	0	55	50	15
Educational services (NAICS 61)	35	10	25	10	0	0	85	20	65	45	10	35	45	10	35	115	35	75	10	0	0	0	0	0	0	0	0	345	85	235
Health care and social assistance (NAICS 62)	20	0	15	0	0	0	85	0	80	25	10	20	30	10	25	70	15	55	0	0	0	0	0	0	10	0	0	240	35	195
Accommodation and food services (NAICS 72)	10	10	10	0	0	0	25	10	15	0	0	0	0	0	10	10	0	10	0	0	0	10	0	0	0	0	0	55	20	45
Other services (except public administration) (NAICS 81)	0	0	0	0	0	0	0	10	0	0	0	0	0	10	0	10	10	0	10	10	0	0	0	0	0	0	0	20	40	0
Public Administration (NAICS 91)	35	30	10	0	0	0	110	55	55	40	25	15	35	15	15	70	35	35	10	10	10	10	10	0	0	0	0	310	180	140
Other industry categories not included above (NAICS 22, 31-33, 41, 51, 52, 53, 54, 55, 56, 71)	0	0	0	0	0	0	25	20	10	10	10	0	20	10	30	20	30	0	0	0	0	0	0	0	0	0	0	75	70	40

Source: Statistics Canada 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases 10. Totals may not add up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Descharme Lake, and Garson Lake.

d) Includes the experienced labour force, which refers to persons aged 15 years and over who during the Census were employed and the unemployed who had last worked for pay or in self-employment prior to the Census.

e) Includes unemployed persons aged 15 years and over who have never worked for pay or in self-employment or who had last worked prior to 1 January 2015.

f) Refers to the general nature of the business carried out in the establishment where the person worked. The data are produced according to the NAICS 2012.

LSA = local study area; NAICS = North American Industry Classification System.

Table 18A-18a: Employment by Industry Sectors, for Local Study Area, 2001 to 2016

Industry Sector	Employment[a,b,c]												Percentage of Employment by Sector[a,b,c,d]											
	2001			2006			2011			2016			2001			2006			2011			2016		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total labour force population aged 15 years and over by Industry	1685	905	770	1555	825	720	1305	660	650	1815	905	905	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c
Industry - not applicable	300	180	130	225	130	80	145	80	50	205	115	75	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c	n/c
All industry categories	1375	740	640	1325	690	660	1165	565	595	1605	785	820	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
11 Agriculture, forestry, fishing and hunting	110	70	10	35	35	10	20	20	0	70	60	10	8.0%	9.5%	1.6%	2.6%	5.1%	1.5%	1.7%	3.5%	0.0%	4.4%	7.6%	1.2%
21 Mining, quarrying, oil and gas extraction	35	30	10	55	70	0	130	110	20	110	105	0	2.5%	4.1%	1.6%	4.2%	10.1%	0.0%	11.2%	19.5%	3.4%	6.9%	13.4%	0.0%
22 Utilities	10	40	0	10	0	0	0	0	0	0	0	0	0.7%	5.4%	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
23 Construction	115	120	0	120	110	10	60	45	0	165	140	10	8.4%	16.2%	0.0%	9.1%	15.9%	1.5%	5.2%	8.0%	0.0%	10.3%	17.8%	1.2%
31-33 Manufacturing	85	50	0	25	20	15	0	0	0	0	10	0	6.2%	6.8%	0.0%	1.9%	2.9%	2.3%	0.0%	0.0%	0.0%	0.0%	1.3%	0.0%
41 Wholesale trade	0	10	0	20	20	10	0	0	0	0	0	0	0.0%	1.4%	0.0%	1.5%	2.9%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
44-45 Retail trade	140	80	70	115	50	60	120	50	60	135	65	90	10.2%	10.8%	10.9%	8.7%	7.2%	9.1%	10.3%	8.8%	10.1%	8.4%	8.3%	11.0%
48-49 Transportation and warehousing	80	45	10	65	40	30	50	20	10	55	50	15	5.8%	6.1%	1.6%	4.9%	5.8%	4.5%	4.3%	3.5%	1.7%	3.4%	6.4%	1.8%
51 Information and cultural industries	10	0	0	20	10	0	0	0	0	0	0	10	0.7%	0.0%	0.0%	1.5%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.2%
52 Finance and insurance	15	0	10	30	10	20	0	0	0	0	0	0	1.1%	0.0%	1.6%	2.3%	1.4%	3.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
53 Real estate and rental and leasing	30	20	10	10	0	0	0	0	10	10	0	10	2.2%	2.7%	1.6%	0.8%	0.0%	0.0%	0.0%	0.0%	1.7%	0.6%	0.0%	1.2%
54 Professional, scientific, and technical services	0	0	0	10	20	0	0	0	0	0	10	0	0.0%	0.0%	0.0%	0.8%	2.9%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%	0.0%
55 Management of companies and enterprises	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
56 Administrative and support, waste management, and remediation services	10	10	10	30	30	0	10	0	0	55	40	20	0.7%	1.4%	1.6%	2.3%	4.3%	0.0%	0.9%	0.0%	0.0%	3.4%	5.1%	2.4%
61 Educational services	265	75	180	220	75	150	215	65	150	345	85	235	19.3%	10.1%	28.1%	16.6%	10.9%	22.7%	18.5%	11.5%	25.2%	21.5%	10.8%	28.7%
62 Health care and social assistance	170	30	130	225	30	195	150	10	130	240	35	195	12.4%	4.1%	20.3%	17.0%	4.3%	29.5%	12.9%	1.8%	21.8%	15.0%	4.5%	23.8%
71 Arts, entertainment, and recreation	0	10	0	10	0	0	10	0	0	10	10	0	0.0%	1.4%	0.0%	0.8%	0.0%	0.0%	0.9%	0.0%	0.0%	0.6%	1.3%	0.0%
72 Accommodation and food services	65	15	15	55	20	35	35	0	35	55	20	45	4.7%	2.0%	2.3%	4.2%	2.9%	5.3%	3.0%	0.0%	5.9%	3.4%	2.5%	5.5%
81 Other services (except public administration)	25	20	40	40	25	20	0	0	0	20	40	0	1.8%	2.7%	6.3%	3.0%	3.6%	3.0%	0.0%	0.0%	0.0%	1.2%	5.1%	0.0%
91 Public administration	275	160	105	235	140	90	335	160	165	310	180	140	20.0%	21.6%	16.4%	17.7%	20.3%	13.6%	28.8%	28.3%	27.7%	19.3%	22.9%	17.1%

Source: Statistics Canada 2002, 2007, 2012, 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases 10. Totals may not add up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake.

d) Percentages of employment by sector calculated by InterGroup Consultants Ltd.

n/c = not calculated.

Table 18A-18b: Employment by Industry Sectors for Local Study Area Communities, 2001 to 2016

Industry Sector	Birch Narrows Dene Nation(a,b,c)				Buffalo Narrows(a,b,c)				Buffalo River Dene Nation 193(a,b,c)				Clearwater River Dene 222(a,b,c)				La Loche(a,b,c)			
	2001	2006	2011	2016	2001	2006	2011	2016	2001	2006	2011	2016	2001	2006	2011	2016	2001	2006	2011	2016
Total labour force population aged 15 years and over by Industry	80	60	n/d	165	505	520	420	475	220	230	235	260	205	155	165	270	570	550	470	525
Industry - not applicable	0	0	n/d	10	25	25	10	15	30	50	35	30	40	50	15	55	195	90	85	75
All industry categories	75	55	n/d	160	475	495	415	460	190	185	200	230	165	100	150	210	375	455	385	455
11 Agriculture, forestry, fishing and hunting	10	0	n/d	10	40	15	0	30	10	10	10	20	0	0	0	10	20	10	10	0
21 Mining, quarrying, oil and gas extraction	0	0	n/d	10	15	25	55	25	0	0	20	15	10	0	15	15	10	30	40	35
22 Utilities	10	0	n/d	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
23 Construction	10	0	n/d	10	35	35	10	25	15	20	10	25	10	15	15	40	35	50	25	45
31-33 Manufacturing	0	0	n/d	0	15	15	0	0	30	10	0	0	10	0	0	0	10	0	0	0
41 Wholesale trade	0	10	n/d	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44-45 Retail trade	10	0	n/d	15	55	30	30	30	10	15	30	15	25	10	15	20	40	60	45	55
48-49 Transportation and warehousing	10	0	n/d	0	30	35	25	25	10	0	10	15	0	0	0	0	10	10	15	15
51 Information and cultural industries	0	0	n/d	0	10	10	0	0	0	0	0	0	0	0	0	0	0	10	0	0
52 Finance and insurance	0	0	n/d	0	15	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53 Real estate and rental and leasing	0	0	n/d	0	10	0	0	0	0	0	0	0	10	10	0	10	10	0	0	0
54 Professional, scientific, and technical services	0	0	n/d	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55 Management of companies and enterprises	0	0	n/d	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56 Administrative and support, waste management, and remediation services	0	10	n/d	0	10	0	0	15	0	0	0	10	0	0	0	10	0	10	10	20
61 Educational services	15	20	n/d	35	60	35	40	85	35	20	30	45	30	25	45	45	100	110	100	115
62 Health care and social assistance	0	10	n/d	20	60	100	55	85	20	20	20	25	25	20	15	30	55	75	60	70
71 Arts, entertainment, and recreation	0	0	n/d	0	0	0	0	10	0	0	0	0	0	0	0	0	0	10	10	0
72 Accommodation and food services	0	0	n/d	10	20	15	25	25	10	10	0	0	10	10	0	0	25	20	10	10
81 Other services (except public administration)	0	0	n/d	0	10	30	0	0	0	0	0	0	0	0	0	0	15	10	0	10
91 Public administration	25	15	n/d	35	90	95	170	110	45	45	50	40	50	15	30	35	45	55	75	70

Source: Statistics Canada 2002, 2007, 2012, 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases 10. Totals may not add up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) Proportions of employment by industry categories calculated by InterGroup Consultants Ltd.

n/d = no data available.

Table 18A-19a: Personal Income, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan (2015)

Personal Income	LSA[a,b,c,d,e]									Northern Saskatchewan (RSA)[a,b,c,d,f]									Saskatchewan[a,b,c,d]								
	Total			Indigenous Identity			Non-Indigenous Identity			Total			Indigenous Identity			Non-Indigenous Identity			Total			Indigenous Identity			Non-Indigenous Identity		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Average Total Income in 2015 Among Recipients[g,h]	**$30,810**	**$30,718**	**$30,910**	**$28,009**	**$27,735**	**$28,257**	**$68,440**	**$64,923**	**$71,183**	**$31,971**	**$34,485**	**$29,519**	**$25,961**	**$26,070**	**$25,859**	**$60,580**	**$70,208**	**$49,175**	**$49,409**	**$58,791**	**$40,184**	**$32,976**	**$35,768**	**$30,523**	**$51,838**	**$61,973**	**$41,704**
Total Number of Individuals 15 Years and Older with Income	3,390	1,580	1,810	3,160	1,455	1,695	240	120	130	22,760	11,235	11,525	18,815	9,100	9,715	3,950	2,140	1,810	822,540	407,835	414,705	105,925	49,535	56,390	716,620	358,305	358,315
Under $10,000	970	525	360	960	520	350	n/d	n/d	n/d	7,070	4,050	3,020	6,750	3,910	2,840	325	145	180	106,475	46,815	59,665	27,765	14,945	12,820	78,715	31,875	46,845
$10,000 to $19,999	705	280	355	690	265	355	n/d	n/d	n/d	4,435	1,790	2,640	3,975	1,600	2,375	455	190	265	117,515	46,740	70,780	19,560	7,935	11,630	97,955	38,805	59,150
$20,000 to $29,999	475	135	305	460	125	295	n/d	n/d	n/d	2,860	1,160	1,700	2,440	980	1,460	420	180	240	108,430	42,550	65,880	14,615	5,420	9,190	93,815	37,130	56,685
$30,000 to $39,999	300	85	180	285	85	180	n/d	n/d	n/d	2,035	825	1,215	1,675	665	1,010	365	160	200	95,735	41,515	54,220	11,650	4,535	7,115	84,090	36,980	47,105
$40,000 to $49,999	230	70	130	220	65	130	n/d	n/d	n/d	1,495	615	875	1,125	435	685	370	180	185	88,575	41,635	46,940	8,880	3,500	5,380	79,700	38,135	41,565
$50,000 to $59,999	150	70	65	135	60	55	n/d	n/d	n/d	1,050	465	580	710	300	405	345	165	170	70,625	37,265	33,360	6,320	2,955	3,365	64,310	34,315	29,995
$60,000 to $69,999	140	65	60	90	45	50	n/d	n/d	n/d	870	485	380	530	260	270	335	225	115	53,855	30,935	22,920	4,520	2,365	2,155	49,335	28,570	20,765
$70,000 to $79,999	120	50	65	105	50	50	n/d	n/d	n/d	605	315	295	360	170	190	245	145	100	41,680	24,930	16,745	3,360	1,775	1,585	38,320	23,150	15,165
$80,000 to $99,999[i]	160	95	95	100	45	35	n/d	n/d	n/d	1,055	570	495	585	280	310	475	280	195	60,370	37,025	23,345	4,660	2,670	1,985	55,710	34,360	21,355
$100,000 and over	140	85	50	95	65	30	n/d	n/d	n/d	1,285	960	325	670	495	175	615	460	150	79,280	58,415	20,860	4,605	3,440	1,170	74,670	54,980	19,690

Source: Statistics Canada 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases 10. Totals may not add up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) Income variables do not account for inflation.

d) Personal income variables were derived from 25% sample data. However, on Indian Reserves and in remote communities, attempts are made to obtain data from 100% of the population.

e) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George’s Hill, and Turnor Lake. However, data are not available: for Bear Creek, Black Point, Descharme Lake, Garson Lake, Michel Village, St. George’s Hill, and Turnor Lake; by income breakdown for male and female groups for Birch Narrows Dene Nation – Turnor Lake 193B; and by income breakdown for non-Indigenous identity income recipients.

f) Northern Saskatchewan (RSA) is defined as Census Division No.18.

g) Total income (i.e., personal income) refers to the total money income received during the calendar year prior to the Census year. Sources of income are: wages and salaries, net farm income; net non-farm income from unincorporated business and/or professional practice; child benefits; Old Age Security pension and Guaranteed Income Supplement; benefits from Canada Pension Plan or Quebec Pension Plan; benefits from Employment Insurance; other income from government sources; dividends, interest on bonds, deposits and savings certificates and other investment income; retirement pensions, superannuation and annuities, including those from RRSPs and RRIFs; and other money income. Not included in all Census years as total income: income tax refunds, lump sum inheritance payments, gambling revenue, lump sum insurance policy settlements, capital gains or losses, receipts from the sale of property or belongings, loan repayments, property tax rebates or refunds of pension contributions.

h) LSA average total income in 2015 among recipients is calculated based on the weighted average of Number of employment income recipients and Average employment income of the Indian Reserves, villages and hamlets.

i) The 2015 data sets group $80,000 to $99,999 as $80,000 to $89,999 and $90,000 to $99,999. These categories have been collapsed in the table.

LSA = local study area; RSA = regional study area; n/d = no data available.

Table 18A-19b: Personal Income, for Local Study Area Communities (2015)

Personal Income	LSA[a,b,c,d,e]																	
	Birch Narrows Dene Nation			Buffalo Narrows			Buffalo River Dene Nation 193			Clearwater River Dene 222			La Loche			LSA Total		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Average Total Income in 2015 Among Recipients[f,g]	**$26,702**	**$28,922**	**$24,744**	**$43,901**	**$43,758**	**$44,020**	**$25,238**	**$26,269**	**$24,228**	**$24,473**	**$25,187**	**$23,820**	**$29,030**	**$28,058**	**$29,846**	**$30,810**	**$30,718**	**$30,910**
Total Number of Individuals 15 Years and Older with Income	285	135	155	725	330	395	485	240	245	490	230	255	1,405	645	760	3,390	1,580	1,810
Under $10,000	85	n/d	n/d	120	65	55	195	105	90	215	120	95	355	235	120	970	525	360
$10,000 to $19,999	70	n/d	n/d	145	80	70	80	25	50	85	25	60	325	150	175	705	280	355
$20,000 to $29,999	40	n/d	n/d	70	15	50	65	35	35	60	30	35	240	55	185	475	135	305
$30,000 to $39,999	30	n/d	n/d	40	15	30	40	15	25	40	15	20	150	40	105	300	85	180
$40,000 to $49,999	15	n/d	n/d	65	20	40	20	10	0	25	10	15	105	30	75	230	70	130
$50,000 to $59,999	10	n/d	n/d	30	15	15	20	10	10	25	10	10	65	35	30	150	70	65
$60,000 to $69,999	10	n/d	n/d	65	30	30	15	10	0	10	0	10	40	25	20	140	65	60
$70,000 to $79,999	10	n/d	n/d	55	25	35	10	0	0	10	10	10	35	15	20	120	50	65
$80,000 to $99,999[h]	0	n/d	n/d	75	35	45	20	20	20	20	10	20	45	30	10	160	95	95
$100,000 and over	10	n/d	n/d	55	30	25	15	15	0	15	10	10	45	30	15	140	85	50

Source: Statistics Canada 2017a.
a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases 10. Totals may not add up due to rounding.
b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.
c) Income variables do not account for inflation.
d) Personal income variables were derived from 25% sample data. However, on Indian Reserves and in remote communities, attempts are made to obtain data from 100% of the population.
e) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available: for Bear Creek, Black Point, Descharme Lake, Garson Lake, Michel Village, St. George's Hill, and Turnor Lake; by income breakdown for male and female groups for Birch Narrows Dene Nation – Turnor Lake 193B; and by income breakdown for Non-Indigenous identity income recipients.
f) Total income (i.e., personal income) refers to the total money income received during the calendar year prior to the Census year. Sources of income are: wages and salaries, net farm income; net non-farm income from unincorporated business and/or professional practice; child benefits; Old Age Security pension and Guaranteed Income Supplement; benefits from Canada Pension Plan or Quebec Pension Plan; benefits from Employment Insurance; other income from government sources; dividends, interest on bonds, deposits and savings certificates and other investment income; retirement pensions, superannuation and annuities, including those from RRSPs and RRIFs; and other money income. Not included in all Census years as total income: income tax refunds, lump sum inheritance payments, gambling revenue, lump sum insurance policy settlements, capital gains or losses, receipts from the sale of property or belongings, loan repayments, property tax rebates or refunds of pension contributions.
g) LSA average total income in 2015 among recipients is calculated based on the weighted average of Number of employment income recipients and Average employment income of the Indian Reserves, villages and hamlets.
h) The 2015 data sets group $80,000 to $99,999 as $80,000 to $89,999 and $90,000 to $99,999. These categories have been collapsed in the table.
LSA = local study area; n/d = no data available due to data suppression.

Table 18A-20a: Household Income, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan (2015)

Household Income	LSA[a,b,c,d,e]			Northern Saskatchewan (RSA)[a,b,c,d,f]			Saskatchewan[a,b,c,d]		
	Total	Indigenous Identity	Non-Indigenous Identity	Total	Indigenous Identity	Non-Indigenous Identity	Total	Indigenous Identity	Non-Indigenous Identity
Average Income in 2015 for Private Households (before taxes)[g,h]	**$64,906**	**$62,750**	**$89,361**	**$71,111**	**$63,370**	**$106,767**	**$93,942**	**$75,155**	**$97,253**
Total Number of Private Households with Income in 2015[i]	1,600	1,490	105	10,230	8,410	1,825	432,625	64,830	367,790
Under $5,000	65	70	10	460	455	10	7,020	2,375	4,640
$5,000 to $9,999	60	60	0	315	310	10	4,585	1,630	2,955
$10,000 to $14,999	85	85	10	400	375	25	7,725	2,135	5,590
$15,000 to $19,999	130	135	0	780	735	45	17,985	3,820	14,170
$20,000 to $29,999[j]	170	160	0	1,145	1,045	95	33,620	6,230	27,395
$30,000 to $39,999[j]	200	180	0	955	850	100	35,345	6,380	28,970
$40,000 to $49,999[j]	135	125	10	845	730	125	33,595	5,870	27,720
$50,000 to $59,999	100	95	10	715	600	115	31,285	4,585	26,700
$60,000 to $69,999	100	75	0	610	460	150	30,150	4,290	25,860
$70,000 to $79,999	115	95	10	515	425	95	27,360	3,630	23,730
$80,000 to $89,999	70	50	0	475	360	115	25,860	3,495	22,365
$90,000 to $99,999	85	65	20	425	290	135	23,115	2,900	20,215

Table 18A-20a: Household Income, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan (2015)

Household Income	LSA(a,b,c,d,e)			Northern Saskatchewan (RSA)(a,b,c,d,f)			Saskatchewan(a,b,c,d)		
	Total	Indigenous Identity	Non-Indigenous Identity	Total	Indigenous Identity	Non-Indigenous Identity	Total	Indigenous Identity	Non-Indigenous Identity
$100,000 to $124,999	120	100	20	870	640	230	48,580	6,055	42,525
$125,000 to $149,999	80	75	10	605	390	215	34,875	4,145	30,725
$150,000 and over(j)	165	110	15	1,115	745	370	71,525	7,280	64,245

Source: Statistics Canada 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases 10. Totals may not add up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) Income variables do not account for inflation.

d) Household income variables were derived from 25% sample data. However, on Indian Reserves and in remote communities, attempts are made to obtain data from 100% of the population.

e) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, Garson Lake, Michel Village, St. George's Hill, and Turnor Lake.

f) Northern Saskatchewan (RSA) is defined as Census Division No.18.

g) Income refers to Total Income (i.e., household income). Total income is the total money income received during the calendar year prior to the Census year. Sources of income are: wages and salaries, net farm income; net non-farm income from unincorporated business and/or professional practice; child benefits; Old Age Security pension and Guaranteed Income Supplement; benefits from Canada Pension Plan or Quebec Pension Plan; benefits from Employment Insurance; other income from government sources; dividends, interest on bonds, deposits and savings certificates and other investment income; retirement pensions, superannuation and annuities, including those from RRSPs and RRIFs; and other money income. Not included in all Census years as total income: income tax refunds, lump sum inheritance payments, gambling revenue, lump sum insurance policy settlements, capital gains or losses, receipts from the sale of property or belongings, loan repayments, property tax rebates or refunds of pension contributions.

h) LSA average income in 2015 for private households is calculated based on the weighted average of Number and Average income of private households of the Indian Reserves, villages and hamlets.

i) Private household refers to a person or a group of persons (other than foreign residents) who occupy the same dwelling and do not have a usual place of residence elsewhere in Canada. It may consist of a family group (census family) with or without other persons, of two or more families sharing a dwelling, of a group of unrelated persons, or of one person living alone. Household members who are temporarily absent on Census Day (e.g., temporary residents elsewhere) are considered as part of their usual household. For census purposes, every person is a member of one and only one household. Unless otherwise specified, all data in household reports are for private households only.

j) The 2015 data sets grouped include: $20,000 to $29,999 as $20,000 to $24,999 and $25,000 to $29,999. These categories have been collapsed in the table; $30,000 to $39,999 as $30,000 to $34,999 and $35,000 to $39,999. These categories have been collapsed in the table; $40,000 to $49,999 as $40,000 to $44,999 and $45,000 to $49,999. These categories have been collapsed in the table; $150,000 and over as $150,000 to $199,999 and $200,000 and over. These categories have been collapsed in the table.

LSA = local study area; RSA = regional study area.

Table 18A-20b: Household Income, for Local Study Area Communities (2015)

Household Income	LSA[a,b,c,d,e]					
	Birch Narrows Dene Nation	Buffalo Narrows	Buffalo River Dene Nation 193	Clearwater River Dene 222	La Loche	LSA Total
Average Income in 2015 for Private Households (before taxes)[f,g]	**$58,296**	**$79,638**	**$52,534**	**$63,786**	**$62,036**	**$64,906**
Total Number of Private Households with Income in 2015[h]	130	400	230	185	655	1,600
Under $5,000	10	0	30	15	10	65
$5,000 to $9,999	10	10	20	10	10	60
$10,000 to $14,999	10	15	10	15	35	85
$15,000 to $19,999	10	50	15	10	45	130
$20,000 to $29,999[i]	25	25	25	10	85	170
$30,000 to $39,999[i]	25	30	25	25	95	200
$40,000 to $49,999[i]	10	30	20	10	65	135
$50,000 to $59,999	10	10	15	15	50	100
$60,000 to $69,999	10	30	10	10	40	100
$70,000 to $79,999	10	35	15	15	40	115
$80,000 to $89,999	10	15	0	10	35	70
$90,000 to $99,999	10	25	10	15	25	85
$100,000 to $124,999	10	55	10	0	45	120
$125,000 to $149,999	10	15	15	10	30	80
$150,000 and over[i]	20	65	20	20	40	165

Source: Statistics Canada 2017a.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases 10. Totals may not add up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) Income variables do not account for inflation.

d) Household income variables were derived from 25% sample data. However, on Indian Reserves and in remote communities, attempts are made to obtain data from 100% of the population.

e) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, Garson Lake, Michel Village, St. George's Hill, and Turnor Lake.

f) Income refers to Total Income (i.e., household income). Total income is the total money income received during the calendar year prior to the Census year. Sources of income are: wages and salaries, net farm income; net non-farm income from unincorporated business and/or professional practice; child benefits; Old Age Security pension and Guaranteed Income Supplement; benefits from Canada Pension Plan or Quebec Pension Plan; benefits from Employment Insurance; other income from government sources; dividends, interest on bonds, deposits and savings certificates and other investment income; retirement pensions, superannuation and annuities, including those from RRSPs and RRIFs; and other money income. Not included in all Census years as total income: income tax refunds, lump sum inheritance payments, gambling revenue, lump sum insurance policy settlements, capital gains or losses, receipts from the sale of property or belongings, loan repayments, property tax rebates or refunds of pension contributions.

g) The LSA average income in 2015 for private households is calculated based on the weighted average of Number and Average income of private households of the Indian Reserves, villages, and hamlets.

h) Private household refers to a person or a group of persons (other than foreign residents) who occupy the same dwelling and do not have a usual place of residence elsewhere in Canada. It may consist of a family group (census family) with or without other persons, of two or more families sharing a dwelling, of a group of unrelated persons, or of one person living alone. Household members who are temporarily absent on Census Day (e.g., temporary residents elsewhere) are considered as part of their usual household. For census purposes, every person is a member of one and only one household. Unless otherwise specified, all data in household reports are for private households only.

i) The 2015 data sets grouped include: $20,000 to $29,999 as $20,000 to $24,999 and $25,000 to $29,999. These categories have been collapsed in the table; $30,000 to $39,999 as $30,000 to $34,999 and $35,000 to $39,999. These categories have been collapsed in the table; $40,000 to $49,999 as $40,000 to $44,999 and $45,000 to $49,999. These categories have been collapsed in the table; $150,000 and over as $150,000 to $199,999 and $200,000 and over. These categories have been collapsed in the table.

LSA = local study area.

Table 18A-21a: Total Income Sources, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan (2015)

Income Sources	LSA[c,d]									Northern Saskatchewan (RSA)[e]									Saskatchewan								
	Total			Indigenous Identity			Non-Indigenous Identity			Total			Indigenous Identity			Non-Indigenous Identity			Total			Indigenous Identity			Non-Indigenous Identity		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Employment income[a]	67%	75%	60%	63%	72%	56%	92%	85%	91%	72%	79%	64%	68%	77%	59%	81%	82%	78%	73%	77%	68%	74%	82%	66%	73%	77%	69%
Government transfer payments[b]	31%	21%	40%	36%	24%	44%	6%	3%	0%	22%	14%	30%	29%	19%	37%	8%	6%	10%	11%	7%	15%	20%	12%	28%	10%	7%	14%
Other	2%	3%	0%	1%	4%	0%	2%	12%	9%	6%	7%	6%	4%	4%	4%	12%	12%	12%	16%	16%	17%	7%	7%	6%	17%	16%	18%

Source: Statistics Canada 2017a.

a) Employment income - All income received as wages salaries and commissions from paid employment and net self-employment income from farm or non-farm unincorporated business and/or professional practice during the reference period. For the 2016 Census the reference period is the calendar year 2015 for all income variables.

b) Government transfers - All cash benefits received from federal provincial territorial or municipal governments during the reference period. It includes: Old Age Security pension Guaranteed Income Supplement Allowance or Allowance for the Survivor, retirement disability and survivor benefits from Canada Pension Plan and Québec Pension Plan, benefits from Employment Insurance and Québec parental insurance plan, child benefits from federal and provincial programs, social assistance benefits, workers' compensation benefits, working income tax benefit, goods and services tax credit and harmonized sales tax credit, other income from government sources. For the 2016 Census the reference period is the calendar year 2015 for all income variables.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, Garson Lake, Michel Village, St. George's Hill, and Turnor Lake.

d) The LSA income source proportions in 2015 are calculated based on the weighted average of Number of income recipients and Income source proportions of the Indian Reserves, villages and hamlets.

e) Northern Saskatchewan (RSA) is defined as Census Division No.18.

LSA = local study area; RSA = regional study area.

Table 18A-21b: Total Income Sources, for Local Study Area Communities (2015)

Income Sources	LSA[c,d]																	
	Birch Narrows Dene Nation			Buffalo Narrows			Buffalo River Dene Nation 193			Clearwater River Dene 222			La Loche			LSA Total		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Employment income[a]	67%	77%	56%	78%	82%	76%	70%	75%	65%	68%	75%	61%	56%	70%	45%	67%	75%	60%
Government Transfer payments[b]	29%	19%	37%	17%	14%	20%	28%	22%	35%	29%	20%	37%	41%	25%	53%	31%	21%	40%
Other	5%	4%	7%	5%	4%	5%	2%	3%	0%	4%	5%	2%	3%	5%	2%	2%	3%	0%

Source: Statistics Canada 2017a.

a) Employment income - All income received as wages salaries and commissions from paid employment and net self-employment income from farm or non-farm unincorporated business and/or professional practice during the reference period. For the 2016 Census, the reference period is the calendar year 2015 for all income variables.

b) Government transfers - All cash benefits received from federal provincial territorial or municipal governments during the reference period. It includes: Old Age Security pension Guaranteed Income Supplement Allowance or Allowance for the Survivor, retirement disability and survivor benefits from Canada Pension Plan and Québec Pension Plan, benefits from Employment Insurance and Québec parental insurance plan, child benefits from federal and provincial programs, social assistance benefits, workers' compensation benefits, working income tax benefit, goods and services tax credit and harmonized sales tax credit, other income from government sources. For the 2016 Census the reference period is the calendar year 2015 for all income variables.

c) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, Garson Lake, Michel Village, St. George's Hill, and Turnor Lake.

d) LSA income source proportions in 2015 are calculated based on the weighted average of Number of income recipients and Income source proportions of the Indian Reserves, villages and hamlets.

LSA = local study area.

Table 18A-22a: Educational Attainment for the Population 15 Years of Age and Older, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016

Educational Attainment	Educational Attainment for the Population 15 Years of Age and Older																										
	LSA[a,b,c,d]									Northern Saskatchewan (RSA)[a,b,c,e]									Saskatchewan[a,b,c]								
	Total			Indigenous Identity			Non-Indigenous Identity			Total			Indigenous Identity			Non-Indigenous Identity			Total			Indigenous Identity			Non-Indigenous Identity		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total Population 15 and Over by Highest Certificate, Diploma or Degree[f]	**4,025**	**1,905**	**2,115**	**3,785**	**1,780**	**2,005**	**225**	**120**	**120**	**25,295**	**12,605**	**12,685**	**21,245**	**10,415**	**10,825**	**4,055**	**2,190**	**1,860**	**857,295**	**424,265**	**433,030**	**117,325**	**55,640**	**61,685**	**739,970**	**368,620**	**371,345**
Less than high school certificate	2,255	1,170	1,105	2,235	1,140	1,070	35	35	0	12,865	6,945	5,925	12,210	6,520	5,690	655	425	230	177,205	96,680	80,530	45,655	24,255	21,395	131,555	72,425	59,130
High school certificate or equivalent[g]	675	240	420	625	220	425	45	35	20	5,200	2,245	2,955	4,280	1,755	2,525	920	490	425	261,205	133,730	127,480	33,065	15,185	17,880	228,145	118,545	109,600
Apprenticeship or trades certificate or diploma	420	275	150	420	270	140	10	20	10	2,080	1,500	585	1,575	1,100	475	510	400	105	89,440	64,100	25,340	11,270	7,675	3,590	78,175	56,425	21,755
Post-Secondary non-university certificate or diploma[h]	380	150	235	350	135	200	55	10	15	2,815	1,180	1,630	1,950	780	1,170	865	400	465	146,765	51,240	95,525	15,900	5,135	10,760	130,870	46,100	84,765
University certificate or diploma below the bachelor's level	60	30	55	65	10	55	10	0	0	480	110	365	345	70	270	130	40	90	28,195	10,785	17,405	2,495	685	1,815	25,695	10,100	15,595
University degree at bachelor level or above	215	75	150	115	10	65	125	45	85	1,860	630	1,230	885	195	690	980	435	540	154,475	67,725	86,745	8,945	2,700	6,245	145,530	65,030	80,500

Educational Attainment	Proportions by Educational Attainment[i]																				
	LSA									Northern Saskatchewan			Saskatchewan		
	Total			Indigenous Identity			Non-Indigenous Identity								
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total Population 15 and Over by Highest Certificate, Diploma or Degree[f]	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Less than high school certificate	56.3%	60.3%	52.2%	58.7%	63.9%	54.7%	12.5%	24.1%	0.0%	50.8%	55.1%	46.7%	20.7%	22.8%	18.6%
High school certificate or equivalent[g]	16.9%	12.4%	19.9%	16.4%	12.3%	21.7%	16.1%	24.1%	15.4%	20.6%	17.8%	23.3%	30.5%	31.5%	29.4%
Apprenticeship or trades certificate or diploma	10.5%	14.2%	7.1%	11.0%	15.1%	7.2%	3.6%	13.8%	7.7%	8.2%	11.9%	4.6%	10.4%	15.1%	5.9%
Post-Secondary non-university certificate or diploma[h]	9.5%	7.7%	11.1%	9.2%	7.6%	10.2%	19.6%	6.9%	11.5%	11.1%	9.4%	12.8%	17.1%	12.1%	22.1%
University certificate or diploma below the bachelor's level	1.5%	1.5%	2.6%	1.7%	0.6%	2.8%	3.6%	0.0%	0.0%	1.9%	0.9%	2.9%	3.3%	2.5%	4.0%
University degree at bachelor level or above	5.4%	3.9%	7.1%	3.0%	0.6%	3.3%	44.6%	31.0%	65.4%	7.4%	5.0%	9.7%	18.0%	16.0%	20.0%

Source: Statistics Canada 2017a.
a) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Totals may not add up due to rounding.
b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.
c) Educational attainment data for 2016 were derived from 30% data. However, on Indian reserves and in remote communities, Statistics Canada attempts to obtain data from 100% of the population.
d) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake.
e) Northern Saskatchewan (RSA) is defined as Census Division No.18.
f) "Highest certificate, diploma or degree" refers to the highest certificate, diploma or degree the individual has completed based primarily on time spent" in-class." For high school graduates, a university education is considered to be a higher level of education than a college diploma, while a college education is considered to be a higher level of education than a trade. Although some trades requirements may take as long or longer to complete than a given college or university program, the majority of time acquiring trade certification may be on-the-job, as opposed to being in a classroom.
g) "High school certificate or equivalent" includes persons who have graduated from a secondary school or equivalent. Excludes persons with a postsecondary certificate, diploma or degree.
h) "Postsecondary non-university certificate or diploma" includes non-degree-granting institutions such as community colleges, CEGEPs, private business colleges and technical institutes.
i) Proportions by educational attainment calculated by InterGroup Consultants Ltd.
LSA = local study area; RSA = regional study area; CEGEP = Collège d'enseignement général et professionnel.

Table 18A-22b: Educational Attainment for the Population 15 Years of Age and Older, for Local Study Area Communities, 2016

Educational Attainment	LSA[a,b,c,d]																										
	Birch Narrows Dene Nation			Buffalo Narrows			Buffalo River Dene Nation 193			Clearwater River Dene 222			La Loche			Michel Village			St. George's Hill			Turnor Lake			LSA Total		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total Population 15 and Over by Highest Certificate, Diploma or Degree[e]	**315**	**150**	**165**	**760**	**360**	**405**	**550**	**270**	**275**	**570**	**280**	**290**	**1,585**	**735**	**850**	**45**	**20**	**25**	**105**	**50**	**50**	**95**	**40**	**55**	**4,025**	**1,905**	**2,115**
Less than high school certificate	135	75	65	245	155	95	300	160	140	370	205	170	1,065	505	560	20	10	10	70	35	35	50	25	30	2,255	1,170	1,105
High school certificate or equivalent[f]	70	25	45	145	50	95	55	20	35	95	35	65	255	100	150	15	0	10	20	0	10	20	10	10	675	240	420
Apprenticeship or trades certificate or diploma	40	30	10	125	70	55	105	70	35	35	25	15	90	60	25	15	10	0	0	10	0	10	0	10	420	275	150
Post-Secondary non-university certificate or diploma[g]	40	10	30	130	55	75	45	20	25	35	15	20	105	40	65	nd	n/d	n/d	10	10	10	15	0	10	380	150	235
University certificate or diploma below the bachelor's level	0	10	0	30	0	35	10	10	10	10	0	0	10	0	10	n/d	n/d	n/d	0	0	0	0	10	0	60	30	55
University degree at bachelor level or above	20	10	15	85	25	55	30	0	25	15	10	15	65	20	40	n/d	n/d	n/d	0	10	0	0	0	0	215	75	150

Source: Statistics Canada 2017a.

a) Statistics Canada data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 and in some cases, 10. Totals may not add up due to rounding.

b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.

c) Educational attainment data for 2016 were derived from 30% data. However, on Indian reserves and in remote communities, Statistics Canada attempts to obtain data from 100% of the population.

d) The LSA includes Bear Creek, Birch Narrows Dene Nation (Turnor Lake 193B), Black Point, Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake.

e) “Highest certificate, diploma or degree” refers to the highest certificate, diploma or degree the individual has completed based primarily on time spent” in-class.” For high school graduates, a university education is considered to be a higher level of education than a college diploma, while a college education is considered to be a higher level of education than a trade. Although some trades requirements may take as long or longer to complete than a given college or university program, the majority of time acquiring trade certification may be on-the-job, as opposed to being in a classroom.

f) “High school certificate or equivalent” includes persons who have graduated from a secondary school or equivalent. Excludes persons with a postsecondary certificate, diploma, or degree.

g) “Postsecondary non-university certificate or diploma” includes non-degree-granting institutions such as community colleges, CEGEPs, private business colleges and technical institutes.

LSA = local study area; CEGEP = Collège d'enseignement général et professionnel; n/d = no data available.

NexGen Energy Ltd.

Table 18A-23a: Labour Force Characteristics by Highest certificate, diploma or degree, for Local Study Area, Northern Saskatchewan (Regional Study Area), and Saskatchewan, 2016

Educational Attainment	LSA[a,b,c]					Northern Saskatchewan (RSA)[a,b,d]				Saskatchewan[a,b]			
	Population Aged 15 Years and Over[e]	Not in the Labour Force	In the Labour Force	Employed	Unemployed	Population Aged 15 Years and Over[e]	In the Labour Force	Employed	Unemployed	Population Aged 15 Years and Over[e]	In the Labour Force	Employed	Unemployed
Total - Highest certificate, diploma or degree[f]	**4,015**	**2,220**	**1,795**	**1,300**	**500**	**25,295**	**12,355**	**9,420**	**2,935**	**857,300**	**585,535**	**544,095**	**41,445**
No certificate, diploma, or degree	2,255	1,640	615	360	250	12,865	3,990	2,435	1,560	177,210	73,960	63,675	10,290
Secondary (high) school diploma or equivalency certificate	670	325	345	265	100	5,200	2,895	2,215	685	261,205	187,530	172,750	14,785
Apprenticeship or trades certificate or diploma	425	145	280	180	85	2,080	1,415	1,140	280	89,440	67,280	62,570	4,705
College, CEGEP, or other non-university certificate or diploma	370	70	300	235	55	2,815	2,100	1,785	315	146,770	111,365	105,860	5,505
University certificate or diploma below bachelor level	50	(10)	60	55	10	475	345	310	35	28,195	19,435	18,475	965
University degree	225	30	195	210	0	1,860	1,610	1,545	65	154,480	125,960	120,765	5,200

Source: Number of Positions (Payroll) from NexGen Energy Rook I Feasibility Study Spreadsheet.
a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases 10. Totals may not add up due to rounding.
b) In addition to random rounding, area and data suppression has been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If the community searched has a population of less than 40 persons, only the total population counts will be available. Suppression of data can be due to poor data quality or to other technical reasons.
c) The LSA includes Birch Narrows Dene Nation (Turnor Lake 193B), Buffalo Narrows, Buffalo River Dene Nation 193, Clearwater River Dene 222, Descharme Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data are not available for Descharme Lake.
d) Northern Saskatchewan (RSA) is defined as Census Division No.18.
e) Refers to whether a person aged 15 years and over was employed, unemployed or not in the labour force during the week of Sunday, 1 May, to Saturday, 7 May 2016.
f) Users are advised to consult data quality comments for 'Highest certificate diploma or degree ' available in the Education Reference Guide Census of Population 2016 Catalogue no. 98-500-X2016013.
LSA = local study area; RSA = regional study area; CEGEP = Collège d'enseignement général et professionnel.

Table 18A- 23b: Construction On-Site Labour, Annual Peak

Construction On Site	Year -4	Year -3	Year -2	Year -1
Surface construction	101	63	138	3
Underground: shaft sinking – contactor	88	129	64	0
Underground: lateral development / construction – contractor	0	0	78	88
Process plant / paste plant	0	0	1	59
Integrated execution team	18	40	49	28
Visitors, contractors, and consultants	10	12	17	17
Total	216	243	348	248

Source: Stantec 2021, Table 10-16 and Table 10-18.

Table 18A- 24: Number of Labour Positions in Payroll

Estimated Level of Education[(a)]	Total Labour Positions	Proportion in Total	LSA Employment		
			75%	50%	25%
Number of Labour Positions in Payroll					
On-the-job training	26	n/c	n/c	n/c	n/c
Trade	140	n/c	n/c	n/c	n/c
Trade / diploma / on-the-job training	4	n/c	n/c	n/c	n/c
Trade / diploma	2	n/c	n/c	n/c	n/c
Diploma	24	n/c	n/c	n/c	n/c
Diploma / on-the-job training	245	n/c	n/c	n/c	n/c
University	43	n/c	n/c	n/c	n/c
University / diploma	2	n/c	n/c	n/c	n/c
Total	486	n/c	n/c	n/c	n/c
Grouping of the Number of Annual Peak Labour Positions (Year 2) in Payroll					
Diploma / on-the-job training	295	60.7%	221	148	74
Trades	146	30.0%	110	73	37
University	45	9.3%	34	23	11
Total	486	100.0%	365	243	122
Input-Output Model Direct Employment Estimates in a Typical Operating Year					
Diploma / on-the-job training	277	60.7%	208	138	69
Trades	137	30.0%	103	68	34
University	42	9.3%	32	21	11
Total	456	100.0%	342	228	114

Source: Number of positions (payroll) with estimated level of education are based on the data provided by NexGen Energy Ltd. as Rook I Project Feasibility Study Workbook (Halliday 2021a, 2021b; Oakes 2021). Typical operating year labour positions total from Statistics Canada 2021b. Labour positions in payroll allocated into three groups by estimated level of education calculated by InterGroup Consultants Ltd.
a) Education requirement for average operations peak is estimated by calculating the proportion from annual peak allocation.
LSA = local study area; n/c = not calculated.

Table 18A-25: Detailed Labour Positions at Peak Year with Estimated Level of Education

Role	On-site	Payroll	Estimated Level of Education
Mine Labour Profile - Peak Year			
Mine Management			
Mine Superintendent	1	1	University
Underground Mine General Supervisor	1	2	Diploma / on-the-job training
Mine Clerk	1	2	Diploma / on-the-job training
Training Coordinator	2	4	Diploma / on-the-job training
Safety Officer	2	4	Diploma
Subtotal Mine Management	**7**	**13**	
Technical Services			
Mine Technical Services Manager	1	1	University
Senior Mine Engineer	3	6	University
Mine Engineer	2	4	University
Mine Technician and Surveyor	4	8	Diploma / on-the-job training
Automation Technician	4	8	Diploma / on-the-job training
Ventilation and Radiation Technician	4	8	Diploma / on-the-job training
Senior Mine Geologist	1	2	University
Geologist	2	4	University
Geological Technician	3	6	Diploma / on-the-job training
Subtotal Technical Services	**24**	**47**	
Mine Operations			
Shift Supervisor	6	12	Diploma / on-the-job training
Development Miner	6	12	Diploma / on-the-job training
Bolter	8	16	Diploma / on-the-job training
Load Haul Dump Operator	13	26	Diploma / on-the-job training
Shotcrete Operator	6	12	Diploma / on-the-job training
Service Miner	5	10	Diploma / on-the-job training
Trainee / Supply Delivery	4	8	On-the-job training
Production Driller	8	16	Diploma / on-the-job training
Cablebolt Driller	4	8	Diploma / on-the-job training
Blasting Operator	4	8	Diploma / on-the-job training
Construction Miner	8	16	Diploma / on-the-job training
Skip / Cage Tender	2	4	Diploma / on-the-job training
Batch Plant Operator	4	8	Diploma / on-the-job training
Paste Backfill Deposition Crew	4	8	Diploma / on-the-job training
Hoist Operator	2	4	Diploma / on-the-job training
Rock Breaker Operator	2	4	Diploma / on-the-job training
Grader Operator	1	2	Diploma / on-the-job training
Underground Truck Operator	2	4	Diploma / on-the-job training
Surface Truck Operator	6	12	Diploma / on-the-job training
Surface Labourer	1	2	On-the-job training
Subtotal Mine Operations	**96**	**192**	

Table 18A-25: Detailed Labour Positions at Peak Year with Estimated Level of Education

Role	On-site	Payroll	Estimated Level of Education
Mine Maintenance			
Maintenance Supervisor	1	2	Trade
Maintenance Planner	1	2	Diploma
Maintenance Clerk	1	2	Diploma / on-the-job training
Mechanical Leader	1	2	Trade
Electrical Leader	1	2	Trade
Mechanic	22	44	Trade
Hoist Mechanic	1	2	Trade
Electrician	4	8	Trade
Drill Repair	1	2	Trade
Maintenance Shop Labourers	4	8	On-the-job training
Warehouse Operator	3	6	Diploma / on-the-job training
Subtotal Mine Maintenance	**40**	**80**	
Mine Labour Positions, Total	**167**	**332**	
Process Plant / Paste Plant Labour Profile - Peak Year			
Process Operations			
Superintendent Process Plant	1	1	University
General Supervisor, Process Plant	1	2	University
Shift Supervisor, Process Plant	3	6	University
Control Room Operator	4	8	Diploma / on-the-job training
Grinding Operator			
Processing / Milling Operator II	2	4	Trade
Labourer	2	4	On-the-job training
Leaching and Counter Current Decantation Operator			
Processing / Milling Operator II	2	4	Trade
Labourer	2	4	On-the-job training
Solvent Extraction Operator			
Processing / Milling Operator III	2	4	Trade
Processing / Milling Operator I	2	4	Trade
Gypsum Precipitation Operator			
Processing / Milling Operator II	2	4	Trade
Yellowcake Precipitation and Calcining Operator			
Processing / Milling Operator III	2	4	Trade
Processing / Milling Operator I	2	4	Trade
Product Handling Operator			
Processing / Milling Operator II	2	4	Trade
Effluent Treatment Operator			
Effluent Treatment Plant Operator	1	2	Trade / diploma
Processing / Milling Operator I	2	4	Trade
Subtotal – Process Operations	**32**	**63**	

Table 18A-25: Detailed Labour Positions at Peak Year with Estimated Level of Education

Role	On-site	Payroll	Estimated Level of Education
Acid Plant			
Acid Plant Operator			
Processing / Milling Operator III	1	2	Trade
Processing / Milling Operator I	2	4	Trade
Subtotal – Process Acid Plant	**3**	**6**	
Process Maintenance			
Mill Maintenance General Supervisor			
General Supervisor, Maintenance	1	2	Trade
Mechanical Engineer	1	2	University
Maintenance Planner / Scheduler			
Maintenance Planner	1	2	Diploma / on-the-job training
Maintenance Clerk	1	2	Diploma / on-the-job training
Mechanical Supervisor			
Shift Supervisor, Maintenance	1	2	Trade
Electrician Supervisor			
Shift Supervisor, Maintenance	1	2	Trade
Electrician			
Electrician / Instrumentation Technician	2	4	Trade
Instrumentation Technician			
Electrician / Instrumentation Technician	2	4	Trade
Millwright			
Millwright / Welder	4	8	Trade
Mill Pipefitter / Welder			
Millwright / Welder	2	4	Trade
Mill Machinist			
Maintenance Mechanic III	1	2	Trade
Subtotal – Process Maintenance	**17**	**34**	
Process Technical Services			
Senior Metallurgist	1	1	University
Metallurgist	2	3	University
Laboratory Supervisor	1	2	University / diploma
Lab Technician	4	8	Diploma
Subtotal – Process Technical Services	**8**	**14**	
Paste Plant			
Paste Plant Operator			
Processing / Milling Operator III	2	4	Trade
Processing / Milling Operator I	2	4	Trade
Subtotal – Paste Plant	**4**	**8**	
Detailed Process Plant / Paste Plant Labour Profile, Total	**64**	**125**	

Table 18A-25: Detailed Labour Positions at Peak Year with Estimated Level of Education

Role	On-site	Payroll	Estimated Level of Education
General and Administration Labour Profile[a]			
Management and Administration			
General Manager	1	1	University
Administrative Assistant	1	1	Diploma / on-the-job training
Health and Safety			
Superintendent, Health, Safety, and Radiation Protection	1	1	University
Emergency Response Team Captain	1	1	Diploma
Radiation Protection Officer	1	1	University
Radiation Protection Specialist	1	1	University
Radiation Technician	3	3	Diploma
Environment			
Superintendent, Environment, and Permitting	1	1	University
Environmental Coordinator	1	1	University
Environmental Technician	2	2	Diploma
Procurement and Logistics			
Buyer	1	1	Diploma
Contracts Lead	1	1	Diploma
Accounting			
Accounts Payable Clerk	1	1	Diploma / on-the-job training
Site Controller	1	1	University
Finance Clerk	1	1	Diploma
Information Technology and Communications			
Information Technology / Communications Technician	1	1	Diploma
Surface Support and Maintenance			
Superintendent, Maintenance	1	1	University
Flight / Logistics (Travel) Coordinator	1	1	Diploma / on-the-job training
Site Services Supervisor	1	1	Trade / diploma / on-the-job training
Warehouse Supervisor	1	1	Trade / diploma / on-the-job training
Warehouse Technician	2	2	Trade / diploma / on-the-job training
Human Resources			
Superintendent, Human Resources	1	1	University
Human Resources Coordinator	1	1	University
Security			
Security Supervisor	1	1	Diploma / on-the-job training
Security Officer	1	1	Diploma / on-the-job training
General Administration Labour Positions, Total	**29**	**29**	
TOTAL	**260[b]**	**486**	

Source: Stantec 2021, Table 10-19, Table 10-21, and Table 10-22.
a) General and administration labour on-site labour numbers in Table 10-22 of the Feasibility Study are assumed equal to payroll.
b) The 260 people are expected to be on site at any one time at peak employment. Most personnel will work a two-week-in, two-week-out rotation, on a fly-in and fly-out basis. Some of the senior staff will work a rotation of four days on site, and three days off site, without a cross shift.

Table 18A-26: Estimated Direct Payments to Government for a Typical Operating Year

Government Level	Payment to Government	Estimated Payment in Typical Operating Year ($ millions [2020])
Saskatchewan Government	Resource surcharge	$32.6
	Basic royalty	$46.2
	Profit royalty	$127.7
	Corporate income tax	$80.9
	Personal income tax	$1.1
	Saskatchewan Government Total	**$288.5**
Federal Government	Corporate income tax	$101.1
	Personal income tax	$2.8
	Federal Government Total	**$103.9**
Total	**Saskatchewan and Federal Government Totals**	**$392.4**

Note: Estimates of federal and provincial personal income taxes were calculated based on median effective tax rates reported by Statistics Canada.

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Appendix 18B Rook I Project Economic Impact Modelling Results

Abbreviations and Units of Measure

Abbreviation	Definition
GDP	gross domestic product
I/O	input/output
NexGen	NexGen Energy Ltd.
Project	Rook I Project

Unit	Definition
%	percent

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18B.1 Introduction and Background

This appendix summarizes economic impact modelling results that were undertaken to support the assessment of potential effects on the economy of the Rook I Project (Project). Two analyses were completed:

- input/output (I/O) modelling; and
- government revenues modelling.

18B.2 Input/Output Modelling

Statistics Canada's I/O model uses the Canadian I/O tables to track and quantify the economic activity generated by changes in consumption or production. One common use of the I/O model is to simulate the impact of a demand shock[1] on the economy (Poole 1993) such as would occur with the construction and operation of a major development.

18B.2.1 Definitions

The I/O model results provide estimates of the direct, indirect and induced economic impacts of the Project, defined as the following (Statistics Canada 2021a):

- **Direct impact** measures the initial requirements for an extra dollar's worth of output of a given industry. The direct impact on the output of an industry is a one dollar change in output to meet the change of one dollar in final demand. Associated with this change, there will also be direct impacts on gross domestic product (GDP), jobs, and imports.
- **Indirect impact** measures the changes due to inter-industry purchases as they respond to the new demands of the directly affected industries. This includes all the chain reaction of output up the production stream since each of the products purchased will require, in turn, the production of various inputs.
- **Induced impact** measures the changes in the production of goods and services in response to consumer expenditures induced by households' incomes (e.g., wages) generated by the production of the direct and indirect requirements.

I/O modelling includes both an open and closed model. Total impact in the **open model** is equal to the sum of the direct and indirect impacts. Total impact in the **closed model** is equal to the sum of the direct, indirect, and induced impacts.

18B.2.2 Cautions and Limitations

Statistics Canada provides a number of cautions and limitations to note when interpreting I/O model results:

- The I/O model is based on the assumption of fixed technological coefficients. It does not take into account economies of scale, constraint capacities, technological change, externalities, or price changes. This makes impact analysis less accurate for long-term and large impacts as firms adjust their production technology and the I/O technological coefficients become outdated. Assuming that firms adjust their production technology over time to become more efficient implies that the impact of a change in final demand will tend to be overestimated.

[1] A demand shock means any departure from the status quo or any change in demand for goods and services.

- The household consumption assumptions within the I/O model are based on constant consumption behaviour and fixed expenditure shares relative to incomes.
- It is generally acknowledged that the open model underestimates economic impacts since household activity is absent and the closed model overestimates economic impacts because of the rigid assumptions about labour incomes and consumer spending. They can be considered as upper and lower bounds of impact.

Full-time equivalence and number of jobs

Two types of jobs impacts and multipliers are available: one for the total number of jobs and another that transforms the paid employee jobs into a full-time-equivalent number of jobs. The estimate of the total number of jobs covers two main categories: employee jobs and self-employed jobs (including persons working in a family business without pay). The total number of jobs includes full-time, part-time, temporary jobs, and self-employed jobs. It does not take into account the number of hours worked per employee. Full-time-equivalent jobs include only employee jobs that are converted to full-time equivalence based on the overall average full-time hours worked in either the business or government sectors.

Industrial classification and sectoring in the I/O accounts

Industries are organized according to three broad sectors of the economy: business, government, and non-profit institutions serving households sectors. The business sector is disaggregated by industry according to the North American Industrial Classification System. The non-profit institutions serving households sector is disaggregated into the few industries where its activities are concentrated and a large aggregation of residual industries. The government sector, however, is disaggregated, not by industry, but by broad functions, such as education, health, and public administration. Activities of government business enterprises operating for a profit are classified to the business sector industries. However, agencies, commissions, and boards financed from public funds are classified to the government sector.

18B.2.3 Input/Output Modelling Scenarios and Data Inputs

Five I/O modelling runs were completed for three categories and two types of expenditures:

- capital spending during Project Construction:
  - capital expenditures in purchaser prices (approximately $416 million of total construction costs);
  - industry inputs expenditures in purchaser prices (approximately $884 million in total construction costs)
- operating spending during a typical year in Operations (approximately $1,087 million in a typical year);
- sustaining capital spending during a typical year in Operations:
  - capital expenditures in purchaser prices (approximately $4 million of typical annual sustaining capital costs); and
  - industry inputs expenditures in purchaser prices (approximately $5 million of typical annual sustaining capital costs).

Data provided to Statistics Canada for modelling purposes were taken from the Project feasibility study (Stantec 2021) and cash flow modelling prepared for NexGen (Halliday 2021). Other assumptions used in preparing the inputs to the modelling include:

- It was assumed 75% of operating labour would be supplied by residents of Saskatchewan.
- Spending profiles were allocated by Statistics Canada into different commodity codes based on Statistics Canada's economic profile information.
- Contingencies included in budgets were allocated proportionately to each cost area.

Input sheets used in the I/O analysis are included as Attachment 1 through Attachment 5. Consistent with the guidance provided in Section 18B.2.2, Cautions and Limitations, results for the closed and open model are presented as boundaries on the range of potential economic impact outcomes.

18B.2.4 Input/Output Modelling Results

Table 18B-1 summarizes the results of the I/O modelling for Construction for GDP at basic prices[2], labour income, and jobs.

Table 18B-1: Input/Output Modelling Results for Construction

Metric	Saskatchewan			Canada		
	Capital Expenditures	Industry Input Expenditures	Total	Capital Expenditures	Industry Input Expenditures	Total
GDP at basic prices ($millions)						
Direct	112.7	444.0	556.7	147.7	444.0	591.6
Direct + Indirect (open model)	158.9	549.5	708.4	255.5	668.0	923.4
Direct + Indirect + Induced (closed model)	188.4	723.8	912.3	327.0	954.6	1,281.6
Labour Income ($millions)						
Direct	63.7	444.0	507.7	88.0	444.0	531.9
Direct + Indirect (open model)	90.4	504.9	595.3	152.1	578.3	730.3
Direct + Indirect + Induced (closed model)	101.5	570.5	672.0	183.4	701.6	885.0
Jobs, full-time equivalent						
Direct	732	4,869	5,601	999	4,869	5,868
Direct + Indirect (open model)	1,031	5,628	6,659	1,737	6,497	8,234
Direct + Indirect + Induced (closed model)	1,214	6,710	7,924	2,208	8,371	10,579

Note: Totals may not sum due to rounding.

Key results from the I/O model indicate:

- Direct full-time equivalent jobs during Construction from the industry input expenditures are estimated to be approximately 4,870.

[2] Statistics Canada defines GDP at basic prices as gross domestic product at market prices minus taxes less subsidies on products. Gross domestic product at basic prices is also equal to the traditional value at factor cost plus taxes less subsidies on the factors of production (labour and capital).

- Total direct, indirect, and induced jobs across Canada as a result of Construction could range from approximately 8,200 jobs (open model results) to 10,600 (closed model results).
- Total direct labour income during Construction is estimated at approximately $532 million, including an allocation of contingencies to labour.
- Total direct, indirect, and induced labour income across Canada as a result of Construction could range from approximately $730 million (open model results) to $885 million (closed model results).

Table 18B-2 summarizes the results of the I/O modelling for a typical Operations year for GDP at basic prices, labour income and jobs.

Table 18B-2: Input/Output Modelling Results for Typical Operations Year

Metric	Saskatchewan	Canada
GDP at basic prices ($millions)		
Direct	960.9	974.6
Direct + Indirect (open model)	998.2	1,054.2
Direct + Indirect + Induced (closed model)	1,014.9	1,095.1
Labour Income ($millions)		
Direct	41.3	55.0
Direct + Indirect (open model)	56.0	94.1
Direct + Indirect + Induced (closed model)	62.3	112.1
Jobs, full-time equivalent		
Direct	335	456
Direct + Indirect (open model)	543	959
Direct + Indirect + Induced (closed model)	647	1,235

Note: Totals may not sum due to rounding.

Key results from the I/O model indicate:

- The I/O model estimates direct employment of approximately 456 full-time equivalent jobs in a typical operating year for Canada as a whole. This is similar to the 486 estimated jobs at peak included in the feasibility study (Appendix 18A, Socio-Economic Statistical Data, Table 18A-25; and Stantec 2021, Table 10-19, Table 10-21, and Table 10-22). For Saskatchewan, it is estimated there would be approximately 335 full-time equivalent jobs in a typical operating year.
- Total direct, indirect, and induced jobs across Canada could range from approximately 959 jobs (open model results) to 1,235 (closed model results).
- The I/O model estimates direct labour income of approximately $55 million in a typical operating year, of which approximately $41 million would occur in Saskatchewan.
- Total direct, indirect, and induced labour income across Canada could range from approximately $94 million (open model results) to $112 million (closed model results).

Table 18B-3 summarizes the results of the I/O modelling for a typical Operations year for GDP at basic prices, labour income and jobs due to sustaining capital expenditures. These are in addition to the economic impacts shown in Table 18B-2.

Table 18B-3: Input/Output Modelling Results for Typical Sustaining Capital Year

Metric	Saskatchewan			Canada		
	Capital Expenditures	Industry Input Expenditures	Total	Capital Expenditures	Industry Input Expenditures	Total
GDP at basic prices ($millions)						
Direct	0.5	2.3	2.9	1.1	2.3	3.4
Direct + Indirect (open model)	0.7	2.9	3.6	1.6	3.7	5.2
Direct + Indirect + Induced (closed model)	0.8	3.8	4.6	2.0	5.2	7.2
Labour Income ($millions)						
Direct	0.3	2.3	2.6	0.7	2.3	3.0
Direct + Indirect (open model)	0.3	2.7	3.0	1.0	3.1	4.1
Direct + Indirect + Induced (closed model)	0.4	3.0	3.4	1.2	3.8	4.9
Jobs, full-time equivalent						
Direct	4	26	29	8	26	34
Direct + Indirect (open model)	4	30	34	12	35	47
Direct + Indirect + Induced (closed model)	5	36	41	15	45	60

Note: Totals may not sum due to rounding.

Key results from the I/O model indicate:

- Direct full-time equivalent jobs are estimated to be approximately 34 jobs.
- Total direct, indirect, and induced jobs across Canada could range from approximately 47 jobs (open model results) to 60 jobs (closed model results).

18B.3 Government Revenues

Government revenues were estimated for a typical operating year based on cash flow modelling (Halliday 2021) prepared for NexGen and Statistics Canada 50th percentile income tax rates for census families and persons not in census families (Statistics Canada 2021b). Table 18B-4 summarizes the estimated payments to government in a typical operating year. Table 18B-5 provides the estimate of federal and provincial personal income tax.

Table 18B-4: Summary of Estimated Government Revenues for a Typical Operating Year ($ Millions)

Government of Saskatchewan	Total
Resource surcharge	32.6
Basic royalty	46.2
Profit royalty	127.7
Provincial corporate income tax	80.9
Provincial personal income tax	1.1
Saskatchewan Total	**288.5**
Government of Canada	**Total**
Corporate income tax	101.1
Personal income tax	2.8
Canada Total	**103.9**

Table 18B-5: Summary of Estimated Personal Income Tax for a Typical Operating Year ($ Millions)[3]

Metric	Estimates
Total labour costs	$55.0
Average payroll burden[4]	28%
Estimated direct compensation	$43.0
2018 50th percentile federal income tax rate	6.5%
Estimated federal personal income tax	$2.8
2018 50th percentile Saskatchewan provincial income tax rate	3.3%
Estimated provincial personal income tax	$1.1

Key results from the government revenues modelling indicate:

- Direct Project revenues to the Government of Saskatchewan during a typical operating year are estimated to be approximately $289 million, of which approximately $207 million is from royalties and the resource surcharge, $81 million is from corporate income tax, and $1 million is from personal income tax.
- Direct Project revenues to the Government of Canada during a typical operating year are estimated to be approximately $104 million, of which approximately $101 million is from corporate income tax.

[3] 50th percentile income tax rates available (Statistics Canada 2021b).
[4] 28% is a rough estimate across job categories. Burden percentage varies by position type. Burden includes workers compensation, employment insurance, CPP, statutory holiday pay, vacation pay, group insurance and RRSP contributions.

18B.4 References

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Attachment 1 Construction – Capital Expenditure, In Purchaser Prices, at the Detailed Level

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Construction, Capital Expenditure, in Purchase Prices)

Thousands of dollars

		Commodities (Detail level)	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
1	MPG111A01	Canola (including rapeseed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	MPG111A02	Oilseeds (except canola)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	MPG111A03	Wheat	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	MPG111A04	Grains (except wheat)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	MPG111A05	Fresh potatoes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	MPG111A10	Fresh fruits and nuts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	MPG111A11	Other miscellaneous crop products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	MPG111A08	Fresh vegetables (except potatoes)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	IMG111A09	Imputed feed (animal feed produced for own consumption)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	MPG111400	Nursery and floriculture products (except cannabis)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	MPG111C00	Cannabis plants, seeds and flowering tops	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	MPG112001	Cattle and calves	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	MPG112002	Unprocessed fluid milk	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	MPG112003	Hogs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	MPG112004	Eggs in shell	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	MPG112005	Poultry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	MPG112006	Other live animals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	MPG112007	Raw furskins, and animal products n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	IMG112008	Imputed fertilizer (fertilizer produced for own consumption)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	MPG113001	Logs and bolts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	MPG113002	Pulpwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	ENE113003	Fuel wood	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	MPG113004	Rough untreated poles, posts and piling	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	MPG114000	Fish, crustaceans, shellfish and other fishery products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	MPS11X000	Custom work services for forestry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	MPS115A01	Support services for crop production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	MPS115A02	Support services for animal production, hunting and fishing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	MPS115300	Support services for forestry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	ENE211105	Conventional crude oil	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	ENE211106	Synthetic crude oil	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	ENE211102	Natural gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	ENE211103	Natural gas liquids and related products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	ENE211104	Crude and diluted bitumen	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	ENE212100	Coal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	MPG212210	Iron ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	MPG212220	Gold and silver ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	MPG212231	Copper ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	MPG212232	Nickel ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	MPG212233	Lead and zinc ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	MPG212291	Radioactive ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	MPG212299	Other metal ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	MPG212310	Stone	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	MPG212320	Sand, gravel, clay, and refractory minerals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	MPG212392	Uncut and industrial diamonds	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	MPG212396	Potash	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	MPG21239C	Non-metallic minerals (except diamonds)	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Construction, Capital Expenditure, in Purchase Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
47	MPS21311A	Support services for oil and gas extraction (except exploration)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	MPS21311B	Support services for mining and quarrying (except exploration)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	MPS21A000	Mineral and oil and gas exploration	0	0	0	0	0	0	0	7,411	0	0	0	0	0	0
50	ENE221100	Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	MPS221200	Natural gas distribution	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	MPS221301	Water delivered by water works and irrigation systems	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	MPS221302	Sewage and dirty water disposal and cleaning services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	ENE221303	Steam and heated or cooled air or water	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	MPG23A000	Residential construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	MPG23B001	Industrial buildings	0	0	0	0	0	0	0	2,542	0	0	0	0	0	0
57	MPG23B002	Office buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	MPG23B003	Shopping centers, plazas, malls and stores	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	MPG23B004	Other commercial buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	MPG23B005	Schools, colleges, universities and other educational buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	MPG23B006	Health care buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	MPG23B007	Other institutional buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	MPG23C101	Highways, roads, streets, bridges and tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	MPG23C109	Other transportation construction	0	0	0	0	0	0	0	78	0	0	0	0	0	0
65	MPG23C201	Production facilities in oil and gas extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	MPG23C209	Other oil and gas engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	MPG23C300	Electric power engineering construction	0	0	0	0	0	0	0	1,167	0	0	0	0	0	0
68	MPG23C400	Communication engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	MPG23C501	Marine engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	MPG23C502	Waterworks engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	MPG23C503	Sewage engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	MPG23C504	Mining engineering construction	0	0	0	0	0	0	0	175,169	0	0	0	0	0	0
73	MPG23C509	Other engineering construction	0	0	0	0	0	0	0	111	0	0	0	0	0	0
74	MPS23D000	Repair construction services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	MPG311101	Dog and cat food	0	0	0	0	0	0	0	0	0	0	0	0	0	0
76	MPG311109	Other animal feed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77	MPG311204	Flour and other grain mill products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
78	MPG311202	Margarine and cooking oils	0	0	0	0	0	0	0	0	0	0	0	0	0	0
79	MPG311203	Breakfast cereal and other cereal products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	MPG311208	Grain and oilseed products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81	MPG311301	Sugar and sugar mill by-products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	MPG311302	Chocolate (except confectionery)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	MPG311303	Confectionery products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
84	MPG311401	Fresh, frozen and canned fruit and vegetable juices	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85	MPG311402	Preserved fruit and vegetables and frozen foods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
86	MPG311501	Processed fluid milk and milk products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
87	MPG311502	Cheese and cheese products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
88	MPG311503	Butter and dry and canned dairy products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
89	MPG311504	Ice cream, sherbet and similar frozen desserts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	MPG311601	Fresh and frozen beef and veal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	MPG311602	Fresh and frozen pork	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	MPG311603	Fresh and frozen poultry of all types	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Construction, Capital Expenditure, in Purchase Prices)

Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
93	MPG311605	Processed meat products, other miscellaneous meats and animal by-products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	MPG311700	Prepared and packaged seafood products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	MPG311801	Bread, rolls and flatbreads	0	0	0	0	0	0	0	0	0	0	0	0	0	0
96	MPG311802	Cookies, crackers and baked sweet goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
97	MPG311803	Flour mixes, dough and dry pasta	0	0	0	0	0	0	0	0	0	0	0	0	0	0
98	MPG311901	Snack food products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99	MPG311902	Coffee and tea	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	MPG311903	Flavouring syrups, seasonings and dressings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
101	MPG311909	Other food products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
102	MPG312110	Bottled water, soft drinks and ice	0	0	0	0	0	0	0	0	0	0	0	0	0	0
103	MPG312120	Beer	0	0	0	0	0	0	0	0	0	0	0	0	0	0
104	MPG3121A1	Wine and brandy	0	0	0	0	0	0	0	0	0	0	0	0	0	0
105	MPG3121A2	Distilled liquor	0	0	0	0	0	0	0	0	0	0	0	0	0	0
106	MPG312201	Stemmed, redried or reconstituted tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
107	MPG312202	Cigarettes, cigars, chewing and smoking tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
108	MPG312300	Cannabis products (except plants, seeds and flowering tops)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
109	MPG31A001	Fibre, yarn and thread	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	MPG31A002	Fabrics	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	MPG31A003	Carpets, rugs and mats	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112	MPG31A004	Other textile furnishings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
113	MPG31A005	Textile products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
114	MPS31A006	Textile and fabric finishing and coating services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115	MPG31B001	Men's, women's, boys' and girls' clothing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
116	MPG31B002	Infant clothing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
117	MPG31B003	Clothing accessories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
118	MPG31B004	Leather and dressed furs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
119	MPG31B005	Footwear	0	0	0	0	0	0	0	0	0	0	0	0	0	0
120	MPG31B006	Suitcases, handbags and other leather and allied products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
121	MPG321101	Hardwood lumber	0	0	0	0	0	0	0	0	0	0	0	0	0	0
122	MPG321102	Softwood lumber	0	0	0	0	0	0	0	0	0	0	0	0	0	0
123	MPG321103	Wood chips	0	0	0	0	0	0	0	0	0	0	0	0	0	0
124	MPG321104	Other sawmill products and treated wood products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
125	MPG321201	Veneer and plywood	0	0	0	0	0	0	0	0	0	0	0	0	0	0
126	MPG321202	Wood trusses and engineered wood members	0	0	0	0	0	0	0	0	0	0	0	0	0	0
127	MPG321203	Reconstituted wood products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
128	MPG321901	Wood windows and doors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
129	MPG321903	Wood containers and pallets	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	MPG321904	Prefabricated wood and manufactured (mobile) buildings and components	0	0	0	0	0	0	0	0	0	0	0	0	0	0
131	MPG321908	Wood products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
132	MPG321X00	Waste and scrap of wood and wood by-products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
133	MPG322101	Wood pulp	0	0	0	0	0	0	0	0	0	0	0	0	0	0
134	MPG322102	Paper (except newsprint)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135	MPG322103	Newsprint	0	0	0	0	0	0	0	0	0	0	0	0	0	0
136	MPG322104	Paperboard	0	0	0	0	0	0	0	0	0	0	0	0	0	0
137	MPG322201	Paperboard containers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
138	MPG322202	Paper office supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Construction, Capital Expenditure, in Purchase Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
139	MPG322203	Disposable diapers and feminine hygiene products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
140	MPG322204	Sanitary paper products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
141	MPG322209	Other converted paper products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
142	MPG322X00	Waste and scrap of paper and paperboard	0	0	0	0	0	0	0	0	0	0	0	0	0	0
143	MPG323001	Printed products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
144	MPS323002	Support services for printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
145	MPS323003	Contract printing services for publishers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
146	ENE324111	Gasoline	0	0	0	0	0	0	0	0	0	0	0	0	0	0
147	ENE324112	Diesel and biodiesel fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
148	ENE324113	Light fuel oils	0	0	0	0	0	0	0	0	0	0	0	0	0	0
149	ENE324114	Jet fuel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150	ENE324115	Heavy fuel oils	0	0	0	0	0	0	0	0	0	0	0	0	0	0
151	MPG3241A8	Lubricants and other petroleum refinery products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
152	MPG3241A1	Asphalt (except natural) and asphalt products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
153	ENE3241A2	Coke and other coke oven products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
154	ENE32A000	Solid fuel products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
155	MPG325101	Petrochemicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
156	MPG325102	Industrial gases	0	0	0	0	0	0	0	0	0	0	0	0	0	0
157	MPG325103	Dyes and pigments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
158	MPG325106	Other basic inorganic chemicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
159	MPG325105	Basic organic chemicals, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
160	MPG325201	Plastic resins	0	0	0	0	0	0	0	0	0	0	0	0	0	0
161	MPG325202	Rubber and rubber compounds and mixtures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
162	MPG325203	Artificial and synthetic fibres and filaments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
163	MPG325301	Ammonia and chemical fertilizers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
164	MPG325302	Pesticides and other agricultural chemicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
165	MPG325400	Pharmaceutical and medicinal products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
166	MPG325500	Paints, coatings and adhesive products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
167	MPG325601	Soaps and cleaning compounds	0	0	0	0	0	0	0	0	0	0	0	0	0	0
168	MPG325602	Perfumes and toiletries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
169	MPG325900	Chemical products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
170	MPG326101	Plastic bags	0	0	0	0	0	0	0	0	0	0	0	0	0	0
171	MPG326102	Plastic films and non-rigid sheets	0	0	0	0	0	0	0	0	0	0	0	0	0	0
172	MPG326103	Plastic and foam building and construction materials	0	0	0	0	0	0	0	0	0	0	0	0	0	0
173	MPG326104	Plastic profile shapes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
174	MPG326105	Foam products (except for construction)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
175	MPG326106	Plastic bottles	0	0	0	0	0	0	0	0	0	0	0	0	0	0
176	MPG326107	Motor vehicle plastic parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
177	MPG326109	Plastic products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
178	MPG326201	Tires	0	0	0	0	0	0	0	0	0	0	0	0	0	0
179	MPG326202	Rubber and plastic hoses and belts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
180	MPG326209	Rubber products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
181	MPG326X00	Waste and scrap of plastic and rubber	0	0	0	0	0	0	0	0	0	0	0	0	0	0
182	MPG327301	Cement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
183	MPG327302	Ready-mixed concrete	0	0	0	0	0	0	0	0	0	0	0	0	0	0
184	MPG327303	Concrete products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
185	MPG327A01	Clay and ceramic products and refractories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
186	MPG327A02	Glass (including automotive), glass products and glass containers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
187	MPG327A03	Waste and scrap of glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0
188	MPG327A04	Lime and gypsum products	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Construction, Capital Expenditure, in Purchase Prices)
Thousands of dollars

		Commodities (Detail level)	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
189	MPG327A09	Non-metallic mineral products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
190	MPG331100	Iron and steel basic shapes and ferro-alloy products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
191	MPG331201	Iron and steel pipes and tubes (except castings)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
192	MPG331202	Wire and other rolled and drawn steel products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
193	MPG331301	Bauxite and aluminum oxide	0	0	0	0	0	0	0	0	0	0	0	0	0	0
194	MPG331302	Unwrought aluminum including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
195	MPG331303	Basic and semi-finished products of aluminum and alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
196	MPG331401	Unwrought copper including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
197	MPG331402	Unwrought nickel including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
198	MPG331403	Unwrought precious metals including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
199	MPG331404	Other unwrought non-ferrous metals including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200	MPG331405	Gold, store of value	0	0	0	0	0	0	0	0	0	0	0	0	0	0
201	MPG331406	Basic and semi-finished products of non-ferrous metals and alloys (except aluminum)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
202	MPG331501	Ferrous metal castings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
203	MPG331502	Non-ferrous metal castings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
204	MPG331X01	Waste and scrap of iron and steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
205	MPG331X02	Waste and scrap of non-ferrous metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
206	MPG332101	Forged and stamped metal products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
207	MPG332301	Prefabricated metal buildings and components	0	0	0	0	0	0	0	0	0	0	0	0	0	0
208	MPG332302	Fabricated steel plates and other fabricated structural metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
209	MPG332303	Metal windows and doors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
210	MPG332A05	Other architectural metal products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
211	MPG332401	Light gauge metal containers, crowns and closures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
212	MPG332402	Boilers, tanks and heavy gauge metal containers	0	0	0	0	0	0	0	4,655	0	0	0	0	0	0
213	MPG332500	Builders, motor vehicle and other hardware	0	0	0	0	0	0	0	0	0	0	0	0	0	0
214	MPG332600	Springs and wire products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
215	MPG332700	Threaded metal fasteners and other turned metal products including automotive	0	0	0	0	0	0	0	0	0	0	0	0	0	0
216	MPS332800	Coating, engraving, heat treating and similar metal processing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
217	MPG332A01	Hand tools, kitchen utensils and cutlery (except precious metal)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
218	MPG332A02	Metal valves and pipe fittings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
219	MPG332A03	Ball and roller bearings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
220	MPG332A04	Guns, ammunition and other munitions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
221	MPG332A08	Fabricated metal products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
222	MPG333101	Agricultural, lawn and garden machinery and equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
223	MPG333102	Logging, mining and construction machinery and equipment	0	0	0	0	0	0	0	143,234	0	0	0	0	0	0
224	MPG333200	Other industry-specific machinery	0	0	0	0	0	0	0	304	0	0	0	0	0	0
225	MPG333300	Commercial and service industry machinery	0	0	0	0	0	0	0	68	0	0	0	0	0	0
226	MPG333401	Industrial and commercial fans, blowers and air purification equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Capital expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Construction, Capital Expenditure, in Purchase Prices)

Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
227	MPG333402	Heating and cooling equipment (except household refrigerators and freezers)	0	0	0	0	0	0	0	942	0	0	0	0	0	0
228	MPG333500	Metalworking machinery and industrial moulds	0	0	0	0	0	0	0	0	0	0	0	0	0	0
229	MPG333601	Turbines, turbine generators, and turbine generator sets	0	0	0	0	0	0	0	475	0	0	0	0	0	0
230	MPG333609	Other engine and power transmission equipment	0	0	0	0	0	0	0	142	0	0	0	0	0	0
231	MPG333901	Pumps and compressors (except fluid power)	0	0	0	0	0	0	0	3,643	0	0	0	0	0	0
232	MPG333902	Material handling equipment	0	0	0	0	0	0	0	17,537	0	0	0	0	0	0
233	MPG333909	Other miscellaneous general-purpose machinery	0	0	0	0	0	0	0	1,392	0	0	0	0	0	0
234	MPG334100	Computers, computer peripherals and parts	0	0	0	0	0	0	0	94	0	0	0	0	0	0
235	MPG334201	Telephone apparatus	0	0	0	0	0	0	0	221	0	0	0	0	0	0
236	MPG334209	Other communications equipment	0	0	0	0	0	0	0	354	0	0	0	0	0	0
237	MPG334A01	Audio and video equipment and unrecorded media	0	0	0	0	0	0	0	16	0	0	0	0	0	0
238	MPG334A02	Navigational and guidance instruments	0	0	0	0	0	0	0	7	0	0	0	0	0	0
239	MPG334A05	Medical devices	0	0	0	0	0	0	0	0	0	0	0	0	0	0
240	MPG334A06	Measuring, control and scientific instruments	0	0	0	0	0	0	0	8,612	0	0	0	0	0	0
241	MPG334401	Printed and integrated circuits, semiconductors and printed circuit assemblies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
242	MPG334409	Other electronic components	0	0	0	0	0	0	0	0	0	0	0	0	0	0
243	MPG335101	Electric light bulbs and tubes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
244	MPG335102	Lighting fixtures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
245	MPG335203	Small electric appliances	0	0	0	0	0	0	0	0	0	0	0	0	0	0
246	MPG335204	Major appliances	0	0	0	0	0	0	0	0	0	0	0	0	0	0
247	MPG335301	Power, distribution and other transformers	0	0	0	0	0	0	0	28,566	0	0	0	0	0	0
248	MPG335302	Electric motors and generators	0	0	0	0	0	0	0	431	0	0	0	0	0	0
249	MPG335303	Switchgear, switchboards, relays and industrial control apparatus	0	0	0	0	0	0	0	639	0	0	0	0	0	0
250	MPG335901	Batteries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
251	MPG335902	Communication and electric wire and cable	0	0	0	0	0	0	0	0	0	0	0	0	0	0
252	MPG335903	Wiring devices	0	0	0	0	0	0	0	0	0	0	0	0	0	0
253	MPG335909	Other electrical equipment and components	0	0	0	0	0	0	0	0	0	0	0	0	0	0
254	MPG336111	Passenger cars	0	0	0	0	0	0	0	8	0	0	0	0	0	0
255	MPG336112	Light-duty trucks, vans and sport utility vehicles (SUVs)	0	0	0	0	0	0	0	155	0	0	0	0	0	0
256	MPG336120	Medium and heavy-duty trucks and chassis	0	0	0	0	0	0	0	305	0	0	0	0	0	0
257	MPG336201	Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
258	MPG336202	Motor vehicle bodies and special purpose motor vehicles	0	0	0	0	0	0	0	1,441	0	0	0	0	0	0
259	MPG336203	Freight and utility trailers	0	0	0	0	0	0	0	1	0	0	0	0	0	0
260	MPG336204	Motor homes, travel trailers and camping trailers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
261	MPG336310	Motor vehicle gasoline engines and engine parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
262	MPG336320	Motor vehicle electrical and electronic equipment and instruments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
263	MPG336330	Motor vehicle steering and suspension components	0	0	0	0	0	0	0	0	0	0	0	0	0	0
264	MPG336340	Motor vehicle brakes and brake systems	0	0	0	0	0	0	0	0	0	0	0	0	0	0
265	MPG336350	Motor vehicle transmission and power train parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Construction, Capital Expenditure, in Purchase Prices)

Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
266	MPG336360	Motor vehicle interior trim, seats and seat parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
267	MPG336370	Motor vehicle metal stamping	0	0	0	0	0	0	0	0	0	0	0	0	0	0
268	MPG336390	Other miscellaneous motor vehicle parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
269	MPG336401	Aircraft	0	0	0	0	0	0	0	0	0	0	0	0	0	0
270	MPG336402	Aircraft engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
271	MPG336403	Aircraft parts and other aerospace equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
272	MPG336501	Locomotives, railway rolling stock, and rapid transit equipment	0	0	0	0	0	0	0	8,315	0	0	0	0	0	0
273	MPG336502	Parts of railway rolling stock	0	0	0	0	0	0	0	0	0	0	0	0	0	0
274	MPG336601	Ships	0	0	0	0	0	0	0	0	0	0	0	0	0	0
275	MPG336602	Boats and personal watercraft	0	0	0	0	0	0	0	0	0	0	0	0	0	0
276	MPG336900	Other transportation equipment and related parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
277	MPG337101	Wood kitchen cabinets and counter tops	0	0	0	0	0	0	0	0	0	0	0	0	0	0
278	MPG337102	Household furniture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
279	MPG337103	Institutional and other furniture, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
280	MPG337203	Office furniture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
281	MPG337204	Office and store fixtures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
282	MPG337901	Mattresses and foundations	0	0	0	0	0	0	0	0	0	0	0	0	0	0
283	MPG337902	Blinds and shades	0	0	0	0	0	0	0	0	0	0	0	0	0	0
284	MPG339100	Medical, dental and personal safety supplies, instruments and equipment	0	0	0	0	0	0	0	4	0	0	0	0	0	0
285	MPG339901	Jewellery and silverware	0	0	0	0	0	0	0	0	0	0	0	0	0	0
286	MPG339902	Sporting and athletic goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
287	MPG339903	Toys and games	0	0	0	0	0	0	0	0	0	0	0	0	0	0
288	MPG339904	Office supplies (except paper)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
289	MPG339905	Signs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
290	MPG339909	Other miscellaneous manufactured products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
291	MPS3X0000	Custom work manufacturing services (except printing, finishing textiles and metals)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
292	MPS411000	Wholesale margins - farm products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
293	MPS412000	Wholesale margins - petroleum and petroleum products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
294	MPS413000	Wholesale margins - food, beverages and tobacco products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
295	MPS414000	Wholesale margins - personal and household goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
296	MPS415000	Wholesale margins - motor vehicles, motor vehicle parts and accessories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
297	MPS416000	Wholesale margins - building materials and supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
298	MPS417000	Wholesale margins - machinery, equipment and supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
299	MPS418000	Wholesale margins - miscellaneous products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
300	MPS410002	Wholesale trade commissions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
301	MPS441000	Retail margins - motor vehicles and parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
302	MPS442000	Retail margins - furniture and home	0	0	0	0	0	0	0	0	0	0	0	0	0	0
303	MPS443000	Retail margins - electronics and appliances	0	0	0	0	0	0	0	0	0	0	0	0	0	0
304	MPS444000	Retail margins - building materials, garden equipment and supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
305	MPS445000	Retail margins - food and beverages	0	0	0	0	0	0	0	0	0	0	0	0	0	0
306	MPS446000	Retail margins - health and personal care products	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1.1a Summary of original shock (Construction, Capital Expenditure, in Purchase Prices)

Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
307	MPS447000	Retail margins - automotive fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
308	MPS448000	Retail margins - clothing and clothing accessories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
309	MPS451000	Retail margins - sporting and leisure products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
310	MPS453A00	Retail margins - miscellaneous products (except cannabis)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
311	MPS453BL0	Retail margins - cannabis products (licensed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
312	MPS453BU0	Retail margins - cannabis products (unlicensed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
313	MPS454310	Retail margins - household fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
314	MPS4A0002	Used motor vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0	0
315	MPS4A0003	Other used consumer goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
316	MPS4A0004	Retail trade commissions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
317	MPS481001	Air passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
318	MPS481002	Air freight transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
319	MPS481003	Air specialty services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
320	MPS482001	Rail passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
321	MPS482002	Rail freight transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
322	MPS483001	Water passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
323	MPS483002	Water freight transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
324	MPS484001	Moving services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
325	MPS484004	Truck transportation services for general freight	0	0	0	0	0	0	0	0	0	0	0	0	0	0
326	MPS484005	Truck transportation services for specialized freight	0	0	0	0	0	0	0	0	0	0	0	0	0	0
327	MPS485100	Urban transit services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
328	MPS48A001	Interurban and rural bus passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
329	MPS48A002	School bus services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
330	MPS48A003	Other transit and passenger transportation services by road	0	0	0	0	0	0	0	0	0	0	0	0	0	0
331	MPS48A004	Scenic and sightseeing tour services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
332	MPS485300	Taxi and limousine services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
333	MPS486200	Transportation of natural gas by pipeline	0	0	0	0	0	0	0	0	0	0	0	0	0	0
334	MPS486A00	Transportation of crude oil and other commodities by pipeline	0	0	0	0	0	0	0	0	0	0	0	0	0	0
335	MPS488001	Air transportation support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
336	MPS488002	Aircraft maintenance and repair services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
337	MPS488003	Rail transportation support, maintenance and repair services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
338	MPS488004	Water transportation support, maintenance and repair services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
339	MPS488005	Road transportation support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
340	MPS488006	Freight transportation arrangement and customs brokering services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
341	MPS488009	Other transportation support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
342	MPS491000	Postal services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
343	MPS492000	Courier, parcel, and local messenger and delivery services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
344	MPS493001	Grain storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0
345	MPS493002	Warehousing and storage services (except grain storage)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
346	MPG511111	Newspapers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
347	MPS511112	Advertising space in printed newspapers	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Construction, Capital Expenditure, in Purchase Prices)

Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
348	MPG5111A1	Periodicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
349	MPG5111A2	Books	0	0	0	0	0	0	0	0	0	0	0	0	0	0
350	MPG5111A3	Other published products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
351	MPS5111A4	Advertising space in printed periodicals and in other printed publications	0	0	0	0	0	0	0	0	0	0	0	0	0	0
352	MPS51AX00	Licensing of rights to use literary works and artistic works (except software licensing)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
353	MPS511200	General purpose software	0	0	0	0	0	0	0	65	0	0	0	0	0	0
354	MPS5121A1	Recorded movies, television programs and videos	0	0	0	0	0	0	0	0	0	0	0	0	0	0
355	MPS5121A2	Movie, television program and video production, post-production and editing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
356	MPS5121A3	Licensing of rights to use audiovisual works	0	0	0	0	0	0	0	0	0	0	0	0	0	0
357	MPS512130	Admissions to motion picture film exhibitions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
358	MPS512201	Recorded music and other sound recordings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
359	MPS512202	Audio recording services and copyright administration	0	0	0	0	0	0	0	0	0	0	0	0	0	0
360	MPS512203	Licensing of rights to use musical works and sound recordings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
361	MPS515100	Advertising air time on radio	0	0	0	0	0	0	0	0	0	0	0	0	0	0
362	MPS515A01	Advertising air time on television	0	0	0	0	0	0	0	0	0	0	0	0	0	0
363	MPS515A02	Fees for the distribution of television and radio program channels (affiliation payments)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
364	MPS517001	Fixed telecommunications services (except Internet access)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
365	MPS517002	Mobile telecommunications services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
366	MPS517003	Cable, satellite and other program distribution services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
367	MPS517004	Fixed Internet access services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
368	MPS518000	Data processing, hosting, and related services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
369	MPS519001	Subscriptions for online content	0	0	0	0	0	0	0	0	0	0	0	0	0	0
370	MPS519002	Internet advertising	0	0	0	0	0	0	0	0	0	0	0	0	0	0
371	MPS519008	Other information services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
372	MPS521000	Central banking services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
373	MPS522130	Local credit union services - explicit charges (fees)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
374	MPS5221A0	Banking and other depository credit intermediation services - explicit charges	0	0	0	0	0	0	0	0	0	0	0	0	0	0
375	MPS522200	Non-depository credit intermediation services - explicit charges (fees)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
376	MPS522300	Other services related to credit intermediation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
377	MPS523001	Investment banking services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
378	MPS523002	Security brokerage and securities dealing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
379	MPS523003	Portfolio management services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
380	MPS523004	Investment counselling services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
381	MPS523009	Holding company services and other financial investment and related activities	0	0	0	0	0	0	0	0	0	0	0	0	0	0
382	MPS524101	Life insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
383	MPS524102	Accident and sickness insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
384	MPS524103	Automotive insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
385	MPS524104	Property insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Construction, Capital Expenditure, in Purchase Prices)

Thousands of dollars

		Commodities (Detail level)	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
386	MPS524105	Liability and other property and casualty insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
387	MPS524200	Brokerage and other insurance related services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
388	MPS526111	Trusteed pension fund services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
389	MPS526A00	Mutual funds (cost of service) and other similar services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
390	MPS52X001	Deposit intermediation services indirectly measured (FISIM)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
391	MPS52X002	Residential mortgage intermediation services indirectly measured (FISIM)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
392	MPS52X003	Other loan intermediation services indirectly measured (FISIM)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
393	MPS531101	Rental of residential real estate	0	0	0	0	0	0	0	0	0	0	0	0	0	0
394	MPS531102	Rental of non-residential real estate	0	0	0	0	0	0	0	0	0	0	0	0	0	0
395	IMS5311A0	Imputed rental of owner-occupied dwellings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
396	MPS531A00	Real estate brokerage and other services related to real estate	0	0	0	0	0	0	0	21	0	0	0	0	0	0
397	MPS532100	Motor vehicle rental and leasing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
398	MPS532A01	Computer equipment rental and leasing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
399	MPS532A02	Office machinery and equipment (except computer equipment) rental and leasing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
400	MPS532A03	Commercial and industrial machinery and equipment (except office equipment) rental and leasing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
401	MPS532A09	Rental and leasing services of other goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
402	MPS533000	Licensing of rights to non-financial produced intangible assets (except software and other copyright licensing)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
403	MPS541100	Legal services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
404	MPS541200	Accounting, tax preparation, bookkeeping and payroll services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
405	MPS541300	Architectural, engineering and related services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
406	MPS541400	Specialized design services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
407	MPS541501	Custom software design and development services	0	0	0	0	0	0	0	774	0	0	0	0	0	0
408	IMS541502	Own-account software design and development services	0	0	0	0	0	0	0	561	0	0	0	0	0	0
409	MPS541503	Computer systems design and related services (except software development)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
410	MPS541600	Management, scientific and technical consulting services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
411	MPS541701	Research and development services	0	0	0	0	0	0	0	153	0	0	0	0	0	0
412	IMS541702	Own-account research and development (except software development)	0	0	0	0	0	0	0	6,497	0	0	0	0	0	0
413	MPS541800	Advertising, public relations and related services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
414	MPS541901	Photographic services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
415	MPS541902	Veterinary services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
416	MPS541909	Other professional, scientific and technical services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
417	IMS551001	Holding company services (imputed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
418	IMS551002	Head office services (imputed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Construction, Capital Expenditure, in Purchase Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
419	MPS561100	Office administrative services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
420	MPS561300	Employment services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
421	MPS561400	Business support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
422	MPS561500	Travel arrangement, reservation and planning services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
423	MPS561600	Investigation and security services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
424	MPS561700	Services to buildings and dwellings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
425	MPS561A00	Facilities and other support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
426	MPS562000	Waste management and remediation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
427	MPS610001	Tuition and similar fees for elementary and secondary schools	0	0	0	0	0	0	0	0	0	0	0	0	0	0
428	MPS610002	Tuition and similar fees for colleges and C.E.G.E.P.s	0	0	0	0	0	0	0	0	0	0	0	0	0	0
429	MPS610003	Tuition and similar fees for universities	0	0	0	0	0	0	0	0	0	0	0	0	0	0
430	MPS610004	Tuition and similar fees for trade, technical and professional training	0	0	0	0	0	0	0	0	0	0	0	0	0	0
431	MPS610009	Other educational training and services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
432	MPS621100	Physician services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
433	MPS621200	Dental services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
434	MPS621A01	Other health practitioner services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
435	MPS621A02	Medical laboratory diagnostic and testing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
436	MPS621A03	Ambulance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
437	MPS622000	Hospital services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
438	MPS623000	Nursing and residential care services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
439	MPS624001	Child day-care services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
440	MPS62A000	Other ambulatory health care services and social assistance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
441	MPS71A001	Admissions to live sporting events	0	0	0	0	0	0	0	0	0	0	0	0	0	0
442	MPS71A002	Admissions to live performing arts performances	0	0	0	0	0	0	0	0	0	0	0	0	0	0
443	MPS71A003	Sport and performing arts event organization and support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
444	MPS71A004	Career management and representation services of public figures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
445	MPS71A005	Contract production of live performing arts performances, live sporting events and copyrighted works	0	0	0	0	0	0	0	0	0	0	0	0	0	0
446	MPS71A009	Broadcast and other media rights	0	0	0	0	0	0	0	0	0	0	0	0	0	0
447	MPS71A008	Heritage institution services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
448	MPS713A00	Amusement and recreation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
449	MPS713200	Gambling (net wagers)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
450	MPS721100	Room or unit accommodation services for travellers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
451	MPS721A01	Recreational vehicle park and recreational camp services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
452	MPS721A02	Rooming and boarding services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
453	MPS722001	Prepared meals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
454	MPS722002	Alcoholic beverages for immediate consumption	0	0	0	0	0	0	0	0	0	0	0	0	0	0
455	MPS811100	Motor vehicle repair and maintenance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
456	MPS811A00	Repair and maintenance services (except for buildings and motor vehicles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
457	MPS812200	Funeral services	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Construction, Capital Expenditure, in Purchase Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
458	MPS812300	Laundry and dry-cleaning services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
459	MPS812A01	Hair care and aesthetic services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
460	MPS812A02	Parking services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
461	MPS812A09	Other personal and personal care services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
462	MPS813000	Other membership services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
463	MPS814001	Babysitting services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
464	MPS814002	Private household services (except babysitting)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
465	MPS9A0000	Sales of other services by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
466	MPS9B0000	Sales of other government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
467	FIC110000	Repair and maintenance	0	0	0	0	0	0	0	0	0	0	0	0	0	0
468	FIC120000	Operating supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
469	FIC130000	Office supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
470	FIC210000	Advertising, promotion, meals and entertainment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
471	FIC220000	Travel, meetings and conventions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
472	FIC300000	Transportation margins	0	0	0	0	0	0	0	0	0	0	0	0	0	0
473	NNP610000	Educational services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
474	NNP621000	Ambulatory health care services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
475	NNP624000	Social assistance services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
476	NNP710000	Arts, entertainment and recreation services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
477	NNP813100	Religious services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
478	NNP813A01	Grant-making, civic, and professional and similar organization services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
479	NNP813930	Labour organization membership services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
480	NNP813940	Political organization services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
481	NNP999999	Other services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
482	NGS611100	Elementary and secondary school services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
483	NGS611200	Community college and C.E.G.E.P services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
484	NGS611300	University services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
485	NGS611A00	Other educational services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
486	NGS622000	Hospital services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
487	NGS623000	Residential care facility services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
488	NGS911100	Defence services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
489	NGS911A00	Other federal government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
490	NGS912000	Other provincial and territorial government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
491	NGS913000	Other municipal government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
492	NGS914000	Other aboriginal government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
493	PRM100000	Taxes on products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
494	PRM200000	Subsidies on products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
495	PRM300000	Subsidies on production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
496	PRM400000	Taxes on production	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Capital expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Construction, Capital Expenditure, in Purchase Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
497	**PRM500000**	Wages and salaries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
498	**PRM600000**	Employers' social contributions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
499	**PRM700000**	Gross mixed income	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500	**PRM800000**	Gross operating surplus	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**416,110**	**0**	**0**	**0**	**0**	**0**	**0**

Attachment 2 Construction – Industry Inputs Expenditure, In Purchaser Prices, at the Detailed Level

Simulation options Industry inputs expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Construction, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

		Commodities (Detail level)	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
1	MPG111A01	Canola (including rapeseed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	MPG111A02	Oilseeds (except canola)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	MPG111A03	Wheat	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	MPG111A04	Grains (except wheat)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	MPG111A05	Fresh potatoes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	MPG111A10	Fresh fruits and nuts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	MPG111A11	Other miscellaneous crop products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	MPG111A08	Fresh vegetables (except potatoes)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	IMG111A09	Imputed feed (animal feed produced for own consumption)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	MPG111400	Nursery and floriculture products (except cannabis)	0	0	0	0	0	0	0	452	0	0	0	0	0	0
11	MPG111C00	Cannabis plants, seeds and flowering tops	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	MPG112001	Cattle and calves	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	MPG112002	Unprocessed fluid milk	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	MPG112003	Hogs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	MPG112004	Eggs in shell	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	MPG112005	Poultry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	MPG112006	Other live animals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	MPG112007	Raw furskins, and animal products n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	IMG112008	Imputed fertilizer (fertilizer produced for own consumption)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	MPG113001	Logs and bolts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	MPG113002	Pulpwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	ENE113003	Fuel wood	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	MPG113004	Rough untreated poles, posts and piling	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	MPG114000	Fish, crustaceans, shellfish and other fishery products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	MPS11X000	Custom work services for forestry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	MPS115A01	Support services for crop production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	MPS115A02	Support services for animal production, hunting and fishing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	MPS115300	Support services for forestry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	ENE211105	Conventional crude oil	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	ENE211106	Synthetic crude oil	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	ENE211102	Natural gas	0	0	0	0	0	0	0	36	0	0	0	0	0	0
32	ENE211103	Natural gas liquids and related products	0	0	0	0	0	0	0	10	0	0	0	0	0	0
33	ENE211104	Crude and diluted bitumen	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	ENE212100	Coal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	MPG212210	Iron ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	MPG212220	Gold and silver ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	MPG212231	Copper ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	MPG212232	Nickel ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	MPG212233	Lead and zinc ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	MPG212291	Radioactive ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	MPG212299	Other metal ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	MPG212310	Stone	0	0	0	0	0	0	0	1,789	0	0	0	0	0	0
43	MPG212320	Sand, gravel, clay, and refractory minerals	0	0	0	0	0	0	0	1,844	0	0	0	0	0	0
44	MPG212392	Uncut and industrial diamonds	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	MPG212396	Potash	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	MPG21239C	Non-metallic minerals (except diamonds)	0	0	0	0	0	0	0	2,628	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Construction, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
47	**MPS21311A**	Support services for oil and gas extraction (except exploration)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	**MPS21311B**	Support services for mining and quarrying (except exploration)	0	0	0	0	0	0	0	50,542	0	0	0	0	0	0
49	**MPS21A000**	Mineral and oil and gas exploration	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	**ENE221100**	Electricity	0	0	0	0	0	0	0	419	0	0	0	0	0	0
51	**MPS221200**	Natural gas distribution	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	**MPS221301**	Water delivered by water works and irrigation systems	0	0	0	0	0	0	0	10	0	0	0	0	0	0
53	**MPS221302**	Sewage and dirty water disposal and cleaning services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	**ENE221303**	Steam and heated or cooled air or water	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	**MPG23A000**	Residential construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	**MPG23B001**	Industrial buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	**MPG23B002**	Office buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	**MPG23B003**	Shopping centers, plazas, malls and stores	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	**MPG23B004**	Other commercial buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	**MPG23B005**	Schools, colleges, universities and other educational buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	**MPG23B006**	Health care buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	**MPG23B007**	Other institutional buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	**MPG23C101**	Highways, roads, streets, bridges and tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	**MPG23C109**	Other transportation construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	**MPG23C201**	Production facilities in oil and gas extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	**MPG23C209**	Other oil and gas engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	**MPG23C300**	Electric power engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	**MPG23C400**	Communication engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	**MPG23C501**	Marine engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	**MPG23C502**	Waterworks engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	**MPG23C503**	Sewage engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	**MPG23C504**	Mining engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	**MPG23C509**	Other engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	**MPS23D000**	Repair construction services	0	0	0	0	0	0	0	106	0	0	0	0	0	0
75	**MPG311101**	Dog and cat food	0	0	0	0	0	0	0	0	0	0	0	0	0	0
76	**MPG311109**	Other animal feed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77	**MPG311204**	Flour and other grain mill products	0	0	0	0	0	0	0	1	0	0	0	0	0	0
78	**MPG311202**	Margarine and cooking oils	0	0	0	0	0	0	0	1	0	0	0	0	0	0
79	**MPG311203**	Breakfast cereal and other cereal products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	**MPG311208**	Grain and oilseed products, n.e.c.	0	0	0	0	0	0	0	7	0	0	0	0	0	0
81	**MPG311301**	Sugar and sugar mill by-products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	**MPG311302**	Chocolate (except confectionery)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	**MPG311303**	Confectionery products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
84	**MPG311401**	Fresh, frozen and canned fruit and vegetable juices	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85	**MPG311402**	Preserved fruit and vegetables and frozen foods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
86	**MPG311501**	Processed fluid milk and milk products	0	0	0	0	0	0	0	2	0	0	0	0	0	0
87	**MPG311502**	Cheese and cheese products	0	0	0	0	0	0	0	1	0	0	0	0	0	0
88	**MPG311503**	Butter and dry and canned dairy products	0	0	0	0	0	0	0	1	0	0	0	0	0	0
89	**MPG311504**	Ice cream, sherbet and similar frozen desserts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	**MPG311601**	Fresh and frozen beef and veal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	**MPG311602**	Fresh and frozen pork	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	**MPG311603**	Fresh and frozen poultry of all types	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Construction, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

		Commodities (Detail level)	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
93	MPG311605	Processed meat products, other miscellaneous meats and animal by-products	0	0	0	0	0	0	0	1	0	0	0	0	0	0
94	MPG311700	Prepared and packaged seafood products	0	0	0	0	0	0	0	2	0	0	0	0	0	0
95	MPG311801	Bread, rolls and flatbreads	0	0	0	0	0	0	0	1	0	0	0	0	0	0
96	MPG311802	Cookies, crackers and baked sweet goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
97	MPG311803	Flour mixes, dough and dry pasta	0	0	0	0	0	0	0	0	0	0	0	0	0	0
98	MPG311901	Snack food products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99	MPG311902	Coffee and tea	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	MPG311903	Flavouring syrups, seasonings and dressings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
101	MPG311909	Other food products, n.e.c.	0	0	0	0	0	0	0	3	0	0	0	0	0	0
102	MPG312110	Bottled water, soft drinks and ice	0	0	0	0	0	0	0	6	0	0	0	0	0	0
103	MPG312120	Beer	0	0	0	0	0	0	0	9	0	0	0	0	0	0
104	MPG3121A1	Wine and brandy	0	0	0	0	0	0	0	2	0	0	0	0	0	0
105	MPG3121A2	Distilled liquor	0	0	0	0	0	0	0	1	0	0	0	0	0	0
106	MPG312201	Stemmed, redried or reconstituted tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
107	MPG312202	Cigarettes, cigars, chewing and smoking tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
108	MPG312300	Cannabis products (except plants, seeds and flowering tops)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
109	MPG31A001	Fibre, yarn and thread	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	MPG31A002	Fabrics	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	MPG31A003	Carpets, rugs and mats	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112	MPG31A004	Other textile furnishings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
113	MPG31A005	Textile products, n.e.c.	0	0	0	0	0	0	0	17	0	0	0	0	0	0
114	MPS31A006	Textile and fabric finishing and coating services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115	MPG31B001	Men's, women's, boys' and girls' clothing	0	0	0	0	0	0	0	3	0	0	0	0	0	0
116	MPG31B002	Infant clothing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
117	MPG31B003	Clothing accessories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
118	MPG31B004	Leather and dressed furs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
119	MPG31B005	Footwear	0	0	0	0	0	0	0	24	0	0	0	0	0	0
120	MPG31B006	Suitcases, handbags and other leather and allied products	0	0	0	0	0	0	0	1	0	0	0	0	0	0
121	MPG321101	Hardwood lumber	0	0	0	0	0	0	0	152	0	0	0	0	0	0
122	MPG321102	Softwood lumber	0	0	0	0	0	0	0	2,911	0	0	0	0	0	0
123	MPG321103	Wood chips	0	0	0	0	0	0	0	0	0	0	0	0	0	0
124	MPG321104	Other sawmill products and treated wood products	0	0	0	0	0	0	0	452	0	0	0	0	0	0
125	MPG321201	Veneer and plywood	0	0	0	0	0	0	0	0	0	0	0	0	0	0
126	MPG321202	Wood trusses and engineered wood members	0	0	0	0	0	0	0	1,214	0	0	0	0	0	0
127	MPG321203	Reconstituted wood products	0	0	0	0	0	0	0	1,270	0	0	0	0	0	0
128	MPG321901	Wood windows and doors	0	0	0	0	0	0	0	317	0	0	0	0	0	0
129	MPG321903	Wood containers and pallets	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	MPG321904	Prefabricated wood and manufactured (mobile) buildings and components	0	0	0	0	0	0	0	2,791	0	0	0	0	0	0
131	MPG321908	Wood products, n.e.c.	0	0	0	0	0	0	0	1,252	0	0	0	0	0	0
132	MPG321X00	Waste and scrap of wood and wood by-products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
133	MPG322101	Wood pulp	0	0	0	0	0	0	0	0	0	0	0	0	0	0
134	MPG322102	Paper (except newsprint)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135	MPG322103	Newsprint	0	0	0	0	0	0	0	0	0	0	0	0	0	0
136	MPG322104	Paperboard	0	0	0	0	0	0	0	0	0	0	0	0	0	0
137	MPG322201	Paperboard containers	0	0	0	0	0	0	0	58	0	0	0	0	0	0
138	MPG322202	Paper office supplies	0	0	0	0	0	0	0	7	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Construction, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
139	MPG322203	Disposable diapers and feminine hygiene products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
140	MPG322204	Sanitary paper products	0	0	0	0	0	0	0	1	0	0	0	0	0	0
141	MPG322209	Other converted paper products	0	0	0	0	0	0	0	219	0	0	0	0	0	0
142	MPG322X00	Waste and scrap of paper and paperboard	0	0	0	0	0	0	0	0	0	0	0	0	0	0
143	MPG323001	Printed products	0	0	0	0	0	0	0	59	0	0	0	0	0	0
144	MPS323002	Support services for printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
145	MPS323003	Contract printing services for publishers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
146	ENE324111	Gasoline	0	0	0	0	0	0	0	358	0	0	0	0	0	0
147	ENE324112	Diesel and biodiesel fuels	0	0	0	0	0	0	0	4,652	0	0	0	0	0	0
148	ENE324113	Light fuel oils	0	0	0	0	0	0	0	24	0	0	0	0	0	0
149	ENE324114	Jet fuel	0	0	0	0	0	0	0	161	0	0	0	0	0	0
150	ENE324115	Heavy fuel oils	0	0	0	0	0	0	0	4	0	0	0	0	0	0
151	MPG3241A8	Lubricants and other petroleum refinery products	0	0	0	0	0	0	0	90	0	0	0	0	0	0
152	MPG3241A1	Asphalt (except natural) and asphalt products	0	0	0	0	0	0	0	1,968	0	0	0	0	0	0
153	ENE3241A2	Coke and other coke oven products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
154	ENE32A000	Solid fuel products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
155	MPG325101	Petrochemicals	0	0	0	0	0	0	0	88	0	0	0	0	0	0
156	MPG325102	Industrial gases	0	0	0	0	0	0	0	55	0	0	0	0	0	0
157	MPG325103	Dyes and pigments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
158	MPG325106	Other basic inorganic chemicals	0	0	0	0	0	0	0	26	0	0	0	0	0	0
159	MPG325105	Basic organic chemicals, n.e.c.	0	0	0	0	0	0	0	680	0	0	0	0	0	0
160	MPG325201	Plastic resins	0	0	0	0	0	0	0	0	0	0	0	0	0	0
161	MPG325202	Rubber and rubber compounds and mixtures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
162	MPG325203	Artificial and synthetic fibres and filaments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
163	MPG325301	Ammonia and chemical fertilizers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
164	MPG325302	Pesticides and other agricultural chemicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
165	MPG325400	Pharmaceutical and medicinal products	0	0	0	0	0	0	0	45	0	0	0	0	0	0
166	MPG325500	Paints, coatings and adhesive products	0	0	0	0	0	0	0	1,417	0	0	0	0	0	0
167	MPG325601	Soaps and cleaning compounds	0	0	0	0	0	0	0	37	0	0	0	0	0	0
168	MPG325602	Perfumes and toiletries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
169	MPG325900	Chemical products, n.e.c.	0	0	0	0	0	0	0	1,958	0	0	0	0	0	0
170	MPG326101	Plastic bags	0	0	0	0	0	0	0	0	0	0	0	0	0	0
171	MPG326102	Plastic films and non-rigid sheets	0	0	0	0	0	0	0	2,699	0	0	0	0	0	0
172	MPG326103	Plastic and foam building and construction materials	0	0	0	0	0	0	0	5,290	0	0	0	0	0	0
173	MPG326104	Plastic profile shapes	0	0	0	0	0	0	0	1,607	0	0	0	0	0	0
174	MPG326105	Foam products (except for construction)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
175	MPG326106	Plastic bottles	0	0	0	0	0	0	0	0	0	0	0	0	0	0
176	MPG326107	Motor vehicle plastic parts	0	0	0	0	0	0	0	152	0	0	0	0	0	0
177	MPG326109	Plastic products, n.e.c.	0	0	0	0	0	0	0	2,091	0	0	0	0	0	0
178	MPG326201	Tires	0	0	0	0	0	0	0	656	0	0	0	0	0	0
179	MPG326202	Rubber and plastic hoses and belts	0	0	0	0	0	0	0	5,182	0	0	0	0	0	0
180	MPG326209	Rubber products, n.e.c.	0	0	0	0	0	0	0	3,420	0	0	0	0	0	0
181	MPG326X00	Waste and scrap of plastic and rubber	0	0	0	0	0	0	0	0	0	0	0	0	0	0
182	MPG327301	Cement	0	0	0	0	0	0	0	1,007	0	0	0	0	0	0
183	MPG327302	Ready-mixed concrete	0	0	0	0	0	0	0	16,531	0	0	0	0	0	0
184	MPG327303	Concrete products	0	0	0	0	0	0	0	12,234	0	0	0	0	0	0
185	MPG327A01	Clay and ceramic products and refractories	0	0	0	0	0	0	0	468	0	0	0	0	0	0
186	MPG327A02	Glass (including automotive), glass products and glass containers	0	0	0	0	0	0	0	5	0	0	0	0	0	0
187	MPG327A03	Waste and scrap of glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0
188	MPG327A04	Lime and gypsum products	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Industry inputs expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Construction, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

		Commodities (Detail level)	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
189	MPG327A09	Non-metallic mineral products, n.e.c.	0	0	0	0	0	0	0	1,874	0	0	0	0	0	0
190	MPG331100	Iron and steel basic shapes and ferro-alloy products	0	0	0	0	0	0	0	245	0	0	0	0	0	0
191	MPG331201	Iron and steel pipes and tubes (except castings)	0	0	0	0	0	0	0	3,132	0	0	0	0	0	0
192	MPG331202	Wire and other rolled and drawn steel products	0	0	0	0	0	0	0	1,505	0	0	0	0	0	0
193	MPG331301	Bauxite and aluminum oxide	0	0	0	0	0	0	0	0	0	0	0	0	0	0
194	MPG331302	Unwrought aluminum including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
195	MPG331303	Basic and semi-finished products of aluminum and alloys	0	0	0	0	0	0	0	675	0	0	0	0	0	0
196	MPG331401	Unwrought copper including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
197	MPG331402	Unwrought nickel including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
198	MPG331403	Unwrought precious metals including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
199	MPG331404	Other unwrought non-ferrous metals including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200	MPG331405	Gold, store of value	0	0	0	0	0	0	0	0	0	0	0	0	0	0
201	MPG331406	Basic and semi-finished products of non-ferrous metals and alloys (except aluminum)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
202	MPG331501	Ferrous metal castings	0	0	0	0	0	0	0	1,545	0	0	0	0	0	0
203	MPG331502	Non-ferrous metal castings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
204	MPG331X01	Waste and scrap of iron and steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
205	MPG331X02	Waste and scrap of non-ferrous metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
206	MPG332101	Forged and stamped metal products	0	0	0	0	0	0	0	78	0	0	0	0	0	0
207	MPG332301	Prefabricated metal buildings and components	0	0	0	0	0	0	0	12,606	0	0	0	0	0	0
208	MPG332302	Fabricated steel plates and other fabricated structural metal	0	0	0	0	0	0	0	25,127	0	0	0	0	0	0
209	MPG332303	Metal windows and doors	0	0	0	0	0	0	0	2,381	0	0	0	0	0	0
210	MPG332A05	Other architectural metal products	0	0	0	0	0	0	0	26,005	0	0	0	0	0	0
211	MPG332401	Light gauge metal containers, crowns and closures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
212	MPG332402	Boilers, tanks and heavy gauge metal containers	0	0	0	0	0	0	0	4,432	0	0	0	0	0	0
213	MPG332500	Builders, motor vehicle and other hardware	0	0	0	0	0	0	0	363	0	0	0	0	0	0
214	MPG332600	Springs and wire products	0	0	0	0	0	0	0	4,573	0	0	0	0	0	0
215	MPG332700	Threaded metal fasteners and other turned metal products including automotive	0	0	0	0	0	0	0	1,902	0	0	0	0	0	0
216	MPS332800	Coating, engraving, heat treating and similar metal processing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
217	MPG332A01	Hand tools, kitchen utensils and cutlery (except precious metal)	0	0	0	0	0	0	0	395	0	0	0	0	0	0
218	MPG332A02	Metal valves and pipe fittings	0	0	0	0	0	0	0	14,060	0	0	0	0	0	0
219	MPG332A03	Ball and roller bearings	0	0	0	0	0	0	0	1,772	0	0	0	0	0	0
220	MPG332A04	Guns, ammunition and other munitions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
221	MPG332A08	Fabricated metal products, n.e.c.	0	0	0	0	0	0	0	1,070	0	0	0	0	0	0
222	MPG333101	Agricultural, lawn and garden machinery and equipment	0	0	0	0	0	0	0	164	0	0	0	0	0	0
223	MPG333102	Logging, mining and construction machinery and equipment	0	0	0	0	0	0	0	58,177	0	0	0	0	0	0
224	MPG333200	Other industry-specific machinery	0	0	0	0	0	0	0	6,280	0	0	0	0	0	0
225	MPG333300	Commercial and service industry machinery	0	0	0	0	0	0	0	1,002	0	0	0	0	0	0
226	MPG333401	Industrial and commercial fans, blowers and air purification equipment	0	0	0	0	0	0	0	8,415	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Construction, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
227	**MPG333402**	Heating and cooling equipment (except household refrigerators and freezers)	0	0	0	0	0	0	0	229	0	0	0	0	0	0
228	**MPG333500**	Metalworking machinery and industrial moulds	0	0	0	0	0	0	0	4	0	0	0	0	0	0
229	**MPG333601**	Turbines, turbine generators, and turbine generator sets	0	0	0	0	0	0	0	182	0	0	0	0	0	0
230	**MPG333609**	Other engine and power transmission equipment	0	0	0	0	0	0	0	3,753	0	0	0	0	0	0
231	**MPG333901**	Pumps and compressors (except fluid power)	0	0	0	0	0	0	0	28,764	0	0	0	0	0	0
232	**MPG333902**	Material handling equipment	0	0	0	0	0	0	0	13,650	0	0	0	0	0	0
233	**MPG333909**	Other miscellaneous general-purpose machinery	0	0	0	0	0	0	0	17,186	0	0	0	0	0	0
234	**MPG334100**	Computers, computer peripherals and parts	0	0	0	0	0	0	0	121	0	0	0	0	0	0
235	**MPG334201**	Telephone apparatus	0	0	0	0	0	0	0	455	0	0	0	0	0	0
236	**MPG334209**	Other communications equipment	0	0	0	0	0	0	0	7,828	0	0	0	0	0	0
237	**MPG334A01**	Audio and video equipment and unrecorded media	0	0	0	0	0	0	0	0	0	0	0	0	0	0
238	**MPG334A02**	Navigational and guidance instruments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
239	**MPG334A05**	Medical devices	0	0	0	0	0	0	0	489	0	0	0	0	0	0
240	**MPG334A06**	Measuring, control and scientific instruments	0	0	0	0	0	0	0	553	0	0	0	0	0	0
241	**MPG334401**	Printed and integrated circuits, semiconductors and printed circuit assemblies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
242	**MPG334409**	Other electronic components	0	0	0	0	0	0	0	11	0	0	0	0	0	0
243	**MPG335101**	Electric light bulbs and tubes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
244	**MPG335102**	Lighting fixtures	0	0	0	0	0	0	0	6	0	0	0	0	0	0
245	**MPG335203**	Small electric appliances	0	0	0	0	0	0	0	1,567	0	0	0	0	0	0
246	**MPG335204**	Major appliances	0	0	0	0	0	0	0	17	0	0	0	0	0	0
247	**MPG335301**	Power, distribution and other transformers	0	0	0	0	0	0	0	53	0	0	0	0	0	0
248	**MPG335302**	Electric motors and generators	0	0	0	0	0	0	0	765	0	0	0	0	0	0
249	**MPG335303**	Switchgear, switchboards, relays and industrial control apparatus	0	0	0	0	0	0	0	63	0	0	0	0	0	0
250	**MPG335901**	Batteries	0	0	0	0	0	0	0	241	0	0	0	0	0	0
251	**MPG335902**	Communication and electric wire and cable	0	0	0	0	0	0	0	9,866	0	0	0	0	0	0
252	**MPG335903**	Wiring devices	0	0	0	0	0	0	0	23	0	0	0	0	0	0
253	**MPG335909**	Other electrical equipment and components	0	0	0	0	0	0	0	1,161	0	0	0	0	0	0
254	**MPG336111**	Passenger cars	0	0	0	0	0	0	0	0	0	0	0	0	0	0
255	**MPG336112**	Light-duty trucks, vans and sport utility vehicles (SUVs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
256	**MPG336120**	Medium and heavy-duty trucks and chassis	0	0	0	0	0	0	0	0	0	0	0	0	0	0
257	**MPG336201**	Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
258	**MPG336202**	Motor vehicle bodies and special purpose motor vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0	0
259	**MPG336203**	Freight and utility trailers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
260	**MPG336204**	Motor homes, travel trailers and camping trailers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
261	**MPG336310**	Motor vehicle gasoline engines and engine parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
262	**MPG336320**	Motor vehicle electrical and electronic equipment and instruments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
263	**MPG336330**	Motor vehicle steering and suspension components	0	0	0	0	0	0	0	178	0	0	0	0	0	0
264	**MPG336340**	Motor vehicle brakes and brake systems	0	0	0	0	0	0	0	308	0	0	0	0	0	0
265	**MPG336350**	Motor vehicle transmission and power train parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Construction, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

Commodities (Detail level)			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
266	MPG336360	Motor vehicle interior trim, seats and seat parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
267	MPG336370	Motor vehicle metal stamping	0	0	0	0	0	0	0	0	0	0	0	0	0	0
268	MPG336390	Other miscellaneous motor vehicle parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
269	MPG336401	Aircraft	0	0	0	0	0	0	0	0	0	0	0	0	0	0
270	MPG336402	Aircraft engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
271	MPG336403	Aircraft parts and other aerospace equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
272	MPG336501	Locomotives, railway rolling stock, and rapid transit equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
273	MPG336502	Parts of railway rolling stock	0	0	0	0	0	0	0	0	0	0	0	0	0	0
274	MPG336601	Ships	0	0	0	0	0	0	0	0	0	0	0	0	0	0
275	MPG336602	Boats and personal watercraft	0	0	0	0	0	0	0	0	0	0	0	0	0	0
276	MPG336900	Other transportation equipment and related parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
277	MPG337101	Wood kitchen cabinets and counter tops	0	0	0	0	0	0	0	249	0	0	0	0	0	0
278	MPG337102	Household furniture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
279	MPG337103	Institutional and other furniture, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
280	MPG337203	Office furniture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
281	MPG337204	Office and store fixtures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
282	MPG337901	Mattresses and foundations	0	0	0	0	0	0	0	0	0	0	0	0	0	0
283	MPG337902	Blinds and shades	0	0	0	0	0	0	0	0	0	0	0	0	0	0
284	MPG339100	Medical, dental and personal safety supplies, instruments and equipment	0	0	0	0	0	0	0	542	0	0	0	0	0	0
285	MPG339901	Jewellery and silverware	0	0	0	0	0	0	0	0	0	0	0	0	0	0
286	MPG339902	Sporting and athletic goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
287	MPG339903	Toys and games	0	0	0	0	0	0	0	0	0	0	0	0	0	0
288	MPG339904	Office supplies (except paper)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
289	MPG339905	Signs	0	0	0	0	0	0	0	7	0	0	0	0	0	0
290	MPG339909	Other miscellaneous manufactured products	0	0	0	0	0	0	0	488	0	0	0	0	0	0
291	MPS3X0000	Custom work manufacturing services (except printing, finishing textiles and metals)	0	0	0	0	0	0	0	185	0	0	0	0	0	0
292	MPS411000	Wholesale margins - farm products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
293	MPS412000	Wholesale margins - petroleum and petroleum products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
294	MPS413000	Wholesale margins - food, beverages and tobacco products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
295	MPS414000	Wholesale margins - personal and household goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
296	MPS415000	Wholesale margins - motor vehicles, motor vehicle parts and accessories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
297	MPS416000	Wholesale margins - building materials and supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
298	MPS417000	Wholesale margins - machinery, equipment and supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
299	MPS418000	Wholesale margins - miscellaneous products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
300	MPS410002	Wholesale trade commissions	0	0	0	0	0	0	0	1,039	0	0	0	0	0	0
301	MPS441000	Retail margins - motor vehicles and parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
302	MPS442000	Retail margins - furniture and home	0	0	0	0	0	0	0	0	0	0	0	0	0	0
303	MPS443000	Retail margins - electronics and appliances	0	0	0	0	0	0	0	0	0	0	0	0	0	0
304	MPS444000	Retail margins - building materials, garden equipment and supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
305	MPS445000	Retail margins - food and beverages	0	0	0	0	0	0	0	0	0	0	0	0	0	0
306	MPS446000	Retail margins - health and personal care products	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Construction, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

		Commodities (Detail level)	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
307	MPS447000	Retail margins - automotive fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
308	MPS448000	Retail margins - clothing and clothing accessories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
309	MPS451000	Retail margins - sporting and leisure products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
310	MPS453A00	Retail margins - miscellaneous products (except cannabis)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
311	MPS453BL0	Retail margins - cannabis products (licensed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
312	MPS453BU0	Retail margins - cannabis products (unlicensed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
313	MPS454310	Retail margins - household fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
314	MPS4A0002	Used motor vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0	0
315	MPS4A0003	Other used consumer goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
316	MPS4A0004	Retail trade commissions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
317	MPS481001	Air passenger transportation services	0	0	0	0	0	0	0	41	0	0	0	0	0	0
318	MPS481002	Air freight transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
319	MPS481003	Air specialty services	0	0	0	0	0	0	0	479	0	0	0	0	0	0
320	MPS482001	Rail passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
321	MPS482002	Rail freight transportation services	0	0	0	0	0	0	0	10	0	0	0	0	0	0
322	MPS483001	Water passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
323	MPS483002	Water freight transportation services	0	0	0	0	0	0	0	623	0	0	0	0	0	0
324	MPS484001	Moving services	0	0	0	0	0	0	0	2	0	0	0	0	0	0
325	MPS484004	Truck transportation services for general freight	0	0	0	0	0	0	0	46	0	0	0	0	0	0
326	MPS484005	Truck transportation services for specialized freight	0	0	0	0	0	0	0	349	0	0	0	0	0	0
327	MPS485100	Urban transit services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
328	MPS48A001	Interurban and rural bus passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
329	MPS48A002	School bus services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
330	MPS48A003	Other transit and passenger transportation services by road	0	0	0	0	0	0	0	0	0	0	0	0	0	0
331	MPS48A004	Scenic and sightseeing tour services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
332	MPS485300	Taxi and limousine services	0	0	0	0	0	0	0	3	0	0	0	0	0	0
333	MPS486200	Transportation of natural gas by pipeline	0	0	0	0	0	0	0	0	0	0	0	0	0	0
334	MPS486A00	Transportation of crude oil and other commodities by pipeline	0	0	0	0	0	0	0	0	0	0	0	0	0	0
335	MPS488001	Air transportation support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
336	MPS488002	Aircraft maintenance and repair services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
337	MPS488003	Rail transportation support, maintenance and repair services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
338	MPS488004	Water transportation support, maintenance and repair services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
339	MPS488005	Road transportation support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
340	MPS488006	Freight transportation arrangement and customs brokering services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
341	MPS488009	Other transportation support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
342	MPS491000	Postal services	0	0	0	0	0	0	0	62	0	0	0	0	0	0
343	MPS492000	Courier, parcel, and local messenger and delivery services	0	0	0	0	0	0	0	108	0	0	0	0	0	0
344	MPS493001	Grain storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0
345	MPS493002	Warehousing and storage services (except grain storage)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
346	MPG511111	Newspapers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
347	MPS511112	Advertising space in printed newspapers	0	0	0	0	0	0	0	10	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Construction, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

		Commodities (Detail level)	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
348	MPG5111A1	Periodicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
349	MPG5111A2	Books	0	0	0	0	0	0	0	8	0	0	0	0	0	0
350	MPG5111A3	Other published products	0	0	0	0	0	0	0	15	0	0	0	0	0	0
351	MPS5111A4	Advertising space in printed periodicals and in other printed publications	0	0	0	0	0	0	0	3	0	0	0	0	0	0
352	MPS51AX00	Licensing of rights to use literary works and artistic works (except software licensing)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
353	MPS511200	General purpose software	0	0	0	0	0	0	0	2	0	0	0	0	0	0
354	MPS5121A1	Recorded movies, television programs and videos	0	0	0	0	0	0	0	0	0	0	0	0	0	0
355	MPS5121A2	Movie, television program and video production, post-production and editing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
356	MPS5121A3	Licensing of rights to use audiovisual works	0	0	0	0	0	0	0	0	0	0	0	0	0	0
357	MPS512130	Admissions to motion picture film exhibitions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
358	MPS512201	Recorded music and other sound recordings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
359	MPS512202	Audio recording services and copyright administration	0	0	0	0	0	0	0	0	0	0	0	0	0	0
360	MPS512203	Licensing of rights to use musical works and sound recordings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
361	MPS515100	Advertising air time on radio	0	0	0	0	0	0	0	0	0	0	0	0	0	0
362	MPS515A01	Advertising air time on television	0	0	0	0	0	0	0	0	0	0	0	0	0	0
363	MPS515A02	Fees for the distribution of television and radio program channels (affiliation payments)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
364	MPS517001	Fixed telecommunications services (except Internet access)	0	0	0	0	0	0	0	189	0	0	0	0	0	0
365	MPS517002	Mobile telecommunications services	0	0	0	0	0	0	0	304	0	0	0	0	0	0
366	MPS517003	Cable, satellite and other program distribution services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
367	MPS517004	Fixed Internet access services	0	0	0	0	0	0	0	83	0	0	0	0	0	0
368	MPS518000	Data processing, hosting, and related services	0	0	0	0	0	0	0	613	0	0	0	0	0	0
369	MPS519001	Subscriptions for online content	0	0	0	0	0	0	0	0	0	0	0	0	0	0
370	MPS519002	Internet advertising	0	0	0	0	0	0	0	10	0	0	0	0	0	0
371	MPS519008	Other information services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
372	MPS521000	Central banking services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
373	MPS522130	Local credit union services - explicit charges (fees)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
374	MPS5221A0	Banking and other depository credit intermediation services - explicit charges	0	0	0	0	0	0	0	665	0	0	0	0	0	0
375	MPS522200	Non-depository credit intermediation services - explicit charges (fees)	0	0	0	0	0	0	0	831	0	0	0	0	0	0
376	MPS522300	Other services related to credit intermediation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
377	MPS523001	Investment banking services	0	0	0	0	0	0	0	860	0	0	0	0	0	0
378	MPS523002	Security brokerage and securities dealing services	0	0	0	0	0	0	0	1,572	0	0	0	0	0	0
379	MPS523003	Portfolio management services	0	0	0	0	0	0	0	79	0	0	0	0	0	0
380	MPS523004	Investment counselling services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
381	MPS523009	Holding company services and other financial investment and related activities	0	0	0	0	0	0	0	281	0	0	0	0	0	0
382	MPS524101	Life insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
383	MPS524102	Accident and sickness insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
384	MPS524103	Automotive insurance services	0	0	0	0	0	0	0	299	0	0	0	0	0	0
385	MPS524104	Property insurance services	0	0	0	0	0	0	0	21	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Construction, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
386	**MPS524105**	Liability and other property and casualty insurance services	0	0	0	0	0	0	0	72	0	0	0	0	0	0
387	**MPS524200**	Brokerage and other insurance related services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
388	**MPS526111**	Trusteed pension fund services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
389	**MPS526A00**	Mutual funds (cost of service) and other similar services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
390	**MPS52X001**	Deposit intermediation services indirectly measured (FISIM)	0	0	0	0	0	0	0	691	0	0	0	0	0	0
391	**MPS52X002**	Residential mortgage intermediation services indirectly measured (FISIM)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
392	**MPS52X003**	Other loan intermediation services indirectly measured (FISIM)	0	0	0	0	0	0	0	230	0	0	0	0	0	0
393	**MPS531101**	Rental of residential real estate	0	0	0	0	0	0	0	0	0	0	0	0	0	0
394	**MPS531102**	Rental of non-residential real estate	0	0	0	0	0	0	0	803	0	0	0	0	0	0
395	**IMS5311A0**	Imputed rental of owner-occupied dwellings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
396	**MPS531A00**	Real estate brokerage and other services related to real estate	0	0	0	0	0	0	0	24	0	0	0	0	0	0
397	**MPS532100**	Motor vehicle rental and leasing services	0	0	0	0	0	0	0	1,016	0	0	0	0	0	0
398	**MPS532A01**	Computer equipment rental and leasing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
399	**MPS532A02**	Office machinery and equipment (except computer equipment) rental and leasing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
400	**MPS532A03**	Commercial and industrial machinery and equipment (except office equipment) rental and leasing services	0	0	0	0	0	0	0	1,706	0	0	0	0	0	0
401	**MPS532A09**	Rental and leasing services of other goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
402	**MPS533000**	Licensing of rights to non-financial produced intangible assets (except software and other copyright licensing)	0	0	0	0	0	0	0	819	0	0	0	0	0	0
403	**MPS541100**	Legal services	0	0	0	0	0	0	0	554	0	0	0	0	0	0
404	**MPS541200**	Accounting, tax preparation, bookkeeping and payroll services	0	0	0	0	0	0	0	648	0	0	0	0	0	0
405	**MPS541300**	Architectural, engineering and related services	0	0	0	0	0	0	0	21,325	0	0	0	0	0	0
406	**MPS541400**	Specialized design services	0	0	0	0	0	0	0	615	0	0	0	0	0	0
407	**MPS541501**	Custom software design and development services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
408	**IMS541502**	Own-account software design and development services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
409	**MPS541503**	Computer systems design and related services (except software development)	0	0	0	0	0	0	0	8	0	0	0	0	0	0
410	**MPS541600**	Management, scientific and technical consulting services	0	0	0	0	0	0	0	1,409	0	0	0	0	0	0
411	**MPS541701**	Research and development services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
412	**IMS541702**	Own-account research and development (except software development)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
413	**MPS541800**	Advertising, public relations and related services	0	0	0	0	0	0	0	34	0	0	0	0	0	0
414	**MPS541901**	Photographic services	0	0	0	0	0	0	0	1	0	0	0	0	0	0
415	**MPS541902**	Veterinary services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
416	**MPS541909**	Other professional, scientific and technical services	0	0	0	0	0	0	0	121	0	0	0	0	0	0
417	**IMS551001**	Holding company services (imputed)	0	0	0	0	0	0	0	44	0	0	0	0	0	0
418	**IMS551002**	Head office services (imputed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Industry inputs expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Construction, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
419	MPS561100	Office administrative services	0	0	0	0	0	0	0	1,341	0	0	0	0	0	0
420	MPS561300	Employment services	0	0	0	0	0	0	0	110	0	0	0	0	0	0
421	MPS561400	Business support services	0	0	0	0	0	0	0	312	0	0	0	0	0	0
422	MPS561500	Travel arrangement, reservation and planning services	0	0	0	0	0	0	0	2	0	0	0	0	0	0
423	MPS561600	Investigation and security services	0	0	0	0	0	0	0	380	0	0	0	0	0	0
424	MPS561700	Services to buildings and dwellings	0	0	0	0	0	0	0	20	0	0	0	0	0	0
425	MPS561A00	Facilities and other support services	0	0	0	0	0	0	0	72	0	0	0	0	0	0
426	MPS562000	Waste management and remediation services	0	0	0	0	0	0	0	3	0	0	0	0	0	0
427	MPS610001	Tuition and similar fees for elementary and secondary schools	0	0	0	0	0	0	0	0	0	0	0	0	0	0
428	MPS610002	Tuition and similar fees for colleges and C.E.G.E.P.s	0	0	0	0	0	0	0	0	0	0	0	0	0	0
429	MPS610003	Tuition and similar fees for universities	0	0	0	0	0	0	0	0	0	0	0	0	0	0
430	MPS610004	Tuition and similar fees for trade, technical and professional training	0	0	0	0	0	0	0	124	0	0	0	0	0	0
431	MPS610009	Other educational training and services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
432	MPS621100	Physician services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
433	MPS621200	Dental services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
434	MPS621A01	Other health practitioner services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
435	MPS621A02	Medical laboratory diagnostic and testing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
436	MPS621A03	Ambulance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
437	MPS622000	Hospital services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
438	MPS623000	Nursing and residential care services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
439	MPS624001	Child day-care services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
440	MPS62A000	Other ambulatory health care services and social assistance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
441	MPS71A001	Admissions to live sporting events	0	0	0	0	0	0	0	0	0	0	0	0	0	0
442	MPS71A002	Admissions to live performing arts performances	0	0	0	0	0	0	0	0	0	0	0	0	0	0
443	MPS71A003	Sport and performing arts event organization and support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
444	MPS71A004	Career management and representation services of public figures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
445	MPS71A005	Contract production of live performing arts performances, live sporting events and copyrighted works	0	0	0	0	0	0	0	0	0	0	0	0	0	0
446	MPS71A009	Broadcast and other media rights	0	0	0	0	0	0	0	0	0	0	0	0	0	0
447	MPS71A008	Heritage institution services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
448	MPS713A00	Amusement and recreation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
449	MPS713200	Gambling (net wagers)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
450	MPS721100	Room or unit accommodation services for travellers	0	0	0	0	0	0	0	29	0	0	0	0	0	0
451	MPS721A01	Recreational vehicle park and recreational camp services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
452	MPS721A02	Rooming and boarding services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
453	MPS722001	Prepared meals	0	0	0	0	0	0	0	34	0	0	0	0	0	0
454	MPS722002	Alcoholic beverages for immediate consumption	0	0	0	0	0	0	0	11	0	0	0	0	0	0
455	MPS811100	Motor vehicle repair and maintenance services	0	0	0	0	0	0	0	4	0	0	0	0	0	0
456	MPS811A00	Repair and maintenance services (except for buildings and motor vehicles)	0	0	0	0	0	0	0	288	0	0	0	0	0	0
457	MPS812200	Funeral services	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Industry inputs expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Construction, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
458	MPS812300	Laundry and dry-cleaning services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
459	MPS812A01	Hair care and aesthetic services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
460	MPS812A02	Parking services	0	0	0	0	0	0	0	7	0	0	0	0	0	0
461	MPS812A09	Other personal and personal care services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
462	MPS813000	Other membership services	0	0	0	0	0	0	0	112	0	0	0	0	0	0
463	MPS814001	Babysitting services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
464	MPS814002	Private household services (except babysitting)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
465	MPS9A0000	Sales of other services by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
466	MPS9B0000	Sales of other government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
467	FIC110000	Repair and maintenance	0	0	0	0	0	0	0	0	0	0	0	0	0	0
468	FIC120000	Operating supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
469	FIC130000	Office supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
470	FIC210000	Advertising, promotion, meals and entertainment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
471	FIC220000	Travel, meetings and conventions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
472	FIC300000	Transportation margins	0	0	0	0	0	0	0	0	0	0	0	0	0	0
473	NNP610000	Educational services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
474	NNP621000	Ambulatory health care services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
475	NNP624000	Social assistance services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
476	NNP710000	Arts, entertainment and recreation services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
477	NNP813100	Religious services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
478	NNP813A01	Grant-making, civic, and professional and similar organization services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
479	NNP813930	Labour organization membership services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
480	NNP813940	Political organization services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
481	NNP999999	Other services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
482	NGS611100	Elementary and secondary school services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
483	NGS611200	Community college and C.E.G.E.P services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
484	NGS611300	University services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
485	NGS611A00	Other educational services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
486	NGS622000	Hospital services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
487	NGS623000	Residential care facility services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
488	NGS911100	Defence services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
489	NGS911A00	Other federal government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
490	NGS912000	Other provincial and territorial government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
491	NGS913000	Other municipal government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
492	NGS914000	Other aboriginal government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
493	PRM100000	Taxes on products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
494	PRM200000	Subsidies on products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
495	PRM300000	Subsidies on production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
496	PRM400000	Taxes on production	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Industry inputs expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Construction, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
497	PRM500000	Wages and salaries	0	0	0	0	0	0	0	412,513	0	0	0	0	0	0
498	PRM600000	Employers' social contributions	0	0	0	0	0	0	0	31,440	0	0	0	0	0	0
499	PRM700000	Gross mixed income	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500	PRM800000	Gross operating surplus	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**883,773**	**0**	**0**	**0**	**0**	**0**	**0**

Attachment 3 Operations – Industry Inputs Expenditure, In Purchaser Prices, at the Detailed level

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Operations, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
1	MPG111A01	Canola (including rapeseed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	MPG111A02	Oilseeds (except canola)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	MPG111A03	Wheat	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	MPG111A04	Grains (except wheat)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	MPG111A05	Fresh potatoes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	MPG111A10	Fresh fruits and nuts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	MPG111A11	Other miscellaneous crop products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	MPG111A08	Fresh vegetables (except potatoes)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	IMG111A09	Imputed feed (animal feed produced for own consumption)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	MPG111400	Nursery and floriculture products (except cannabis)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	MPG111C00	Cannabis plants, seeds and flowering tops	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	MPG112001	Cattle and calves	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	MPG112002	Unprocessed fluid milk	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	MPG112003	Hogs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	MPG112004	Eggs in shell	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	MPG112005	Poultry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	MPG112006	Other live animals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	MPG112007	Raw furskins, and animal products n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	IMG112008	Imputed fertilizer (fertilizer produced for own consumption)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	MPG113001	Logs and bolts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	MPG113002	Pulpwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	ENE113003	Fuel wood	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	MPG113004	Rough untreated poles, posts and piling	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	MPG114000	Fish, crustaceans, shellfish and other fishery products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	MPS11X000	Custom work services for forestry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	MPS115A01	Support services for crop production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	MPS115A02	Support services for animal production, hunting and fishing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	MPS115300	Support services for forestry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	ENE211105	Conventional crude oil	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	ENE211106	Synthetic crude oil	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	ENE211102	Natural gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	ENE211103	Natural gas liquids and related products	0	0	0	0	0	0	0	23,121	0	0	0	0	0	0
33	ENE211104	Crude and diluted bitumen	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	ENE212100	Coal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	MPG212210	Iron ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	MPG212220	Gold and silver ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	MPG212231	Copper ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	MPG212232	Nickel ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	MPG212233	Lead and zinc ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	MPG212291	Radioactive ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	MPG212299	Other metal ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	MPG212310	Stone	0	0	0	0	0	0	0	127	0	0	0	0	0	0
43	MPG212320	Sand, gravel, clay, and refractory minerals	0	0	0	0	0	0	0	43	0	0	0	0	0	0
44	MPG212392	Uncut and industrial diamonds	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	MPG212396	Potash	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	MPG21239C	Non-metallic minerals (except diamonds)	0	0	0	0	0	0	0	56	0	0	0	0	0	0

Simulation options Industry inputs expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Operations, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
47	MPS21311A	Support services for oil and gas extraction (except exploration)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	MPS21311B	Support services for mining and quarrying (except exploration)	0	0	0	0	0	0	0	122	0	0	0	0	0	0
49	MPS21A000	Mineral and oil and gas exploration	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	ENE221100	Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	MPS221200	Natural gas distribution	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	MPS221301	Water delivered by water works and irrigation systems	0	0	0	0	0	0	0	26	0	0	0	0	0	0
53	MPS221302	Sewage and dirty water disposal and cleaning services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	ENE221303	Steam and heated or cooled air or water	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	MPG23A000	Residential construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	MPG23B001	Industrial buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	MPG23B002	Office buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	MPG23B003	Shopping centers, plazas, malls and stores	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	MPG23B004	Other commercial buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	MPG23B005	Schools, colleges, universities and other educational buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	MPG23B006	Health care buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	MPG23B007	Other institutional buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	MPG23C101	Highways, roads, streets, bridges and tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	MPG23C109	Other transportation construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	MPG23C201	Production facilities in oil and gas extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	MPG23C209	Other oil and gas engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	MPG23C300	Electric power engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	MPG23C400	Communication engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	MPG23C501	Marine engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	MPG23C502	Waterworks engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	MPG23C503	Sewage engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	MPG23C504	Mining engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	MPG23C509	Other engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	MPS23D000	Repair construction services	0	0	0	0	0	0	0	1,790	0	0	0	0	0	0
75	MPG311101	Dog and cat food	0	0	0	0	0	0	0	0	0	0	0	0	0	0
76	MPG311109	Other animal feed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77	MPG311204	Flour and other grain mill products	0	0	0	0	0	0	0	33	0	0	0	0	0	0
78	MPG311202	Margarine and cooking oils	0	0	0	0	0	0	0	47	0	0	0	0	0	0
79	MPG311203	Breakfast cereal and other cereal products	0	0	0	0	0	0	0	13	0	0	0	0	0	0
80	MPG311208	Grain and oilseed products, n.e.c.	0	0	0	0	0	0	0	549	0	0	0	0	0	0
81	MPG311301	Sugar and sugar mill by-products	0	0	0	0	0	0	0	28	0	0	0	0	0	0
82	MPG311302	Chocolate (except confectionery)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	MPG311303	Confectionery products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
84	MPG311401	Fresh, frozen and canned fruit and vegetable juices	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85	MPG311402	Preserved fruit and vegetables and frozen foods	0	0	0	0	0	0	0	28	0	0	0	0	0	0
86	MPG311501	Processed fluid milk and milk products	0	0	0	0	0	0	0	135	0	0	0	0	0	0
87	MPG311502	Cheese and cheese products	0	0	0	0	0	0	0	53	0	0	0	0	0	0
88	MPG311503	Butter and dry and canned dairy products	0	0	0	0	0	0	0	74	0	0	0	0	0	0
89	MPG311504	Ice cream, sherbet and similar frozen desserts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	MPG311601	Fresh and frozen beef and veal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	MPG311602	Fresh and frozen pork	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	MPG311603	Fresh and frozen poultry of all types	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Operations, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

Commodities (Detail level)			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
93	MPG311605	Processed meat products, other miscellaneous meats and animal by-products	0	0	0	0	0	0	0	62	0	0	0	0	0	0
94	MPG311700	Prepared and packaged seafood products	0	0	0	0	0	0	0	122	0	0	0	0	0	0
95	MPG311801	Bread, rolls and flatbreads	0	0	0	0	0	0	0	34	0	0	0	0	0	0
96	MPG311802	Cookies, crackers and baked sweet goods	0	0	0	0	0	0	0	25	0	0	0	0	0	0
97	MPG311803	Flour mixes, dough and dry pasta	0	0	0	0	0	0	0	19	0	0	0	0	0	0
98	MPG311901	Snack food products	0	0	0	0	0	0	0	19	0	0	0	0	0	0
99	MPG311902	Coffee and tea	0	0	0	0	0	0	0	30	0	0	0	0	0	0
100	MPG311903	Flavouring syrups, seasonings and dressings	0	0	0	0	0	0	0	25	0	0	0	0	0	0
101	MPG311909	Other food products, n.e.c.	0	0	0	0	0	0	0	214	0	0	0	0	0	0
102	MPG312110	Bottled water, soft drinks and ice	0	0	0	0	0	0	0	233	0	0	0	0	0	0
103	MPG312120	Beer	0	0	0	0	0	0	0	236	0	0	0	0	0	0
104	MPG3121A1	Wine and brandy	0	0	0	0	0	0	0	45	0	0	0	0	0	0
105	MPG3121A2	Distilled liquor	0	0	0	0	0	0	0	11	0	0	0	0	0	0
106	MPG312201	Stemmed, redried or reconstituted tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
107	MPG312202	Cigarettes, cigars, chewing and smoking tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
108	MPG312300	Cannabis products (except plants, seeds and flowering tops)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
109	MPG31A001	Fibre, yarn and thread	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	MPG31A002	Fabrics	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	MPG31A003	Carpets, rugs and mats	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112	MPG31A004	Other textile furnishings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
113	MPG31A005	Textile products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
114	MPS31A006	Textile and fabric finishing and coating services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115	MPG31B001	Men's, women's, boys' and girls' clothing	0	0	0	0	0	0	0	39	0	0	0	0	0	0
116	MPG31B002	Infant clothing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
117	MPG31B003	Clothing accessories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
118	MPG31B004	Leather and dressed furs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
119	MPG31B005	Footwear	0	0	0	0	0	0	0	10	0	0	0	0	0	0
120	MPG31B006	Suitcases, handbags and other leather and allied products	0	0	0	0	0	0	0	3	0	0	0	0	0	0
121	MPG321101	Hardwood lumber	0	0	0	0	0	0	0	0	0	0	0	0	0	0
122	MPG321102	Softwood lumber	0	0	0	0	0	0	0	0	0	0	0	0	0	0
123	MPG321103	Wood chips	0	0	0	0	0	0	0	0	0	0	0	0	0	0
124	MPG321104	Other sawmill products and treated wood products	0	0	0	0	0	0	0	1	0	0	0	0	0	0
125	MPG321201	Veneer and plywood	0	0	0	0	0	0	0	0	0	0	0	0	0	0
126	MPG321202	Wood trusses and engineered wood members	0	0	0	0	0	0	0	0	0	0	0	0	0	0
127	MPG321203	Reconstituted wood products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
128	MPG321901	Wood windows and doors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
129	MPG321903	Wood containers and pallets	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	MPG321904	Prefabricated wood and manufactured (mobile) buildings and components	0	0	0	0	0	0	0	0	0	0	0	0	0	0
131	MPG321908	Wood products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
132	MPG321X00	Waste and scrap of wood and wood by-products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
133	MPG322101	Wood pulp	0	0	0	0	0	0	0	0	0	0	0	0	0	0
134	MPG322102	Paper (except newsprint)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135	MPG322103	Newsprint	0	0	0	0	0	0	0	0	0	0	0	0	0	0
136	MPG322104	Paperboard	0	0	0	0	0	0	0	0	0	0	0	0	0	0
137	MPG322201	Paperboard containers	0	0	0	0	0	0	0	62	0	0	0	0	0	0
138	MPG322202	Paper office supplies	0	0	0	0	0	0	0	17	0	0	0	0	0	0

Simulation options Industry inputs expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Operations, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
139	MPG322203	Disposable diapers and feminine hygiene products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
140	MPG322204	Sanitary paper products	0	0	0	0	0	0	0	11	0	0	0	0	0	0
141	MPG322209	Other converted paper products	0	0	0	0	0	0	0	19	0	0	0	0	0	0
142	MPG322X00	Waste and scrap of paper and paperboard	0	0	0	0	0	0	0	0	0	0	0	0	0	0
143	MPG323001	Printed products	0	0	0	0	0	0	0	186	0	0	0	0	0	0
144	MPS323002	Support services for printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
145	MPS323003	Contract printing services for publishers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
146	ENE324111	Gasoline	0	0	0	0	0	0	0	0	0	0	0	0	0	0
147	ENE324112	Diesel and biodiesel fuels	0	0	0	0	0	0	0	3,581	0	0	0	0	0	0
148	ENE324113	Light fuel oils	0	0	0	0	0	0	0	0	0	0	0	0	0	0
149	ENE324114	Jet fuel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150	ENE324115	Heavy fuel oils	0	0	0	0	0	0	0	0	0	0	0	0	0	0
151	MPG3241A8	Lubricants and other petroleum refinery products	0	0	0	0	0	0	0	185	0	0	0	0	0	0
152	MPG3241A1	Asphalt (except natural) and asphalt products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
153	ENE3241A2	Coke and other coke oven products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
154	ENE32A000	Solid fuel products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
155	MPG325101	Petrochemicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
156	MPG325102	Industrial gases	0	0	0	0	0	0	0	16	0	0	0	0	0	0
157	MPG325103	Dyes and pigments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
158	MPG325106	Other basic inorganic chemicals	0	0	0	0	0	0	0	522	0	0	0	0	0	0
159	MPG325105	Basic organic chemicals, n.e.c.	0	0	0	0	0	0	0	3,427	0	0	0	0	0	0
160	MPG325201	Plastic resins	0	0	0	0	0	0	0	0	0	0	0	0	0	0
161	MPG325202	Rubber and rubber compounds and mixtures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
162	MPG325203	Artificial and synthetic fibres and filaments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
163	MPG325301	Ammonia and chemical fertilizers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
164	MPG325302	Pesticides and other agricultural chemicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
165	MPG325400	Pharmaceutical and medicinal products	0	0	0	0	0	0	0	94	0	0	0	0	0	0
166	MPG325500	Paints, coatings and adhesive products	0	0	0	0	0	0	0	18	0	0	0	0	0	0
167	MPG325601	Soaps and cleaning compounds	0	0	0	0	0	0	0	21	0	0	0	0	0	0
168	MPG325602	Perfumes and toiletries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
169	MPG325900	Chemical products, n.e.c.	0	0	0	0	0	0	0	5,179	0	0	0	0	0	0
170	MPG326101	Plastic bags	0	0	0	0	0	0	0	2	0	0	0	0	0	0
171	MPG326102	Plastic films and non-rigid sheets	0	0	0	0	0	0	0	0	0	0	0	0	0	0
172	MPG326103	Plastic and foam building and construction materials	0	0	0	0	0	0	0	105	0	0	0	0	0	0
173	MPG326104	Plastic profile shapes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
174	MPG326105	Foam products (except for construction)	0	0	0	0	0	0	0	2	0	0	0	0	0	0
175	MPG326106	Plastic bottles	0	0	0	0	0	0	0	0	0	0	0	0	0	0
176	MPG326107	Motor vehicle plastic parts	0	0	0	0	0	0	0	168	0	0	0	0	0	0
177	MPG326109	Plastic products, n.e.c.	0	0	0	0	0	0	0	24	0	0	0	0	0	0
178	MPG326201	Tires	0	0	0	0	0	0	0	374	0	0	0	0	0	0
179	MPG326202	Rubber and plastic hoses and belts	0	0	0	0	0	0	0	19	0	0	0	0	0	0
180	MPG326209	Rubber products, n.e.c.	0	0	0	0	0	0	0	1	0	0	0	0	0	0
181	MPG326X00	Waste and scrap of plastic and rubber	0	0	0	0	0	0	0	0	0	0	0	0	0	0
182	MPG327301	Cement	0	0	0	0	0	0	0	11,826	0	0	0	0	0	0
183	MPG327302	Ready-mixed concrete	0	0	0	0	0	0	0	0	0	0	0	0	0	0
184	MPG327303	Concrete products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
185	MPG327A01	Clay and ceramic products and refractories	0	0	0	0	0	0	0	18	0	0	0	0	0	0
186	MPG327A02	Glass (including automotive), glass products and glass containers	0	0	0	0	0	0	0	7	0	0	0	0	0	0
187	MPG327A03	Waste and scrap of glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0
188	MPG327A04	Lime and gypsum products	0	0	0	0	0	0	0	27,287	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Operations, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

		Commodities (Detail level)	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
189	MPG327A09	Non-metallic mineral products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
190	MPG331100	Iron and steel basic shapes and ferro-alloy products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
191	MPG331201	Iron and steel pipes and tubes (except castings)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
192	MPG331202	Wire and other rolled and drawn steel products	0	0	0	0	0	0	0	29	0	0	0	0	0	0
193	MPG331301	Bauxite and aluminum oxide	0	0	0	0	0	0	0	0	0	0	0	0	0	0
194	MPG331302	Unwrought aluminum including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
195	MPG331303	Basic and semi-finished products of aluminum and alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
196	MPG331401	Unwrought copper including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
197	MPG331402	Unwrought nickel including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
198	MPG331403	Unwrought precious metals including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
199	MPG331404	Other unwrought non-ferrous metals including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200	MPG331405	Gold, store of value	0	0	0	0	0	0	0	0	0	0	0	0	0	0
201	MPG331406	Basic and semi-finished products of non-ferrous metals and alloys (except aluminum)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
202	MPG331501	Ferrous metal castings	0	0	0	0	0	0	0	72	0	0	0	0	0	0
203	MPG331502	Non-ferrous metal castings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
204	MPG331X01	Waste and scrap of iron and steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
205	MPG331X02	Waste and scrap of non-ferrous metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
206	MPG332101	Forged and stamped metal products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
207	MPG332301	Prefabricated metal buildings and components	0	0	0	0	0	0	0	0	0	0	0	0	0	0
208	MPG332302	Fabricated steel plates and other fabricated structural metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
209	MPG332303	Metal windows and doors	0	0	0	0	0	0	0	20	0	0	0	0	0	0
210	MPG332A05	Other architectural metal products	0	0	0	0	0	0	0	3	0	0	0	0	0	0
211	MPG332401	Light gauge metal containers, crowns and closures	0	0	0	0	0	0	0	3	0	0	0	0	0	0
212	MPG332402	Boilers, tanks and heavy gauge metal containers	0	0	0	0	0	0	0	295	0	0	0	0	0	0
213	MPG332500	Builders, motor vehicle and other hardware	0	0	0	0	0	0	0	48	0	0	0	0	0	0
214	MPG332600	Springs and wire products	0	0	0	0	0	0	0	5	0	0	0	0	0	0
215	MPG332700	Threaded metal fasteners and other turned metal products including automotive	0	0	0	0	0	0	0	12	0	0	0	0	0	0
216	MPS332800	Coating, engraving, heat treating and similar metal processing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
217	MPG332A01	Hand tools, kitchen utensils and cutlery (except precious metal)	0	0	0	0	0	0	0	29	0	0	0	0	0	0
218	MPG332A02	Metal valves and pipe fittings	0	0	0	0	0	0	0	257	0	0	0	0	0	0
219	MPG332A03	Ball and roller bearings	0	0	0	0	0	0	0	159	0	0	0	0	0	0
220	MPG332A04	Guns, ammunition and other munitions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
221	MPG332A08	Fabricated metal products, n.e.c.	0	0	0	0	0	0	0	29	0	0	0	0	0	0
222	MPG333101	Agricultural, lawn and garden machinery and equipment	0	0	0	0	0	0	0	33	0	0	0	0	0	0
223	MPG333102	Logging, mining and construction machinery and equipment	0	0	0	0	0	0	0	12,922	0	0	0	0	0	0
224	MPG333200	Other industry-specific machinery	0	0	0	0	0	0	0	48	0	0	0	0	0	0
225	MPG333300	Commercial and service industry machinery	0	0	0	0	0	0	0	0	0	0	0	0	0	0
226	MPG333401	Industrial and commercial fans, blowers and air purification equipment	0	0	0	0	0	0	0	16	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Operations, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
227	MPG333402	Heating and cooling equipment (except household refrigerators and freezers)	0	0	0	0	0	0	0	25	0	0	0	0	0	0
228	MPG333500	Metalworking machinery and industrial moulds	0	0	0	0	0	0	0	0	0	0	0	0	0	0
229	MPG333601	Turbines, turbine generators, and turbine generator sets	0	0	0	0	0	0	0	65	0	0	0	0	0	0
230	MPG333609	Other engine and power transmission equipment	0	0	0	0	0	0	0	63	0	0	0	0	0	0
231	MPG333901	Pumps and compressors (except fluid power)	0	0	0	0	0	0	0	162	0	0	0	0	0	0
232	MPG333902	Material handling equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
233	MPG333909	Other miscellaneous general-purpose machinery	0	0	0	0	0	0	0	18	0	0	0	0	0	0
234	MPG334100	Computers, computer peripherals and parts	0	0	0	0	0	0	0	28	0	0	0	0	0	0
235	MPG334201	Telephone apparatus	0	0	0	0	0	0	0	107	0	0	0	0	0	0
236	MPG334209	Other communications equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
237	MPG334A01	Audio and video equipment and unrecorded media	0	0	0	0	0	0	0	0	0	0	0	0	0	0
238	MPG334A02	Navigational and guidance instruments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
239	MPG334A05	Medical devices	0	0	0	0	0	0	0	0	0	0	0	0	0	0
240	MPG334A06	Measuring, control and scientific instruments	0	0	0	0	0	0	0	152	0	0	0	0	0	0
241	MPG334401	Printed and integrated circuits, semiconductors and printed circuit assemblies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
242	MPG334409	Other electronic components	0	0	0	0	0	0	0	29	0	0	0	0	0	0
243	MPG335101	Electric light bulbs and tubes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
244	MPG335102	Lighting fixtures	0	0	0	0	0	0	0	7	0	0	0	0	0	0
245	MPG335203	Small electric appliances	0	0	0	0	0	0	0	16	0	0	0	0	0	0
246	MPG335204	Major appliances	0	0	0	0	0	0	0	4	0	0	0	0	0	0
247	MPG335301	Power, distribution and other transformers	0	0	0	0	0	0	0	24	0	0	0	0	0	0
248	MPG335302	Electric motors and generators	0	0	0	0	0	0	0	31	0	0	0	0	0	0
249	MPG335303	Switchgear, switchboards, relays and industrial control apparatus	0	0	0	0	0	0	0	29	0	0	0	0	0	0
250	MPG335901	Batteries	0	0	0	0	0	0	0	7	0	0	0	0	0	0
251	MPG335902	Communication and electric wire and cable	0	0	0	0	0	0	0	1	0	0	0	0	0	0
252	MPG335903	Wiring devices	0	0	0	0	0	0	0	10	0	0	0	0	0	0
253	MPG335909	Other electrical equipment and components	0	0	0	0	0	0	0	20	0	0	0	0	0	0
254	MPG336111	Passenger cars	0	0	0	0	0	0	0	0	0	0	0	0	0	0
255	MPG336112	Light-duty trucks, vans and sport utility vehicles (SUVs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
256	MPG336120	Medium and heavy-duty trucks and chassis	0	0	0	0	0	0	0	0	0	0	0	0	0	0
257	MPG336201	Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
258	MPG336202	Motor vehicle bodies and special purpose motor vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0	0
259	MPG336203	Freight and utility trailers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
260	MPG336204	Motor homes, travel trailers and camping trailers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
261	MPG336310	Motor vehicle gasoline engines and engine parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
262	MPG336320	Motor vehicle electrical and electronic equipment and instruments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
263	MPG336330	Motor vehicle steering and suspension components	0	0	0	0	0	0	0	37	0	0	0	0	0	0
264	MPG336340	Motor vehicle brakes and brake systems	0	0	0	0	0	0	0	65	0	0	0	0	0	0
265	MPG336350	Motor vehicle transmission and power train parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Operations, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

Commodities (Detail level)			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
266	MPG336360	Motor vehicle interior trim, seats and seat parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
267	MPG336370	Motor vehicle metal stamping	0	0	0	0	0	0	0	0	0	0	0	0	0	0
268	MPG336390	Other miscellaneous motor vehicle parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
269	MPG336401	Aircraft	0	0	0	0	0	0	0	0	0	0	0	0	0	0
270	MPG336402	Aircraft engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
271	MPG336403	Aircraft parts and other aerospace equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
272	MPG336501	Locomotives, railway rolling stock, and rapid transit equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
273	MPG336502	Parts of railway rolling stock	0	0	0	0	0	0	0	0	0	0	0	0	0	0
274	MPG336601	Ships	0	0	0	0	0	0	0	0	0	0	0	0	0	0
275	MPG336602	Boats and personal watercraft	0	0	0	0	0	0	0	0	0	0	0	0	0	0
276	MPG336900	Other transportation equipment and related parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
277	MPG337101	Wood kitchen cabinets and counter tops	0	0	0	0	0	0	0	0	0	0	0	0	0	0
278	MPG337102	Household furniture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
279	MPG337103	Institutional and other furniture, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
280	MPG337203	Office furniture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
281	MPG337204	Office and store fixtures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
282	MPG337901	Mattresses and foundations	0	0	0	0	0	0	0	0	0	0	0	0	0	0
283	MPG337902	Blinds and shades	0	0	0	0	0	0	0	0	0	0	0	0	0	0
284	MPG339100	Medical, dental and personal safety supplies, instruments and equipment	0	0	0	0	0	0	0	11	0	0	0	0	0	0
285	MPG339901	Jewellery and silverware	0	0	0	0	0	0	0	0	0	0	0	0	0	0
286	MPG339902	Sporting and athletic goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
287	MPG339903	Toys and games	0	0	0	0	0	0	0	0	0	0	0	0	0	0
288	MPG339904	Office supplies (except paper)	0	0	0	0	0	0	0	8	0	0	0	0	0	0
289	MPG339905	Signs	0	0	0	0	0	0	0	32	0	0	0	0	0	0
290	MPG339909	Other miscellaneous manufactured products	0	0	0	0	0	0	0	23	0	0	0	0	0	0
291	MPS3X0000	Custom work manufacturing services (except printing, finishing textiles and metals)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
292	MPS411000	Wholesale margins - farm products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
293	MPS412000	Wholesale margins - petroleum and petroleum products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
294	MPS413000	Wholesale margins - food, beverages and tobacco products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
295	MPS414000	Wholesale margins - personal and household goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
296	MPS415000	Wholesale margins - motor vehicles, motor vehicle parts and accessories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
297	MPS416000	Wholesale margins - building materials and supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
298	MPS417000	Wholesale margins - machinery, equipment and supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
299	MPS418000	Wholesale margins - miscellaneous products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
300	MPS410002	Wholesale trade commissions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
301	MPS441000	Retail margins - motor vehicles and parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
302	MPS442000	Retail margins - furniture and home	0	0	0	0	0	0	0	0	0	0	0	0	0	0
303	MPS443000	Retail margins - electronics and appliances	0	0	0	0	0	0	0	0	0	0	0	0	0	0
304	MPS444000	Retail margins - building materials, garden equipment and supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
305	MPS445000	Retail margins - food and beverages	0	0	0	0	0	0	0	0	0	0	0	0	0	0
306	MPS446000	Retail margins - health and personal care products	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Industry inputs expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Operations, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
307	MPS447000	Retail margins - automotive fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
308	MPS448000	Retail margins - clothing and clothing accessories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
309	MPS451000	Retail margins - sporting and leisure products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
310	MPS453A00	Retail margins - miscellaneous products (except cannabis)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
311	MPS453BL0	Retail margins - cannabis products (licensed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
312	MPS453BU0	Retail margins - cannabis products (unlicensed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
313	MPS454310	Retail margins - household fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
314	MPS4A0002	Used motor vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0	0
315	MPS4A0003	Other used consumer goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
316	MPS4A0004	Retail trade commissions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
317	MPS481001	Air passenger transportation services	0	0	0	0	0	0	0	2,086	0	0	0	0	0	0
318	MPS481002	Air freight transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
319	MPS481003	Air specialty services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
320	MPS482001	Rail passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
321	MPS482002	Rail freight transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
322	MPS483001	Water passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
323	MPS483002	Water freight transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
324	MPS484001	Moving services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
325	MPS484004	Truck transportation services for general freight	0	0	0	0	0	0	0	0	0	0	0	0	0	0
326	MPS484005	Truck transportation services for specialized freight	0	0	0	0	0	0	0	0	0	0	0	0	0	0
327	MPS485100	Urban transit services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
328	MPS48A001	Interurban and rural bus passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
329	MPS48A002	School bus services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
330	MPS48A003	Other transit and passenger transportation services by road	0	0	0	0	0	0	0	0	0	0	0	0	0	0
331	MPS48A004	Scenic and sightseeing tour services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
332	MPS485300	Taxi and limousine services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
333	MPS486200	Transportation of natural gas by pipeline	0	0	0	0	0	0	0	0	0	0	0	0	0	0
334	MPS486A00	Transportation of crude oil and other commodities by pipeline	0	0	0	0	0	0	0	0	0	0	0	0	0	0
335	MPS488001	Air transportation support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
336	MPS488002	Aircraft maintenance and repair services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
337	MPS488003	Rail transportation support, maintenance and repair services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
338	MPS488004	Water transportation support, maintenance and repair services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
339	MPS488005	Road transportation support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
340	MPS488006	Freight transportation arrangement and customs brokering services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
341	MPS488009	Other transportation support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
342	MPS491000	Postal services	0	0	0	0	0	0	0	20	0	0	0	0	0	0
343	MPS492000	Courier, parcel, and local messenger and delivery services	0	0	0	0	0	0	0	71	0	0	0	0	0	0
344	MPS493001	Grain storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0
345	MPS493002	Warehousing and storage services (except grain storage)	0	0	0	0	0	0	0	81	0	0	0	0	0	0
346	MPG511111	Newspapers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
347	MPS511112	Advertising space in printed newspapers	0	0	0	0	0	0	0	21	0	0	0	0	0	0

Simulation options Industry inputs expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Operations, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
348	MPG5111A1	Periodicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
349	MPG5111A2	Books	0	0	0	0	0	0	0	8	0	0	0	0	0	0
350	MPG5111A3	Other published products	0	0	0	0	0	0	0	15	0	0	0	0	0	0
351	MPS5111A4	Advertising space in printed periodicals and in other printed publications	0	0	0	0	0	0	0	8	0	0	0	0	0	0
352	MPS51AX00	Licensing of rights to use literary works and artistic works (except software licensing)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
353	MPS511200	General purpose software	0	0	0	0	0	0	0	6	0	0	0	0	0	0
354	MPS5121A1	Recorded movies, television programs and videos	0	0	0	0	0	0	0	0	0	0	0	0	0	0
355	MPS5121A2	Movie, television program and video production, post-production and editing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
356	MPS5121A3	Licensing of rights to use audiovisual works	0	0	0	0	0	0	0	0	0	0	0	0	0	0
357	MPS512130	Admissions to motion picture film exhibitions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
358	MPS512201	Recorded music and other sound recordings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
359	MPS512202	Audio recording services and copyright administration	0	0	0	0	0	0	0	0	0	0	0	0	0	0
360	MPS512203	Licensing of rights to use musical works and sound recordings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
361	MPS515100	Advertising air time on radio	0	0	0	0	0	0	0	0	0	0	0	0	0	0
362	MPS515A01	Advertising air time on television	0	0	0	0	0	0	0	0	0	0	0	0	0	0
363	MPS515A02	Fees for the distribution of television and radio program channels (affiliation payments)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
364	MPS517001	Fixed telecommunications services (except Internet access)	0	0	0	0	0	0	0	120	0	0	0	0	0	0
365	MPS517002	Mobile telecommunications services	0	0	0	0	0	0	0	124	0	0	0	0	0	0
366	MPS517003	Cable, satellite and other program distribution services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
367	MPS517004	Fixed Internet access services	0	0	0	0	0	0	0	24	0	0	0	0	0	0
368	MPS518000	Data processing, hosting, and related services	0	0	0	0	0	0	0	50	0	0	0	0	0	0
369	MPS519001	Subscriptions for online content	0	0	0	0	0	0	0	0	0	0	0	0	0	0
370	MPS519002	Internet advertising	0	0	0	0	0	0	0	17	0	0	0	0	0	0
371	MPS519008	Other information services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
372	MPS521000	Central banking services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
373	MPS522130	Local credit union services - explicit charges (fees)	0	0	0	0	0	0	0	3	0	0	0	0	0	0
374	MPS5221A0	Banking and other depository credit intermediation services - explicit charges	0	0	0	0	0	0	0	126	0	0	0	0	0	0
375	MPS522200	Non-depository credit intermediation services - explicit charges (fees)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
376	MPS522300	Other services related to credit intermediation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
377	MPS523001	Investment banking services	0	0	0	0	0	0	0	20	0	0	0	0	0	0
378	MPS523002	Security brokerage and securities dealing services	0	0	0	0	0	0	0	95	0	0	0	0	0	0
379	MPS523003	Portfolio management services	0	0	0	0	0	0	0	80	0	0	0	0	0	0
380	MPS523004	Investment counselling services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
381	MPS523009	Holding company services and other financial investment and related activities	0	0	0	0	0	0	0	547	0	0	0	0	0	0
382	MPS524101	Life insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
383	MPS524102	Accident and sickness insurance services	0	0	0	0	0	0	0	50	0	0	0	0	0	0
384	MPS524103	Automotive insurance services	0	0	0	0	0	0	0	293	0	0	0	0	0	0
385	MPS524104	Property insurance services	0	0	0	0	0	0	0	71	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Operations, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

Commodities (Detail level)			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
386	MPS524105	Liability and other property and casualty insurance services	0	0	0	0	0	0	0	234	0	0	0	0	0	0
387	MPS524200	Brokerage and other insurance related services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
388	MPS526111	Trusteed pension fund services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
389	MPS526A00	Mutual funds (cost of service) and other similar services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
390	MPS52X001	Deposit intermediation services indirectly measured (FISIM)	0	0	0	0	0	0	0	397	0	0	0	0	0	0
391	MPS52X002	Residential mortgage intermediation services indirectly measured (FISIM)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
392	MPS52X003	Other loan intermediation services indirectly measured (FISIM)	0	0	0	0	0	0	0	305	0	0	0	0	0	0
393	MPS531101	Rental of residential real estate	0	0	0	0	0	0	0	0	0	0	0	0	0	0
394	MPS531102	Rental of non-residential real estate	0	0	0	0	0	0	0	145	0	0	0	0	0	0
395	IMS5311A0	Imputed rental of owner-occupied dwellings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
396	MPS531A00	Real estate brokerage and other services related to real estate	0	0	0	0	0	0	0	11	0	0	0	0	0	0
397	MPS532100	Motor vehicle rental and leasing services	0	0	0	0	0	0	0	190	0	0	0	0	0	0
398	MPS532A01	Computer equipment rental and leasing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
399	MPS532A02	Office machinery and equipment (except computer equipment) rental and leasing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
400	MPS532A03	Commercial and industrial machinery and equipment (except office equipment) rental and leasing services	0	0	0	0	0	0	0	289	0	0	0	0	0	0
401	MPS532A09	Rental and leasing services of other goods	0	0	0	0	0	0	0	2	0	0	0	0	0	0
402	MPS533000	Licensing of rights to non-financial produced intangible assets (except software and other copyright licensing)	0	0	0	0	0	0	0	62	0	0	0	0	0	0
403	MPS541100	Legal services	0	0	0	0	0	0	0	88	0	0	0	0	0	0
404	MPS541200	Accounting, tax preparation, bookkeeping and payroll services	0	0	0	0	0	0	0	21	0	0	0	0	0	0
405	MPS541300	Architectural, engineering and related services	0	0	0	0	0	0	0	87	0	0	0	0	0	0
406	MPS541400	Specialized design services	0	0	0	0	0	0	0	166	0	0	0	0	0	0
407	MPS541501	Custom software design and development services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
408	IMS541502	Own-account software design and development services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
409	MPS541503	Computer systems design and related services (except software development)	0	0	0	0	0	0	0	3	0	0	0	0	0	0
410	MPS541600	Management, scientific and technical consulting services	0	0	0	0	0	0	0	3	0	0	0	0	0	0
411	MPS541701	Research and development services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
412	IMS541702	Own-account research and development (except software development)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
413	MPS541800	Advertising, public relations and related services	0	0	0	0	0	0	0	61	0	0	0	0	0	0
414	MPS541901	Photographic services	0	0	0	0	0	0	0	1	0	0	0	0	0	0
415	MPS541902	Veterinary services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
416	MPS541909	Other professional, scientific and technical services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
417	IMS551001	Holding company services (imputed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
418	IMS551002	Head office services (imputed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Operations, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

Commodities (Detail level)			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
419	MPS561100	Office administrative services	0	0	0	0	0	0	0	132	0	0	0	0	0	0
420	MPS561300	Employment services	0	0	0	0	0	0	0	99	0	0	0	0	0	0
421	MPS561400	Business support services	0	0	0	0	0	0	0	110	0	0	0	0	0	0
422	MPS561500	Travel arrangement, reservation and planning services	0	0	0	0	0	0	0	5	0	0	0	0	0	0
423	MPS561600	Investigation and security services	0	0	0	0	0	0	0	13	0	0	0	0	0	0
424	MPS561700	Services to buildings and dwellings	0	0	0	0	0	0	0	1,094	0	0	0	0	0	0
425	MPS561A00	Facilities and other support services	0	0	0	0	0	0	0	457	0	0	0	0	0	0
426	MPS562000	Waste management and remediation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
427	MPS610001	Tuition and similar fees for elementary and secondary schools	0	0	0	0	0	0	0	0	0	0	0	0	0	0
428	MPS610002	Tuition and similar fees for colleges and C.E.G.E.P.s	0	0	0	0	0	0	0	0	0	0	0	0	0	0
429	MPS610003	Tuition and similar fees for universities	0	0	0	0	0	0	0	0	0	0	0	0	0	0
430	MPS610004	Tuition and similar fees for trade, technical and professional training	0	0	0	0	0	0	0	2	0	0	0	0	0	0
431	MPS610009	Other educational training and services	0	0	0	0	0	0	0	11	0	0	0	0	0	0
432	MPS621100	Physician services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
433	MPS621200	Dental services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
434	MPS621A01	Other health practitioner services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
435	MPS621A02	Medical laboratory diagnostic and testing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
436	MPS621A03	Ambulance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
437	MPS622000	Hospital services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
438	MPS623000	Nursing and residential care services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
439	MPS624001	Child day-care services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
440	MPS62A000	Other ambulatory health care services and social assistance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
441	MPS71A001	Admissions to live sporting events	0	0	0	0	0	0	0	0	0	0	0	0	0	0
442	MPS71A002	Admissions to live performing arts performances	0	0	0	0	0	0	0	0	0	0	0	0	0	0
443	MPS71A003	Sport and performing arts event organization and support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
444	MPS71A004	Career management and representation services of public figures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
445	MPS71A005	Contract production of live performing arts performances, live sporting events and copyrighted works	0	0	0	0	0	0	0	0	0	0	0	0	0	0
446	MPS71A009	Broadcast and other media rights	0	0	0	0	0	0	0	0	0	0	0	0	0	0
447	MPS71A008	Heritage institution services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
448	MPS713A00	Amusement and recreation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
449	MPS713200	Gambling (net wagers)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
450	MPS721100	Room or unit accommodation services for travellers	0	0	0	0	0	0	0	695	0	0	0	0	0	0
451	MPS721A01	Recreational vehicle park and recreational camp services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
452	MPS721A02	Rooming and boarding services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
453	MPS722001	Prepared meals	0	0	0	0	0	0	0	1,116	0	0	0	0	0	0
454	MPS722002	Alcoholic beverages for immediate consumption	0	0	0	0	0	0	0	0	0	0	0	0	0	0
455	MPS811100	Motor vehicle repair and maintenance services	0	0	0	0	0	0	0	18	0	0	0	0	0	0
456	MPS811A00	Repair and maintenance services (except for buildings and motor vehicles)	0	0	0	0	0	0	0	6,694	0	0	0	0	0	0
457	MPS812200	Funeral services	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Industry inputs expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Operations, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
458	MPS812300	Laundry and dry-cleaning services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
459	MPS812A01	Hair care and aesthetic services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
460	MPS812A02	Parking services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
461	MPS812A09	Other personal and personal care services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
462	MPS813000	Other membership services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
463	MPS814001	Babysitting services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
464	MPS814002	Private household services (except babysitting)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
465	MPS9A0000	Sales of other services by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
466	MPS9B0000	Sales of other government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
467	FIC110000	Repair and maintenance	0	0	0	0	0	0	0	0	0	0	0	0	0	0
468	FIC120000	Operating supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
469	FIC130000	Office supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
470	FIC210000	Advertising, promotion, meals and entertainment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
471	FIC220000	Travel, meetings and conventions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
472	FIC300000	Transportation margins	0	0	0	0	0	0	0	0	0	0	0	0	0	0
473	NNP610000	Educational services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
474	NNP621000	Ambulatory health care services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
475	NNP624000	Social assistance services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
476	NNP710000	Arts, entertainment and recreation services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
477	NNP813100	Religious services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
478	NNP813A01	Grant-making, civic, and professional and similar organization services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
479	NNP813930	Labour organization membership services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
480	NNP813940	Political organization services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
481	NNP999999	Other services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
482	NGS611100	Elementary and secondary school services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
483	NGS611200	Community college and C.E.G.E.P services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
484	NGS611300	University services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
485	NGS611A00	Other educational services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
486	NGS622000	Hospital services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
487	NGS623000	Residential care facility services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
488	NGS911100	Defence services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
489	NGS911A00	Other federal government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
490	NGS912000	Other provincial and territorial government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
491	NGS913000	Other municipal government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
492	NGS914000	Other aboriginal government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
493	PRM100000	Taxes on products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
494	PRM200000	Subsidies on products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
495	PRM300000	Subsidies on production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
496	PRM400000	Taxes on production	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Industry inputs expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Operations, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
497	PRM500000	Wages and salaries	0	0	0	0	6,256	4,385	16	31,972	0	0	0	0	0	0
498	PRM600000	Employers' social contributions	0	0	0	0	1,816	1,273	5	9,283	0	0	0	0	0	0
499	PRM700000	Gross mixed income	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500	PRM800000	Gross operating surplus	0	0	0	0	0	0	0	919,641	0	0	0	0	0	0
Total			**0**	**0**	**0**	**0**	**8,073**	**5,658**	**21**	**1,072,836**	**0**	**0**	**0**	**0**	**0**	**0**

Attachment 4 Sustaining Capital – Capital Expenditure, In Purchaser Prices, at the Detailed level

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Sustaining Capital, Capital Expenditure, In Purchaser Prices)

Thousands of dollars			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
1	MPG111A01	Canola (including rapeseed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	MPG111A02	Oilseeds (except canola)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	MPG111A03	Wheat	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	MPG111A04	Grains (except wheat)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	MPG111A05	Fresh potatoes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	MPG111A10	Fresh fruits and nuts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	MPG111A11	Other miscellaneous crop products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	MPG111A08	Fresh vegetables (except potatoes)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	IMG111A09	Imputed feed (animal feed produced for own consumption)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	MPG111400	Nursery and floriculture products (except cannabis)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	MPG111C00	Cannabis plants, seeds and flowering tops	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	MPG112001	Cattle and calves	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	MPG112002	Unprocessed fluid milk	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	MPG112003	Hogs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	MPG112004	Eggs in shell	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	MPG112005	Poultry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	MPG112006	Other live animals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	MPG112007	Raw furskins, and animal products n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	IMG112008	Imputed fertilizer (fertilizer produced for own consumption)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	MPG113001	Logs and bolts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	MPG113002	Pulpwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	ENE113003	Fuel wood	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	MPG113004	Rough untreated poles, posts and piling	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	MPG114000	Fish, crustaceans, shellfish and other fishery products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	MPS11X000	Custom work services for forestry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	MPS115A01	Support services for crop production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	MPS115A02	Support services for animal production, hunting and fishing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	MPS115300	Support services for forestry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	ENE211105	Conventional crude oil	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	ENE211106	Synthetic crude oil	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	ENE211102	Natural gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	ENE211103	Natural gas liquids and related products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	ENE211104	Crude and diluted bitumen	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	ENE212100	Coal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	MPG212210	Iron ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	MPG212220	Gold and silver ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	MPG212231	Copper ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	MPG212232	Nickel ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	MPG212233	Lead and zinc ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	MPG212291	Radioactive ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	MPG212299	Other metal ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	MPG212310	Stone	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	MPG212320	Sand, gravel, clay, and refractory minerals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	MPG212392	Uncut and industrial diamonds	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	MPG212396	Potash	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	MPG21239C	Non-metallic minerals (except diamonds)	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Capital expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Capital Expenditure, In Purchaser Prices)

		Commodities (Detail level)	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
47	MPS21311A	Support services for oil and gas extraction (except exploration)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	MPS21311B	Support services for mining and quarrying (except exploration)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	MPS21A000	Mineral and oil and gas exploration	0	0	0	0	0	0	0	3	0	0	0	0	0	0
50	ENE221100	Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	MPS221200	Natural gas distribution	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	MPS221301	Water delivered by water works and irrigation systems	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	MPS221302	Sewage and dirty water disposal and cleaning services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	ENE221303	Steam and heated or cooled air or water	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	MPG23A000	Residential construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	MPG23B001	Industrial buildings	0	0	0	0	0	0	0	1	0	0	0	0	0	0
57	MPG23B002	Office buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	MPG23B003	Shopping centers, plazas, malls and stores	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	MPG23B004	Other commercial buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	MPG23B005	Schools, colleges, universities and other educational buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	MPG23B006	Health care buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	MPG23B007	Other institutional buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	MPG23C101	Highways, roads, streets, bridges and tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	MPG23C109	Other transportation construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	MPG23C201	Production facilities in oil and gas extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	MPG23C209	Other oil and gas engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	MPG23C300	Electric power engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	MPG23C400	Communication engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	MPG23C501	Marine engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	MPG23C502	Waterworks engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	MPG23C503	Sewage engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	MPG23C504	Mining engineering construction	0	0	0	0	0	0	0	69	0	0	0	0	0	0
73	MPG23C509	Other engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	MPS23D000	Repair construction services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	MPG311101	Dog and cat food	0	0	0	0	0	0	0	0	0	0	0	0	0	0
76	MPG311109	Other animal feed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77	MPG311204	Flour and other grain mill products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
78	MPG311202	Margarine and cooking oils	0	0	0	0	0	0	0	0	0	0	0	0	0	0
79	MPG311203	Breakfast cereal and other cereal products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	MPG311208	Grain and oilseed products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81	MPG311301	Sugar and sugar mill by-products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	MPG311302	Chocolate (except confectionery)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	MPG311303	Confectionery products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
84	MPG311401	Fresh, frozen and canned fruit and vegetable juices	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85	MPG311402	Preserved fruit and vegetables and frozen foods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
86	MPG311501	Processed fluid milk and milk products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
87	MPG311502	Cheese and cheese products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
88	MPG311503	Butter and dry and canned dairy products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
89	MPG311504	Ice cream, sherbet and similar frozen desserts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	MPG311601	Fresh and frozen beef and veal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	MPG311602	Fresh and frozen pork	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	MPG311603	Fresh and frozen poultry of all types	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Sustaining Capital, Capital Expenditure, In Purchaser Prices)

Commodities (Detail level)			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
93	MPG311605	Processed meat products, other miscellaneous meats and animal by-products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	MPG311700	Prepared and packaged seafood products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	MPG311801	Bread, rolls and flatbreads	0	0	0	0	0	0	0	0	0	0	0	0	0	0
96	MPG311802	Cookies, crackers and baked sweet goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
97	MPG311803	Flour mixes, dough and dry pasta	0	0	0	0	0	0	0	0	0	0	0	0	0	0
98	MPG311901	Snack food products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99	MPG311902	Coffee and tea	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	MPG311903	Flavouring syrups, seasonings and dressings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
101	MPG311909	Other food products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
102	MPG312110	Bottled water, soft drinks and ice	0	0	0	0	0	0	0	0	0	0	0	0	0	0
103	MPG312120	Beer	0	0	0	0	0	0	0	0	0	0	0	0	0	0
104	MPG3121A1	Wine and brandy	0	0	0	0	0	0	0	0	0	0	0	0	0	0
105	MPG3121A2	Distilled liquor	0	0	0	0	0	0	0	0	0	0	0	0	0	0
106	MPG312201	Stemmed, redried or reconstituted tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
107	MPG312202	Cigarettes, cigars, chewing and smoking tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
108	MPG312300	Cannabis products (except plants, seeds and flowering tops)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
109	MPG31A001	Fibre, yarn and thread	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	MPG31A002	Fabrics	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	MPG31A003	Carpets, rugs and mats	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112	MPG31A004	Other textile furnishings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
113	MPG31A005	Textile products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
114	MPS31A006	Textile and fabric finishing and coating services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115	MPG31B001	Men's, women's, boys' and girls' clothing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
116	MPG31B002	Infant clothing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
117	MPG31B003	Clothing accessories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
118	MPG31B004	Leather and dressed furs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
119	MPG31B005	Footwear	0	0	0	0	0	0	0	0	0	0	0	0	0	0
120	MPG31B006	Suitcases, handbags and other leather and allied products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
121	MPG321101	Hardwood lumber	0	0	0	0	0	0	0	0	0	0	0	0	0	0
122	MPG321102	Softwood lumber	0	0	0	0	0	0	0	0	0	0	0	0	0	0
123	MPG321103	Wood chips	0	0	0	0	0	0	0	0	0	0	0	0	0	0
124	MPG321104	Other sawmill products and treated wood products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
125	MPG321201	Veneer and plywood	0	0	0	0	0	0	0	0	0	0	0	0	0	0
126	MPG321202	Wood trusses and engineered wood members	0	0	0	0	0	0	0	0	0	0	0	0	0	0
127	MPG321203	Reconstituted wood products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
128	MPG321901	Wood windows and doors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
129	MPG321903	Wood containers and pallets	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	MPG321904	Prefabricated wood and manufactured (mobile) buildings and components	0	0	0	0	0	0	0	0	0	0	0	0	0	0
131	MPG321908	Wood products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
132	MPG321X00	Waste and scrap of wood and wood by-products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
133	MPG322101	Wood pulp	0	0	0	0	0	0	0	0	0	0	0	0	0	0
134	MPG322102	Paper (except newsprint)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135	MPG322103	Newsprint	0	0	0	0	0	0	0	0	0	0	0	0	0	0
136	MPG322104	Paperboard	0	0	0	0	0	0	0	0	0	0	0	0	0	0
137	MPG322201	Paperboard containers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
138	MPG322202	Paper office supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Capital expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Capital Expenditure, In Purchaser Prices)

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
139	MPG322203	Disposable diapers and feminine hygiene products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
140	MPG322204	Sanitary paper products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
141	MPG322209	Other converted paper products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
142	MPG322X00	Waste and scrap of paper and paperboard	0	0	0	0	0	0	0	0	0	0	0	0	0	0
143	MPG323001	Printed products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
144	MPS323002	Support services for printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
145	MPS323003	Contract printing services for publishers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
146	ENE324111	Gasoline	0	0	0	0	0	0	0	0	0	0	0	0	0	0
147	ENE324112	Diesel and biodiesel fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
148	ENE324113	Light fuel oils	0	0	0	0	0	0	0	0	0	0	0	0	0	0
149	ENE324114	Jet fuel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150	ENE324115	Heavy fuel oils	0	0	0	0	0	0	0	0	0	0	0	0	0	0
151	MPG3241A8	Lubricants and other petroleum refinery products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
152	MPG3241A1	Asphalt (except natural) and asphalt products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
153	ENE3241A2	Coke and other coke oven products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
154	ENE32A000	Solid fuel products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
155	MPG325101	Petrochemicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
156	MPG325102	Industrial gases	0	0	0	0	0	0	0	0	0	0	0	0	0	0
157	MPG325103	Dyes and pigments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
158	MPG325106	Other basic inorganic chemicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
159	MPG325105	Basic organic chemicals, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
160	MPG325201	Plastic resins	0	0	0	0	0	0	0	0	0	0	0	0	0	0
161	MPG325202	Rubber and rubber compounds and mixtures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
162	MPG325203	Artificial and synthetic fibres and filaments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
163	MPG325301	Ammonia and chemical fertilizers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
164	MPG325302	Pesticides and other agricultural chemicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
165	MPG325400	Pharmaceutical and medicinal products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
166	MPG325500	Paints, coatings and adhesive products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
167	MPG325601	Soaps and cleaning compounds	0	0	0	0	0	0	0	0	0	0	0	0	0	0
168	MPG325602	Perfumes and toiletries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
169	MPG325900	Chemical products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
170	MPG326101	Plastic bags	0	0	0	0	0	0	0	0	0	0	0	0	0	0
171	MPG326102	Plastic films and non-rigid sheets	0	0	0	0	0	0	0	0	0	0	0	0	0	0
172	MPG326103	Plastic and foam building and construction materials	0	0	0	0	0	0	0	0	0	0	0	0	0	0
173	MPG326104	Plastic profile shapes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
174	MPG326105	Foam products (except for construction)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
175	MPG326106	Plastic bottles	0	0	0	0	0	0	0	0	0	0	0	0	0	0
176	MPG326107	Motor vehicle plastic parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
177	MPG326109	Plastic products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
178	MPG326201	Tires	0	0	0	0	0	0	0	0	0	0	0	0	0	0
179	MPG326202	Rubber and plastic hoses and belts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
180	MPG326209	Rubber products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
181	MPG326X00	Waste and scrap of plastic and rubber	0	0	0	0	0	0	0	0	0	0	0	0	0	0
182	MPG327301	Cement	0	0	0	0	0	0	0	0	0	0	0	0	0	0
183	MPG327302	Ready-mixed concrete	0	0	0	0	0	0	0	0	0	0	0	0	0	0
184	MPG327303	Concrete products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
185	MPG327A01	Clay and ceramic products and refractories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
186	MPG327A02	Glass (including automotive), glass products and glass containers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
187	MPG327A03	Waste and scrap of glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0
188	MPG327A04	Lime and gypsum products	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Sustaining Capital, Capital Expenditure, In Purchaser Prices)

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
189	MPG327A09	Non-metallic mineral products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
190	MPG331100	Iron and steel basic shapes and ferro-alloy products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
191	MPG331201	Iron and steel pipes and tubes (except castings)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
192	MPG331202	Wire and other rolled and drawn steel products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
193	MPG331301	Bauxite and aluminum oxide	0	0	0	0	0	0	0	0	0	0	0	0	0	0
194	MPG331302	Unwrought aluminum including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
195	MPG331303	Basic and semi-finished products of aluminum and alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
196	MPG331401	Unwrought copper including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
197	MPG331402	Unwrought nickel including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
198	MPG331403	Unwrought precious metals including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
199	MPG331404	Other unwrought non-ferrous metals including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200	MPG331405	Gold, store of value	0	0	0	0	0	0	0	0	0	0	0	0	0	0
201	MPG331406	Basic and semi-finished products of non-ferrous metals and alloys (except aluminum)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
202	MPG331501	Ferrous metal castings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
203	MPG331502	Non-ferrous metal castings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
204	MPG331X01	Waste and scrap of iron and steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
205	MPG331X02	Waste and scrap of non-ferrous metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
206	MPG332101	Forged and stamped metal products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
207	MPG332301	Prefabricated metal buildings and components	0	0	0	0	0	0	0	0	0	0	0	0	0	0
208	MPG332302	Fabricated steel plates and other fabricated structural metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
209	MPG332303	Metal windows and doors	0	0	0	0	0	0	0	0	0	0	0	0	0	0
210	MPG332A05	Other architectural metal products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
211	MPG332401	Light gauge metal containers, crowns and closures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
212	MPG332402	Boilers, tanks and heavy gauge metal containers	0	0	0	0	0	0	0	74	0	0	0	0	0	0
213	MPG332500	Builders, motor vehicle and other hardware	0	0	0	0	0	0	0	0	0	0	0	0	0	0
214	MPG332600	Springs and wire products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
215	MPG332700	Threaded metal fasteners and other turned metal products including automotive	0	0	0	0	0	0	0	0	0	0	0	0	0	0
216	MPS332800	Coating, engraving, heat treating and similar metal processing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
217	MPG332A01	Hand tools, kitchen utensils and cutlery (except precious metal)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
218	MPG332A02	Metal valves and pipe fittings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
219	MPG332A03	Ball and roller bearings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
220	MPG332A04	Guns, ammunition and other munitions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
221	MPG332A08	Fabricated metal products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
222	MPG333101	Agricultural, lawn and garden machinery and equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
223	MPG333102	Logging, mining and construction machinery and equipment	0	0	0	0	0	0	0	2,265	0	0	0	0	0	0
224	MPG333200	Other industry-specific machinery	0	0	0	0	0	0	0	5	0	0	0	0	0	0
225	MPG333300	Commercial and service industry machinery	0	0	0	0	0	0	0	1	0	0	0	0	0	0
226	MPG333401	Industrial and commercial fans, blowers and air purification equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Capital expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Capital Expenditure, In Purchaser Prices)

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
227	MPG333402	Heating and cooling equipment (except household refrigerators and freezers)	0	0	0	0	0	0	0	15	0	0	0	0	0	0
228	MPG333500	Metalworking machinery and industrial moulds	0	0	0	0	0	0	0	0	0	0	0	0	0	0
229	MPG333601	Turbines, turbine generators, and turbine generator sets	0	0	0	0	0	0	0	8	0	0	0	0	0	0
230	MPG333609	Other engine and power transmission equipment	0	0	0	0	0	0	0	2	0	0	0	0	0	0
231	MPG333901	Pumps and compressors (except fluid power)	0	0	0	0	0	0	0	58	0	0	0	0	0	0
232	MPG333902	Material handling equipment	0	0	0	0	0	0	0	277	0	0	0	0	0	0
233	MPG333909	Other miscellaneous general-purpose machinery	0	0	0	0	0	0	0	22	0	0	0	0	0	0
234	MPG334100	Computers, computer peripherals and parts	0	0	0	0	0	0	0	1	0	0	0	0	0	0
235	MPG334201	Telephone apparatus	0	0	0	0	0	0	0	4	0	0	0	0	0	0
236	MPG334209	Other communications equipment	0	0	0	0	0	0	0	6	0	0	0	0	0	0
237	MPG334A01	Audio and video equipment and unrecorded media	0	0	0	0	0	0	0	0	0	0	0	0	0	0
238	MPG334A02	Navigational and guidance instruments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
239	MPG334A05	Medical devices	0	0	0	0	0	0	0	0	0	0	0	0	0	0
240	MPG334A06	Measuring, control and scientific instruments	0	0	0	0	0	0	0	136	0	0	0	0	0	0
241	MPG334401	Printed and integrated circuits, semiconductors and printed circuit assemblies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
242	MPG334409	Other electronic components	0	0	0	0	0	0	0	0	0	0	0	0	0	0
243	MPG335101	Electric light bulbs and tubes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
244	MPG335102	Lighting fixtures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
245	MPG335203	Small electric appliances	0	0	0	0	0	0	0	0	0	0	0	0	0	0
246	MPG335204	Major appliances	0	0	0	0	0	0	0	0	0	0	0	0	0	0
247	MPG335301	Power, distribution and other transformers	0	0	0	0	0	0	0	452	0	0	0	0	0	0
248	MPG335302	Electric motors and generators	0	0	0	0	0	0	0	7	0	0	0	0	0	0
249	MPG335303	Switchgear, switchboards, relays and industrial control apparatus	0	0	0	0	0	0	0	10	0	0	0	0	0	0
250	MPG335901	Batteries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
251	MPG335902	Communication and electric wire and cable	0	0	0	0	0	0	0	0	0	0	0	0	0	0
252	MPG335903	Wiring devices	0	0	0	0	0	0	0	0	0	0	0	0	0	0
253	MPG335909	Other electrical equipment and components	0	0	0	0	0	0	0	0	0	0	0	0	0	0
254	MPG336111	Passenger cars	0	0	0	0	0	0	0	0	0	0	0	0	0	0
255	MPG336112	Light-duty trucks, vans and sport utility vehicles (SUVs)	0	0	0	0	0	0	0	2	0	0	0	0	0	0
256	MPG336120	Medium and heavy-duty trucks and chassis	0	0	0	0	0	0	0	5	0	0	0	0	0	0
257	MPG336201	Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
258	MPG336202	Motor vehicle bodies and special purpose motor vehicles	0	0	0	0	0	0	0	23	0	0	0	0	0	0
259	MPG336203	Freight and utility trailers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
260	MPG336204	Motor homes, travel trailers and camping trailers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
261	MPG336310	Motor vehicle gasoline engines and engine parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
262	MPG336320	Motor vehicle electrical and electronic equipment and instruments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
263	MPG336330	Motor vehicle steering and suspension components	0	0	0	0	0	0	0	0	0	0	0	0	0	0
264	MPG336340	Motor vehicle brakes and brake systems	0	0	0	0	0	0	0	0	0	0	0	0	0	0
265	MPG336350	Motor vehicle transmission and power train parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Sustaining Capital, Capital Expenditure, In Purchaser Prices)

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
266	MPG336360	Motor vehicle interior trim, seats and seat parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
267	MPG336370	Motor vehicle metal stamping	0	0	0	0	0	0	0	0	0	0	0	0	0	0
268	MPG336390	Other miscellaneous motor vehicle parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
269	MPG336401	Aircraft	0	0	0	0	0	0	0	0	0	0	0	0	0	0
270	MPG336402	Aircraft engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
271	MPG336403	Aircraft parts and other aerospace equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
272	MPG336501	Locomotives, railway rolling stock, and rapid transit equipment	0	0	0	0	0	0	0	132	0	0	0	0	0	0
273	MPG336502	Parts of railway rolling stock	0	0	0	0	0	0	0	0	0	0	0	0	0	0
274	MPG336601	Ships	0	0	0	0	0	0	0	0	0	0	0	0	0	0
275	MPG336602	Boats and personal watercraft	0	0	0	0	0	0	0	0	0	0	0	0	0	0
276	MPG336900	Other transportation equipment and related parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
277	MPG337101	Wood kitchen cabinets and counter tops	0	0	0	0	0	0	0	0	0	0	0	0	0	0
278	MPG337102	Household furniture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
279	MPG337103	Institutional and other furniture, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
280	MPG337203	Office furniture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
281	MPG337204	Office and store fixtures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
282	MPG337901	Mattresses and foundations	0	0	0	0	0	0	0	0	0	0	0	0	0	0
283	MPG337902	Blinds and shades	0	0	0	0	0	0	0	0	0	0	0	0	0	0
284	MPG339100	Medical, dental and personal safety supplies, instruments and equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
285	MPG339901	Jewellery and silverware	0	0	0	0	0	0	0	0	0	0	0	0	0	0
286	MPG339902	Sporting and athletic goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
287	MPG339903	Toys and games	0	0	0	0	0	0	0	0	0	0	0	0	0	0
288	MPG339904	Office supplies (except paper)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
289	MPG339905	Signs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
290	MPG339909	Other miscellaneous manufactured products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
291	MPS3X0000	Custom work manufacturing services (except printing, finishing textiles and metals)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
292	MPS411000	Wholesale margins - farm products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
293	MPS412000	Wholesale margins - petroleum and petroleum products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
294	MPS413000	Wholesale margins - food, beverages and tobacco products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
295	MPS414000	Wholesale margins - personal and household goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
296	MPS415000	Wholesale margins - motor vehicles, motor vehicle parts and accessories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
297	MPS416000	Wholesale margins - building materials and supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
298	MPS417000	Wholesale margins - machinery, equipment and supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
299	MPS418000	Wholesale margins - miscellaneous products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
300	MPS410002	Wholesale trade commissions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
301	MPS441000	Retail margins - motor vehicles and parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
302	MPS442000	Retail margins - furniture and home	0	0	0	0	0	0	0	0	0	0	0	0	0	0
303	MPS443000	Retail margins - electronics and appliances	0	0	0	0	0	0	0	0	0	0	0	0	0	0
304	MPS444000	Retail margins - building materials, garden equipment and supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
305	MPS445000	Retail margins - food and beverages	0	0	0	0	0	0	0	0	0	0	0	0	0	0
306	MPS446000	Retail margins - health and personal care products	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Capital expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Capital Expenditure, In Purchaser Prices)

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
307	**MPS447000**	Retail margins - automotive fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
308	**MPS448000**	Retail margins - clothing and clothing accessories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
309	**MPS451000**	Retail margins - sporting and leisure products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
310	**MPS453A00**	Retail margins - miscellaneous products (except cannabis)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
311	**MPS453BL0**	Retail margins - cannabis products (licensed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
312	**MPS453BU0**	Retail margins - cannabis products (unlicensed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
313	**MPS454310**	Retail margins - household fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
314	**MPS4A0002**	Used motor vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0	0
315	**MPS4A0003**	Other used consumer goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
316	**MPS4A0004**	Retail trade commissions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
317	**MPS481001**	Air passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
318	**MPS481002**	Air freight transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
319	**MPS481003**	Air specialty services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
320	**MPS482001**	Rail passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
321	**MPS482002**	Rail freight transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
322	**MPS483001**	Water passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
323	**MPS483002**	Water freight transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
324	**MPS484001**	Moving services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
325	**MPS484004**	Truck transportation services for general freight	0	0	0	0	0	0	0	0	0	0	0	0	0	0
326	**MPS484005**	Truck transportation services for specialized freight	0	0	0	0	0	0	0	0	0	0	0	0	0	0
327	**MPS485100**	Urban transit services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
328	**MPS48A001**	Interurban and rural bus passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
329	**MPS48A002**	School bus services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
330	**MPS48A003**	Other transit and passenger transportation services by road	0	0	0	0	0	0	0	0	0	0	0	0	0	0
331	**MPS48A004**	Scenic and sightseeing tour services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
332	**MPS485300**	Taxi and limousine services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
333	**MPS486200**	Transportation of natural gas by pipeline	0	0	0	0	0	0	0	0	0	0	0	0	0	0
334	**MPS486A00**	Transportation of crude oil and other commodities by pipeline	0	0	0	0	0	0	0	0	0	0	0	0	0	0
335	**MPS488001**	Air transportation support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
336	**MPS488002**	Aircraft maintenance and repair services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
337	**MPS488003**	Rail transportation support, maintenance and repair services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
338	**MPS488004**	Water transportation support, maintenance and repair services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
339	**MPS488005**	Road transportation support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
340	**MPS488006**	Freight transportation arrangement and customs brokering services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
341	**MPS488009**	Other transportation support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
342	**MPS491000**	Postal services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
343	**MPS492000**	Courier, parcel, and local messenger and delivery services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
344	**MPS493001**	Grain storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0
345	**MPS493002**	Warehousing and storage services (except grain storage)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
346	**MPG511111**	Newspapers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
347	**MPS511112**	Advertising space in printed newspapers	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Sustaining Capital, Capital Expenditure, In Purchaser Prices)

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
348	MPG5111A1	Periodicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
349	MPG5111A2	Books	0	0	0	0	0	0	0	0	0	0	0	0	0	0
350	MPG5111A3	Other published products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
351	MPS5111A4	Advertising space in printed periodicals and in other printed publications	0	0	0	0	0	0	0	0	0	0	0	0	0	0
352	MPS51AX00	Licensing of rights to use literary works and artistic works (except software licensing)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
353	MPS511200	General purpose software	0	0	0	0	0	0	0	0	0	0	0	0	0	0
354	MPS5121A1	Recorded movies, television programs and videos	0	0	0	0	0	0	0	0	0	0	0	0	0	0
355	MPS5121A2	Movie, television program and video production, post-production and editing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
356	MPS5121A3	Licensing of rights to use audiovisual works	0	0	0	0	0	0	0	0	0	0	0	0	0	0
357	MPS512130	Admissions to motion picture film exhibitions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
358	MPS512201	Recorded music and other sound recordings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
359	MPS512202	Audio recording services and copyright administration	0	0	0	0	0	0	0	0	0	0	0	0	0	0
360	MPS512203	Licensing of rights to use musical works and sound recordings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
361	MPS515100	Advertising air time on radio	0	0	0	0	0	0	0	0	0	0	0	0	0	0
362	MPS515A01	Advertising air time on television	0	0	0	0	0	0	0	0	0	0	0	0	0	0
363	MPS515A02	Fees for the distribution of television and radio program channels (affiliation payments)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
364	MPS517001	Fixed telecommunications services (except Internet access)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
365	MPS517002	Mobile telecommunications services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
366	MPS517003	Cable, satellite and other program distribution services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
367	MPS517004	Fixed Internet access services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
368	MPS518000	Data processing, hosting, and related services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
369	MPS519001	Subscriptions for online content	0	0	0	0	0	0	0	0	0	0	0	0	0	0
370	MPS519002	Internet advertising	0	0	0	0	0	0	0	0	0	0	0	0	0	0
371	MPS519008	Other information services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
372	MPS521000	Central banking services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
373	MPS522130	Local credit union services - explicit charges (fees)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
374	MPS5221A0	Banking and other depository credit intermediation services - explicit charges	0	0	0	0	0	0	0	0	0	0	0	0	0	0
375	MPS522200	Non-depository credit intermediation services - explicit charges (fees)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
376	MPS522300	Other services related to credit intermediation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
377	MPS523001	Investment banking services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
378	MPS523002	Security brokerage and securities dealing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
379	MPS523003	Portfolio management services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
380	MPS523004	Investment counselling services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
381	MPS523009	Holding company services and other financial investment and related activities	0	0	0	0	0	0	0	0	0	0	0	0	0	0
382	MPS524101	Life insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
383	MPS524102	Accident and sickness insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
384	MPS524103	Automotive insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
385	MPS524104	Property insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Capital expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Sustaining Capital, Capital Expenditure, In Purchaser Prices)

Commodities (Detail level)			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
386	MPS524105	Liability and other property and casualty insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
387	MPS524200	Brokerage and other insurance related services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
388	MPS526111	Trusteed pension fund services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
389	MPS526A00	Mutual funds (cost of service) and other similar services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
390	MPS52X001	Deposit intermediation services indirectly measured (FISIM)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
391	MPS52X002	Residential mortgage intermediation services indirectly measured (FISIM)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
392	MPS52X003	Other loan intermediation services indirectly measured (FISIM)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
393	MPS531101	Rental of residential real estate	0	0	0	0	0	0	0	0	0	0	0	0	0	0
394	MPS531102	Rental of non-residential real estate	0	0	0	0	0	0	0	0	0	0	0	0	0	0
395	IMS5311A0	Imputed rental of owner-occupied dwellings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
396	MPS531A00	Real estate brokerage and other services related to real estate	0	0	0	0	0	0	0	0	0	0	0	0	0	0
397	MPS532100	Motor vehicle rental and leasing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
398	MPS532A01	Computer equipment rental and leasing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
399	MPS532A02	Office machinery and equipment (except computer equipment) rental and leasing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
400	MPS532A03	Commercial and industrial machinery and equipment (except office equipment) rental and leasing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
401	MPS532A09	Rental and leasing services of other goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
402	MPS533000	Licensing of rights to non-financial produced intangible assets (except software and other copyright licensing)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
403	MPS541100	Legal services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
404	MPS541200	Accounting, tax preparation, bookkeeping and payroll services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
405	MPS541300	Architectural, engineering and related services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
406	MPS541400	Specialized design services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
407	MPS541501	Custom software design and development services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
408	IMS541502	Own-account software design and development services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
409	MPS541503	Computer systems design and related services (except software development)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
410	MPS541600	Management, scientific and technical consulting services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
411	MPS541701	Research and development services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
412	IMS541702	Own-account research and development (except software development)	0	0	0	0	0	0	0	3	0	0	0	0	0	0
413	MPS541800	Advertising, public relations and related services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
414	MPS541901	Photographic services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
415	MPS541902	Veterinary services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
416	MPS541909	Other professional, scientific and technical services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
417	IMS551001	Holding company services (imputed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
418	IMS551002	Head office services (imputed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Capital expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Capital Expenditure, In Purchaser Prices)

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
419	**MPS561100**	Office administrative services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
420	**MPS561300**	Employment services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
421	**MPS561400**	Business support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
422	**MPS561500**	Travel arrangement, reservation and planning services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
423	**MPS561600**	Investigation and security services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
424	**MPS561700**	Services to buildings and dwellings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
425	**MPS561A00**	Facilities and other support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
426	**MPS562000**	Waste management and remediation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
427	**MPS610001**	Tuition and similar fees for elementary and secondary schools	0	0	0	0	0	0	0	0	0	0	0	0	0	0
428	**MPS610002**	Tuition and similar fees for colleges and C.E.G.E.P.s	0	0	0	0	0	0	0	0	0	0	0	0	0	0
429	**MPS610003**	Tuition and similar fees for universities	0	0	0	0	0	0	0	0	0	0	0	0	0	0
430	**MPS610004**	Tuition and similar fees for trade, technical and professional training	0	0	0	0	0	0	0	0	0	0	0	0	0	0
431	**MPS610009**	Other educational training and services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
432	**MPS621100**	Physician services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
433	**MPS621200**	Dental services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
434	**MPS621A01**	Other health practitioner services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
435	**MPS621A02**	Medical laboratory diagnostic and testing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
436	**MPS621A03**	Ambulance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
437	**MPS622000**	Hospital services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
438	**MPS623000**	Nursing and residential care services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
439	**MPS624001**	Child day-care services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
440	**MPS62A000**	Other ambulatory health care services and social assistance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
441	**MPS71A001**	Admissions to live sporting events	0	0	0	0	0	0	0	0	0	0	0	0	0	0
442	**MPS71A002**	Admissions to live performing arts performances	0	0	0	0	0	0	0	0	0	0	0	0	0	0
443	**MPS71A003**	Sport and performing arts event organization and support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
444	**MPS71A004**	Career management and representation services of public figures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
445	**MPS71A005**	Contract production of live performing arts performances, live sporting events and copyrighted works	0	0	0	0	0	0	0	0	0	0	0	0	0	0
446	**MPS71A009**	Broadcast and other media rights	0	0	0	0	0	0	0	0	0	0	0	0	0	0
447	**MPS71A008**	Heritage institution services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
448	**MPS713A00**	Amusement and recreation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
449	**MPS713200**	Gambling (net wagers)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
450	**MPS721100**	Room or unit accommodation services for travellers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
451	**MPS721A01**	Recreational vehicle park and recreational camp services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
452	**MPS721A02**	Rooming and boarding services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
453	**MPS722001**	Prepared meals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
454	**MPS722002**	Alcoholic beverages for immediate consumption	0	0	0	0	0	0	0	0	0	0	0	0	0	0
455	**MPS811100**	Motor vehicle repair and maintenance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
456	**MPS811A00**	Repair and maintenance services (except for buildings and motor vehicles)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
457	**MPS812200**	Funeral services	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Capital expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Capital Expenditure, In Purchaser Prices)

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
458	MPS812300	Laundry and dry-cleaning services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
459	MPS812A01	Hair care and aesthetic services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
460	MPS812A02	Parking services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
461	MPS812A09	Other personal and personal care services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
462	MPS813000	Other membership services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
463	MPS814001	Babysitting services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
464	MPS814002	Private household services (except babysitting)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
465	MPS9A0000	Sales of other services by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
466	MPS9B0000	Sales of other government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
467	FIC110000	Repair and maintenance	0	0	0	0	0	0	0	0	0	0	0	0	0	0
468	FIC120000	Operating supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
469	FIC130000	Office supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
470	FIC210000	Advertising, promotion, meals and entertainment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
471	FIC220000	Travel, meetings and conventions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
472	FIC300000	Transportation margins	0	0	0	0	0	0	0	0	0	0	0	0	0	0
473	NNP610000	Educational services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
474	NNP621000	Ambulatory health care services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
475	NNP624000	Social assistance services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
476	NNP710000	Arts, entertainment and recreation services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
477	NNP813100	Religious services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
478	NNP813A01	Grant-making, civic, and professional and similar organization services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
479	NNP813930	Labour organization membership services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
480	NNP813940	Political organization services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
481	NNP999999	Other services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
482	NGS611100	Elementary and secondary school services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
483	NGS611200	Community college and C.E.G.E.P services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
484	NGS611300	University services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
485	NGS611A00	Other educational services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
486	NGS622000	Hospital services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
487	NGS623000	Residential care facility services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
488	NGS911100	Defence services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
489	NGS911A00	Other federal government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
490	NGS912000	Other provincial and territorial government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
491	NGS913000	Other municipal government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
492	NGS914000	Other aboriginal government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
493	PRM100000	Taxes on products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
494	PRM200000	Subsidies on products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
495	PRM300000	Subsidies on production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
496	PRM400000	Taxes on production	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Capital expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Capital Expenditure, In Purchaser Prices)

	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)														
497 PRM500000 Wages and salaries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
498 PRM600000 Employers' social contributions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
499 PRM700000 Gross mixed income	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500 PRM800000 Gross operating surplus	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3,581**	**0**	**0**	**0**	**0**	**0**	**0**

Attachment 5 Sustaining Capital – Industry Inputs Expenditure, In Purchaser Prices, at the Detailed level

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
1	MPG111A01	Canola (including rapeseed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	MPG111A02	Oilseeds (except canola)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	MPG111A03	Wheat	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	MPG111A04	Grains (except wheat)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	MPG111A05	Fresh potatoes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	MPG111A10	Fresh fruits and nuts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	MPG111A11	Other miscellaneous crop products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	MPG111A08	Fresh vegetables (except potatoes)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	IMG111A09	Imputed feed (animal feed produced for own consumption)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	MPG111400	Nursery and floriculture products (except cannabis)	0	0	0	0	0	0	0	4	0	0	0	0	0	0
11	MPG111C00	Cannabis plants, seeds and flowering tops	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	MPG112001	Cattle and calves	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	MPG112002	Unprocessed fluid milk	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	MPG112003	Hogs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	MPG112004	Eggs in shell	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	MPG112005	Poultry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	MPG112006	Other live animals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	MPG112007	Raw furskins, and animal products n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	IMG112008	Imputed fertilizer (fertilizer produced for own consumption)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	MPG113001	Logs and bolts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	MPG113002	Pulpwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	ENE113003	Fuel wood	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	MPG113004	Rough untreated poles, posts and piling	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	MPG114000	Fish, crustaceans, shellfish and other fishery products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	MPS11X000	Custom work services for forestry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	MPS115A01	Support services for crop production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	MPS115A02	Support services for animal production, hunting and fishing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	MPS115300	Support services for forestry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	ENE211105	Conventional crude oil	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	ENE211106	Synthetic crude oil	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	ENE211102	Natural gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	ENE211103	Natural gas liquids and related products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	ENE211104	Crude and diluted bitumen	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	ENE212100	Coal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	MPG212210	Iron ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	MPG212220	Gold and silver ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	MPG212231	Copper ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	MPG212232	Nickel ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	MPG212233	Lead and zinc ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	MPG212291	Radioactive ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	MPG212299	Other metal ores and concentrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	MPG212310	Stone	0	0	0	0	0	0	0	15	0	0	0	0	0	0
43	MPG212320	Sand, gravel, clay, and refractory minerals	0	0	0	0	0	0	0	15	0	0	0	0	0	0
44	MPG212392	Uncut and industrial diamonds	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	MPG212396	Potash	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	MPG21239C	Non-metallic minerals (except diamonds)	0	0	0	0	0	0	0	22	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
47	MPS21311A	Support services for oil and gas extraction (except exploration)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	MPS21311B	Support services for mining and quarrying (except exploration)	0	0	0	0	0	0	0	89	0	0	0	0	0	0
49	MPS21A000	Mineral and oil and gas exploration	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	ENE221100	Electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	MPS221200	Natural gas distribution	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	MPS221301	Water delivered by water works and irrigation systems	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	MPS221302	Sewage and dirty water disposal and cleaning services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	ENE221303	Steam and heated or cooled air or water	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	MPG23A000	Residential construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	MPG23B001	Industrial buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	MPG23B002	Office buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	MPG23B003	Shopping centers, plazas, malls and stores	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	MPG23B004	Other commercial buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	MPG23B005	Schools, colleges, universities and other educational buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	MPG23B006	Health care buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	MPG23B007	Other institutional buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	MPG23C101	Highways, roads, streets, bridges and tunnels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	MPG23C109	Other transportation construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	MPG23C201	Production facilities in oil and gas extraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	MPG23C209	Other oil and gas engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	MPG23C300	Electric power engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	MPG23C400	Communication engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	MPG23C501	Marine engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	MPG23C502	Waterworks engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	MPG23C503	Sewage engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	MPG23C504	Mining engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	MPG23C509	Other engineering construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	MPS23D000	Repair construction services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	MPG311101	Dog and cat food	0	0	0	0	0	0	0	0	0	0	0	0	0	0
76	MPG311109	Other animal feed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77	MPG311204	Flour and other grain mill products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
78	MPG311202	Margarine and cooking oils	0	0	0	0	0	0	0	0	0	0	0	0	0	0
79	MPG311203	Breakfast cereal and other cereal products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	MPG311208	Grain and oilseed products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81	MPG311301	Sugar and sugar mill by-products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	MPG311302	Chocolate (except confectionery)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	MPG311303	Confectionery products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
84	MPG311401	Fresh, frozen and canned fruit and vegetable juices	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85	MPG311402	Preserved fruit and vegetables and frozen foods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
86	MPG311501	Processed fluid milk and milk products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
87	MPG311502	Cheese and cheese products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
88	MPG311503	Butter and dry and canned dairy products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
89	MPG311504	Ice cream, sherbet and similar frozen desserts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	MPG311601	Fresh and frozen beef and veal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	MPG311602	Fresh and frozen pork	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	MPG311603	Fresh and frozen poultry of all types	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
93	MPG311605	Processed meat products, other miscellaneous meats and animal by-products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	MPG311700	Prepared and packaged seafood products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	MPG311801	Bread, rolls and flatbreads	0	0	0	0	0	0	0	0	0	0	0	0	0	0
96	MPG311802	Cookies, crackers and baked sweet goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
97	MPG311803	Flour mixes, dough and dry pasta	0	0	0	0	0	0	0	0	0	0	0	0	0	0
98	MPG311901	Snack food products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99	MPG311902	Coffee and tea	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	MPG311903	Flavouring syrups, seasonings and dressings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
101	MPG311909	Other food products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
102	MPG312110	Bottled water, soft drinks and ice	0	0	0	0	0	0	0	0	0	0	0	0	0	0
103	MPG312120	Beer	0	0	0	0	0	0	0	0	0	0	0	0	0	0
104	MPG3121A1	Wine and brandy	0	0	0	0	0	0	0	0	0	0	0	0	0	0
105	MPG3121A2	Distilled liquor	0	0	0	0	0	0	0	0	0	0	0	0	0	0
106	MPG312201	Stemmed, redried or reconstituted tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
107	MPG312202	Cigarettes, cigars, chewing and smoking tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
108	MPG312300	Cannabis products (except plants, seeds and flowering tops)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
109	MPG31A001	Fibre, yarn and thread	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	MPG31A002	Fabrics	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	MPG31A003	Carpets, rugs and mats	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112	MPG31A004	Other textile furnishings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
113	MPG31A005	Textile products, n.e.c.	0	0	0	0	0	0	0	1	0	0	0	0	0	0
114	MPS31A006	Textile and fabric finishing and coating services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115	MPG31B001	Men's, women's, boys' and girls' clothing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
116	MPG31B002	Infant clothing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
117	MPG31B003	Clothing accessories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
118	MPG31B004	Leather and dressed furs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
119	MPG31B005	Footwear	0	0	0	0	0	0	0	1	0	0	0	0	0	0
120	MPG31B006	Suitcases, handbags and other leather and allied products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
121	MPG321101	Hardwood lumber	0	0	0	0	0	0	0	1	0	0	0	0	0	0
122	MPG321102	Softwood lumber	0	0	0	0	0	0	0	24	0	0	0	0	0	0
123	MPG321103	Wood chips	0	0	0	0	0	0	0	0	0	0	0	0	0	0
124	MPG321104	Other sawmill products and treated wood products	0	0	0	0	0	0	0	4	0	0	0	0	0	0
125	MPG321201	Veneer and plywood	0	0	0	0	0	0	0	0	0	0	0	0	0	0
126	MPG321202	Wood trusses and engineered wood members	0	0	0	0	0	0	0	10	0	0	0	0	0	0
127	MPG321203	Reconstituted wood products	0	0	0	0	0	0	0	11	0	0	0	0	0	0
128	MPG321901	Wood windows and doors	0	0	0	0	0	0	0	3	0	0	0	0	0	0
129	MPG321903	Wood containers and pallets	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	MPG321904	Prefabricated wood and manufactured (mobile) buildings and components	0	0	0	0	0	0	0	23	0	0	0	0	0	0
131	MPG321908	Wood products, n.e.c.	0	0	0	0	0	0	0	10	0	0	0	0	0	0
132	MPG321X00	Waste and scrap of wood and wood by-products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
133	MPG322101	Wood pulp	0	0	0	0	0	0	0	0	0	0	0	0	0	0
134	MPG322102	Paper (except newsprint)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135	MPG322103	Newsprint	0	0	0	0	0	0	0	0	0	0	0	0	0	0
136	MPG322104	Paperboard	0	0	0	0	0	0	0	0	0	0	0	0	0	0
137	MPG322201	Paperboard containers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
138	MPG322202	Paper office supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
139	MPG322203	Disposable diapers and feminine hygiene products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
140	MPG322204	Sanitary paper products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
141	MPG322209	Other converted paper products	0	0	0	0	0	0	0	9	0	0	0	0	0	0
142	MPG322X00	Waste and scrap of paper and paperboard	0	0	0	0	0	0	0	0	0	0	0	0	0	0
143	MPG323001	Printed products	0	0	0	0	0	0	0	3	0	0	0	0	0	0
144	MPS323002	Support services for printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
145	MPS323003	Contract printing services for publishers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
146	ENE324111	Gasoline	0	0	0	0	0	0	0	16	0	0	0	0	0	0
147	ENE324112	Diesel and biodiesel fuels	0	0	0	0	0	0	0	207	0	0	0	0	0	0
148	ENE324113	Light fuel oils	0	0	0	0	0	0	0	0	0	0	0	0	0	0
149	ENE324114	Jet fuel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150	ENE324115	Heavy fuel oils	0	0	0	0	0	0	0	0	0	0	0	0	0	0
151	MPG3241A8	Lubricants and other petroleum refinery products	0	0	0	0	0	0	0	4	0	0	0	0	0	0
152	MPG3241A1	Asphalt (except natural) and asphalt products	0	0	0	0	0	0	0	16	0	0	0	0	0	0
153	ENE3241A2	Coke and other coke oven products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
154	ENE32A000	Solid fuel products, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
155	MPG325101	Petrochemicals	0	0	0	0	0	0	0	1	0	0	0	0	0	0
156	MPG325102	Industrial gases	0	0	0	0	0	0	0	0	0	0	0	0	0	0
157	MPG325103	Dyes and pigments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
158	MPG325106	Other basic inorganic chemicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
159	MPG325105	Basic organic chemicals, n.e.c.	0	0	0	0	0	0	0	6	0	0	0	0	0	0
160	MPG325201	Plastic resins	0	0	0	0	0	0	0	0	0	0	0	0	0	0
161	MPG325202	Rubber and rubber compounds and mixtures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
162	MPG325203	Artificial and synthetic fibres and filaments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
163	MPG325301	Ammonia and chemical fertilizers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
164	MPG325302	Pesticides and other agricultural chemicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
165	MPG325400	Pharmaceutical and medicinal products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
166	MPG325500	Paints, coatings and adhesive products	0	0	0	0	0	0	0	12	0	0	0	0	0	0
167	MPG325601	Soaps and cleaning compounds	0	0	0	0	0	0	0	0	0	0	0	0	0	0
168	MPG325602	Perfumes and toiletries	0	0	0	0	0	0	0	0	0	0	0	0	0	0
169	MPG325900	Chemical products, n.e.c.	0	0	0	0	0	0	0	16	0	0	0	0	0	0
170	MPG326101	Plastic bags	0	0	0	0	0	0	0	0	0	0	0	0	0	0
171	MPG326102	Plastic films and non-rigid sheets	0	0	0	0	0	0	0	22	0	0	0	0	0	0
172	MPG326103	Plastic and foam building and construction materials	0	0	0	0	0	0	0	44	0	0	0	0	0	0
173	MPG326104	Plastic profile shapes	0	0	0	0	0	0	0	13	0	0	0	0	0	0
174	MPG326105	Foam products (except for construction)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
175	MPG326106	Plastic bottles	0	0	0	0	0	0	0	0	0	0	0	0	0	0
176	MPG326107	Motor vehicle plastic parts	0	0	0	0	0	0	0	1	0	0	0	0	0	0
177	MPG326109	Plastic products, n.e.c.	0	0	0	0	0	0	0	17	0	0	0	0	0	0
178	MPG326201	Tires	0	0	0	0	0	0	0	6	0	0	0	0	0	0
179	MPG326202	Rubber and plastic hoses and belts	0	0	0	0	0	0	0	45	0	0	0	0	0	0
180	MPG326209	Rubber products, n.e.c.	0	0	0	0	0	0	0	29	0	0	0	0	0	0
181	MPG326X00	Waste and scrap of plastic and rubber	0	0	0	0	0	0	0	0	0	0	0	0	0	0
182	MPG327301	Cement	0	0	0	0	0	0	0	8	0	0	0	0	0	0
183	MPG327302	Ready-mixed concrete	0	0	0	0	0	0	0	138	0	0	0	0	0	0
184	MPG327303	Concrete products	0	0	0	0	0	0	0	102	0	0	0	0	0	0
185	MPG327A01	Clay and ceramic products and refractories	0	0	0	0	0	0	0	4	0	0	0	0	0	0
186	MPG327A02	Glass (including automotive), glass products and glass containers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
187	MPG327A03	Waste and scrap of glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0
188	MPG327A04	Lime and gypsum products	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
189	MPG327A09	Non-metallic mineral products, n.e.c.	0	0	0	0	0	0	0	16	0	0	0	0	0	0
190	MPG331100	Iron and steel basic shapes and ferro-alloy products	0	0	0	0	0	0	0	2	0	0	0	0	0	0
191	MPG331201	Iron and steel pipes and tubes (except castings)	0	0	0	0	0	0	0	26	0	0	0	0	0	0
192	MPG331202	Wire and other rolled and drawn steel products	0	0	0	0	0	0	0	13	0	0	0	0	0	0
193	MPG331301	Bauxite and aluminum oxide	0	0	0	0	0	0	0	0	0	0	0	0	0	0
194	MPG331302	Unwrought aluminum including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
195	MPG331303	Basic and semi-finished products of aluminum and alloys	0	0	0	0	0	0	0	6	0	0	0	0	0	0
196	MPG331401	Unwrought copper including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
197	MPG331402	Unwrought nickel including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
198	MPG331403	Unwrought precious metals including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
199	MPG331404	Other unwrought non-ferrous metals including alloys	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200	MPG331405	Gold, store of value	0	0	0	0	0	0	0	0	0	0	0	0	0	0
201	MPG331406	Basic and semi-finished products of non-ferrous metals and alloys (except aluminum)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
202	MPG331501	Ferrous metal castings	0	0	0	0	0	0	0	13	0	0	0	0	0	0
203	MPG331502	Non-ferrous metal castings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
204	MPG331X01	Waste and scrap of iron and steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
205	MPG331X02	Waste and scrap of non-ferrous metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
206	MPG332101	Forged and stamped metal products	0	0	0	0	0	0	0	1	0	0	0	0	0	0
207	MPG332301	Prefabricated metal buildings and components	0	0	0	0	0	0	0	105	0	0	0	0	0	0
208	MPG332302	Fabricated steel plates and other fabricated structural metal	0	0	0	0	0	0	0	209	0	0	0	0	0	0
209	MPG332303	Metal windows and doors	0	0	0	0	0	0	0	20	0	0	0	0	0	0
210	MPG332A05	Other architectural metal products	0	0	0	0	0	0	0	217	0	0	0	0	0	0
211	MPG332401	Light gauge metal containers, crowns and closures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
212	MPG332402	Boilers, tanks and heavy gauge metal containers	0	0	0	0	0	0	0	37	0	0	0	0	0	0
213	MPG332500	Builders, motor vehicle and other hardware	0	0	0	0	0	0	0	3	0	0	0	0	0	0
214	MPG332600	Springs and wire products	0	0	0	0	0	0	0	38	0	0	0	0	0	0
215	MPG332700	Threaded metal fasteners and other turned metal products including automotive	0	0	0	0	0	0	0	16	0	0	0	0	0	0
216	MPS332800	Coating, engraving, heat treating and similar metal processing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
217	MPG332A01	Hand tools, kitchen utensils and cutlery (except precious metal)	0	0	0	0	0	0	0	3	0	0	0	0	0	0
218	MPG332A02	Metal valves and pipe fittings	0	0	0	0	0	0	0	117	0	0	0	0	0	0
219	MPG332A03	Ball and roller bearings	0	0	0	0	0	0	0	15	0	0	0	0	0	0
220	MPG332A04	Guns, ammunition and other munitions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
221	MPG332A08	Fabricated metal products, n.e.c.	0	0	0	0	0	0	0	9	0	0	0	0	0	0
222	MPG333101	Agricultural, lawn and garden machinery and equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
223	MPG333102	Logging, mining and construction machinery and equipment	0	0	0	0	0	0	0	127	0	0	0	0	0	0
224	MPG333200	Other industry-specific machinery	0	0	0	0	0	0	0	14	0	0	0	0	0	0
225	MPG333300	Commercial and service industry machinery	0	0	0	0	0	0	0	2	0	0	0	0	0	0
226	MPG333401	Industrial and commercial fans, blowers and air purification equipment	0	0	0	0	0	0	0	18	0	0	0	0	0	0

Simulation options Industry inputs expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Sustaining Capital, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
227	MPG333402	Heating and cooling equipment (except household refrigerators and freezers)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
228	MPG333500	Metalworking machinery and industrial moulds	0	0	0	0	0	0	0	0	0	0	0	0	0	0
229	MPG333601	Turbines, turbine generators, and turbine generator sets	0	0	0	0	0	0	0	2	0	0	0	0	0	0
230	MPG333609	Other engine and power transmission equipment	0	0	0	0	0	0	0	8	0	0	0	0	0	0
231	MPG333901	Pumps and compressors (except fluid power)	0	0	0	0	0	0	0	63	0	0	0	0	0	0
232	MPG333902	Material handling equipment	0	0	0	0	0	0	0	30	0	0	0	0	0	0
233	MPG333909	Other miscellaneous general-purpose machinery	0	0	0	0	0	0	0	38	0	0	0	0	0	0
234	MPG334100	Computers, computer peripherals and parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
235	MPG334201	Telephone apparatus	0	0	0	0	0	0	0	1	0	0	0	0	0	0
236	MPG334209	Other communications equipment	0	0	0	0	0	0	0	17	0	0	0	0	0	0
237	MPG334A01	Audio and video equipment and unrecorded media	0	0	0	0	0	0	0	0	0	0	0	0	0	0
238	MPG334A02	Navigational and guidance instruments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
239	MPG334A05	Medical devices	0	0	0	0	0	0	0	22	0	0	0	0	0	0
240	MPG334A06	Measuring, control and scientific instruments	0	0	0	0	0	0	0	25	0	0	0	0	0	0
241	MPG334401	Printed and integrated circuits, semiconductors and printed circuit assemblies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
242	MPG334409	Other electronic components	0	0	0	0	0	0	0	0	0	0	0	0	0	0
243	MPG335101	Electric light bulbs and tubes	0	0	0	0	0	0	0	0	0	0	0	0	0	0
244	MPG335102	Lighting fixtures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
245	MPG335203	Small electric appliances	0	0	0	0	0	0	0	3	0	0	0	0	0	0
246	MPG335204	Major appliances	0	0	0	0	0	0	0	0	0	0	0	0	0	0
247	MPG335301	Power, distribution and other transformers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
248	MPG335302	Electric motors and generators	0	0	0	0	0	0	0	2	0	0	0	0	0	0
249	MPG335303	Switchgear, switchboards, relays and industrial control apparatus	0	0	0	0	0	0	0	1	0	0	0	0	0	0
250	MPG335901	Batteries	0	0	0	0	0	0	0	2	0	0	0	0	0	0
251	MPG335902	Communication and electric wire and cable	0	0	0	0	0	0	0	82	0	0	0	0	0	0
252	MPG335903	Wiring devices	0	0	0	0	0	0	0	0	0	0	0	0	0	0
253	MPG335909	Other electrical equipment and components	0	0	0	0	0	0	0	2	0	0	0	0	0	0
254	MPG336111	Passenger cars	0	0	0	0	0	0	0	0	0	0	0	0	0	0
255	MPG336112	Light-duty trucks, vans and sport utility vehicles (SUVs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
256	MPG336120	Medium and heavy-duty trucks and chassis	0	0	0	0	0	0	0	0	0	0	0	0	0	0
257	MPG336201	Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0
258	MPG336202	Motor vehicle bodies and special purpose motor vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0	0
259	MPG336203	Freight and utility trailers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
260	MPG336204	Motor homes, travel trailers and camping trailers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
261	MPG336310	Motor vehicle gasoline engines and engine parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
262	MPG336320	Motor vehicle electrical and electronic equipment and instruments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
263	MPG336330	Motor vehicle steering and suspension components	0	0	0	0	0	0	0	0	0	0	0	0	0	0
264	MPG336340	Motor vehicle brakes and brake systems	0	0	0	0	0	0	0	1	0	0	0	0	0	0
265	MPG336350	Motor vehicle transmission and power train parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Industry inputs expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Sustaining Capital, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
266	**MPG336360**	Motor vehicle interior trim, seats and seat parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
267	**MPG336370**	Motor vehicle metal stamping	0	0	0	0	0	0	0	0	0	0	0	0	0	0
268	**MPG336390**	Other miscellaneous motor vehicle parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
269	**MPG336401**	Aircraft	0	0	0	0	0	0	0	0	0	0	0	0	0	0
270	**MPG336402**	Aircraft engines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
271	**MPG336403**	Aircraft parts and other aerospace equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
272	**MPG336501**	Locomotives, railway rolling stock, and rapid transit equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
273	**MPG336502**	Parts of railway rolling stock	0	0	0	0	0	0	0	0	0	0	0	0	0	0
274	**MPG336601**	Ships	0	0	0	0	0	0	0	0	0	0	0	0	0	0
275	**MPG336602**	Boats and personal watercraft	0	0	0	0	0	0	0	0	0	0	0	0	0	0
276	**MPG336900**	Other transportation equipment and related parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
277	**MPG337101**	Wood kitchen cabinets and counter tops	0	0	0	0	0	0	0	2	0	0	0	0	0	0
278	**MPG337102**	Household furniture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
279	**MPG337103**	Institutional and other furniture, n.e.c.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
280	**MPG337203**	Office furniture	0	0	0	0	0	0	0	0	0	0	0	0	0	0
281	**MPG337204**	Office and store fixtures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
282	**MPG337901**	Mattresses and foundations	0	0	0	0	0	0	0	0	0	0	0	0	0	0
283	**MPG337902**	Blinds and shades	0	0	0	0	0	0	0	0	0	0	0	0	0	0
284	**MPG339100**	Medical, dental and personal safety supplies, instruments and equipment	0	0	0	0	0	0	0	1	0	0	0	0	0	0
285	**MPG339901**	Jewellery and silverware	0	0	0	0	0	0	0	0	0	0	0	0	0	0
286	**MPG339902**	Sporting and athletic goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
287	**MPG339903**	Toys and games	0	0	0	0	0	0	0	0	0	0	0	0	0	0
288	**MPG339904**	Office supplies (except paper)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
289	**MPG339905**	Signs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
290	**MPG339909**	Other miscellaneous manufactured products	0	0	0	0	0	0	0	4	0	0	0	0	0	0
291	**MPS3X0000**	Custom work manufacturing services (except printing, finishing textiles and metals)	0	0	0	0	0	0	0	2	0	0	0	0	0	0
292	**MPS411000**	Wholesale margins - farm products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
293	**MPS412000**	Wholesale margins - petroleum and petroleum products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
294	**MPS413000**	Wholesale margins - food, beverages and tobacco products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
295	**MPS414000**	Wholesale margins - personal and household goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
296	**MPS415000**	Wholesale margins - motor vehicles, motor vehicle parts and accessories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
297	**MPS416000**	Wholesale margins - building materials and supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
298	**MPS417000**	Wholesale margins - machinery, equipment and supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
299	**MPS418000**	Wholesale margins - miscellaneous products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
300	**MPS410002**	Wholesale trade commissions	0	0	0	0	0	0	0	2	0	0	0	0	0	0
301	**MPS441000**	Retail margins - motor vehicles and parts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
302	**MPS442000**	Retail margins - furniture and home	0	0	0	0	0	0	0	0	0	0	0	0	0	0
303	**MPS443000**	Retail margins - electronics and appliances	0	0	0	0	0	0	0	0	0	0	0	0	0	0
304	**MPS444000**	Retail margins - building materials, garden equipment and supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
305	**MPS445000**	Retail margins - food and beverages	0	0	0	0	0	0	0	0	0	0	0	0	0	0
306	**MPS446000**	Retail margins - health and personal care products	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Industry inputs expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Sustaining Capital, Industry Inputs Expenditure, In Purchaser Prices)

Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
307	MPS447000	Retail margins - automotive fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
308	MPS448000	Retail margins - clothing and clothing accessories	0	0	0	0	0	0	0	0	0	0	0	0	0	0
309	MPS451000	Retail margins - sporting and leisure products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
310	MPS453A00	Retail margins - miscellaneous products (except cannabis)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
311	MPS453BL0	Retail margins - cannabis products (licensed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
312	MPS453BU0	Retail margins - cannabis products (unlicensed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
313	MPS454310	Retail margins - household fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
314	MPS4A0002	Used motor vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0	0
315	MPS4A0003	Other used consumer goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
316	MPS4A0004	Retail trade commissions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
317	MPS481001	Air passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
318	MPS481002	Air freight transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
319	MPS481003	Air specialty services	0	0	0	0	0	0	0	1	0	0	0	0	0	0
320	MPS482001	Rail passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
321	MPS482002	Rail freight transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
322	MPS483001	Water passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
323	MPS483002	Water freight transportation services	0	0	0	0	0	0	0	1	0	0	0	0	0	0
324	MPS484001	Moving services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
325	MPS484004	Truck transportation services for general freight	0	0	0	0	0	0	0	0	0	0	0	0	0	0
326	MPS484005	Truck transportation services for specialized freight	0	0	0	0	0	0	0	1	0	0	0	0	0	0
327	MPS485100	Urban transit services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
328	MPS48A001	Interurban and rural bus passenger transportation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
329	MPS48A002	School bus services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
330	MPS48A003	Other transit and passenger transportation services by road	0	0	0	0	0	0	0	0	0	0	0	0	0	0
331	MPS48A004	Scenic and sightseeing tour services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
332	MPS485300	Taxi and limousine services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
333	MPS486200	Transportation of natural gas by pipeline	0	0	0	0	0	0	0	0	0	0	0	0	0	0
334	MPS486A00	Transportation of crude oil and other commodities by pipeline	0	0	0	0	0	0	0	0	0	0	0	0	0	0
335	MPS488001	Air transportation support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
336	MPS488002	Aircraft maintenance and repair services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
337	MPS488003	Rail transportation support, maintenance and repair services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
338	MPS488004	Water transportation support, maintenance and repair services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
339	MPS488005	Road transportation support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
340	MPS488006	Freight transportation arrangement and customs brokering services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
341	MPS488009	Other transportation support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
342	MPS491000	Postal services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
343	MPS492000	Courier, parcel, and local messenger and delivery services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
344	MPS493001	Grain storage	0	0	0	0	0	0	0	0	0	0	0	0	0	0
345	MPS493002	Warehousing and storage services (except grain storage)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
346	MPG511111	Newspapers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
347	MPS511112	Advertising space in printed newspapers	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
348	MPG5111A1	Periodicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
349	MPG5111A2	Books	0	0	0	0	0	0	0	0	0	0	0	0	0	0
350	MPG5111A3	Other published products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
351	MPS5111A4	Advertising space in printed periodicals and in other printed publications	0	0	0	0	0	0	0	0	0	0	0	0	0	0
352	MPS51AX00	Licensing of rights to use literary works and artistic works (except software licensing)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
353	MPS511200	General purpose software	0	0	0	0	0	0	0	0	0	0	0	0	0	0
354	MPS5121A1	Recorded movies, television programs and videos	0	0	0	0	0	0	0	0	0	0	0	0	0	0
355	MPS5121A2	Movie, television program and video production, post-production and editing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
356	MPS5121A3	Licensing of rights to use audiovisual works	0	0	0	0	0	0	0	0	0	0	0	0	0	0
357	MPS512130	Admissions to motion picture film exhibitions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
358	MPS512201	Recorded music and other sound recordings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
359	MPS512202	Audio recording services and copyright administration	0	0	0	0	0	0	0	0	0	0	0	0	0	0
360	MPS512203	Licensing of rights to use musical works and sound recordings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
361	MPS515100	Advertising air time on radio	0	0	0	0	0	0	0	0	0	0	0	0	0	0
362	MPS515A01	Advertising air time on television	0	0	0	0	0	0	0	0	0	0	0	0	0	0
363	MPS515A02	Fees for the distribution of television and radio program channels (affiliation payments)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
364	MPS517001	Fixed telecommunications services (except Internet access)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
365	MPS517002	Mobile telecommunications services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
366	MPS517003	Cable, satellite and other program distribution services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
367	MPS517004	Fixed Internet access services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
368	MPS518000	Data processing, hosting, and related services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
369	MPS519001	Subscriptions for online content	0	0	0	0	0	0	0	0	0	0	0	0	0	0
370	MPS519002	Internet advertising	0	0	0	0	0	0	0	0	0	0	0	0	0	0
371	MPS519008	Other information services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
372	MPS521000	Central banking services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
373	MPS522130	Local credit union services - explicit charges (fees)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
374	MPS5221A0	Banking and other depository credit intermediation services - explicit charges	0	0	0	0	0	0	0	0	0	0	0	0	0	0
375	MPS522200	Non-depository credit intermediation services - explicit charges (fees)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
376	MPS522300	Other services related to credit intermediation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
377	MPS523001	Investment banking services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
378	MPS523002	Security brokerage and securities dealing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
379	MPS523003	Portfolio management services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
380	MPS523004	Investment counselling services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
381	MPS523009	Holding company services and other financial investment and related activities	0	0	0	0	0	0	0	0	0	0	0	0	0	0
382	MPS524101	Life insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
383	MPS524102	Accident and sickness insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
384	MPS524103	Automotive insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
385	MPS524104	Property insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

		Commodities (Detail level)	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
386	MPS524105	Liability and other property and casualty insurance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
387	MPS524200	Brokerage and other insurance related services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
388	MPS526111	Trusteed pension fund services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
389	MPS526A00	Mutual funds (cost of service) and other similar services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
390	MPS52X001	Deposit intermediation services indirectly measured (FISIM)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
391	MPS52X002	Residential mortgage intermediation services indirectly measured (FISIM)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
392	MPS52X003	Other loan intermediation services indirectly measured (FISIM)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
393	MPS531101	Rental of residential real estate	0	0	0	0	0	0	0	0	0	0	0	0	0	0
394	MPS531102	Rental of non-residential real estate	0	0	0	0	0	0	0	0	0	0	0	0	0	0
395	IMS5311A0	Imputed rental of owner-occupied dwellings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
396	MPS531A00	Real estate brokerage and other services related to real estate	0	0	0	0	0	0	0	0	0	0	0	0	0	0
397	MPS532100	Motor vehicle rental and leasing services	0	0	0	0	0	0	0	45	0	0	0	0	0	0
398	MPS532A01	Computer equipment rental and leasing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
399	MPS532A02	Office machinery and equipment (except computer equipment) rental and leasing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
400	MPS532A03	Commercial and industrial machinery and equipment (except office equipment) rental and leasing services	0	0	0	0	0	0	0	76	0	0	0	0	0	0
401	MPS532A09	Rental and leasing services of other goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0
402	MPS533000	Licensing of rights to non-financial produced intangible assets (except software and other copyright licensing)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
403	MPS541100	Legal services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
404	MPS541200	Accounting, tax preparation, bookkeeping and payroll services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
405	MPS541300	Architectural, engineering and related services	0	0	0	0	0	0	0	37	0	0	0	0	0	0
406	MPS541400	Specialized design services	0	0	0	0	0	0	0	1	0	0	0	0	0	0
407	MPS541501	Custom software design and development services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
408	IMS541502	Own-account software design and development services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
409	MPS541503	Computer systems design and related services (except software development)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
410	MPS541600	Management, scientific and technical consulting services	0	0	0	0	0	0	0	2	0	0	0	0	0	0
411	MPS541701	Research and development services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
412	IMS541702	Own-account research and development (except software development)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
413	MPS541800	Advertising, public relations and related services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
414	MPS541901	Photographic services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
415	MPS541902	Veterinary services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
416	MPS541909	Other professional, scientific and technical services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
417	IMS551001	Holding company services (imputed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
418	IMS551002	Head office services (imputed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

		Commodities (Detail level)	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
419	MPS561100	Office administrative services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
420	MPS561300	Employment services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
421	MPS561400	Business support services	0	0	0	0	0	0	0	1	0	0	0	0	0	0
422	MPS561500	Travel arrangement, reservation and planning services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
423	MPS561600	Investigation and security services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
424	MPS561700	Services to buildings and dwellings	0	0	0	0	0	0	0	0	0	0	0	0	0	0
425	MPS561A00	Facilities and other support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
426	MPS562000	Waste management and remediation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
427	MPS610001	Tuition and similar fees for elementary and secondary schools	0	0	0	0	0	0	0	0	0	0	0	0	0	0
428	MPS610002	Tuition and similar fees for colleges and C.E.G.E.P.s	0	0	0	0	0	0	0	0	0	0	0	0	0	0
429	MPS610003	Tuition and similar fees for universities	0	0	0	0	0	0	0	0	0	0	0	0	0	0
430	MPS610004	Tuition and similar fees for trade, technical and professional training	0	0	0	0	0	0	0	0	0	0	0	0	0	0
431	MPS610009	Other educational training and services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
432	MPS621100	Physician services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
433	MPS621200	Dental services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
434	MPS621A01	Other health practitioner services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
435	MPS621A02	Medical laboratory diagnostic and testing services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
436	MPS621A03	Ambulance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
437	MPS622000	Hospital services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
438	MPS623000	Nursing and residential care services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
439	MPS624001	Child day-care services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
440	MPS62A000	Other ambulatory health care services and social assistance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
441	MPS71A001	Admissions to live sporting events	0	0	0	0	0	0	0	0	0	0	0	0	0	0
442	MPS71A002	Admissions to live performing arts performances	0	0	0	0	0	0	0	0	0	0	0	0	0	0
443	MPS71A003	Sport and performing arts event organization and support services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
444	MPS71A004	Career management and representation services of public figures	0	0	0	0	0	0	0	0	0	0	0	0	0	0
445	MPS71A005	Contract production of live performing arts performances, live sporting events and copyrighted works	0	0	0	0	0	0	0	0	0	0	0	0	0	0
446	MPS71A009	Broadcast and other media rights	0	0	0	0	0	0	0	0	0	0	0	0	0	0
447	MPS71A008	Heritage institution services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
448	MPS713A00	Amusement and recreation services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
449	MPS713200	Gambling (net wagers)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
450	MPS721100	Room or unit accommodation services for travellers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
451	MPS721A01	Recreational vehicle park and recreational camp services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
452	MPS721A02	Rooming and boarding services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
453	MPS722001	Prepared meals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
454	MPS722002	Alcoholic beverages for immediate consumption	0	0	0	0	0	0	0	0	0	0	0	0	0	0
455	MPS811100	Motor vehicle repair and maintenance services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
456	MPS811A00	Repair and maintenance services (except for buildings and motor vehicles)	0	0	0	0	0	0	0	13	0	0	0	0	0	0
457	MPS812200	Funeral services	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options **Industry inputs expenditure, in purchaser prices, at the Detailed level.**

Table 1.1a Summary of original shock (Sustaining Capital, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
458	MPS812300	Laundry and dry-cleaning services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
459	MPS812A01	Hair care and aesthetic services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
460	MPS812A02	Parking services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
461	MPS812A09	Other personal and personal care services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
462	MPS813000	Other membership services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
463	MPS814001	Babysitting services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
464	MPS814002	Private household services (except babysitting)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
465	MPS9A0000	Sales of other services by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
466	MPS9B0000	Sales of other government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
467	FIC110000	Repair and maintenance	0	0	0	0	0	0	0	0	0	0	0	0	0	0
468	FIC120000	Operating supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
469	FIC130000	Office supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
470	FIC210000	Advertising, promotion, meals and entertainment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
471	FIC220000	Travel, meetings and conventions	0	0	0	0	0	0	0	0	0	0	0	0	0	0
472	FIC300000	Transportation margins	0	0	0	0	0	0	0	0	0	0	0	0	0	0
473	NNP610000	Educational services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
474	NNP621000	Ambulatory health care services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
475	NNP624000	Social assistance services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
476	NNP710000	Arts, entertainment and recreation services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
477	NNP813100	Religious services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
478	NNP813A01	Grant-making, civic, and professional and similar organization services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
479	NNP813930	Labour organization membership services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
480	NNP813940	Political organization services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
481	NNP999999	Other services provided by Non-Profit Institutions Serving Households	0	0	0	0	0	0	0	0	0	0	0	0	0	0
482	NGS611100	Elementary and secondary school services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
483	NGS611200	Community college and C.E.G.E.P services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
484	NGS611300	University services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
485	NGS611A00	Other educational services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
486	NGS622000	Hospital services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
487	NGS623000	Residential care facility services provided by governments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
488	NGS911100	Defence services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
489	NGS911A00	Other federal government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
490	NGS912000	Other provincial and territorial government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
491	NGS913000	Other municipal government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
492	NGS914000	Other aboriginal government services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
493	PRM100000	Taxes on products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
494	PRM200000	Subsidies on products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
495	PRM300000	Subsidies on production	0	0	0	0	0	0	0	0	0	0	0	0	0	0
496	PRM400000	Taxes on production	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Simulation options Industry inputs expenditure, in purchaser prices, at the Detailed level.

Table 1.1a Summary of original shock (Sustaining Capital, Industry Inputs Expenditure, In Purchaser Prices)
Thousands of dollars

			Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories	Nunavut	Canadian territorial enclaves abroad
Commodities (Detail level)																
497	PRM500000	Wages and salaries	0	0	0	0	0	0	0	2,180	0	0	0	0	0	0
498	PRM600000	Employers' social contributions	0	0	0	0	0	0	0	166	0	0	0	0	0	0
499	PRM700000	Gross mixed income	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500	PRM800000	Gross operating surplus	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4,816**	**0**	**0**	**0**	**0**	**0**	**0**

Rook I Project

Environmental Impact Statement

Section 19 Community Well-Being

Submitted to:
Canadian Nuclear Safety Commission
Saskatchewan Ministry of Environment

Submitted by:
NexGen Energy Ltd.
3150-1021 W Hastings St
Vancouver, BC
V6E 0C3

November 2024

Executive Summary

Section Purpose

Section 19 of the Environmental Impact Statement (EIS) provides a comprehensive assessment of potential effects of the Rook I Project (Project) on community well-being. This assessment included consideration of both potential effects from the Project and cumulative effects from the Project and other reasonably foreseeable developments (RFDs). The community well-being assessment used widely accepted scientific practices and incorporated Indigenous and Local Knowledge.

Community well-being represented a valued component (VC) for the Environmental Assessment (EA); the selection was based on the combined importance of social and cultural, health, environmental, educational, and economic factors to the function and overall well-being of a community. The social determinants of health (i.e., the conditions in which people are “born, grow, live, work, and age” [World Health Organization 2022]) were used as a framework for describing community well-being and for evaluating the potential effects of the Project on the community well-being VC.

The assessment of effects on community well-being was informed by the assessments completed for Indigenous land and resource use, other land and resource use, and economy. Results from the assessment of community well-being did not provide inputs to other EIS sections.

Setting

At a regional scale, the Project would be located within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system, approximately 40 km east of the Saskatchewan-Alberta border and 640 km northwest of the city of Saskatoon. The Project would reside within Treaty 8 territory and the Métis Homeland, and adjacent to Treaty 10 territory.

The local study area (LSA) for the assessment of community well-being is represented by the communities closest to the Project that would experience most of the Project effects and for which NexGen would prioritize local training, employment, and business opportunities for the Project.

Communities and Indigenous Groups in the LSA include:

- Clearwater River Dene Nation (CRDN);
- Clearwater Clear Lake (Métis Nation – Saskatchewan name for Northern Region 2);
- La Loche;
- Birch Narrows Dene Nation (BNDN);
- Turnor Lake;
- Buffalo River Dene Nation (BRDN) / Dillon;
- Buffalo Narrows;
- Bear Creek;
- Descharme Lake;
- Garson Lake;
- Black Point;
- Michel Village; and
- St. George’s Hill.

The focus of the assessment was placed on the larger communities within the LSA, which included the CRDN, BNDN, and BRDN, and the municipalities of La Loche and Buffalo Narrows. These communities were used due to their population size, the availability of data, and the limited data available for the smaller communities. The larger communities also act as service centres for the smaller neighbouring communities; as such, it was reasonable to assume their community well-being is analogous to the well-being of the surrounding population.

The regional study area (RSA) represents the area where potential cumulative effects of the Project and RFDs could occur and aligns spatially with the Northern Saskatchewan Administrative District.

Existing Conditions (Section 19.3)

The existing socio-economic environment was characterized through different methods. Secondary literature reviews (e.g., statistical sources, government reports, academic reports) were undertaken and supplemented through primary data collection methods in the forms of a key person (KP) interview program, Joint Working Group (JWG) discussions, Indigenous Knowledge and Traditional Land Use Studies, workshops, and other engagement activities. The existing socio-economic conditions were then characterized under the groupings described below.

Societal and Cultural Well-Being

Societal and cultural well-being describes the social adaptability for the LSA communities in connection to the values and features that community members share; cultural connection and the role it plays in creating community cohesion; and governance, goals, and plans for LSA communities.

The LSA is characterized by a dispersed settlement pattern of primarily small and highly remote Indigenous communities with a total population of about 6,000 in 2016. The age structure of the LSA population in 2016 was younger than the Saskatchewan population. Overall, the data reflects the higher proportions of youth and the contraction of young working-aged cohorts.

Community context and cultural continuity, including the maintenance of traditional ways of life and the intergenerational transmission of knowledge, were identified to be important factors within each of the communities.

Safety and security are important factors in community well-being. Data from the Royal Canadian Mounted Police (RCMP) detachments indicate that crime rates and safety are variable. Local community members who participated in KP interviews differed in their opinions on community safety, with some feeling their communities were safe while others feeling the opposite.

Governance as a tool for self-determination was identified as a key social determinant of health for Indigenous Peoples as it influences other social determinants of health such as education, housing, and safety. Aspects of self-determination were shared through discussions about freedom and control at JWG meetings and reinforced the influence of self-determination on community well-being. At the JWG meetings, goals and aspirations specific to each community were identified.

Health Well-Being

Health well-being refers to community health, with reference to health infrastructure and health services, and overall health of residents in the LSA communities.

The LSA is in the Northwest Region of the Saskatchewan Health Authority (SHA)[1]. The SHA facilities in the LSA include the La Loche Health Centre and Hospital and the Buffalo Narrows Health Centre. To access health services, residents in the smaller northern hamlets and villages travel to a larger community centre, primarily Dillon, for less severe, non-emergency medical issues, and Île-à-la-Crosse or La Loche for medical issues such as emergencies and more specialized services.

The Meadow Lake Tribal Council (MLTC) directs health services for First Nation community reserves in the LSA. These services include nutrition, health advocacy, community health and wellness, addictions, community education, and counselling.

There are limited psychiatric, dental, and optometry services provided to members of the CRDN, BNDN, and BRDN. Dental therapy and psychiatric care are available within the communities on an irregular schedule, while no optometry is available within the communities.

Currently, health care, especially mental health care, is a concern in the LSA communities. Results from the KP interview program indicate that there are some mental health services available but that they do not currently meet the demand. The SHA is also addressing the recommendations in the Mental Health and Addictions Plan in its planning for the 2021 to 2022 period (Saskatchewan Health Authority 2021).

Diet in the LSA consists of a balance between a traditional diet and a store-bought diet. The communities in the LSA have noted the importance of Traditional Foods in their diet. Harvesting Traditional Foods is identified to be important for communities for a range of reasons, including supporting social bonds within families and communities, maintaining cultural identities, forming a nutritious part of the Indigenous diet (Council of Canadian Academies 2014), providing food security, and offsetting the high cost of living in northern Saskatchewan.

Neighbourhood and Physical Environment Well-Being

The neighbourhood and physical environment well-being refers to the built environments within the LSA communities and the programs and services intended to support the well-being of community residents (e.g., recreation centres, community centres).

In the LSA, housing on reserve is largely provided by the bands who maintain current housing stock and build new houses. Some housing is privately owned by members in Dillon, Birch Narrows, and Clearwater River Band No. 222. Both privately owned and rental housing are common for off-reserve housing in the LSA. Due to limited funding and high demand, housing can be slow to build and maintain, which results in members moving to different communities until housing is available. In the KP interview program, it was noted that housing shortages have resulted in extensive waitlists and homelessness is an issue. Due to the lack of housing available, many residents live in crowded conditions and stay with family members or friends (2019 to 2021 KP interview program). Many homes in the LSA require repairs.

Recreation infrastructure and facilities in the LSA communities include both sporting and cultural facilities. Examples include hockey arenas, outdoor rinks, gyms, baseball diamonds, and community halls.

Policing services in the LSA are provided by the RCMP. There are two main detachments: one in La Loche and one in Buffalo Narrows. The Buffalo Narrows detachment has two additional stations, one in Turnor Lake / Birch Narrows and one in Dillon.

Fire suppression services are conducted by communities in the LSA on a volunteer basis. La Loche fire suppression provides services to the CRDN, and in Birch Narrows and Turnor Lake, services are provided by

[1] Previously the Keewatin Yatthé Regional Health Authority.

the BNDN. In Dillon, fire suppression is handled by volunteer firefighters with fire trucks maintained and driven by the heavy equipment workers of the BRDN maintenance crew. Services in Buffalo Narrows are provided by the local fire hall with approximately 10 volunteer firefighters.

Ambulance services for the LSA communities are based in La Loche through the municipalities and the SHA.

The provincially managed highways leading to the proposed Project location include Highway 155 and Highway 955. Highway 155 is an all-weather paved highway, while Highway 955 is an all-weather highway that is almost entirely unpaved.

Two airports are located in the LSA; the Buffalo Narrows Airport is located south of Buffalo Narrows off Highway 155, and La Loche Airport is located southeast of La Loche off Highway 155.

Educational Well-Being

The educational well-being environment describes the educational characteristics of each of the key LSA communities with reference to educational opportunities, attainment, and participation.

Childcare facilities are available in La Loche, Birch Narrows, Dillon, and Buffalo Narrows. All childcare facilities available in the LSA have waitlists due to limited space.

Primary and secondary public-school education in the LSA communities is administered under the Northern Lights School District (NLSD) No.113. The majority of students between kindergarten and grade 12 in the NLSD self-identify as Indigenous. Attendance data overall for NLSD No.113 students was lower than the provincial average for all grades. Educational attainment in the CRDN, BNDN, and La Loche fluctuated between 2006 and 2016 and remained below the RSA level.

The lack of youth and adult training facilities and the frequent need for students to leave the community to pursue further education were identified during JWG meetings as issues.

In northern Saskatchewan, uranium companies have partnered with Northern Career Quest Inc. (NCQ) and training institutions to deliver training specific to employment within their operations. All programs delivered by NCQ must have guaranteed employment and the training delivered must be either industry or institution approved. During the NCQ's initial thirteen years of operation (i.e., 2008 to 2021), 81% of the graduates obtained quality employment and over 75% remain employed today.

Economic Well-Being

Economic well-being refers to those economic characteristics of each of the key LSA communities relevant to the consideration of community well-being, including labour force, employment, income, and local business characteristics.

In LSA communities, most employment is concentrated in public sector positions, including Indigenous governance and municipalities. Employment rates vary between LSA communities. Local community members are active in both the wage economy and the traditional economy.

In comparison to other northern communities in the RSA, the LSA communities exhibit less business activity, with a limited number of locally owned businesses operating. Goods and services in the LSA are often sourced externally. Interviews conducted with residents indicated a strong interest in expanding local business opportunities, including exploring partnerships between communities.

Project Interactions, Mitigations, and Benefit Enhancements (Section 19.4)

An analysis was completed to evaluate Project components and activities and associated effects pathways that could potentially affect community well-being; this analysis included consideration of both adverse and beneficial effects. The evaluation also considered similar combined effects from the Fission Patterson Lake South Property, the identified RFD for the community well-being assessment.

Project activities that would have the potential to affect community well-being during the Project lifespan include:

- land clearing, site preparation, and construction of facilities and infrastructure;
- development of the underground mine/shaft;
- processing facilities and underground operations;
- handling and storage of waste rock, special waste rock, and ore;
- water intake for potable and process water;
- effluent treatment plant;
- sewage treatment plant;
- additional infrastructure (e.g., camp, maintenance shop, offices);
- power generation;
- access road upgrade;
- provision of services to the Project such as food, housekeeping, maintenance, and environmental monitoring;
- project-related training and employment opportunities;
- project-related rotating shifts;
- provision of housing in the on-site camp;
- removal of infrastructure;
- reclamation and revegetation of facility and infrastructure areas;
- transportation of personnel and materials to and from the site; and
- other supporting mining construction, operation, and decommissioning and reclamation activities.

Project workers would be housed in on-site worker accommodation serviced by fly-in/fly-out (FIFO) access. Materials and equipment would be transported to and from site via Highway 155 and Highway 955.

Similar activities that could affect community well-being would be expected to occur for the Fission Patterson Lake South Property.

As part of the pathways analysis, proposed environmental design features and mitigation measures were considered to determine whether effects on the environment could be avoided or reduced to negligible levels, thereby removing the pathway. For beneficial pathways, enhancement measures and actions were also considered.

Project environmental design features such as the underground tailings management facility and a limited Project footprint were designed to minimize the Project's effects on community well-being by reducing the physical maximum disturbance area of the Project.

Proposed mitigation and enhancement measures would reduce adverse effects and enhance beneficial effects on the local communities. Measures would include the development of culturally sensitive employment policies, provision of dedicated space for Elders, and development and implementation of human resource policies (e.g., employee and family assistance program) to assist workers in finding information and referral services for family-related resources. NexGen would also seek to establish a forum for regular communication and information exchange between NexGen and communities. In addition, NexGen would implement an Indigenous and Public Engagement Program to effectively engage with communities on Project activities, effects, mitigation, and monitoring to keep people informed and provide opportunities to provide feedback for continual improvement through a grievance mechanism.

In addition to these mitigation and enhancement measures, NexGen has negotiated and signed Benefit Agreements with all four primary Indigenous Groups in the LSA. Although details of these agreements are confidential, they are premised on commitments including proactively engaging with local communities; supporting the economic participation of affected communities; seeking to provide opportunities resulting in sustainable, lasting benefits to local communities beyond the Project lifespan; and providing clear and timely information to those who have a direct interest in the Project. Implementation of items agreed to in Benefit Agreements is also expected to reduce adverse effects and enhance beneficial effects on community well-being.

Similar mitigation, adaptive management practices, and enhancement measures would also be expected to be implemented by the Fission Patterson Lake South Property.

After mitigation measures were considered, the pathways analysis determined that many potentially adverse pathways from the Project to the environment (i.e., biophysical and human) could be removed from the assessment. However, it was identified that the Project could still adversely affect community well-being from the following pathways:

- access restrictions and avoidance of areas may reduce participation in traditional activities, adversely affecting cultural continuity, including the transmission of knowledge from Elders to youth; and
- time spent by workers away from their communities and families participating in the worker rotation system may result in effects on quality of life, local community cohesion, and family stability.

Therefore, these pathways were carried forward into the residual effects analysis.

Beneficial Pathways

The proposed Project is expected to produce the following beneficial effects that could positively influence community well-being in the LSA and RSA:

- Increased income for local community members that would be expected to result in:
  - increased access to housing and/or education;
  - increased disposable income to support participation in traditional harvesting activities and improve individual diets;
  - retaining community youth who may otherwise leave the LSA; and
  - promotion of local economic well-being through increased incomes and spending at local businesses.
- Increased community revenue through procurement opportunities that may enhance quality of life through investments in communities (e.g., infrastructure, services).

- Benefit Agreements include payments to primary Indigenous Groups based on revenue generated throughout the life of the Project. Indigenous Groups would determine how to best spend or distribute funds.
- Increased educational and training opportunities that could:
  - increase well-being and community cohesion, and create pathways to employment opportunities;
  - increase the ability of residents in LSA communities to engage in economic opportunities; and
  - open a pathway to other employment, which could further stimulate the LSA economy.

Beneficial pathways were not carried forward for further assessment or assessed for significance; however, these pathways do provide important context for how residents and communities are likely to experience the Project.

Residual Effects Analysis (Section 19.5)

A residual effects analysis was conducted to determine the potential effects on community well-being under two assessment cases: effects of the Project (i.e., Application Case), and combined effects of the Project and the Fission Patterson Lake South Property (i.e., RFD Case). The residual effects analysis considered five measurement indicators (i.e., societal and cultural, health, neighbourhood and physical environment, educational, and economic well-being), which were characterized for the primary pathways using measurement indicator groupings of cultural continuity, social adaptability, and demand for community infrastructure and services.

Cultural Continuity

For the purposes of the community well-being assessment, cultural continuity is defined as the ability to maintain cultural practices, including cultural experiences, diet (traditional and store-bought), land use opportunities, and the intergenerational sharing of knowledge.

In both the Application Case and RFD Case, a loss of cultural continuity would be expected, resulting from a break in the transmission of knowledge tied to those areas around Patterson Lake that would no longer be accessible or may be avoided. Some Indigenous community members may change the location of traditional activities, resulting in the loss of site-specific knowledge. Changes are anticipated to be of low magnitude in the Application Case and of moderate magnitude in the RFD Case. The higher magnitude in the RFD Case would be reflective of two uranium mines and processing plants simultaneously operating adjacent to Patterson Lake.

The level of change in resource use would vary by individual and would depend on the results of mitigations with other land users (e.g., trappers, outfitters) as presented in Section 17.4 and mitigations with Indigenous land and resource users as presented in Section 16.4. Access restrictions are expected to also be addressed by cultural continuity programs supported through the Benefit Agreements. While it is not within the operational control of the Project to minimize the effects of another project on access restrictions, it is assumed that Fission would also incorporate some support for cultural continuity in keeping with good industry practice.

Social Adaptability

For the purposes of the community well-being assessment, social adaptability refers to the ability of the community to cope with and adapt to social changes resulting from the worker rotation system for the Project. Social adaptability includes changes to population demographics, community safety, governance, social cohesion, and community dynamics.

In both the Application Case and RFD Case, negligible to small changes in social adaptability would be expected as individuals and families learn to cope with the changes associated with participation in the worker rotation systems. The assessment of changes in the worker rotation systems could affect participation in volunteerism, individual worker mental health, family/network mental health, and family dynamics. It is important to note that not all workers would experience negative effects. Potential challenges in adjusting to changes in work and home life and shift work, increased stress, and feelings of isolation would depend on the individual and such effects would be expected to concentrate among workers and their families. In the RFD Case, it is anticipated that there would be an incremental increase in the number of workers and families that may experience stress and hardship from participation in the worker rotation systems that would affect social adaptability; however, the effects would be distributed across the RSA.

Mitigation has been designed to provide supports to the individual workers and their families. NexGen would assist family members and the community through commitments such as: implementing provisions of the Benefit Agreements related to culture, traditional values, employment, training, and economic development; providing dedicated space on site for Elders; establishing mentoring programs and recruitment strategies; and implementing human resources policies (e.g., employee and family assistance program) to assist workers with finding information and referral services for family-related resources. It is assumed that the Fission Patterson Lake South Property would have similar support programs for workers and their families.

Demand for Community Infrastructure and Services

For the purposes of the community well-being assessment, demand for community infrastructure and services refers to the ability and capacity of community health and family support infrastructure and services to meet the communities' needs as a result of Project. Potential effects of the Project considered are those related to access restrictions or avoidance of areas near the Project and the worker rotation system.

In the Application Case and RFD Case, there would be a negligible to small increase in demand for social and mental health services in response to stress and challenges primarily associated with effects of the worker rotation systems, with some effects as a result of restricted access and avoidance in the area around Patterson Lake. The increase in demand for infrastructure and services is expected to be distributed throughout communities in the LSA and RSA and not concentrated in any one area. It is reasonable to assume potential workers from the RSA would have FIFO experience in the uranium industry, as well as support networks and access to community services, as these communities have already experienced FIFO workforces for the uranium industry.

NexGen's mitigations for demand for community infrastructure and services would be similar to those for cultural continuity and social adaptability (e.g., employee and family assistance program). While it is not within the operational control of the Project to minimize the effects of another project on community services, it is expected that support in the Benefit Agreements and the Community Vitality Monitoring Partnership Program (CVMPP) would work towards minimizing residual cumulative effects. The CVMPP is a multi-stakeholder group that includes mine operators, health authorities, and the provincial government that completes or commissions research on topics related to quality of life in northern Saskatchewan at a regional scale (Government of Saskatchewan 2020). In northern Saskatchewan, mine operators are mandated to participate in the CVMPP in their Mineral Surface Lease Agreements.

Significance Determination (Section 19.6)

Overall, the weight of evidence from the analysis, including consideration of the literature reviewed, experiences at other uranium operations in northern Saskatchewan, and input from community members in the LSA on what they value in their home communities, suggests that community well-being in the LSA communities would be maintained.

Incremental and cumulative effects resulting from the Project, previous and existing developments, and the Fission Patterson Lake South Property on the community well-being are predicted to be **not significant**.

Prediction Confidence and Uncertainty (Section 19.7)

Overall, there was a medium-high degree of confidence in the predictions related to the community well-being assessment. Uncertainty was primarily and appropriately addressed by making assumptions that conservatively overestimated rather than underestimated potential effects (i.e., a precautionary assessment). In describing beneficial pathways, the precautionary approach was applied by describing the potential magnitude and distribution in a manner that was less likely to overstate potential benefits.

Monitoring, Follow-Up, and Adaptive Management (Section 19.8)

In northern Saskatchewan, mine operators are mandated to participate in the CVMPP in their Mineral Surface Lease Agreements. It is assumed that the Project would be subject to the CVMPP mandate; however, NexGen is committed to working with local Indigenous Groups and communities on community well-being indicators regardless, and to maximize positive outcomes and minimize adverse effects.

NexGen would work with local Indigenous Groups and communities to develop an effective monitoring and communication approach to track community well-being. The monitoring program would be developed to address the well-being indicators including societal and cultural, health, neighbourhood and physical environment, education, and economic well-being.

While NexGen has no jurisdictional authority to monitor the use of services it does not directly provide (e.g., health care and social services in communities), NexGen would work with local authorities on issues related to potential stress on infrastructure and services. It is anticipated that NexGen would track usage of on-site programs related to health and wellness (e.g., Elder counsellors; mentors) and conduct periodic surveys to determine if on-site services and programs are meeting employee needs.

NexGen has committed in the Benefit Agreements with each primary Indigenous Group to establish an Implementation Committee. The Implementation Committee would be tasked with the responsibility of facilitating an effective ongoing working relationship and confirming that all commitments for community well-being made within the Benefit Agreements are met.

Abbreviations and Units of Measure

Abbreviation	Definition
ATV	all-terrain vehicle
BNDN	Birch Narrows Dene Nation
BRDN	Buffalo River Dene Nation
CNSC	Canadian Nuclear Safety Commission
CRDN	Clearwater River Dene Nation
CVMPP	Community Vitality Monitoring Partnership Program
EA	Environmental Assessment
EFAP	employee and family assistance program
EIS	Environmental Impact Statement
ETP	effluent treatment plant
GDI	Gabriel Dumont Institute
IR	Indian Reserve
IKTLU	Indigenous Knowledge and Traditional Land Use
JWG	Joint Working Group
Joint Panel	Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan
KP	key person
LSA	local study area
MLTC	Meadow Lake Tribal Council
MN-S	Métis Nation – Saskatchewan
NCQ	Northern Career Quest Inc.
NexGen	NexGen Energy Ltd.
NLSD	Northern Lights School Division
NR2	Northern Region 2
Project	Rook I Project
RCMP	Royal Canadian Mounted Police
RFD	reasonably foreseeable development
RSA	regional study area
SHA	Saskatchewan Health Authority
STP	sewage treatment plant
TSD	technical support document
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
VC	valued component

Unit	Definition
%	percent
$	Canadian dollars unless otherwise stated
kg	kilogram
km	kilometre
km/h	kilometres per hour
m	metre
mg	milligram
MVkm	million-vehicle-kilometre

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19 COMMUNITY WELL-BEING

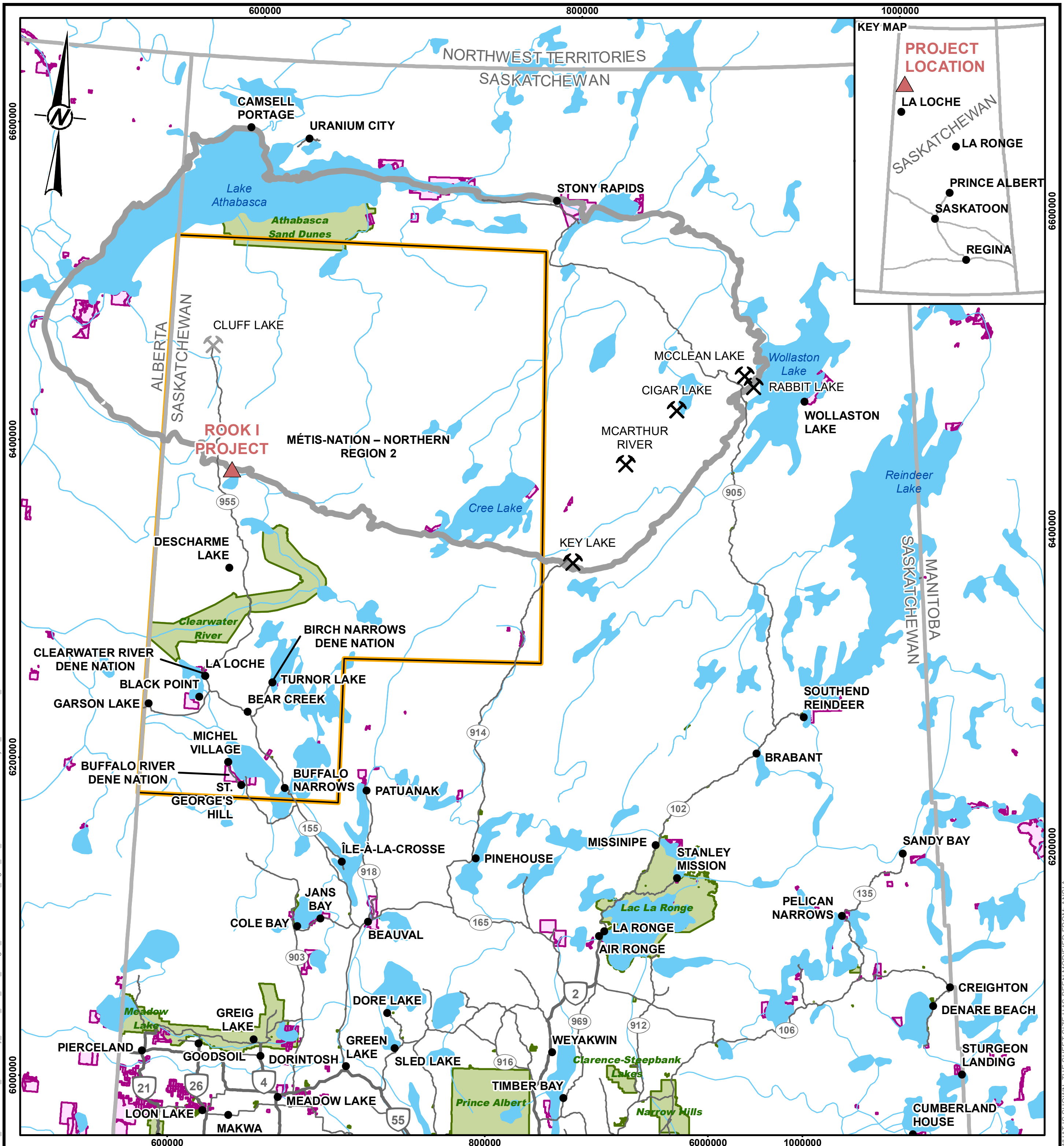
19.1 Introduction

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The Project would be located approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the Northern Village of La Loche, and 640 km northwest of the city of Saskatoon (Figure 19.1-1). The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Patterson Lake is at the interface of the Boreal Shield and Boreal Plain ecozones. Access to the Project would be from an existing road off Highway 955 (Figure 19.1-2), with on-site worker accommodation serviced by fly-in/fly-out access.

Section 19, Community Well-Being, of the Environmental Impact Statement (EIS) characterizes the potential residual effects of the Project on community well-being, which is a valued component (VC) for the Environmental Assessment (EA).

Community well-being can be defined and measured in different ways. This assessment examined several aspects of community well-being to develop an approach based on common, contemporary practice and tailored to the local communities and their potential interactions with the Project. Well-being can broadly be considered to be “the combination of social, economic, environmental, cultural, and political conditions identified by individuals and their communities as essential for them to flourish and fulfill their potential” (Wiseman and Brasher 2008). Common practice in Canada is to consider the social determinants of health (i.e., the conditions in which people are “born, grow, live, work, and age” [World Health Organization 2022]) as a useful framework for describing community well-being in EA practice. According to the World Health Organization constitution, “health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” (World Health Organization 2020). Consideration was also given to how First Nations and Métis Groups (collectively referred to as Indigenous Groups) local to the proposed Project described their community well-being, which tended to consider mental health and addiction, educational and employment opportunities, and cultural continuity. The Buffalo River Dene Nation (BRDN) noted their term “Spirituality” during a meeting to share their customs, culture, and history. They defined spirituality as mental health and well-being, how you feel, and how you look (BRDN-JWG 2021f); this was an important consideration in determining the key elements that make up community well-being.

Based on these definitions and considerations, the assessment utilized the social determinants of health as a framework for describing community well-being and for evaluating the potential effects of the Project on the community well-being VC. In this regard, well-being is defined for the Project as a combination of elements, with the combined balance of all elements used to determine a beneficial or adverse change in well-being. Figure 19.1-3 outlines the elements considered for the community well-being VC based on the social determinants of health framework, and their applicability to the receiving environment (i.e., the communities in the area of the Project). More information on the details of these community well-being elements is included in Section 19.2.2, Valued Components, Measurement Indicators, and Assessment Endpoints.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN BOUNDARY
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROJECT LOCATION
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

0 100 200
1:3,500,000 KILOMETRES

REFERENCE(S)
1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
LOCATION OF THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 19.1-1

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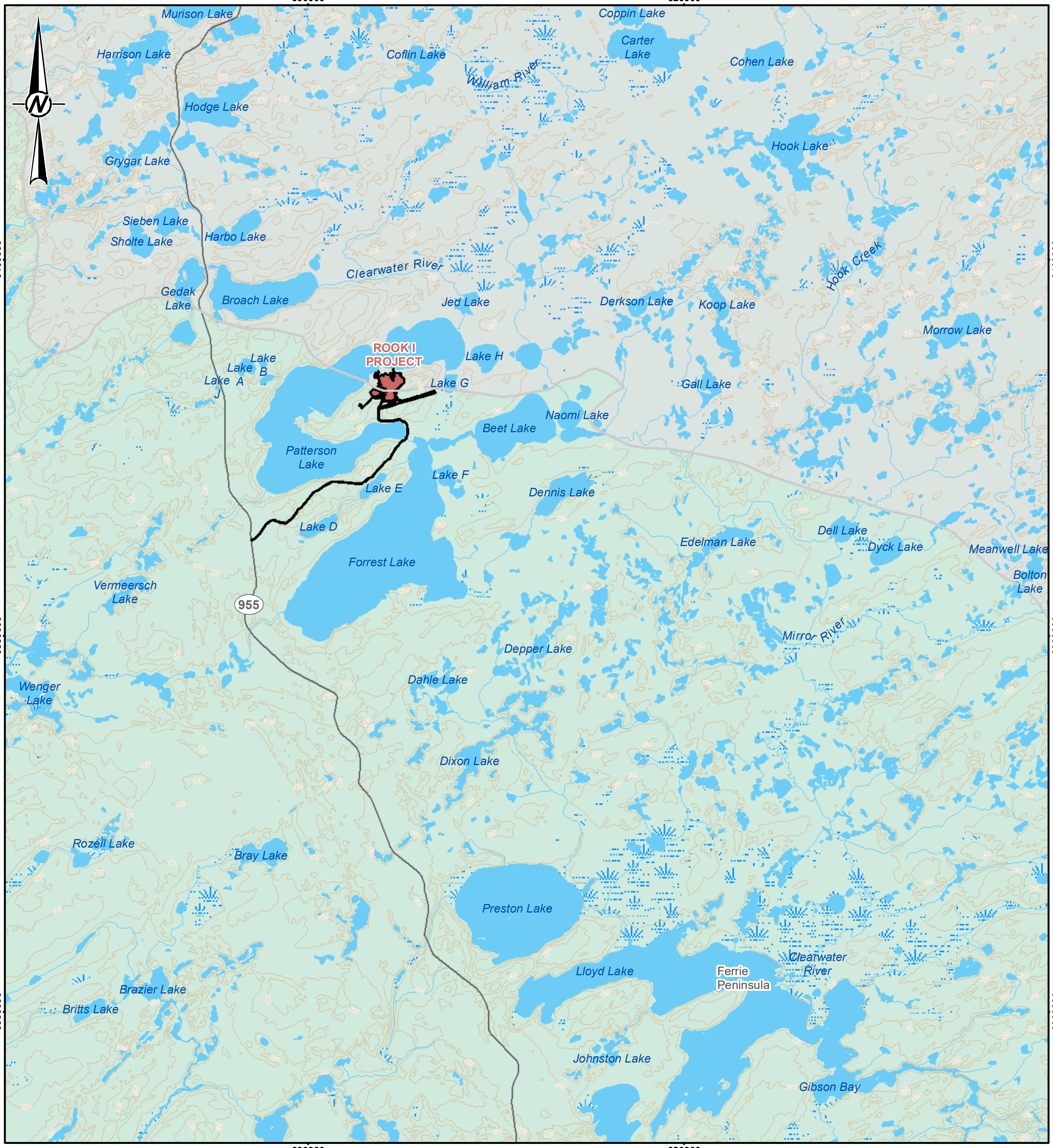

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN
- WATERBODY
- WETLAND
- WOODED AREA
- PROPOSED PROJECT FOOTPRINT

0 5 10

1:300,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 19.1-2

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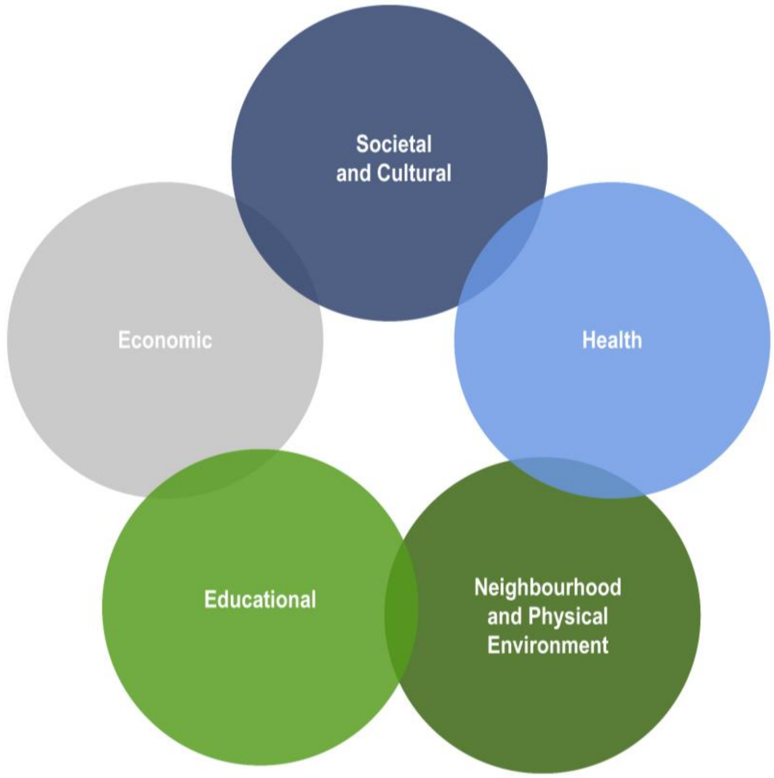
Figure 19.1-3: Community Well-Being Elements

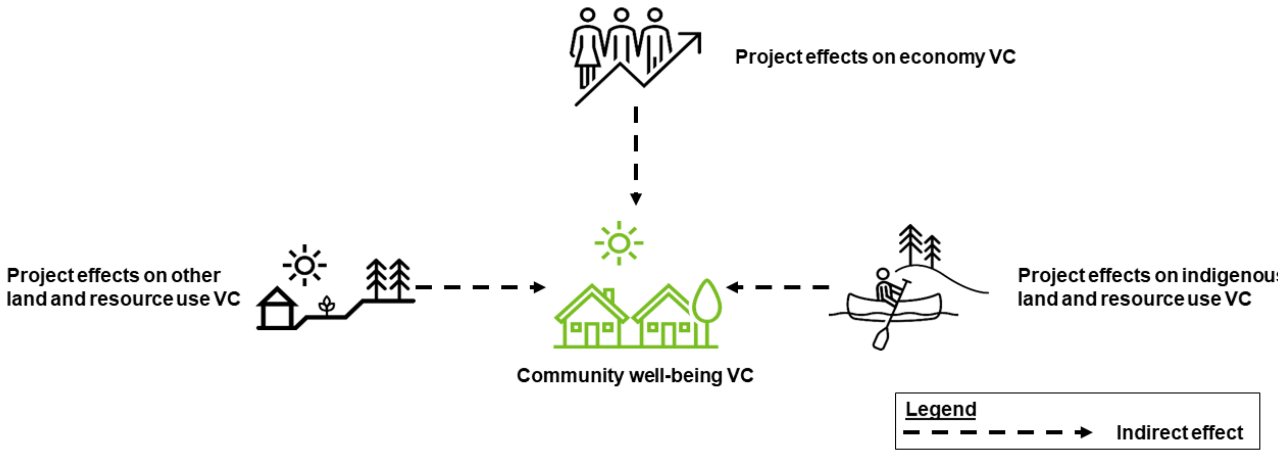


Community well-being is complex, and the multi-faceted interactions among the elements can affect overall well-being. Project effects on community well-being elements can be both positive and adverse; therefore, the likely net outcome is important to understand. As an example, working at the Project would provide socio-economic benefits to individuals, families, and communities but could also affect family and community stability and the transfer of language and culture as workers spend time away from the community and their families.

The assessment of effects on community well-being relies on inputs from Indigenous land and resource use (Section 16), other land and resource use (Section 17), and the economy (Section 18). Results from the assessment of community well-being do not provide inputs to other EIS sections. A simplified linkage diagram, Figure 19.1-4, illustrates how proposed Project activities could result in direct or indirect effects on community well-being. Understanding both the positive beneficial and negative adverse effects of the Project is critical to determining the likely outcome for the community well-being VC.

To understand the potential effects of the Project on the community well-being VC, a detailed assessment considering the interconnectivity of well-being elements was conducted. This included consideration of the beneficial and adverse attributes of each potential Project effect, as well as the relationship between each potential effect. The complexity of these interconnectivities and relationships was rationalized through the grouping of common themes, as described in Section 19.2.8, Residual Effects Analysis.

Figure 19.1-4: Linkage Diagram of Project Effects on Community Well-Being



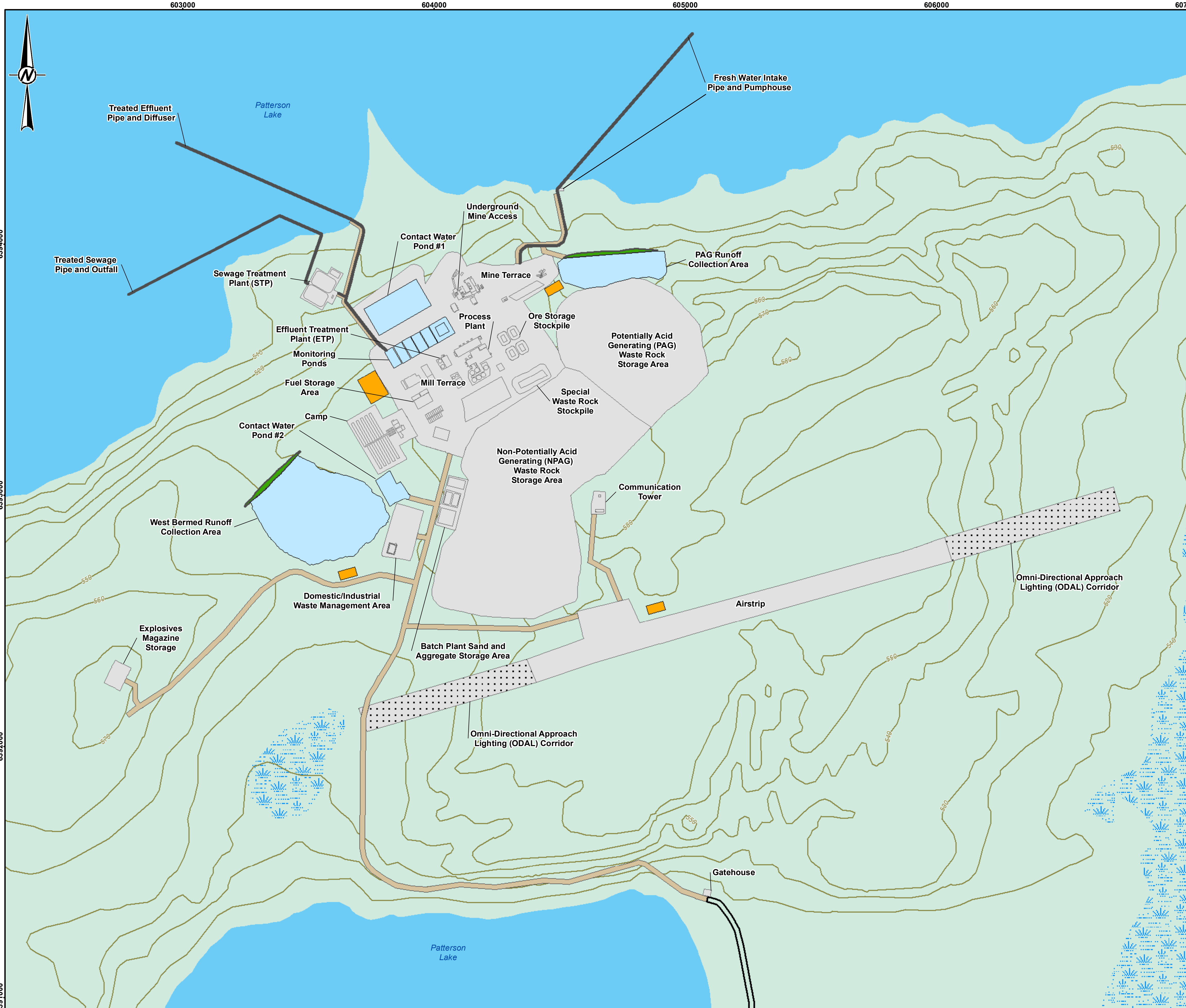
19.1.1 Project Summary

The Project would include the following key facilities to support the extraction and processing of uranium from the Arrow deposit for transportation off site (Figure 19.1-5):

- underground mine development;
- process plant buildings, including uranium concentrate packaging facilities;
- paste tailings distribution system;
- underground tailings management facility;
- potentially acid generating waste rock storage area;
- non-potentially acid generating waste rock storage area;
- special waste rock[2] and ore storage stockpiles;
- surface and underground water management infrastructure, including water management ponds, effluent treatment plant (ETP), and sewage treatment plant (STP);
- conventional waste management facilities and fuel storage facilities;
- ancillary infrastructure, including maintenance shop, warehouse, administration building, and camp;
- airstrip and associated infrastructure; and
- access road to Project and site roads.

Project workers would be housed in on-site worker accommodation serviced by fly-in/fly-out access. Materials and equipment would be transported to and from site via Highway 155 and Highway 955. The site would primarily use liquified natural gas for power generation.

[2] Special waste rock is mine rock that is mineralized with insufficient grade to be considered ore (i.e., greater than 0.03% of triuranium octoxide [U_3O_8] and less than 0.26% U_3O_8). All special waste would be temporarily stored in the special waste rock stockpile.



LEGEND

- ELEVATION CONTOUR (10 m INTERVAL)
- WATERBODY
- WETLAND
- WOODED AREA
- INTAKE OR DISCHARGE PIPE
- ACCESS ROAD
- CONTACT WATER CONTAINMENT BERM
- OMNI-DIRECTIONAL APPROACH LIGHTING (ODAL) CORRIDOR
- PROJECT INFRASTRUCTURE
- SITE ROAD
- TOPSOIL STORAGE AREA
- WATER MANAGEMENT POND

0 0.5 1

1:15,500 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021 AND UPDATED JUNE 8, 2021 .
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LAYOUT OF INFRASTRUCTURE AND FACILITIES FOR THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 19.1-5

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19.1.2 Purpose and Approach to the Assessment

The purpose of Section 19 is to provide a detailed and comprehensive assessment of all potential Project-specific effects and cumulative effects from the Project and other previous, existing, and reasonably foreseeable developments (RFDs), if applicable, on community well-being. This section meets the Terms of Reference for the Project submitted to the Saskatchewan Ministry of Environment and the Canadian Nuclear Safety Commission (CNSC) *Generic Guidelines for the Preparation of an Environmental Impact Statement – Pursuant to the Canadian Environmental Assessment Act, 2012* (Appendix 1A, Concordance Tables). The assessment of community well-being followed the overall EA approach and methods (Section 6, Environmental Assessment Approach and Methods) and includes the following primary steps:

Step 1 – Define component-specific methods (Section 19.2): presents the specific approaches and methods used to measure and assess the effects of the Project on community well-being as well as cumulative effects from the Project, other previous and existing projects and activities, and RFDs, if applicable.

Step 2 – Characterize existing conditions (Section 19.3): describes and characterizes existing conditions to provide context and a basis for evaluating potential changes to community well-being caused by the Project.

Step 3 – Evaluate Project interactions and mitigations (Section 19.4): identifies Project components and/or activities with the potential to affect community well-being (both beneficial and adverse effects) and provides environmental design features and mitigation policies and actions committed to by NexGen to avoid or minimize potential adverse effects and sustainably enhance beneficial effects. A pathways analysis was used to focus further assessment on key interactions between the Project and community well-being by evaluating the different effects pathways to determine if, after incorporation of mitigation, there is still potential to cause residual adverse effects. Primary pathways anticipated to result in residual adverse effects after incorporation of mitigation are carried forward to Step 4 for further analysis. Where potential adverse effects are adequately mitigated and thus not forwarded for further analysis (i.e., where mitigation results in negligible effects or avoids the pathway altogether), the reasons for concluding the assessment at this stage are provided.

Step 4 – Analyze residual effects (Section 19.5): evaluates and describes the potential Project effects on community well-being that are anticipated to occur through the primary pathways. The residual effects analysis is presented as an integrated narrative that describes the effects of the Project over time and highlights predicted effects at the point when adverse effects of the Project are expected to be greatest. This step also includes an analysis of residual cumulative effects from the Project, other previous and existing projects and activities, and RFDs. Beneficial effects on community well-being from the Project are identified and described in Section 19.4, Project Interactions and Mitigations, but not further analyzed in Section 19.5, Residual Effects Analysis.

Step 5 – Classify residual effects and determine significance (Section 19.6): summarizes the results of the residual effects analysis using effects criteria (i.e., direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence). Significance was determined using the results of the residual effects analysis and classification. Significance was determined for adverse effects only (i.e., significance was not determined for beneficial effects) and for the maximum adverse effects of the Project and the cumulative effects from the Project, other previous and existing projects and activities, and RFDs.

Step 6 – Describe uncertainty and define prediction confidence (Section 19.7): identifies key uncertainties and explains how these uncertainties have been addressed to achieve a conservative, precautionary assessment. The implications of the approaches used to address uncertainties and the level of confidence in the residual effects analysis are discussed.

Step 7 – Identify monitoring and follow-up (Section 19.8): outlines the proposed actions to verify predicted residual effects. The purpose of these actions is to evaluate effectiveness of planned mitigation designs, policies, and practices, and address key sources of uncertainty.

19.2 Component Methods

19.2.1 Incorporation of Indigenous and Local Knowledge

Indigenous and Local Knowledge included in the assessment of community well-being was shared by potentially affected Indigenous Groups and local priority area (LPA) community members through the Project engagement process. The LPA consists of the local communities closest to the Project that would experience most of the Project effects and for which NexGen would prioritize local training, employment, and business opportunities for the Project. These communities are located along, or accessed via, Highways 155 and 955 north of the intersection of Highways 155 and 925 and include the following communities (Figure 19.1-1):

- Clearwater River Dene Nation (CRDN);
- Clearwater Clear Lake (Métis Nation – Saskatchewan [MN-S] name for Northern Region 2 [NR2]);
- La Loche (Local 39);
- Birch Narrows Dene Nation (BNDN);
- Turnor Lake (Local 40);
- BRDN / Dillon;
- Buffalo Narrows (Local 62);
- Bear Creek (Local 156);
- Descharme Lake;
- Garson Lake;
- Black Point (Local 162);
- Michel Village (Local 65); and
- St. George's Hill (Local 70).

The overall approach and methods for the incorporation of Indigenous and Local Knowledge into the EA is discussed in detail in Section 3, Indigenous and Local Knowledge. Issues and concerns related to community well-being raised by Indigenous Groups and LPA community members, and how these comments were addressed, are summarized in Appendix 2B, Summary of Issues and Concerns Identified by Indigenous Groups, and identified and addressed in this assessment, where applicable.

A key source of Indigenous and Local Knowledge is the Project-specific studies completed by Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, and Indigenous Rights and Knowledge studies (henceforth referred to collectively as Indigenous Knowledge and Traditional Land Use [IKTLU] Studies). The IKTLU Studies that were reviewed and referenced in the EIS as technical support documents (TSDs) are listed below:

- TSD II (BNDN), Birch Narrows Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;

- TSD III (BRDN), Buffalo River Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;
- TSD IV (MN-S), Métis Nation – Saskatchewan Northern Region 2 Traditional Land Use & Diet Study for the NexGen Rook I Project;
- TSD V.1 (CRDN), Preliminary Identification of Issues and Concerns Related to the Proposed NexGen Energy Ltd. Rook I Project in the Patterson Lake Area; A Review; Clearwater River Dene Nation; Traditional Land Use and Occupancy Mapping Interviews; 2010 – 2016;
- TSD V.2 (CRDN), Clearwater River Dene Nation Indigenous Rights and Knowledge Survey Related to the Proposed NexGen Energy Ltd. Rook 1 Project in the Patterson Lake Area; and
- TSD VI (YNLR), Provision of Athabasca Denesųłiné Traditional Knowledge, Land Use and Occupancy Information for the NexGen Rook I Project Environmental Assessment.

The CRDN provided an additional socio-economic and harvest study report and the main themes of this study were considered in Section 19. This study is referenced as:

- TSD V.3 (CRDN), Clearwater River Dene Nation Socio-economic and Harvest Study for NexGen Rook 1 Project.

Another key source of Indigenous and Local Knowledge was information shared by Indigenous Group representatives during Joint Working Group (JWG) meetings. The JWGs represent an agreed-upon primary engagement mechanism as outlined in the Study Agreements signed by each Indigenous Group and NexGen. More details regarding the JWGs can be found in Section 2 and Section 3. There are four JWGs with the Project's primary Indigenous Groups (Section 2.4.1, Identification of Indigenous Groups for Engagement):

- CRDN JWG;
- MN-S JWG representing MN-S NR2;
- BNDN JWG; and
- BRDN JWG.

The leadership of each Indigenous Group selected their JWG participants with consideration of group diversity; where possible, members included Elders, youth, different genders, a range of ages, and land users around Patterson Lake.

In addition to the IKTLU Studies and JWGs, Indigenous and Local Knowledge shared during specific engagement activities undertaken through the EA development process was incorporated into the assessment, where appropriate. These engagement activities included, but were not limited to:

- community information sessions held in four locations in 2019 (NexGen 2019);
- site tours;
- comments from the CRDN (2019a) on the Cluff Lake Mine licence renewal;
- other formal and informal meetings;
- workshops with specific groups (e.g., Fur Block N-19 trapper's workshop); and
- environmental and socio-economic baseline data collection.

Comments submitted by Indigenous Groups on the Project Description (CRDN 2019b; MN-S 2019; YNLRO 2019; ACFN 2019; CNSC 2019) were also reviewed for applicable Indigenous and Local Knowledge.

Indigenous and Local Knowledge related to community well-being was incorporated into the assessment by considering and viewing the information as complementary and influential alongside scientific information. Where possible, knowledge from each potentially affected Indigenous Group or LPA community member was described separately and cited accordingly. Where information is described for multiple potentially affected Indigenous Groups, they are collectively referred to as “Indigenous Groups” throughout the assessment.

Indigenous and Local Knowledge was included in the community well-being assessment in the following ways:

- **Component Methods – VCs:** Indigenous and Local Knowledge was considered in the selection of the VC community well-being and reflects the importance of physical and mental health, social cohesion, cultural continuity, spirituality, and educational and employment opportunities to Indigenous Groups and LPA community members (Section 19.2.2.1, Valued Components).
- **Component Methods – Existing Conditions:** Characterization of existing conditions was informed by Indigenous and Local Knowledge and community perspectives provided by Indigenous Groups and LPA community members through the key person (KP) interview program conducted in all communities and through other engagement activities, including community information sessions, JWG meetings, and workshops with trappers, youth, and women (Section 19.2.6, Existing Conditions).
- **Existing Conditions:** Indigenous and Local Knowledge and community perspectives were shared by Indigenous Groups and LPA community members to characterize existing conditions related to the following topics (Section 19.3, Existing Conditions):
  - community context and cultural continuity, including the maintenance of traditional ways of life and the intergenerational transmission of knowledge;
  - health, including mental health and addictions, and traditional diets;
  - housing, recreation, emergency and protection services, and transportation infrastructure;
  - educational facilities and education levels;
  - employment and community economics; and
  - the well-being of the community.
- **Project Interactions and Mitigation:** Indigenous and Local Knowledge informed the scoping of Project interactions, pathway analyses, and consideration of mitigation measures (Section 19.4). This includes observations and experiences of land users related to the effects from industry, including mining activities, on discipline-specific measurement indicators / effect pathways (Section 19.4).
- **Monitoring, Follow-Up, and Management:** Feedback provided by Indigenous Groups during engagement, including recommendations, was considered in the development of monitoring and follow-up activities (Section 19.8). In addition, NexGen has committed to working with LPA Indigenous Groups and communities on developing and monitoring community well-being indicators to maximize beneficial outcomes for communities and minimize effects where practical and to develop mitigation, management approaches, or sustainable enhancements as applicable.

Specific references to Indigenous and Local Knowledge, and Project comments and concerns related to community well-being raised by Indigenous Groups and LPA community members, are included in the applicable subsections of this assessment.

19.2.2 Valued Components, Measurement Indicators, and Assessment Endpoints

19.2.2.1 Valued Components

Valued components are aspects of the biophysical, cultural, and socio-economic environments that are considered to have scientific, social, cultural, economic, historical, archaeological, or aesthetic importance (Beanlands and Duinker 1983; CNSC 2021). The BNDN and BRDN define VCs as tangible biophysical resources (e.g., particular places and species) and less tangible social, economic, cultural, health, and knowledge-based values (e.g., social cohesion, place names, Indigenous language) (TSD II: BNDN; TSD III: BRDN).

Valued components were selected based on multiple considerations (Section 6.3.1, Valued Components) such as:

- potential for interaction with the Project and degree of interaction, including presence, abundance, and amount of spatial overlap of a VC with the Project;
- sensitivity of a VC to potential Project effects and level of damage or harm that could be realized should an adverse effect occur;
- ecological and socio-economic/cultural value to Indigenous Groups and local communities, government agencies, and the public;
- recent experience with similar projects in Saskatchewan and other jurisdictions in Canada; and
- avoidance of redundancy with other VCs; for example, if two potential VCs represent the same attributes, mitigation actions, and potential effects from the Project, only one was evaluated as part of the assessment.

Selection of the community well-being VC was based on literature reviewed; Indigenous and Local Knowledge and feedback received during previous community engagement sessions for the Project in La Loche, Turnor Lake, Buffalo River, and Buffalo Narrows (Section 2 and Section 3); information provided by IKTLU Studies (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD V.3: CRDN; TSD VI: YNLR); KP interviews with community administration and leadership; JWG meetings (Section 3); and collective team experience.

The measurement indicators for each community well-being element identified in Section 19.1, Introduction, are outlined below.

19.2.2.2 Measurement Indicators

Measurement indicators are used to characterize changes to attributes of the human environment from the Project, other human developments, and natural factors. The changes in measurement indicators are used to predict overall effects on VCs and assessment endpoints (Section 6.3.2, Assessment Endpoints and Measurement Indicators).

As shown in Figure 19.1-4, there are five key elements examined for community well-being. For the purposes of the community well-being assessment, each well-being element has been identified as a measurement indicator. Due to the complexity of assessing community well-being, a suite of supporting indicators were developed to predict changes in each community well-being measurement indicator. Figure 19.2-1 provides a visual depiction of the measurement indicators (bold) and supporting indicator factors as they link to community well-being.

Figure 19.2-1: Community Well-Being Measurement Indictors and Supporting Indicators

To provide additional context, the measurement indicators for community well-being are shown in **bold** below with definitions to define the scope of each measurement indicator. Table 19.2-1 then defines the supporting indicators and the factors considered for each measurement indicator.

- **Societal and cultural well-being**: refers to changes to societal and cultural well-being due to changes in population demographics, cultural continuity, crime and safety, and governance.
- **Health well-being**: refers to changes in community health due to changes in health infrastructure, health services, and overall health of residents in communities.
- **Neighbourhood and physical environment well-being**: refers to changes in physical aspects of communities such as housing availability and recreational and transportation infrastructure, as well as supporting local and regional planning.
- **Educational well-being**: refers to changes in local educational and training opportunities, the prevalence of educational institutions active in communities, and the levels of participation in education and training initiatives and programs.
- **Economic well-being**: refers to changes to Indigenous Groups and communities' local economy through direct (i.e., Project), indirect (i.e., contracting and supplying), and induced (i.e., flow-down effects from increased household income) employment and/or business opportunities. These changes would affect the labour force characteristics, economic opportunities and attainment, and income levels.

Table 19.2-1: Measurement Indicators, Supporting Indicators, and Factors Considered

Measurement Indicator	Supporting Indicator	Factors Considered
Societal and cultural well-being	Demographics	▪ Changes in migration patterns and retention of young adults can result in changes in social cohesion and community dynamics[(a)]
	Culture	▪ Changes in access to culture and cultural experiences can affect how all community members participate in their culture, including the "degree to which one is integrated with one's culture" (FNIGC 2018)
	Crime and safety	▪ Changes in employment, income, and community dynamics can result in changes to crime rates and safety or amplify existing issues (e.g., mental health issues, substance abuse) in communities. Changes in traffic patterns and volume can affect the safety of communities and other road users
	Governance	▪ Changes in population and payments to communities can result in changes to governance processes and approaches
Health well-being	Health infrastructure	▪ Changes in the quality and accessibility of health infrastructure can occur as a result of changes in demand
	Health services	▪ Changes in available health services and demand for health services can affect service delivery
	Overall health	▪ Changes in social cohesion, community dynamics, and education and employment opportunities can result in changes in overall health (i.e., physical and mental health)
Neighbourhood and physical environment well-being	Housing	▪ Changes in housing availability can occur as a result of changes in demand
	Recreation	▪ Changes in the population and in work patterns can result in changes in use or demand for different recreational opportunities and infrastructure; shift work can change opportunities for volunteerism for both workers and workers' partners
	Transportation infrastructure	▪ Changes in traffic patterns and volumes can change road condition quality. Changes in airport infrastructure and use can change access for flights
	Local/regional planning	▪ Changes in the socio-economic conditions and regional opportunities can result in the need for changes to local and regional planning
Educational well-being	Educational opportunities and attainment	▪ Changes to the number and types of educational opportunities (i.e., programs and courses) and educational attainment can occur
	Educational institutions	▪ Changes to the number of educational institutions active in communities can occur based on demand
	Educational participation levels	▪ Changes to levels of participation in education programs by community members can occur
Economic well-being	Labour force characteristics	▪ Changes in the participation rate and employment/unemployment rates can occur
	Economic opportunities and attainment	▪ Changes to employment opportunities and business opportunities, and the number and value of contracts to LPA businesses, can occur
	Income levels	▪ Changes in personal and household income levels due to direct Project employment, indirect employment (i.e., employed in sectors supplying goods and services to the Project), and induced employment (i.e., employed as a result of consumer expenditures generated by direct and indirect employment, such as retail employment changes as a result of differences in local spending)

LPA = local priority area.
a) Community dynamics can be seen as the changes in community structure or composition over time; or how individuals and groups within a community interact.

19.2.2.3 Assessment Endpoints

Assessment endpoints are qualitative expressions that represent the key properties of VCs that should be protected; as such, assessment endpoints incorporate the concept of sustainability and function as significance thresholds (Section 6.3.2). The significance of effects from the Project and other human developments on community well-being was evaluated by linking changes in measurement indicators to the influence on the assessment endpoint of maintenance of local community well-being (Table 19.2-2). The determination of significance for community well-being is partially influenced by the assessments of Indigenous land and resource use (Section 16), other land and resource use (Section 17), and economy (Section 18). Details on the application of maintaining local community well-being as a significance threshold are provided in Section 19.2.9, Residual Effects Classification and Determination of Significance. The compilation and interpretation of the results from analyzing changes in measurement indicators provide lines of evidence that collectively provide a determination of whether the assessment endpoint for community well-being is maintained or achieved (Section 6.3.2).

Table 19.2-2: Valued Component, Rationale, Measurement Indicators, and Assessment Endpoints

VC	Rationale	Measurement Indicators	Assessment Endpoints
Community well-being	Job creation, economic influences, and changes to land use resulting from the Project can change the current balance and structure of communities, families, and cultural values, affecting both individual and community well-being.	▪ Societal and cultural well-being ▪ Health well-being ▪ Neighbourhood and physical environment well-being ▪ Educational well-being ▪ Economic well-being	Maintenance of local community well-being

VC = valued component.

19.2.3 Spatial Boundaries

The local study area (LSA) for the assessment of community well-being is represented by the communities included in the LPA (Section 19.2.1, Incorporation of Indigenous and Local Knowledge).

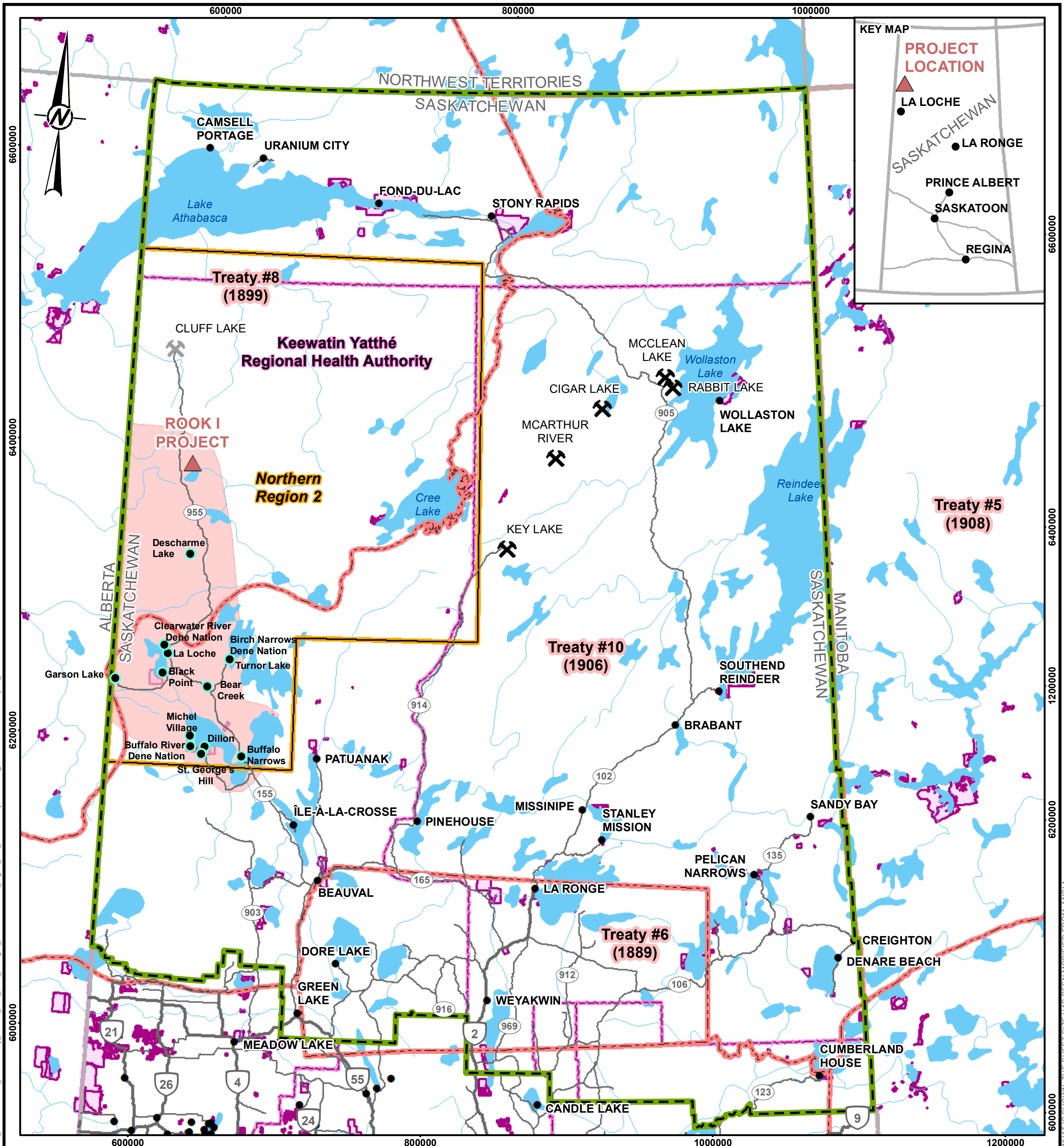
The LPA reflects all primary Indigenous Groups within the LSA, including MN-S NR2, which is represented through several communities. For the purposes of the community well-being assessment, focus was placed on the larger communities in the LSA (i.e., the CRDN, BNDN, and BRDN and the municipalities of La Loche and Buffalo Narrows). These communities were the focus of the assessment due to their population size, the availability of data for these larger communities, and the limited data available for the smaller communities (Section 19.2.6.4.1). These communities also act as service centres for the smaller neighbouring communities. As such, it was reasonable to assume their community well-being is analogous to the well-being of the surrounding population. Further information regarding the communities assessed for community well-being is as follows:

- CRDN:
  - all on-reserve CRDN residents, primarily residing in Clearwater River Dene Band No. 222.
- La Loche:
  - all residents in La Loche, which include primarily Dene and Métis nations; and
  - analogous for Descharme Lake, Black Point, Garson Lake, and Bear Creek.

- BNDN:
  - all on-reserve BNDN residents, primarily residing in Turnor Lake Indian Reserve (IR) 193B; and
  - analogous for Turnor Lake.
- BRDN:
  - all on-reserve BRDN residents, primarily residing in IR 193; and
  - analogous for Dillon, Michel Village, and St. George's Hill.
- Buffalo Narrows:
  - all residents in Buffalo Narrows, which include primarily Cree, Métis, and Dene nations.

The regional study area (RSA) for community well-being is the Northern Saskatchewan Administrative District as defined in *The Northern Municipalities Act, 2010* and has the same boundaries as Statistics Canada Census Division No. 18 (Figure 19.2-2). The RSA was chosen for the following reasons:

- The proposed Project would be located on Crown Land in the Northern Saskatchewan Administrative District and would require a Mineral Surface Lease Agreement to operate (Government of Saskatchewan 2021a). It is expected the lease would include a range of provisions about land tenure, environmental protection measures, occupational health and safety, and reporting on socio-economic benefits for all residents of the Northern Saskatchewan Administrative District and be based on other Mineral Surface Lease Agreements issued by the government for uranium mines in Northern Saskatchewan (Government of Saskatchewan 2018a). Therefore, communities and Indigenous Groups in the broader RSA are also expected to experience some employment, income, and training benefits from the Project.
- The Northern Saskatchewan Administrative District is used by the provincial government and Saskatchewan Health Authority (SHA) for the delivery of services that are intended to manage aspects of community well-being.
- The Northern Saskatchewan Administrative District is the focus of the Community Vitality Monitoring Partnership Program (CVMPP) Steering Committee, the entity initiated as an outcome of the Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan (Joint Panel) in 1998, which expects uranium operations to participate in community vitality monitoring as a part of their respective surface lease agreements (CVMPP 2013; Government of Saskatchewan 2018a).



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- WATERBODY
- PROJECT LOCATION
- COMMUNITY WELL-BEING LOCAL STUDY AREA COMMUNITIES
- COMMUNITY WELL-BEING REGIONAL STUDY AREA
- FIRST NATION TREATY BOUNDARIES
- HEALTH REGIONS
- LOCAL PRIORITY AREA
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

REFERENCE(S)
1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
COMMUNITY WELL-BEING
LOCAL AND REGIONAL STUDY AREAS

CONSULTANT
wsp

PROJECT		20144150	PHASE 3314 - 6
DESIGN	GE	2023-02-10	SCALE AS SHOWN REV. 0
GIS	NO	2023-02-10	FIGURE 19.2-2
CHECK	AT	2023-02-10	
REVIEW	KG	2023-02-10	

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19.2.4 Temporal Boundaries

The temporal scope of the assessment focuses on the 43-year period from initial Construction to the end of Decommissioning and Reclamation (i.e., Closure) as defined by the following Project phases (Section 6.4.2, Temporal Boundaries):

- **Construction Phase (Construction):** includes site preparation; mine, process plant, and additional infrastructure development; transportation of people and materials to and from the Project; and all activities associated with commissioning the Project up until Operations commences. The duration of Construction is expected to be four years.
- **Operations Phase (Operations):** includes all activities associated with mining and processing ore; tailings management; management of waste rock, domestic waste, and hazardous materials; water management; release of treated effluent; site maintenance; progressive reclamation; and transportation of staff and materials to and from the Project up until Decommissioning and Reclamation commences. The duration of Operations is expected to be 24 years.
- **Decommissioning and Reclamation Phase (Closure):** includes two stages expected to occur over 15 years:
  - **Active Closure Stage:** includes active decommissioning and reclamation activities that occur post-Operations, such as backfilling mine workings, removal of physical infrastructure, recontouring and revegetating disturbed areas, waste disposal and removal, and any other activities required to achieve decommissioning objectives and return the site to a safe and stable condition prior to the Transitional Monitoring Stage. The duration of the Active Closure Stage is expected to be five years.
  - **Transitional Monitoring Stage:** includes monitoring and reporting activities that occur post-Active Closure that would continue until monitoring and reporting verifies that the performance criteria have been met. Once performance criteria have been fully demonstrated, an application to be released from the CNSC licence would be submitted to the CNSC for approval. Once that is achieved, and upon Provincial approval, the land would be transferred under Provincial management through the Institutional Control Program. The duration of the Transitional Monitoring Stage is nominally 10 years; however, NexGen acknowledges this duration would be dependent on the achievement of performance criteria.

19.2.5 Assessment Cases

The concept of assessment cases was applied to the community well-being assessment to estimate the incremental and cumulative effects from the Project and other developments (Section 6.5, Assessment Cases). The approach incorporated temporal boundaries for analyzing the potential effects from previous, existing, and approved projects and RFDs before, during, and after the anticipated lifespan of the Project. There are no known approved (but not yet constructed) projects in the LSA and RSA for community well-being. Assessment cases for the Project included a Base Case, Application Case, and RFD Case.

Base Case for community well-being is represented by existing conditions. The Base Case describes the existing conditions for community well-being in the LSA before application of the Project to provide an understanding of the current conditions that may be influenced by the Project. The temporal boundary of the Base Case includes the combined effects from previous and existing human developments and policies on the social and cultural environment, which influence community well-being. As such, existing conditions represent the cumulative effects of historical and current human developments, activities, policies, and unpredictable factors (e.g., global pandemics) that have influenced the observed condition and patterns of community well-being (CEA Agency 2018).

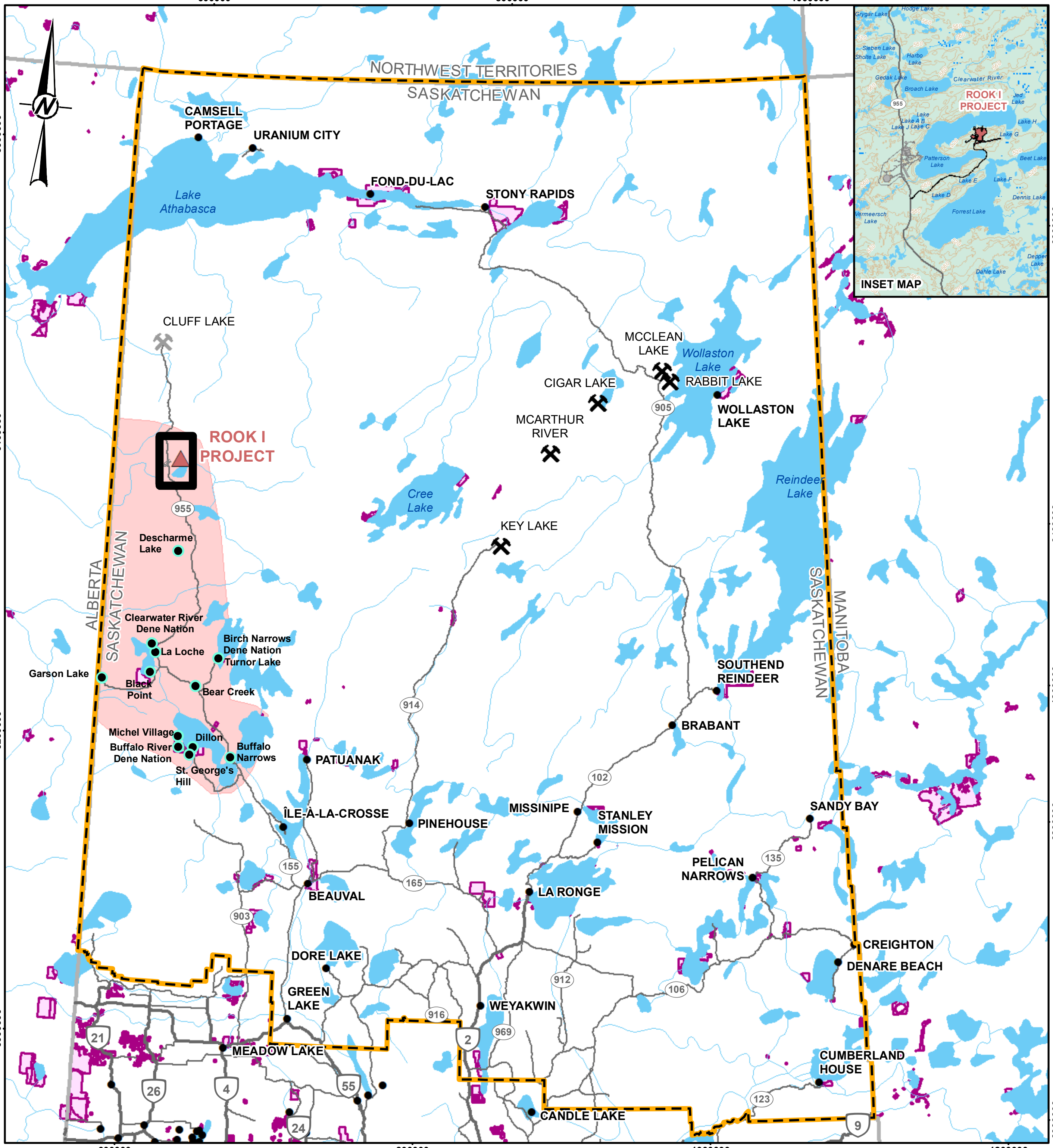
Application Case for community well-being represents predictions of the combined effects of the previous and existing projects/activities and natural factors in the Base Case plus the potential effects from the proposed Project. This case was also used to identify and assess incremental, Project-specific changes that are predicted to occur to community well-being.

Reasonably Foreseeable Development Case for community well-being includes the Base Case, Application Case, and RFDs that have not yet been approved. Reasonably foreseeable developments are defined as projects and activities that fit any of the first three and both of the last two criteria from the list below:

- are currently under regulatory review or have officially entered a formal regulatory application process;
- have been publicly disclosed by other proponents;
- may be induced by the Project;
- have the potential to change the Project or the effects predictions; and
- occur in the spatial assessment boundary defined by the community well-being VC.

A key criterion for selecting other projects to include in the RFD Case was that the projects must cause similar effects on the community well-being VC influenced by the Project (Hegmann et al. 1999). The Fission Patterson Lake South Property, which is planned by Fission Uranium Corp. (Fission 2019, 2021a), was included in the RFD Case (Figure 19.2-3). The CRDN specifically mentioned concerns regarding cumulative effects from the Project and the nearby proposed Fission Patterson Lake South Property (CRDN 2019a; TSD V.3: CRDN). Public information describes a projected three-year construction period and seven-year operating period (production and processing) (Fission 2019, 2021a). The anticipated start of construction and duration of active decommissioning at the Fission Patterson Lake South Property were not publicly available at the time this assessment was completed. For the assessment, it was assumed that the duration of active decommissioning for the Fission Patterson Lake South Property would be similar to the Active Closure Stage for the Project (i.e., five years) and time for transitional monitoring would also be similar to the Transitional Monitoring Stage for the Project (i.e., 10 years) (Section 6.5.3, Reasonably Foreseeable Development Case). In other words, the time required for closure of the Fission Patterson Lake South Property was assumed to be the same as that of Closure for the Project (i.e., 15 years) (Section 19.2.4, Temporal Boundaries).

The assessment includes a qualitative analysis of predicted changes on measurement indicators and associated effects from the Fission Patterson Lake South Property on community well-being.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- WATERBODY
- PROJECT LOCATION
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- COMMUNITY WELL-BEING LOCAL STUDY AREA COMMUNITIES
- COMMUNITY WELL-BEING REGIONAL STUDY AREA
- LOCAL PRIORITY AREA

0 100 200

1:3,800,000 KILOMETRES

REFERENCE(S)

1. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
3. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

REASONABLY FORESEEABLE DEVELOPMENT IN THE REGIONAL STUDY AREA

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	GE	2023-02-10	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-10	FIGURE 19.2-3	
CHECK	AT	2023-02-10		
REVIEW	KG	2023-02-10		

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\19_Community_Health_and_Well_Being\8_5x11\20144150_Fig19_2-3_Community-WellBeing-RSA-LSA-RookI-Project_RFD_Rev0.mxd PRINTED ON: 2023-02-10 AT: 7:48:23 AM

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25mm

19.2.6 Existing Conditions

Existing conditions were characterized to provide context for the assessment of incremental and cumulative effects from the proposed Project and other developments in the LSA and RSA. The characterization of the existing environment reflects primary and secondary data sources, including secondary literature (e.g., statistical sources, government reports, academic reports); a KP interview program conducted for all Project communities; and Project engagement. The approach to documenting the existing socio-economic environment was designed to confirm that sufficient information was collected to understand current conditions. This process involved reviewing regulatory guidance documents; previous EAs, particularly for other uranium mining projects in Saskatchewan; reports from the CVMPP (established to monitor the socio-economic effects of the uranium mining industry in northern Saskatchewan); and information provided by LSA residents through a variety of mechanisms. All of these were considered to support a robust understanding of potential effects of the Project on the community well-being VC.

Data collection began with a review of existing literature and databases from a variety of public sources, and included both quantitative and qualitative data, where available. Primary data collection was undertaken to supplement available secondary data and gain community-based perspectives. Primary data collection took place in the form of KP interviews, which is standard practice for socio-economic baselines and effects assessments. Joint Working Group discussions, IKTLU Studies, and workshops also assisted in identifying existing conditions and related community interests and concerns. Joint Working Groups, specifically, provided an opportunity for Indigenous Groups to discuss topics of their choice related to the Project, and information shared from these meetings pertinent to potential community and well-being VCs was incorporated into this assessment, where appropriate. For the Project, these interviews took place with individuals from the LSA. This program was supported through engagement activities, including a regional youth workshop with high school students, and the JWG processes. A JWG session in 2020 was specifically developed to discuss community definitions of well-being, the factors that both contribute to and detract from well-being, and how participants felt the proposed Project might interact with these factors. The above sources of information provided an understanding of existing conditions for all measurement indicators (Table 19.2-1). Additional information on the existing conditions for community well-being are provided in the Annex X, Socio-economic Baseline Report.

19.2.6.1 Literature Review

The review of literature and databases included the following sources:

- statistical data sources (e.g., Statistics Canada, Crown-Indigenous Relations and Northern Affairs Canada, SHA);
- federal, provincial, municipal, and Indigenous government reports and data;
- community plans (i.e., Official Community Plans and the BNDN Comprehensive Community Plan[3]);
- academic literature on community well-being definitions and indices for measuring well-being; and
- online sources (e.g., community and organization websites).

[3] Name for the BNDN Community Plan.

The most recently available data from these sources were used to characterize existing conditions. Secondary data provide the backbone for the description of existing conditions and helped guide primary data collection, which allowed for a deeper understanding of existing conditions by supplementing and enhancing the available secondary data. Where possible, multiple datasets were used to validate/triangulate data and increase confidence. To the extent practical, the JWGs were also used to confirm data and assumptions from literature reviews.

19.2.6.2 Key Person Interview Program

A KP interview program was undertaken to confirm trends observed in quantitative data, supplement and augment data that could not be readily filled by secondary sources, and provide context and perspectives on community interests and concerns. Interview guides were developed to address information needs and acquire local context. Topics covered during KP interviews included health, education, economic development, social services, crime and safety, and community well-being.

The CRDN indicated a desire to undertake KP interviews for their community independently; as a result, NexGen provided the CRDN the KP interview guide and directions for interviewers. The CRDN subsequently provided the Clearwater River Dene Nation Socio-economic and Harvest Study for the Rook 1 Project, which contained information from the KP interviews completed by the CRDN (TSD V.3: CRDN). Following receipt, this information was considered in the EA. Where information presented in Section 19 is based on information provided in KP interviews, it is cited as “2019 to 2021 KP interview program” or “TSD V.3: CRDN” for CRDN-conducted KP interviews, as applicable.

Research was completed in conjunction with primary information gathering activities for the other land and resource use (Section 17) and economy (Section 18) baselines due to their interconnectivity with community well-being. This process also allowed the opportunity to maximize efficiencies in the KP interview process and limit engagement fatigue with Indigenous Groups, communities, services providers, and other key persons. Key person interviews were conducted between October 2019 to July 2021 for all communities except the CRDN, who conducted their own KP interviews at the end of 2021. Not including the CRDN KP interviews, a total of 78 interviews were conducted by the Project team with community members including business owners, school principals and staff, housing clerks, health care directors, band councillors, women with knowledge of and experience with mine worker rotation systems, and the Royal Canadian Mounted Police (RCMP).

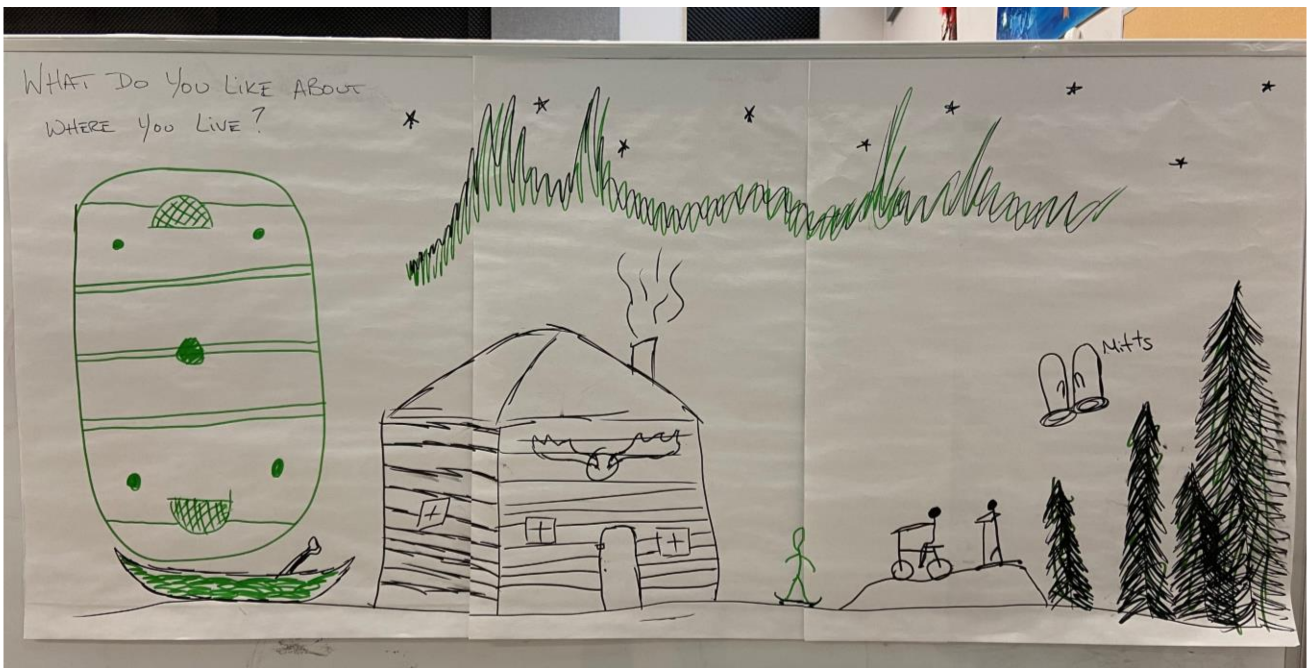
Interviews were conducted with the consent of individual interview participants and community leadership. Community Coordinators were hired and trained to assist in identifying participants in the KP interview program. Interviews were conducted in La Loche (20 interviews), BNDN / Turnor Lake (9 interviews), BRDN (21 interviews), Buffalo Narrows (24 interviews), and other northern hamlets and villages (3 interviews) in the LSA, as well as with the Meadow Lake Tribal Council (MLTC; 1 interview), which provides services locally.

19.2.6.3 Engagement

Indigenous and Local Knowledge was incorporated into the description of the existing environment as described in Section 19.2.1. Engagement input was used as a data source for the assessment of Project effects on the community well-being VC. Engagement included community information sessions, JWG meetings, a regional youth workshop with high school students held in La Loche (cited in this EIS section as “2020 youth workshop”), (Section 2.6.3.1.3, Summary of Youth Workshop), and a trappers workshop (Section 2.6.3.1.5, Summary of Trappers Workshop). Interviews were also conducted with women identified by each Indigenous Group who had direct or indirect (i.e., a family member) experience with participation in mining employment (Section 2.6.3.1.2, Summary of Key Person Interview Research Program). Section 2 provides a description of the engagement program and summaries of engagement. Part of the youth workshop included a focused discussion on youth perspectives on community well-being (Figure 19.2-4). Joint Working Group sessions also included dialogue on topics associated with community well-being. The sessions included discussion of the factors that improve or detract from the quality of life, which provided a foundation for how community well-being was understood and defined in this section, along with other associated topics such as land and resource use and its linkages to cultural continuity; education, training, and employment; and the role of the traditional economy (Section 18.3.6.1, Traditional Economy Participation and Income).

Information from the community information sessions, youth workshop, and JWG process was reviewed and categorized for consideration and inclusion in the existing conditions (Section 19.3) to provide community perspectives and validate and augment information gathered through secondary data collection. Figure 19.2-4 shows an example of how various methods were used to collect information at different events. This example is an illustration from one of the youth workshops highlighting what participants like about where they live. This type of exercise helped identify what community members value in their communities, which in turn informed the assessment of community well-being.

Figure 19.2-4: Illustration from Youth Workshop – What Do You Like about Where You Live?



19.2.6.4 Data Limitations

19.2.6.4.1 Limitations of Secondary Data

As a key source of quantitative (e.g., secondary) data, Statistics Canada data contribute to developing an understanding of socio-economic conditions and how they have changed over time. Data was interpreted with caution due to comparability issues across years, confidentiality, and data quality. Information was reviewed for a number of indicators from the Census of Canada over time. In 2011, there was a change in how the census was administered, with a National Household Survey replacing the previous long-form census. One of the key differences was a change from a mandatory to an optional response requirement. In JWG discussions, some individuals noted that Statistics Canada data were not always representative of their communities, due in part to low participation in census surveys; however, the Statistics Canada economic data did seem to accurately represent the community (BRDN-JWG 2021e). Statistics Canada has processes to address low participation rates and would limit the data it believed not to be an accurate representation, either by not releasing the data or releasing it with strong disclaimers noting the lack of confidence in the accuracy of the information or the limitations in use of the data. No such disclaimers were attached to the Statistics Canada data profiles for the LSA communities.

The most recent census data available are from the 2016 Statistics Canada Census. Where more updated data were not available, this report endeavours to qualitatively capture current conditions using historical data as a framing tool to identify trends. Information drawn from the 2016 Statistics Canada Census Aboriginal Community Profiles is understood to potentially be dated and not reflective of current community social and economic conditions. Changes in the local, regional, and national economy arising from the COVID-19 pandemic are not captured in the 2016 census data.

Statistics Canada also suppresses data for confidentiality or data quality reasons (Statistics Canada 2017a):

- **Data suppression for confidentiality reasons** is meant to prevent the disclosure of data that could be used to identify individuals. Data suppression is often used for income characteristics in geographic areas with small populations or numbers of private households.
- **Data suppression due to data quality** is done for a variety of reasons, including incompletely enumerated reserve parcels or IR settlements or a global non-response rate of equal to or higher than 50%.

Census data for a number of indicators were not available for small communities in the LSA such as Bear Creek, Black Point, Descharme Lake, Garson Lake, Turnor Lake, St. George's Hill, and Michel Village. As such, existing conditions for community well-being in these communities was considered to be analogous to the community well-being of the larger communities and Indigenous Groups. Data presented for some indicators (e.g., housing) have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5, and in some cases, 10. Totals in tables therefore may not equal the sum of values among rows due to rounding. A data note is included with each table affected by the rounding convention.

Other datasets used in the assessment have similar limitations related to survey methods. These limitations are noted throughout the assessment subsections, where applicable. Other literature, while relevant to examining topics in greater detail, and often in the context of northern Saskatchewan, may not be solely specific to the LSA community context. In many instances, it was not possible to isolate the LSA communities individually or collectively from the broader scope of the literature. To address these limitations, key trends or findings were confirmed where possible through KP interviews, through triangulation of multiple sources, and in discussion with the JWGs.

19.2.6.4.2 Limitations of Primary Data

The data collected from KP interviews may not be representative of the perspectives of all community members. Key persons were selected by the communities based on their knowledge and experience that could be relevant to characterizing the socio-economic baseline of the community, and is consistent with industry good practice. Data presented from the KP interviews are based on the interviewed community members' knowledge and experience and on their willingness to participate and share data openly. Collaboration was sought with LSA

Indigenous Groups to assist in identifying KP interviewees. As a result, some participants in the KP interview program were identified with the assistance of Community Coordinators who live in the communities.

Due to the COVID-19 pandemic and resulting provincial and local government restrictions on travel of non-residents within communities, in-person engagement was not possible for much of 2020 and 2021. Typically, primary data collection involved engagement regarding the overall scope and methods of the socio-economic baseline and impact assessment in support of identification/coverage of key issues/concerns in the study. Digital engagement endeavoured to capture the concerns of primary data collection participants during this time. Without direct, targeted engagement, this process may be less accessible and may have achieved fewer comprehensive results than an in-person engagement.

The demographic data used in this report rely upon publicly available data, primarily from government sources. It is acknowledged that some Indigenous Groups caution against the validity and utility of official census data, which do not accurately or holistically portray economic, social, cultural, and health characteristics of their communities.

The existing conditions section makes best efforts to describe economic, services and infrastructure, and health and well-being conditions as they currently exist in the RSA and LSA, based on available information, and presents some conclusions about historical and future trends to support the assessment of potential effects. The difficulty in projecting economic and social conditions into the future for the LSA communities is partly limited by the baseline data. To address these limitations, key trends or findings were confirmed where possible through KP interviews or other published reports and data.

19.2.6.5 COVID-19 Impacts

The unanticipated onset of the COVID-19 global pandemic in early 2020 resulted in several challenges for NexGen and the LSA Indigenous Groups and communities. For all parties, the onset of the pandemic resulted in an immediate shift in priorities followed by the transition to a new way of engaging. NexGen and LSA Indigenous Groups and communities temporarily postponed engagement activities in April 2020 and focused on overall health and safety. During this time, NexGen and the LSA Indigenous Groups and communities explored opportunities to provide support in the local area, where many people were concerned about the scale and potential for harm to themselves and their communities from the pandemic. This included the following NexGen initiatives in collaboration with Indigenous Groups and LSA communities:

- funded a Community Pandemic Coordinator in conjunction with the CRDN, MN-S Local #39, and La Loche;
- delivered health and safety supplies including masks and hand sanitizer to LSA communities to assist with COVID-19 responses;
- modified the Breakfast Programs so students could still have a healthy breakfast while schools were closed;
- supported food hampers in various LSA communities;
- provided grocery gift cards to LSA communities to assist community members facing challenges during the pandemic;
- organized an online event with a Saskatchewan Roughrider to give a talk to the students of the schools in the LSA about healthy living and mental health during difficult times; and
- seconded site-based local staff to support areas in their communities that required additional resources as a result of the pandemic.

After approximately four months from the onset of the pandemic (i.e., when the initial impacts of the pandemic subsided), NexGen and the LSA Indigenous Groups and communities began to explore opportunities for safe, ongoing engagement. NexGen's primary focus for engagement activities during the COVID-19 pandemic was safely working with LSA Indigenous Groups and communities while not adversely affecting these groups by limiting the availability of individuals who also maintained responsibilities within their communities to help manage pandemic-related issues. As examples, NexGen did not want to bring its non-local staff into the LSA due to concerns about spreading COVID-19, and limited groups travelling from the LSA to Saskatoon for meetings at NexGen offices for the same reason. Instead, NexGen continued to work with LSA Indigenous Groups and communities using agreed upon means of continued engagement to conduct meetings, including online platforms like Zoom and Microsoft Teams. As COVID-19 restrictions began to lift, NexGen and Indigenous Groups occasionally worked together in small groups to respect the shared desire for face-to-face meetings, though digital platforms were still commonly used to protect the health and safety of the participants and the communities. This hybrid approach enabled ongoing Project communications, though at a reduced frequency. For NexGen, this was a change from the preferred enhanced (i.e., frequent, face-to-face) engagement approach intended for the Project. However, in consideration of the challenges provided by the COVID-19 pandemic, the efforts made by the LSA Indigenous Groups and communities to continue engaging through pandemic conditions are commendable and showed their commitment to working together to discuss the Project.

The COVID-19 pandemic affected several aspects of the Project socio-economic baseline program. The pandemic occurred after the initial KP interview program was complete; however, the pandemic did limit the ability of NexGen to conduct follow-up interviews and workshops to augment datasets received through the KP interview program. A women's workshop scheduled for 2020 was postponed due to the pandemic. This workshop was eventually cancelled due to COVID-19-related concerns, and instead a revised telephone interview program was conducted with women identified by the LSA Indigenous Groups as having direct or indirect experience with mining, particularly fly-in/fly-out operations (Section 2.6.3.1.4, Women's Interviews). A workshop for members of the LGBTQ2S+ (lesbian, gay, bisexual, transgender, queer or questioning, and two-spirit plus) community was postponed due to COVID-19, and later cancelled based on the change in participants' willingness to participate, which was respected. A regional service providers' workshop to allow providers to discuss regional challenges and needs was cancelled based on a change in participants' willingness to participate, which was again respected. These workshops, plus a potential men's workshop, which was considered and then not actioned for discussion with communities due to COVID-19, will be discussed with the communities if individuals wish to participate and the content is seen as beneficial to future community well-being.

NexGen conducted community events in 2019 in the communities of CRDN, La Loche, Buffalo Narrows, BNDN, and BRDN. These events introduced the Project to communities, outlined some of the studies and Project employment opportunities, and provided a forum for community feedback and concerns. A subsequent set of community information sessions was planned for 2021; however, due to a resurgence in COVID-19 cases in the LSA, these events were postponed. A key purpose of the 2021 community information sessions was to update the communities on the Project and the various EIS studies and findings. The sessions were also intended to convey the efforts completed to date through the JWGs and help connect community members to the JWG process. These sessions were seen as an opportunity for NexGen to make sure the engagement approach was reaching a broad community audience. NexGen also intended to conduct a perception survey at the session to better understand community concerns with past and present uranium mining operations in Saskatchewan.

In lieu of the ability to conduct in-person engagement, NexGen focused on other means to convey information and receive feedback on the Project. Joint Working Group summaries were created to help communicate information discussed at the JWGs to the communities. In addition, NexGen developed a series of newsletters to better inform community members. The Project website was updated to increase information accessibility on the digital platform. NexGen also opened a La Loche office with a local, full-time staff member to increase community access to the Project. In addition to maintaining a regular presence at the La Loche office, this staff member has also travelled between the various LSA communities to arrange one-on-one and small group meetings to increase Project accessibility to a broader audience.

In summary, engagement challenges encountered during COVID-19 were addressed by exploring alternative engagement approaches in collaboration with local Indigenous Group and community leadership, with focuses on keeping Project information accessible to LSA residents and seeking feedback.

19.2.7 Project Interactions and Mitigations

Interactions (i.e., linkages) between Project components or activities, and the corresponding potential changes to measurement indicators, were identified by a pathway analysis that was then used to inform the residual effects assessment for community well-being (Section 6.7, Pathways Analysis). The first part of the analysis was to identify all potential effects pathways for all phases of the Project (Section 6.7.1, Identification of Project Interactions). Each pathway was initially assumed to have a linkage to potential effects on community well-being.

Potential pathways from Project activities to community well-being were identified using the following:

- review of the Project description (Section 5) and potential effect scoping by the Project development, environmental, and socio-economic teams for the Project;
- input from Indigenous, regulatory, and public engagement (Section 2) and Indigenous and Local Knowledge (Section 3);
- scientific knowledge;
- previous experience with mining projects; and
- consideration of potential effects identified from the Terms of Reference (Section 1, Appendix 1A).

Potential adverse effects of the Project were then identified, and practicable mitigation was applied to avoid, minimize, and/or rehabilitate adverse effects on, and enhance beneficial outcomes for, community well-being (Section 6.7.2, Identification of Mitigation). The mitigation measures applied included mitigations developed as part of the socio-economic management framework (Section 23, Summary of Mitigation, Monitoring and Follow-Up Programs).

Each potential effect pathway was evaluated using proposed mitigation to predict whether the pathway had the potential to cause residual adverse effects (Section 6.7.3, Pathway Screening) or create benefits. A screening-level assessment was applied using Indigenous and Local Knowledge, scientific knowledge, logic, experience with similar developments, and an understanding of the effectiveness of mitigation (i.e., level of certainty that mitigation would work) to assign each pathway to one of the following categories:

- **Beneficial pathway:** The pathway is likely to result in a potential beneficial effect (i.e., positive outcome). Project design features or enhancement measures that may be available to enhance beneficial effects are described. It is important to note that some beneficial pathways can have both beneficial and adverse effects, which are also considered in the determination of and subsequent classification as a beneficial pathway.

- **No pathway:** Analysis reveals that the pathway could be removed (i.e., the adverse effect is avoided) by mitigation so that the Project would result in no measurable socio-economic change relative to existing conditions or guideline values and, therefore, would have no residual effect on community well-being.
- **Secondary pathway:** The pathway could result in a measurable but minor adverse socio-economic change relative to existing conditions or guideline values, but this change would be sufficiently small that it would have a negligible residual effect on community well-being. Therefore, the pathway is not expected to contribute to effects of RFDs to cause a significant effect.
- **Primary pathway:** The pathway is likely to result in an adverse socio-economic change relative to existing conditions or guideline values and could cause a greater than negligible effect on community well-being.

Project interactions determined as being a beneficial pathway, no pathway, or secondary pathway were not carried forward for further assessment (Section 6.7.3). Pathways that could result in changes to community well-being and one or more associated measurement indicator and have the potential to cause a greater than negligible adverse effect on community well-being were carried forward to the residual effects analysis and residual effects classification (Section 19.5).

19.2.8 Residual Effects Analysis

The residual effects analysis measures and describes the adverse effects of the Project on the community well-being VC relative to existing conditions. The residual effects analysis was conducted using the spatial boundaries (Section 19.2.3, Spatial Boundaries) and temporal boundaries (Section 19.2.4) identified for the assessment. Residual effects are described for each of the measurement indicators (Section 19.2.2.2) for the primary pathways identified for the community well-being VC in the LSA and RSA (Section 19.4.4, Primary Pathways). The residual effects analysis was completed for the Application Case and the RFD Case (Section 6.8, Residual Effects Analysis).

For the assessment of primary pathways for community well-being, a holistic approach was undertaken examining several measurement indicators (Section 19.2.2.2) in parallel. The holistic approach was achieved by grouping the socio-economic components of various measurement indicators relevant to the assessment. To focus the analysis, the Project effects were characterized for the primary pathways using the following measurement indicator groupings **(bold)** in consideration of the beneficial and adverse attributes of each:

- Changes to **cultural continuity**, taking into account the assessment of potential Project effects on Indigenous land and resource use (Section 16) identified through the ability to maintain cultural practices, including cultural experiences, diet (Traditional Foods), land use opportunities, and the intergenerational sharing of knowledge. The assessment of changes to cultural continuity mainly incorporate societal and cultural and health well-being measurement indicators.
- Changes to **social adaptability** as identified through the ability of the individual or community to cope with and adapt to social changes resulting from the Project such as population and demographics, income and employment levels, the worker rotation system, and community dynamics. The assessment of changes to social adaptability mainly incorporate societal and cultural, health, neighbourhood and physical environment, educational, and economic well-being measurement indicators.
- Changes to **demand for community infrastructure and services** identified through the ability of community infrastructure and services to meet the communities' needs based on a qualitative comparison of the current availability and capacity of community infrastructure and services that the Project is

anticipated to affect (e.g., health care, social services, recreation facilities and services) and the potential for increased demand from Project effects related to population, income and employment, the worker rotation system, and changes to health because of changes to Indigenous land and resource use. The assessment of changes in demand for community infrastructure and services mainly incorporate health, neighbourhood and physical environment, and educational well-being measurement indicators.

Each of these groupings contain some or all of the measurement indicators and associated supporting indicators described in Section 19.2.2.2. Through this approach, all measurement indicators were considered in the assessment through the pathway analysis (Section 19.4), residual effects analysis (Section 19.5), or both.

19.2.9 Residual Effects Classification and Determination of Significance

The residual effects analysis uses a reasoned narrative to describe anticipated changes to each measurement indicator grouping caused by the proposed Project and the associated effects on the community well-being VC. The residual effects analysis also considers effects from both the Project and RFDs. These narrative descriptions of anticipated effects represent the foundation for the residual effects classification and significance determination. Residual effects are summarized or classified in tabular form using effects criteria, which are intended to provide structure and comparability across VCs and intermediate components assessed for the Project (Section 6.9.1, Residual Effects Classification).

The residual effects classification uses direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence as criteria. The approach to classify each residual effect criterion for the community well-being VC is provided in Table 19.2-3.

While most criteria could be assigned categorical ratings for the community well-being VC, predicted effect sizes were provided in qualitative terms (i.e., narrative) in the residual effects characterization (Table 19.2-3). Similarly, duration was described in specific terms (e.g., months, years, number of generations) for context. Applying a category rating to a criterion such as magnitude might lead to confusion or misinterpretation of the effects assessment, or result in the criterion not being easily categorized in a meaningful way. For example, characterizing magnitude using an ordinal scale (i.e., low, moderate, or high) in a manner meaningful for the community well-being VC is often not appropriate as additional context is required to properly characterize the effects. A small change in one indicator may be considered low magnitude, while a small change in another indicator could be considered high magnitude depending on the existing conditions for each indicator (i.e., state of remaining resilience or tolerance to change). When categorizations of effects criteria are applied, they are supported by a qualitative expression.

Table 19.2-3: Definitions Applied to Effects Criteria Classifications for the Assessment of Community Well-Being

Criterion	Rating	Definition
Direction	Positive	Change in measurement indicator grouping results in net improvement or benefit to community well-being (i.e., positive outcome)
	Neutral	Change in measurement indicator grouping results in net balance to community well-being (i.e., net neutral outcome)
	Negative	Change in measurement indicator grouping results in net degradation to community well-being (i.e., negative outcome)
Magnitude	Qualitative narrative	Change in measurement indicator grouping is described by effect size (e.g., changes to cultural continuity, demand for community infrastructure and services)
	Local	Change in measurement indicator grouping affects the communities in the LSA

Table 19.2-3: Definitions Applied to Effects Criteria Classifications for the Assessment of Community Well-Being

Criterion	Rating	Definition
Geographic extent	Regional	Change in measurement indicator grouping extends beyond the LSA but is confined to the RSA (i.e., the Northern Saskatchewan Administrative District)
	Beyond regional	Change in measurement indicator grouping extends beyond the RSA
Duration	Qualitative narrative or numeric quantification	Change in measurement indicator grouping is described by effect duration (e.g., months, years). Where practical, duration for community well-being is associated with Project phases or described in terms of the number of generations
Reversibility	Reversible	Change in measurement indicator grouping is reversible within a clearly defined time period
	Irreversible	Change in measurement indicator grouping is predicted to influence the component indefinitely
Frequency	Occasional	Change in measurement indicator grouping is expected to occur rarely (e.g., once, a few times)
	Periodic	Change in measurement indicator grouping is expected to occur consistently at regular intervals or associated with temporal events (e.g., at phase transitions for the Project)
	Continuous	Change in measurement indicator grouping is expected to occur all the time
Probability of occurrence	Unlikely	Change in measurement indicator grouping is not expected to occur, but not impossible
	Possible	Change in measurement indicator grouping may occur, but is not likely
	Probable	Change in measurement indicator grouping is likely to occur, but is uncertain
	Certain	Change in measurement indicator grouping would occur

RSA = regional study area; LSA = local study area.

The significance of adverse residual effects on the community well-being VC was evaluated using the assessment endpoints as significance thresholds defined in Section 19.2.2.3, Assessment Endpoints; in general, the determination of significance followed the approach provided in Section 6.9.2, Significance Determination. The classification of residual effects criteria provides the foundation for determining if the threshold for significance (i.e., assessment endpoint) is exceeded. For community well-being, the threshold used for significance was the maintenance of local community well-being.

The understanding of local community well-being is based on the literature review (Section 19.2.6.1), which provided a broad understanding of factors contributing to community well-being, and information from community members in the LSA (Section 19.2.6). The ability of communities to adapt to potential Project-related effects without undermining key values was also considered in the assessment.

Resilience, societal/cultural tolerance or adaptability, and existing conditions provide important social and cultural context for the determination of significance. Existing conditions represent the combined effects of previous and current human activities, legislation, government policies, and natural factors that have shaped the observed condition of the community well-being VC in the LSA and RSA. These conditions were the starting point for assessing the incremental effects of the Project and the cumulative effects of the Project and the Fission Patterson Lake South Property. Overall, a detailed and transparent account of whether the predicted effects of the Project and cumulative effects of previous and existing developments, the Project, and the Fission Patterson Lake Project Property could be significant was conducted. This account was completed by combining residual effects criteria, available data and information collected in the LSA and RSA, and logical reasoning (i.e., a weight of evidence or reasoned narrative approach) to determine significance, which was determined by whether predicted effects would exceed the assessment endpoint of maintenance of local community well-being. The values expressed by the communities in the LSA were also central when considering the determination of significance.

Confidence in the significance prediction was considered for the community well-being VC as part of the reasoned narrative. If uncertainty was high about where a threshold for a significant effect would occur in the range of potential values, and if the effect could be assessed as significant or not significant, a precautionary approach was applied, and the effect was identified as significant.

19.2.10 Prediction Confidence and Uncertainty

The purpose of the assessment is to predict the future conditions for community well-being with the addition of the Project and the Fission Patterson Lake South Property. As with all predictions of future conditions, the predictions made in this assessment embody some degree of uncertainty. The assessment applied a precautionary (i.e., conservative) approach to address uncertainty by identifying the greatest magnitude, duration, and geographic extent of potential adverse effects when a range of possible outcomes were possible. Consequently, uncertainty was addressed in a manner that increased the level of confidence that residual effects were conservatively estimated. The key uncertainties for community well-being and the way they were addressed are presented as part of this assessment (Section 19.7, Prediction Confidence and Uncertainty).

In describing beneficial pathways, the precautionary approach was applied by describing the potential magnitude and distribution of benefits conservatively. This approach increases confidence that benefits are described in a way that is less likely to overstate potential benefits.

19.2.11 Monitoring, Follow-Up, and Adaptive Management

Monitoring programs are proposed to address the uncertainties associated with the effects predictions and to evaluate the performance of mitigation. In general, monitoring is used to verify the effects predictions. Monitoring is also used to identify any unanticipated effects and to support the implementation of adaptive management to limit these effects. Typically, monitoring includes one or both of the following categories that may be applied during the Project lifespan:

- **Regulatory compliance monitoring:** monitoring activities, procedures, and programs undertaken to confirm the implementation of approved design standards, mitigation and conditions of approval, and NexGen commitments (e.g., monitoring local employment and contracting outcomes as may be committed to as part of Mineral Surface Lease Agreements or other agreements).
- **Follow-up monitoring:** programs designed to test the accuracy of effects predictions, reduce or address uncertainties, determine the effectiveness of mitigation, or provide appropriate feedback to operations for modifying or adopting new mitigation designs, policies, and practices (e.g., implementation of adaptive management). Results from these programs can be used to increase the certainty of effect predictions in future EAs.

Where relevant, conceptual monitoring programs would also be proposed to address the uncertainties associated with the effect predictions and mitigation, and upon Project approval, would be included in the Integrated Management System.

Adaptive management measures may also be proposed to address the uncertainties associated with the effects predictions and mitigation. The process for determining when, how, and where to use adaptive management would be described within the Integrated Management System Manual.

Monitoring and management plans can also examine ways to maximize opportunities. NexGen has demonstrated a commitment to working with LSA Indigenous Groups and communities to realize the potential socio-economic benefits the Project would provide. As such, NexGen would develop monitoring plans and policies to aim to achieve these beneficial effects.

19.3 Existing Conditions

The topics discussed in existing conditions and how they are linked to the measurement indicators used within the assessment are provided in Table 19.3-1. The remainder of Section 19.3 provides further context regarding current community well-being as it relates to the measurement indicators and associated indicator groupings, as well as a discussion on LSA community well-being indices.

Table 19.3-1: Measurement Indicators and Topics in Existing Conditions

Measurement Indicators	Topics in Existing Conditions
Societal and cultural well-being	▪ Population and demographics ▪ Community context ▪ Cultural connection ▪ Safety and security ▪ Governance, goals, and plans
Health well-being	▪ Health care facilities and services ▪ Social services ▪ Overall health ▪ Diet
Neighbourhood and physical environment well-being	▪ Housing ▪ Recreation ▪ Emergency services ▪ Road transportation infrastructure ▪ Air transportation infrastructure
Educational well-being	▪ Educational facilities and services ▪ Population educational characteristics
Economic well-being	▪ Labour force characteristics ▪ Employment ▪ Income

19.3.1 Societal and Cultural Well-Being

Community and social adaptability describe the “connection of the contexts within which people live, learn, work and play” (CDC 2021) and can cover a broad range of topics. This subsection describes the social adaptability for the LSA communities in connection to the values and features that community members share; cultural connection and the role it plays in creating community cohesion; and governance, goals, and plans for LSA communities. Together, these topics present a snapshot of each community, the shared experiences of residents, and what they collectively value most about their home communities. The specific social adaptability is important for understanding community well-being because “perceptions of well-being vary according to several factors, including geographic location, economy, language, and culture” (ISC 2019a).

19.3.1.1 Population and Demographics

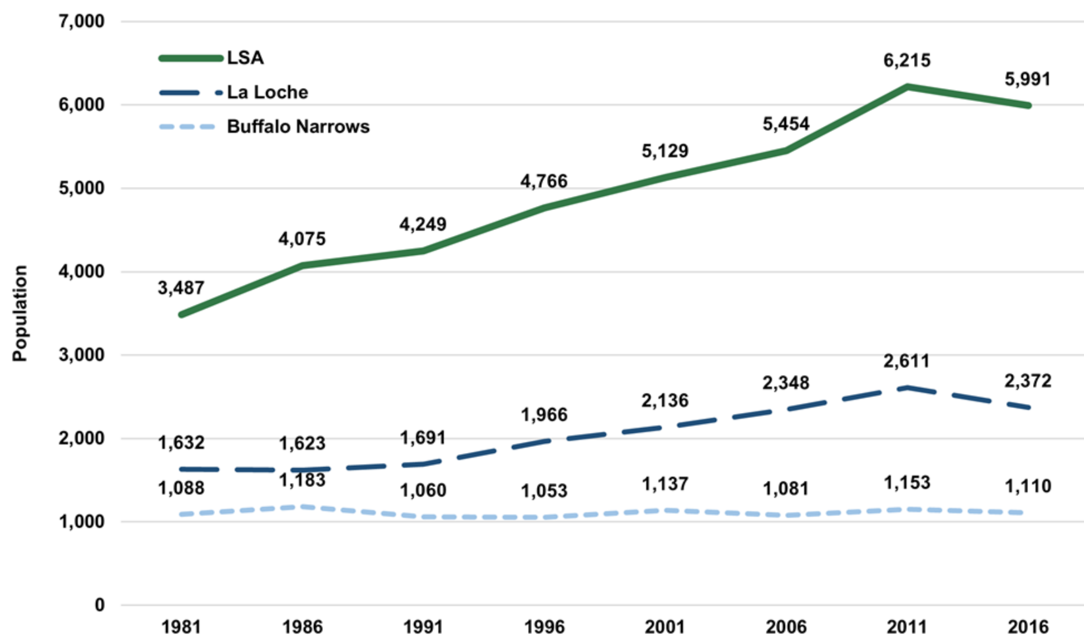
This subsection describes the historical and current populations and demographics in the LSA based on Statistics Canada data. Information from the RSA (i.e., Census Division No. 18, which includes all of northern Saskatchewan) and the Province of Saskatchewan are provided for comparative purposes. It is important to note that population data from Statistics Canada are subject to random rounding (i.e., to 0 or 5) resulting in not all values adding up to totals; thus, estimates provided are approximate values and this should be taken into account in interpreting the data, in particular for small populations. A comprehensive discussion of the population and demographic characteristics of the LSA is provided in the economy assessment (Section 18.3, Existing Conditions) and Appendix 18A, Socio-economic Statistical Data.

19.3.1.1.1 Local Study Area

19.3.1.1.1.1 Population

Figure 19.3-1 shows the population of the LSA from 1981 to 2016 as reported in the Census of Canada for each five-year census period as well as the populations for the largest communities in the LSA (i.e., La Loche and Buffalo Narrows). The data show population increases in the LSA from 1981 to 2011 followed by a small decline in 2016. La Loche's population trend was similar to that of the LSA, though not at the same rate, suggesting population growth also occurred in other LSA communities. Buffalo Narrows' population by contrast has remained fairly stagnant, with only minor variations in population growth and contraction over the same period. In 2016, the LSA population was 5,991. The 2016 populations for communities in the LSA range in size from 2,372 people (i.e., La Loche) to 10 or fewer people (i.e., Descharme Lake and Garson Lake, individually) (Appendix 18A, Table 18A-1b). The LSA population increased from 3,487 people in 1981 to 6,215 in 2011, followed by a decline to 5,991 people in 2016 (Appendix 18A, Table 18A-1b[4]).

Figure 19.3-1: Local Study Area, La Loche and Buffalo Narrows Population, 1981 to 2016

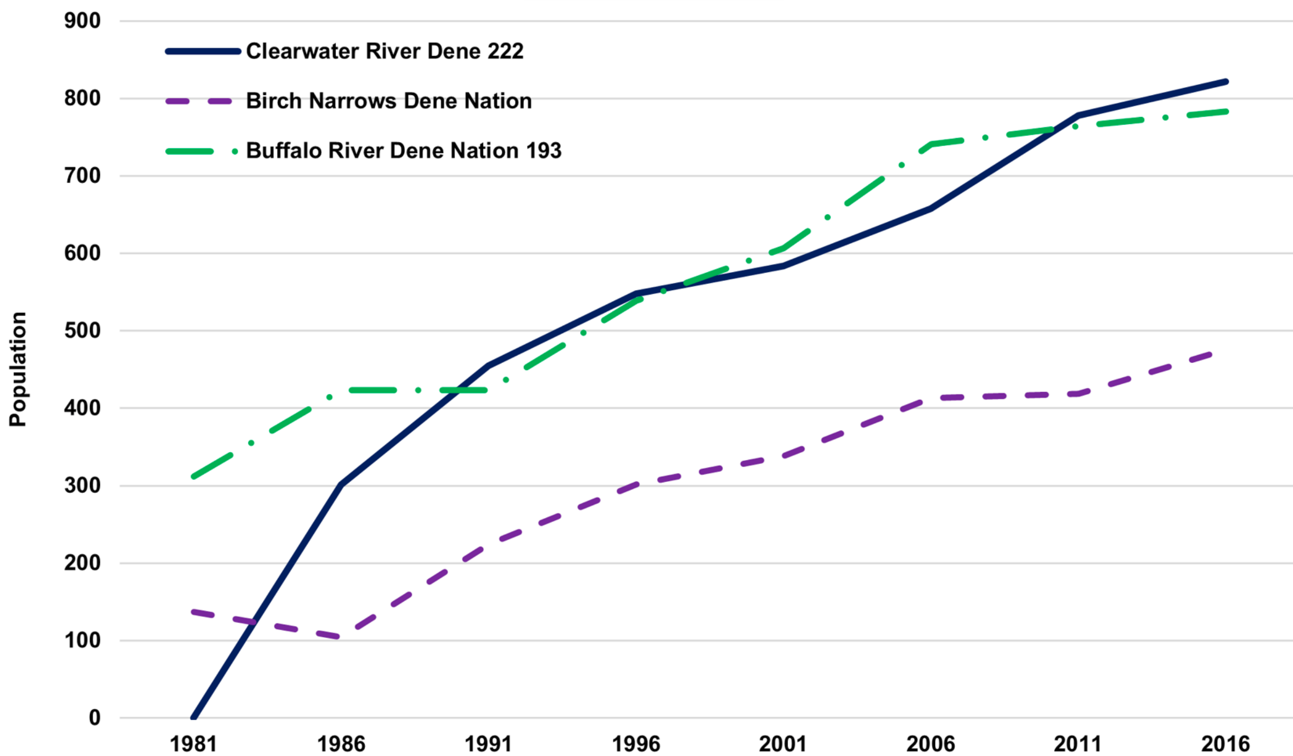


Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.
Note: Population numbers for 2011 and 2016 include four northern settlements (i.e., Bear Creek, Black Point, Descharme Lake, and Garson Lake) for which data were not available in previous Census Profiles.
LSA = local study area.

[4] The LSA includes Bear Creek, BNDN (Turnor Lake IR 193B), Black Point, Buffalo Narrows, BRDN IR 193, Clearwater River Dene IR 222, Descharme Lake, Garson Lake, La Loche, Michel Village, St. George's Hill, and Turnor Lake. However, data were not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake for 1981 to 2006.

Figure 19.3-2 shows the population for the Dene Nation communities in the LSA over the same period. The data show population increases in all three communities (i.e., CRDN, BNDN, and BRDN), which account for the rest of the population growth in the LSA identified in Figure 19.3-1. Effectively, on-reserve population growth constituted the bulk of population growth from 1981, with the remainder largely in La Loche. Further details on the population for each community are provided below, with more comprehensive datasets also available in Appendix 18A.

Figure 19.3-2: Local Study Area Selected Communities Population, 1981 to 2016



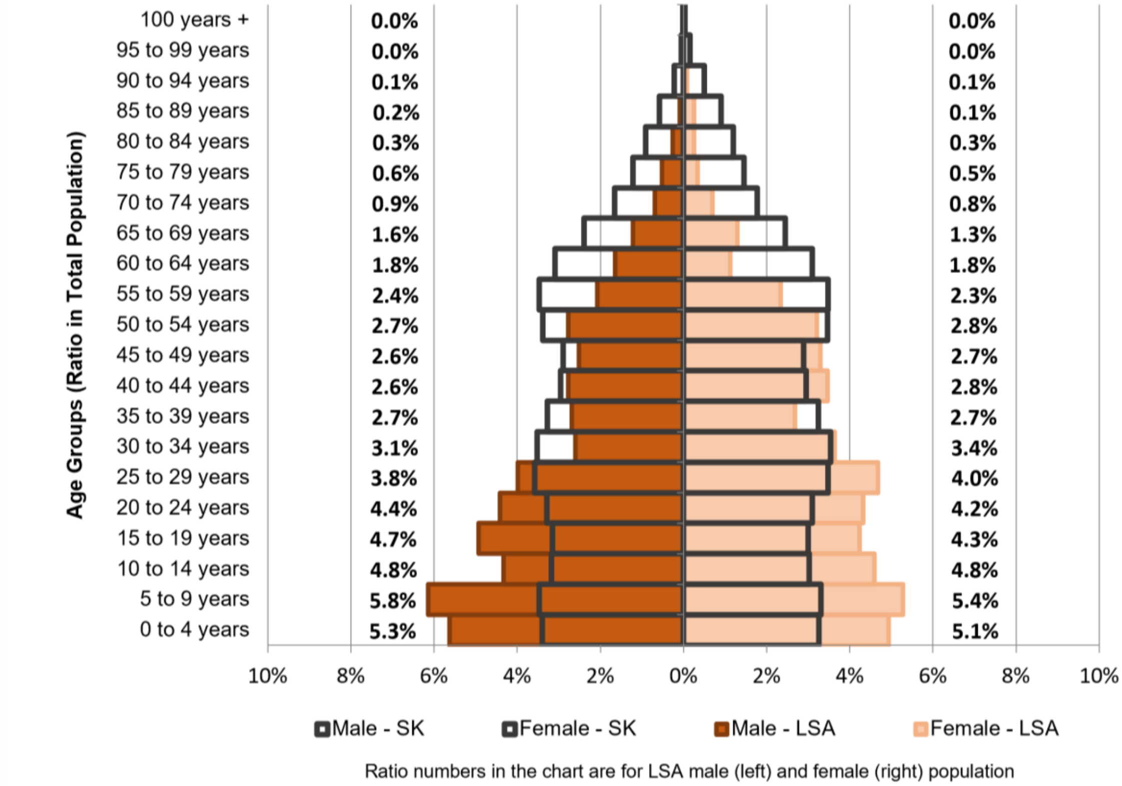
Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.
Average annual percentage population changes calculated by InterGroup Consultants Ltd.
Notes: The figure does not include four northern settlements (i.e., Bear Creek, Black Point, Descharme Lake, and Garson Lake) for which population numbers were available only for 2011 and 2016 were not available in previous Census Profiles.

19.3.1.1.1.2 Age and Gender Distribution

Figure 19.3-3 shows the 2016 population for the LSA and Saskatchewan by sex[5] and age cohort. The age structure of the LSA population in 2016 was younger than the Saskatchewan population (Appendix 18A, Table 18A-5a). Figure 19.3-4 shows the change in the age distribution of the LSA population from 1986 to 2016. The proportion of LSA population 24 years of age or younger steadily decreased between 1986 (i.e., 63.3%) and 2016 (i.e., 48.8%). The proportion of population 45 years or older steadily increased over the same period (i.e., an increase from 13.4% to 25.2%).

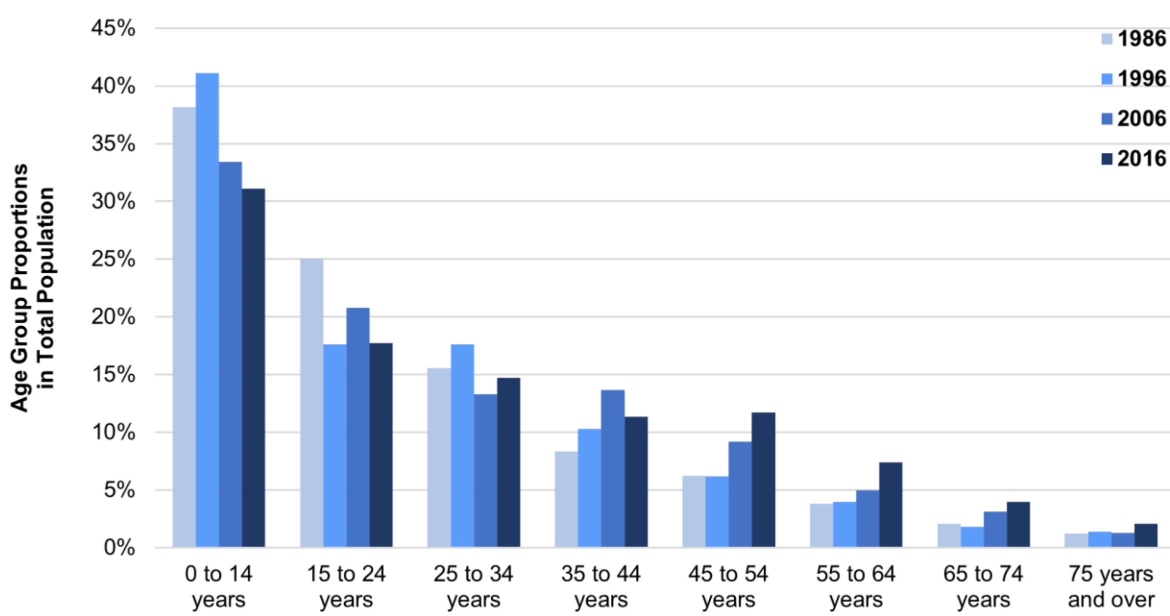
[5] Refers to the sex assigned at birth (Statistics Canada 2022).

Figure 19.3-3: Population Age Structure by Sex for the Local Study Area and Saskatchewan, 2016



SK = Saskatchewan; LSA = local study area.

Figure 19.3-4: Population Distribution by Age Group for the Local Study Area 1986 to 2016



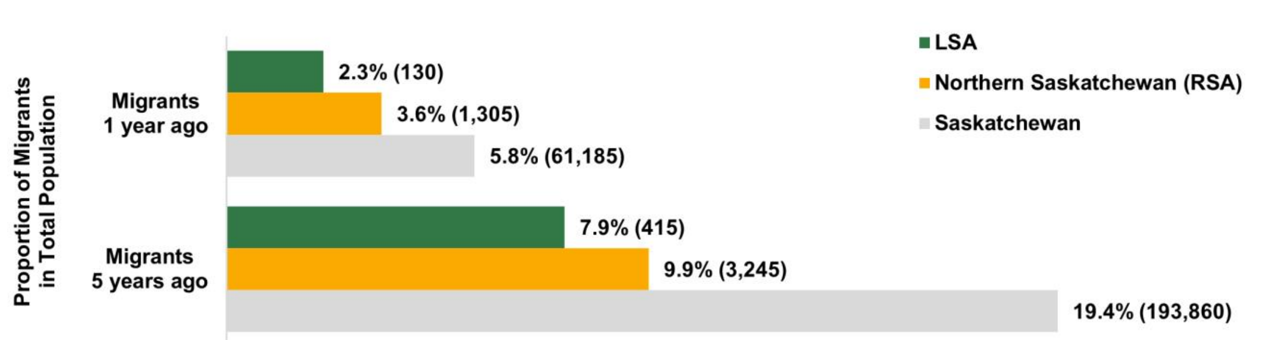
Source: Statistics Canada 1987, 1992, 1997, 2002, 2007, 2012, 2017a.
Note: Data were not available for Bear Creek, Black Point, Descharme Lake, and Garson Lake.

With respect to sex balance in the LSA, females make up a slightly higher proportion (i.e., 51.2%) of the total population than males (48.8%). The populations of the RSA and Saskatchewan are split slightly more evenly between females and males (i.e., 49.7% and 50.3% female portion for the RSA and Saskatchewan, respectively) (Appendix 18A, Table 18A-5a). The age structure of the LSA population in 2016 was similar to the RSA and younger than the Saskatchewan population. Overall, the data reflect the higher proportions of youth and the contraction of young working-aged cohorts, particularly males over 30. The contraction of male cohorts may be attributed to the lack of economic opportunities (Section 18.3.2, Overview of Local Study Area Economy). Correspondingly, the data show higher proportions of working-aged females in the 25- to 34-year-old age cohorts. This aligns with labour force analysis (Section 18.3.4, Labour Force Characteristics), which notes the main industries in the LSA are traditionally female orientated (e.g., service industries). This analysis was corroborated in discussions with the JWGs in August 2021 (BRDN-JWG 2021a; BNDN-JWG 2021b). The data also show the proportion of older age cohorts in the LSA is substantially below the comparable Saskatchewan data, which highlights the challenges of northern rural living on aged residents.

19.3.1.1.1.3 Migration

Population mobility can be a key driver of population changes. For the purposes of this assessment, migrants represent people who relocated to a new census subdivision and include both internal migrants who moved to a different city, town, township, village, or IR within Canada and external migrants who lived outside Canada at an earlier date. Migrants do not include people who moved within the same census subdivision[6] (Statistics Canada 2017b). Figure 19.3-5 shows the proportion of the LSA, RSA, and Saskatchewan population who migrated within the last year (where data were available; i.e., 2016) and the five years previous (i.e., 2011 to 2016). A smaller proportion of the LSA population are migrants within the last year (where data were available) and the five years previous compared to the RSA and Saskatchewan as a whole.

Figure 19.3-5: Proportion of Population Who Were Migrants within Last 1 Year and 5 Years, 2016



Source: Statistics Canada 2017a.
Note: Data were not available for Bear Creek, Descharme Lake, and Garson Lake.
LSA = local study area; RSA = regional study area.

[6] Statistics Canada defines non-migrant movers as those who moved within the same census subdivision. Migrants are defined as those who do not live in the same census subdivision as they did in the last reference period.

19.3.1.1.2 Clearwater River Dene Nation

The CRDN is the third largest LSA community, with a 2016 population of 820 (Appendix 18A, Table 18A-1b). The CRDN is predominantly First Nations (i.e., 95.1%) with some Métis (i.e., 3.7%). Between 2011 and 2016, population growth in CRDN was modest, with a four-year growth rate above the RSA (i.e., 5.1% compared to 1.4%). The CRDN is the LSA community with the highest population growth rate over the past decade to 2016 (i.e., 24.2%) (Annex X, Table 5).

The CRDN is the youngest LSA community, with a median age of 23.8 years (Appendix 18A, Table 18A-5b). Between 2006 and 2016, the median age of CRDN increased slightly (i.e., 21.2 to 23.8 years) but remained lower than the median age of the RSA (i.e., 25.7 years). The proportion of the working age population (i.e., 20 to 64 years old) in the CRDN increased between 2011 and 2016 (i.e., a change from 50.6% to 54.8%) and remains slightly higher than the RSA (i.e., 53.0%). The 4.1% increase in the working age population was the highest among the LSA communities. The CRDN has a lower proportion of the population who are of retirement age compared to the RSA (i.e., 4.3% compared to 6.8%). The proportion of people of retirement age in the CRDN decreased by 0.8% between 2011 and 2016 relative to a 4.1% increase in the proportion of the working age population. The decrease in people of retirement age in the CRDN is contrary to the trend in the RSA over the same period (i.e., 1.4%) (Annex X, Table 5).

The sex ratio in the CRDN population has remained relatively consistent across the 10 years ending in 2016, with slightly more males in the community than females (i.e., 50.6% compared to 50.0%, with rounding error), which is generally consistent with the RSA (i.e., 50.3% compared to 49.7%) (Appendix 18A, Table 18A-5b). Analysis of specific age groups shows higher proportions of males than females in the 0 to 19 years and the 65 years and over age groups, consistent with the RSA. The high male proportion of population in the 0 to 19 age group skews the overall sex ratio in the community.

In 2016, the proportion of population in the CRDN who were migrants within one year and migrants within five years was 1.9% and 6.8%, respectively. The CRDN had lower migration rates than the LSA (i.e., 2.3% for one year and 7.9% for five years) and the RSA (i.e., 3.6% for one year and 9.9% for five years) (Appendix 18A, Table 18A-9a).

Some common reasons for migration stated by LSA residents include attending school, limited housing availability within a community, and limited availability of employment. Residents of smaller communities within the LSA often move to larger communities such as Buffalo Narrows or La Loche for schooling and housing. Some LSA residents commented that people who leave the community for schooling often do not return as they seek further education or employment opportunities elsewhere (2019 to 2021 KP interview program).

19.3.1.1.3 Métis Nation – Saskatchewan Northern Region 2

The MN-S NR2 resident population is captured throughout the LSA in various communities. Focus was placed on the two larger centres of La Loche and Buffalo Narrows as no distinct datasets for Métis residents of LSA communities are available. It is also noted that all LSA communities are a combination of several groups, including Métis, Dene, Cree, and non-Indigenous people. La Loche and Buffalo Narrows are described in this subsection because the Métis are the majority population of the various groups (i.e., 50.0% in La Loche and 65.8% in Buffalo Narrows).

19.3.1.1.3.1 La Loche

La Loche is the largest LSA community, with a 2016 population of 2,372 (Appendix 18A, Table 18A-1b). In 2016, La Loche had slightly more Métis residents (i.e., 1,185) than First Nations (i.e., 1,095) (Appendix 18A, Table 18A-6c). The proportion of Métis residents in the community has declined by 605 people since 2011 (i.e., 33.8% decrease), while the proportion of First Nations residents has increased by 355 people (i.e., 48.0%) (Annex X, Table 4).

La Loche is the LSA community that experienced the largest decline in population between 2011 and 2016 (i.e., 9.2% decrease). This decrease was specifically observed in the population younger than 50 years of age (Appendix 18A, Table 18A-4). Key person interviewees identified the need to pursue employment and education opportunities elsewhere and lack of housing availability locally as reasons for leaving La Loche. An economic analysis completed for La Loche noted the community did not show the typical signs of population decline; for example, there remains a housing shortage despite several new builds (DMCA 2018). However, this could be indicative of overcrowding and housing shortages prior to depopulation.

The median age of the La Loche population in 2016 was 24.0 years (Appendix 18A, Table 18A-5b). Between 2006 and 2016, the median age of the La Loche population increased substantially (i.e., 20.5 to 24.0 years) (Annex X, Table 5). Among the LSA communities, La Loche has the lowest proportion of working age cohort (i.e., 52.5%), which is comparable to the RSA (i.e., 53.0%, respectively). La Loche has a slightly lower proportion of population who are of retirement age (i.e., 4.6%) compared to the RSA (i.e., 6.8%). However, La Loche's population is aging, with the proportion of retirees increasing by 1.5% between 2011 and 2016 relative to a 0.2% decrease in the proportion of the working age population. The increase in retirees was comparable to the RSA trend (i.e., 1.4% increase) over the same period.

More females than males live within La Loche (i.e., 1,235 females or 52.1% compared to 1,135 males or 47.9%), with the sex ratio widening over the last decade (Annex X, Table 5). This trend is different than all other LSA communities and the RSA. There are more females than males within the 20 to 64 age group and more males in the 0 to 19 and 65 years and over age groups.

Among the LSA communities, La Loche had the lowest migration rate within one year (i.e., 1.1%) and within five years (i.e., 3.8%; Appendix 18A, Table 18A-9b). Migration rates in La Loche were lower than the RSA for both within one year and within five years (i.e., 3.6% and 9.9%, respectively in the RSA) (Appendix 18A, Table 18A-9a).

19.3.1.1.3.2 Buffalo Narrows

Buffalo Narrows is the second largest community in the LSA with a 2016 population of 1,110 (Appendix 18A, Table 18A-1b). The Buffalo Narrows Indigenous population is predominantly Métis (i.e., 80.2%) with some First Nations (i.e., 19.8%) (Appendix 18A, Table 18A-6c). The community has experienced fluctuations in the number of First Nations and Métis residents, with the number of Métis rising from 810 to 950 between 2006 and 2011 and falling to 725 in 2016. The number of First Nations residents in the community declined from 140 to 45 between 2006 and 2011 and rose to 180 in 2016. Part of this change could be attributed to the different census approach in 2011, which was voluntary and may have resulted in fewer responses and reduced accuracy. Between 2011 and 2016, the population of Buffalo Narrows decreased by 3.9%, while the RSA experienced a small population increase during the same period (i.e., 0.2%).

In 2016, the Buffalo Narrows population had a median age of 30.8 years, compared to 25.7 years for the RSA (Appendix 18A, Table 18A-5b). Between 2006 and 2016, the median age of the Buffalo Narrows population increased by 3.5 years. Buffalo Narrows has the second lowest proportion of population in the working age cohort (i.e., 54.0%) amongst the LSA communities. Compared to all LSA communities, Buffalo Narrows has the highest proportion of the population who are of retirement age (i.e., 9.9%). The population of Buffalo Narrows is aging, with the proportion of retirees increasing by 2.5% between 2011 and 2016 relative to a 0.5% decrease in the proportion of the working age population (Annex X, Table 5).

There has been some change in the sex ratio of the Buffalo Narrows population between the most recent year of data (i.e., 2016) and 10 years prior. Slightly more males than females now live in Buffalo Narrows (i.e., 50.5% compared to 49.5%). The 0 to 19 years age group and the 45 to 64 years and over age group have more males than females (i.e., 39.3% and 31.8%, and 25.0% and 24.5%, respectively; Annex X, Section 6.1). As in other communities, the large size of the male 0 to 19 population skews the gender ratio in the community.

In 2016, the proportion of population in Buffalo Narrows who were migrants within one year and migrants within five years was 4.3% and 12.6%, respectively (Appendix 18A, Table 18A-9b). Buffalo Narrows had the highest migration rate within one year of all LSA communities and higher migration rates overall than the LSA (i.e., 2.3% for one year and 7.9% for five years) and the RSA (i.e., 3.6% for one year and 9.9% for five years) (Appendix 18A, Table 18A-9a).

19.3.1.1.4 Birch Narrows Dene Nation

In 2016, the population of the BNDN was 475, a 14.5% increase from 2011 (i.e., 415) and 2006 (i.e., 415) (Appendix 18, Table 18A-1b). The rate of population growth in BNDN between 2011 and 2016 (i.e., 14.5%) was the highest among the LSA communities and higher than the RSA (i.e., 1.4%). The BNDN is a predominantly First Nations community (i.e., 95.7% of overall population), with a small proportion who are Métis (i.e., 4.3%) (Appendix 18A, Table 18A-6c). The median age of BNDN residents in 2016 was 24.6 years, younger than the RSA median age of 25.7 years (Appendix 18A, Table 18A-5b). The BNDN has a similar proportion of the population who are of retirement age (i.e., 5.3%) compared to the RSA (i.e., 6.8%). The BNDN has the highest proportion of population in the working-age cohort (i.e., 55.8%) among the LSA communities, which is higher than the RSA (i.e., 53.0%). The proportion of retirees increased by 2.9% between 2011 and 2016 relative to a 7.6% increase in the proportion of the working-age population. The rise in working age population was the highest among the LSA communities. The increase in retirees (i.e., 2.9%) was the highest among the LSA communities, and higher compared to the RSA trend (i.e., 1.4% increase over the same period). The increase in working-age population (7.6%) is much higher compared to the RSA trend (i.e., 1.6% increase) over the same period.

There has been little change in the gender ratio in the community between 2011 and 2016, with the community continuing to have more females (i.e., 53.7%) than males (i.e., 47.4%) in 2016 (Appendix 18A, Table 18A-5b). The community has a larger percentage of females compared to the other LSA communities.

In 2016, the proportion of population in the BNDN who were migrants within one year was 3.2% and within five years was 13.1% (Appendix 18A, Table 18A-9b). The BNDN had higher migration rates than the LSA as a whole (i.e., 2.3% for one year and 7.9% for five years), a similar one-year migration rate to the RSA (i.e., 3.6%), a higher five-year migration rate to the RSA (i.e., 9.9%), and the highest five-year migration rate of all LSA communities (Appendix 18A, Table 18A-9a).

19.3.1.1.5 Buffalo River Dene Nation (Dillon)

In 2016, the population of the BRDN was 785, a 3.3% increase from 2011 (i.e., 760) and 5.4% from 2006 (i.e., 745) (Appendix 18A, Table 18A-1b). Growth in the BRDN has been modest, with the growth rate between 2011 and 2016 (i.e., 3.3%) exceeding the RSA growth rate (i.e., 1.4%). The BRDN is predominantly First Nations (i.e., 98.1%), with a small proportion of Métis (1.3%) (Appendix 18A, Table 18A-6c).

In 2016, the median age of the BRDN population was 26.8 years, slightly older than the RSA population (i.e., 25.7 years). Between 2006 and 2016, the median age of the BRDN population increased by 4.0 years (Appendix 18A, Table 18A-5b). The BRDN's population that is of working age (i.e., 54.8%) is comparable to the RSA (i.e., 53.0%). The proportion of the BRDN's population that is of retirement age is 5.1% and is lower than the RSA (i.e., 6.8%). The population of the BRDN is aging faster than the other LSA communities, with the proportion of retirees increasing by 1.2% between 2011 and 2016 relative to a 4.4% decrease in the proportion of the working age population. The decrease in working age population was highest among the LSA communities. The decrease in working age population is contrary to the RSA, which had a 1.6% increase over the same period.

Slightly more females than males lived in the BRDN in 2016 (i.e., 50.3% compared to 49.7%); however, only the 20- to 44-year age group had more females, suggesting a disproportionate distribution of females in the community within this age cohort (Appendix 18A, Table 18A-5b). There has been a slight shift in the sex ratio in BRDN over the 10-year period prior to 2016, as the community had more males in 2006 (i.e., 50.6%).

In 2016, the proportion of population in the BRDN who were migrants within one year and within five years was 1.3% and 7.7%, respectively (Appendix 18A, Table 18A-9b). The BRDN had lower migration rates than the LSA as a whole (i.e., 2.3% for one year and 7.9% for five years) and the RSA (i.e., 3.6% for one year and 9.9% for five years), and lower migration rates overall compared with the majority of LSA communities (Appendix 18A, Table 18A-9a).

19.3.1.2 Community Context

The community context describes those aspects of each community that create a shared sense of belonging based on similar values. These values are described based on the views expressed during the KP interview program, JWG meetings, and engagement activities (e.g., the youth workshop). Community aspirations are described in Section 19.3.1.5, Governance, Goals, and Plans.

19.3.1.2.1 Clearwater River Dene Nation

Clearwater River Dene Nation members share a common identity as Denesųłiné people (TSD V.2: CRDN). This shared identity is supported through activities and values including being out on the land and engaged in harvesting activities (e.g., hunting, trapping, fishing, gathering), having freedom of movement, respecting the land, having ecological knowledge of the land, and participating in the sharing of communal use cabins and harvests among community members. These activities tie community members to each other and to their heritage. Clearwater River Dene Nation youth also commented that they enjoy traditional activities including hunting and fishing, being out on the land, and eating Traditional Foods such as moose meat and berries. Youth also noted that they valued the culture camps held by the CRDN (2020 youth workshop).

19.3.1.2.2 Métis Nation – Saskatchewan Northern Region 2

Métis Nation – Saskatchewan citizens living in NR2 shared how they value their sense of community. They described the sense of community in terms of friendly people who know each other and the small-town atmosphere of the LSA communities (MN-S-JWG 2020). Youth from both La Loche and Buffalo Narrows noted the close-knit atmosphere of their home communities where everyone is family even if they are not formally related. They added that they enjoyed social activities that brought community members together, such as community suppers. The youth also commented that they liked team sports (2020 youth workshop).

Citizens identified the themes of freedom and control over their traditional territory as important aspects of their shared values. Freedom was described within the context of being able to go out and use the land and living in the north. Part of the atmosphere that citizens highlighted is the semi-isolation of the communities and the fact that you can "hear the grass blowing" (MN-S-JWG 2020). Uses of the land include hunting and fishing for Traditional Foods, and recreation (MN-S-JWG 2020; 2020 youth workshop).

The environment around the LSA communities was described as clean:

> We live in a very clean environment . . . . The air is very clean, we can drink the water and eat the berries wherever they are. As you come south, those things change. We live in a very clean land; in our culture we call it the "land of the white eagle"; because of the snow, and that represents clean. (MN-S-JWG 2020)

The clean environment supports citizens by providing sustenance and supporting Métis culture.

19.3.1.2.3 Birch Narrows Dene Nation

Birch Narrows Dene Nation members shared that they value the people in Birch Narrows, everyone is family, and they share a common "northerner" perspective. Community members are "hilarious, caring, helpful – up north, if you see someone who needs help, you're there, individually or as a community" (BNDN-JWG 2020). The commitment to other community members translates into a sense of belonging (2019 to 2021 KP interview program). One BNDN member shared that they valued knowing the community well. Youth added that they enjoyed social activities that brought community members to places where they could "gather and hang out together" (2020 youth workshop).

Community members identified the environment as a direct benefit with positive effects on the community and its identity. Ties to the land contribute to community members sense of spirituality. The environment is described as beautiful, clean, deserving respect, and having the "best water in the world" (BNDN-JWG 2020). Community members can go out on the land to hunt, fish, and spend time with family and friends (2019 to 2021 KP interview program; 2020 youth workshop).

One BNDN member shared that they valued the resiliency of the community and its members, noting that "We just live with it, in spite of the inconvenience. We just want to live" (BNDN-JWG 2020).

19.3.1.2.4 Buffalo River Dene Nation (Dillon)

Buffalo River Dene Nation members noted that they value the sense of community among members living on reserve. Members shared that not everyone may see eye-to-eye all the time, but in moments of crisis, when the community needs to pull together, everyone pitches in and helps (BRDN-JWG 2020). The presence of immediate and extended family in the community was noted as an important aspect of the BRDN (Dillon) (BRDN-JWG 2020; 2019 to 2021 KP interview program; 2020 youth workshop). Community members also valued having youth in their community and teaching the youth traditional ways (TSD III: BRDN), which is discussed in Section 19.3.1.3, Cultural Connection.

Community members identified the theme of freedom as an important aspect of their shared values. Freedom was described in connection with being able to go out on the land and use it. For BRDN members, it is considered a distinct characteristic of the north: "If you go south, even as far as Green Lake, they have lost this all already. Past Big River they've really lost it" (BNDN-JWG 2020). Those aspects of the land that BRDN members highlighted include hunting and fishing, natural and wild foods, and access to the lake, water, and fresh air. The ability to go out was seen as fundamental to maintaining the BRDN way of life, which is considered healthy (BRDN-JWG 2020; 2020 youth workshop).

19.3.1.3 Cultural Connection

Cultural connection is embodied through language; ways of knowing; and cultural activities that include land and resource use activities, ceremonies, and other activities such as beading and making traditional garments (e.g., mukluks). The Indigenous residents of the primary Indigenous Groups of the LSA have experienced hundreds of years of colonial policies that have restricted their way of life, culture, and language and separated them from the lands and resources that support their culture (Truth and Reconciliation Commission of Canada 2015). In the IKTLU Studies and during the JWG sessions about community well-being, members and citizens shared the historical factors that have influenced well-being that cultural connection supports in their communities; these factors include the *Indian Act*, residential schools, Indian day schools, *the Saskatchewan Natural Resources Transfer Agreement (Treaty Land Entitlement) Act*, the implementation of fur conservation areas, and the establishment of the Primrose Lake Air Weapons Range (also known as the Cold Lake Air Weapons Range) (TSD V.1: CRDN; TSD V.2: CRDN; TSD IV: MN-S; TSD II: BNDN; TSD III: BRDN; BRDN-JWG 2020; BNDN-JWG 2020; MN-S-JWG 2020). The historical factors are described in more detail in Section 16.3.2, Overview of Indigenous Groups, and throughout the Socio-economic Baseline Report (Annex X).

This subsection focuses on the key programs in place, and activities undertaken, in each community to support and encourage cultural connection and the role these play in community well-being. For those primary Indigenous Groups that took part in the JWG meeting where community well-being was discussed, information is also provided.

NexGen understands and respects the importance of culture to the communities in the LPA and throughout northern Saskatchewan. With this understanding and through relationships developed with local communities, NexGen has participated in and supported cultural activities and initiatives in the LPA since 2014. These activities and initiatives have included Métis music programs, Clearwater River Ventures programs, youth/Elder hunting trips, a Dene language documentary, and annual culture days within the communities.

19.3.1.3.1 Clearwater River Dene Nation

In its IKTLU Study, the CRDN (TSD V.1: CRDN; TSD V.2: CRDN) described some of the activities the community uses to encourage cultural activities and transmit their culture from one generation to another. These activities include the following (geographic place names shown in Figure 19.1-2):

- land- and water-based school curriculum near Patterson Lake;
- multi-day canoe trips through the Pelican River Loop, which includes Patterson Lake;
- camps and learning places on Preston, Bray, and Descharme lakes; and
- an Elders camp at Gedak Lake.

Cabins are also an important aspect of cultural transmission:

> . . . this includes the ways in which such traditional knowledge is transmitted to current and future generations of CRDN children. In this regard, cabins are the base camp '"schooling" places where youngsters have the opportunity, guidance, and support of tradition-oriented parents, grandparents, and extended family members to learn and understand the values, customs, practices and traditions which are the core of Dene identity – all of which are imbedded in the Dene language. (TSD V.1: CRDN)

The CRDN acknowledge the importance of language in maintaining their culture:

> Language is the principal instrument by which the Dene worldview, the wisdom of the ancestors, and the distinctive Denesųłiné ways of being are transmitted to the next generations. The Dene language cannot be divorced from the land from which it emerged; nor can the transmission of knowledge be divorced from a healthy productive land base which draws on the knowledge and experience of the ancestors, Elders, and current harvesters. (TSD V.1: CRDN)

The CRDN have observed a shift in Dene language skills among children. Parents have stopped speaking Dene to the youngest children, who now speak English in public. To address this shift, the students at Clearwater River School learn Dene in all grades. NexGen respects the importance of cultural continuity and has participated and supported cultural activities and initiatives (including a Dene language documentary) in the LPA since 2014.

19.3.1.3.2 Métis Nation – Saskatchewan Northern Region 2

Métis Nation – Saskatchewan citizens described the importance of language and culture. Cultural activities were considered within the context of MN-S freedom to be out on the land and live their Métis culture:

> We're a lot freer than in the city – we can't just go anywhere and do what we like in Saskatoon in terms of traditional land use, camping, etc. We can just go on the lake and set up camp – it's a totally different atmosphere – friendly, the environment itself. (MN-S-JWG 2020)

Citizens also shared how they were concerned that Traditional Knowledge and teachings were becoming more difficult to find and to learn. One MN-S citizen noted that Elders with Traditional Knowledge are more difficult to locate, and another MN-S citizen shared the following:

> We talk about our young people's mentality, that they don't share the stuff from our Elders anymore; more stuff is coming in from southern institutions, steering us in a different direction. We're losing a lot of stuff because we're losing communication/miscommunication with our young people. Institutions are taking over from the traditional teachings. Traditional teachings are not consistent. (MN-S-JWG 2020)

Youth who attend high school in La Loche and Buffalo Narrows also consider traditional activities important to their well-being, noting that they value being Métis, jigging[7], and engaging in other traditional activities such as hunting, fishing, picking berries, and beading (2020 youth workshop).

19.3.1.3.2.1 La Loche

Métis Nation – Saskatchewan citizens living in La Loche have noted the importance of supporting cultural activities. These activities appear to be done primarily through relationships within families and the community. One MN-S citizen commented that "There's a lot of culture in the north. La Loche really pushes culture – the Dene language, living off the land. Two of my grandkids take a whole six straight months of this culture" (MN-S-JWG 2020). The relationship between generations is key for cultural transmission:

> And I see as the way to pass things on, is as seniors we work with the youth to teach what little we know and what we've learned. Through the cultural camps that we have put on, and will put on, there is a lot of knowledge that is passed down. (MN-S-JWG 2019a)

Dene High School offers a one-week outdoor school program every year. Students sign up in the spring to go north for a week. Feedback has been positive from the students who participate. They enjoy being on the land and the physical activity (2019 to 2021 KP interview program).

19.3.1.3.2.2 Buffalo Narrows

Métis Nation – Saskatchewan citizens living in Buffalo Narrows consider the maintenance and preservation of Métis culture important. Cultural transmission occurs through experiential learning informally on the land and through the schools. One citizen noted:

> Moving people off the land into communities, killing the trapping industry, burning the forest are all ways that have made it hard for us to educate our children. Today, some of our children and communities are angry because they lost this knowledge. We are trying to put it back, but the bottom [line] is we can educate them, but if we have nowhere to let them go and live, if we destroy the land, how do they use it? (MN-S-JWG 2019b)

Dene language is offered at the Twin Lakes Community School, and community members volunteer to teach traditional activities to students (TSD IV: MN-S).

[7] A combination of First Nations dancing and Scottish and French-Canadian step-dancing, and reel, jig, and quadrille steps.

19.3.1.3.3 Birch Narrows Dene Nation

Birch Narrows Dene Nation members described multiple traditional activities that support community well-being, including land-based activities (e.g., hunting), teaching, and being out on the land. The connection with the land supports the spirituality of community members, which permeates all aspects of life and entails reckoning with the shame that centuries of colonial policies has instilled within Indigenous Peoples:

> When you talk about community well-being, it its more than just the environment; it's what my people are thinking. How can we stand on our own two feet and become self-reliant and proud of who we are? I'm proud to be Dene-Cree. I started my life as a non-Indigenous person, a non-status Indian, then became Métis, then First Nations. It's deeply ingrained, and that's part of the issues we have. Until that day comes – look at the process South Africa went through. That's where we got the Truth and Reconciliation concept from, but we're struggling with it. It's hard for an Indigenous person, especially with all the stuff that's happening. (BNDN-JWG 2020)

The BNDN (BNDN-JWG 2021a) have established community goals to preserve and foster Dene language and culture, including the following:

- Support members in conducting traditional ceremonies.
- Ensure that Dene and Cree languages are preserved for future generations.
- Provide opportunities for members to learn traditional skills including hunting, trapping, fishing, boat making, wayfinding skills, survival skills, and knowledge of traditional medicine.
- Provide opportunities for Elders to share teachings with youth.
- Study, document, and share Birch Narrows history with members.

Cultural programming is offered through the Birch Narrows Community School, which owns a cabin where the school offers land-based programming to the students. Students can attend outings where they are taught to hunt and fish, as well as have contact with Elders. The use of the cabin is primarily aimed towards the elementary students at the school (2019 to 2021 KP interview program; 2020 youth workshop).

The BNDN has been experiencing a cultural revitalization in recent years:

> For traditional pursuits within the community, about 80%, especially with land-based learning – the programs we have run, the camp-outs like the one I just had last week – we had some hunting, fishing, cultural stuff. That's land-based learning.
>
> Regarding traditional arts and crafts, they were kind of dying down and only some older ladies were doing it. Now there's a lot more. Some young ladies are producing mitts, earrings, pop sockets, and lanyards. There's a lot of learning going on in that aspect.
>
> Taking people out – my children are grown up, and I take them out every summer. We have cabins – we hunt, fish, make dry meat. They know our traditional area around Frobisher Lake and Clear Lake. Quite a few people go out on this lake and do their hunting and annual harvesting. (BNDN-JWG 2021b)

In revitalizing traditional culture, a BNDN member highlighted that culture is a living thing:

> Something has always bothered and disturbed me: the term “loss of culture”. We’ve fallen into this lie that somehow we’ve lost our culture. We’ve failed to recognize that culture is not static, it’s dynamic. The more we believe this lie that we’ve lost our culture, we somehow lose our footing as to who we are and our identity. What really bothers me is when the young children are hearing this. We have a dynamic culture here.
>
> It makes it difficult for us sometimes because we’re trying to go back and retain or retrieve what we thought was our culture, when all we need to do is look within and identify where we’re at in terms of our culture. There are a lot of positive things there, and somehow we lose those. This is something I’ve preached before. My people have to stop looking at that. Yes, there were a lot of good things in the past, so let’s look back at what we can retain or retrieve, but right now let’s celebrate the culture we do have. In Turnor Lake we have a very rich, vibrant land-based culture. Somehow when we say loss of culture, we’re throwing all of that away. I always tell people let's not talk like that, because part of that is saying we’ve lost our identity. (BNDN-JWG 2021a)

19.3.1.3.4 Buffalo River Dene Nation (Dillon)

Buffalo River Dene Nation members consider traditional activities and way of life important aspects of community well-being. They noted that it is a healthy lifestyle and free. It also provides the necessities for life and connects generations: “things our grandparents did that I can remember – walking, the smell of a fresh net just taken out of the water and hung. Just the scent gave me a visual of my grandpa sitting on the ground fixing the net” (BRDN-JWG 2020). Another BRDN member commented that “kids learn from their parents, but they’ve lost it because of the impacts, so now we’re doing a different approach to land-based learning, to reintroduce it the way we learned it, the way we know it” (BRDN-JWG 2020).

The BRDN offers land-based programming to students at the Buffalo River School. Programming is funded by the MLTC and has been offered since 2017. Programming is for all students and teaches students practical skills on the land. Scheduling conflicts and class availability due to other events limits the number of students involved in the program. A fall berry camp and spring fishing camp are the main programs offered, though other programs, including preparing and cooking snared rabbits and storytelling by Elders, are offered (CBC 2019; 2019 to 2021 KP interview program).

The land-based education is an opportunity to not only learn skills such as hunting, trapping, and fishing, as one BRDN member shared, it was an opportunity to connect youth with community Elders:

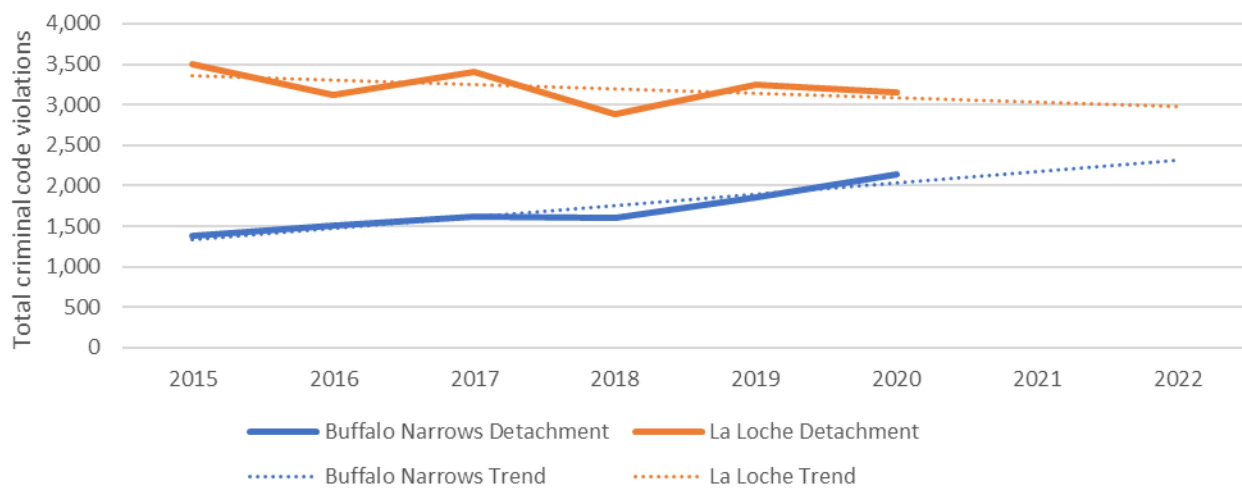
> The Elders would stay out there for the whole two weeks in canvas tents, and the kids would come out daily and spend the night with the Elders out there. They’d do the fishing, fillet the fish, prepare the fish for meals. Then they’d come back into town and go door-to-door to the Elders and drop off a bag of fillets or dried fish. If they did any trapping, they’d be shown how to skin muskrat or whatever, then they’d smoke it and give it to the Elders. (BRDN-JWG 2021a)

19.3.1.4 Safety and Security

Changes in employment, income, and community dynamics can result in changes to crime rates and safety (both real and perceived) or amplify existing issues (e.g., mental health issues, substance abuse) in communities. This subsection outlines the key safety and security issues identified in the KP interviews with linkages to Statistics Canada data from the two RCMP detachments in the LSA (i.e., the La Loche RCMP Detachment, and the Buffalo Narrows RCMP Detachment).

Figure 19.3-6 outlines the criminal code violations (i.e., crimes) committed each year in the Buffalo Narrows and La Loche RCMP Detachment areas. The data show the number of violations in the Buffalo Narrows RCMP Detachment area are lower than those in the La Loche RCMP Detachment area; however, crimes in the Buffalo Narrows RCMP Detachment area are increasing each year and trending higher, while the La Loche RCMP Detachment area are more variable but trending lower. There was a 55.1% increase in total criminal code violations from 2015 to 2020 for the Buffalo Narrows RCMP Detachment area. The La Loche RCMP Detachment area reported total criminal code violations decreased 9.8% from 2015 to 2020. Despite the decrease in criminal code violations in the La Loche RCMP Detachment area, interviews indicated that there is a perception that the community is not safe (2019 to 2021 KP interview program). Saskatchewan criminal code violations increased by 2.2% in the same period. Data for Saskatchewan are not shown in Figure 19.3-6 due to the comparatively large numbers of violations that would make presentation against Buffalo Narrows and La Loche data illegible.

Figure 19.3-6: Criminal Code Violation Data for Buffalo Narrows and La Loche Detachments, 2015 to 2020

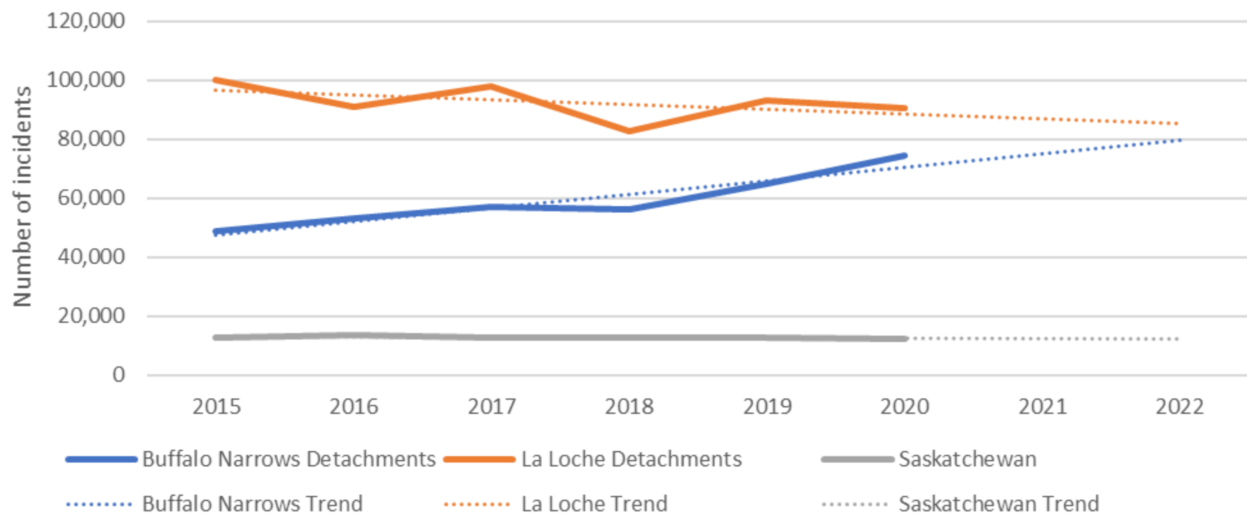


Source: Statistics Canada 2021.
Note: Incarceration rates for the LSA communities and RSA are not available.
LSA = local study area; RSA = regional study area.

Additional crime rate data show Buffalo Narrows RCMP Detachment area experienced a 51.7% increase in the crime rate[8] from 2015 to 2020, while the La Loche RCMP Detachment area crime rate decreased by 9.2% (Figure 19.3-7). The provincial crime rate decreased by 5.4% in the same period. The Buffalo Narrows RCMP Detachment area crime rate is trending to surpass the La Loche RCMP Detachment area rate around 2023. Incarceration rates for the LSA communities and RSA are not available.

[8] Crime rate is presented as the number of incidences per 100,000 people.

Figure 19.3-7: Crime Rate Data for Buffalo Narrows and La Loche Detachments, 2015 to 2020



Source: Statistics Canada 2021.

Interviewees in the KP interview program felt that substance abuse issues like alcohol abuse are prevalent in many of the LSA communities (e.g., Turnor Lake, Dillon, La Loche, Buffalo Narrows) while drug abuse (e.g., crack cocaine) is prevalent in Buffalo Narrows, La Loche and to a lesser extent in the smaller communities (2019 to 2021 KP interview program). Poverty, unemployment, lack of education, isolation, lack of pro-social relationships, inadequate resources, and intergenerational trauma were identified as contributing factors for issues within the communities. The communities do not have social supports related to domestic abuse and the closest women's shelter is in Meadow Lake. Due to lack of local support services in the LSA, the RCMP is often used as family services and social services on a 24-hour basis (2019 to 2021 KP interview program).

Feedback during KP interviews indicated that community members in Turnor Lake and the BNDN feel very safe in the community due to its isolated location; some community members sleep with unlocked doors. Community members in the BRDN also reported feeling safe in their community, though they have noted increasing rates of addiction (2019 to 2021 KP interview program).

19.3.1.5 Governance, Goals, and Plans

Effective governance has been identified as a key contributing factor to a community's socio-economic progress and overall well-being as it allows Indigenous communities to:

- "take greater control over the decisions that affect their lives;
- carry out effective relationships with other governments;
- take advantage of economic development opportunities;
- improve programs and services; and
- enhance their social and economic well-being." (AANDC 2015)

Indigenous governance also considers the need to balance traditions and culture. Indigenous Peoples are not homogenous, and the most appropriate form of governance will vary among nations (RCAP 1996).

Governance is an important tool for self-determination (Missens 2008), which is a key social determinant of health for Indigenous Peoples as it influences other social determinants of health, such as education, housing, and safety, by ensuring that Indigenous People are participating in decision making that affects the well-being of their communities (Reading and Wien 2009). Aspects of self-determination shared through discussions about freedom and control at JWG meetings reinforce the influence of self-determination on community well-being. This subsection describes formal goals and plans based on information that is publicly available and presents the hopes and aspirations community members shared during the KP interview program and through engagement. Further information, including a list of the elected representatives, is presented in the Socio-economic Baseline Report (Annex X, Section 5.2).

19.3.1.5.1 Clearwater River Dene Nation

The CRDN has a custom electoral system (Indigenous Services Canada 2015). A Chief and five councillors are elected to four-year terms. The current leadership began their terms in July 2021 and these terms will end in July 2025 (INAC 2021a). Additional information on governance vision and goals, such as may be defined in a community plan, were not publicly available at the time the EIS submission was prepared.

19.3.1.5.2 Métis Nation – Saskatchewan

The MN-S was incorporated in 2000 and represents the interests of Métis citizens in Saskatchewan, including their rights under Section 35 of the *Constitution Act, 1982*. The MN-S operates through an elected representative system at local, regional, and provincial levels (University of Saskatchewan n.d.). Métis locals provide representation at the community level. Governance of the MN-S is guided by the Constitution of the Métis Nation of Saskatchewan (MN-S 2008), *The Métis Act,* the *Métis Nation – Saskatchewan Citizens Act, The Regional Boundaries Act, 1977, Métis Nation of Saskatchewan Senate Act, The Métis Nation Legislative Assembly Act,* and *The Métis Wildlife and Conservation Act*.

At the provincial level, the MN-S governance structure includes the Provincial Métis Council, which is a four-member executive; Cabinet; and the Métis Nation Legislative Assembly, which is composed of the Local Presidents, the Provincial Métis Council, four representatives of the Métis Women of Saskatchewan, and four representatives from the Provincial Métis Youth Council. The Métis Nation Legislative Assembly has the authority to enact legislation, rules, and regulations (MN-S 2008).

In 2019, the MN-S concluded the Métis Government Recognition and Self-Government Agreement with the Government of Canada that affirmed the right to self-government, recognized the MN-S's mandate, and established a process to formally recognize the MN-S government as an Indigenous government in Canadian law (CIRNAC 2019b). The agreement requires the MN-S to undertake constitutional reform consultations to provide Métis citizens with an update on proposed amendments to the MN-S Constitution and new legislation to meet the Métis Government Recognition and Self-Government Agreement with Canada (MN-S 2021). The agreement also establishes processes for negotiation agreements regarding additional areas of jurisdiction beyond core areas of governance in the future (CIRNAC 2019b). In August 2021, the Government of Canada sent a letter to the MN-S, reaffirming its commitment to meaningly advancing Métis self-determination and self-government in Saskatchewan (MN-S 2021).

Northern Region 2

The MN-S is divided into 12 regions. The LSA communities are in NR2, which includes the following locals:

- Local 39 – La Loche;
- Local 40 – Turnor Lake;
- Local 62 – Buffalo Narrows;
- Local 65 – Michel Village;
- Local 70 – St George's Hill;
- Local 127 – Garson Lake (currently inactive);
- Local 130 – Descharme Lake (currently inactive);
- Local 156 – Bear Creek; and
- Local 162 – Black Point.

Leadership for locals is elected and defined by the constitution of each local. Terms for leaders can be between one and three years (MN-S 2008).

Through the JWG processes and KP interviews, MN-S citizens living in the NR2 communities shared their goals and aspirations for the future, which include economic opportunities, maintaining Métis ways of life, and preserving environmental integrity.

When MN-S citizens talked about economic opportunities, it was typically within the context of future opportunities such as those potentially available through mining operations: "It is important that our youth go into technical fields too, not just labour. Other uranium companies have good training programs for technical fields and train students just out of school into trades like power engineering" (MN-S-JWG 2019a). Opportunities that are close to home are important: "We have qualified people who are going out to BC and Ontario looking for work, when they could be working close to home. They should be employed before people from the south are hired to work in this area" (MN-S-JWG 2019a). Participants in the KP interview program also see substantial future economic opportunities that could help community members end the cycle of poverty (2019 to 2021 KP interview program).

Maintaining Métis identity is another important goal for MN-S citizens, which they described through their connection with their relationship with the land and freedom. Through the KP interview program, citizens noted that cultural identity and taking pride in their Métis identity is important. Without a sense of identity, social issues arise and people feel lost (2019 to 2021 KP interview program). Another citizen echoed this sentiment at a JWG meeting: "All children want to learn where they are from, who they are and where they are going. If we do not teach them our culture, they are angry at us later" (MN-S-JWG 2019a). Métis Nation – Saskatchewan citizens of NR2 have taken steps to ensure that their goal of maintaining Métis ways of life continues through school programming and culture days (Section 19.3.5.2, Métis Nation – Saskatchewan Northern Region 2). Freedom is an important part of their cultural identity, and MN-S citizens note the threat that industry, including NexGen, is to their freedom: "I thought about this aspect before I came. NexGen and other mining companies are a threat to our freedom in different ways – freedom of access to the land, freedom of using the land. It's how you work with us to limit that freedom" (MN-S-JWG 2020).

Another goal of MN-S citizens is the preservation of environmental integrity for current and future generations:

> Environment is very important; I am an Elder today. I was born in the North, and it was pristine. Today with the mining industry, I see changes coming. Changes that relate to pollution affect my children, my grandchildren and the children still not born. That is my biggest focus: make sure we don't leave the uranium sitting behind. We want to see no footprint. I want to see a clean environment. I have nothing against what you are doing, the world needs it, but at the same time don't leave us the garbage. (MN-S-JWG 2019a)

> When it comes to environment, we only have one command and that is respect for all living things and all the dead things. If you do not respect the earth and can't grow food, you won't last for more than two months. If you don't respect the water and keep it clean and pure, you only live for two weeks. If you don't respect the air and keep it clean, you only live for two minutes. (MN-S-JWG 2019a)

19.3.1.5.3 La Loche

The village of La Loche is governed by a mayor and six council members. Mayor and council members hold office for four years, and the next municipal election will be in fall 2024 (Government of Saskatchewan 2021b).

In 2016 and 2017, La Loche embarked on a process to develop a community wellness plan in response to the 2016 shooting at Dene High School (La Loche 2017). One product of the community wellness plan was a vision and mission statement for the community. The vision statement is *Ela nadetser* (together we are strong) and the mission statement is:

> The Northern Village of La Loche is a Dene-Métis community focused on assisting its people to become healthy productive community members through economic development and culture while protecting its natural resources. (NVLL 2017)

Helping to express the community's vision are six themes and 26 actions to support a safer and healthier community, which are presented in the Community Wellness Plan (La Loche 2017), and the goals articulated in the Official Community Plan (La Loche 2018), which was developed to meet the requirements set out in *The Planning and Development Act*, *2007*. The Community Wellness Plan is in place from 2017 to 2022 with the understanding that it will be revised and updated continually. It is intended to be a living document. The six themes established in the Community Wellness Plan to support a safer and healthier community are as follows:

- **Holistic health**: includes a range of actions including securing five trained Indigenous doulas / birth workers in the north and developing traditional parenting program and suicide prevention programs.
- **Empowerment (accountability)**: includes actions to support intra-community and intra-agency collaboration, increasing awareness of services available in La Loche, and planting a community garden.
- **Language and culture**: includes creating strategies to promote language and culture as protective factors and working to support Elders.
- **Youth wellness**: includes developing a mentorship program and a for-credit land-based course as well as building a new Ducharme School Cabin.
- **Public safety**: includes revitalizing the women's wellness group and increasing awareness of alternative justice measures.

- **Reduction of poverty**: includes creating an economic development corporation and planning for construction of an office/business building in the community.

The Official Community Plan (La Loche 2018) also articulates a series of goals, which are presented in Table 19.3-2. The goals developed for the Official Community Plan reflect some of the same values expressed in the KP interviews and JWG meetings. In particular, La Loche's goals for managing and maintaining the natural environment, supporting the culture of residents, and ensuring that the services provided in the community support the health and well-being of residents are relevant to fostering community well-being.

Table 19.3-2: La Loche Official Community Plan Goals

Theme	Goals
Responsible governance	▪ La Loche will be known for its leadership through transparency, responsiveness, and accountability ▪ Residents of La Loche will have a voice and be encouraged to participate, where possible, on decisions that affect the future of the community ▪ Leaders will have a broad and long-term perspective that is rooted in an understanding of the historical, cultural, and social complexities of the community
Natural environment	▪ Planning and developments will be integrated with the natural environment to better manage municipal land and water resources ▪ Protection of the shoreline, wetlands, and land with ecological value will be encouraged to improve the environmental quality and enhance biodiversity in the community
Built environment	▪ La Loche will be a pleasant, livable, walkable, and accessible community ▪ The community will grow sustainably and efficiently maximize the use of existing infrastructure and buildings to avoid unforeseen operating and development costs ▪ Diverse and affordable housing opportunities that reflect the needs of current residents and future generations will be available
Economic diversification and growth	▪ La Loche will strive to create a diverse economy with a wide range of rewarding jobs and training opportunities ▪ Entrepreneurial activities will be promoted for a sustainable economy ▪ Diverse employment opportunities will be encouraged to influence sustainable growth by promoting tourism, recreation, commercial and industrial ventures, and natural resource industries
Culture and society	▪ Cultural heritage will be expressed by supporting events and business avenues that embrace the culture of residents ▪ La Loche will promote cultural attractions and community facilities such as schools, libraries, daycare centres, and leisure and cultural facilities ▪ Use of public spaces will encourage informal social activity, scheduled recreation, and civic gatherings ▪ Opportunities will be provided for leisure, recreation, sports, and other activities
Health, safety, and community well-being	▪ Council will continue to play an important role in the community's health, safety, and well-being in terms of provision of supporting services, including social, administrative, judicial, and medical services ▪ Council will support development that confirms residents of the community have access to a range of services and facilities that meet their needs ▪ Planning decisions will embrace and reflect strong cultural values
Community engagement and inter-municipal cooperation	▪ Effective and inclusive resident participation will be encouraged in community planning decisions ▪ Council will commit to continual cooperation with the neighbouring CRDN to enhance regional partnerships, promote regional services and facilities, and support regional growth and development ▪ La Loche will be a community that strives for health, well-being, and safety for all residents

Source: La Loche 2018.
CRDN = Clearwater River Dene Nation.

19.3.1.5.4 Birch Narrows Dene Nation

The BNDN has a custom electoral system (Indigenous Services Canada 2015). A Chief and four councillors are elected to four-year terms (BNDN 2018). The leadership at the time of writing of this assessment began their terms in March 2018 and will end them in February 2022 (INAC 2021b).

In 2018, the BNDN completed a comprehensive community plan. The Comprehensive Community Plan outlines the goals for growth and development in Birch Narrows and provides direction to leadership, staff, and community members on how to address key issues. The Comprehensive Community Plan was developed through engagement with leadership, staff, and community members (BNDN 2018).

The following is the community vision statement for the BNDN:

> We are the Indigenous Denesųłiné of the Eghes t'oni'a (Clear Lake) Region and the Creator put us in this region to act for the benefit of our children and their children.

The BNDN value statement is "As proud and united Birch Narrows Dene Nation citizens, we value health, self-reliance, education, and our culture" (BNDN 2018). To support the vision and values of the BNDN, the Comprehensive Community Plan establishes goals for 12 areas (Table 19.3-3). While all the goals presented in the Comprehensive Community Plan support community well-being by fostering engaged, healthy, supported, and culturally connected members, of particular importance as discussed during KP interviews and the JWG are the goals to foster language and culture, improve and expand social and health services, and protect the environment.

Many of these goals were the subject of dialogue during the KP interview program and JWG meetings. Birch Narrows Dene Nation members expressed the hope for additional community facilities, including a bigger health centre and band office, more classroom space, and a youth centre (BRDN-JWG 2020), and a need for more housing in the community (2019 to 2021 KP interview program). The community-wide commitment to maintain cultural activities is demonstrated by the commitment to land-based education. The BNDN's goals to protect the environment and pursue economic development opportunities are both advanced through the establishment of the *Nuh Nene* (Our Land) Department, as further described in Section 19.3.1.5.4.1, Nuh Nene.

Table 19.3-3: Birch Narrows Dene Nation Goals in Comprehensive Community Plan

Theme	Goals
Governance and administration	▪ Establish and enforce by-laws and policies to govern the community ▪ Engage members in governing the community
Language and culture	▪ Support members in conducting traditional ceremonies ▪ Ensure that the Dene and Cree languages are preserved for future generations ▪ Provide opportunities for members to learn traditional skills ▪ Provide opportunities for Elders to share their teachings with youth members ▪ Study, document, and share Birch Narrows history with members
Caring for community	▪ Improve community social services ▪ Create opportunities for members to gather ▪ Encourage community involvement and support member lead initiatives ▪ Provide preventative support programs ▪ Educate members and increase awareness of community social issues
Justice	▪ Ensure the community is a safe place to live ▪ Strengthen the relationship between community members and the RCMP
Recreation	▪ Ensure members have access to recreation opportunities

Table 19.3-3: Birch Narrows Dene Nation Goals in Comprehensive Community Plan

Theme	Goals
Healing and wellness	▪ Invest in community health facilities ▪ Provide additional health services ▪ Improve health staff capacity ▪ Address addictions in the community ▪ Improve the community medical transportation service
Education	▪ Enhance school programming ▪ Make positive connections between school and community ▪ Invest in and support post-secondary education for members
Employment and training	▪ Create employment opportunities in the community ▪ Provide training and workshops to build members employable skills
Economic development	▪ Support local business development and entrepreneurship in the community ▪ Pursue the development of additional commercial enterprises in the community ▪ Research and prepare for resource companies' interest in the community
Lands and resources	▪ Keep a strong personal connection with land and environment ▪ Protect natural areas in the community
Housing	▪ Provide more housing in the community ▪ Maintain current housing stock ▪ Support members living in urban centres
Infrastructure and facilities	▪ Build additional community facilities ▪ Ensure that community infrastructure and facilities are well equipped to support programs and services

19.3.1.5.4.1 Nuh Nene

During the JWG process and in the IKTLU Studies, BNDN members have noted the need to organize internally:

> We have to organize as a community, and as leadership within the community, it is upon us to how we are going to participate with NexGen or other companies. The north is going to change. What does that mean for us? There will be major impact, but also major benefits. It will change with or without us, so preferably with us. (BNDN-JWG 2019)

The need to organize comes from the increase in industrial development and encroachment on BNDN traditional territory by government policies, recreational users, and industry:

> The biggest fear for Indigenous land users is, when you look at the Saskatchewan government's Duty to Consult document, with agricultural land and leased land to agriculture, First Nations people and Indigenous land users are prohibited from going on without permission. That's one of the greatest fears we have, that with a lot of leases throughout the north, we hope the government will not play dirty and impose – so far they haven't mentioned anything related to mining leases and that whole concept of needing permission from the lessees to go and hunt and use the land. It hasn't happened as far as we are aware. But one of the fears we have is that maybe at some point government will impose such an idea to prevent people going on these leased lands. It may come to that, who knows. (BNDN-JWG 2021c)

The increase in mineral exploration and development and the need for a consistent, proactive approach to consultation to preserve environmental integrity and Aboriginal and Treaty Rights, while advancing partnership opportunities and the associated benefits, led the BNDN to establish the *Nuh Nene* (Our Land) Department. In

June 2021, Chief and Council endorsed the creation of the *Nuh Nene* Department and provided a mandate. The following principles guide the department:

- **Rights:** talk on a nation-to-nation basis; acknowledge unceded territory; honour Aboriginal and Treaty Rights, self-determination, the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), and free, prior, and informed consent; acknowledge the Truth and Reconciliation Commission findings and the legacy of colonialism; and good faith and mutual respect.
- **Environmental protection:** integrate Indigenous Knowledge and environmental stewardship and protection; establish an environmental monitoring role for members.
- **Meaningful consultation and accommodation:** establish community participation, capacity building, net benefit, early involvement, and collaboration with neighbours (e.g., Turnor Lake Métis Local 40 and the northern hamlet of Turnor Lake).

The *Nuh Nene* Department reports directly to Chief and Council and includes a board, a manager, and staff. The board includes five to seven members, including a councillor, three to five BNDN members, and an Elder Advisor. All members are appointed by Chief and Council. The manager is responsible for day-to-day operations.

The *Nuh Nene* Department is a tool to assert self-determination and control over developments that affect the BNDN, its members, and its traditional territory. A BNDN member shared the importance of self-determination and having a say regarding developments in their traditional territory:

> We have been brainwashed that we don't own this land, and perhaps we do have a say. We are trying to overcome this. We are telling our kids you have a right or a say of what happens on our land. We used to hear words of hopelessness, but UNDRIP has breathed rights into us, and we want our kids to catch hope. It is time we start talking Nation to Nation; we can't lose that. (BNDN-JWG 2019)

19.3.1.5.5 Buffalo River Dene Nation (Dillon)

The BRDN has a custom election act that originally passed in 1995/1996. The act has since been revised twice: once in 2001 and again in 2017. The BRDN is governed by a Chief and five councillors, who at the time of writing this assessment were elected in March 2019. They are serving a three-year term that ends in March 2022 (INAC 2021c).

Included in the custom election act is the following declaration that outlines the overall goals for community leadership:

> The Buffalo River Dene Nation Government recognizes the responsibility of the elected leadership to the Creator and the Dene people and will uphold the responsibility to the Creator and the Dene people to protect:
>
> > The inherent and Aboriginal Rights of the Dene people as an Indigenous People;
> >
> > The Treaty 10 signed with the Dene Nation and all rights of the Dene people accorded by Treaty 10;
> >
> > The democratic laws, institutions, and principles which have always been part of our history;
> >
> > The spiritual beliefs, language, traditions, culture, and customs of the Dene people; and

> The natural laws and responsibilities and obligations that govern our relationship with the Creator and the right to live in harmony with nature and mankind. (*Buffalo River Dene Nation Band Custom Election Act*)

The responsibilities included in the declaration are apparent in, for example, the land-based programming provided to BRDN members to support language traditions, culture, and customs of the Dene people (Section 19.3.1.3.4, Buffalo River Dene Nation [Dillon]). The ability to fully express their culture, maintain their way of life, and govern themselves supports values related to community well-being shared in the KP interviews and JWG meetings.

19.3.1.5.6 Buffalo Narrows

The village of Buffalo Narrows is governed by a mayor and six council members. The mayor and council members hold office for four years, and the next municipal election will be in fall 2024 (Government of Saskatchewan 2021b).

In 2019, Buffalo Narrows adopted its Official Community Plan. The plan was developed to meet requirements set out in *The Planning and Development Act, 2007*. The Official Community Plan provides a framework of goals, objectives, and policies to guide land management and use within municipal boundaries. The following municipal goals set out by Buffalo Narrows in the Official Community Plan echo some of the goals from the village's earlier strategic plan (Buffalo Narrows 2016, 2019):

- diverse and sustainable growth, including diverse land use activities and maintenance of a positive relationship with environmental values, resource capabilities, and community strength;
- orderly and efficient development, including cost-efficient development consistent with the vision and goals of the community;
- serving as a strong regional centre, including maintaining and enhancing the role of the village as an administrative and service centre in northwest Saskatchewan;
- enhancing community attractiveness to enhance the Buffalo Narrows as a recreation and tourism destination; and
- building a healthy, resilient community to ensure that the village can take advantage of economic development opportunities.

The Official Community Plan also established goals related to economic development Buffalo Narrows serving as a regional centre and attracting tourists to the area. The plan highlighted the need for additional infrastructure and services in the community, which participants in the KP interview program noted were still required. Participants in the KP interview program also expressed their desire to pursue economic development opportunities (2019 to 2021 KP interview program).

19.3.2 Health Well-Being

This subsection describes the health care facilities and services available to residents of the LSA communities, along with community perspectives on health. Health well-being also considers the types and prevalence of health conditions in the communities such as diseases, diet, mental health, and substance abuse. An overview of regional facilities and services and additional information on health outcomes in the LSA communities is provided in the Socio-economic Baseline Report (Annex X, Section 6.7).

19.3.2.1 Health Care Facilities and Services

The LSA is in the Northwest Region of the SHA[9]. The SHA facilities in the LSA include the La Loche Health Centre and Hospital and the Buffalo Narrows Health Centre. To access health services, residents in the smaller hamlets and villages travel to a larger community centre, primarily Dillon, for less severe, non-emergency medical issues, and Île-à-la-Crosse or La Loche for medial issues such as emergencies and more specialized services (2019 to 2021 KP interview program). To access further services, community members travel to larger centres such as Île-à-la-Crosse, Meadow Lake, Prince Albert, North Battleford, and Saskatoon (2019 to 2021 KP interview program).

Health services on reserve in First Nations communities in the LSA are directed by the planning committee of the MLTC (2019 to 2021 KP interview program). The MLTC provides services to its nine First Nations members, which include the CRDN, BNDN, and BRDN. These services include nutrition, health advocacy, community health and wellness, addictions, community education, and counselling. The MLTC has an agreement with the Northern Inter-Tribal Health Authority where the health authority provides the MLTC with expertise in emergency situations, such as the COVID-19 pandemic, and other information including topics such as immunizations. The MLTC also works with the SHA as partners when required for health services, such as doctor days on reserve (2019 to 2021 KP interview program).

The MLTC Health Committee is made up of band councillors from the communities that hold the health portfolio. The committees direct and implement changes for health services within the communities and occasionally conduct studies to inform further decisions (2019 to 2021 KP interview program).

There are limited psychiatric, dental, and optometry services provided to members of the CRDN, BNDN, and BRDN. Dental therapy and psychiatric care are available within the communities on an irregular schedule, while no optometry is available within the communities. To access these services, members must travel to Meadow Lake, Prince Albert, North Battleford, or Saskatoon. Mental health therapists, when brought into the community, are often not well received. During KP interviews, it was shared that often, residents do not trust the therapist, particularly if they have connections to the community, and would prefer to speak to someone from outside the community. Mental health therapists are not brought in on a regular schedule into the community and are primarily brought in during a crisis (2019 to 2021 KP interview program).

19.3.2.1.1 Clearwater River Dene Nation

Services available at the CRDN Health Centre include (Northern Saskatchewan Health Services 2009a; TSD V.3: CRDN):

- primary care services (nurse practitioner, physician services, maternal child health worker);
- dental therapist;
- dietitian;
- nurse-in-charge / nurse manager; and
- mental health / holistic health services (services may include family support, suicide prevention, youth suicide services, addictions, National Native Alcohol and Drug Abuse Program workers, and mental health therapists).

[9] Previously the Keewatin Yatthé Regional Health Authority.

The Armand Bekkattla Treatment Centre, which is part of the National Native Alcohol and Drug Abuse Program, is located in Clearwater River Band No. 222. The facility is available for all First Nations and Inuit, and has programs for concurrent disorders, residential schools, child counselling, and couples counselling. It accepts clients with physical disabilities, pregnant women, court referral or corrections clients, and clients on methadone, suboxone, or other psychoactive medications (Government of Canada 2021a). The facility includes the following services (TSD V.3: CRDN):

- holistic treatment;
- inpatient treatment;
- individualized treatment;
- 12-step program;
- substance abuse treatment; and
- life skills.

19.3.2.1.2 Métis Nation – Saskatchewan Northern Region 2

19.3.2.1.2.1 La Loche

The La Loche Health Centre and Hospital provides health services and programming to the residents of La Loche and the surrounding area. The facility has physician services four days a week, with three full-time physicians available at any one time. Physicians work on a two-week-in/two-week-out schedule, each contributing 26 weeks of service annually (Keewatin Yatthé Regional Health Authority 2017). Physicians at the Health Centre and Hospital also travel to outlying clinics (2019 to 2021 KP interview program).

A variety of health care programs and services are available through the La Loche Health Centre and Hospital, including the following:

- acute and emergency care;
- medical clinics with capacity for walk-in and scheduled appointments;
- long-term care;
- X-ray and laboratory services;
- public health clinic;
- home care;
- inpatient social detoxification;
- mental health and addictions;
- community outreach and educations services;
- dental therapy;
- physical therapy;
- tuberculosis and human immunodeficiency virus educators; and
- community health development programs (Keewatin Yatthé Regional Health Authority 2017; 2019 to 2021 KP interview program).

The Health Centre and Hospital in La Loche has noted staffing challenges and has difficulty hiring for the location due to cost of living, job availability for spouses, and culture shock due to the remoteness of the location (2019 to 2021 KP interview program).

Mental health services within the community are on an outpatient basis. Addictions services such as outpatient and detoxification services are available at the La Loche Family Healing Unit, and National Native Alcohol and Drug Abuse Program services for First Nations and Inuit residents are available in Clearwater River Band No. 222 at the Armand Bekkattla Treatment Centre (WorkSafe Saskatchewan 2020; Government of Canada 2021a). Mental health is the largest challenge facing the general population, including youth. Lack of full-time mental health professionals in the community is considered an issue by residents (MN-S 2019).

La Loche health care servicing issues identified by the community include a lack of local heath services such as dentistry and optometry, and access to adequate health services (2019 to 2021 KP interview program; 2020 youth workshop). Elders and seniors in the community also experience a difficulty accessing long-term care homes and home care services (2019 to 2021 KP interview program).

19.3.2.1.2.2 Buffalo Narrows

Buffalo Narrows has a primary care clinic with 24/7 on-call registered nurse coverage and emergency medical services (Keewatin Yatthé Regional Health Authority 2017). Physician services are available four days a week, and a nurse practitioner is on staff and available during open hours five days a week (2019 to 2021 KP interview program). Other services available include the following:

- public health;
- home care services;
- mental health and addictions;
- dental therapy;
- community outreach and education services;
- medical transportation; and
- community health development programs.

For services not available in Buffalo Narrows, residents often travel to Prince Albert, Saskatoon, and North Battleford, with some preferring to travel to Edmonton. The closest optometrists and dentists are in Meadow Lake, Prince Albert, and Saskatoon (2019 to 2021 KP interview program).

The Cancer Bus, which travels between communities throughout Saskatchewan, visits Buffalo Narrows. The purpose of the bus is to assist in the early detection of breast cancer. The bus is fully booked when it visits the community (Saskatchewan Cancer Agency 2017; 2019 to 2021 KP interview program).

Seniors do not have access to free transportation for medical appointments located outside the community. Seniors can book medical appointment transportation provided there is available space, though they are responsible for their own meals, accommodation, and associated transportation costs during the trips (2019 to 2021 KP interview program). Outpatient services for mental health and addictions are available at the Buffalo Narrows Health Centre (WorkSafe Saskatchewan 2020).

19.3.2.1.3 Birch Narrows Dene Nation / Turnor Lake

The Annie Bagg Memorial Nursing Station is in Birch Narrows and serves BNDN members and residents of Turnor Lake (Northern Saskatchewan Health Services 2009b; 2019 to 2021 KP interview program). The nursing station has a nurse practitioner on staff and physician services once a week from the La Loche Health Centre and Hospital. Dental therapy services are provided by the MLTC every few months, though the schedule may vary. Mental health therapy is a service provided in the community, with an approved list of therapists provided by Health Canada. Therapists are brought in when required, such as during a community crisis (2019 to 2021 KP interview program).

Services provided at the Annie Bagg Memorial Nursing Station include the following (Northern Saskatchewan Health Services 2009b; 2019 to 2021 KP interview program):

- addiction services;
- dental therapy;
- home care services;
- mental health / holistic services;
- primary care services; and
- TeleHealth services.

While the nursing station has regularly scheduled physician visits, residents feel the access to health services could be improved (2019 to 2021 KP interview program). The closest hospital to the community is the La Loche Health Centre. For services not available in Birch Narrows or La Loche, residents travel to Île-à-la-Crosse or Meadow Lake. Birch Narrows Dene Nation members would like a larger heath centre and a treatment centre for addictions and mental health in the community itself (BNDN-JWG 2020) as they must travel for any specialist treatments, often as far as Saskatoon.

19.3.2.1.4 Buffalo River Dene Nation (Dillon)

The Buffalo River Health Clinic is located in Dillon. It is a primary care clinic that has approximately 29 staff members, including administrative staff and nursing staff, and provides the following services (Northern Saskatchewan Health Services 2009c; 2019 to 2021 KP interview program):

- addiction services;
- home care services;
- medical transportation;
- primary care services;
- wellness coordinator; and
- tuberculosis services.

For services not available at the Buffalo River Health Clinic, BRDN and Dillon residents travel to St. Joseph's in Île-à-la-Crosse. If further services not offered are required, members travel to Meadow Lake, North Battleford, Prince Albert, and Saskatoon. Services that could be used in the community include increased cancer screening. Key person interviewees shared that, when cancer is detected within the community, it is often at a more advanced stage, thus resulting in a greater likelihood of adverse outcomes (2019 to 2021 KP interview program).

Buffalo River Dene Nation members have noted a lack of social services and facilities in the community. Facilities the community would like to see include a youth centre, Elder's centre, and friendship centre (BRDN-JWG 2020; 2019 to 2021 KP interview program).

For those afflicted by mental health and addictions issues, there are no facilities within the community for BRDN members. Currently, there is no aftercare in the community to assist those who return from facilities to treat mental health and addictions. The only option offered within the community for those seeking mental health and addiction support is the clinic (BRDN-JWG 2021d).

The quality of the roads leading into the community has also been noted to extend emergency response times for ambulances that travel from Buffalo Narrows or Île-à-la-Crosse (2019 to 2021 KP interview program; 2020 youth workshop). Providing adequate Elder care in Dillon is difficult within the community as there is no long-term care facility. Previously, Elders would remain in the community and family would care for them, but as more BRDN members participate in the wage economy and family members leave the community for work and education, Elders may have to leave the community for care if they require assistance. There is currently no hospice care in the community to assist in meals and home care for Elders (BRDN-JWG 2020; 2019 to 2021 KP interview program).

19.3.2.2 Social Services

The MLTC provides several social services across a broad region, including the LSA. The MLTC runs programs for members of the CRDN, BNDN, and BRDN. Programs include the Meadow Lake Child and Family Services, Youth Development Program, and the Justice Program, and are coordinated by a committee of band councillors associated with the MLTC who make decisions on funding and programming. Programs include the following:

- **The Child and Family Services Program:** includes child prevention services, alternative/foster care services, family connections services, and family support. The program relies more heavily on prevention workers who work directly with families; it is preferred that children remain with their families whenever possible rather than apprehending and placing them in alternative/foster care (MLTC 2018; 2019 to 2021 KP interview program).
- **The Youth Development Program:** includes support to maintain youth programing, team building, prevention programming, and the National Aboriginal Youth Suicide Prevention Strategy. Resources distributed include those from Educators for Social Responsibility, Reclaiming Youth, Circle of Courage, Violence Prevention, Self Esteem Information, Developmental Assistance, and Search Institute (MLTC 2018).
- **The Sport Program:** is a portion of youth development provided by the MLTC. To provide this program, the MLTC partners with various organizations such as the Federation of Sovereign Indigenous Nations Sports, Culture, and Recreation Board; Saskatchewan Sports; sport governing bodies; and Saskatchewan Lotteries. The purpose of this program is to support the delivery of community-based recreation and leisure programming and to give First Nations youth an opportunity to develop and grow into young adults (MLTC 2021).
- **The Justice Program:** provides restorative and community-based justice services. The program is facilitated through a Justice Coordinator who provides services, which include mediation files, fine options plans, court appearances, and other justice initiatives (MLTC 2018). It was indicated during KP interviews that mediation and circles are generally supported in Dillon whenever possible through the Justice Program due to tensions with the RCMP (2019 to 2021 KP interview program).

19.3.2.2.1 Clearwater River Dene Nation

Programs offered in the CRDN include Project Venture, which is a youth crime prevention project that began in 2017 and is provided to high-risk Indigenous youth from Clearwater River School and Dene High School. Project Venture involves getting high-risk Indigenous youth out on the land and active in their culture. The program uses outdoor activities and games to teach youth about their Indigenous culture as well as life skills such as problem solving and communication. The program also aims to reduce substance abuse, drug-related crime, and interpersonal violence. The Government of Canada provided $2.2 million in funding towards the project, which was distributed over five years between 2016 to 2021. In 2021, Public Safety Canada was conducting performance monitoring and assessment of the program (Public Safety Canada 2021).

Clearwater River Dene Nation KP interviews identified community concerns in relation to drug and substance abuse and high rates of suicides. The KP interviews indicated the need for additional support for the provision of outreach programs that encourage healthy life skills, manage substance abuse, and assist with suicide prevention (TSD V.3: CRDN). At the time of writing, information on social supports in the CRDN was not available.

19.3.2.2.2 Métis Nation – Saskatchewan Northern Region 2

19.3.2.2.2.1 La Loche

The La Loche Friendship Centre is an important resource and gathering place in the community and is dedicated to promoting sport, culture, recreation, youth, and community (La Loche Friendship Centre 2020). It is a not-for-profit organization operated by the Aboriginal Friendship Centres of Saskatchewan, which also runs friendship centres across the province and is funded by the Government of Canada via the Native Association of Friendship Centres and through provincial and territorial associations (Aboriginal Friendship Centres of Saskatchewan 2018). Programs offered at the La Loche Friendship Centre include the following:

- **The Justice Program:** focuses on mediation in the court system. The purpose of the program is to assist infrequent offenders or those who have committed non-violent offences such as vandalism. To participate in the program, victims of the offender must agree that the individual can participate (2019 to 2021 KP interview program).
- **The Youth Intervention Program:** aimed at young offenders within the community between the ages of 14 and 23, and participation is mandated by their probation officers. The program focuses on integrating youth into society and providing them with training and employment opportunities (2019 to 2021 KP interview program). The program has one staff member.
- **The Homelessness Initiative:** provides a sheltered indoor space for the unhoused to spend their time during the day. The initiative focuses on providing necessary services to those in need, including seasonally appropriate clothing and three meals a week (i.e., Monday, Wednesday, and Friday) to unhoused individuals and low-income families (2019 to 2021 KP interview program).
- **The Family Support Program:** works with at-risk families mandated by the Ministry of Social Services to participate. Those mandated into the program are at a higher risk of children being removed from the home based on court decisions. Other clients use diversion services, which aim to assist in the development of healthy families and children; these clients are either community referred or walk-in. The program has two program workers and a coordinator. The program has a diverse group of clients and over 100 applicants (La Loche Friendship Centre 2020; 2019 to 2021 KP interview program).

Other social services in La Loche include Project Venture (Section 19.3.2.2.1, Clearwater River Dene Nation), Kids First North, and Healthy Moms, Babies and Families:

- **Kids First North:** a voluntary, confidential support program designed to help families with children in the early years of development (i.e., aged five and under). It aims to provide support and knowledge and build family strengths. It is provincially funded and directed (Kids First North 2018).
- **Healthy Moms, Babies and Families:** a prenatal and postnatal nutrition support group that assists in transportation to and from checkups and referrals to other agencies in the community (Northern Business Directory 2017). The program services Indigenous Groups, those living in rural and remote areas, single parents, and teen parents. Funding is provided by the Canada Prenatal Nutrition Program and the Public Healthy Agency of Canada (Public Health Agency of Canada 2016).

Health issues vary between different parts of the population. Men are considered to have a poorer health status due to lifestyle and employment. Men are more often found to be homeless in La Loche compared to women in the community (Prairie ID Consulting 2015; 2019 to 2021 KP interview program). During KP interviews, participants expressed concern in relation to the lack of health and wellness resources available in La Loche and the prevalence of addiction (i.e., drug and alcohol) and mental health issues in the population (2019 to 2021 KP interview program; 2020 youth workshop).

19.3.2.2.2.2 Buffalo Narrows

The Buffalo Narrows Friendship Centre oversees three programs in the community:

- **Kids First North:** designed to assist families with children in the early years of development (i.e., aged five and under; Kids First North 2018; 2019 to 2021 KP interview program).
- **Family Support Services:** mandated by the provincial government and includes three field workers (Government of Saskatchewan 2018b). The program focuses on families in crisis within the community. Workers check in on local families and provide recommendations based on living conditions and family structure. If recommended, children may be removed from the home temporarily. Parents continue to be contacted when children have been removed to determine whether children can be reunited with their parents in the future (2019 to 2021 KP interview program).
- **The Aboriginal Head Start School Program:** consists of early education for children aged three and four to prepare them for kindergarten. Programming is conducted at a secondary location near the Little Eagles Daycare and Twin Lakes Community School (2019 to 2021 KP interview program).

Homeless people in Buffalo Narrows often spend their day at the Buffalo Narrows Friendship Centre. Occasionally, the Friendship Centre will provide meals for the homeless but is limited by available funding. Community events at the Friendship Centre are also limited due to funding (2019 to 2021 KP interview program).

Youth in the community often suffer from mental health issues, such as depression, aggression, and addictions (2019 to 2021 KP interview program). Lack of full-time mental health professionals in the community is considered an issue by residents (MN-S 2019). Buffalo Narrows is working to address these concerns through programs such as the Buffalo Narrows NorthSask Victim Services and Children Exposed to Violence:

- **NorthSask Victim Services:** include crisis intervention, information support, and referrals to other specialized programs for victims of crime and is offered by the Government of Saskatchewan (Government of Saskatchewan 2018b).

- **Children Exposed to Violence:** a government program in Saskatchewan aimed at children and youth who have witnessed or experienced interpersonal violence or abuse, with the goal of preventing them from becoming victims or perpetrators of violence and abuse in the future (Government of Saskatchewan 2018b).

The SHA's Recovery Plan for the 2021 to 2022 period aims to address recommendations in the Mental Health and Addictions Plan (Saskatchewan Health Authority 2021).

Changes in water quality were also raised by community members. Various residents of Buffalo Narrows noted that a primary issue for health is the differences in the water of the lakes in recent years, with an increase in sludge in the river system. This change affects not only the ability of community members to drink the water when out on the land, but also the fish and animals the community uses as food (2019 to 2021 KP interview program).

19.3.2.2.3 Birch Narrows Dene Nation and Turnor Lake

Along with programs run in the community through the MLTC, the BNDN has its own Youth Development Program that has run annually since 2005. The Youth Development Program provides an opportunity for youth in the community to get together in a setting that combines traditional and Christian values to share meals and spend time together. The program runs for four days and three nights and ends with a candlelight vigil. Other communities in the region, such as La Loche, have participated in the program in the past (2019 to 2021 KP interview program).

The community is looking to increase their outreach to members through a range of means, including the following:

- establishing programming for Elders;
- establishing a women's and men's group; and
- providing youth group activities.

The BNDN wants to establish programming to ensure members with special needs are included and supported. In addition, the BNDN would also like continuing ongoing support for the community crisis team and increased education on community social issues such as addictions, suicide prevention, and reducing shame (BNDN 2018). The BNDN would also like a youth centre since the old one has closed (BNDN-JWG 2020; 2020 youth workshop).

Results from KP interviews noted that stigmatization prevents people from coming forward when they have mental health issues, though people are becoming more open with their mental wellness and seeking help. There is reported to be a lack of supports for mental health in BNDN and Turnor Lake. Intergenerational trauma, feelings of marginalization in society, and addictions are major issues in mental health within the community and contributes to poor health (2019 to 2021 KP interview program).

Forest fires have also been identified as an issue due to smoke inhalation and proximity to communities, homes, and other infrastructure, including hunting cabins. Forest fires also reduce the availability of country foods as animals move out of the area after a fire (2019 to 2021 KP interview program).

Social assistance is provided in the BNDN through the MLTC. Along with funding assistance, the MLTC brings programs in for clients, such as social life skills and helping members apply for jobs (2019 to 2021 KP interview program).

Social services programs available at facilities such as the Annie Bagg Memorial Nursing Station are available for both BNDN members and Turnor Lake residents (2019 to 2021 KP interview program).

19.3.2.2.4 Buffalo River Dene Nation (Dillon)

Programs funded by Jordan’s Principle are run out of the health centre. Jordan’s Principle is a legal rule established in 2016 by the Government of Canada after the Canadian Human Rights Tribunal determined the government’s method for services for First Nations children in Canada was discriminatory. Through the funding provided through Jordan’s Principle, the BRDN is able to provide mental health supports to youth in the community, as well as cost assistance for families with disabled children. Program facilitators assist First Nations children in accessing products, services, and supports when they need them, which includes health, social, and educational needs (Government of Canada 2021b).

During National Addictions Awareness Week in 2019, many programs were run to inform residents of the causes of addictions and how to prevent or reduce the effects. These programs were offered in association with the health centre and with funding from Jordan’s Principle (2019 to 2021 KP interview program).

Currently, there is no aftercare in the community to assist those who return from facilities to treat mental health and addictions within the community. The only option offered within the community for those seeking mental health and additions support is the clinic (BRDN-JWG 2021e). The community also has a high suicide rate, due in part to the lack of available care. There is a desire within the community to offer a program on mental health awareness (2019 to 2021 KP interview program). Currently, the only available care is at the health centre (BRDN-JWG 2021e). Buffalo River Dene Nation members have noted a lack of social services and facilities in the community. Facilities the community would like to see include a youth centre, Elder’s centre, and friendship centre (BRDN-JWG 2020; 2019 to 2021 KP interview program).

Residents are often reluctant to seek assistance. Reasons for this include bullying from other residents and a reluctance to own up to their own actions. Residents are often struggling through grief and loss (2019 to 2021 KP interview program).

19.3.2.3 Overall Health

Table 19.3-4 provides a summary of key health outcomes for the population at the regional level. Health indicator data are presented at the level of the Keewatin Yatthé Health Region (Figure 19.2-3), the health authority that included the LSA communities before Saskatchewan amalgamated the health regions in the province in 2017. Data are presented at the regional level to protect the confidentiality of the communities in the LSA, many of which have small populations; data at the community level are not publicly available. A detailed discussion of health outcomes, including relevant quantitative data, is included in the Socio-economic Baseline Report (Annex X, Section 6.7).

Table 19.3-4: Summary of Regional Health Issues and Outcomes

Indicator	Health Issue and Outcomes
Infant health	▪ The infant mortality rate in northern Saskatchewan was 10.6 deaths per 1,000 live births in the period between 2004 and 2013 and was lower in the Keewatin Yatthé Health Region over the same period at 7.6 infant deaths per 1,000 live births
Life expectancy and causes of death[(a)]	▪ The crude age-standardized general mortality rate (i.e., death by all causes) in northern Saskatchewan in the period from 2005 to 2014 was 943 deaths per 100,000 compared to 790 per 100,000 in the province as whole. The age-standardized general mortality rate for Keewatin Yatthé Health Region in the same period was 1,067 per 100,000 population (NSPHU 2017) ▪ The leading causes of death in the northern Saskatchewan are injuries, cancers, circulatory diseases, and respiratory diseases (which includes chronic disease) (NSPHU 2017) ▪ Between 2005 and 2014, 74% of all deaths in northern Saskatchewan were premature, having occurred in individuals aged 74 years and younger (NSPHU 2017). Preventable deaths are linked to factors that can be modified, such as physical activity, healthy eating, smoking, or alcohol consumption, in addition to public health interventions such as vaccination or safety legislation (NSPHU 2017)
Chronic disease	▪ In Canada, two-thirds of all deaths each year are a result of major chronic diseases (e.g., cardiovascular diseases, cancers, chronic respiratory diseases, diabetes) and are largely preventable (Public Health Agency of Canada 2016)
Diabetes	▪ Diabetes was the third most common cause of mortality for those aged 60 and above in northern Saskatchewan in the 2005 to 2014 period (NSPHU 2017) ▪ The age-standardized prevalence rate of diabetes in northern Saskatchewan was over 12%, which was the highest for the health regions in Saskatchewan and higher than the provincial prevalence rate of just under 8% (Government of Saskatchewan 2016)
Cancer	▪ Breast cancer was the cancer with the highest incidence rate in females in northern Saskatchewan in the 1995 to 2014 period ▪ Prostate cancer was the cancer with the highest incidence rate for males in the three northern health regions in the 1994 to 2014 period ▪ Lung cancer was the second most prominent cancer for both males and females in northern Saskatchewan. Lung cancer incidence rates in females in the northern health regions remained consistently higher than provincial rates over the 1995 to 2014 period, climbing to 82.5 per 100,000 in the 2011 to 2014 period
Mental health	▪ The rates of individuals self-reporting their mental health status as excellent or very good in northern Saskatchewan has remained relatively stable from the 2007 to 2008 period to the 2013 to 2014 period, ranging between 56% and 64%, which is lower than the provincial rate of 68% to 72% for the same period ▪ The northern Saskatchewan off-reserve population self-reported higher rates of life stress compared to the province as a whole. Between the 2007 to 2008 and 2013 to 2014 periods, northern Saskatchewan rates ranged from 19% to 23%, while provincial rates ranged from 19% to 20%
Personal behaviours	▪ In 2014 in northern Saskatchewan, the smoking rate was 49% for females and 46% for males as compared to the provincial rate of 20% for females and 23% for males. The overall smoking rate of northern Saskatchewan in the 2013 to 2014 period was 41%, which is high in comparison to many other northern regions in Canada ▪ The rates of active or moderately active physical activity levels in northern Saskatchewan ranged between 50% in the 2007 to 2008 period and 58% in the 2013 to 2014 period. Corresponding rates in Saskatchewan ranged between 48% and 53% (NSPHU 2016) ▪ The proportion of the northern population that reports consuming five or more servings of fruit and vegetables a day has remained fairly stable; it was 35% between 2007 and 2008 and 41% between 2013 and 2014. During the same time period, the provincial rate ranged between 35% and 39% (NSPHU 2016)

Source: NSPHU 2016, 2017; Government of Saskatchewan 2016.

a) Mortality data are taken from the Saskatchewan Vital Statistics Database and exclude out-of-province deaths.

19.3.2.4 Diet

Diet in the LSA consists of the balance between a traditional diet and a store-bought diet. An overview of the traditional diet is provided below, as well as an overview of the challenges of food insecurity among Indigenous Peoples, including residents of the LSA communities.

19.3.2.4.1 Traditional Diet

Harvesting country foods (i.e., Traditional Foods) is important to Indigenous communities for a range of reasons, including its importance in supporting social bonds within families and communities, maintaining cultural identities, forming a nutritious part of the Indigenous diet (Council of Canadian Academies 2014), and offsetting the high cost of living in northern Saskatchewan and food insecurity (Council of Canadian Academies 2014; CVMPP 2005). The importance of harvesting country foods was shared by the Indigenous Groups in the LSA as noted in the following quotes:

> Many CRDN members depend on food harvested from Up North. Diminished opportunities to secure food will have a tangible and substantial negative economic impact on community families. This impact will be compounded if foods from preferred harvesting areas are not deemed to be safe, forcing households to resort to imported store-bought food. As noted by one CRDN member, being cash-poor and eating well is not the same as simply being cash-poor. Not only would such a shift impose an economic (cash) hardship; it would deprive CRDN families of healthy, nutritious, and culturally affirming foods, customs, and traditions which are fundamental to Denesųłiné heritage and identity. (TSD V.1: CRDN)

> Reliance on the land is still considerable, members estimating that on average 70% of their food comes from hunting, trapping, fishing, and gathering. Another member estimates that 50% of his diet consists of Traditional Food, the likes of fish, duck, and moose. Others in the community almost exclusively rely on Traditional Food: one member, for example, estimates that 95% of his diet comes from the land, primarily moose but also deer, grouse, and fish, as well as dried meat; one couple lived for an entire year in a cabin up the river, eating bannock, fish, rabbit, deer, and the like; another member eats Traditional Food every day. The closest store to St. George's Hill is in Dillon, which is 9 km from St. George's Hill and 26 km from Michel Village. Additionally, store-bought food is not only too expensive but also unhealthy, leaving them with no other option than to live off the land. (TSD IV: MN-S)

> Mostly off the land instead of always having to run to the store where you spend your money on high-priced food. . .. I . . . hardly eat . . . from the store. I always make sure I have a lot of moose meat, fish and rabbits and whatever I can get. . .. I've been living that way for quite a while now, ever since . . . I was able to get a gun and go out and shoot. And I have nets that I get people to set for me and I get fish. . .. It's very important to me [for her to get her food from the land]. Because . . . when I go to the south . . . I go to the restaurants: I eat fast food. Oh, I get sick. I really get sick for a couple days…. (TSD II: BNDN)

> Well, like we're talking about, this is very important, . . . fishing and hunting and you know all these animals, what we use it for food, that's what we care for. . .. I don't [want to] buy a big steak all the time from the store here because it costs so . . . much. You know? We like fishing, we like fish. If I didn't eat whitefish for one month, . . . I get hungry for fish. I [have to] get one or two, you know. (TSD III: BRDN)

For Indigenous Peoples, one aspect of food security and healthy diets is continued access to Traditional or country foods. "In Saskatchewan, traditional food harvesting (hunting, fishing, and gathering of wild plants), is an important part of the Traditional Food systems and food security of First Nations communities" (Chan et al. 2018). The *First Nations Food, Nutrition and Environment Study* (Chan et al. 2018) found that almost all First Nations adults in Saskatchewan (i.e., 94%) reported eating Traditional Foods as part of their diet. Of the population included in the survey, First Nations adults in Saskatchewan ate land mammals (i.e., 83%), berries (i.e., 78%), fish (i.e., 51%), wild birds (i.e., 46%), and wild plant foods and teas (i.e., 43%) (Chan et al. 2018). For more information on traditional diets in the LSA refer to Section 15, Human Health.

The communities in the LSA have noted the importance of Traditional Foods in their diet. The CRDN engage in land-based activities in part to provide food for their families, and members are concerned about the potential for harvesting contaminated resources in their traditional territory (TSD V.1: CRDN; TSD V.2: CRDN). The CRDN noted that members' reliance on the land for sustenance, physical health, mental health, and transference of culture is considerable (TSD V.2: CRDN).

Métis Nation – Saskatchewan citizens who participated in the IKTLU Study estimate that, on average, 70% of their diet comes from hunting, trapping, fishing, and gathering plants, with one citizen estimating that 95% of his diet came from the land (TSD IV: MN-S). Aside from continuing to eat as their ancestors did, MN-S citizens rely on Traditional Foods to supplement store-bought food because going to a grocery store for some citizens can involve travel and because store-bought food is expensive and considered unhealthy.

The proportion of Traditional Food varies for BRDN members depending on their lifestyle. Some members estimate that their diet is over 80% country foods, while others note that the amount of country foods in one's diet depends on lifestyle and the season (BRDN-JWG 2021e). The BNDN and BRDN noted that approximately 80% of their populations were active in the traditional economy, which included harvesting for personal, family, and community consumption (BNDN-JWG 2021d; BRDN-JWG 2021a).

19.3.2.4.2 Food Insecurity

Food insecurity is "the inability to acquire or consume an adequate diet quality or sufficient quantity of food in socially acceptable ways, or the uncertainty that one will be able to do so" (Health Canada 2020). According to the Regional Health Survey Phase 3 (FNIGC 2018), people living in First Nations communities (i.e., reserves and settlements) have higher rates of food insecurity nationally than the general population in Canada, though the rate has decreased slightly for adults since the Regional Health Survey Phase 2, which was conducted between 2008 and 2010. Access to Traditional Foods is an important way to help alleviate food insecurity for First Nations people as more than half of First Nations adults who had Traditional Foods shared with their households reported always or almost always eating nutritious, balanced meals. Traditional Foods are culturally, spiritually, or nutritionally valuable native plant or wildlife species that are harvested locally. They reflect Indigenous Knowledge, and the relationship Indigenous Peoples have with the area where they live (Council of Canadian Academies 2014). More First Nations adults were considered severely food insecure when they never had Traditional Food shared with their household (i.e., 17.4%; FNIGC 2018).

Statistical information describing provincial Indigenous food insecurity is available through the *First Nations Food, Nutrition and Environment Study* (Chan et al. 2018). For First Nations people living in Saskatchewan, 37% of First Nations households were classified as food insecure. Twenty-seven percent of all households were considered moderately food insecure and 10% were considered severely food insecure. Households with children experienced greater food insecurity than households without children (i.e., 41% and 25%, respectively [Chan et al. 2018]).

Grocery stores in the LSA are in La Loche (i.e., CenterPoint Grocery and Northern Store), Birch Narrows (i.e., Birch Narrows Grocery-Gas Bar), and Buffalo Narrows (i.e., Northern Store). There is a convenience store in the BRDN (Dillon). Prices in grocery stores in the communities have been noted to be high due to transportation costs, low volumes of sales as compared to larger centres, and limited competition. Many residents purchase groceries when they travel to larger cities such as North Battleford, Prince Albert, and Saskatoon. The types of foods available and costs influence diets in the LSA. In La Loche, the President's Choice modular farm is used to provide fresh produce to students in La Loche schools. There is a community garden located in Buffalo Narrows with a food bank available. Country foods are typically shared with Elders and other community members by family and friends (2019 to 2021 KP interview program).

19.3.3 Neighbourhood and Physical Environment Well-Being

Neighbourhood and physical environment refers to the built environments within communities and the programs and services intended to support the well-being of community residents (e.g., recreation centres, other facilities to support the delivery of services).

19.3.3.1 Housing

Housing in the LSA is described for both First Nations on reserve and for other communities (i.e., off-reserve) as the ownership and maintenance of housing between these communities is distinct. A detailed discussion of housing in the LSA communities is presented in the Socio-economic Baseline Report (Annex X, Section 6.9).

19.3.3.1.1 On-Reserve Housing

As prescribed by the Government of Canada, "Providing and managing housing on reserve is the responsibility of First Nations. The Government of Canada provides funding to First Nations for safe and affordable on-reserve housing" (Indigenous Services Canada 2016). In the LSA, housing on reserve is largely provided by the bands, while some housing is privately owned by members in Dillon, Birch Narrows, and Clearwater River Band No. 222, which is not fully represented in Census of Population data (2019 to 2021 KP interview program). The bands maintain current housing stock and build new houses. Table 19.3-5 outlines the private households by tenure and occupied private dwellings by conditions for LSA reserves (i.e., CRDN, BNDN, and BRDN). It is important to note that the dataset has random rounding (i.e., to 0 or 5), resulting in not all values adding up to totals; thus, the data presented are approximate values rather than precise data and should be interpreted as such.

Due to limited funding and high demand, housing can be slow to build and maintain, which results in members moving to different communities until housing is available (2019 to 2021 KP interview program). Housing was noted as a serious issue at Clearwater River Band No. 222 (TSD V.3: CRDN). In particular, the need for better housing was identified, and there is some concern regarding a lack of available land supply for housing (TSD V.3: CRDN). Housing conditions are variable in Dillon and Birch Narrows (2019 to 2021 KP interview program). Housing was noted as an important part of community well-being by the BRDN, and it was indicated that there is currently a housing shortage in Dillon (BRDN-JWG 2020). There is currently a waitlist for band housing in Birch Narrows and the BRDN (i.e., Dillon). In 2020, there was a waitlist of 30 or more people in Birch Narrows, and people may be on the waitlist for several years (2019 to 2021 KP interview program). In Dillon, the housing waitlist is extensive[10] and homelessness is an issue. In 2019, the BRDN bought a camper trailer for those in need as there is no formal housing for the homeless. Due to the high demand for housing, prioritizing housing for families over single people occurs for members of both the BNDN and BRDN.

Funding from Crown-Indigenous Relations and Northern Affairs Canada depends on population statistics, and interviewees noted that not everyone was available for the census count, making the statistics inaccurate (2019 to 2021 KP interview program).

In 2016, most dwellings on reserve in the LSA required regular maintenance or minor repairs (i.e., 62% in Clearwater River Band No. 222, 69% in Birch Narrows, and 59% in the BRDN [Dillon]; Table 19.3-5). Major repairs required in Birch Narrows and the BRDN (Dillon) include treating black mould and fixing or replacing roofing. Black mould is a common problem in Dillon and Birch Narrows and can often result in families moving into temporary housing while issues are addressed (2019 to 2021 KP interview program).

Table 19.3-5: Private Households by Tenure and Occupied Private Dwellings by Conditions for Local Study Area Reserves, 2016

Metric	CRDN[a,b,c]	BNDN[a,b,d]	BRDN[a,b,e]
Private households by tenure[f,g]	185	130	235
Owner	10 (5%)	0 (0%)	35 (15%)
Renter	15 (8%)	10 (8%)	15 (6%)
Band housing	170 (91%)	120 (92%)	180 (77%)
Occupied private dwellings by dwelling condition[g,h]	185	130	230
Only regular maintenance or minor repairs needed	115 (62%)	90 (69%)	135 (59%)
Major repairs needed	75 (41%)	40 (31%)	100 (43%)

Source: Statistics Canada 2017a.
a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 or, in some cases, 10. Totals may not add up to 100% due to rounding.
b) In addition to random rounding, area and data suppression have been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If a community has a population of less than 40 persons, only the total population count is available. Suppression of data can be due to poor data quality or other technical reasons.
c) Statistics Canada refers to CRDN as Clearwater River Dene Nation Band 222.
d) Statistics Canada refers to BNDN as Birch Narrows Dene Nation – Turnor Lake 193B.
e) Statistics Canada refers to BRDN as Buffalo River Dene Nation Band 193.
f) Tenure refers to whether the household owns or rents their private dwelling. The private dwelling may be situated on rented or leased land or be part of a condominium. A household is considered to own their dwelling if some member of the household owns the dwelling even if it is not fully paid (e.g., if there is a mortgage or some other claim on it). A household is considered to rent their dwelling if no member of the household owns the dwelling. A household is considered to rent that dwelling even if the dwelling is provided without cash rent or at a reduced rent or if the dwelling is part of a cooperative. For historical and statutory reasons, shelter occupancy on IRs or settlements does not lend itself to the usual classification by standard tenure categories. Therefore, a special category, band housing, has been created and is included in the classification of tenure.
g) 25% sample data.
h) Dwelling condition refers to whether the dwelling is in need of repairs. It does not include desirable remodelling or additions.
CRDN = Clearwater River Dene Nation; BNDN = Birch Narrows Dene Nation; BRDN = Buffalo River Dene Nation; IR = Indian Reserve.

[10] The waitlist count is not exact, with some interviewees indicating that it is over 100 people; however, it should be noted that some applicants reapply multiple times (2019 to 2021 KP interview program).

19.3.3.1.2 Community Housing

Table 19.3-6 presents the number of private households by tenure and condition for La Loche, Turnor Lake, Buffalo Narrows, and other northern villages and hamlets within the LSA. Renting is more common in La Loche, with most dwellings rented by residents (i.e., 430 rented dwellings versus 225 owned by occupants) from local companies such as Methy Housing. Except for Turnor Lake, most private dwellings in the other municipalities in the LSA are owned by the occupant.

In La Loche, Buffalo Narrows, Turnor Lake, St. George's Hill, and Michel Village, most private dwellings require regular maintenance or minor repairs. In Black Point, most private dwellings require major repairs (Table 19.3-6).

Table 19.3-6: Private Households by Tenure and Occupied Private Dwellings by Conditions for Local Study Area Communities, 2016

Metric	La Loche[a,b]	Buffalo Narrows[a,b]	Turnor Lake[a,b]	Black Point[a,b]	St. George's Hill[a,b]	Michel Village[a,b]
Private households by tenure[c,d]	655	400	45	20	45	20
Owner	225 (34%)	245 (61%)	20 (44%)	10 (50%)	30 (67%)	15 (75%)
Renter	430 (66%)	150 (38%)	20 (44%)	0 (0%)	15 (33%)	0 (0%)
Occupied private dwellings by dwelling condition[d,e]	655	400	45	15	45	25
Only regular maintenance or minor repairs needed	505 (77%)	345 (86%)	30 (67%)	0 (0%)	25 (56%)	15 (60%)
Major repairs needed	155 (24%)	55 (14%)	15 (33%)	10 (67%)	20 (44%)	0 (0%)

Source: Statistics Canada 2017a.

Note: Due to supressed data, Ducharme Lake and Garson Lake have been omitted from the table.

a) Data have been subjected to a confidentiality procedure known as random rounding whereby values are rounded either up or down to a multiple of 5 or, in some cases, 10. Totals may not add up to 100% due to rounding.

b) In addition to random rounding, area and data suppression have been adopted to further protect the confidentiality of individual respondents' personal information. Area and data suppression results in the deletion of all information for geographic areas with populations below a specified size. For example, areas with a population of less than 40 persons are suppressed. If a community has a population of less than 40 persons, only the total population count is available. Suppression of data can be due to poor data quality or other technical reasons.

c) Tenure refers to whether the household owns or rents their private dwelling. The private dwelling may be situated on rented or leased land or be part of a condominium. A household is considered to own their dwelling if some member of the household owns the dwelling even if it is not fully paid, for example, if there is a mortgage or some other claim on it. A household is considered to rent their dwelling if no member of the household owns the dwelling. A household is considered to rent that dwelling even if the dwelling is provided without cash rent or at a reduced rent or if the dwelling is part of a cooperative.

d) 25% sample data.

e) Dwelling condition refers to whether the dwelling is in need of repairs. It does not include desirable remodelling or additions.

Additional information on off-reserve housing in the LSA communities was provided through KP interviews. Some housing in the LSA communities is owned by the Northern Lights School Division (NLSD), the RCMP, and the SHA and is rented out to their respective employees. The village of La Loche also has made efforts to secure housing for nurses of the health district.

Funding is the largest barrier to further housing being built within the communities, as well as part of the cause for slow repairs to existing rental housing. As well, subdivisions are slow to build, with some subdivisions not containing full municipal utility access. Due to the lack of housing available, many residents live in crowded conditions and stay with family members or friends (2019 to 2021 KP interview program).

Housing is reported to be very overcrowded in La Loche, and some people reside in houses with 10 to 15 other people (2019 to 2021 KP interviews). High rental costs and crowded conditions, along with lack of available housing relative to the demand, is also common in Buffalo Narrows. Although there is considered to be less homelessness in Buffalo Narrows compared to La Loche, exact numbers are unknown as many people stay with friends and relatives (Prairie ID Consulting 2015). The lack of housing in municipalities in the LSA was noted by Métis citizens as something that detracts from community well-being (MN-S-JWG 2020).

Housing shortages also affect the northern hamlets and settlements in the LSA, which do not have enough housing or developed land to meet demand, often resulting in younger residents moving away. The people in northern hamlets and settlements believe that many residents would return if more housing were made available (2019 to 2021 KP interview program). In La Loche, Buffalo Narrows, Turnor Lake, St. George's Hill, and Michel Village, most private dwellings require regular maintenance or minor repairs (Table 19.3-6). Issues include mould and inadequate windows and doors. In Dillon, those with mould in their homes receive modular homes (2019 to 2021 KP interview program). In La Loche, the homes are in average condition and typically last 30 years. Some of the houses in La Loche do not have running water or sewage facilities. While the La Loche community has the contractors for repairs, their access to funding is limited. The community also has difficulty in collecting taxes since many residents refuse to pay due to the mindset that others are not paying taxes and they are getting minimal services (2019 to 2021 KP interview program). Michel Village has 26 houses that are in fair condition and seasonally inhabited.

19.3.3.2 Recreation

This subsection discusses existing recreational infrastructure and events that occur within the LSA.

19.3.3.2.1 Clearwater River Dene Nation

Recreation infrastructure provided to CRDN members living on reserve includes an indoor rink and an outdoor rink, a beach volleyball court, a local playground, a community hall, a small bike park, and ball diamonds (CRDN 2013). NexGen has also supplied recreational equipment such as an indoor gym equipment for the CRDN Youth Centre in 2020. At the time of writing, additional information on recreational services and facilities in CRDN was not available. This information will be integrated when available.

19.3.3.2.2 Métis Nation – Saskatchewan Northern Region 2

19.3.3.2.2.1 La Loche

La Loche has a hockey arena, town park, skateboard park, two outdoor rinks, and a library available to residents. NexGen provides funding for the La Loche Sports, Recreation and Culture Board employees to maintain and operate the recreational facilities including the hockey arena and outdoor rinks. This funding also supports other recreational and cultural activities (e.g., crafts). In a partnership with the La Loche Sports, Recreation and Culture Board, NexGen provided fencing for the children's spray park in La Loche. The nearby lakes offer a range of activities including fishing, boating, swimming, camping, sightseeing, picnicking, and touring. In the winter, residents hunt, ice skate, snowmobile, and ski. The La Loche Arena Complex includes the Robbie Fontaine Memorial Arena, which is used regularly throughout the winter months. Sports programs such as hockey are available through the arena. Recreation programs for students such as volleyball are supported through the high school (NLSD 2020a).

Since 2017, NexGen has provided support to minor volleyball and hockey teams in the LPA communities. This supports local youth engagement in sports and provides opportunities to participate in sporting events throughout the province and across Canada. These sports programs were suspended during the pandemic but resumed for the 2021/2022 year and are an ongoing initiative.

Bingo and other community and social events are also available to the residents of La Loche. Bingo is provided by the local radio station, CHPN Radio, which also provides community TV (Northern Business Directory 2017). In 2016, a community wellness plan was developed for the community of La Loche, which included the planning of family events such as picnics to celebrate Mother's Day, Father's Day, and National Aboriginal Day (La Loche 2018, Appendix F). Treaty Days are an annual social event held in La Loche.

Since 2018, NexGen has provided funding for ongoing recreational programming through the La Loche Sports, Recreation and Culture Board. This programming provides structured after-school and summer holiday recreational events and opportunities for the youth community and community members, and consists of activities such as beadwork, holiday decorating, traditional music lessons, and free public skating. The programming was paused in Q2 2020 due to disruptions associated with the pandemic and resumed in Q3 2020. Recreational programming was adjusted during the pandemic to accommodate all COVID-19 related restrictions and public health orders.

Dene High School has a weight room for students that is also open to community members for a small fee. As noted in the KP interview program and youth workshop, the facility is in regular use and is fully staffed to assure being open to the community (2019 to 2021 KP interview program; 2020 Youth Workshop).

19.3.3.2.2.2 Buffalo Narrows

Buffalo Narrows has various recreation opportunities. There is a hockey arena, the Lakeview Complex Arena, as well as a baseball and soccer field. The Lakeview Complex Arena uses artificial ice and is heavily used by the community (NLSD 2020b; 2019 to 2021 KP interview program).

Buffalo Narrows has a volunteer-run community recreation board. The board relies on fundraising and grants to offer recreation events. Events include movie nights, gym nights, craft nights, and women's and men's event nights, which provide various activities for community members such as cooking, knife making, painting, bingo, and various sports (2019 to 2021 KP interview program).

Baseball is offered as a local activity in the summer, though it does not have a designated league. Hockey is offered primarily in the winter with various leagues, including an adult recreation league, minor leagues, and a senior league. Programming is limited by the amount of time volunteers can dedicate to recreation programming and by funding (2019 to 2021 KP interview program).

Buffalo Narrows is situated between Peter Pond Lake and Churchill Lake, a location which offers opportunities for outdoor recreation such as canoeing, kayaking, and fishing. There are also hiking trails close to the community (Tourism Saskatchewan 2022). Other recreation activities near Buffalo Narrows include Buffalo Narrows Sand Dunes Park, which includes Big Buffalo Beach Recreation Area and is located a few kilometres from the village. This area is a sandy beach located along the southwest shore of Big Peter Pond Lake (Tourism Saskatchewan 2022).

19.3.3.2.3 Birch Narrows Dene Nation and Turnor Lake

The BNDN recognizes that recreation is important to youth and adults and plays an important role in preventing social and health issues, including substance abuse (BNDN 2018). Birch Narrows Dene Nation members and residents of Turnor Lake have access to an indoor ice rink, baseball diamonds, a school gym, a weight room, and a running track on the reserve (BNDN 2018; 2019 to 2021 KP interview program). The lake and surrounding areas provide opportunities for outdoor activities including fishing, canoeing, hiking, cross-country skiing, and other activities.

There are bingo events two nights a week in Birch Narrows (BNDN 2013; 2019 to 2021 KP interview program; 2020 youth workshop). The BNDN has one employee and one elected councillor who provide recreation activities. Volunteers run many of the programs and they rely on financial support from fundraising or corporations. Birch Narrows Dene Nation youth would like support for basketball, hockey, and soccer programming (BNDN 2018).

19.3.3.2.4 Buffalo River Dene Nation (Dillon)

The BRDN plans events for both winter and summer while working through the year with youth. The band holds local summer and winter games, which include activities such as hockey, basketball, running, canoeing, badminton, basketball, baseball, and volleyball. As the community is located along Peter Pond Lake, members fish and boat on the lake. The BRDN holds an annual fishing competition.

On-reserve recreational facilities are a hockey arena, beach volleyball court, and school gym. The hockey arena recently had an upgrade of the cooling system (2019 to 2021 KP interview program).

Gaps in the community include a lack of playgrounds, water parks, and recreational facilities where youth can play games and activities, such as pool. There is also a gap in Elders' facilities for activities within the community (2019 to 2021 KP interview program).

19.3.3.3 Emergency and Protection Services

This subsection discusses police services, fire suppression services, and emergency medical services that are provided within the LSA.

19.3.3.3.1 Police Services

Policing services in the LSA are provided by the RCMP. There are two main detachments: one in La Loche and one in Buffalo Narrows. The Buffalo Narrows detachment has two additional stations, one in Turnor Lake / Birch Narrows and one in Dillon (Table 19.3-7). The posts in La Loche and Buffalo Narrows are three-year postings, while those in Turnor Lake and Dillon are two-year postings unless an extension is requested or required (2019 to 2021 KP interview program).

The main policing issues within the LSA include addiction, interpersonal violence, and traffic by-law violations. Previously, the Buffalo Narrows detachment had one location in Buffalo Narrows. When policing was required in other communities, such as Dillon, St. George's Hill, and Michel Village, the RCMP would travel from Buffalo Narrows. Due to the travel required, it was requested that the detachment have locations in the smaller communities such as Dillon and Birch Narrows. There is dissatisfaction with the current system, which requires calls to be directed outside the communities before police will attend an incident in the community. Facilities in Dillon currently require upgrading. Due to the requirement for upgrading, arrests in Dillon, St. George's Hill, and Michel Village are transported to Buffalo Narrows. Holding cells are available in Buffalo Narrows, Birch Narrows / Turnor Lake, and La Loche (2019 to 2021 KP interview program).

The RCMP in Dillon (BRDN) enforce provincial laws and the federal *Indian Act*, but do not enforce community by-laws. Current by-laws in Dillon do not allow bootlegging[11], which is enforced by the BRDN council (2019 to 2021 KP interview program).

[11] The illegal manufacture, distribution, or sale of goods, especially alcohol.

Table 19.3-7: Policing and Emergency Services in Local Study Area Communities

Station	Communities Served	Staffing
Buffalo Narrows	Buffalo Narrows, Turnor Lake, BNDN, BRDN, Dillon, St. Georges Hill, Michel Village, the Landing (CRDN), Bear Creek	▪ Seven regular staff ▪ Two support staff ▪ One victim services staff ▪ Five part-time guards
Dillon	Part of the Buffalo Narrows detachment	▪ Five regular staff ▪ One support staff
Turnor Lake	Part of the Buffalo Narrows detachment	▪ Five regular staff ▪ One support staff
La Loche	La Loche, CRDN, Black Point, Garson Lake, Descharme Lake, some of Clearwater Provincial Park	n/a[(a)]

Source: RCMP 2018a; RCMP 2018b; 2019 to 2021 KP interview program.
a) The La Loche RCMP detachment did not provide staffing breakdown but stated that it was fully staffed.
n/a = not available; BNDN = Buffalo Narrows Dene Nation; BRDN = Buffalo River Dene Nation; CRDN = Clearwater River Dene Nation.

Provincial court dates vary throughout the LSA but are available locally depending on the nature of the offence. Court dates for trials and dockets vary by month. Trials are conducted in person, while dockets are conducted by video at the local circuit point. Circuit point locations are available in the La Loche Provincial Building, the Turnor Lake / BNDN arena, the BRDN Band Hall, and the Buffalo Narrows Provincial Building. Trials regarding traffic tickets can currently occur over the phone (Courts of Saskatchewan 2021a). Matters relating the Court of Queen's Bench are handled in Meadow Lake and are filed through the Battleford Queen's Bench Local Registrar's Office or Sheriff's Office (Courts of Saskatchewan 2021b), while the court of appeal is handled through Saskatoon and Regina (Courts of Saskatchewan 2021c).

19.3.3.3.2 Fire Suppression Services

Fire suppression services are conducted by communities in the LSA on a volunteer basis.

- La Loche fire suppression provides services to the CRDN. There are 10 regular volunteers on the crew and another 10 volunteers who also assist when available. The service has a few fire trucks, a water truck, and jaws of life. A new fire hall is currently being built (La Loche 2018; 2019 to 2021 KP interview program).
- Fire suppression in Birch Narrows and Turnor Lake is provided by the BNDN (BNDN 2013).
- In Dillon, fire suppression is handled by volunteer firefighters with fire trucks maintained and driven by the heavy equipment workers of the BRDN maintenance crew. There are approximately 10 volunteer firefighters in Dillon. Equipment is stored at the local fire hall (2019 to 2021 KP interview program).
- Services in Buffalo Narrows are provided by the local fire hall with approximately 10 volunteer firefighters. The fire hall has two response vehicles, one a 400-gallon tank truck and the other a 900-gallon pumper truck. Other fire services within the community are located at the Buffalo Narrows airport and consist of the fire management and forest protection base (Buffalo Narrows 2019).

The other northern hamlets and settlements in the LSA have their own fire suppression equipment; however, they may rely on support from other communities during a fire event. For example, crews in La Loche may assist in Black Point either with personnel or with additional equipment if necessary (2019 to 2021 KP interview program).

The Saskatchewan Public Safety Agency has four fire bases in the northwestern Buffalo Narrows response region (SPSA 2021). There is a fire base and regional response centre located in Buffalo Narrows, a fire base located in La Loche, and two satellite bases located at Turnor Lake and Dillon Lake (SPSA n.d.a). Emergency services officers and protections officers, who are stationed at response centres, are trained to assist first responders and communities during and after emergencies or disasters (SPSA n.d.b). An emergency response team is typically a four-person team including a crew leader, and there are three different types of response crews based on their responsibilities. The Saskatchewan Public Safety Agency Type 1 response crews can assist Type 2 and Type 3 crews on sustained action fires, work on initial and sustained wildfires, and assist communities during times of flooding and other emergencies. Type 2 crews are referred to as First Nation and northern community crews and, through formal agreements with First Nations and northern communities, work on sustained fire action and assist Type 1 crews with the initial response to new wildfires (SPSA n.d.b). The Type 2 crew consists of a five-person team including a crew leader. Type 3 crews are emergency fire personnel who are qualified firefighters hired on an emergency basis to support Type 1 and Type 2 crews working on sustained action wildfires (SPSA n.d.b).

In 2018, Prince Albert Grand Council initiated a Wildfire Task Force to evaluate the emergency response work crews in northern Saskatchewan. In 2018, there were 58 Type 2 First Nation and 22 northern work crews, but the Wildlife Task Force concluded it would be beneficial to move to an 8-person or 10-person crew including a cook and camp helper and switch to a remote camp model instead of flying in daily (Prince Albert Grand Council 2018). Information on the current number of fire crews is not available.

19.3.3.3.3 Emergency Medical

Ambulance services for the LSA communities are based in La Loche through the municipalities and SHA. In some instances, this arrangement means that ambulance services come from Île-à-la-Crosse, which is located in the RSA. Patients are typically transported to the La Loche and Île-à-la-Crosse health centres to receive primary care (Keewatin Yatthé Regional Health Authority 2017; 2019 to 2021 KP interview program).

19.3.3.4 Road Transportation Infrastructure

19.3.3.4.1 Highways

The provincially managed paved and gravel highways leading to the proposed Project location include Provincial Highways 155 and 955. The existing exploration camp is approximately 160 km from La Loche off Highway 955 and is accessed by an existing 13 km all-season road.

19.3.3.4.1.1 Highway 155

Highway 155 is an all-season paved highway with a speed limit of 100 km/h; however, the highway travels through Buffalo Narrows and La Loche, where the speed limit reduces to 50 km/h (Wagner 2018). The total length of Highway 155 is about 300 km, and it intersects Highway 55 at Green Lake and Highway 955 at La Loche (Saskatchewan Government Insurance 2018). The narrowest portion of Highway 155 is 8 m wide, shoulder to shoulder (Wagner 2018). The current traffic volumes on Highway 155 are not an issue with respect to road integrity (Wagner 2018).

Highway 155 is designated as a secondary highway (Government of Saskatchewan 2016). As a secondary highway, trucks with a maximum gross vehicle weight of 61,800 kg and a nine-axle configuration (i.e., two sets of three axels [tridems] plus one front and two rear axels) are allowed to operate over this highway (Government of Saskatchewan 2016). Updated weight restrictions for specific vehicles travelling on primary or secondary highways can be found by contacting the Saskatchewan Ministry of Highways and Infrastructure (Wagner 2018). Highway 155 has seasonal restrictions dependent on spring weather (i.e., freeze/thaw and flooding), which normally begins in March or April and has a duration of six weeks. During this six-week period, the highway reduces to secondary weight limits, resulting in 1,650 kg maximum per tire (i.e., 5,000 for single axle, 13,200 for tandem, and 19,800 for tridem) (Wagner 2018).

Maintenance for highways in Saskatchewan is conducted by the Ministry of Highways and Infrastructure; however, maintenance may be contracted out occasionally to address lack of resources due to equipment breakdowns or shortage of equipment operators (Read 2018). Maintenance is prioritized by average annual daily traffic (Read 2018):

- Level 1 highways (i.e., inter-provincial routes) receive the highest priority and have average annual daily traffic of over 1,500 vehicles.
- Level 2 highways have priority after Level 1 and have average annual daily traffic of 300 to 1,500 vehicles.
- Level 3 highways have the lowest priority with average annual daily traffic of less than 300 vehicles.

Highway 155 is a Level 2 priority highway and maintenance is primarily provided by the highway maintenance shops in La Loche, Buffalo Narrows, and Green Lake. Within 12 hours of a storm, Level 2 highways receive snow plowing from driving lanes, as well as ice treatment or assessment for treatment (Read 2018).

19.3.3.4.1.2 Highway 955

Highway 955, known locally as the Semchuk Trail, is an all-season highway that is almost entirely unpaved, with the exception of an approximately 4.5 km section of paved highway from La Loche to the turn off to the CRDN reserve. Highway 955 extends for 245 km from La Loche to the closed Cluff Lake Mine, and then an additional 25 km to Carswell Lake for a total of approximately 270 km. The speed limit on Highway 955 is 80 km/h, though the portion of the highway through La Loche has a 50 km/h limit (Wagner 2018). Highway 955 traffic volumes are not an issue with respect to road integrity (Wagner 2018). The narrowest portion of Highway 955 is 7 m wide, shoulder to shoulder (Wagner 2018). Highway 955 does not have formal services, such as gas stations, and drivers using the route should carry extra fuel and other supplies (Wagner 2018).

Highway 955 is designated as a secondary highway (Government of Saskatchewan 2016). As a secondary highway, trucks with a maximum gross vehicle weight of 61,800 kg and a nine-axle configuration are allowed to operate over this highway (Government of Saskatchewan 2016). Highway 955 has a permanent bridge and highway restriction from south of Douglas River bridge to the north limits of Highway 955 near Carswell Lake (Government of Saskatchewan 2016). The maximum gross vehicle weight allowed on this stretch of Highway 955 is 41,500 kg (Government of Saskatchewan 2016). The south point of the bridge and highway restriction, Douglas River bridge, is north of the 13 km all-season road to the existing exploration camp. Updated weight restrictions for specific vehicles travelling on primary or secondary highways are established by the Saskatchewan Ministry of Highways and Infrastructure (Wagner 2018). Highway 955 has seasonal restrictions dependent on spring weather (i.e., freeze/thaw and flooding) that normally begins in March or April for a duration of six weeks. During this six-week period, the highway reduces to secondary weight limits, resulting in a 1,650 kg maximum per tire (i.e., 5,000 for single axle, 13,200 for tandem, 19,800 for tridem; Wagner 2018).

Maintenance on Highway 955 is based on Level 3 priority and is primarily provided by the highway maintenance shop in La Loche. During the winter months, snow removal commences as soon as resources are available without jeopardizing services on Level 1 or Level 2 highways. Snow is plowed and ice treated or assessed within 24 hours of the end of a storm (Wagner 2018). During the summer months, dust control, which involves applying a calcium chloride solution, occurs on Highway 955. The dust treatment is tendered out by the Government of Saskatchewan each year (Wagner 2018).

19.3.3.4.2 Traffic Volumes

Traffic volume is measured by annual travel (i.e., million-vehicle-kilometre [MVkm]) for Provincial Highway 155 and Provincial Highway 955 (Saskatchewan Government Insurance 2018). Highway 155 annual travel is 51 MVkm and Highway 955 annual travel is 10 MVkm (Saskatchewan Government Insurance 2018).

19.3.3.4.3 Traffic Accident Rates

Traffic accident rates are based on the number of accidents per annual traffic volume (i.e., accidents per MVkm) for a given highway or region (i.e., Saskatchewan). The total number of accidents reported by Saskatchewan Government Insurance (2018) in 2018 for Highway 155 and 955 was 59 and 8, respectively. Given the annual travel of 51 MVkm for Highway 155 and annual travel of 10 MVkm for Highway 955, the accident rates (i.e., accidents per MVkm) were 1.16 for Highway 155 and 0.8 for Highway 955 (Saskatchewan Government Insurance 2018).

Saskatchewan Government Insurance (2018) reported that 15.6% of rural traffic accidents involved wildlife, only 0.4% of the rural traffic accidents involved pedestrians, and 0.1% of all traffic collisions involved a vehicle fire or explosion.

19.3.3.5 Air Transportation Infrastructure

19.3.3.5.1 Buffalo Narrows Airport

The Buffalo Narrows Airport is located south of Buffalo Narrows off Highway 155. The airport consists of a runway, passenger terminal, hanger, weather station, government building, highways crew building, fire cache, and two privately owned small hangers. Primary maintenance for the runway is conducted by the Saskatchewan Ministry of Highways and Infrastructure, including repairs, salting, and plowing (2019 to 2021 KP interview program).

The runway at the Buffalo Narrows Airport can accommodate airplanes up to the size of an ATR 72, which can seat up to 78 passengers (ATR 2021), and provides sufficient capacity for the Project, which anticipates requiring capacity for a Bombardier Dash 8 Q300 (i.e., to accommodate 48 passengers) or ATR 42-320 (i.e., to accommodate 42 passengers). The ATR-42-320 is the most common plane using the airport (NexGen 2021; ATR 2021; 2019 to 2021 KP interview program). The most common use for the current air traffic services is charters. Typical air traffic at the airport includes medical transportation, parties travelling for court proceedings in the LSA, and RCMP (Saskatchewan Highways and Transportation 2002; 2019 to 2021 KP interview program).

19.3.3.5.2 La Loche Airport

The La Loche Airport is located southeast of La Loche off Highway 155. Maintenance at the airport, including repairs, salting, and plowing, is conducted by the La Loche-based provincial government highways crew. Aside from the runway and one hangar, there is no supporting infrastructure. Three- to nine-passenger charters are the most common planes that use the La Loche Airport. Charters typically include medical transportation and court party and RCMP air traffic, with larger planes using the airport when required (Saskatchewan Highways and Transportation 2002; 2019 to 2021 KP interview program).

19.3.4 Educational Well-Being

Educational attainment has been shown to improve employment and income opportunities as well as lead to better health (Public Health in Canada 2008). This subsection describes the educational characteristics of each of the key LSA communities with reference to educational opportunities (i.e., pre-school, primary, secondary, and post-secondary), attainment, and participation. Additional information on the educational well-being of the LSA and RSA is provided in the Socio-economic Baseline Report (Annex X, Section 6.6).

19.3.4.1 Educational Facilities and Services

19.3.4.1.1 Daycare and Pre-school Facilities

Childcare facilities are available in La Loche, Birch Narrows, Dillon, and Buffalo Narrows. All childcare available in the LSA has a waitlist due to limited space in the facilities.

At the La Loche facility, 12 spaces are available. There are three places for infants, five for toddlers, three for pre-kindergarten children, and one flexible pre-kindergarten spot open for those not requiring full-time childcare from the facility. There is generally a waitlist of two to three months. High school students with children are prioritized for childcare spots so they can continue attending classes.

Dillon (BRDN) has a new pre-school and daycare modular facility with space for twelve children at the daycare and 10 children for the pre-school (2019 to 2021 KP interview program). The childcare facilities in Dillon were upgraded in early 2020 due to the collapse of the floor in the previous facility. The waitlist typically has three to five children. Difficulty in finding childcare was noted as a barrier to employment and education during the KP interviews (2019 to 2021 KP interview program).

The Little Eagles Daycare, a daycare/pre-school facility in Buffalo Narrows, has 36 full-time spots available for children within the community, and there are approximately nine children on the waitlist at any given time. Childcare spaces fill up quickly and many mothers will add their names to the waitlist when they are on maternity leave. In 2019, the facilities were sufficient for the community's needs. While the facility will take casual walk-ins, these spots do not become available until after 09:30 each day. Some spots are occupied by children in pre-kindergarten and kindergarten. These students count as full-time spots as the children attend the daycare before school, have lunch at the daycare, and return to the daycare after school and remain there until pick-up. Since the daycare is located beside Twin Lakes Community School and the Aboriginal Head Start Pre-school, students are taken to the facilities by the staff at the daycare (2019 to 2021 KP interview program). The Buffalo Narrows Aboriginal Head Start Program has 40 pre-school spaces and six staff members. In 2019, the pre-school had an enrollment of 26. The program is free and paid for by the NLSD.

19.3.4.1.2 Primary, Secondary, and Post-Secondary Educational Facilities

Primary and secondary public school education in the LSA communities is administered under the NLSD No.113, which is the administrative body for all public schools in the RSA. The majority of students between kindergarten and grade 12 in the NLSD self-identify as Indigenous. Between 2015/2016 and 2018/2019, Indigenous students made up over two-thirds of the total enrollment in the LSA; in 2019/2020, they made up over three-quarters of total enrollment (NLSD 2020b). In 2020, the NLSD had 280 full-time equivalent teachers and 265 other educational staff (positions that support educational programming). Transportation costs, which include costs for mileage, room and board, and airfare, are waived by the NLSD for students in remote communities who are required to leave their communities to attend high school. Table 19.3-8 provides a summary of the educational facilities and services available in the LSA.

Table 19.3-8: Educational Facilities and Services in the Local Study Area

Indicator	Description of Services
CRDN	▪ The CRDN has one school, the Clearwater River School. The school offers kindergarten to grade 9 and is staffed by 18 teachers (Clearwater River School 2021). In the 2019/2020 school year, the school had 230 students (CBC 2020) ▪ There is no post-secondary program in the CRDN
La Loche	▪ As the largest LSA community, La Loche has the largest educational facilities and provides primary, secondary, and post-secondary education for the community and surrounding areas ▪ Ducharme School, a kindergarten to grade 6 school with 31 teachers provides education for approximately 500 students (NLSD n.d.) ▪ Dene High School provides grade 7 to 12 education and can accommodate approximately 500 students. The elementary school has traditional education programs that provide outdoor education opportunities for children including a modular farm from President's Choice Children's Charity. The high school offers trades courses in construction and carpentry, as well as an Adult 12 program ▪ The GDI, a post-secondary education facility, offers a range of programs including programs to support adults to upgrade their education (including Adult 12), various post-secondary courses, and industry-recognized training, and programs leading into an apprenticeship (GDI 2021). The GDI also offers Adult Basic Education levels 1 to 4 to community members. These programs provide a range of educational skills from literacy to interpersonal skills to lifelong learning skills ▪ The Northern Economic Development Intern Program, run through the GDI, offers online distance learning with a paid internship that involves data management, mapping, and workplace skills development (GDI 2018; 2019 to 2021 KP interview program) ▪ Northlands College, a post-secondary education facility based in Buffalo Narrows, also has a small satellite campus in La Loche located at the Dene High School
Buffalo Narrows	▪ Twin Lakes Community School in Buffalo Narrows offers kindergarten through grade 12 for approximately 300 children from Buffalo Narrows and the surrounding area, and is staffed with 20 teachers (Twin Lakes Community School n.d.; 2019 to 2021 KP interview program). Aside from the core school subjects, such as math and English, it offers welding, carpentry, commercial cooking, and drafting. The school offers Adult 12 (grade 12 education for adults aged 18 to 21) ▪ Northlands College offers post-secondary education to approximately 80 students from Buffalo Narrows as well as surrounding communities. Learning programs include Nursing, Institutional Cooking, Bachelor of Arts, Bachelor of Social Work, as well as other certificate and diploma programs. Northlands College offers Adult 12 as well as a variety of university level courses
BRDN (Dillon)	▪ Buffalo River School in Dillon offers kindergarten to grade 12 for approximately 300 students for BRDN and neighbouring hamlets. Enrolment fluctuates year to year and at the end of the year as well ▪ There is no post-secondary program offered in BRDN
BNDN	▪ Birch Narrows Community School serves students from both BNDN and Turnor Lake. In the 2019/2020 year, there were 206 students enrolled and the school can accommodate up to 350 students (2019 to 2021 KP interview program). Adult students are integrated into the classroom and are allowed to attend until 21 ▪ There is no post-secondary program offered in Birch Narrows

KP = key person; BRDN = Buffalo River Dene Nation; BNDN = Birch Narrows Dene Nation; CRDN = Clearwater River Dene Nation; GDI = Gabriel Dumont Institute; LSA = local study area.

Participants in JWG sessions noted concerns about there not being enough training facilities for both youth and adults, not enough students taking math and sciences in high school to better prepare them to take advantage of job opportunities, and the frequent need for students to leave the community to pursue further education (MN-S-JWG 2020; BRDN-JWG 2020; BNDN-JWG 2020).

Northern Career Quest Inc. (NCQ) is a registered "not-for-profit", industry-led training program directed toward Indigenous residents in northern Saskatchewan. Working with training institutions active in northern Saskatchewan (e.g., Northlands College, Gabriel Dumont Institute [GDI], the Saskatchewan Indian Institute of Technologies), NCQ leverages its industry partnerships to meet the needs of both labour supply and demand in response to emerging needs of businesses, including, but not limited to, the mining, natural resource, and infrastructure sectors. Since its inception, both uranium mining companies active in northern Saskatchewan have partnered on a regular basis with NCQ to deliver training specific to employment within their operations.

The majority of funding to support NCQ programs is secured from the federal and provincial governments, under four-year funding agreements, with mining companies generally providing “in-kind” contributions related to their specific training needs. Northern Career Quest funding is for the training of Indigenous People in programs that lead to new long-term and/or full-time employment opportunities, or for training with existing employees leading to succession opportunities. All programs delivered by NCQ must have guaranteed employment and the training delivered must be either industry or institution approved. During its initial 13 years of operation (i.e., 2008 to 2021), NCQ delivered a total of 4,742 NCQ training program graduates. Over three quarters (i.e., 81%) of the graduates obtained quality employment and over 75% remain employed today.

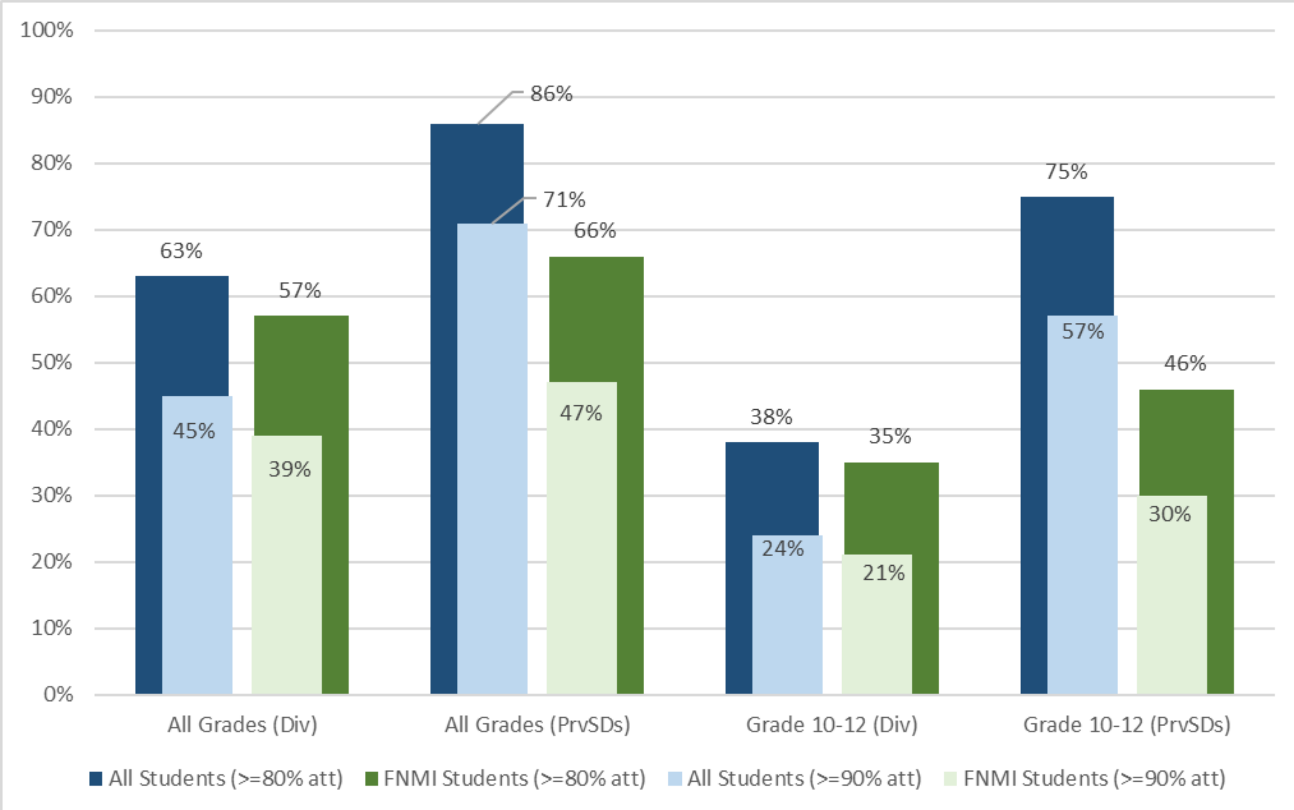
19.3.4.2 Population Educational Characteristics

19.3.4.2.1 Attendance Rates

Attendance for NLSD students overall was lower than the provincial average for all grades, with 63% of students achieving 80% attendance[12] compared to the provincial average of 86% (Figure 19.3-8) (NLSD 2020c). Attendance results have remained consistent between 2014/2015 to 2018/2019, with about 60% of students in all grades with at least 80% attendance (NLSD 2020c). In 2018/2019, the proportion of students in grades 10 to 12 was considerably lower than the provincial average, with only 38% of all students in those grades achieving at least 80% attendance compared to 75% of students in the province. Self-identified Indigenous students in the NLSD also had slightly lower rates of 80% attendance at 21% lower than at the provincial level (i.e., 30%). Data on attendance rates for schools in each LSA community were not available.

[12] Percentages represent all attendance that occurred in the school division in the years reported. This includes all reported attendance for students attending the division during that year, whether or not they are currently enrolled in that division, but only includes attendance data while students were enrolled in the school division. Each percentage is a weighted average of the monthly percentages of students enrolled in the division with at least 80% and at least 90% attendance. Results for populations of fewer than 10 have not been reported to avoid identifying individuals or very small groups of students (NLSD 2020c).

Figure 19.3-8: Percentage of Students with at Least 80% and 90% Attendance, Northern Lights School District 113, and Provincial School Divisions, 2018 to 2019



Source: NLSD 2019.
Note: Percentages represent all attendance that occurred in the school division in the years reported. This includes all reported attendance for students attending the division during that year, whether or not they are currently enrolled in that division, but only includes attendance data while students were enrolled in the school division. Each percentage is a weighted average of the monthly percentages of students enrolled in the division with at least 80% and at least 90% attendance. Results for populations of fewer than 10 have not been reported to avoid identifying individuals or very small groups of students.
FNMI = First Nations (Registered/Treaty/Status Indian, Non-Status Indian), Métis, or Inuit/Inuk; Div = Northern Lights School District; PrvSDs = Provincial School Divisions; ≥ = greater than or equal to; att = attendance.

19.3.4.2.2 Educational Attainment

Educational attainment in the LSA communities is discussed in detail in the Socio-economic Baseline Report (Annex X, Section 6.6). The following subsections provide a summary of attainment in the key communities.

19.3.4.2.2.1 Clearwater River Dene Nation

Educational attainment in the CRDN fluctuated between 2006 and 2016 and remains substantially lower than the RSA average for every level of educational attainment during the same period. Key educational metrics for the CRDN are:

- The majority of the CRDN population over the age of 15 (i.e., 64.9%) has no certificate, diploma, or degree, compared to 57.5% of the RSA population. The proportion of CRDN population without a certificate, diploma, or degree, in 2016 was, however, lower than both 2011 (i.e., 71.2%) and 2006 (i.e., 81.7%). A larger proportion of males (i.e., 73.2%) have no certificate, diploma, or degree compared to females (i.e., 58.6%), with the gap growing from 7.7% to 14.6% between 2006 and 2016.

- Of the CRDN population over the age of 15, 16.7% had high school as their highest level of education in 2016. The high school graduation rate has continued to rise, increasing by 1.3% from 2011 and 3.3% from 2006.
- The proportion of population obtaining an apprenticeship or trade in 2016 was 6.1% compared to 9.6% in 2011, and below the 2016 average for the RSA (i.e., 7.4%).
- From 2006 to 2016, the proportion of those aged 15 and over with a college or other non-university certificate or diploma increased from 2.4% to 6.1%, comparable to the RSA increase (6.2% to 9.2%).
- While the proportion of university graduates in the CRDN increased between 2006 and 2016 to 2.6% in 2016, it continues to be lower than the RSA (i.e., 4.2%) (Annex X, Table 16).

19.3.4.2.2.2 La Loche

Educational attainment in La Loche fluctuated over the 10 years prior to and including 2016, with 2016 reflecting increased educational attainment for all levels of education. Educational attainment in La Loche remains below RSA levels. Key educational metrics for La Loche are:

- In 2016, the majority of the population aged 15 and over (i.e., 67.2%) had no certificate, diploma, or degree, substantially higher than the RSA (i.e., 57.5%). The proportion of people without a certificate, diploma, or degree was lower in 2016 (67.2%) than in 2011 (i.e., 81.3%) and 2006 (i.e., 80.4%). A larger proportion of males (i.e., 68.7%) had no certificate, diploma, or degree compared to females (i.e., 65.9%) in 2016.
- In 2016, 16.1% of the La Loche population aged 15 and over has completed high school as their highest level of education, lower than the RSA (i.e., 20.1%). Similar to the trends at the RSA and provincial level, this metric for La Loche steadily increased in the ten years prior to 2016, from 12.2% in 2011 and 9.3% in 2006.
- In 2016, the proportion of the population aged 15 and over with a trades education (i.e., 5.7%) had risen beyond 2011 levels (i.e., 1.8%) and the 2006 level (i.e., 5.0%).
- From 2006 to 2016, the proportion of those with a college or other non-university certificate or diploma rose from 2.8% to 6.6%, comparable to the change at the RSA level (6.2% to 9.2%).
- The proportion of university graduates in La Loche increased over the ten years prior to 2016, with the 2016 proportion of 4.1%, slightly below the RSA average of 4.2% (Annex X, Table 16).

19.3.4.2.2.3 Buffalo Narrows

Buffalo Narrows has the highest overall educational attainment among the LSA communities. The community has seen increases for every level of education over the 10 years ending in 2016 and exceeds almost all RSA educational attainment averages based on 2016 data. Key educational metrics for Buffalo Narrows as of 2016 are:

- A total of 32.2% of Buffalo Narrows have no certificate, diploma, or degree, which is substantially lower than the RSA (i.e., 57.5%). The proportion of people without a certificate, diploma, or degree was less than in 2011 (i.e., 43.4%) and 2006 (i.e., 43.3%). A substantially larger proportion of males (i.e., 43.1%) have no certificate, diploma, or degree compared to females (i.e., 23.5%), with the difference remaining relatively constant between 2006 to 2016.

- A total of 19.1% of the Buffalo Narrows population aged 15 and over has completed high school as their highest level of education, only slightly lower than the RSA average (i.e., 20.1%). This metric fluctuated in the 10 years prior to 2016, rising from 20.1% in 2006 to 33.1% in 2011 and falling to 19.1% in 2016.
- Among the LSA communities, Buffalo Narrows has the second largest proportion of its population with a trades education as their highest level of education (i.e., 16.4%), exceeding the 2016 RSA proportion (i.e., 7.4%).
- A total of 17.1% of the Buffalo Narrows population aged 15 and over has a college level education as their highest level of education, exceeding the proportion in the RSA (i.e., 9.2%).
- The proportion of Buffalo Narrows residents aged 15 and over with a university degree or higher steadily increased in the 10-year period ending in 2016, rising from 2.2% in 2006 to 5.1% in 2011 and 11.2% in 2016, substantially higher than in the RSA (i.e., 4.2%) (Annex X, Table 16).

19.3.4.2.2.4 Birch Narrows Dene Nation

Educational attainment in the BNDN improved in the period from 2006 to 2016 for all levels. However, like other LSA communities, educational attainment in the community as of 2016 remained below the RSA level. Key educational metrics for the BNDN as of 2016 are:

- The proportion of the community that has no certificate, diploma, or degree (i.e., 45.2%) is lower than the RSA (i.e., 57.5%). The proportion of people without a certificate, diploma, or degree was smaller than in 2006 (i.e., 84.0%). A larger proportion of males (i.e., 46.7%) have no certificate, diploma or degree compared to females (i.e., 39.4%).
- A total of 22.6% of the BNDN population aged 15 and over has high school as their highest level of education, a substantial increase from the 10% in 2006.
- The proportion of the population with a trades education (i.e., 12.9%) has risen substantially (i.e., 8.9%) since 2006, now higher than the RSA (i.e., 7.4%).
- From 2006 to 2016, the proportion of those aged 15 and over with a college or other non-university certificate or diploma grew substantially from 0% to 12.9%, exceeding the RSA average (i.e., 9.2%).
- The proportion of university graduates in the BNDN has increased over time from 4.0% in 2006 to 8.1% in 2016, and is higher than the RSA averages (i.e., 4.2%) but lower than the Indigenous provincial averages (i.e., 7.6%) (Annex X, Table 16).

19.3.4.2.2.5 Buffalo River Dene Nation

Educational attainment in the BRDN improved between 2006 and 2016 for all educational attainment levels. Key educational metrics for the BNDN as of 2016 are:

- The proportion of the population with no certificate, diploma, or degree (i.e., 54.5%) is slightly lower than the RSA (i.e., 57.5%). The proportion of people without a certificate, diploma, or degree was smaller than in 2011 (i.e., 70.5%) and 2006 (i.e., 74.5%). A larger proportion of males (i.e., 56.4%) have no certificate, diploma, or degree compared to females (i.e., 52.7%), though the difference narrowed from 14.7% to 3.7% in 10-year period ending in 2016.

- A total of 10.0% of the BRDN population aged 15 or over has high school as their highest level of education, which is approximately half of the value for the RSA (i.e., 20.1%). This metric decreased slightly from 2011 (i.e., 11.4%) but was an increase from 2006 (i.e., 9.8%). This trend was in contrast with the trends at the RSA level, which continually increased between 2006 and 2016.
- Among the LSA communities, the BRDN has the largest proportion of its population with a trades education (i.e., 19.1%). This is a substantial increase from 2011 (i.e., 7.6%) and 2006 (i.e., 5.9%) levels, while also exceeding the 2016 RSA (i.e., 7.4%).
- From 2006 to 2016, the proportion of those with a college or other non-university certificate or diploma increased from 5.9% to 9.1%, comparable to the RSA levels in 2016 (i.e., 9.2%).
- The proportion of university graduates in the BRDN has increased over time to from 2.9% in 2006 to 5.5% in 2016, exceeding the RSA (i.e., 4.2%) (Annex X, Table 16).

19.3.5 Economic Well-Being

Existing conditions for economic stability are described in detail in Annex X, including current employment and income levels. This subsection provides a summary of the economic characteristics of each of the key LSA communities relevant to the consideration of community well-being. It is important to note population data from Statistics Canada are subject to random rounding (i.e., to 0 or 5) resulting in not all values adding up to totals; thus, estimates provided are approximate values and this should be taken into account in interpreting the data, in particular for small populations (e.g., a relatively large proportional change in a statistic can result from a small change in the number of individuals).

19.3.5.1 Clearwater River Dene Nation

In 2016, the CRDN had a labour force of 270 people, a labour force participation rate of 47.8%, and an unemployment rate of 44.4%. Between 2011 and 2016, the CRDN labour force increased by 63% (i.e., 165 people to 270 people) (Annex X, Table 13). During this period, participation in the labour force grew robustly (i.e., from 30.8% to 47.8%). It is not clear why there was such a strong trend of people entering the labour force from 2011 to 2016.

Participation in the labour force is higher for males (i.e., 50.9%) than females (i.e., 46.6%) in the CRDN, and both are higher than that for the LSA (i.e., 49.3% and 45.3%, respectively) and similar to the RSA (i.e., 51.9% and 45.8%, respectively). The difference between male and female participation in the CRDN is the smallest among the LSA communities at 4.3% (Annex X, Table 13).

The 2016 the CRDN unemployment rate (i.e., 44.4%) was considerably higher than the LSA (i.e., 29.5%) and the RSA (i.e., 23.8%) and was the highest among the LSA communities. Unemployment in the community fluctuated between 2006 and 2016. The 2016 unemployment rate increased from a low of 24.2% in 2011 and is higher than the 2006 rate of 37.5%. The increase in the unemployment rate between 2011 and 2016 corresponds with the increase in the labour force participation rate noted above. The unemployment rate in the community has been consistently higher for males (i.e., 53.6% in 2016, 37.5% in 2011, and 50.0% in 2006) than females (i.e., 33.3% in 2016, 17.6% in 2011, and 28.6% in 2006). Among the LSA communities, the CRDN had the largest difference between the unemployment rate of males and females, with a 20.3% difference in 2016, a slight decrease from a decade earlier when there was a 21.4% difference (Annex X, Table 13).

A larger proportion of working-aged females in the CRDN are likely discouraged from entering the labour market by external factors. With females more commonly filling the role as primary care giver to young children, access to childcare is likely a common barrier to their participation in the labour force and in obtaining higher education (2019 to 2021 KP interview program).

Effects on income are characterized considering both wage or market income (e.g., employment income or income from trapping or commercial fishing) and traditional economy income. The traditional economy or subsistence economy refers to activities such as hunting, fishing, trapping, plant harvesting, and crafting that take place outside of the market or wage economy (Annex X, Section 6.5). Participation in the traditional economy is typically not captured in Statistics Canada labour force and income statistics; however, it is described in detail in Annex X, Section 6.5).

In 2015, the total average personal income in the CRDN was $24,437, much lower than in the LSA (i.e., $30,810) and the RSA (i.e., $31,971) (Annex X, Table 14). Average personal income among males in the CRDN is higher than among females (i.e., $25,187 compared to $23,820). When compared to the LSA (i.e., 75% for males and 60% for females), a similar proportion of total income in CRDN is derived from employment income (i.e., 75% for men and 61% for women in the CRDN). The RSA has a higher proportion of total income derived from employment income (i.e., 79.0% for males and 63.8% for females in the RSA) (Annex X, Table 14).

19.3.5.2 Métis Nation – Saskatchewan Northern Region 2

19.3.5.2.1 La Loche

In 2016, La Loche had a labour force of 525 people, a labour force participation rate of 33.1%, and an unemployment rate of 27.6% (Annex X, Table 13). Between 2011 and 2016, the La Loche labour force increased by 12% (i.e., 55 people) and the participation rate increased from 26.6% to 33.1%. Despite this increase, the participation rate for La Loche remained the lowest among the LSA communities.

Participation in the labour force is higher for males (i.e., 36.7%) than females (i.e., 30.4%), but both are much lower than the LSA and RSA (i.e., 49.3% and 45.3%, and 51.9% and 45.8%, respectively). The participation rate difference between sexes has remained the same for the last decade at 6.3%. The labour force participation rate for La Loche has fluctuated in the past decade and in 2016 remained slightly lower than the 2006 rate (i.e., 36.4%; Annex X, Table 13).

The unemployment rate in La Loche (i.e., 27.6%) was slightly lower than the LSA unemployment rate (i.e., 29.5%) and higher than the RSA unemployment rate (i.e., 23.8%). This is reflective of the fact that only a small portion of the working age population is participating in the labour force, likely meaning less competition for employment opportunities. Unemployment in the community fluctuated between 2006 and 2016, dropping from 26.4% in 2006 to 22.3% in 2011, and rising again to 27.6% in 2016. The unemployment rate in the community is higher for males than females, with a widening difference; there was a 14.0% difference in 2016 compared to a 10.8% difference in 2006 (Annex X, Table 13).

According to a 2018 report, La Loche has a lack of economic opportunities, discouraging many from participating in the labour force (DMCA 2018). Contributing factors to the lack of economic opportunities include the small number of employers and the absence of major industries, as well as the community's lack of economic diversity (Annex X, Section 6.5). The 2018 report indicated that re-training, programming, and counselling will not be impactful until there are more economic opportunities.

In 2015, the total average personal income in La Loche was $29,030, slightly lower than the LSA (i.e., $30,810) and the RSA (i.e., $31,971); (Annex X, Table 14). Average personal income among females in La Loche (i.e., $29,846) is slightly higher than among males (i.e., $28,058). Overall, females in La Loche have a lower proportion of total income derived from employment sources compared to males (i.e., 45.3% compared to 70.2%). Females in La Loche also have a lower proportion of total income derived from employment sources compared to the LSA and RSA (i.e., 45.0% compared to 60.0% and 64.0%, respectively). Males in La Loche have a lower proportion of employment income compared to the LSA and RSA (i.e., 70.0% compared to 75% and 79.0%, respectively) (Annex X, Table 14).

19.3.5.2.2 Buffalo Narrows

In 2016, Buffalo Narrows had a labour force of 480 people, a labour force participation rate of 62.7%, and an unemployment rate of 12.5% (Annex X, Table 13). The Buffalo Narrows labour force increased by 13% (i.e., 55 people) between 2011 and 2016. During this period, participation in the labour force grew (i.e., from 52.5% to 62.7%). Buffalo Narrows has a higher participation rate than the LSA and the RSA (i.e., 35.7% and 48.9%, respectively). Buffalo Narrows is the only LSA community with a higher participation rate for females (i.e., 64.2%) than males (i.e., 60.3%), both higher than the LSA and the RSA participation rate (i.e., 49.3% and 45.3%, and 51.9% and 45.8%, respectively) (Annex X, Table 13).

In 2016, unemployment in Buffalo Narrows (i.e., 12.5%) was considerably lower than both the LSA and RSA unemployment rate (i.e., 29.5% and 23.8%, respectively). Unemployment in the community fluctuated between 2006 and 2016, with a low of 9.4% in 2011. The unemployment rate in the community has remained higher for males than females between 2006 (i.e., 20.4% compared to 17.6% respectively) and 2016 (i.e., 18.2% compared to 7.7% respectively). The difference in unemployment rate in the community has widened between males and females, from 2.8% in 2006 to 10.5% in 2016 (Annex X, Table 13).

The last downturn in the mining sector in the RSA reportedly affected more than 20 workers in Buffalo Narrows (Annex X, Section 6.4). Others who had worked for decades for other uranium mining companies noted they were not formally trained, did not acquire health and safety tickets, and would have had to take certification again (2019 to 2021 KP interview program). However, many of the unemployed in Buffalo Narrows were also reported to not be looking for work. As they had previously worked in the mining industry, interviewees reported that they do not want employment that pays less than what they had previously earned. Key person interviews indicated that some residents in Buffalo Narrows feel overlooked as companies are perceived to not hire from Buffalo Narrows and solely employ workers from La Loche.

In 2015, the total average personal income in Buffalo Narrows was $43,901, higher than all other LSA communities, the LSA as a whole (i.e., $30,810) and the RSA (i.e., $31,971) (Annex X, Table 14). Average personal income among females in Buffalo Narrows is slightly higher than among males (i.e., $44,020 compared to $43,758). Both sexes reported higher average personal income levels compared to other LSA communities, the LSA as a whole, and the RSA. For both sexes reported, the proportion of total income derived from employment income (i.e., 82.0% for males and 76.0% for females) was higher than reported for other LSA communities, the LSA as a whole, and the RSA (Annex X, Table 14).

19.3.5.3 Birch Narrows Dene Nation

In 2016, the BNDN had a labour force of 165 people, a labour force participation rate of 52.4%, and unemployment rate of 33.3% (Annex X, Table 13). Longitudinal labour force data are not available for the BNDN due to data suppression (i.e., confidentiality or data quality reasons) by Statistics Canada. Participation in the labour force was higher for males (i.e., 56.7%) than females (i.e., 50.0%), and higher than the LSA and RSA (i.e., 49.3% and 45.3%, and 51.9% and 45.8%, respectively). The unemployment rate in the BNDN (i.e., 33.3%) was higher than the LSA (i.e., 29.5%) and RSA (i.e., 23.8%) and was higher for males than females (i.e., 41.2% compared to 25%) (Annex X, Table 13).

In 2015, the total average personal income in the BNDN was $26,702, lower than the LSA (i.e., $30,810) and the RSA (i.e., $31,971) (Annex X, Table 14). Average personal income among females in the BNDN is lower than among males (i.e., $24,744 compared to $28,922). For males, the proportion of total income derived from employment income (i.e., 77.0%) was similar to other LSA communities, the LSA as a whole, and the RSA. However, for females the proportion of total income derived from employment income (i.e., 56%) was lower than other LSA communities, the LSA as a whole, and the RSA (Annex X, Table 14).

19.3.5.4 Buffalo River Dene Nation

In 2016, the BRDN had a labour force of 255, a labour force participation rate of 46.8%, and an unemployment rate of 33.3% (Annex X, Table 13). The BRDN labour force increased in size (i.e., 20 more people) from 2011 to 2016. During this period, participation in the labour force grew from 43.5% to 46.8%. Participation in the labour force was higher for males (i.e., 50.0%) than females (i.e., 43.6%) in the BRDN. Male participation in the labour force was similar to that in the LSA and RSA (i.e., 49.3% and 51.9%, respectively), while female participation rates were lower than in the LSA (i.e., 45.3%) and the RSA (i.e., 45.8%). The difference between male and female participation in the BRDN is the highest among the individual LSA communities with a 6.4% difference, though this difference has decreased since 2006 when the rate was 7.9% (Annex X, Table 13).

In 2016, unemployment in the BRDN (i.e., 33.3%) was higher than both the LSA and RSA unemployment rate (i.e., 29.5% and 23.8%, respectively) (Annex X, Table 13). The difference in the BRDN unemployment rate between the sexes reported widened from 6% (i.e., 34.6% for males compared to 28.6% for females) in 2006 to 15.7% (i.e., 40.7% for males compared to 25.0% for females) in 2016.

Key person interviews with BRDN members regarding unemployment identified contributing factors including that, although many community members have qualifications, they lack employment experience. Further, many are reluctant to leave their family ties in the community in search of employment elsewhere. During the JWG on economies in August 2021, a BRDN participant commented that they expected the unemployment rate for their community was higher in 2021 as a result of the COVID-19 pandemic (BRDN-JWG 2021e).

In 2015, the total average personal income in the BRDN was $25,238, lower than in both the LSA (i.e., $30,810) and RSA (i.e., $31,971). Average personal income was higher for males than females in the BRDN (i.e., $26,269 compared to $24,228). For both sexes reported, the proportion of total income derived from employment income (i.e., 75.0% for males and 65.0% for females) was similar to the LSA, but lower than the RSA (Annex X, Table 14).

The LSA is economically supressed by a lack of economic opportunity due to no suitably sized primary industry since the decline of the fur industry in the 1960s. Most employment is concentrated in public sector positions including Indigenous governance and municipalities. In addition, most industries in the LSA are traditionally female-dominated industries such as health, education, and social services. There is also evidence that some economic activities associated with the traditional economy are occurring in the LSA, which may not be captured in the census data.

A limited number of locally owned businesses operate within the LSA communities, and goods and services are often sourced externally. In comparison to other northern communities in the RSA, the LSA communities exhibit less business activity. While several local businesses in Buffalo Narrows and La Loche have experienced some growth in recent years due to mineral exploration in the area, a 2018 study noted that there were limited companies in the La Loche / CRDN region related to mining, construction, accommodation, and food services (DMCA 2018). Interviews with residents indicated a strong interest in expanding local business opportunities, including exploring partnerships between communities. Local study area residents have commented that they see substantial value not just in expanding employment opportunities, but also ownership interests in businesses.

19.3.6 Community Well-Being Index

Indicators discussed in the economy assessment (Section 18) that contribute to community well-being, but do not provide a complete understanding of community well-being, are represented in the community well-being index score calculated by Statistics Canada. The community well-being index uses data from Statistics Canada on education, labour force, income, and housing to provide "a relatively quick and convenient measure of well-being, focusing on the socio-economic dimensions" (Murphy 2010). The index is intended to provide a systematic summary of socio-economic well-being for communities, illustrate differences across communities, enable tracking over time, and be compatible with other community-level data on well-being (Indigenous Services Canada 2019a). The component scores consider the following indicators:

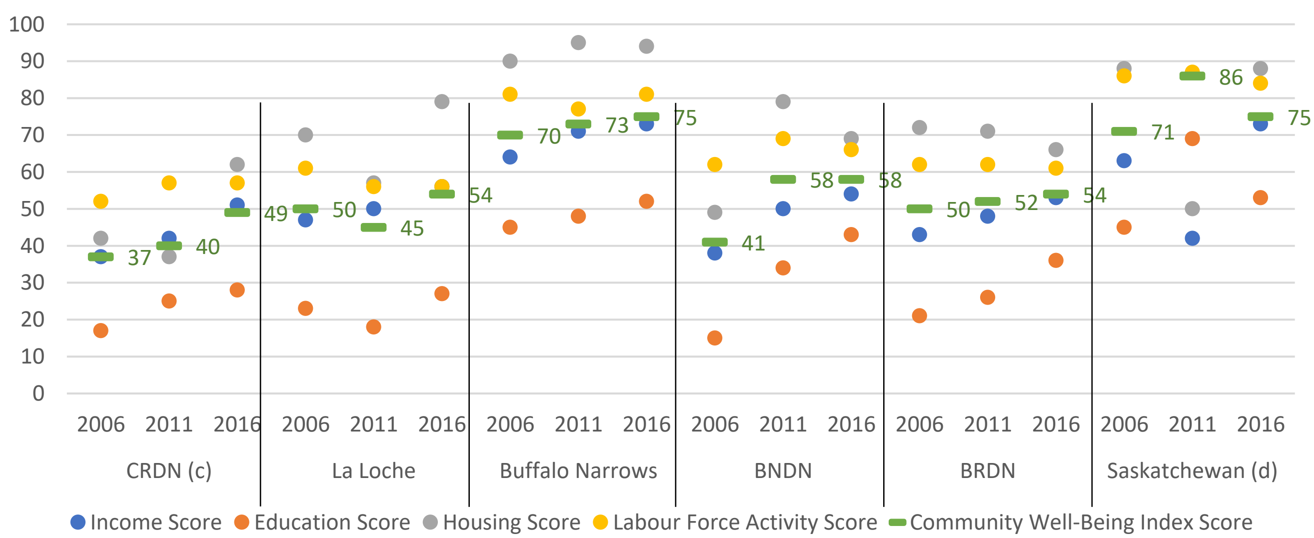
- income, which is based on income per capita;
- education, which factors in the proportion of a community's population 20 years and older that has at least a high school certificate and the proportion of a community's population 25 years and older that has at least a bachelor's level degree;
- housing, which comprises indicators on housing quantity and quality; and
- labour force activity, which quantifies the labour force participation and employment rate in the community for members between the ages of 20 and 64 (Indigenous Services Canada 2019b).

Of the four component scores, education, income, and housing are generally acknowledged as key social determinants of health. These components are covered in more detail in other sections of the EIS: employment and labour force activity for the LSA communities in Section 18.3.4 and in Section 19.3.5, Economic Well-Being; education, including educational attainment and educational facilities and programs, in Section 18.3.6, Income, and Section 19.3.4, Educational Well-Being; income in Section 18.3.6 and Section 19.3.5; and housing in Section 19.3.2, Health Well-Being.

The community well-being index presents a quantitative assessment of community well-being based on census data. These data can be tied to the social determinants of health as quantitative data from a point in time (i.e., the census) for a selected set of measurement indicators, but do not capture all aspects of well-being considered in this assessment. As such, the community well-being index is included as a supplemental quantitative dataset to support the evaluation and determination of overall well-being.

Figure 19.3-9 highlights the community well-being index scores across the four indicators for each main LSA community for the past three census years (i.e., 2006, 2011, and 2016). The scores show variations by indicators in all communities, with education scores the lowest, and housing the highest except for CRDN, which had labour force activity as the highest in 2006 and 2011. Buffalo Narrows' scores are more similar to Saskatchewan, while the others are well below the provincial scores.

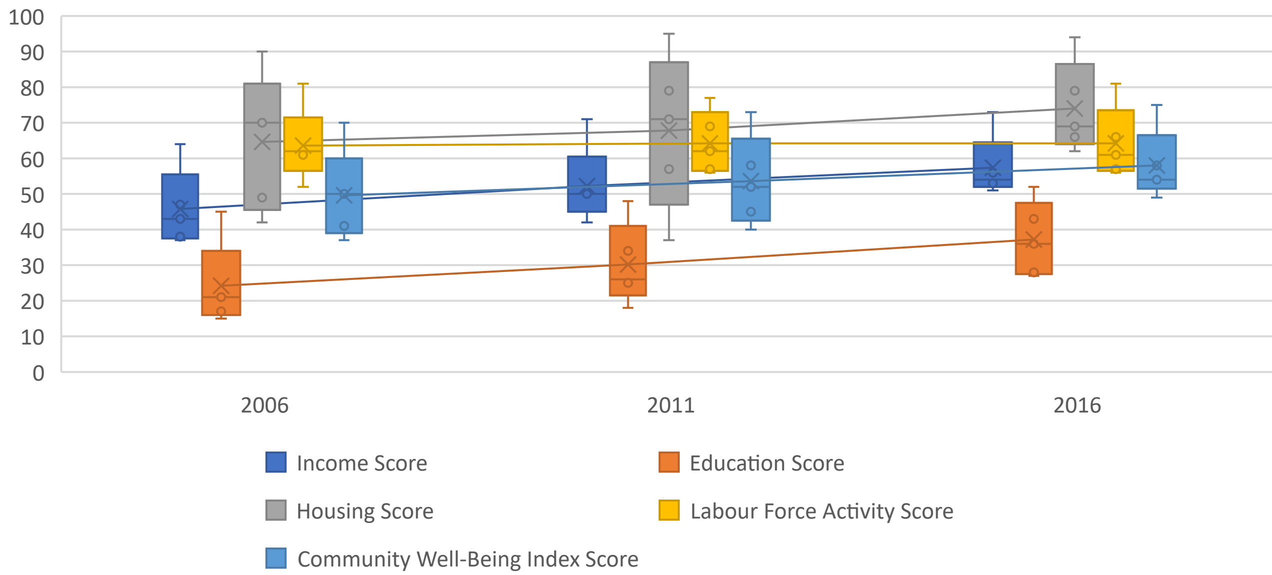
Figure 19.3-9: Community Well-Being Index[(a)] for the Main Local Study Area Communities[(b)] and Saskatchewan, 2006 to 2016 Census Years



Source: CIRNAC 2019a.
a) Each community well-being score and each component score can range from a low of 0 to a high of 100.
b) Data for the other LSA communities were not available.
c) The community well-being index is calculated for Clearwater River Dene IR 222.
d) Mean score for Saskatchewan calculated by InterGroup Consultants.
CRDN = Clearwater River Dene Nation; BNDN = Birch Narrows Dene Nation; BRDN = Buffalo River Dene Nation; IR = Indian Reserve; LSA = local study area.

Figure 19.3-10 highlights the LSA composite community well-being index across the four indicators for the past three census years (i.e., 2006, 2011, and 2016). This composite index for the LSA shows the range of scores from a regional perspective. Trend lines are also applied to show the average trend across the region. This shows income, education, and housing scores trending upward, while labour force activity is stagnant.

Figure 19.3-10: Local Study Area Composite Community Well-Being Index Scores[(a)], 2006 to 2016 Census Years

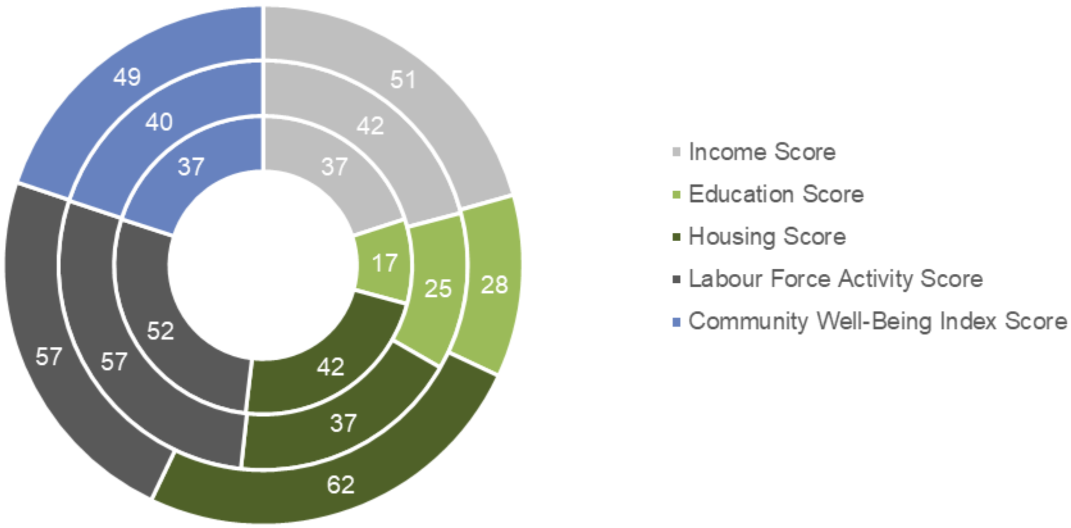


Source: CIRNAC 2019a.
a) Each community well-being score and each component score can range from a low of 0 to a high of 100.

19.3.6.1 Clearwater River Dene Nation

Figure 19.3-11 shows the community well-being score for the CRDN for the last three census years (i.e., 2006, 2011, and 2016). The CRDN has the lowest community well-being score (i.e., 49) among the LSA communities in 2016 due to it having the lowest component scores for income (i.e., 51) and housing (i.e., 62), and only a slightly higher education score (i.e., 28) than La Loche (i.e., 27). However, the CRDN's community well-being score improved by 12 points between 2006 and 2016 (Figure 19.3-10), the second highest increase among the LSA communities (Figure 19.3-8). Between 2006 and 2016, the community saw improvements in every metric, especially housing, income, and education, with increases of 20, 14, and 11 points, respectively, and a slight improvement in its labour force activity score, with a 5-point increase (Figure 19.3-11). Between 2006 and 2016, the CRDN experienced greater improvements in component scores and overall community well-being than the province during the same period, but scores were still substantially lower, ranging from 22 to 27 points behind provincial index scores.

Figure 19.3-11: Clearwater River Dene Nation Community Well-Being Index Scores, 2006 to 2016 Census Years

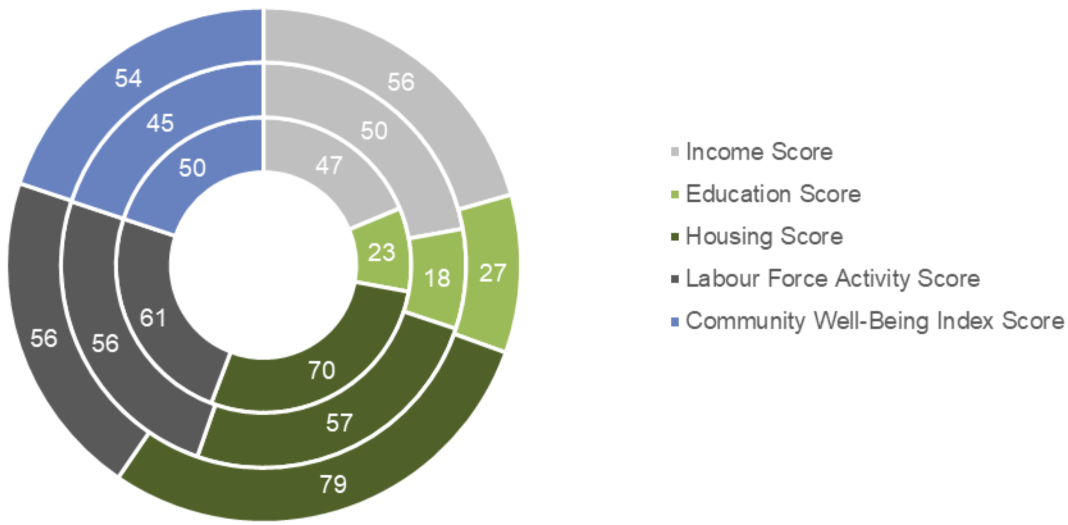


Source: CIRNAC 2019a.
Notes: The inner ring presents 2006 data, the middle ring 2011 data, and the outer ring 2016 data.
Each community well-being score and each component score can range from a low of 0 to a high of 100.
The community well-being index is calculated for Clearwater River Dene IR 222.
IR = Indian Reserve.

19.3.6.2 Métis Nation – Saskatchewan Northern Region 2

Figure 19.3-12 and Figure 19.3-13 show the community well-being score for the predominantly Métis communities of La Loche and Buffalo Narrows, respectively, for the last three census years (i.e., 2006, 2011, and 2016). For residents of La Loche, the community well-being score remained fairly consistent between 2006 and 2016, decreasing to 45 in 2011 and improving to 54 in 2016 (Figure 19.3-12). The decrease in score in 2011 was driven by lower component scores in education, housing, and labour force activity. In 2016, La Loche had the lowest component scores for education and labour force activity among the LSA communities at 27 and 56, respectively, and experienced a decrease in its labour force activity score from 61 to 56 (Figure 19.3-9). Between 2006 and 2016, La Loche experienced a greater increase in its housing score with a 9-point increase compared to the province, which had no increase. Like most of the other LSA communities, La Loche has consistently had lower component and overall community well-being scores compared to the province.

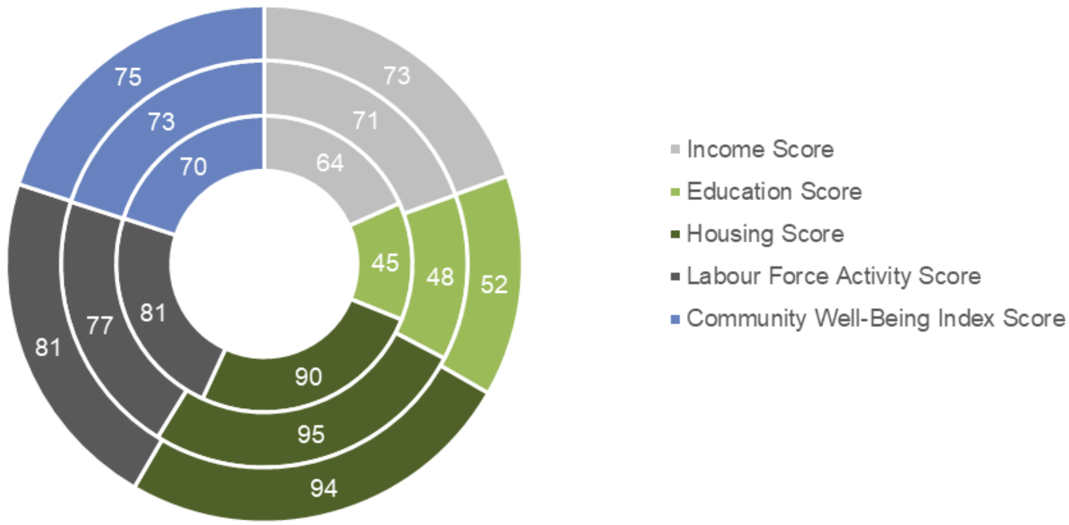
Figure 19.3-12: Community Well-Being Index Scores for La Loche, 2006 to 2016 Census Years



Source: CIRNAC 2019a.
Notes: The inner ring presents 2006 data, the middle ring 2011 data, and the outer ring 2016 data.
Each community well-being score and each component score can range from a low of 0 to a high of 100.

Buffalo Narrows has the highest community well-being score of the LSA communities with a 75 in 2016 and the highest scores for all components (Figure 19.3-9). In 2016, Buffalo Narrows had a community well-being score that matched the provincial score and scored at the provincial level for income and exceeded it for housing (Figure 19.3-13). The community experienced increases in almost all component scores between 2006 and 2016, but experienced lower score component increases compared to the province (Figure 19.3-9). Between 2006 and 2016, the community's community well-being score increased from 70 to 75 and saw improvements in all components except for labour force activity (Figure 19.3-13).

Figure 19.3-13: Community Well-Being Index Scores for Buffalo Narrows, 2006 to 2016 Census Years

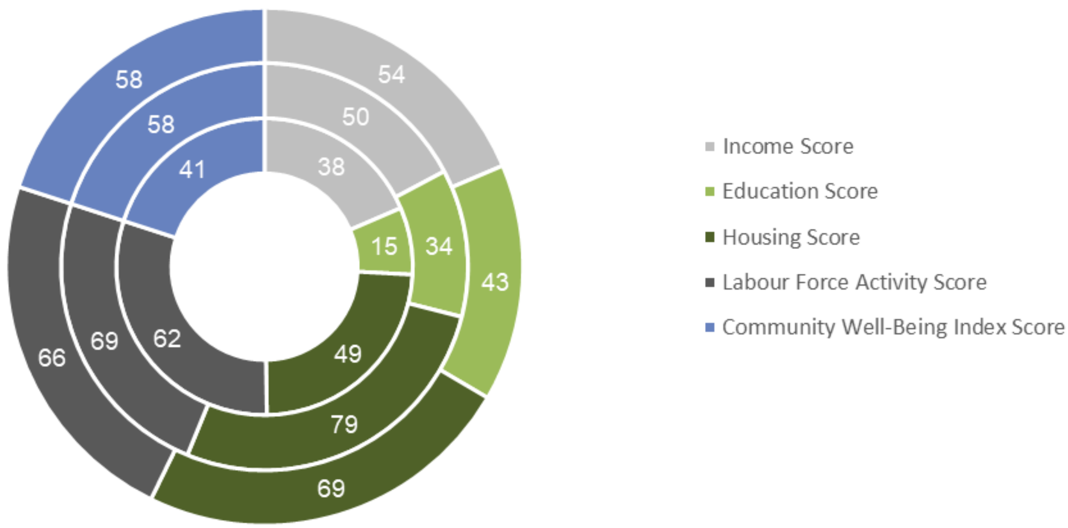


Source: CIRNAC 2019a**.**
Notes: The inner ring presents 2006 data, the middle ring 2011 data, and the outer ring 2016 data.
Each community well-being score and each component score can range from a low of 0 to a high of 100.

19.3.6.3 Birch Narrows Dene Nation

Figure 19.3-14 shows the community well-being score for the BNDN for the last three census years (i.e., 2006, 2011, and 2016). The BNDN has the second highest community well-being score among the LSA communities, with 58 in 2016. The community well-being score for the BNDN increased between 2006 and 2016 from 41 to 58 but remains below the provincial score of 75 (Figure 19.3-9). Between 2006 and 2016, there were substantial increases in education, income, and housing, with larger improvements than the province during the same period; however, scores were still lower than the province by 10 to 19 points. Among the LSA communities, the BNDN experienced the largest increase in education component scores, rising from 15 to 43 points between 2006 and 2016. The BNDN's labour force activity score increased the least between 2006 and 2016, by 4 points, and was higher in 2011 than in 2006 and 2016 (Figure 19.3-14).

Figure 19.3-14: Birch Narrows Dene Nation Community Well-Being Index Scores, 2006 to 2016 Census Years

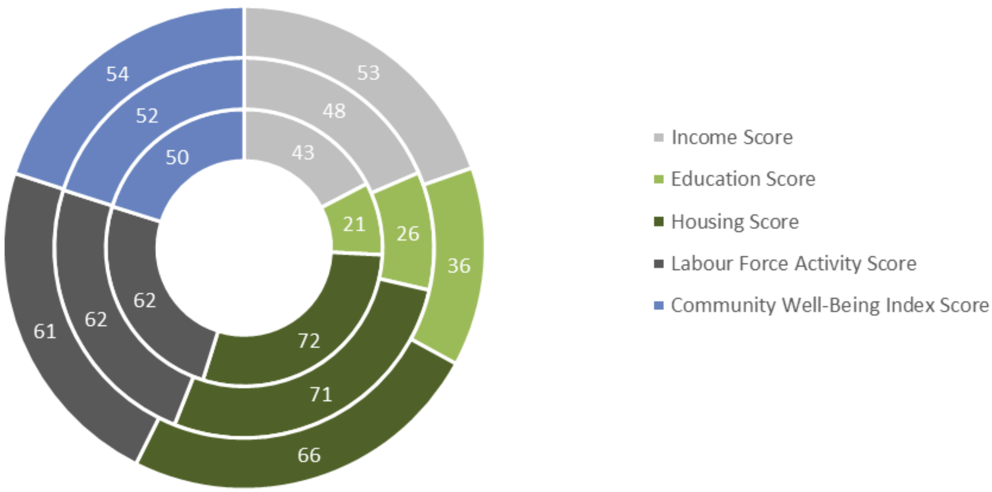


Source: CIRNAC 2019a**.**
Notes: The inner ring presents 2006 data, the middle ring 2011 data, and the outer ring 2016 data.
Each community well-being score and each component score can range from a low of 0 to a high of 100.

19.3.6.4 Buffalo River Dene Nation

Figure 19.3-15 shows the community well-being score for the BRDN for the last three census years (i.e., 2006, 2011, and 2016). The BRDN had a community well-being score of 54 in 2016, the same as La Loche (Figure 19.3-9). Between 2006 and 2016, BRDN saw steady increases in its community well-being score, driven primarily by increases in its education and income scores with 15- and 10-point increases, respectively (Figure 19.3-15). However, the BRDN is the only LSA community to see decreases in both housing and labour force activity scores with 6- and 1-point decreases, respectively, during the same period (Figure 19.3-9). The decrease in the BRDN's housing score was the largest decrease among LSA communities for any component. The BRDN has lower component scores than the province for every component by 17 to 23 points (Figure 19.3-9).

Figure 19.3-15: Buffalo River Dene Nation Community Well-Being Index Scores, 2006 to 2016 Census Years



Source: CIRNAC 2019a**.**
Notes: The inner ring presents 2006 data, the middle ring 2011 data, and the outer ring 2016 data.
Each community well-being score and each component score can range from a low of 0 to a high of 100.

19.4 Project Interactions and Mitigations

The pathway analysis identified potential beneficial and adverse effects of the Project on community well-being, identified practicable mitigation for these potential adverse effects and enhancement for potential beneficial effects, and determined whether any of the potential adverse effects could be sufficiently mitigated such that they are not expected to cause a residual adverse effect. As described in Section 19.2.7, Project Interactions and Mitigations, the pathway analysis assigned each potential effect as:

- beneficial pathway (i.e., effects are positive or beneficial);
- no pathway (i.e., mitigation results in no effect on community well-being);
- secondary pathway (i.e., mitigation results in a negligible adverse effect on community well-being); or
- primary pathway (i.e., adverse effect that is greater than negligible and carried forward for further assessment).

The pathway analysis is summarized in Table 19.4-1. The subsections following the table provide the rationale used to assign potential effects to the beneficial pathway, no pathway, and secondary pathway categories and list primary pathways. Each Project interaction identified as a primary pathway was carried forward for detailed assessment. Positive outcome interactions for community well-being were classified as beneficial pathways and were not carried forward for further assessment (Section 6.7.3, Pathway Screening). Effects pathways apply to all Project phases unless otherwise noted.

The environmental design features, mitigations, and enhancements in Table 19.4-1 represent the list of key actions used to inform the pathway analysis as part of preparing the EIS. Potential accidents and malfunctions that have the capability to influence biophysical or human environments are discussed in Section 21, Accidents and Malfunctions.

For added clarity, the community well-being pathways as related to the measurement indicators are presented in Table 19.4-2.

Table 19.4-1: Potential Effects Pathways for Community Well-Being

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation, and Enhancements	Pathway Assessment
CWB-01	Project components/activities that may influence Indigenous identity during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ handling of waste rock, special waste rock, and ore ▪ processing facilities and underground operations ▪ additional infrastructure (e.g., roads, airstrip, camp, offices) ▪ ETP ▪ STP ▪ power generation ▪ access road upgrade ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ transportation of personnel and materials to and from the site	**Access restrictions and avoidance:** ▪ Restricted land access and avoidance of areas may reduce participation in traditional activities, adversely affecting cultural continuity, including the transmission of knowledge from Elders to youth	▪ **Limit the Project footprint** to the extent practical using practices such as: o optimizing use of cleared areas for Project activity o using existing road infrastructure, including existing access road and bridge crossing o using underground storage for tailing o designing an efficient infrastructure footprint (i.e., buildings clustered together) ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ **Reclaim and revegetate areas** where non-permanent Project facilities have been decommissioned ▪ Provide **dedicated space for Elders** to be available to support employees to assist with employee retention ▪ Develop and implement a **Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program ▪ Implement items as agreed to in the **Benefit Agreements** related to culture and traditional values ▪ Establish an **Implementation Committee** to provide a forum for regular communication and information exchange between NexGen and communities for effective management of the Benefit Agreement commitments and for the early resolution of issues and/or disputes that may arise ▪ Implement a **Security Program** to provide safe and coordinated access via the access road to locations where other land and resource use is practiced ▪ Implement **Indigenous and Public Engagement Program** to share information on Project plans and activities ▪ Establish a **Project feedback and grievance mechanism** to record and action issues identified by LPA residents (or other members of the public)	Primary pathway
CWB-02	Project components or activities that may decrease time spent by local workers with their families and communities during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ handling of waste rock, special waste rock, and ore ▪ processing facilities and underground operations ▪ ETP ▪ STP ▪ power generation ▪ food, housekeeping, maintenance, and environmental monitoring services ▪ Project-related training and employment opportunities ▪ Project-related rotating shifts ▪ housing in on-site camp ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ transportation of personnel and materials to and from the site	**Worker rotation system:** ▪ Time spent by workers away from their communities and families participating in the worker rotation system may result in effects on quality of life, local community cohesion, and family stability	▪ Work with local communities to **develop culturally sensitive employment policies** to address both recruitment and retention barriers ▪ Provide **dedicated space for Elders** to be available to support employees to assist with employee retention ▪ Develop and implement **human resource policies** (e.g., EFAP) to assist workers in finding information and referral services for family-related resources, as required ▪ Establish an **Implementation Committee** to provide a forum for regular communication and information exchange between NexGen and communities for effective management of the Benefit Agreement commitments and for the early resolution of issues and/or disputes that may arise ▪ Implement an **Indigenous and Public Engagement Program** to effectively engage with communities on Project activities, effects, mitigation, and monitoring to keep people informed and provide opportunities to provide feedback for continual improvement through a grievance mechanism ▪ Implement provisions of **Benefit Agreements** related to culture, traditional values, employment, training, and economic development	Primary pathway
CWB-03	Project components or activities that may influence harvesting activities and diet during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ handling of waste rock, special waste rock, and ore ▪ processing facilities and underground operations ▪ ETP ▪ STP ▪ power generation ▪ food, housekeeping, maintenance, and environmental monitoring services ▪ Project-related training and employment opportunities ▪ Project-related rotating shifts ▪ housing in on-site camp ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ transportation of personnel and materials to and from the site	**Opportunities for resource harvesting:** ▪ Involvement in Project-related employment may reduce opportunities for resource harvesting, affecting the amount of country foods in a traditional diet	▪ Work with local communities to **develop culturally sensitive employment policies** to facilitate involvement in resource harvesting activities ▪ Support and promote Indigenous community **participation and employment** in the traditional economy ▪ Work with local Indigenous Groups and communities to **develop fishing policies** that consider both fisheries protection and traditional use activities ▪ Implement provisions of **Benefit Agreements** related to culture, traditional values, employment, training, and economic development, and including: o funding and human resources to support community-related initiatives including but not limited to cultural and traditional values o the establishment of an **Implementation Committee** to communicate regularly and to reach early resolution of issues and/or disputes that may arise	Secondary pathway

Table 19.4-1: Potential Effects Pathways for Community Well-Being

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation, and Enhancements	Pathway Assessment
CWB-04	Project components or activities that result in expenditures and employment during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ handling of waste rock, special waste rock, and ore ▪ processing facilities and underground operations ▪ ETP ▪ STP ▪ power generation ▪ food, housekeeping, maintenance, and environmental monitoring services ▪ Project-related training and employment opportunities ▪ Project-related rotating shifts ▪ housing in on-site camp ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ transportation of personnel and materials to and from the site	**Amplification of community issues from increased disposable income:** ▪ Increased income for local community members may result in spending choices that amplify existing community issues, resulting in an adverse effect on quality of life	▪ Provide **employment readiness training** for employees ▪ Develop and implement a **pre-Construction communications process** to raise public awareness in communities of potential Project opportunities and effects ▪ **Develop and implement human resource policies** (e.g., EFAP) to assist workers in finding information and referral services for family-related resources, as required ▪ Establish an **Implementation Committee** to provide a forum for regular communication and information exchange between NexGen and communities for effective management of Benefit Agreement commitments and for the early resolution of issues and/or disputes that may arise	Secondary pathway
CWB-05	Project components or activities that result in expenditures and employment during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ handling of waste rock, special waste rock, and ore ▪ processing facilities and underground operations ▪ ETP ▪ STP ▪ power generation ▪ food, housekeeping, maintenance, and environmental monitoring services ▪ Project-related training and employment opportunities ▪ Project-related rotating shifts ▪ housing in on-site camp ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ transportation of personnel and materials to and from the site	**Population changes:** ▪ Increased employment opportunities may result in increased mobility (i.e., an influx of new or returning residents in the LSA, or existing residents moving to other centres outside the LSA). Increased opportunities may also result in fewer residents leaving the LSA to seek educational, economic, or social opportunities. These factors could affect demographics, community dynamics, and demand for community infrastructure and services	▪ Work with local communities to **develop culturally sensitive employment policies** to address both recruitment and retention barriers ▪ Provide **dedicated space for Elders** to be available to support employees to assist with employee retention ▪ Use best efforts to provide qualified local residents with a **first preference for employment and training opportunities** ▪ Work with relevant training institutions to facilitate delivery of **certified and accredited training and recruitment programs for construction and mining-related skills** targeted at employment opportunities for LSA residents and continue to provide scholarship and summer student opportunities ▪ Implement a tailored **local workforce recruitment strategy** to confirm that LSA residents are fully aware of and understand access to Project employment opportunities ▪ Set a long-term aspirational target of **75% of the Project's workforce** being composed of LSA residents ▪ Establish a **mentoring program** to support long-term participation of LSA residents in the Project workforce ▪ Prioritize **advancement** of qualified local residents into increasingly senior positions ▪ Implement provisions of **Benefit Agreements** related to employment, training, and economic development	Secondary pathway
CWB-06	Project activities that reduce employment and income opportunities during **Closure**: ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure	**Contracting and employment opportunities:** ▪ Decline in contracting, employment, and income opportunities due to both unscheduled slowdowns or shutdowns and scheduled Closure may result in adverse effects on quality of life	▪ Implement a **workforce transition plan** to address reduction in employment and training opportunities during unscheduled slowdowns or shutdowns and scheduled Closure ▪ Work with local communities to **maintain a local business registry** ▪ **Maintain ongoing communication with employees and contractors** about future workforce and contracting needs and the schedule for Decommissioning and Reclamation (i.e., Closure)	Secondary pathway
CWB-07	Project components or activities that influence provincial transportation infrastructure and related public safety during **all Project phases**: ▪ transportation of personnel and materials to and from the site	**Road transportation of materials and workforce:** ▪ Transportation of materials (all Project phases) and workers (early Construction) may affect local road infrastructure, which could affect the safety of road travel by community members	▪ Hold discussions, as required, with the Government of Saskatchewan on **provincial road use, maintenance, and upgrades to inform provincial planning purposes** ▪ Develop a **Ground Transportation Emergency Response Plan** to address traffic safety on the access road, including education of workers (e.g., staff contractors)	Secondary pathway
CWB-08	Project components or activities that influence provincial transportation infrastructure and related public safety during **all Project phases**: ▪ transportation of personnel and materials to and from the site	**Air transportation of workforce:** ▪ Transportation of workers may affect local air transportation infrastructure, resulting in improved air transportation access for community members	▪ No applicable Project design features or mitigations	No pathway

Table 19.4-1: Potential Effects Pathways for Community Well-Being

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation, and Enhancements	Pathway Assessment
CWB-09	Project components or activities that result in expenditures and employment during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ handling of waste rock, special waste rock, and ore ▪ processing facilities and underground operations ▪ ETP ▪ STP ▪ power generation ▪ food, housekeeping, maintenance, and environmental monitoring services ▪ Project-related training and employment opportunities ▪ Project-related rotating shifts ▪ housing in on-site camp ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ transportation of personnel and materials to and from the site	**Increased income:** ▪ Increased income for local community members through direct, indirect, and induced employment may enhance quality of life	▪ Work with local communities to **develop culturally sensitive employment policies** including addressing recruitment and retention barriers ▪ Establish a **mentoring program** to support long-term participation of LSA residents in the Project workforce ▪ Provide **dedicated space for Elders** to be available to support employees to assist with employee retention ▪ Establish a long-term aspirational target of **75% of the Project's workforce** being composed of LSA residents ▪ Use best efforts to provide qualified local residents, with a **first preference for employment and training opportunities** ▪ Work with relevant training institutions to facilitate delivery of **certified and accredited training and recruitment programs for construction and mining-related skills** targeted at employment opportunities for local residents ▪ Continue to **provide scholarship and summer student opportunities** ▪ Prioritize **advancement of qualified local residents** into increasingly senior positions ▪ Implement items as agreed to in the **Benefit Agreements** related to employment and training ▪ Implement a tailored **local workforce recruitment strategy** to confirm that LSA residents are fully aware of and understand access to Project employment opportunities	Beneficial pathway
CWB-10	Project components or activities that result in expenditures and employment during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ handling of waste rock, special waste rock, and ore ▪ processing facilities and underground operations ▪ ETP ▪ STP ▪ power generation ▪ food, housekeeping, maintenance, and environmental monitoring services ▪ Project-related training and employment opportunities ▪ Project-related rotating shifts ▪ housing in on-site camp ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ transportation of personnel and materials to and from the site	**Increased community revenue:** ▪ Increased community revenue through procurement opportunities may enhance quality of life through investments in communities (e.g., infrastructure and services)	▪ Provide a **first preference to local businesses** that meet or exceed requirements ▪ Develop and maintain a **business opportunities workplan** that describes the steps NexGen and each primary Indigenous Group would take to achieve the desired outcomes of the respective **Benefit Agreement** ▪ Provide **advance notice** of business opportunities ▪ Work with local communities to **maintain a local business registry** ▪ Design **procurement practices** to increase involvement of local businesses within the LSA and RSA, including providing information to communities on the size and timing of contracting opportunities ▪ **Pre-qualify** each Indigenous business listed in the business registry and provide feedback to any Indigenous business that does not successfully pre-qualify ▪ Develop and implement a **single source process** and a **preferred competitive bid process** to facilitate the success of capable and suitably qualified Indigenous businesses ▪ Implement items as agreed to in the **Benefit Agreements** related to employment, training, and economic development ▪ Establish a long-term aspirational target of **30% of external spending** being awarded to LSA and RSA businesses	Beneficial pathway
CWB-11	Project components or activities that result in expenditures and employment during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ handling of waste rock, special waste rock, and ore ▪ processing facilities and underground operations ▪ ETP ▪ STP ▪ power generation ▪ food, housekeeping, maintenance, and environmental monitoring services ▪ Project-related training and employment opportunities ▪ Project-related rotating shifts ▪ housing in on-site camp ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ transportation of personnel and materials to and from the site	**Payments to Indigenous Groups:** ▪ Benefit Agreements include payments to primary Indigenous Groups based on revenue generated throughout the Project lifespan	▪ Implement provisions of the **Benefit Agreements**	Beneficial pathway

Table 19.4-1: Potential Effects Pathways for Community Well-Being

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation, and Enhancements	Pathway Assessment
CWB-12	Project components or activities that result in expenditures and employment during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ handling of waste rock, special waste rock, and ore ▪ underground shaft and mine development ▪ processing facilities and underground operations ▪ ETP ▪ STP ▪ power generation ▪ food, housekeeping, maintenance, and environmental monitoring services ▪ Project-related training and employment opportunities ▪ Project-related rotating shifts ▪ housing in on-site camp ▪ removal of infrastructure ▪ restoration and revegetation of facilities and infrastructure ▪ transportation of personnel and materials to and from the site	**Increased educational and training opportunities:** ▪ Skills and accreditations acquired through training and employment opportunities may enhance the quality of life	▪ Use best efforts to provide qualified local residents with a **first preference for employment and training opportunities** ▪ Work with relevant training institutions to facilitate delivery of **certified and accredited training and recruitment programs for construction and mining-related skills** targeted at employment opportunities for local residents ▪ Continue to **provide scholarship and summer student opportunities** ▪ Prioritize **advancement of qualified local residents** into increasingly senior positions ▪ Implement items as agreed to in the **Benefit Agreements** related to employment and training ▪ Implement a tailored **local workforce recruitment strategy** to confirm that LSA residents are fully aware of and understand access to Project employment opportunities ▪ Work with local communities to **develop culturally sensitive employment policies** including addressing recruitment and retention barriers ▪ Establish a **mentoring program** to support long-term participation of LSA residents in the Project workforce	Beneficial pathway

Bolded text represents the key topic of the environmental design features and mitigation.
LSA = local study area; RSA = regional study area; LPA = local priority area; EFAP = employee and family assistance program; ETP = effluent treatment plant; STP = sewage treatment plant.

Table 19.4-2: Pathway Linkages to Community Well-Being Measurement Indicator Groupings, Measurement Indicators, and Associated Supporting Indicators

Pathway	Measurement Indicator Grouping		
	Cultural Continuity	Social Adaptability	Demand for Community Infrastructure and Services
	Measurement Indicators (numbered) Supporting Indicators (lettered)		
CWB-01: Access restrictions and avoidance (primary)	1. Societal and cultural well-being: a. Culture 2. Health well-being: a. Overall health	×	1. Health well-being: a. Health services
CWB-02: Worker rotation system (primary)	×	1. Societal and cultural well-being: a. Demographics b. Culture 2. Health well-being: a. Overall health 3. Neighbourhood and physical environment well-being: a. Recreation 4. Educational well-being: a. Educational participation levels 5. Economic well-being: a. Labour force characteristics	1. Health well-being: a. Overall health b. Health services
CWB-03: Opportunities for resource harvesting (secondary)	1. Societal and cultural well-being: a. Culture 2. Health well-being: a. Overall health	×	×
CWB-04: Amplification of community issues from increased disposable income (secondary)	×	1. Societal and cultural well-being: a. Crime and safety 2. Health well-being: a. Overall health	1. Health well-being: a. Overall health b. Health services
CWB-05: Population changes (secondary)	×	1. Societal and cultural well-being: a. Demographics b. Culture 2. Health well-being: a. Health infrastructure b. Health services 3. Neighbourhood and physical environment well-being: a. Housing 4. Educational well-being: a. Educational opportunities and attainment b. Educational institutions	1. Societal and cultural well-being: a. Demographics 2. Health well-being: a. Health infrastructure b. Health services 3. Neighbourhood and physical environment well-being: a. Housing
CWB-06: Contracting and employment opportunities (secondary)	×	1. Societal and cultural well-being: a. Demographics 2. Health well-being: a. Overall health 3. Economic well-being: a. Economic Opportunities and Attainment b. Labour force characteristics c. Income Levels	1. Health well-being: a. Health infrastructure

Table 19.4-2: Pathway Linkages to Community Well-Being Measurement Indicator Groupings, Measurement Indicators, and Associated Supporting Indicators

<table>
<tr><th rowspan="3">Pathway</th><th colspan="3">Measurement Indicator Grouping</th></tr>
<tr><th>Cultural Continuity</th><th>Social Adaptability</th><th>Demand for Community Infrastructure and Services</th></tr>
<tr><th colspan="3">Measurement Indicators (numbered)
Supporting Indicators (lettered)</th></tr>
<tr><td>CWB-07: Road transportation of materials and workforce (secondary)</td><td>1. Societal and cultural well-being:
a. Culture</td><td>×</td><td>1. Societal and cultural well-being:
a. Crime and safety
2. Neighbourhood and physical environment well-being:
a. Transportation infrastructure</td></tr>
<tr><td>CWB-08: Air transportation of workforce (no pathway)</td><td>×</td><td>×</td><td>1. Neighbourhood and physical environment well-being:
a. Transportation infrastructure</td></tr>
<tr><td>CWB-09: Increased income (beneficial)</td><td>1. Societal and cultural well-being:
a. Culture</td><td>1. Societal and cultural well-being:
a. Crime and safety
b. Governance
2. Health well-being:
a. Overall health
3. Neighbourhood and physical environment well-being:
a. Local/regional planning
4. Educational well-being:
a. Educational opportunities and attainment
5. Economic well-being:
a. Economic opportunities and attainment
b. Income levels</td><td>×</td></tr>
<tr><td>CWB-10: Increased community revenue (beneficial)</td><td>×</td><td>1. Societal and cultural well-being:
a. Governance
2. Health well-being:
a. Overall health
3. Educational well-being:
a. Educational opportunities and attainment
4. Economic well-being:
a. Economic opportunities and attainment
b. Income Levels</td><td>1. Health well-being:
a. Health infrastructure
b. Health services
2. Neighbourhood and physical environment well-being:
a. Local/regional planning
3. Educational well-being:
a. Educational institutions</td></tr>
<tr><td>CWB-11: Payments to Indigenous Groups (beneficial)</td><td>1. Societal and cultural well-being:
a. Culture
2. Health well-being:
a. Overall health
3. Neighbourhood and physical environment well-being:
a. Local/regional planning</td><td>1. Societal and cultural well-being:
a. Culture
2. Health well-being:
a. Overall health
3. Neighbourhood and physical environment well-being:
a. Local/regional planning
4. Educational well-being:
a. Educational opportunities and attainment
5. Economic well-being:
a. Economic opportunities and attainment
b. Income Levels</td><td>1. Health well-being:
a. Health infrastructure
b. Health services
2. Neighbourhood and physical environment well-being:
a. Housing
b. Local/regional planning
3. Educational well-being:
a. Economic opportunities and attainment</td></tr>
</table>

Table 19.4-2: Pathway Linkages to Community Well-Being Measurement Indicator Groupings, Measurement Indicators, and Associated Supporting Indicators

Pathway	Measurement Indicator Grouping		
	Cultural Continuity	Social Adaptability	Demand for Community Infrastructure and Services
	Measurement Indicators (numbered) Supporting Indicators (lettered)		
CWB-12: Increased educational and training opportunities (beneficial)	×	1. Health well-being: a. Overall health 2. Educational well-being: a. Educational opportunities and attainment 3. Economic well-being: a. Economic opportunities and attainment	1. Health well-being: a. Overall health

× = pathway has no linkage to measurement indicator.

19.4.1 Beneficial Pathways

The following Project interactions were predicted to result in beneficial pathways to community well-being and were not carried forward in the assessment.

CWB-09: Increased income:

- Increased income for local community members through direct, indirect, and induced employment may enhance quality of life.

The Project would provide opportunities for increased income for both individuals and families. Increased income would come through direct (e.g., employment) and indirect (e.g., suppliers) opportunities associated with the Project, as well as induced income associated with additional jobs in the communities from workers spending their incomes. To help enhance personal income and revenue opportunities for community members in the LSA, NexGen is committing to a long-term aspirational employment target of 75% of peak operating jobs with residents from the LSA communities, and a long-term aspirational target of 30% of the Project's external spend being awarded to local businesses (i.e., within the LSA and RSA). Meeting these targets may require hiring 40% of the 2016 LSA population over the age of 15 with a high school, college, or university certificate who were unemployed or not in the labour force in 2016 (i.e., 221 positions out of 550 people) and 48% of the LSA population over the age of 15 with an apprenticeship or trades certificate or diploma who were unemployed or not in the labour force in 2016 (i.e., 110 positions out of 230 people).

In addition to the aspirational LSA targets, Benefit Agreements between NexGen and the primary Indigenous Groups (i.e., the CRDN, MN-S, BNDN, and BRDN) would include commitments for employment, training, and contracting opportunities. NexGen has signed Benefit Agreements with the CRDN, MN-S, BNDN, and BRDN. The Benefit Agreements stipulate that NexGen and each primary Indigenous Group would, among other things:

- Work with local communities to develop culturally sensitive employment policies including addressing recruitment and retention barriers.
- Implement a tailored local workforce recruitment strategy to confirm that LSA residents are fully aware of and understand how to access Project employment opportunities.
- Use best efforts to provide qualified local residents with a first preference for employment and training opportunities.

- Prioritize advancement opportunities for qualified local residents into increasingly senior positions.
- Establish a mentoring program to support long-term participation of LSA residents in the Project workforce.

In addition to the commitments under the Benefit Agreements, NexGen is committed to:

- providing dedicated space for Elders to be available to support employees and assist with employee retention; and
- working with relevant training institutions to facilitate the delivery of certified and accredited training and recruitment programs for construction and mining-related skills targeted at employment opportunities for local residents and continue to provide scholarship and summer student opportunities.

Employment and income have the potential to benefit community well-being in multiple ways, as identified during the 2019 to 2021 KP interview program and April 2021 JWG meetings (BNDN-JWG 2021d; BRDN-JWG 2021b). Quality of life can be improved through increased access to housing or education. Health benefits can be realized through having disposable income to support participation in traditional harvesting activities and improve individual diets. The ability to attract local community members for employment could promote societal and cultural well-being by retaining youth who might leave the LSA for high-paying jobs elsewhere. This may also promote economic well-being through increased spending at local businesses (2019 to 2021 KP interview program). The potential adverse effects of increased income are discussed in Section 19.4.3, Secondary Pathways.

A BNDN member noted that "a lot of people will use it [income] properly, to help themselves and their families build a better life and be able to do some of those cultural activities that we enjoy a lot easier and quicker" (BNDN-JWG 2021a). The BNDN has already seen some of the positive benefits associated with greater income through payments made to individual members after the conclusion of the Cold Lake Air Weapons Range Settlement with the Government of Canada (BNDN-JWG 2021b). It was noted that some members had spent their payment on gear to help with traditional activities and were spending more time on the land:

> There are more quads and boats now in our community than there was. Some families didn't have a proper motor; now they have boats and can take their family to the lake. You create that opportunity. People are more active out there. The kids grow up learning and knowing about the land. They're not only swimming at the beach; they're swimming out there on the land. I grew up all over Turnor, Frobisher and Clear Lakes . . . . We were all land-based back then. It's good, it's healthy. It brings back that we are the Dene. You have to know your land, your language. That's your identity. (BNDN-JWG 2021d)

The CRDN confirmed that participating in the wage economy can help support traditional activities:

> A number of harvesters specifically described how wage-based jobs (i.e., individual or within the extended family) financially support the imperatives to live as Denesųłiné people engaged in land-based activities and the provision of food. (TSD V.1: CRDN)

This positive relationship between the wage economy and traditional economy was also noted by other Indigenous Groups (BNDN-JWG 2021d; BRDN-JWG 2021e), as were the effects of government transfers on some of their members' ability to actively engage in those economies (BNDN-JWG 2021d; BRDN-JWG 2021c).

Increased income has the potential to change social cohesion and community dynamics by changing the access to and distribution of wealth in the community. This could result in a noticeable change in communities, though eventually economic equilibrium would be attained, and a new norm would likely occur. Given NexGen's long-term aspirational targets of 75% direct employment for the Project from the LSA communities and 30% local procurement from the LSA and RSA, economic opportunities would exist for the duration of the Project.

Conversely, mining has the potential to create fluctuating economies, with the inevitable adverse effect being scheduled declines (e.g., Closure) or unscheduled declines (e.g., temporary suspension of operations). In consideration of these concerns, NexGen is committed to:

- implementing a workforce transition plan to address reduction in employment and training opportunities during Closure and considering slowdowns or shutdowns associated with care and maintenance in the development of the plan;
- developing and implementing a pre-Construction communications process to raise public awareness in communities of potential Project opportunities and effects; and
- maintaining ongoing communication with employees and contractors about future workforce and contracting needs and the schedule for Closure.

Overall, the beneficial effects associated with increased income for local community members are anticipated to outweigh potential adverse effects, especially after the implementation of mitigation; therefore, increased income was deemed to be a beneficial pathway.

CWB-10: Increased community revenue:

- Increased community revenue through procurement opportunities may enhance quality of life through investments in communities (e.g., infrastructure and services).

How communities benefit from increased revenue through procurement opportunities would depend on the nature and structure of businesses. Joint ventures or multi-community owned businesses might not result in direct investment into community revenue streams, while businesses that are owned or managed by the communities themselves can contribute substantial sums to community revenue streams or reinvest revenue in business expansion (CVMPP 2013). Community governments will determine how to best spend funds for the benefit of their communities.

CWB-11: Payments to Indigenous Groups:

- Benefit Agreements include payments to primary Indigenous Groups based on revenue generated throughout the Project lifespan.

The analysis of beneficial effects on community well-being considers Benefit Agreements signed with the CRDN, MN-S, BNDN, and BRDN. As a foundational principle, NexGen acknowledges and values the community interests and aspirations of those potentially affected by the Project. NexGen fosters trusting relationships that facilitate collaboration and optimize benefits to Indigenous Groups and Project stakeholders by:

- respecting the diverse cultures and perspectives of those with whom the Project interacts;
- proactively and transparently engaging with Project-affected communities;
- enhancing workers' awareness of the history, traditions, and rights of Indigenous Peoples;
- supporting the economic participation of local communities;
- seeking to provide opportunities resulting from Project benefits to local communities with the ability to last beyond the Project lifespan; and
- providing clear and timely information to those who have a direct interest in the Project.

Each Benefit Agreement is valid for the lifespan of the proposed Project, continuing until such time that the fully decommissioned and reclaimed Project site is returned to Institutional Control under Provincial management.

Each Indigenous Group would determine how to best spend funds or allocate payments for the benefit of their members.

CWB-12: Increased educational and training opportunities:

- Skills and accreditations acquired through training and employment opportunities may enhance the quality of life.

Educational opportunities are the pathway to many employment opportunities. Access to education and training opportunities have been communicated by Indigenous Groups and community members as an important benefit from the Project (NexGen 2019; CRDN-JWG 2021; BNDN-JWG 2021d; BRDN-JWG 2021b; MN-S-JWG 2021b; TSD V.3: CRDN). Some Indigenous Groups have also expressed the desire to have some education and training focus on community enhancements, such as financial skills training, which could benefit many community members, not just future Project employees (BNDN-JWG 2021b). Indigenous Groups also noted the importance of land-based education in their schools, and the effect those programs have on school retention rates and Indigenous Knowledge transfer to future generations, including language (BNDN-JWG 2021d; BRDN-JWG 2021e). The low educational scores from the community well-being index (Section 19.3.6) highlight the benefit increases in educational opportunities and attainment could have on the overall well-being of the communities. The BNDN noted that increasing educational opportunities for on-reserve residents would increase well-being, community cohesion, and pathways to employment opportunities (BNDN-JWG 2021b).

As noted in Section 18.4.1, Beneficial Pathways, educational opportunities are expected to have a beneficial effect on communities. This beneficial effect is not limited to direct Project opportunities, as educational skills can be transferable and can open a pathway to other employment, which could further stimulate the LSA economy. Increases in educational opportunities would increase the ability of residents in LSA communities to engage in economic opportunities. Given NexGen's long-term aspirational targets of 75% direct employment for the Project from the LSA communities and 30% local procurement from the LSA and RSA, educational and economic opportunities would exist for the duration of the Project.

19.4.2 No Pathways

The following Project interaction was predicted to result in no pathway to community well-being and was not carried forward in the assessment.

CWB-08: Air transportation of workforce:

- Transportation of workers may affect local air transportation infrastructure, resulting in improved air transportation access for community members.

Before the Project airstrip and supporting infrastructure for the proposed Project is built to receive the workforce, NexGen plans to fly employees to the La Loche Airport and bus them to site. During Construction, on-site labour is expected to peak at 348 workers, including labour associated with surface and underground construction, supervision, staff, maintenance, general and administration positions, the integrated execution team, and consultants and contractors. Actual on-site labour requirements would vary throughout Construction. Currently, there is no supporting infrastructure at the La Loche Airport beyond a hangar, which could present difficulties if a sizeable portion of the workforce is expected to travel from La Loche to the Project. Further, the lack of infrastructure would present limitations to sheltering workers if there are delays (e.g., weather) and while workers wait for either the bus or departing flights. In consideration of this concern, NexGen would consider providing temporary infrastructure or contracting with a local business to provide the temporary infrastructure and maintenance required while employees use the airport.

During Operations, peak employment is expected to comprise 260 positions on site and a total of 486 positions on payroll. Most personnel would work a two-week-in/two-week-out rotation, on a fly-in/fly-out basis. Some senior staff would work a rotation of four days on site and three days off site without a cross shift (NexGen 2021). It is anticipated that Operations would provide greater potential for hiring residents from the LSA communities than Construction due to the longer duration of the positions as well as recruitment, education, and training plans implemented to progress toward NexGen's long-term aspirational target of 75% of the workforce being residents of the LSA.

NexGen is currently considering using the Buffalo Narrows Airport as a pick-up point in the LSA. There may also be an additional pick-up point within the LSA (e.g., La Loche), and there would be pick-up points outside of the LSA in communities where there is a skilled workforce (e.g., Saskatoon); these locations are to be confirmed. The runway at the Buffalo Narrows Airport can accommodate airplanes up to the size of an ATR 72, which can seat up to 78 passengers, and provides sufficient capacity for the Project, which anticipates requiring capacity for a Bombardier Dash 8 Q300 (i.e., to accommodate 48 passengers) or ATR 42-320 (i.e., to accommodate 42 passengers) (NexGen 2021; ATR 2021; 2019 to 2021 KP interview program).

During Construction, if required, the provision of temporary infrastructure at the La Loche Airport by NexGen directly, through service agreement, or through contracting with a local business is expected to alleviate any potential effects related to using the airport until the Project airstrip is built. During Operations, the current capacity of the runway at the Buffalo Narrows Airport would be able to accommodate the planes NexGen would use to transport its workforce. In addition, no concerns have been expressed around increased air traffic at the airport, which is currently used primarily for charters (2019 to 2021 KP interview program). Therefore, there is no expected change or disruption to air infrastructure and services, which are typically used for medical transportation or transportation related to policing and the courts system (Section 19.3.3.5.1, Buffalo Narrows Airport). This pathway was determined to have no effect on community well-being and was not carried forward in the assessment.

19.4.3 Secondary Pathways

The following Project interactions were predicted to result in secondary pathways to community well-being and were not carried forward in the assessment.

CWB-03: Opportunities for resource harvesting:

- Involvement in Project-related employment may reduce opportunities for resource harvesting, affecting the amount of country foods in a traditional diet.

The Project may reduce opportunities for resource harvesting due to the time that LSA residents are required to remain at site when on work rotation. NexGen's worker rotation system for most direct employees would likely be a two-week-in/two-week-out rotation, which means that employees would be on site for two weeks at a time. The worker rotation system may affect resource harvesting if employees are on site during key windows for hunting or fishing or if they have other obligations (e.g., medical appointments) that need to be fulfilled during the two weeks off. For example, one BRDN member shared:

> That's something with hunting seasons at different times. In spring we have duck eggs, ducks, muskrats, beavers; in summer the moose are getting fat. In fall we have whitefish . . . . We live off wild meat all year round. (BRDN-JWG 2021d)

A study on the effects of the worker rotation in northern Saskatchewan, which included residents of northwestern Saskatchewan (i.e., LSA communities), confirmed that some workers felt that there was not enough time during their off time to fulfil other obligations and go out on the land (CVMPP 2005). Overall, however, most participants in the worker rotation study felt that the worker rotation did not interfere with traditional land use activities, while other respondents felt that it allowed them to participate more (CVMPP 2005). Women with experience with the mining industry worker rotation system interviewed as part of the KP interview program felt that the commuter rotation system did not limit time spent on the land and instead provided greater opportunities to go out (2019 to 2021 KP interview program). As noted in connection with the traditional economy (Section 18), participation in the wage economy can be a deterrent to spending longer periods on the land (BNDN-JWG 2021b; BRDN-JWG 2021b); however, income earned in the market economy can also contribute to success in traditional economy activities as market income can be used to purchase supplies and equipment needed for traditional economy activities (BNDN-JWG 2021b; BRDN-JWG 2021b). The BRDN noted that there has been an increase in community participation in the traditional economy due to the modern equipment available, including boats and all-terrain vehicles (ATVs) (BRDN-JWG 2021b), while the BNDN noted that payments from the Primrose Lake Air Weapons Test Range settlement resulted in similar local spends on equipment to better access traditional territories (BNDN-JWG 2021d; Section 19.4.1, Beneficial Pathways).

To mitigate reduced opportunities to engage in resource harvesting, NexGen would work with local communities to develop culturally sensitive human resource policies. These policies would consider the seasonal round, which depicts harvesting times and seasonality for various plants and wildlife species, and would look for opportunities to accommodate important harvesting periods, to the extent possible. The Conference Board of Canada (2019) examined Indigenous recruitment and retention in Canada's northern and remote regions and cited flexible work arrangements to accommodate important cultural activities as methods that can support the creation of inclusive, accepting work environments for Indigenous employees. The mitigation is well understood through other uranium operations in northern Saskatchewan that have provided employees with flexible work arrangements. These mitigations, along with information derived from the CVMPP study and feedback received from Indigenous Groups suggesting that participation in the wage economy can increase traditional land use activities, indicate that a greater than negligible adverse effect is unlikely; therefore, this pathway was determined to have a negligible effect on community well-being and was not carried forward in the assessment.

CWB-04: Amplification of community issues from increased disposable income:

- Increased income for local community members may result in spending choices that amplify existing community issues, resulting in an adverse effect on quality of life.

The Project would provide opportunities for increased personal income through direct (e.g., employee) and indirect (e.g., contractor) employment on the Project. There may also be induced income associated with additional jobs in the communities, though research suggests community members employed in the uranium industry often use their increased income to travel to larger centres to purchase groceries, clothing, and other consumer goods (CVMPP 2013). The potential employment and income opportunities are discussed in more detail in Section 18.4.1.

While increased income for local community members may be beneficial (Section 19.4.1), there is also the potential to spend increased disposable income in ways that can amplify current community issues, particularly substance abuse, domestic violence, and mental health. These issues could have an adverse effect on social adaptability by disrupting social and cultural norms and harming relationships among individual community members. The communities in the LSA have expressed concern about the potential adverse effects on workers, their families, and communities from increased income (BNDN-JWG 2020; BRDN-JWG 2020; MN-S-JWG 2020; 2019 to 2021 KP interview program). Based on previous experiences with other mine sites, one MN-S citizen commented:

> People come back from work with lots of money, party with their friends, go back to work, and the families are left behind. The biggest area is social problems like addictions; that would be very important to have [support services] available so people don't have to take time off work to go for counselling unless it's really serious. (MN-S-JWG 2020)

A BNDN member commented:

> By the same token, when we think about the addictions that are occurring in our community, from our end we will have to really think this through as to how we can provide mitigation measures to alleviate and prevent some of these issues with addictions. Money will flow quicker and easier. Those are some of the main concerns that the health department will really need to consider and plan for, because they will crop up . . . . Addictions would be one major issue I know for sure we'll be dealing with. (BNDN-JWG 2021b)

Potential workers may or may not be prepared for the intense work regime (i.e., a long daily routine and little time off during the work rotation schedule), the separation of living in a work camp away from their home community, and the sudden increase in income. These conditions may result in stress for some potential workers.

For those struggling to adapt or who may not be successful in trying to secure employment, substance abuse is a known coping factor for stress (Gibson and Klinck 2007), with alcohol identified as a coping mechanism for a host of issues (Oxford Treatment Center 2021; CCSA 2010; CAMH 2022). Local study area communities have already noted ongoing issues with substance abuse and addictions (2019 to 2021 KP interview program) and that employment and the associated income in some circumstances may exacerbate them.

How community members would spend increased disposable income would depend on the individual. The BNDN noted that individuals with a strong relationship with the land would likely do well:

> Those with a strong spiritual connection to the land will keep their head above water and do the right things, because they have that foundation that gives them strength to be able to deal with even unemployment. They still have that food storage out there; even if there's no job they can go put in a net. Those things aren't forgotten. It will have a negative impact if there are no jobs available if things do take a downturn. But for those who know how to live off the land and have that strong connection, it won't make much difference to the way they live. (BNDN-JWG 2021b)

A BNDN JWG participant also noted many of the BNDN's members had a different concept of savings and noted the challenges with saving income in a culture that shares and spends immediately (BNDN-JWG 2021b). This difference can present several challenges for individuals including spending choices, dissatisfaction with working for little long-term benefit, and family/community pressures to spend savings. The ramification of these challenges can be experienced at the individual, family, or community level. Conversely, financial training and estate planning can result in beneficial outcomes for all (BNDN-JWG 2021b).

It should be noted that most research that shows the positive relationship between a higher income and improved health uses data from people who have these higher incomes over longer periods of time, and they tend to be in larger urban centres. This relationship is related to "higher socio-economic status", not necessarily those who experience sudden increases in income for limited periods of time, which does not necessarily change long-term socio-economic status (Scott and Lessard 2002). Research suggests that, after one or two years, communities can adjust to increased income levels through an increase in social stability and improved services (NAHO 2008). This finding suggests that Construction employment may represent an opportunity for poor spending choices. However, income earned from sustained employment and increased advancement opportunities during the 24 years of Operations is more likely to contribute to overall improvements to individual health and well-being.

While the potential for adverse effects associated with income is dependent on individual behaviours, NexGen would implement mitigations (Table 19.4-1). The establishment of health and wellness programming on site, including an employee and family assistance program (EFAP) to help workers locate resources not available in their home communities, would support workers dealing with addictions. The EFAP would include services such as free assessments, short-term counselling, referrals, and follow-up to employees and their family members who are having personal or work-related problems. The EFAP could also work to establish relationships with existing services to assist with development of programs to support current or future workers and their families with challenges associated with increased income.

The BNDN noted a community need for life skills training, including household budgeting and savings (BNDN-JWG 2021d). NexGen would support such life skills training or similar with the communities in the manner communities think would serve their members best. Life skills training curriculums vary, but often money management is included. Training programs could include a combination of on-site or in-community options as determined appropriate through engagement. Some Indigenous Groups have identified life skills training as effective mitigation (BNDN-JWG 2021d; BRDN-JWG 2021c), and another would like to see funding put in place (TSD IV: MN-S). The CRDN recommended NexGen offer or provide support for outreach programs to encourage healthy life skills, manage substance abuse, and for suicide prevention. Support could include direct assistance or supporting the creation of a community task force to support the RCMP in any of its initiatives to combat alcohol and substance abuse (TSD V.3: CRDN). The Conference Board of Canada (2019) confirms that life skills training is important for helping Indigenous Peoples enter and remain part of the wage economy.

Under the assumption that mitigation opportunities are effectively implemented and received by community members, this pathway was determined to have a negligible effect on community well-being. Therefore, this pathway was not carried forward in the assessment.

CWB-05: Population changes:

- Increased employment opportunities may result in increased mobility (i.e., an influx of new or returning residents in the LSA, or existing residents moving to other centres outside the LSA). Increased opportunities may also result in fewer residents leaving the LSA to seek educational, economic, or social opportunities. These factors could affect demographics, community dynamics, and demand for community infrastructure and services.

Changes in employment, business, and income opportunities may affect population in-migration and out-migration as assessed in Section 18.4.3 (Secondary Pathways). The availability of local employment opportunities may provide an incentive for people to move to the LSA. This influx could include former residents who return home when employment opportunities increase. Increased income may also allow local residents to move within the LSA, or in some cases, outside the LSA to larger centres like Saskatoon. In-migration can have cascading effects, which can adversely affect social cohesion, access to community services, and housing. The communities in the LSA are small and tightly knit, and an increase in population may stress services that community members have already noted are insufficient for meeting current needs (Section 19.3.2.1, Health Care Facilities and Services; Section 19.3.2.2, Social Services) or housing, which is also in short supply in the LSA (Section 19.3.3.1, Housing). These changes may also unbalance community dynamics and social cohesion, and potentially amplify existing issues like substance abuse and mental health.

Census data have shown modest decreases in population in the LSA in recent years, though at other times in the past, the LSA has experienced faster population growth. Population changes also vary by community (Figure 19.3-1 and Figure 19.3-12). Population growth rates in some of the LSA communities have been higher than the RSA (Figure 18.3-1; BNDN-JWG 2021b). Current population projections for the Keewatin Yatthé Health Region, in which the LSA is located, range from a cumulative increase of approximately 7% from 2018 to 2049 in the high growth scenario to a decrease of approximately 10% from 2018 to 2049 in the low growth scenario (Figure 18-3.8). However, projecting population changes for small populations has a high degree of uncertainty.

Local study area residents have noted during KP interviews that a number of factors influence migration decisions, including access to employment, education, housing, and other amenities. Local study area residents often relocate to the surrounding communities such as Buffalo Narrows for educational training (BNDN-JWG 2021a; 2019 to 2021 KP interview program). Previous research has also indicated that many RSA residents have a strong sense of home and connection to the area and return if they can find employment (BNDN-JWG 2021a; Anderson Fast & Associates 2000).

Unmanageable levels of in-migration are unlikely, primarily because the Project is of sufficient distance from the closest community, La Loche, that a daily commute is not possible. However, it is likely that some former LSA residents may return, while future adults who may have otherwise left the LSA may be retained due to increased educational and employment opportunities. To limit the potential for adverse effects from an influx, particularly from people without connections to the LSA, mitigation to reduce the incentive to relocate to the LSA from other locations would include providing a variety of pick-up points for workers throughout Saskatchewan. This mitigation is already part of the Project design, as some employees would likely be recruited from outside the LSA. Outside of the LSA, pick-up points are currently anticipated for Saskatoon and Prince Albert, with additional locations to be determined depending on eligible labour force supply. During Closure, the decline in employment opportunities would reduce or eliminate incentives to relocate.

Out-migration is also a potential outcome of the Project. Out-migrating residents would likely be existing residents who secure direct employment with the Project and then determine they would prefer to live in another location given the fly-in/fly-out nature of the operation. Out-migration was witnessed to varying degrees in some of the Athabasca Basin communities in the RSA, mainly due to better access to services and infrastructure provided by larger centres that support family and social opportunities, or to be closer to friends and family in those external communities (Intergroup 2011). This out-migration is not anticipated to occur on a wide scale but is likely to occur to some degree within the LSA communities.

The retention of existing residents who otherwise may have left the LSA for educational, employment, or social opportunities is also likely to occur. Current LSA data (e.g., demographics, mobility) show a portion of young adults are mobile in LSA communities, and increased opportunities in the LSA could alter the choice to pursue opportunities outside of the LSA (i.e., reduce the likelihood of young adults leaving). This could affect population and demographics in a positive way (i.e., retention of young adults in the communities) and in adverse ways (e.g., increased young adults more likely to be involved in anti-social behaviour [Greenberg 1985; Sampson and Laub 1995]), though the retention of some youth is predicted to result in a positive outcome for communities.

Working with LSA communities to develop hiring policies and commuter transportation options that provide flexibility for workers to maintain employment, specifically if they choose to relocate south to access education or other amenities for themselves or family members, can help planning and management of population changes. Manageable in-migration in most communities would be seen as a positive outcome, particularly if it consisted of returning residents, as would the retention of young adults who may otherwise have left the LSA.

Based on the above information and considerations, increases in employment and income opportunities may affect in-migration decisions based on individual circumstances. Providing commuter options from places such as Saskatoon and Prince Albert should reduce the incentive for people currently residing in those communities to relocate to the LSA communities, which is anticipated to limit both new and returning residents. When considering all factors, potential population changes related to the Project would likely result in minor changes to social adaptability, demand for services, and housing. Therefore, pressures on in-migration are expected to have negligible residual effects on community well-being, and the pathway was not carried forward for further assessment.

CWB-06: Contracting and employment opportunities:

- Decline in contracting, employment, and income opportunities due to both unscheduled slowdowns or shutdowns and scheduled Closure may result in adverse effects on quality of life.

Communities in the LSA have expressed concern with the boom-bust cycle that is often associated with mining and the potential to experience declining quality of life following Operations as contracting, employment, and income opportunities decline. In addition to experiencing the closure of the Cluff Lake Mine, many uranium operations in northern Saskatchewan experienced a downturn in the last five years due to low uranium prices (e.g., McArthur River Mine in 2018; Shield 2022) and COVID-19 (e.g., Cigar Lake Mine in 2020; Bramadat-Willcock 2020) and transitioned from operations to care and maintenance, meaning that residents of the LSA and RSA have seen the effects of boom-bust cycles first-hand. For example, one MN-S citizen shared:

> Yes. . . . People bought houses, vehicles and all of a sudden, they're getting laid off the next day. . . . It affects their families and anger goes through the guy who then vents on their families. (MN-S-JWG 2019a)

During Construction and Operations, there would be increases in contracting, employment, and income opportunities (Section 18.4.4). During the Active Closure Stage, activities such as backfilling mine workings, removing physical infrastructure, and recontouring and revegetating disturbed areas, which are necessary to achieve decommissioning objectives and return the site to a safe and stable condition, would continue for an anticipated five years (Section 19.2.4). Unplanned decreases in production or transitions to care and maintenance, often due to decreases in uranium prices, can have an even greater affect on communities. The transition from Operations and the Active Closure Stage to the Transitional Monitoring Stage would result in decreases to contracting, employment, and income opportunities. However, compared to existing conditions, the work experience and training gained from the Project should result in a more experienced and qualified local labour force with transferable skills to other mines or industries, which represents a residual benefit in the ability to obtain other employment and income opportunities.

Job loss can have adverse effects on individuals, their families, and communities. For individuals, unemployment can have an adverse effect on mental and physical health, even if there is no associated financial strain. For individuals whose living and financial situations are more precarious, adverse mental and physical outcomes are often more pronounced (Pappas 2020). Looking at other communities that have experienced the disappearance of a major economic driver, domestic disturbances and demand for social services may increase (Pembina Institute 2008). Additionally, the lack of alternative employment opportunities in the LSA and the lower wages of many current opportunities could result in some former workers refusing to work for less pay, resulting in increased unemployment. Lack of alternative employment opportunities also may result in a requirement for workers to relocate to other communities where opportunities exist or result in longer commutes to employment opportunities outside the LSA (e.g., oil sands employment in Alberta).

The Joint Panel noted uranium mining produces a boom-bust economic cycle. The Joint Panel observed that employment and business opportunities created by operating mines and mills are not permanent, but the benefits of training and work experience can produce more enduring benefits (IAAC 2016). The Joint Panel indicated its view that the continuation of initiatives, such as the Multi-Party Training Plan[13], are necessary to

[13] The Multi-Party Training Plan was a multi-stakeholder partnership between public, private, and non-profit organizations. It enabled mining companies to pool their labour projections and other partners to combine resources in linking training directly to the mineral sector's demand.

provide opportunities for northerners in the uranium mining industry. Further information about the Multi-Party Training Plan is provided in Section 18.3.1, Overview of Provincial and Northern Saskatchewan Economies.

A workforce transition plan and maintaining ongoing communication with employees and local communities can help workers plan for a transition to other employment and income opportunities. Workers would have acquired skills, credentials, and experience during employment that could help improve future employment prospects. General trends in resource sector employment should also help minimize the adverse effects of reduced Project employment as the sector is trending away from a demand for low-skill labour and more toward science, technology, engineering, and mathematics skill sets (CCAB 2019; COPS 2017), meaning the skills that workers obtain with the Project would be transferable to those increasingly in demand by other sectors.

Communities have conveyed the importance of building capacity and maintaining diverse economies. With a workforce transition plan, including communication about the Project transitioning from Operations to either Closure or potential slowdowns or shutdowns associated with care and maintenance, residents of LSA communities and local businesses should be able to transition to other employment and procurement opportunities. On balance, considering the residual benefits of work experience and training, and the availability of mitigation including a workforce transition plan, the declines in employment and income opportunities are expected to have negligible effects on community well-being compared to existing conditions. Therefore, this pathway was not carried forward in the assessment.

CWB-07: Road transportation of materials and workforce:

- Transportation of materials (all Project phases) and workers (early Construction) may affect local road infrastructure, which could affect the safety of road travel by community members.

Local study area communities have expressed concern with Project-related traffic along Highway 155 from Green Lake to La Loche and along Highway 955 from La Loche to the Project (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.2: CRDN). Increased traffic volumes on local transportation infrastructure may increase maintenance requirements, which may affect the safety of road travel by community members. Changes to public safety may also occur because of vehicle accidents or interference between land and resource use activities, especially in proximity to Highway 955; these pathways are discussed in Section 16.4.1, No Pathways, and Section 17.4.2, Secondary Pathways, respectively.

There is expected to be an increase in traffic volumes along Highway 155 and Highway 955 during Construction and Operations (Table 19.4-3), which is expected to require more frequent maintenance of the roadways to accommodate Project-related traffic. Community members have noted that the roadways are in poor condition in certain areas, and expressed specific concerns about the Buffalo Narrows bridge acting as a bottleneck for traffic (BNDN-JWG 2021a). The increase in traffic would largely be commercial vehicles transporting materials and equipment to and from the Project site, and transportation of uranium concentrate from the Project site to market. This increase would be an issue for users of both highways, though particularly for Highway 155, which is the primary transportation corridor for LSA residents moving around the communities and the only main highway out of the LSA to the rest of the province and Canada. Given the route of Highway 155 through Buffalo Narrows, particular attention would need to be paid to road safety for residents crossing the highway, which would benefit all LSA residents as noted during several JWGs where concerns were expressed over traffic and road safety (BNDN-JWG 2021a; BRDN-JWG 2021b; CRDN-JWG 2021; MN-S-JWG 2021a).

Table 19.4-3: Project-Related Traffic during Construction and Operations

Category	Trips / Day	Trips / Week	One-Time Trips
Construction			
Expendables	24	11	0
Labour	0	50	0
Construction equipment/materials	0	1	1,970
Total Construction	**24**	**62**	**1,970**
Operations			
Expendables	26	18	0
Labour	10	0	0
One-time equipment deliveries	0	0	182
Exports	2	0	0
Total Operations	**38**	**18**	**182**

Source: TSD IX, Transportation Risk Assessment Report.

The maintenance of public roadways is not a NexGen responsibility; however, NexGen would work with the Government of Saskatchewan as required to hold discussions on provincial road use for planning purposes. It is expected that routine maintenance by the Government of Saskatchewan along Highway 955 would be revised, as may be required, to accommodate increased traffic volumes on the highway. This maintenance would support continued safe road travel by community members along public roads. The mitigation is well understood and expected to be effective. In addition, NexGen would:

- Develop a Ground Transportation Emergency Response Plan to mitigate safety risks related to the transportation of materials and equipment to and from the Project site.
- Develop an Emergency Response Assistance Plan for the transportation of uranium concentrate from the Project site.
- Educate Project workers (e.g., staff and contractors) on traffic safety, including consideration of the safety of other non-Project users of the roads.
- Hold discussions, as required, with the Government of Saskatchewan on provincial road use, maintenance, and upgrades to inform provincial planning purposes.
- Develop and implement a pre-Construction communications process to raise public awareness in communities of potential Project opportunities and effects.

When considering the proposed mitigations, including programs designed to minimize safety risks (e.g., potential accidents), this pathway is considered to have negligible effects on community well-being and was not carried forward in the assessment.

19.4.4 Primary Pathways

The following Project interactions were predicted to be primary pathways to community well-being and were advanced for further assessment of residual effects (Section 19.5):

CWB-01: Access restrictions and avoidance:

- Restricted land access and avoidance of areas may reduce participation in traditional activities, adversely affecting cultural continuity, including the transmission of knowledge from Elders to youth.

CWB-02: Worker rotation system:

- Time spent by workers away from their communities and families participating in the worker rotation system may result in effects on quality of life, local community cohesion, and family stability.

19.5 Residual Effects Analysis

19.5.1 Application Case

For the assessment of primary pathways for community well-being, a holistic approach was undertaken to examine several well-being elements in parallel (Section 19.2.8) with respect to the indicator groupings of cultural continuity, social adaptability, and demand for community infrastructure and services. Effects for each of the indicator groupings in terms of changes to well-being from access restrictions and avoidance and the worker rotation system are discussed in Section 19.5.1.1, Access Restrictions and Avoidance, and Section 19.5.1.2, Worker Rotation System, respectively.

19.5.1.1 Access Restrictions and Avoidance

Changes in land use due to access restrictions or avoidance of areas near the Project could affect community well-being with respect to cultural continuity and demand for community infrastructure and services. Cultural continuity includes changes in cultural practices, including cultural experiences, diet, land use opportunities, and the intergenerational sharing of knowledge. Demand for community infrastructure and services includes changes in the health and family support infrastructure and services.

The effects from access restrictions and avoidance of areas near the Project on community well-being overlap with the effects from access restrictions on Indigenous land and resource use assessed in Section 16.5.1.1, Access to and Area Available for Indigenous Land and Resource Use, and access restrictions on other land and resource use assessed in Section 17.5.1.1, Access to and Area Available for Land and Resource Use. In addition, there is overlap of effects on well-being with the effects on the cultural landscape as assessed in Section 16.5.1.3.7. The following discussion assesses access restrictions and avoidance of areas near the Project on community well-being with a focus on cultural continuity and demand for community infrastructure and services.

Indigenous Groups noted in their IKTLU Studies that Project effects on cultural continuity are important to consider. For example, CRDN members have expressed concern about changing access to Patterson Lake, including the areas where some members have cabins: “losing the land, is our connection to who we are” (TSD V.3: CRDN). There is also concern that the Project and similar projects could affect the opportunity for CRDN members to practise their Treaty Rights (TSD V.3: CRDN). The MN-S expressed concerns about its citizens’ ability to continue to practice their way of life (MN-S-JWG 2019b; TSD IV: MN-S). The BNDN

(TSD II: BNDN) highlighted that the Project may cause "disruption to the ability and opportunity of BNDN members to transmit cultural knowledge to future generations", and the BRDN (TSD III: BRDN) noted a similar potential effect through "reduced opportunities for knowledge transmission due to impacts to BRDN resource harvesting activities".

Central to the discussion of cultural continuity is that cultural transmission is often related to a location or place. Cultural transmission is experiential (TSD V.1: CRDN; TSD V.2: CRDN; TSD IV: MN-S; TSD II: BNDN; TSD III: BRDN), and some of it is specific to discrete locations. As such, the removal of areas for Indigenous land and resource use is specifically linked to the access and availability of land use areas or changes to the resource use experience that would result in individuals moving their traditional activities to a different location.

For example, the BRDN shared that:

> One of the Elders was telling us that there's a little lake on our traditional territory where in spring when it's starting to melt, the water that sits on top of the ice, there's nothing that tastes so good. He goes there just to have that water every year. Fresh melt water. I would think in Dillon I could drink the water on top of the ice, but he said in that little lake it's totally different. (BRDN-JWG 2020)

A member of the CRDN also described the importance of ancestral ties to locations in connection to the Cluff Lake Mine:

> An often unacknowledged/unrecognized impact of the physical displacement or abandonment of a harvesting area (such as what has occurred with CRDN members in relation to the Cluff Lake Area) is that the traditional knowledge associated with that particular space is lost if the displacement lasts for more than a generation. Since traditional knowledge is customarily transmitted directly in place and on the ground, the displacement of the Nation's members from the Cluff Lake Area for some four decades means that the continuity in the teachings and understandings of this particular area has been irrevocably severed. (TD V.2: CRDN)

A BNDN member expressed concerns that restricted access, along with aging Elders, may create a gap in knowledge (TSD II: BNDN):

> Without knowing, maybe the ones that are coming or that are too little to know . . . . When we pass on as elders, who's going to teach them? They've never been there [the Project]. It's only going to be a book or something that we said that's going to be there. And today, like there's hardly anybody that listens to anything like that anymore.

The CRDN, MN-S, BNDN, and BRDN highlighted the importance of sense of place or the cultural landscape to land and resource use activities and the transmission of knowledge (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN). Project effects from access restrictions or avoidance of areas near the Project could introduce a break in the transmission of knowledge due to the Project, which could lead to the abandonment of previously used areas by some users.

The displacement of land and resource use around the Project associated with access restrictions or avoidance may increase demand for mental health services by the community members affected. Cultural continuity and the ability to engage in activities is an important factor in health and well-being for First Nations people (FNGIC 2018). Métis Nation – Saskatchewan citizens also assert the importance of engaging in traditional activities for their health and well-being (TSD IV: MN-S).

Access restrictions and avoidance of areas near the Project could affect cultural continuity; however, Indigenous Groups also pursue cultural activities and maintain cultural programs that support cultural continuity, either within or close to their home communities. These activities would not be affected by access restrictions and continue to support community well-being. For example, some LSA schools have Dene language classes, including the schools in Clearwater River Band No. 222 and Buffalo Narrows. Most schools have land-based programs that help students connect with their territory. Feedback from the JWGs highlighted the importance of these programs to communities and the positive effects witnessed in the students (BNDN-JWG 2021d; BRDN-JWG 2021e). The BNDN noted the resurgence of beading in the community by female members during the COVID-19 pandemic when community members could not gather (BNDN-JWG 2021b). These activities show the variety of cultural activities prevalent in the LSA communities that support cultural continuity and the transmission of knowledge. NexGen respects the importance of cultural continuity and has participated and supported cultural activities and initiatives in the LPA since 2014. Some of these activities and initiatives support Métis music programs, Clearwater River Ventures programs, youth/Elder hunting trips, Dene language documentary and annual culture days in the community, to name a few. NexGen would continue this support through the lifespan of the Project in addition to minimizing the effects on cultural continuity associated with the restrictions on access to land at the Project.

Specifically addressing access restrictions and avoidance of areas near the Project, mitigation measures would include the implementation of the Security Program, incorporation of Indigenous land use objectives in the Detailed Decommissioning and Reclamation Plan, and funding for full-time independent community-based Indigenous Monitors (i.e., confirm the extent of Project effects on the environment). Further mitigations within the EIS to assist in cultural continuity include the following:

- Work with local communities to develop culturally sensitive employment policies including addressing recruitment and retention barriers.
- Provide dedicated space for Elders to be available to support employees.
- Establish an Implementation Committee to provide a forum for regular communication and information exchange between NexGen and primary Indigenous Groups to communicate regularly and to reach early resolution of issues and/or disputes that may arise.
- Implement an Indigenous and Public Engagement Program to effectively engage with communities on Project activities, effects, mitigation, and monitoring to keep people informed and present opportunities to provide feedback for continual improvement through a grievance mechanism.

In addition, Benefit Agreements with the primary Indigenous Groups would include provisions for in-kind and financial support to the communities with respect to cultural continuity, traditional values, and community-related activities. Through these agreements, NexGen would work closely with Indigenous communities to promote Indigenous resource use activities in proximity to the Project, including continued access for Indigenous land and resource use within the LSA (i.e., outside the maximum disturbance area), and support the transmission of knowledge between generations. Commitments made in the Benefit Agreements would also be available to support the continuation and development of cultural activities and programs in areas that Indigenous communities consider the need greatest (i.e., not limited to direct Project effects on land use).

Related to **cultural continuity**, after mitigation, it is anticipated that access restrictions and avoidance of areas near the Project would have an adverse effect on the well-being of some land users. Access would be restricted only within the maximum disturbance footprint past the gatehouse, though perceptions of the Project effects could extend across a broader area. Changes to access to and area available for Indigenous land and resource use, and changes to the quality of the Indigenous land use experience are assessed in Section 16.5.1, Application Case. The effect on cultural continuity would be limited to site-specific knowledge that may not be shared among generations and the loss of which may not be replaced. The timeframe for these changes is difficult to predict with certainty as the intergenerational transfer of knowledge may be disrupted. If uses in proximity to the Project footprint continue and are encouraged throughout Construction and Operation, the duration of avoidance may be reduced; however, users who decide to avoid the area may stop using the area continuously through the duration of all Project phases. After Closure, effects on cultural continuity would likely be reversible as users start frequenting the area again. Cultural activities that occur in or in proximity to the community, including language courses and cultural activities, are expected to persist and would continue to support cultural continuity and the transmission of knowledge. The implementation of mitigation measures, signing of Benefit Agreements and implementation of the Project's cultural commitments, independent Indigenous monitoring, and effective communication through the Indigenous and Public Engagement Program should enable LSA communities to maintain cultural continuity for the Application Case, including the "degree to which one is integrated with one's culture" (FNIGC 2018), with negligible residual effects on some individuals.

With respect to the **demand for community infrastructure and services**, the mitigation measures to address increased mental health issues associated with access restriction and avoidance would be the same as those described in Section 19.5.1.2 (e.g., EFAP). After mitigation, the demand for mental health services in the LSA communities is expected to increase when access is restricted for the duration of the Project (i.e., 43 years). Demand for health services from loss of the land base may peak as the Project begins Construction and then transitions to Operations, though this would depend on how individuals respond. After mitigation, there is expected to be a small increase in demand for mental health and social services for some residents in the LSA communities. The demand for services is expected to be periodic as it would peak during the first years of Operations as parts of the land base are lost and community members get accustomed to employment on the Project.

19.5.1.2 Worker Rotation System

The worker rotation system for the Project could affect community well-being with respect to social adaptability and demand for community infrastructure and services. Social adaptability includes changes to population demographics, community safety, governance, social cohesion, and community dynamics. As noted in Section 19.5.1.1, demand for community infrastructure and services includes changes in the health and family support infrastructure and services.

It is anticipated that employment of LSA residents at the Project would be challenged by the availability of skilled workers. In recognition of this potential challenge, NexGen would continue to support education and training opportunities in the LSA communities to increase the potential workforce pool. NexGen is already developing programs in consultation with Indigenous Groups and education service providers active in the north, including Northlands College, the GDI and Saskatchewan Indian Institute of Technologies, and Northern Career Quest.

Direct, indirect, and induced employment opportunities as a result of participation in the worker rotation system would result in more career opportunities for community members and may result in a loss of skilled staff for some existing organizations, businesses, and governments (i.e., provincial, municipal, and band). Mining employment opportunities have the potential to attract skilled workers in communities due to higher pay and, for some, the flexibility associated with a two-week-on/two-week-off worker rotation system. It is likely that some staff losses for existing organizations, businesses, and governments would occur given the current small size of the skilled labour pool in the LSA communities. The result for current employers could range from minor disruptions to long-term challenges attracting, training, and retaining staff. It should be noted that not all people are interested in mining careers, including supporting roles in mining, and increased economic diversity is anticipated to be a positive outcome for the region (Section 18; Section 19.4.1). However, LSA businesses, organizations, and governments are likely to lose certain staff and would compete against the mining industry to attract qualified candidates in the future.

Shifts in employment opportunities could be particularly challenging for municipal and band governments in terms of skilled staff shortages, increased workload for remaining staff, and the potential loss of future leaders who choose mining over public careers. Although increased employment opportunities and diversification of the economy of LSA communities would be an important positive outcome, shortages in community leadership roles, though minor, could affect community governance, which is a supporting factor for societal and cultural well-being.

Participation in the worker rotation system, which would entail being out of the community and on site for two weeks at a time, can affect community well-being by limiting workers' abilities to participate in community and cultural activities that bring communities together, and by changing family and community dynamics (Gibson and Klinck 2007). The worker rotation system could also affect volunteerism, worker mental health, family/network mental health, and family dynamics.

For workers participating in the rotation system, documented adverse effects on individuals include the following:

- challenges to adjusting to work and home life, including being a parent and partner, feeling guilty about being away from home half-time, and a feeling of leading two very different lives (CVMPP 2005; Gardner et al. 2019; Villeneuve 2019);
- feelings of isolation and loneliness, which are sometimes signs of anxiety and depression, could be exacerbated by a "macho" culture on site that stigmatizes mental health issues (Villeneuve 2019; Bowers et al. 2018); and
- challenges in adjusting to shift work (2019 to 2021 KP interview program), which has been linked to poor health outcomes (Villeneuve 2019).

It is important to note that not all workers experience adverse effects. The worker rotation system can affect individuals differently depending on several variables, including adaptability, coping mechanisms, frame of mind, personal experiences, support networks, and personality. For some workers, generally younger and single, the rotation system can be experienced as a positive effect, particularly because all meals and domestic duties are catered for, recreational and support facilities are available, and flexibility exists to choose the area where one wishes to reside (Mining People International 2022). People with full-time employment are also less likely to engage in criminal or deviant activity than those who are unemployed or underemployed (Statistics Canada 2005; John Howard Society 2009). In summary, participation in the worker rotation system would provide opportunities for some individuals while creating or amplifying existing issues for other individuals.

For household members, such as partners and spouses, documented adverse effects of the worker rotation system include the following:

- stress created from managing a household and assuming all household roles while a partner is away, especially if there is a crisis at home or a decision needs to be made regarding a child (CVMPP 2005; 2019 to 2021 KP interview program);
- increased rates of domestic violence as a manifestation of family strain and fragmentation (Gibson and Klinck 2007); and

- emotional distress for children while the second parent is away, depending on the children's temperament and their age (CVMPP 2005).

A 2005 study on the effects of the worker rotation on workers, families, and communities in northern Saskatchewan found that the advantages and disadvantages of the worker rotation system were closely linked. Respondents generally felt that the ability to have a whole week off to spend at home, allowing time with the family along with time to complete projects, was the main benefit of the system. Alternatively, spending an entire week at work was most often cited as the major disadvantage, since being away from family and missing major events and milestones in family life was a major concern for many (CVMPP 2005).

The study results also suggested that those who were directly involved in the worker rotation system (i.e., mine workers and their families) experienced the most substantial effects. The study found that the most prominent adverse effect was that the spouse that stayed at home (in most cases, the female partner) had to bear the brunt of the effects of the worker rotation system, acting as a single parent half of the time and assuming most of the associated household and child-rearing activities (CVMPP 2005). While the effects can be serious for some individuals, they are not anticipated to affect communities more broadly. Effects on household members are individualized, with some household members better able to adapt and cope than others.

The demand for community infrastructure and services is expected to change in response to the worker rotation system. Having one parent away for two weeks at a time would also likely increase demand for childcare services for dual-income families, unless extended family or neighbours can help (2019 to 2021 KP interview program). These effects on workers and their families are expected to increase demand for health care, including mental health services and social supports such as childcare, in the LSA communities. Demand for mental health services is expected to increase based on effects to some workers and their families associated with the worker rotation.

Currently, health care, especially mental health care, is a concern in the LSA communities. Results from the KP interview program indicated that there are some mental health services available but that they do not currently meet the demand; additional services would be beneficial to community members (2019 to 2021 KP interview program). Most LSA communities for which community planning is available have developed goals to address community service requirements that they consider priorities, including mental health and addictions services (Section 19.3.6.1, Section 19.3.6.2). In its planning for the 2021 to 2022 period, the Saskatchewan Health Authority is also addressing the recommendations in the Mental Health and Addictions Plan, which are designed to improve the response to mental health and addictions (Saskatchewan Health Authority 2021).

Similarly, childcare facilities are not available in all LSA communities. Currently, childcare facilities are only available in La Loche, Birch Narrows, Turnor Lake, BRDN (Dillon), and Buffalo Narrows. The childcare facilities in the LSA have waitlists, which means that some community members need to rely on family members to help with childcare (2019 to 2021 KP interview program). An increase in demand could have a negative effect on families and the local communities as the resources required to meet current demands are not available. Since the Project would be a fly-in/fly-out operation, this potential increase in demand would be an issue for non-direct employment opportunities in communities, and potentially partners and extended family members of directly employed workers on the worker rotation system who also wanted to work (e.g., in town), pursue educational aspirations, or fulfill other responsibilities in their communities.

NexGen is committed to preparing LSA residents for careers, including incorporating strategies and mitigation to minimize effects on workers and their families with respect to quality of life, local community cohesion, and family stability. NexGen is committed to the following:

- Develop and implement human resource policies (e.g., EFAP) to assist workers and their families in finding information and referral services for family-related resources, as required.
- Provide dedicated space for Elders to be available to support employees.
- Work with local communities to develop culturally sensitive employment policies to, among other things, increase worker satisfaction.
- Implement an Indigenous and Public Engagement Program, which would allow workers and families to provide feedback for continual improvement through a grievance mechanism.
- Implement provisions of Benefit Agreements related to culture, traditional values, employment, training, and economic development.

NexGen plans to develop and implement human resource policies to assist workers and their families in locating and accessing services, which would include the establishment of an EFAP. As discussed in Section 19.4.3, Secondary Pathways, EFAPs typically provide free assessments, short-term counselling, referrals, and follow-up. Many EFAPs can be accessed remotely by workers and their immediate family. To the extent possible, the program selected by NexGen would include services that may not be broadly available within the LSA. NexGen would educate workers on the services provided by the EFAPs, as well as making sure that this information is readily available for workers' families.

NexGen is committed to other human resource policies that are expected to alleviate the demand for mental health services for workers, including providing space for an Elder to be on site to support employees who require guidance and support, and working with communities to develop culturally sensitive human resource policies that can increase worker satisfaction. The availability of culturally appropriate supports on site and inclusive human resource policies is expected to reduce some of the stresses experienced by workers, thereby reducing the demand for health care and social services. For workers on site, NexGen would also provide health and wellness programs and on-site recreation opportunities, which would help reduce demand for health care services in the LSA communities by workers, especially since residents of northern Saskatchewan have expressed a preference for accessing health services on site (CVMPP 2014).

The Indigenous and Public Engagement Program and Benefit Agreements would also help mitigate effects on community well-being. The Indigenous and Public Engagement Program would include a provision where members of the public, including workers and their families, could submit concerns or suggestions through a grievance mechanism. Feedback received would be evaluated to consider opportunities for continual improvement. Within each Benefit Agreement, NexGen also commits to provide resources, both monetary contributions and human resources, to support community-related initiatives in areas such as health and wellness, culture, and traditional values, which can be used to mitigate adverse effects on families experiencing stress from participation in the worker rotation system.

In addition to the implementation of Project-specific mitigation measures, NexGen would also enter into a surface lease agreement with the Province of Saskatchewan. Mineral Surface Lease Agreements for northern mining projects require uranium companies to participate in a community vitally monitoring program process (i.e., the CVMPP). The goal of the CVMPP is to provide information and insight to Indigenous Groups and communities so that they can actively engage in maintaining and improving the quality of life for residents of northern

Saskatchewan. The CVMPP would support development of additional mitigation to address effects on well-being.

The CVMPP has five priority topic areas for gathering information:

- environment and land;
- health;
- economic/social/infrastructure;
- community dynamics and relationships; and
- special topics.

Related to **social adaptability**, after mitigation, it is anticipated that some workers and their families may experience stress and hardship from participation in the worker rotation system, which could lead to changes to individual well-being; however, workers have adapted to the worker rotation system at other mines in Saskatchewan. The level of stress is difficult to predict because it depends on the individuals involved and their willingness to participate in support networks established through the Project or in their community. The potential effects are probable. The effects are expected to be more prominent during Operations when the worker rotation would be in effect to support long-term employment. Effects are expected to be continuous, but greatest when workers start their employment. Over time, workers are anticipated to be able to adjust, particularly with support services and networks in place to assist. While the effects may be challenging for some workers and their families, they are expected to be manageable with access to the proper supports such as counselling and access to cultural activities, which are valued by LSA community members in part because they support the maintenance of family and communal ties. Effects are also expected to be reversible as employees and their families grow accustomed to the worker rotation system or opt out from direct, on-site Project employment opportunities subject to the worker rotation system.

Related to the **demand for community infrastructure and services**, after mitigation, there is expected to be a minor increase in unmet demand for mental health and social services for some residents in the LSA communities because of the currently limited available services. The increase in unmet demand is difficult to quantify because it would depend on the individual, families, and their support networks in the community; the accessibility of services available to workers on site; and decisions by the provincial and federal governments regarding health care that are beyond NexGen's control. The stress and need for mental health support under existing conditions (i.e., Base Case) has been documented; therefore, this effect is probable. NexGen's efforts to support the workforce and their families through an EFAP and other human resource policies would be an important factor in managing the demand, and discussions with Indigenous Groups on culturally appropriate human resource policies would consider aspects such as community well-being. Unmet minor increases in demand for mental health and social services may lead to increased stress among community members, which could express itself through an amplification of existing community issues including depression, anxiety, or violence. This increased demand could also put additional stresses on the service providers and staff due to increased workload. The demand for community infrastructure is expected to be continuous as it peaks during the first years of Operations as parts of the land base are lost and community members become accustomed to the worker rotation system.

19.5.2 Reasonably Foreseeable Development Case

The RFD Case considers the cumulative effects of the Project and the planned Fission Patterson Lake South Property on community well-being following the same holistic approach as for the Application Case in Section 19.5.1.

19.5.2.1 Access Restrictions and Avoidance

Changes in land use due to access restrictions or avoidance of areas near the Project and the Fission Patterson Lake South Property could affect community well-being with respect to cultural continuity and demand for community infrastructure and services. These cumulative effects on community well-being overlap with the effects from access restrictions on Indigenous land and resource use assessed in Section 16.5.2.1, Access to and Area Available for Indigenous Land and Resource Use, and access restrictions on other land and resource use assessed in Section 17.5.2.1, Access to and Area Available for Land and Resource Use. In addition, there is overlap of cumulative effects on well-being with the effects on the cultural landscape as assessed in Section 16.5.2.3.7. The following discussion assesses cumulative access restrictions on community well-being with a focus on cultural continuity and demand for community infrastructure and services.

The Fission Patterson Lake South Property has the potential to amplify cultural continuity effects from the Project, including the transmission of knowledge by CRDN, BNDN, and BRDN members and MN-S citizens through access restrictions or avoidance of areas around the projects.

The cumulative effects are expected to be greater as there would be two uranium mines and processing plants simultaneously operating adjacent to Patterson Lake. The two projects combined would have greater access restrictions and the potential to increase avoidance (Section 16.5.2.1) of the Patterson Lake area by Indigenous community members. The larger area of avoidance of the Patterson Lake area with two mines could further affect cultural continuity and associated transmission of knowledge if it is avoided by some people. This is because teaching and learning traditional knowledge is most often experiential. The CRDN, MN-S, BNDN, and BRDN have shared stories about the transmission of knowledge among families and community members. The transmission of knowledge is through shared experiences, including taking other community members out on the land. Some aspects of transmission of knowledge are site specific. The avoidance of an area means potentially erasing it from familial and community history. As the CRDN noted in connection with cabins:

> Irrespective of the fact that many CRDN cabins have been burnt down by forest fires or are seemingly not “currently” being used, these living places and their remains are considered significant to the history and heritage of the descendent family members and to the Nation as a whole. (TSD V.1: CRDN)

As in the Application Case, cultural activities that occur within communities and throughout the Indigenous Groups’ traditional territory, other than areas near the projects, would continue in the RFD Case, thus still supporting cultural continuity and non-site-specific transmission of knowledge. NexGen would continue to support cultural continuity programs through the lifespan of the Project in addition to minimizing the effects on cultural continuity associated with the restrictions on access to land at the Project.

NexGen’s mitigation for Project effects on cultural continuity as described in the Application Case (Section 19.5.1.1) would also mitigate effects on the cultural landscape in the RFD Case. While it is not within the operational control of the Project to minimize the effects of another project on cultural continuity, a regional approach to monitoring and mitigation is likely to help maintain cultural continuity and the approaches adapted, as necessary, to improve the success of the mitigations. It is also reasonable to assume the Fission Patterson Lake South Property would integrate Indigenous land use objectives in closure planning and be exploring ways to support cultural programs through agreements with Indigenous Groups. NexGen is committed to working with local communities, Indigenous Groups, and Fission to develop regional mitigation strategies to address effects on land use around the projects such as supporting culture camps and other cultural programs.

In the RFD Case, the displacement of land and resource use around the projects associated with access restrictions may further increase demand for mental health services by the community members affected as discussed in the Application Case (Section 19.5.1.1).

Related to **cultural continuity**, after mitigation, the area around Patterson Lake may be avoided by some Indigenous community members during the overlap of the Project and Fission Patterson Lake South Property activities, which could have an adverse effect on cultural continuity as site-specific knowledge may not be shared between generations and the loss of this knowledge may not be replaced. Based on community experience with other projects, avoidance of the area is probable and individualized. The Benefit Agreements would provide cultural supports that contribute to cultural continuity. Changes to cultural continuity would likely extend past the lifespan of the Project and last for at least one generation during the overlap of the projects (i.e., approximately 25 years) as knowledge transmission is intergenerational and restricted access or avoidance would disrupt the chain of knowledge transfer until the area is used again. These changes are also expected to be continuous once activities begin through to when community members once again feel comfortable using the area. The implementation of mitigation measures, the signing of Benefit Agreements, and the implementation of cultural commitments, ongoing community monitoring, and effective communication through the Indigenous and Public Engagement Program should enable LSA residents to maintain cultural continuity for the RFD Case, including the “degree to which one is integrated with one’s culture” (FNIGC 2018) with negligible effects on some individuals.

With respect to the **demand for community infrastructure and services**, the mitigation measures to address the cumulative increased mental health issues associated with access restriction and avoidance of areas near the projects would be the same as those described in Section 19.5.2.2, Worker Rotation System (e.g., EFAP). The cumulative demand for mental health services in the LSA communities would be expected to be for the period of overlap of the projects (i.e., 25 years or one generation). There is expected to be a small cumulative increase in demand for mental health and social services for the residents in the LSA communities who have links to the area of the projects. The cumulative demand for services is expected to be continuous but it peaks during the first years of Operations for each project and the beginning of the period of operational overlap.

19.5.2.2 Worker Rotation System

Worker rotation systems for the Project and the Fission Patterson Lake South Property could cumulatively affect community well-being with respect to social adaptability and demand for community infrastructure and services.

There is not expected to be a large increase in employment levels for the LSA communities in the RFD Case compared to the Application Case due to the limited availability of labour; therefore, the majority of additional labour required would likely be distributed across other northern Saskatchewan communities in the RSA that have already experienced fly-in/fly-out uranium operations. During the early years of operations for the projects, it is anticipated that approximately the same number of LSA residents would be employed in the industry if both projects were to proceed until education and training programs in the LSA could increase the skilled worker pool. It is also expected that Fission would support local education and training programs similar to NexGen, as discussed in Section 19.5.1.2.

Cumulative direct, indirect, and induced employment opportunities as a result of both projects would result in incrementally more career opportunities for community members. The LSA is not expected to be able to meet workforce requirements for both projects and a regional and provincial approach is anticipated to be required for hiring. Since employment would be distributed across the RSA, the loss of skilled staff for some existing organizations, businesses, and governments (i.e., provincial, municipal, and band) would be similar to the Application Case.

In the RFD Case, it is anticipated that there would be an incremental increase in the number of workers and families that may experience stress and hardship from participation in the worker rotation system that would affect social adaptability; however, once hiring is maximized in the LSA, the remaining effects would be distributed across the RSA. These pressures would be mitigated through the Project's worker support policies, EFAP, providing space for an Elder to be on site to support employees, and Benefit Agreements. It is assumed that the Fission Patterson Lake South Property would have similar support programs for workers and their families.

In the RFD Case, similar to in the Application Case, demand for community infrastructure and services (i.e., mental health and childcare) may be affected by changes and participation in the worker rotation system. There may be some increases in demand in the RSA if the projects employ residents of the RSA after maximizing hiring in the LSA, but the increase in demand is expected to be distributed throughout communities in the RSA. It is also reasonable to assume potential workers from the RSA would have fly-in/fly-out experience in the uranium industry, as well as support networks and access to community services, as these communities have already experienced fly-in/fly-out workforces for the uranium industry (CVMPP 2013).

NexGen's mitigation for Project effects on demand for community infrastructure and services is described in Section 19.5.1.2 (e.g., EFAP). While it is not within the operational control of the Project to minimize the effects of another project on community services, it is expected that support in the Benefit Agreements and the CVMPP would work towards minimizing residual effects.

Related to **social adaptability**, after mitigation, negligible to small magnitude effects are expected as individuals and families learn to cope with the changes associated with income and participation in the worker rotation systems. These effects are expected to be concentrated among workers and their families. Since there would not be an increase in employment levels in the LSA communities due to the supply of jobs exceeding the size and capabilities of the labour force, changes to social adaptability when related to employment in the RFD Case are not expected to vary greatly from the Application Case. The extent to which the incremental effects in the RFD Case are expected to last is during the overlap between the two projects (i.e., 25 years or one generation). Effects are also expected to be reversible as employees and their families grow accustomed to the worker rotation systems.

Related to the **demand for community infrastructure and services**, after mitigation in the RFD Case, it is expected that residual effects in the RSA on the demand for community infrastructure and services would be materially the same. These effects are probable. There is the potential for a slight increase in demand for mental health services both in the LSA communities and throughout the RSA communities to address effects from minor changes in social adaptability due to participation in the worker rotation systems for the Project and Fission Patterson Lake South Property. Effects would be periodic as they would likely peak during the first years of operations for both projects before workers grew accustomed to the worker rotation. The increase in demand in the RSA would last for the duration of the overlap between the two projects (i.e., 25 years or one generation), but would be reversible through the provision of additional supports or the end of the overlap.

19.6 Residual Effects Classification and Determination of Significance

19.6.1 Classification Summary

Residual effects were classified for the Application Case and RFD Case after the implementation of effective mitigation (Table 19.6-1). Residual effects were classified according to criteria definitions provided in Section 19.2.9. The significance of residual effects for the Application Case and RFD Case was determined according to the methods described in Section 19.2.9.

Table 19.6-1: Classification of Residual Effects on Community Well-Being Measurement Indicators

Measurement Indicator Grouping	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Cultural continuity (related to access restrictions and avoidance)	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Low magnitude changes to cultural continuity, including transmission of knowledge, as some Indigenous community members may change the location of activities currently undertaken in the Indigenous and other land and resource use LSAs, resulting in the loss of site-specific knowledge (i.e., low magnitude)	▪ Low to moderate magnitude changes to cultural continuity, including transmission of knowledge, as some Indigenous community members may change the location of activities currently undertaken in the Indigenous and other land and resource use LSAs, resulting in the loss of site-specific knowledge (i.e., moderate magnitude)
	Geographic extent	▪ Local: all communities in the community well-being LSA, though the number of resource users in each community with close ties to the Patterson Lake area varies	▪ Local: all communities in the well-being LSA, though the number of resource users in each community with close ties to the Patterson Lake area varies
	Duration	▪ Long-Term: two generations for cultural transmission as transfer of knowledge is intergenerational and location specific. Transmission of knowledge affected by the Project is anticipated to persist for the lifespan of the Project and beyond until the resource users return to the area after Closure and the transfer of knowledge for the area returns	▪ Long-Term: one generation since maximum overlap of projects is 25 years, depending on the extent of temporal overlap between the Project and the Fission Patterson Lake South Property; assumes that resource users return to the area when the one project completes closure and transfer of knowledge for the area returns
	Reversibility	▪ Reversible	▪ Reversible
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Probable	▪ Probable
Social adaptability (related to changes from the worker rotation system)	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Negligible to low magnitude as individuals and families learn to cope with the changes associated with income and participation in the worker rotation system. These effects are expected to be concentrated among workers and their families	▪ Negligible to low magnitude as individuals and families learn to cope with the changes associated with income and participation in the worker rotation system. These effects are expected to be concentrated among workers and their families
	Geographic extent	▪ Local: all communities in the LSA	▪ Regional: all communities in the LSA and those communities in the RSA from which additional employees are drawn

Table 19.6-1: Classification of Residual Effects on Community Well-Being Measurement Indicators

Measurement Indicator Grouping	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Social adaptability (related to changes from the worker rotation system)	Duration	▪ Long-Term: lifespan of the Project (i.e., 43 years) assuming worker rotation system is used throughout all phases of the Project	▪ Long-Term: 25 years or one generation representing maximum overlap of projects; duration of overlap may be less depending on the extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible	▪ Reversible
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Probable	▪ Probable
Demand for community infrastructure and services (related to changes from access restrictions and avoidance, and the worker rotation system)	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Negligible to low magnitude increase in demand for social and mental health services to address issues tied to changes in access restrictions and avoidance ▪ Low magnitude increase in the demand for social and mental health services because of participation in the worker rotation system	▪ Low magnitude increase in demand for social and mental health services due to changes in cultural continuity to address issues tied to changes in access restrictions and avoidance ▪ Low magnitude increase in the demand for social and mental health services because of participation in the worker rotation system; expected similar number or small increase in the number of LSA workers engaged as Application Case because of the size of the available labour force in the LSA. Effects in the RSA communities would be distributed among a larger number of communities
	Geographic extent	▪ Local: all communities in the LSA	▪ Regional: all communities in the LSA and those communities in the RSA from which additional employees are drawn
	Duration	▪ Long-Term: lifespan of the Project (i.e., 43 years) assuming worker rotation system is used throughout all phases of the Project, though most effects would occur during Operations (i.e., 24 years)	▪ Long-Term: 25 years or one generation representing maximum overlap of projects; duration of overlap may be less depending on the extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible	▪ Reversible
	Frequency	▪ Periodic as increased demand for mental health services as a result of changes to cultural continuity may peak when construction starts on the Project ▪ Continuous for increased demand for social services.	▪ Periodic as increased demand for mental health services as a result of changes to cultural continuity may peak when construction starts on the Fission Patterson Lake South Property ▪ Continuous for increased demand for social services. No incremental change in the RFD Case since a similar number of LSA residents are expected to work on both projects as would work on one
	Probability of occurrence	▪ Certain	▪ Certain

RFD = reasonably foreseeable development; LSA = local study area; RSA = regional study area.

19.6.2 Significance Determination

In determining the significance of effects on community well-being, consideration was given to the combination of residual effects resulting from access restrictions and avoidance and the worker rotation system as compared to existing conditions in the LSA communities. Access restrictions and avoidance were examined primarily from the lens of cultural continuity, while the worker rotation system was examined primarily from the lens of social adaptability. Both pathways considered demand for community infrastructure and services. In the Base Case, the northern character of places creates tight-knit communities and contributes to the overall sense of community well-being as characterized through KP interviews and JWG meetings (Section 19.3.5). Connections to the land remain an important aspect to well-being throughout the LSA, and programming that supports cultural continuity is seen as an asset in communities. Community members noted that there are conditions that detract from a good life, including an absence of or limitations in infrastructure and services (e.g., recreational facilities, mental health and addictions services), substance use, and limited educational and employment opportunities. Within each Benefit Agreement with primary Indigenous Groups, NexGen commits to provide resources, both monetary and human, to support community-related initiatives in areas of health and wellness and cultural and traditional values, among other things. NexGen is committed to continuing the existing community support programs (e.g., scholarships, breakfast programs, summer student programs). The LSA community governments and Indigenous Groups with which NexGen has negotiated Benefit Agreements understand their community needs and would prioritize initiatives that reflect existing or emerging trends in their communities.

Application Case

In the Application Case, residual effects due to access restrictions and avoidance of areas near the Project and the worker rotation system are expected to be negative and negligible to small in magnitude. These effects are all linked to the overall understanding of well-being in communities. Predicted effects include the following:

- loss of access to locations within the Project maximum disturbance area and the potential for areas of avoidance around the Project that support experiential, intergenerational, and site-specific transfer of knowledge and the stress that loss may cause;
- participation in the worker rotation system that can affect family dynamics and increase demand for supports outside of traditional support networks (i.e., extended family and neighbours); and
- increased demand for social services within communities adjusting to Project-related changes associated with both loss of access and the worker rotation system.

The benefits would partially offset adverse well-being effects for some community members, particularly those directly or indirectly benefitting from the Project.

The effects on well-being due to changes to access restrictions and the worker rotation system, as well as the associated changes in demand for community infrastructure and services, are expected to be felt in all LSA communities, though the magnitude to which they are readily observable would vary depending on a number of factors. For changes to cultural continuity from access restrictions, the effects would depend on the number of resource users who use the Patterson Lake area, where access would be restricted, and the level of avoidance that may occur due to changes in the land user experience. Although there is an anticipated change to the areas available for use as a result of the Project, cultural continuity is expected to persist and be supported through measures identified in Benefit Agreements and through an added ability to participate in land use through increased disposable income and the worker rotation system (i.e., two-week off intervals). For changes to social adaptability due to the worker rotation system, and changes in demand for community infrastructure and services, effects are expected to be mainly experienced by those families that have a family member participating in the worker rotation system (i.e., related to the number of community members employed by NexGen), though effects may still be experienced throughout the LSA communities from related changes in family dynamics and demands for services.

The residual effects on community well-being are expected to last for the lifespan of the Project (i.e., 43 years). Changes from access restrictions could likely extend until after Closure as knowledge transmission is intergenerational and restricted access or avoidance could disrupt the chain of knowledge transfer until the area is used again. The effects of the worker rotation system, and demand for community infrastructure and services, would last as long the Project uses a worker rotation system, with effects potentially concentrated during Operations as this represents the stage with the highest likelihood of generating local employment. Given the duration of the Project, it is anticipated that individuals, families, and communities would adapt to changes, especially in consideration of planned mitigation measures (e.g., EFAP, Benefit Agreements). The residual effects on community well-being are expected to be reversible and probable. The effects on cultural continuity from access restrictions are anticipated to be continuous, while effects on social adaptability from the worker rotation system, and changes in demand for community infrastructure and services are expected to range from periodic to continuous, depending on the actual Project outcomes and the effectiveness of mitigation.

The communities in the LSA understand their needs and priorities best, and it is assumed that local government and Indigenous Group leadership would use monetary or other benefits resulting from the Project to prioritize community needs to adapt to the effects from changes to cultural continuity from access restrictions, changes to social adaptability from the worker rotation system, and subsequent changes in demand for community infrastructure and services caused by the Project. The Benefit Agreements signed with each primary Indigenous Group are expected to contribute to addressing these priorities. The Indigenous and Public Engagement Program would provide the framework for ongoing engagement with communities to maximize the benefits to community well-being from education, economic, and support for community infrastructure and services while minimizing the potential adverse residual effects from restricted access and the worker rotation system.

Reasonably Foreseeable Development Case

The predicted effects in the RFD Case are anticipated to be similar to the effects in the Application Case as it relates to the worker rotation system and demand for community infrastructure and services. The main source of change in demand for community infrastructure and services would be from participation in the worker rotation system. Since the Project and the Fission South Patterson Lake Property would require workforces with similar skills and experience, and presumably would require a similar worker rotation system, it is assumed that a similar number or a small increase in the number of residents of the LSA would be employed on both projects as would be employed on the Project due to the size and skills of the existing labour force. The effectiveness of education and training programs in the LSA may change the potential labour pool over time. The effects from the worker rotation system, and the subsequent changes in demand for community infrastructure and services may extend to communities in the RSA in the RFD Case as the Project and the Fission Patterson Lake South Property would also draw from a regional labour pool if the labour pool in the LSA cannot fill combined workforce needs for the projects. Changes from the worker rotation system and demand for infrastructure and services in RSA communities would not likely be measurable due to the number of other communities in the RSA and the much larger labour force pool. It is reasonable to assume these changes in RSA communities, particularly those with experience with fly-in/fly-out uranium mining operations, would cause a positive outcome as they would already have the networks and community support services in place (CVMPP 2013).

For cultural continuity changes from access restrictions, the RFD Case would be similar to the Application Case with the exception of magnitude and geographic extent, where a small to moderate change in behaviour and number individuals affected may result in the RFD Case. The change in magnitude relates to the larger loss of lands available for resource use, which may create a somewhat larger area of avoidance, resulting in disruption to transmission of knowledge. The level of change in resource use would vary by individual and would depend on the results of mitigations with other land users (e.g., trappers, outfitters) as presented in Section 17.4, Project Interactions and Mitigations, and mitigations with Indigenous land users as presented in Section 16.4. Access restrictions are expected to also be addressed by cultural continuity programs supported through the Benefit Agreements. While it is not within the operational control of the Project to minimize the effects of another project on access restrictions, it is assumed that Fission would also incorporate some support for cultural continuity in keeping with good industry practice.

The cumulative effects from access restrictions, the worker rotation system, and changes in demand for community infrastructure and services would be concentrated during the overlap between the operations of the Project and Fission Patterson Lake South Property, which is conservatively estimated at 25 years. The effects would be reversible, continuous, and probable.

Significance Summary

Overall, the weight of evidence from the analysis, including consideration of the literature reviewed, experiences at other uranium operations in northern Saskatchewan, and input from community members in the LSA on what they value in their home communities, suggests that community well-being in the LSA communities would be maintained.

Values shared by community members that make life good, such as embodying their Indigenous identity, knowing that their communities would help and support them in times of need, having access to the surrounding land, and participating in cultural activities, would continue despite some adverse effects caused by the Project. However, it is recognized that some residual adverse effects could exist for current publicly available social supports (e.g., mental health services, addictions treatment) and community/family dynamics (i.e., social adaptability).

The Benefit Agreements are anticipated to be an important tool in allowing communities to identify and prioritize initiatives related to health and well-being, along with cultural and traditional values. Overall, the results of the residual effects analysis for community well-being indicate that the incremental and cumulative effects from previous and existing developments, the Project, and the Fission Patterson Lake South Property would still allow for the maintenance of well-being in the LSA communities, and that community well-being would continue. Therefore, the predicted residual effects on the community well-being VC for both the Application Case and the RFD Case are predicted to be **not significant**.

19.7 Prediction Confidence and Uncertainty

Prediction confidence refers to the degree of certainty in effects assessment predictions and associated determination of significance. Scientific inference is associated with uncertainty, and prediction confidence depends on the level of uncertainty and the way it is addressed. The primary factors affecting the confidence in the predictions made in the assessment of effects on community well-being include:

- availability and accuracy of baseline data as discussed in Section 19.2.6;
- system complexity and the multiple factors considered (e.g., housing, income, physical environment), including individual choices that influence changes to community well-being; and
- level of certainty associated with the effectiveness of proposed mitigation and enhancement measures.

Uncertainty was managed by:

- collecting primary data including interviews with knowledgeable local residents about potential effects on the community well-being and talking to diverse populations in the LSA to understand the breadth of potential effects;
- reviewing previously conducted studies specific to the effects of the uranium industry in northern Saskatchewan on community vitality;
- where available, using JWG input to understand potential effects and how communities view community well-being; and
- applying reasonable conservativeness in professional judgment based on knowledge or past industry experience in northern Saskatchewan.

Remaining uncertainty was primarily addressed by making assumptions that are likely to overestimate adverse effects on community well-being while conservatively underestimating benefits. Overall, there is a medium-high degree of confidence in the predictions related to the changes to community well-being during Construction, Operations, and Closure.

19.8 Monitoring, Follow-Up, and Adaptive Management

This subsection presents a summary of the identified monitoring and follow-up proposed to confirm effects predictions and address the uncertainty identified in Section 19.6, Residual Effects Classification and Determination of Significance, and to capture monitoring of beneficial effects discussed in Section 19.4.1 to monitor overall well-being. Monitoring would be discussed with LSA Indigenous Groups and communities during the collaborative development of the Socio-economic Capacity Building Framework (Section 23.4.2, Socio-economic Management).

Specifically, follow-up and monitoring programs would be used to:

- evaluate the effectiveness of mitigation actions, and modify, enhance, or create new mitigations, as necessary;
- identify unanticipated adverse effects, including possible accidents and malfunctions;
- evaluate the overall well-being of communities across all five well-being elements (i.e., measurement indicators); and
- contribute to the overall continual improvement of the Project.

In northern Saskatchewan, mine operators are mandated to participate in the CVMPP in their Mineral Surface Lease Agreements (Section 19.5.1.2). The CVMPP is a multi-stakeholder group that includes mine operators, health authorities, and the provincial government (Section 19.5.1.2). The group completes or commissions research on topics related to quality of life in northern Saskatchewan at a regional scale (Government of Saskatchewan 2020). The CVMPP aligns with NexGen's vision and values toward a sustainable and mutually beneficial Project. It is assumed that the Project would be subject to the CVMPP mandate; however, regardless of this requirement, NexGen commits to working with LPA Indigenous Groups and communities to maximize beneficial outcomes and minimize effects, where practical. NexGen recognizes that Project effects can result in beneficial and adverse outcomes for individuals and communities and is committed to working with LPA Indigenous Groups and communities to aim for overall improvement to community well-being.

Effective monitoring of community well-being measurement indicators would be important to properly identify the beneficial and adverse attributes of Project-induced changes, and to develop mitigation, management approaches, or sustainable enhancements, as applicable. Effective monitoring and communication would also be important when reporting findings to LPA Indigenous Groups and communities. NexGen would work with LPA Indigenous Groups and communities to develop an effective monitoring and communication approach to track community well-being. The monitoring program would be developed to address the well-being indicators including societal and cultural, health, neighbourhood and physical environment, education, and economic well-being.

While NexGen has no jurisdictional authority to monitor the use of services it does not directly provide (e.g., health care and social services in communities), NexGen would work with local authorities on issues related to potential stress on infrastructure and services. It is anticipated that NexGen would track usage of on-site programs related to health and wellness (e.g., Elder counsellors, mentors) and conduct periodic surveys to determine if on-site services and programs are meeting employee needs.

In addition to reporting through the CVMPP, NexGen has committed in the Benefit Agreements with each primary Indigenous Group to establish an Implementation Committee composed of four representatives (i.e., two from NexGen and two from the Indigenous Group party to the agreement). The Implementation Committee would be tasked with the responsibility of facilitating an effective ongoing working relationship and confirming that all commitments made within the Benefit Agreements are realized. The Implementation Committee would provide a forum for regular communication and information exchange and for the early resolution of issues and/or disputes that may arise. As such, the Implementation Committees may also be tasked with monitoring key community well-being indicators like health and social services, education and training programs, and local and regional planning to track overall community well-being. Each Implementation Committee would be required to provide an annual written report on all activities identified within the Benefit Agreements. The Implementation Committee would also provide a community summary of each annual report for community distribution, and would organize and host an annual community meeting to, among other things, provide a summary of the activities undertaken to address the commitments in the Benefit Agreements. This summary would include the environmental, cultural, economic, training, employment, and business development initiatives undertaken, all of which are important to community well-being. Consideration of cumulative effects would be incorporated in the reporting if other projects proceed, as their policies and plans may affect Project outcomes such as employment numbers.

Monitoring programs for land and resource use that contribute to community well-being are presented in Section 16.8 and in Section 17.8, Monitoring, Follow-Up, and Adaptive Management. Similarly, for the economy (Section 18.4), opportunities to sustainably enhance education and training opportunities and employment and business opportunities would be explored. The information and outcomes from these efforts would be processed to identify effects and benefits to community well-being.

19.9 Key Findings

The assessment of potential effects of the Project on community well-being incorporated information from a variety of sources, including JWG meeting discussions, KP interviews, workshops, community events, and IKTLU Studies completed by Indigenous Groups for the Project. Analysis of potential effects considered information from other projects, the experiences of northern Saskatchewan communities with the uranium industry, and the perspectives and concerns shared by the CRDN, MN-S, BNDN, and BRDN.

Community members shared those aspects of their home communities that made life good, including freedom to access the land, the bonds between family members and community members at large, and a clean environment that can supply everything they need to live well. Detracting from community well-being were the lack of community facilities and services, mental health challenges and addictions, and the encroachment of industry and government policies on their freedoms and the land. Land-based programming and the transmission of knowledge within the communities were viewed as key to the well-being of the CRDN, MN-S, BNDN, and BRDN. The communities all have land-based community programming to support the continuation of cultural activities, and some have described activities in their communities, including language classes at the school and land-based school programs.

The Project, through employment and procurement opportunities and Benefit Agreements, would have the opportunity to support and enhance well-being for residents of northern Saskatchewan communities, while mitigating potential effects that could hinder residents and their home communities from flourishing.

The benefits to community well-being from the Project were outlined through the beneficial pathways analysis and are summarized below.

- Increased income for local community members would be expected to result in:
  - increased access to housing and/or education;
  - increased disposable income to support participation in traditional harvesting activities and improve individual diets;
  - retaining community youth who may otherwise leave the LSA; and
  - promotion of local economic well-being through increased spending at local businesses.
- Increased community revenue through procurement opportunities may enhance quality of life through investments in communities (e.g., infrastructure, services).
- Benefit Agreements include payments to primary Indigenous Groups based on revenue generated throughout the life of the Project. Indigenous Groups would determine how to best spend or distribute funds.

- Increased educational and training opportunities could:
  - increase well-being and community cohesion, and create pathways to employment opportunities;
  - increase the ability of residents in LSA communities to engage in economic opportunities; and
  - open a pathway to other employment, which could further stimulate the LSA economy.

Additionally, opportunities associated with the Project may also attract former residents back to the LSA communities, which could benefit community well-being.

In the Application Case, the residual effects are anticipated to be adverse but not significant. There is expected to be a potential local loss of cultural continuity, including transmission of knowledge tied to areas around Patterson Lake that would no longer be accessible. This effect, along with additional strain placed on family dynamics from participation in the worker rotation system (i.e., social adaptability), are expected to increase demands in LSA communities for mental health services. Participation in the worker rotation system is also expected to adversely affect social adaptability by placing increased stress on family dynamics. The extent to which these effects are experienced would vary by Indigenous community and by individual community member. Mitigation is expected to occur on site through inclusive human resource policies and on-site health and wellness programing. Mitigation is also anticipated in LSA communities through the Benefit Agreements.

In the RFD Case, the residual effects are expected to be similar to the effects in the Application Case. Changes associated with the worker rotation system, including changes in social adaptability and demand for infrastructure and services, may expand to the RSA communities as some RSA residents would likely be employed to meet the combined Project and Fission Patterson Lake South Property labour source requirements. However, these changes would not likely be measurable due to the number of communities in the RSA and the much larger labour force pool. With respect to access restrictions, residual effects on cultural continuity from the RFD Case are expected to be comparable to the Application Case with the exception of magnitude, where a small to moderate change may result. This change in magnitude relates to the increased loss of lands available for resource use, which may result in additional avoidance of the area and disruption to transmission of knowledge.

For both the Application Case and the RFD Case, the residual effects are predicted to be **not significant** to the community well-being VC. Community members have shared what makes life good and what detracts from the quality of life in their home communities, all of which factors into community well-being. The Project is anticipated to cause incremental and cumulative effects on community well-being. However, changes to cultural continuity from access restrictions, social adaptability from the inclusion of the worker rotation system, and subsequent changes in demand for community infrastructure and services are not expected to adversely affect those values considered important by community members to a degree where community well-being can no longer be maintained.

When all the well-being elements are considered together, the Project is anticipated to result in a beneficial outcome for the LSA, particularly if mitigation and enhancements are implemented effectively.

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Rook I Project

Environmental Impact Statement

Section 20 Summary of Residual Project and Cumulative Effects

Submitted to:
Canadian Nuclear Safety Commission
Saskatchewan Ministry of Environment

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Abbreviations and Units of Measure

Abbreviation	Definition
EA	Environmental Assessment
NexGen	NexGen Energy Ltd.
Project	Rook I Project
RFD	reasonably foreseeable development
VC	valued component

Unit	Definition
ha	hectare
km	kilometre
m	metre

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20 SUMMARY OF RESIDUAL PROJECT AND CUMULATIVE EFFECTS

20.1 Introduction

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The Project would be located approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the Northern Village of La Loche, and 640 km northwest of the city of Saskatoon. The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Patterson Lake is at the interface of the Boreal Shield and Boreal Plain ecozones. Access to the Project would be from an existing road off Highway 955, with on-site worker accommodation serviced by fly-in/fly-out access.

Section 20, Summary of Residual Project and Cumulative Effects, of the Environmental Impact Statement provides a tabular summary of the classification or characterization of predicted residual effects on valued components (VCs) of the biophysical, cultural, and socio-economic environments that cannot be avoided or mitigated through the relocation or re-design of the proposed Project, or through commitments made by NexGen. The summary includes a determination of significance of the residual Project effects (i.e., Application Case) and cumulative effects (i.e., Reasonably Foreseeable Development [RFD] Case) for VCs. Residual effects are classified using standard assessment criteria and provide the foundation for determining the significance of adverse effects.

Significance was not determined for intermediate components, as the significance of changes in intermediate components can only be evaluated in the context of related influences to VCs, which are the ultimate receptors. Therefore, intermediate components are not discussed in this section except as supporting information for the assessment of VCs.

20.2 Environmental Assessment Approach and Methods

The Environmental Assessment (EA) was developed to identify and evaluate the potential adverse effects and benefits associated with the Project. The detailed EA approach and methods are described in Section 6, Environmental Assessment Approach and Methods. The main steps included are assessment scoping; pathway analysis and identification of environmental design features and mitigations that avoid, minimize, restore, or offset adverse effects; residual effects analysis and classification; and determination of significance. Throughout this process, the EA identified monitoring, follow-up, and adaptive management that would be implemented to address uncertainty in predicted effects and to protect the environment and people.

20.2.1 Scoping and Pathways Analysis

As part of assessment scoping, a list of VCs was developed. Valued components were selected to focus the EA on aspects of the biophysical, cultural, and socio-economic (including human health) environments that are important to Indigenous communities, regulators, government, and other people interested in the Project. Assessment endpoints and measurement indicators were also selected for each VC. The assessment endpoints describe what should be protected for the VC, and the measurement indicators are features or characteristics of the VC that can be measured numerically or described qualitatively and are used to characterize the changes from the Project on the VC. Community engagement, Joint Working Group meetings, and Indigenous Knowledge and Traditional Land Use Studies provided important information for the selection of VCs and their associated measurement indicators and assessment endpoints.

A pathways analysis was completed to focus the EA on key Project-environment interactions that may lead to adverse effects. A comprehensive list of potential pathways was developed, and mitigation was applied to avoid and minimize effects. Community engagement, Joint Working Group meetings, and Indigenous Knowledge and Traditional Land Use Studies provided information that supported identifying and verifying effects pathways. Using scientific knowledge, Indigenous and Local Knowledge, logic, experience with similar developments, and an understanding of the effectiveness of mitigation, each pathway was categorized as beneficial pathway, no pathway, secondary pathway, or primary pathway.

Positive interactions or outcomes (i.e., beneficial pathways) were identified and discussed but were not forwarded for a residual effects analysis or assessed for significance (Section 6.7.3, Pathway Screening). A summary of anticipated benefits associated with the Project is provided in Section 24.4.2.2, Project Benefits. Pathways that were determined to result in no measurable changes (i.e., no pathways) or measurable changes but negligible effects (i.e., secondary pathways) to the biophysical or socio-economic environments were also not forwarded for residual effects analyses or assessed for significance (Section 6.7.3).

Pathways that could potentially cause a greater-than-negligible effect to the biophysical or socio-economic environments (i.e., primary pathways) were the focus of the EA; these pathways formed the basis of the detailed analysis of potential residual adverse effects on VCs and intermediate components.

20.2.2 Residual Effects Analysis and Classification and Determination of Significance

Primary pathways were carried forward in the EA for a detailed analysis of residual effects for each technical discipline. The residual effects were determined for the Application Case and the RFD Case, where appropriate, for the VC or intermediate component. The Patterson Lake South Property, which is planned by Fission Uranium Corp. (Fission 2019, 2021), was designated as an RFD in the EA. Specific to woodland caribou, Carrier Forest Products and Mistik Management Ltd. Forest Management plans were included as RFDs for the assessment within the SK2 West Caribou Administration Unit (SK2 West).

As part of the residual effects analysis, the predicted environmental changes for primary pathways were evaluated using methods appropriate for each VC. Analyses were quantitative where possible and qualitative where necessary, and included data from field studies, modelling results, scientific literature, government publications, monitoring reports, and personal communications. Where available, information from community engagement, Joint Working Group meetings, and Indigenous Knowledge and Traditional Land Use Studies were also used to support the residual effects analysis.

Following the residual effects analysis, the residual effects for each VC and intermediate component were classified or characterized using the following effects criteria:

- **Direction:** adverse (i.e., negative), neutral (i.e., no change), or positive (i.e., improvement) effect.
- **Magnitude:** the intensity of the effect, or the size, degree, or level of change.
- **Geographic extent:** the area, distance covered, or zone of the effect.
- **Duration:** the amount of time from the beginning of an effect to when the effect is reversed.
- **Reversibility:** whether the effect will stop and be reversed, or is permanent.
- **Frequency**: how often the effect occurs during the assessment period.
- **Probability of occurrence**: defined as unlikely, possible, probable, or certain.

The classification of residual effects was then used to determine the significance for VCs; this determination considered whether the significance threshold defined by the assessment endpoint for a VC would be exceeded. Significance determination was binary, such that adverse effects were either deemed significant or not significant for each VC, and was supported by a reasoned narrative.

20.3 Summary of Significance

A summary of the residual effects classification and determination of significance of residual adverse effects of the Project (i.e., Application Case) on biophysical, cultural, and socio-economic VCs is provided in Table 20.3-1. A significance determination is also presented for the cumulative effects from the Project, other previous and existing projects and activities, and RFDs. Although not shown in Table 20.3-1, the classification of residual effects for the RFD Case is provided in each VC-specific section of the Environmental Impact Statement, where applicable.

Also, where applicable, the assessment considered how future climate change may interact with the Project and other developments to affect VCs. Although not shown in Table 20.3-1, climate change is considered in the residual effects classification table provided in applicable VC-specific sections. A summary of the influence of climate change on effects predictions for VCs and intermediate components is also provided in Appendix 6A, Climate Change Road Map.

The classification of effects for direction, reversibility, and frequency were generally consistent between assessment cases. The classification of effects for magnitude and geographic extent were generally larger for the RFD Case relative to the Application Case. Based on public information, the lifespan of the Fission Patterson Lake South Property was assumed to be less than the Project (Section 6.5.3, Reasonably Foreseeable Development Case; Fission 2021), which implies that, for effects that are reversible, the temporal overlap or duration of cumulative effects from the two projects in the RFD Case was shorter than the duration of effects in the Application Case. A brief reasoned narrative is provided in each VC-specific section and summarized in Table 20.3-1 to support the determination of significance for the Application Case and RFD Case.

Table 20.3-1: Summary of Residual Effects Classification and Significance Determination for Valued Components in the Assessment of the Rook I Project

VC	Assessment Endpoints	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Probability of Occurrence	Significance of Residual Project Effects (Application Case)	Significance of Residual Cumulative Effects (RFD Case)
Section 7, Climate Change										
Climate change	▪ Contribution of Project's GHG emissions to the provincial and federal totals ▪ Continued ability for Canada to reach climate change commitments in the form of emission reduction targets	**Negative**	**Low:** ▪ GHG emissions: <0.3% provincial baseline; <0.02% federal baseline	**Beyond regional (global)**	**Permanent**	**Irreversible**	**Continuous**	**Certain**	**Not significant:** ▪ In relation to the assessment endpoints for the climate change VC, the Project GHG emissions would not be significant in affecting Canada's ability to reach the national emission reduction targets or in affecting Canada's alignment to transition to a low carbon economy. At less than 0.5% of the provincial baseline emissions and less than 0.1% of the federal baseline emissions, the Project would not contribute significantly to the respective totals	**Not assessed:** ▪ Due to the nature of GHG emissions, the cumulative effects have been assessed in the Application Case
Section 11, Fish and Fish Habitat										
Northern pike (*Esox lucius*) Walleye (*Sander vitreus*) Lake whitefish (*Coregonus clupeaformis*) Lake trout (*Salvelinus namaycush*)	▪ Self-sustaining and ecologically effective fish populations	**Negative**	**Negligible to low**: ▪ habitat availability: potential for limited changes to the food base for fish resulting from exposure to elevated copper concentrations in the far-future projection ▪ survival and reproduction: due to the potential for toxicological effects (lake whitefish) and/or due to predicted changes in habitat availability (i.e., food base; all VCs) in the far-future projection	**Local:** ▪ habitat availability: effects would be restricted to Patterson Lake North Arm – West Basin, where peak copper concentrations are predicted to occur ▪ survival and reproduction: effects from exposure of fish VCs to copper and changes in habitat availability would be restricted to Patterson Lake North Arm – West Basin. However, as fish VCs can move around, the geographic extent of effects on survival and reproduction was assessed as local	**Permanent**	**Irreversible:** ▪ habitat availability, survival and reproduction: not reversible before end of modelling timeframe	**Periodic:** ▪ habitat availability, survival and reproduction: fluctuating with climate	**Possible**	**Not significant:** ▪ The predicted effects from the Project would not have a significant adverse effect on the assessment endpoint for fish and fish habitat. Although changes to habitat availability and survival and reproduction are possible, the predicted effects would be within the resilience and adaptability limits for the four fish VCs	**Not significant:** ▪ The predicted effects in the RFD Case are similar to the Application Case. The main influence of the Fission Patterson Lake South Property in the RFD Case would be a slight increase in copper concentrations in the receiving environment. However, the RFD Case does not result in changes to the effects predictions for fish VCs determined for the Application Case because mass loading from the Project is the main driver of the predicted effects on surface water quality and fish VCs
Section 13, Vegetation										
Upland ecosystems	▪ Self-sustaining and ecologically effective ecosystems	**Negative**	**Low:** ▪ ecosystem availability: direct physical loss of 868.4 ha (i.e., 1.2% of the RSA) relative to Base Case ▪ ecosystem distribution: minor net change in upland ecosystem distribution centred on the LSA. Almost no change in fragmentation at the RSA scale ▪ ecosystem condition: potential loss of one occurrence of beautiful sedge; edge effects would result in a minor change in ecosystem structure	**Maximum disturbance area:** ▪ ecosystem availability **Local:** ▪ ecosystem condition **Local to regional:** ▪ ecosystem distribution	**Permanent:** ▪ ecosystem availability, ecosystem distribution, ecosystem condition: ELC units covered by permanent features (e.g., waste rock storage areas) **Long-Term (i.e., direct loss):** ▪ ecosystem availability, ecosystem distribution, ecosystem condition: 93 to 113 years = 33 years from start of Construction to the end of the Active Closure Stage, or earlier with progressive reclamation, plus 60 to 80 years to establish mature upland ELC Units	**Irreversible:** ▪ ecosystem availability, ecosystem distribution, ecosystem condition: ELC units covered by permanent features **Reversible:** ▪ ecosystem availability, ecosystem distribution, ecosystem condition: reclaimed ELC units	**Continuous**	**Certain:** ▪ ecosystem availability ▪ ecosystem distribution **Possible:** ▪ ecosystem condition	**Not significant:** ▪ The establishment of reclaimed upland vegetation ecosystems is predicted to occur well beyond the Active Closure Stage, particularly for mature forest types (60 to 80 years). The loss of 868.4 ha (i.e., 1.2% of RSA) of available uplands is predicted to have a small influence on ecological structure and function ▪ One occurrence of beautiful sedge could be lost or removed by the Project. Rare plants within the maximum disturbance area would be marked and avoided, where feasible. Where unavoidable, the Saskatchewan Ministry of Environment would be consulted to determine the best course of action. Additional measures and mitigations to limit disturbance to rare vascular species would also be implemented	**Not significant:** ▪ The Project and the Fission Patterson Lake South Property would result in a direct loss of upland ecosystems, but the implementation of effective mitigation, including reclamation and revegetation, is expected to limit cumulative changes to ecosystem availability, distribution, and condition. Incremental and cumulative effects resulting from the Project, previous and existing developments, and the Fission Patterson Lake South Property on upland ecosystems would be within the resilience and adaptability limits for this VC

NexGen Energy Ltd.

Table 20.3-1: Summary of Residual Effects Classification and Significance Determination for Valued Components in the Assessment of the Rook I Project

VC	Assessment Endpoints	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Probability of Occurrence	Significance of Residual Project Effects (Application Case)	Significance of Residual Cumulative Effects (RFD Case)
Wetland ecosystems	▪ Self-sustaining and ecologically effective ecosystems	**Negative**	**Low:** ▪ ecosystem availability: direct physical loss of 27.8 ha (i.e., <0.1% of the RSA) relative to Base Case ▪ ecosystem distribution: minor net change in wetland ecosystem distribution centred on the LSA Almost no change in fragmentation at the RSA scale ▪ ecosystem condition: edge effects would result in a minor change in ecosystem structure	**Maximum disturbance area:** ▪ ecosystem availability ▪ ecosystem condition **Local:** ▪ ecosystem distribution	**Permanent**	**Irreversible**	**Continuous**	**Certain:** ▪ ecosystem availability ▪ ecosystem distribution **Possible:** ▪ ecosystem condition	**Not significant:** ▪ Changes to ecosystem conditions are possible as the small decrease in ecosystem abundance is anticipated to produce no or few edge effects and would not disturb any known occurrences of rare plant species detected during baseline studies ▪ The loss of 27.8 ha (excluding open water) of available wetlands (i.e., 0.4% of the RSA) is predicted to have a small influence on ecological structure and function. Disturbance would be limited to four ELC units; however, these wetland ecosites remain available in the LSA and RSA are well distributed outside of the Project footprint	**Not significant:** ▪ The Project and the Fission Patterson Lake South Property in the RSA would result in a direct loss of wetland ecosystems, but the implementation of mitigation is expected to limit cumulative changes to ecosystem availability, distribution, and condition. Incremental and cumulative effects as a result of the Project, previous and existing developments, and the Fission Patterson Lake South Property on the wetland ecosystems would be within resilience and adaptability limits for this VC
Riparian ecosystems		**Negative**	**Low:** ▪ ecosystem availability: loss of 39.6 ha (i.e., 0.4% of the RSA) relative to Base Case ▪ ecosystem distribution: minor net change in riparian ecosystem distribution centred on the LSA. Almost no change in fragmentation at the RSA scale ▪ ecosystem condition: edge effects would result in a minor change in ecosystem structure	**Maximum disturbance area:** ▪ ecosystem availability ▪ ecosystem condition **Local:** ▪ ecosystem distribution	**Permanent:** ▪ ecosystem availability, ecosystem distribution, ecosystem condition: wetland ELC units **Long-Term** (i.e., direct loss): ▪ ecosystem availability, ecosystem distribution, ecosystem condition: 93 to 113 years = 33 years from start of Construction to the end of the Active Closure Stage, or earlier with progressive reclamation, plus 60 to 80 years to establish mature upland ELC Units	**Reversible:** ▪ ecosystem availability, ecosystem distribution, ecosystem condition: reclaimed ELC units **Irreversible:** ▪ ecosystem availability, ecosystem distribution, ecosystem condition: wetland ELC units within riparian ecosystems	**Continuous**	**Certain:** ▪ ecosystem availability ▪ ecosystem distribution **Possible:** ▪ ecosystem condition	**Not significant:** ▪ Changes to ecosystem condition are possible as the small decrease in ecosystem abundance is anticipated to produce not too few edge effects and would not disturb occurrences of rare plant species detected during baseline studies ▪ The loss of 39.6 ha of available riparian areas is predicted to have a small influence on ecological structure and function; 80.7% of undisturbed riparian ecosystems present in the LSA and 99.6% in the RSA are predicted to remain in the Application Case. The least common undisturbed riparian ecosites would either not be disturbed by the Project or disturbance would be limited to less than 0.4 ha per ELC type	**Not significant:** ▪ The Project and the Fission Patterson Lake South Property in the RSA would result in a direct loss of riparian ecosystems, but the implementation of mitigation is expected to limit cumulative changes to ecosystem availability, distribution, and condition. Incremental and cumulative effects as a result of the Project, previous and existing developments, and the Fission Patterson Lake South Property on the riparian ecosystems would be within resilience and adaptability limits for this VC
Traditional use plant species	▪ Self-sustaining and ecologically effective traditional use plant populations	**Negative**	**Low:** ▪ species availability: loss of 298.2 ha (i.e., 1.0% in the RSA) relative to Base Case ▪ species distribution: minor net change in traditional use plant habitat distribution centred on the LSA. Almost no change in fragmentation at the RSA scale	**Maximum disturbance area:** ▪ species availability **Local:** ▪ species distribution	**Permanent:** ▪ species availability, species distribution: for wetland ELC units **Long-Term (i.e., direct loss):** ▪ species availability, species distribution: 93 to 113 years = 33 years from the start of Construction to the end of the Active Closure Stage, or earlier with progressive reclamation, plus 60 to 80 years to establish mature upland ELC Units	**Irreversible:** ▪ species availability, species distribution: wetland ecosystems **Reversible:** ▪ species availability, species distribution: reclaimed ELC units	**Continuous**	**Certain**	**Not significant:** ▪ The Project would adversely affect traditional use plant habitat availability and distribution in the RSA and LSA. The effects in the Application Case would change little from Base Case conditions, and the traditional use plant habitat is predicted to continue to be self-sustaining and ecologically effective	**Not significant:** ▪ The assessment predicts that changes to the availability and distribution of traditional use plant habitat within the RSA in the RFD Case would be within the resilience and adaptability limits for this VC

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VC	Assessment Endpoints	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Probability of Occurrence	Significance of Residual Project Effects (Application Case)	Significance of Residual Cumulative Effects (RFD Case)
Section 14, Wildlife and Wildlife Habitat										
Woodland caribou (*Rangifer tarandus caribou*)	▪ Self-sustaining and ecologically effective populations	**Negative**	**High:** ▪ habitat availability: 7.5 ha removal of high suitability habitat, representing a <0.1% reduction in SK2 West (as habitat loss at Base Case exceeds disturbance threshold) **Moderate:** ▪ habitat availability: 24.6 ha removal of moderate suitability habitat, representing a <0.1% reduction in SK2 West (as habitat loss at Base Case exceeds disturbance threshold) **Low:** ▪ habitat availability: 0.3 ha removal of low suitability habitat, representing a <0.1% reduction in SK2 West; includes reduction in functional habitat from sensory disturbance ▪ habitat distribution: small changes to habitat connectivity caused by habitat loss and sensory disturbance (LSA and Highway 955 expected to be partial barrier to caribou movement at Base Case) ▪ survival and reproduction: combined loss of suitable habitat (32.4 ha) represents 0.6% of available habitat and a small portion of one caribou home range **Negligible:** ▪ survival and reproduction: change to abundance and distribution resulting from changes in habitat availability and distribution	**Maximum disturbance area:** ▪ habitat availability: direct habitat loss **Local:** ▪ habitat availability: sensory disturbance (500 m beyond the maximum disturbance area) and distribution **Local to regional:** ▪ habitat distribution (LSA and migration route at Patterson Lake narrows) **Beyond regional:** ▪ habitat distribution, survival and reproduction (Highway 955, including SK2 West)	**Permanent:** ▪ habitat availability, survival and reproduction: habitat covered by permanent features and wetlands **Long-Term:** ▪ habitat availability, habitat distribution, survival and reproduction: direct habitat loss: 73 years = 33 years from the start of Construction to the end of the Active Closure Stage, or earlier with progressive reclamation, plus at least 40 years to establish critical caribou habitat; sensory disturbance: 48 years = 43 years from the start of Construction to end of Closure, plus 5 years beyond Closure	**Irreversible:** ▪ habitat availability, habitat distribution: habitat covered by permanent features and wetlands **Reversible:** ▪ habitat availability: reclaimed habitat and sensory disturbance ▪ habitat distribution: reclaimed habitat ▪ survival and reproduction	**Continuous**	**Certain:** ▪ habitat availability, habitat distribution **Unlikely:** ▪ survival and reproduction	**Significant (prior to offsetting):** ▪ Effects on caribou at Base Case are already significant as the amount of disturbance in the SK2 West is greater than the 35% threshold value ▪ The magnitude of habitat loss has been conservatively overestimated as the anticipated Project footprint is approximately 25% the size of the maximum disturbance area used in the assessment. The geographic extent of habitat loss, plus the 500 m buffer from the Project is limited to the LSA. The amount of habitat loss is much less than one caribou home range ▪ The Project footprint is not expected to change caribou population connectivity, travel efficiency of predators, and caribou-predator encounter rates ▪ Habitat loss from the Project may displace a few individual caribou and would unlikely have a demographic effect at the population level (i.e., effect is not expected but not impossible). Effects from habitat loss are predicted to be reversible 40 years after the Active Closure Stage when reclaimed areas have reached defined critical habitat for caribou ▪ Overall, the Project is predicted to contribute little to the existing cumulative effects on caribou ▪ NexGen is committed to reclaiming habitat disturbed by the Project footprint and implementing a Caribou Mitigation and Offsetting Plan[(a)] to offset the incremental loss of caribou habitat to help achieve self-sustaining and ecologically effective caribou populations	**Significant (prior to offsetting):** ▪ The availability of critical habitat for caribou is expected to remain below the threshold value in SK2 West in the RFD Case. As such, cumulative effects from the Project, Fission Patterson Lake South Property, and forest harvest activities are predicted to be significant for caribou in the RFD Case. Importantly, NexGen's commitment to implementing a Caribou Mitigation and Offsetting Plan is expected to provide a net increase in caribou habitat and help to increase the resilience of caribou populations. It is also anticipated that other future developments such as the Fission Patterson Lake South Property, would implement similar mitigation actions to support a trajectory towards conserving caribou
Moose (*Alces alces*)	▪ Self-sustaining and ecologically effective populations	**Negative**	**Low:** ▪ habitat availability: 56.7 ha removal of high suitability habitat, representing 0.5% reduction in the RSA; 732.0 ha removal of moderate suitability habitat, representing a 1.2% reduction in the RSA; 26.5 ha removal of low suitability habitat, representing a 0.2% reduction in the RSA; includes reduction in functional habitat from sensory disturbance ▪ habitat distribution: small changes to habitat connectivity caused by habitat loss and sensory disturbance (due to high mobility) ▪ survival and reproduction: 8% of one moose home range affected habitat loss **Negligible:** ▪ survival and reproduction: change to abundance and distribution resulting from changes in habitat availability and distribution	**Maximum disturbance area:** ▪ habitat availability: direct habitat loss **Local:** ▪ habitat availability, habitat distribution: sensory disturbance (up to 500 m beyond the maximum disturbance area) ▪ survival and reproduction **Local to regional:** ▪ habitat distribution (LSA and movement route at Patterson Lake narrows) **Beyond regional:** ▪ habitat distribution (Highway 955)	**Permanent:** ▪ habitat availability, habitat distribution, survival and reproduction: habitat covered by permanent features and wetlands **Long-Term:** ▪ habitat availability, habitat distribution, survival and reproduction: direct habitat loss: 43 years = 33 years from the start of Construction to the end of the Active Closure Stage, or earlier with progressive reclamation, plus 6 to 10 years to establish moose habitat; sensory disturbance: 48 years = 43 years from the start of Construction to end of Closure plus 5 years beyond Closure	**Irreversible:** ▪ habitat availability, habitat distribution: habitat covered by permanent features and wetlands **Reversible:** ▪ habitat availability, habitat distribution: reclaimed habitat ▪ survival and reproduction	**Continuous**	**Certain:** ▪ habitat availability, habitat distribution **Unlikely:** ▪ survival and reproduction	**Not significant:** ▪ Changes to habitat availability are likely to have limited effects because moose habitat is common and widespread throughout the RSA. Moose may avoid the Project, but moose also demonstrate adaptive behaviour to human activity (e.g., altering time of day of using habitat adjacent disturbance). Habitat loss from the Project may displace a few individual moose but is predicted to have no measurable demographic effect at the population level ▪ The Project is expected to increase the number of vehicles on Highway 955, which could affect the movement of moose that use habitats within and outside the western portion of the RSA. However, remaining patches of contiguous, undisturbed habitat would remain in areas surrounding the Project, and in the RSA, and would continue to provide landscape connectivity and facilitate moose movement within the region ▪ Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of the moose population(s) overlapping the RSA. Moose are predicted to remain self-sustaining and ecologically effective at the Application Case	**Not significant:** ▪ Small regional changes to the abundance and distribution of moose from the cumulative effects of the Project and Fission Patterson Lake South Property are predicted at the RFD Case. Moose are adaptable, highly mobile, and can accommodate moderate to high levels of anthropogenic disturbance. At Base Case, the RSA has a low level of disturbance that is highly aggregated in the western portion of the study area. Moose habitat is not limited in the RFD Case. Cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the species' resilience and adaptability limits. Moose is predicted to remain self-sustaining and ecologically effective at the RFD Case

Table 20.3-1: Summary of Residual Effects Classification and Significance Determination for Valued Components in the Assessment of the Rook I Project

VC	Assessment Endpoints	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Probability of Occurrence	Significance of Residual Project Effects (Application Case)	Significance of Residual Cumulative Effects (RFD Case)
Grey wolf	▪ Self-sustaining and ecologically effective populations	**Negative**	**Low:** ▪ habitat availability: 146.8 ha removal of high suitability habitat during the snow-free period, representing a 0.4% reduction in the RSA, and 82.0 ha removal of high suitability winter habitat, representing a 0.7% reduction in the RSA; 68.1 ha removal of moderate suitability habitat during the snow-free period, representing a 1.4% reduction in the RSA, and 32.3 ha removal of moderate suitability winter habitat, representing a 0.9% reduction in the RSA; 731.9 ha loss of low suitability habitat during both the snow-free period and winter, representing a 1.5% and 1.3% reduction in the RSA during the snow-free period and winter, respectively; small avoidance of habitat from sensory disturbance during high human activity periods ▪ habitat distribution: small changes to habitat connectivity caused by habitat loss and sensory disturbance (due to high mobility) ▪ survival and reproduction: Portion of one grey wolf home range affected by habitat loss **Negligible:** ▪ survival and reproduction: change to abundance and distribution resulting from changes in habitat availability and distribution	**Maximum disturbance area:** ▪ habitat availability: direct habitat loss **Local:** ▪ habitat availability, habitat distribution: sensory disturbance (within the LSA) ▪ survival and reproduction **Local to regional:** ▪ habitat distribution: within and adjacent to the LSA **Beyond regional:** ▪ habitat distribution (Highway 955)	**Permanent:** ▪ habitat availability, survival and reproduction: habitat covered by permanent features and wetlands **Long-Term:** ▪ habitat availability, habitat distribution, survival and reproduction: direct habitat loss: 38 years = 33 years from the start of Construction to the end of the Active Closure Stage, or earlier with progressive reclamation, plus 5 years to establish wolf habitat; sensory disturbance: 48 years = 43 years from the start of Construction to end of Closure plus 5 years beyond Closure	**Irreversible:** ▪ habitat availability, habitat distribution: habitat covered by permanent features and wetlands **Reversible:** ▪ habitat availability, habitat distribution: reclaimed habitat ▪ survival and reproduction	**Continuous**	**Certain:** ▪ habitat availability, habitat distribution: direct habitat loss **Possible:** ▪ habitat availability, habitat distribution: sensory disturbance **Unlikely:** ▪ survival and reproduction	**Not significant:** ▪ Most habitat loss would occur in low suitability habitat. Overall, this change represents a negligible loss of habitat due to the large home range size of grey wolf (i.e., losses account for a portion of one pack home range). Functional habitat for grey wolf is predicted to become available five years after the end of the Active Closure Stage ▪ Local movement patterns are expected to change because of avoidance associated with the Project; however, wolves can move and disperse through a variety of habitat types. The distribution of suitable habitat would remain largely unchanged as a result of the Project because the maximum disturbance area is primarily located within habitat considered to be low suitability habitat for wolves due to previous burns ▪ Incremental changes to wolf habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within grey wolf resilience and adaptability limits. Grey wolf is predicted to remain self-sustaining and ecologically effective at the Application Case	**Not significant:** ▪ Small regional changes to the abundance and distribution of wolf from the cumulative effects of the Project and Fission Patterson Lake South Property are predicted at the RFD Case. Grey wolf are adaptable, highly mobile, and have the ability to travel large distances across the landscape to avoid any perceived threats created by anthropogenic disturbance. Habitat remains common and well distributed in the RFD Case relative to the Base Case. Accordingly, cumulative effects from the Project, Fission Patterson Lake South Property, and climate change at the RFD Case are expected to remain within the species' resilience and adaptability limits. Grey wolf is predicted to remain self-sustaining and ecologically effective at the RFD Case
Black bear (*Ursus americanus*)	▪ Self-sustaining and ecologically effective populations	**Negative**	**Moderate:** ▪ habitat availability: 42.1 ha removal of moderate suitability spring habitat, representing a 0.4% reduction in the RSA and 23.3 ha removal of moderate suitability fall habitat, representing a 14.4% reduction in the RSA **Low:** ▪ habitat availability: 63.2 ha removal of high suitability spring habitat, representing a 4.3% reduction in the RSA and 759.3 ha removal of high suitability fall habitat, representing a 1.4% reduction in the RSA; 841.5 ha removal of low suitability spring habitat, representing a 1.1% reduction in the RSA and 128.4 ha removal of low suitability fall habitat, representing a 0.4% reduction in the RSA; small avoidance of habitat from sensory disturbance during high activity periods ▪ habitat distribution: small changes to habitat connectivity caused by habitat loss and sensory disturbance (due to high mobility) ▪ survival and reproduction: portion of one home range affected by habitat loss **Negligible:** ▪ survival and reproduction: change to abundance and distribution resulting from changes in habitat availability and distribution	**Maximum disturbance area:** ▪ habitat availability: direct habitat loss **Local:** ▪ survival and reproduction **Local to regional:** ▪ habitat availability: sensory disturbance (within the LSA for foraging habitat but up to 1 km beyond the maximum disturbance area for den sites) ▪ habitat distribution (LSA and movement route at the narrows of Patterson Lake) **Beyond regional:** ▪ habitat distribution (Highway 955)	**Permanent:** ▪ habitat availability, habitat distribution, survival and reproduction: habitat covered by permanent features and wetlands **Long-Term:** ▪ habitat availability, habitat distribution, survival and reproduction: direct habitat loss: 38 years = 33 years from the start of Construction to the end of the Active Closure Stage, or earlier with progressive reclamation, plus 5 years to establish bear habitat; sensory disturbance: 48 years = 43 years from the start of Construction to end of Closure plus 5 years beyond Closure	**Irreversible:** ▪ habitat availability, habitat distribution: habitat covered by permanent features and wetlands **Reversible:** ▪ habitat availability, habitat distribution: reclaimed habitat ▪ survival and reproduction	**Continuous:** ▪ habitat availability, habitat distribution: direct habitat loss ▪ survival and reproduction **Periodic:** ▪ habitat availability, habitat distribution: sensory disturbance	**Certain:** ▪ habitat availability, habitat distribution: direct habitat loss **Possible:** ▪ habitat availability, habitat distribution: sensory disturbance **Unlikely:** ▪ survival and reproduction	**Not significant:** ▪ The amount of habitat loss due to the Project is not expected to have a measurable effect on black bear abundance as the loss accounts for less than one individual home range. Functional habitat for black bear is predicted to become available approximately five years after the end of the Active Closure Stage ▪ Changes to black bear movement and habitat connectivity are expected to be small and localized to specific areas of the LSA and RSA. Because black bear may avoid passing through the maximum disturbance area, an existing migration route identified by Indigenous Knowledge may be affected, which may alter habitat connectivity in the area within and surrounding the LSA. Individuals in the RSA are expected to continue to move throughout the majority of the RSA ▪ Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of the black bear population(s) overlapping the RSA. Black bear is predicted to remain self-sustaining and ecologically effective at the Application Case	**Not significant:** ▪ Small regional changes to the abundance and distribution of black bears from the cumulative effects of the Project and Fission Patterson Lake South Property are predicted at the RFD Case. Black bears are highly mobile, are adaptable to varying food sources, and can accommodate moderate to high levels of anthropogenic disturbance. At Base Case, the RSA has a low level of disturbance that is highly aggregated in the western portion of the study area. Cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the species' resilience and adaptability limits. Black bear is predicted to remain self-sustaining and ecologically effective at the RFD Case

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VC	Assessment Endpoints	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Probability of Occurrence	Significance of Residual Project Effects (Application Case)	Significance of Residual Cumulative Effects (RFD Case)
Beaver (*Castor canadensis*)	▪ Self-sustaining and ecologically effective populations	**Negative**	**Low:** ▪ habitat availability: 7.4 ha removal of high suitability habitat, representing a 0.5% reduction in the RSA; 28.1 ha removal of low suitability habitat, representing a 0.1% reduction in the RSA; small avoidance of habitat from sensory disturbance during high activity periods **Negligible:** ▪ habitat distribution: change in habitat connectivity caused by habitat loss and sensory disturbance ▪ survival and reproduction: change to abundance and distribution resulting from changes in habitat availability and distribution	**Maximum disturbance area:** ▪ habitat availability: direct habitat loss **Local:** ▪ habitat availability: sensory disturbance (well within the LSA) ▪ habitat distribution ▪ survival and reproduction	**Permanent:** ▪ habitat availability, habitat distribution, survival and reproduction: habitat covered by permanent features and wetlands **Long-Term:** ▪ habitat availability, habitat distribution, survival and reproduction: direct habitat loss: 39 to 73 years = 33 years from the start of Construction to end of the Active Closure Stage, or earlier with progressive reclamation, plus 6 to 20 years to establish suitable foraging habitat and at least 40 years to establish mature forest (trees for lodges and dams) **Short-Term:** ▪ habitat availability, habitat distribution, survival and reproduction: sensory disturbance: restricted to Construction and the Active Closure Stage	**Irreversible:** ▪ habitat availability, habitat distribution: habitat covered by permanent features and wetlands **Reversible:** ▪ habitat availability, habitat distribution: reclaimed upland habitat ▪ survival and reproduction	**Continuous:** ▪ habitat availability, habitat distribution: direct habitat loss ▪ survival and reproduction **Occasional:** ▪ habitat availability, habitat distribution: sensory disturbance	**Certain:** ▪ habitat availability: direct habitat loss **Probable:** ▪ habitat distribution: direct habitat loss **Unlikely:** ▪ habitat availability, habitat distribution: sensory disturbance ▪ survival and reproduction	**Not significant:** ▪ Reclamation is predicted to regenerate functional habitat for beaver 6 to 20 years after the end of the Active Closure Stage. Given the mobility of beaver, and the spatial extent and location of Project-related loss of high suitability habitat is unlikely to measurably affect beaver movement within the animals' territories or during juvenile dispersal events ▪ Changes in habitat availability, habitat distribution, and survival and reproduction from the Project are unlikely to affect the ability of beaver to remain self-sustaining and ecologically effective	**Not significant:** ▪ Small regional changes from the Project and Fission Patterson Lake South Property expected in the RFD Case; however, beavers are resilient and adaptable. Although some negative cumulative effects are expected in the RFD Case the changes to habitat availability, habitat distribution, and survival and reproduction are unlikely to significantly alter the ability beaver to remain self-sustaining and ecologically effective
Little brown myotis (*Myotis lucifugus*)	▪ Self-sustaining and ecologically effective populations	**Negative**	**Low:** ▪ habitat availability: Less than 0.1 ha removal of moderate suitability roosting habitat, representing <0.1% reduction in the RSA; 114.7 ha removal of low suitability roosting habitat, representing a 0.5% reduction in the RSA; includes reduction in functional habitat from sensory disturbance ▪ habitat distribution: small changes to habitat connectivity caused by habitat loss and sensory disturbance (due to high mobility) **Negligible:** ▪ survival and reproduction: change to abundance and distribution resulting from changes in habitat availability and distribution: survival and reproduction	**Maximum disturbance area:** ▪ habitat availability: direct habitat loss **Local:** ▪ habitat availability: sensory disturbance (up to 100 m beyond the maximum disturbance area) ▪ habitat distribution ▪ survival and reproduction **Beyond regional:** ▪ habitat distribution (Highway 955)	**Permanent:** ▪ habitat availability, habitat distribution, survival and reproduction: habitat covered by permanent features and wetlands **Long-Term:** ▪ habitat availability, habitat distribution, survival and reproduction: direct habitat loss: 93 to 113 years = 33 years from the start of Construction to end of Active Closure Stage, or earlier with progressive reclamation, plus 60 to 80 years to establish mature ecosites; sensory disturbance: 48 years = 43 years from the start of Construction to end of Closure) and 5 years beyond Closure	**Irreversible:** ▪ habitat availability, habitat distribution: habitat covered by permanent features and wetlands **Reversible:** ▪ habitat availability, habitat distribution: reclaimed habitat ▪ survival and reproduction	**Continuous**	**Certain:** ▪ habitat availability **Probable:** ▪ habitat distribution **Unlikely:** ▪ survival and reproduction	**Not significant:** ▪ Most of the habitat loss would occur in low suitability roosting habitat. Functional roosting habitat for little brown myotis is predicted to become available 60-80 years after the end of the Active Closure Stage. The change in habitat availability would likely induce a small residual effect for little brown myotis, as the species is not a habitat specialist. Little brown myotis are well adapted to anthropogenic disturbance and use buildings, bat houses, and bridges for maternity roosts, which indicates that they have resilience to changes in natural habitat ▪ The Project is expected to increase the number of vehicles on Highway 955, which could affect the movement of little brown myotis within and outside the western portion of the RSA. However, bats would still be able to move through the landscape to access habitat patches in other portions of the RSA. To avoid areas of inhospitable land cover (i.e., open habitat) and sensory disturbance, little brown myotis may alter movement patterns in the LSA by flying around the maximum disturbance area ▪ Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of the little brown myotis populations overlapping the RSA. Little brown myotis is predicted to remain self-sustaining and ecologically effective at the Application Case	**Not significant:** ▪ Little brown myotis are expected to remain self-sustaining and ecologically effective in the RFD Case. However, should white nose syndrome spread into the RSA, effects from the fungus on survival and population viability are expected to exceed the resilience and adaptability limits of the regional population

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Olive-Sided flycatcher (*Contopus cooperi*)	▪ Self-sustaining and ecologically effective populations	**Negative**	**Low:** ▪ habitat availability: 4.1 ha removal of high suitability nesting habitat, representing a 0.1% reduction in the RSA; 90.3 ha removal of moderate suitability nesting habitat, representing a 0.4% reduction in the RSA; 535.3 ha removal of low suitability nesting habitat, representing a 1.2% reduction in the RSA; includes reduction in functional habitat from sensory disturbance ▪ habitat distribution: small change in habitat connectivity caused by habitat loss and sensory disturbance (due to high mobility) ▪ survival and reproduction: 629.7 ha loss of suitable habitat represents approximately 14 breeding territories for the species **Negligible:** ▪ survival and reproduction: small change to abundance and distribution resulting from changes in habitat availability and distribution	**Maximum disturbance area:** ▪ habitat availability: direct habitat loss **Local:** ▪ habitat availability: sensory disturbance (up to 300 m beyond the maximum disturbance area; some effects on habitat quality possible beyond 300 m) ▪ habitat distribution ▪ survival and reproduction **Beyond regional:** ▪ habitat distribution (Highway 955)	**Permanent:** ▪ habitat availability, habitat distribution, survival and reproduction: habitat covered by permanent features and wetlands **Long-Term:** ▪ habitat availability, habitat distribution, survival and reproduction: direct habitat loss: 113 years = 33 years from the start of Construction to end of Active Closure Stage, or earlier with progressive reclamation, plus at least 80 years to establish late seral stage forests ▪ habitat availability, habitat distribution: sensory disturbance: 48 years = 43 years from the start of Construction to end of Closure plus 5 years beyond Closure	**Irreversible:** ▪ habitat availability, habitat distribution: habitat covered by permanent features and wetlands **Reversible:** ▪ habitat availability, habitat distribution: reclaimed habitat ▪ survival and reproduction	**Continuous**	**Certain:** ▪ habitat availability **Probable:** ▪ habitat distribution **Possible:** ▪ survival and reproduction	**Not significant:** ▪ Functional nesting habitat for olive-sided flycatcher is predicted to become available 60-80 years after the end of the Active Closure Stage but take as long as 120 years following the Active Closure Stage. Changes to habitat availability are likely to have negligible effects on the regional breeding population of olive-sided flycatcher given the small anticipated loss of habitat relative to what is available in the RSA ▪ Clearing activities associated with Construction would result in a measurable change to the existing distribution of olive-sided flycatcher habitat in the LSA. The Project is unlikely to have a measurable effect on habitat connectivity and movement in the RSA given the small area of new disturbance concentrated in an area where low and poor suitability habitat are dominant. Further, olive-sided flycatcher is highly mobile and capable of relocating to portions of the RSA not affected by the proposed Project footprint ▪ The Project is expected remove up to 14 breeding territories in the LSA, which could result in a small decrease in abundance adjacent to Patterson Lake. ▪ Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of the olive-sided flycatcher populations overlapping the RSA. Olive-sided flycatcher is predicted to remain self-sustaining and ecologically effective at the Application Case	**Not significant:** ▪ Small regional changes to the abundance and distribution of olive-sided flycatcher from the cumulative effects of the Project and Fission Patterson Lake South Property are predicted at the RFD Case. Overall, the weight of evidence from the analysis of the primary pathways predicts that changes to habitat availability, habitat distribution, and survival and reproduction in the RSA for the RFD Case are expected to be within the resilience and adaptability limits of olive-sided flycatcher, and the population would remain self-sustaining and ecologically effective
Rusty blackbird (*Euphagus carolinus*)	▪ Self-sustaining and ecologically effective populations	**Negative**	**Low:** ▪ habitat availability: 0.2 ha removal of high suitability nesting habitat, representing a 0.1% reduction in the RSA; 0.1 ha removal of moderate suitability nesting habitat, representing a <0.1% reduction in the RSA; 31 ha removal of low suitability nesting habitat, representing a 0.2% reduction in the RSA includes reduction in functional habitat from sensory disturbance ▪ habitat distribution: small change to habitat connectivity caused by habitat loss and sensory disturbance (due high mobility) ▪ survival and reproduction: approximately one breeding range affected by habitat loss **Negligible:** ▪ survival and reproduction: small change to abundance and distribution resulting from changes in habitat availability and distribution	**Maximum disturbance area:** ▪ habitat availability: direct habitat loss **Local:** ▪ habitat availability: sensory disturbance (up to 300 m beyond the maximum disturbance area; some effects on habitat quality possible beyond 300 m) ▪ habitat distribution ▪ survival and reproduction **Beyond regional:** ▪ habitat distribution (Highway 955)	**Permanent:** ▪ habitat availability, habitat distribution, survival and reproduction: habitat covered by permanent features and wetlands **Long-Term:** ▪ habitat availability, habitat distribution, survival and reproduction: direct habitat loss: 43 years = 33 years from the start of Construction to the end of the Active Closure Stage, or earlier with progressive reclamation, plus 6 to 10 years to establish rusty blackbird nesting habitat; sensory disturbance: 48 years = 43 years from the start of Construction to end of Closure plus 5 years beyond Closure	**Irreversible:** ▪ habitat availability, habitat distribution: habitat covered by permanent features and wetlands **Reversible:** ▪ habitat availability, habitat distribution: reclaimed habitat ▪ survival and reproduction	**Continuous**	**Certain:** ▪ habitat availability **Probable:** ▪ habitat distribution **Unlikely:** ▪ survival and reproduction	**Not significant:** ▪ Changes to habitat availability are likely to have limited effects on the regional population of rusty blackbird given the small anticipated loss of habitat relative to what is available to in the RSA. Clearing activities associated with construction would result in a measurable change to the existing distribution of rusty blackbird habitat in the LSA. Functional habitat for rusty blackbird is predicted to become available after the end of the Active Closure Stage. The Project is unlikely to have a measurable effect on rusty blackbird habitat connectivity and movement in the RSA due to the small area affected and the high mobility of the species ▪ Anticipated loss of breeding habitat in the LSA is relatively small compared to the extent of suitable breeding habitat present elsewhere in the RSA. Changes to habitat availability and distribution in the RSA are not expected to have a measurable effect on survival and reproduction for the regional population ▪ Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of the rusty blackbird populations overlapping the RSA. Rusty blackbird is predicted to remain self-sustaining and ecologically effective at the Application Case	**Not significant:** ▪ Small regional changes to the abundance and distribution of rusty blackbird from the cumulative effects of the Project and Fission Patterson Lake South Property are predicted at the RFD Case. The species is highly mobile and habitat remains common and well distributed in the RSA at the RFD Case relative to Base Case. Changes to habitat availability, habitat distribution, and survival and reproduction in the RSA for the RFD Case are expected to be within the resilience and adaptability limits of rusty blackbird, and the population would remain self-sustaining and ecologically effective

Table 20.3-1: Summary of Residual Effects Classification and Significance Determination for Valued Components in the Assessment of the Rook I Project

VC	Assessment Endpoints	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Probability of Occurrence	Significance of Residual Project Effects (Application Case)	Significance of Residual Cumulative Effects (RFD Case)
Common goldeneye (*Bucephala clangula*)	▪ Self-sustaining and ecologically effective populations	**Negative**	**Low:** ▪ habitat availability: 3.5 ha removal of suitable nesting habitat, representing a <0.1% reduction in the RSA; includes reduction in functional habitat from sensory disturbance ▪ habitat distribution: small change to habitat connectivity caused by habitat loss and sensory disturbance (due to high mobility) **Negligible:** ▪ survival and reproduction: Change to abundance and distribution resulting from changes in habitat availability and distribution; one breeding pair may be affected by habitat loss	**Maximum disturbance area:** ▪ habitat availability: direct habitat loss **Local:** ▪ habitat availability: sensory disturbance (up to 100 m beyond the maximum disturbance area) ▪ habitat distribution ▪ survival and reproduction **Beyond regional:** ▪ habitat distribution (Highway 955)	**Permanent:** ▪ habitat availability, habitat distribution, survival and reproduction: habitat covered by permanent features and wetlands **Long-Term:** ▪ habitat availability, habitat distribution, survival and reproduction: direct habitat loss: 93 to 113 years = 33 years from the start of Construction to end of Active Closure Stage, or earlier with progressive reclamation, plus 60 to 80 years to establish late seral stage forests; sensory disturbance: 48 years = 43 years from the start of Construction to end of Closure, plus 5 years beyond Closure	**Irreversible:** ▪ habitat availability, habitat distribution: habitat covered by permanent features and wetlands **Reversible:** ▪ habitat availability, habitat distribution: reclaimed habitat ▪ survival and reproduction	**Continuous**	**Certain:** ▪ habitat availability **Probable:** ▪ habitat distribution **Unlikely:** ▪ survival and reproduction	**Not significant:** ▪ Changes to habitat availability are likely to have limited effects because common goldeneye is a highly mobile species, habitat loss from the Project is minimal, and suitable habitat remains abundant the RSA. Overall, the amount of habitat loss due to the Project is not expected to have a measurable effect on common goldeneye abundance as it is unlikely to displace more than a single breeding pair. Functional habitat for common goldeneye is predicted to become available 60 years to 80 years after the end of the Active Closure Stage ▪ Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of common goldeneye populations overlapping the RSA. Common goldeneye is predicted to remain self-sustaining and ecologically effective at the Application Case	**Not significant:** ▪ Small regional changes to the abundance and distribution of common goldeneye from the cumulative effects of the Project and Fission Patterson Lake South Property are predicted at the RFD Case. Common goldeneye is a highly mobile species and can accommodate moderate levels of anthropogenic disturbance. At Base Case, the RSA has a low level of disturbance that is highly aggregated in the western portion of the study area. Cumulative effects expected to remain within the species' resilience and adaptability limits and the population is predicted to remain self-sustaining and ecologically effective at the RFD Case
Mallard (*Anas platyrhynchos*)	▪ Self-sustaining and ecologically effective populations	**Negative**	**Low:** ▪ habitat availability: 142.1 ha removal of high suitability nesting habitat, representing a 0.5% reduction in the RSA; no removal of moderate suitability nesting habitat in the RSA; 45.1 ha removal of low suitability nesting habitat, representing a 0.2% reduction in the RSA; includes reduction in functional habitat from sensory disturbance ▪ habitat distribution: small change to habitat connectivity caused by habitat loss and sensory disturbance (due high mobility) **Negligible:** ▪ survival and reproduction: change to abundance and distribution resulting from changes in habitat availability and distribution	**Maximum disturbance area:** ▪ habitat availability: direct habitat loss **Local:** ▪ habitat availability: sensory disturbance (up to 100 m beyond the maximum disturbance area) ▪ habitat distribution ▪ survival and reproduction **Beyond regional:** ▪ habitat distribution (Highway 955)	**Permanent:** ▪ habitat availability, habitat distribution, survival and reproduction: habitat covered by permanent features and wetlands **Long-Term:** ▪ habitat availability, habitat distribution, survival and reproduction: direct habitat loss: 43 years = 33 years from the start of Construction to end of the Active Closure Stage, or earlier with progressive reclamation, plus 6 years to 10 years to establish mallard nesting habitat; sensory disturbance: 48 years = 43 years from the start of Construction to end of Closure, plus 5 years beyond Closure	**Irreversible:** ▪ habitat availability, habitat distribution: habitat covered by permanent features and wetlands **Reversible:** ▪ habitat availability, habitat distribution: reclaimed habitat ▪ survival and reproduction	**Continuous**	**Certain:** ▪ habitat availability **Probable:** ▪ habitat distribution **Unlikely:** ▪ survival and reproduction	**Not significant:** ▪ Changes to habitat availability are likely to have limited effects because mallard is a highly mobile species, habitat loss from the Project is minimal, and suitable habitat remains abundant in the RSA. Functional habitat for mallard is predicted to become available 6 years to 10 years after the end of the Active Closure Stage ▪ Given the strong dispersal and movement capabilities of the species, effects of the Project on habitat distribution in the RSA are expected to be negligible ▪ The Project is expected to result in a small reduction in mallard reproduction in the LSA; however, given the relative tolerance of anthropogenic disturbance by the species, these effects are not expected to have consequences for the population occupying the RSA ▪ Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of mallard populations overlapping the RSA. Mallard is predicted to remain self-sustaining and ecologically effective at the Application Case	**Not significant:** ▪ Small regional changes to the abundance and distribution of mallard from the cumulative effects of the Project and Fission Patterson Lake South Property are predicted at the RFD Case. Mallard is a resilient and adaptable species with strong population trends in North America and western Canada. Habitat remains abundant and well distributed in the RFD Case relative to Base Case. Accordingly, cumulative effects are expected to remain within the species' resilience and adaptability limits. Mallard is predicted to remain self-sustaining and ecologically effective at the RFD Case

Table 20.3-1: Summary of Residual Effects Classification and Significance Determination for Valued Components in the Assessment of the Rook I Project

VC	Assessment Endpoints	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Probability of Occurrence	Significance of Residual Project Effects (Application Case)	Significance of Residual Cumulative Effects (RFD Case)
Canadian toad (*Anaxyrus hemiophrys*)		Negative	**Low:** ▪ habitat availability: 27.0 ha removal of suitable breeding habitat, representing a 0.2% reduction in the RSA; includes reduction in functional habitat from sensory disturbance **Low to moderate:** ▪ habitat distribution: small measurable change to habitat connectivity caused by habitat loss and sensory disturbance (due to limited dispersal and mobility) ▪ survival and reproduction: potential change in local abundance if hibernation sites are removed while occupied **Negligible:** ▪ survival and reproduction: change to abundance and distribution resulting from changes in habitat availability and distribution	**Maximum disturbance area:** ▪ habitat availability: direct habitat loss **Local:** ▪ habitat availability: sensory disturbance (up to 90 m beyond the maximum disturbance area) ▪ habitat distribution ▪ survival and reproduction **Beyond regional:** ▪ habitat distribution (Highway 955)	**Permanent:** ▪ habitat availability, habitat distribution, survival and reproduction: loss of wetland breeding habitat and upland habitat covered by permanent features **Long-Term:** ▪ habitat availability, habitat distribution, survival and reproduction: direct habitat loss:43 years = 33 years from the start of Construction to end of the Active Closure Stage, or earlier with progressive reclamation, plus 6 to 10 years to establish suitable foraging habitat; perhaps longer for hibernation habitat; sensory disturbance: 48 years = 43 years from the start of Construction to end of Closure plus 5 years beyond Closure	**Irreversible:** ▪ habitat availability, habitat distribution: habitat covered by permanent features and wetlands **Reversible:** ▪ habitat availability, habitat distribution: reclaimed upland habitat ▪ survival and reproduction	Continuous	**Certain:** ▪ habitat availability **Probable:** ▪ habitat distribution **Unlikely:** ▪ survival and reproduction	**Not significant:** ▪ Changes to habitat availability are likely to have limited effects given the small anticipated loss of habitat relative to what is available in the RSA. Functional upland foraging habitat for Canadian toad is predicted to become available 6 years to 10 years beyond the end of the Active Closure Stage or earlier through progressive reclamation. Loss of upland habitat could decrease the survival of individuals in the LSA if hibernation sites were destroyed during Construction. Pre-construction surveys for potential hibernation sites would be completed to avoid and minimize risks to Canadian toad ▪ The Project could result in some changes to local movement patterns around Patterson Lake and Forrest Lake as Canadian toads move from breeding sites to upland habitats. Remaining patches of contiguous, undisturbed habitat would remain in areas surrounding the LSA and would continue to provide landscape connectivity and facilitate Canadian toad movement within the RSA ▪ The Project is not expected to have a measurable effect on Canadian toad survival and reproduction, due to the species high fecundity and reproductive output ▪ Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within Canadian toad resilience and adaptability limits. Canadian toad is predicted to remain self-sustaining and ecologically effective at the Application Case	**Not significant:** ▪ Small regional changes to the abundance and distribution of Canadian toad from the cumulative effects of the Project and Fission Patterson Lake South Property are predicted at the RFD Case. Canadian toads have high reproductive output and are relatively flexible in their habitat selection during the active season. Habitat remains well distributed and connected in the RSA at the RFD Case relative to Base Case. Accordingly, cumulative effects are expected to remain within the species' resilience and adaptability limits. Canadian toad is predicted to remain self-sustaining and ecologically effective at the RFD Case
Section 15, Human Health										
Human health	▪ Protection of human health	Negative	**Low:** ▪ non-carcinogens (e.g., cobalt, copper, molybdenum, uranium): hazard quotients were below the acceptable risk level for all receptors, locations, and exposure pathways **Negligible**: ▪ carcinogens (e.g., arsenic): the ILCR would exceed the negligible cancer risk level of 1 in 100,000 for the subsistence harvester and seasonal resident harvesting Traditional Foods from Patterson Lake South Arm and Beet Lake during the Project lifespan; the arsenic ILCR was below the negligible cancer risk level of 1 in 100,000 for all other human receptors during Project lifespan; the arsenic ILCR for the subsistence harvester at Patterson Lake South Arm were predicted to be 4 in 100,000 **Low:** ▪ radionuclides and radon: radiation doses to the camp worker, subsistence harvester, seasonal resident, and hypothetical permanent resident were below the Canadian Nuclear Safety Commission public dose limit of 1 mSv/yr. The radiation doses to human health receptors are below or equivalent to the dose constraint for the Project of 0.3 mSv/yr; the incremental radiation dose from all radionuclides in the U-238 decay chain including radon is below the public dose limit of 1 mSv/yr	**Local:** ▪ carcinogens (e.g., arsenic): Patterson Lake South Arm and Beet Lake in the LSA (for the exceedance of negligible cancer risk level) **Regional:** ▪ non-carcinogens (e.g., cobalt, copper, molybdenum, uranium): all locations in the Project footprint, LSA, and RSA. ▪ radionuclides and radon: all locations in the Project footprint, LSA, and RSA	Permanent	**Irreversible:** ▪ non-carcinogens (e.g., cobalt, copper, molybdenum, uranium) ▪ carcinogens (e.g., arsenic): cancer risk is not reversible ▪ radionuclides and radon: radiation dose is not reversible	Continuous	**Unlikely:** ▪ non-carcinogens (e.g., cobalt, copper, molybdenum, uranium): Project hazard quotients are well below the acceptable risk level ▪ radionuclides and radon: radiation dose is below the public dose limit of 1 mSv/yr and dose constraint of 0.3 mSv/yr **Possible:** ▪ carcinogens (e.g., arsenic): arsenic ILCR would exceed negligible cancer risk level for the subsistence harvester; the assessment incorporated conservatism in the Traditional Foods diet, as well as in the modelling assumptions and arsenic oral slope factor	**Not significant:** ▪ Non-carcinogenic constituents of potential concern and the incremental radiation dose are predicted to be below the acceptable risk level and regulatory public dose limit, respectively, for all human receptors in the Application Case. For many of the human receptor groups evaluated, the predicted cancer risks (i.e., ILCRs) would exceed the negligible cancer risk level of 1 in 100,000. However, for all receptors in the Application Case, the predicted cancer risk would fall within the category of negligible to low risk level. Additionally, the overall risk from the Project is likely low for all human receptor groups considering the added conservatism in the assessment and the assumptions in the Traditional Foods diet	**Not significant:** ▪ Similar to the Application Case, non-carcinogenic constituents of potential concern and the incremental radiation dose are predicted to be below the acceptable risk level and regulatory public dose limit, respectively, for all human receptors in the RFD Case

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VC	Assessment Endpoints	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Probability of Occurrence	Significance of Residual Project Effects (Application Case)	Significance of Residual Cumulative Effects (RFD Case)
Section 16, Cultural and Heritage Resources and Indigenous Land and Resource Use										
Cultural and heritage resources	▪ Protection of heritage resources	There are no predicted primary pathways from the Project on cultural and heritage resources as the Project would not be expected to create greater-than-negligible adverse effects. Therefore, the effects to the cultural and heritage resources VC are predicted to be **not significant**.								
Indigenous land and resource use	▪ Continued ability to participate in Indigenous land and resource use activities	Negative	**Moderate:** ▪ quality of the Indigenous land use experience: changes due to changes to aesthetics, perceptions of the quality of resources, and the cultural landscape, with mitigations. Small changes due to Project effects on noise, light, air quality, and safety. Some Indigenous land users in the area may change their behaviours or harvesting patterns because of perceptions of changes in the quality of harvested resources and changes to the cultural landscape. Reduced over time with mitigations **Low:** ▪ access to and area available for Indigenous land and resource use: restrictions to land access for safety purposes within the maximum disturbance area past the gatehouse (i.e., around mine infrastructure for safety purposes); assumed loss of 981 ha of land available for use, representing approximately 0.7% of the LSA ▪ availability of fish, plants, and wildlife for harvesting: small changes to the availability of wildlife (i.e., caribou, moose, black bear, grey wolf, marten, beaver, mallard, and common goldeneye) for harvesting; small changes to the availability of traditional use plants for harvesting ▪ quality of the Indigenous land use experience: effects on noise, light, air quality, and safety **Negligible to low:** ▪ availability of fish, plants, and wildlife for harvesting: negligible to small changes to the availability of fish for harvesting	**Regional:** ▪ availability of fish, plants, and wildlife for harvesting: changes to wide-ranging wildlife species (e.g., moose, black bear) availability due to changes to wildlife movements and distribution beyond the LSA and outside the Highway 955 corridor from increased traffic and sensory disturbance **Local:** ▪ access to and area available for Indigenous land and resource use: maximum disturbance area of 981 ha (or approximately 0.7% of LSA) would be removed ▪ availability of fish, plants, and wildlife for harvesting: availability of fish for harvesting, restricted to Patterson Lake North Arm – West Basin; availability of plants for harvesting, restricted mainly to maximum disturbance area; availability of wildlife for harvesting, restricted to a portion of the LSA, including the maximum disturbance area and wildlife travel route at Patterson Lake ▪ quality of the Indigenous land use experience: includes the maximum disturbance area, 5 km buffer for perceived effects, Patterson Lake, noise LSA, access road corridor, and Highway 955 corridor	**Permanent:** ▪ quality of the Indigenous land use experience: cultural landscape due to areas covered by permanent features (e.g., waste rock storage areas) and perceptions for some individuals **Long-Term:** ▪ availability of fish, plants, and wildlife for harvesting: well beyond the Active Closure Stage (i.e., 60 to 80 years; total of up to 113 years; or up to five generations of Indigenous land users) for caribou, marten, goldeneye, and the availability of plants in mature upland ecosites **Medium-Term:** ▪ access to and area available for Indigenous land and resource use; availability of fish, plants, and wildlife for harvesting: 43 years (i.e., start of Construction to end of Transitional Monitoring Stage), or approximately two generations of Indigenous land users, as transfer of knowledge of an area is intergenerational ▪ quality of the Indigenous land use experience: 43 years (i.e., Construction until end of Transitional Monitoring Stage) for changes to the cultural landscape, aesthetics, and perceptions of the quality of resources or approximately two generations of Indigenous land users as transfer of knowledge of an area is intergenerational; 43 years for effects on land use experience related to noise, air quality, and safety or approximately two generations of Indigenous land users	**Irreversible:** ▪ availability of fish, plants, and wildlife for harvesting: availability of plants in affected wetland ecosystems ▪ quality of the Indigenous land use experience: some perceptions related to permanent infrastructure (e.g., waste rock storage areas), perceptions for some individuals, and cultural landscape with the changes in the history of land use **Reversible:** ▪ access to and area available for Indigenous land and resource use ▪ availability of fish, plants, and wildlife for harvesting: availability of fish, wildlife, and most traditional plants in reclaimed ecosites ▪ quality of the Indigenous land use experience: changes to aesthetics and perceptions of the quality of resources, with mitigation (e.g., Indigenous monitoring); effects on land use experience related to noise, air quality, light, and safety	Continuous	**Certain:** ▪ access to and area available for Indigenous land and resource use ▪ availability of fish, plants, and wildlife for harvesting: availability of most traditional plants, fish, and wildlife species ▪ quality of the Indigenous land use experience: effects on land use experience related to noise, air quality, light, aesthetics, and safety **Probable:** ▪ quality of the Indigenous land use experience: changes to perceptions of the quality of resources and to the cultural landscape	**Not significant:** ▪ When considered collectively, Indigenous land and resource use in the LSA is expected to change to some degree, but overall is anticipated to continue. Changes may be reflected in the species harvested, the location of activities, or in other adjustments to individual behaviour because of changes to the quality of the Indigenous land use experience ▪ Mitigation, including the implementation of a Ground Transportation Emergency Response Plan and Security Program that provides safety for Indigenous land users around the Project, along the access road and Highway 955. The independent Indigenous monitoring program and the Indigenous and Public Engagement Program are expected to reduce perceived effects by effectively communicating the findings to Indigenous Groups and local communities. Commitments in the Benefit Agreements related to monitoring and support for cultural programming are central to minimizing potential adverse outcomes, while enhancing benefit outcomes to Indigenous Groups. With effective mitigation, the assessment endpoint for Indigenous land and resource use is expected to be maintained	**Not significant:** ▪ Based on the residual effects analysis results, changes in access to and area available for Indigenous land use, changes to the availability of wildlife, fish, and traditional use plants for harvesting, and quality of the Indigenous land use experience in the RFD Case are not significant, and opportunities for Indigenous land and resource are expected to continue in the LSA and RSA ▪ Mitigation is anticipated to be effective in the RFD Cases with Benefit Agreements combined with the Independent Indigenous monitoring program around the wider Patterson Lake area and the Public Engagement Program, There are effective regional monitoring programs from the Community Vitality Monitoring Partnership Process for the Athabasca Basin that could be adopted. NexGen would seek to adopt a similar regional monitoring program for the Project in coordination with the Fission Patterson Lake South Property, local Indigenous Groups and communities, and regulators

Table 20.3-1: Summary of Residual Effects Classification and Significance Determination for Valued Components in the Assessment of the Rook I Project

VC	Assessment Endpoints	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Probability of Occurrence	Significance of Residual Project Effects (Application Case)	Significance of Residual Cumulative Effects (RFD Case)
Section 17, Other Land and Resource Use										
Other land and resource use	▪ Continued level of opportunities for other land and resource use	**Negative**	**Negligible to low:** ▪ access to fish and wildlife for harvesting: Negligible restriction on access to land for safety purposes (other alternative areas are locally available); nominal limits to small portions of Patterson Lake during Construction for installation of in-lake infrastructure; nominal restrictions on area for snowmobiling on Patterson Lake where ice formation may be affected ▪ quality of the resource use experience: Negligible for air quality and light effects; noise within guidelines for health and safety, though individual sensitivities may vary from negligible to small; aesthetics managed by reduction in Project footprint and limited shoreline development and workforce fishing; travel safety (managed through road upgrades, a Ground Transportation Emergency Response Plan and a Security Program) would have a negligible to small effect; negligible effect on trappers' perceptions of resources for consumption; negligible effect on lodge and outfitting clients' perceptions of fish for consumption	**Local:** ▪ access to fish and wildlife for harvesting: Maximum disturbance area of 981 ha (or 0.7% of LSA) would be restricted for trapping; portion of Patterson Lake near Project water intakes / treated effluent discharges may affect ice formation and winter travel for trapping ▪ quality of the resource use experience: maximum disturbance area, noise LSA, access road corridor, and Highway 955 corridor	**Long-Term:** ▪ access to fish and wildlife for harvesting, quality of the resource use experience: 43 years –Construction, Operations, and Closure	**Reversible**	**Continuous:** ▪ access to fish and wildlife for harvesting **Periodic:** ▪ quality of the resource use experience	**Certain:** ▪ access to fish and wildlife for harvesting **Probable:** ▪ quality of the resource use experience	**Not significant:** ▪ The magnitude of the predicted changes in access to land and resource use as a result of the Project is expected to be negligible as land-based access for resource use purposes is premised on safety, meaning that access would only be restricted in a small area to maintain both the safety of the operation and of resource users in the maximum disturbance area ▪ Effects would be reversible soon after Closure and uses are expected to be sustained as resource users become accustomed to the presence of the operation. NexGen is committed to maintaining positive working relationships with those active in areas proximal to the Project and would continue to encourage those uses so long as safety permits. Thus, opportunities for other land and resource use are predicted to continue at a similar level in the Application Case relative to the Base Case	**Not significant:** ▪ Overall, the weight of evidence from the analysis, including consideration of experiences at other uranium operations in northern Saskatchewan where multiple uses remain compatible, predicts that other land and resource use can continue in local areas not affected by the projects and resources equivalent in abundance and quality would continue to be available to resource users. Changes to the aesthetics of other land and resource use would be primarily dependent on proximity to the projects and individual sensitivities
Section 18, Economy										
Economy	▪ Enhancing the participation of local Indigenous and non-Indigenous individuals in employment, income, education, and training opportunities ▪ Enhancing Indigenous and locally owned business opportunities ▪ Enhancing government revenue ▪ Maintaining opportunities to participate in the traditional economy	As no pathways were required to be carried forward from the pathways analysis, the effects to the economy VC are predicted to be **not significant**.								

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VC	Assessment Endpoints	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Probability of Occurrence	Significance of Residual Project Effects (Application Case)	Significance of Residual Cumulative Effects (RFD Case)
Section 19, Community Well-Being										
Community well-being	▪ Maintenance of local community well-being	**Negative**	**Low:** ▪ cultural continuity: changes to cultural continuity, including the transmission of knowledge, as some Indigenous community members may change the location of activities currently undertaken in the Indigenous and other land and resource use LSAs, resulting in the loss of site-specific knowledge (i.e., low magnitude) ▪ demand for community infrastructure and services: increase in the demand for social and mental health services because of participation in the worker rotation system **Negligible to low:** ▪ social adaptability: Negligible to low magnitude as individuals and families learn to cope with the changes associated with income and participation in the worker rotation system. These effects are expected to be concentrated among workers and their families ▪ demand for community infrastructure and services: negligible to low magnitude increase in demand for social and mental health services to address issues tied to changes in access restrictions and avoidance	**Local:** ▪ cultural continuity: all communities in the LSA, though the number of resource users in each community with close ties to the Patterson Lake area varies ▪ social adaptability: all communities in the LSA ▪ demand for community infrastructure and services: all communities in the LSA	**Long-Term** ▪ cultural continuity: two generations for cultural transmission as transfer of knowledge is intergenerational and location specific. Transmission of knowledge affected by the Project is anticipated to persist for the lifetime of the Project and beyond until the resource users return to the area after Closure and the transfer of knowledge for the area returns ▪ social adaptability: Lifespan of the Project (i.e., 43 years) assuming worker rotation system is used throughout all phases of the Project ▪ demand for community infrastructure and services: lifespan of the Project (i.e., 43 years) assuming worker rotation system is used throughout all phases of the Project, though most effects would occur during Operations (i.e., 24 years)	**Reversible**	**Continuous**	**Certain:** ▪ demand for community infrastructure and services **Probable:** ▪ cultural continuity ▪ social adaptability	**Not significant:** ▪ The effects of the Project on community well-being include changes to cultural continuity, including transmission of knowledge, because of the displacement of land and resource use activities; social adaptability due to participation in the worker rotation system; and increased demand for community infrastructure and services due to changes to cultural continuity and social adaptability ▪ The change to cultural continuity is expected to be small because the Project may displace some activities and individual resource users may avoid the area; however, the land and resource use activities that support cultural continuity and transmission of knowledge are expected to continue. There is anticipated to be changes to social adaptability as a result of participation in the worker rotation system; however, these effects are anticipated to be periodic, primarily while people start their employment. The changes in cultural continuity and social adaptability would result in a minor increase in unmet demand for mental health and social services for some residents in the LSA communities. These changes are anticipated to be small in magnitude when considered together ▪ Overall, the assessment endpoint of maintenance of local community well-being is expected to be achieved	**Not significant:** ▪ For cultural continuity, changes from access restrictions for the RFD Case would be similar to the Application Case with the exception of magnitude and geographic extent, where a small to moderate change in behaviour may result in the RFD Case. The change in magnitude relates to the larger loss of lands available for resource use, which may create a larger area of avoidance, resulting in disruption to transmission of knowledge ▪ For social adaptability and demand for community infrastructure and services, the predicted effects in the RFD Case are anticipated to be similar to the effects in the Application Case. Some increase in demand for community infrastructure and services may extend to the RSA due to more RSA employees participating in the worker rotation system for both projects; however, due to the significant number of RSA communities, effects are anticipated to be minor ▪ Overall, the assessment endpoint of maintenance of local community well-being is expected to be achieved

a) With the implementation of the Project Caribou Mitigation and Offsetting Plan, the contribution of Project-specific residual adverse effects to woodland caribou are predicted to be not significant.
Note: The classification of residual effects is completed for the Application Case only. Classification of residual effects for the RFD Case is provided in each VC section of the EA.
< = less than; > = greater than; GHG = greenhouse gas; VC = valued component; LSA = local study area; RSA = regional study area; ELC = ecological land classification; RFD = reasonably foreseeable development; ILCR = incremental lifetime cancer risk; mSv/yr = millisieverts per year; Bq/m^3 = becquerels per cubic metre; EA = Environmental Assessment; SK2 West = SK2 West Caribou Administration Unit.

20.4 References

Fission (Fission Uranium Corp.). 2019. Technical Report on the Pre-Feasibility Study of the Patterson Lake South Property using Underground Mining Methods, Northern Saskatchewan, Canada. NI 43-101 Report. Prepared by Roscoe Postle Associates Inc. for Fission Uranium Corp. November 2019.

Fission. 2021. Fission Project Description. Prepared by Clifton Engineering Group Inc. and Canada North Environmental Services Limited Partnership for Fission Energy Corp. 22 November 2021.

Rook I Project

Environmental Impact Statement

Section 21 Accidents and Malfunctions

Submitted to:
Canadian Nuclear Safety Commission

Saskatchewan Ministry of Environment

Prepared by:
WSP Canada Inc.
1721 8th Street East
Saskatoon, SK
S7H 0T4

November 2024

Executive Summary

Section Purpose

Section 21 of the Environmental Impact Statement (EIS) outlines the potential accident and malfunctions that could occur in association with the Rook I Project (Project) and describes the potential effects on the environment and public safety.

An accident is defined as any unintended event, including operating errors, equipment failures, and other mishaps, the consequences, or potential consequences of which are significant from the point of view of protection or safety. A malfunction is defined as a failure in the normal functioning of equipment, infrastructure, or systems that could result in potentially significant consequences. These two risks are assessed separately from "day-to-day" activities that are addressed throughout the EIS.

The assessment considered two distinct evaluations, which were:

- on-site accidents and malfunctions, covering the extent of the Project footprint and associated access road to its junction with Highway 955; and
- transportation-related risks, involving transport vehicles that may occur beyond the access road junction with Highway 955 along the transportation route (i.e., Highways 955 and 155).

The assessment of accidents and malfunctions and transportation-related risks for the Project used a standard, structured risk assessment approach, applied widely accepted scientific practices, and incorporated Indigenous and Local Knowledge.

Setting

At a regional scale, the Project would be located within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system, approximately 40 km east of the Saskatchewan-Alberta border and 640 km northwest of the city of Saskatoon.

The regional location and setting were key factors in the identification of receptors that could be affected by accidents or malfunctions. The selection of aquatic, terrestrial, and human receptors was based on an understanding of how people use the land in the area surrounding the Project and incorporated information from Indigenous Knowledge and Traditional Land Use Studies, community information sessions, and Joint Working Group meetings.

The assessment considered the transportation route of the Project. The setting of this route is remote, and transportation does not traverse any cities or otherwise densely populated areas. Several communities are located along the route including La Loche, Bear Creek, Buffalo Narrows, Beauval, and Green Lake.

Risk Assessment Approach (Section 21.5)

The general approach for the assessment of accidents and malfunctions and transportation-related risks associated with the Project included:

- hazard identification;
- environmental design feature and mitigation evaluation;
- risk measurement, as a function of likelihood and consequence; and
- risk evaluation.

The assessment of accidents and malfunctions began with the initial identification of hazard scenarios. Hazard scenarios were identified using a systematic approach that considered the existence of sources of hazards and initiating events for the Project. After identifying potential hazard scenarios, a subset (i.e., bounding scenarios) was selected as the focus of the detailed risk analysis.

The process taken to identify transportation hazard scenarios considered the potential for the release of chemical and radiological constituents to the aquatic, terrestrial, and atmospheric environments.

Where potential adverse effects on the environment or public safety were identified from a potential accident, malfunction, or transportation scenario, controls were implemented to address the hazards and associated effects. Controls included feasible environmental design features and/or mitigation practices that would be implemented to avoid and minimize potential adverse effects.

After considering environmental design features and mitigations, the residual risk associated with each hazard scenario was estimated as a function of likelihood (i.e., how often the hazard might occur) and consequence (i.e., severity of the hazard). The likelihood and consequence of each hazard scenario were combined to assign an overall risk level to each scenario of either High, Moderate, or Low. Scenarios that were classified with a risk level of High were advanced for further assessment such that a more detailed evaluation of risk and potential management activities could be considered. Scenarios with a Moderate or Low risk level were considered tolerable if risk reduction activities would reduce the risk associated with these scenarios to As Low as Reasonably Practicable (ALARP).

For accidents and malfunctions, the assessment undertaken for each of the identified bounding scenarios consisted of a general description of the hypothetical event, characterization of the resulting release, an assessment of probability, and a description of the resulting potential effects on biophysical and human health VCs. A similar process was used for the assessment of transportation-related hazard scenarios.

Assessment of Effects of Accidents and Malfunctions (Section 21.6)

In total, 93 accident and malfunction hazard scenarios were identified and evaluated in the hazard identification analysis, which were then reviewed to select the bounding scenarios. The approach for selecting bounding scenarios focused on key accidents or malfunctions that were equal to, or exceeded the potential severity of, other possible scenarios that could occur. This approach maintained an appropriate level of conservatism in the assessment, while avoiding redundancies.

Six hazard scenarios were selected as bounding scenarios for more detailed risk analysis. These scenarios were:

- An aquatic (i.e., to water) release of uranium concentrate and radioactivity from a traffic accident at or near the access road bridge crossing of the Clearwater River.
- An aquatic release of fuel or hazardous chemicals from a traffic accident at or near the access road bridge crossing of the Clearwater River.
- An atmospheric (i.e., to air) release of uranium and radioactivity from a fire or explosion involving equipment or vessels containing uranium-bearing solutions in the solvent extraction building.
- A terrestrial (i.e., to ground) release of uranium and radioactivity from a tailings transfer pipe or pump failure at surface.
- A terrestrial release of uranium and radioactivity from untreated effluent transfer pipe failure at the surface.
- An atmospheric release of sulphur dioxide from an acid plant tail gas scrubber failure.

After the detailed risk analysis was complete, the resultant risk level rating for each of these scenarios was assessed to be Low for all scenarios except for the acid plant tail gas scrubber failure scenario, which was deemed to be Low to Moderate risk. The Low to Moderate risk scenario was deemed to represent a tolerable level of risk in consideration of proposed safeguards and design features that reduce the risk level to ALARP.

Assessment of Effects of Transportation-Related Risks (Section 21.7)

Hazard identification was undertaken as part of a detailed technical assessment, and five transportation hazard scenarios were identified and evaluated in the hazard identification analysis. These scenarios were:

- An aquatic release of uranium concentrate or other hazardous materials.
- A terrestrial release of uranium concentrate or other hazardous materials.
- An atmospheric release of uranium concentrate or other hazardous materials.
- A transportation accident scenario involving a vehicle-pedestrian collision.
- A transportation accident scenario involving a vehicle-wildlife collision.

After the detailed risk analysis was complete, the resultant risk level rating was assessed to be Low for all scenarios except for the transportation accident scenario involving a vehicle-pedestrian collision, which was deemed to be a Moderate risk. The Moderate risk scenario was deemed to represent a tolerable level of risk in consideration of proposed safeguards that reduce the risk level to ALARP.

Key Findings (Section 21.8)

From 93 potentially hazardous situations identified in an initial hazard identification for accidents and malfunctions, six scenarios were carried forward for detailed analysis including risk evaluation. Of these, five scenarios were determined to be Low risk overall. The acid plant tail gas scrubber failure scenario was deemed to be Low to Moderate risk. Given that the risk would be managed to be ALARP, this risk was deemed to be tolerable, and no further mitigation was deemed necessary.

The transportation risk assessment considered five main scenarios, of which four were deemed to be Low risk and one was deemed to be Moderate risk overall. The vehicle-human contact was found to be Moderate risk, which represented a tolerable level of risk in consideration of proposed safeguards that reduced the risk level to ALARP.

The potential accident and malfunctions hazards associated with the Project, and the effectiveness of designs and mitigations, would continue to be assessed according to the risk management processes described in the Integrated Management System Manual and the Environmental Protection Program, and in accordance with provincial, Canadian Nuclear Safety Commission, and other regulatory requirements.

Abbreviations and Units of Measure

Abbreviation	Definition
AEGL	acute exposure guideline level
ALARP	as low as reasonably practicable
ALOHA	Areal Locations of Hazardous Atmospheres
BNDN	Birch Narrows Dene Nation
BRDN	Buffalo River Dene Nation
CEAA	Canadian Environmental Assessment Act
CNSC	Canadian Nuclear Safety Commission
CRDN	Clearwater River Dene Nation
EA	Environmental Assessment
EIS	Environmental Impact Statement
ERPG	Emergency Response Planning Guideline
ETP	effluent treatment plant
FMEA	failure modes and effects analysis
JWG	Joint Working Group
U_3O_8	triuranium octoxide
LNG	liquified natural gas
LPA	local priority area
MN-S	Métis Nation – Saskatchewan
NexGen	NexGen Energy Ltd.
NPAG	non-potentially acid generating
PAG	potentially acid generating
PAH	polyaromatic hydrocarbon
Project	Rook I Project
TSD	technical support document
UGTMF	underground tailings management facility
VC	valued component
WRSA	waste rock storage area

Unit	Definition
%	percent
µg/g	micrograms per gram
µg/L	micrograms per litre
Bq/L	becquerels per litre
cm/s	centimetres per second
g/h	grams per hour
g/s	grams per second
kg	kilogram
kg/h	kilograms per hour
km	kilometre
km/h	kilometres per hour
L	litre
L/min	litres per minute
m	metre
m^2	square metre
m^3	cubic metre
mg/m^3	milligrams per cubic metre
mGy/d	milligrays per day
ppm	parts per million
t	tonne

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21 Accidents and Malfunctions

21.1 Introduction

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The Project would be located approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the Northern Village of La Loche, and 640 km northwest of the city of Saskatoon (Figure 21.1-1). The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Patterson Lake is at the interface of the Boreal Shield and Boreal Plain ecozones. Access to the Project would be from an existing road off Highway 955 (Figure 21.1-2), with on-site worker accommodation serviced by fly-in/fly-out access.

This section outlines the potential accidents and malfunctions that could occur in association with the Project and describes the potential effects on the environment and public safety, considering environmental design features and mitigation measures that would be implemented to reduce effects. Two distinct evaluations are discussed in this section: accidents and malfunctions and transportation-related risks. The information presented in this section summarizes the results of the detailed technical assessment of accidents and malfunctions and transportation-related risks for the Project in Technical Support Document (TSD) VIII, Accidents and Malfunctions Report, and TSD IX, Transportation Risk Assessment Report.

An accident is defined as any unintended event, including operating errors, equipment failures, and other mishaps, the consequences, or potential consequences of which are significant from the point of view of protection or safety (REGDOC-3.6 [CNSC 2021a]). A malfunction is defined as a failure in the normal functioning of equipment, infrastructure, or systems that could result in potentially significant consequences. Transportation-related risks refer to motor vehicle incidents involving transport vehicles that may occur along the transportation route to or from a project, and the potential for the consequent release of contaminants to the environment or injury to humans or wildlife from collisions.

Accidents and malfunctions and transportation-related risks are events or conditions caused by industrial hazards that are not part of the normal activity or operation of a project as planned. Nonetheless, the risk of accidents and malfunctions and transportation-related risks can be reduced and mitigated through design, administrative controls, and adoption of safety measures. Since it is impossible to predict when, where, or how such events may occur, the accidents and malfunctions assessment considers a series of hypothetical, reasonable worst-case scenarios to evaluate whether the planned mitigations would be sufficient to reduce the risk to acceptable levels.

The assessment of accidents and malfunctions and transportation-related risks for the proposed Project followed a structured approach, which involved the following steps:

1. identifying potential hazard scenarios that could affect biophysical and human health valued components (VCs) and intermediate components (i.e., those defined in Section 6.3, Assessment Scoping);
2. identifying planned mitigation, including prevention measures that would reduce the probability of these hazards from occurring, and response measures that would reduce the consequence if they were to occur;

3. estimating the likelihood and severity of consequences from an accident, malfunction, or transportation-related event, considering control and response measures that would be implemented; and
4. estimating the residual risks and evaluating whether the risks are tolerable (i.e., as low as reasonably practicable [ALARP]).

The assessment of accidents and malfunctions applied a bounding approach that focused on key accidents or malfunctions that are equal to or exceed the potential severity of other possible scenarios that may occur in association with a given Project component or activity; these accident and malfunction scenarios are referred to as bounding scenarios. The purpose of applying a bounding approach in the evaluation of accidents and malfunctions was to maintain an appropriate level of conservatism in the assessment, while avoiding redundancies.

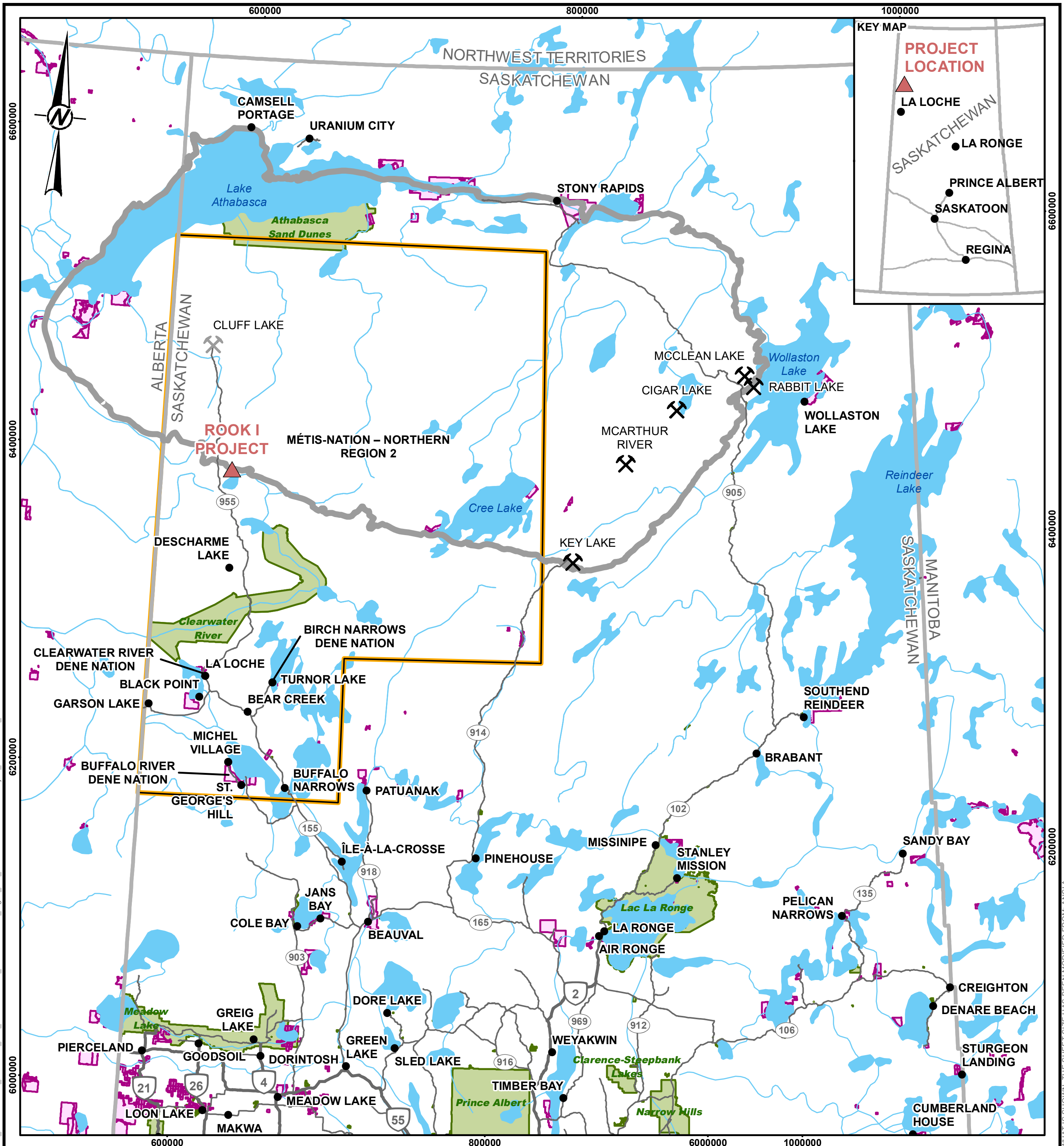
Similarly, the assessment of potential transportation-related risks focused on key scenarios that could result from transportation accidents occurring along the Project's transportation route. The transportation route for the Project is located to the south and southwest of the Project and consists of segments of provincial Highway 955 and Highway 155 (Figure 21.1-3). The Project's transportation route would be used for the transportation of fuel and other hazardous materials, equipment, and supplies to the Project, and for transporting uranium concentrate[1] from the Project.

The scope of the assessment of accidents and malfunctions and transportation-related risks focused on evaluating the potential effects of the identified scenarios on VCs and intermediate components. Potential occupational health and safety risks are not the focus of this assessment. Consistent with Canadian Standards Association (CSA) N288.6-22 (CSA Group 2022), potential risks to nuclear energy workers are addressed as part of the licence application, which includes the results of occupational hazard and exposure assessments and the Radiation Protection Program and Health and Safety Program. These risks, therefore, do not require assessment as part of the accidents and malfunctions and transportation risk assessments. Furthermore, as noted in Section 23, Summary of Mitigation, Monitoring, and Follow-Up Programs, NexGen has committed to implement an Indigenous and Public Engagement Program to share information on Project plans and activities, which would include reporting on worker safety.

The results of the assessment of accidents and malfunctions and transportation-related risks would be used to inform the measures required to effectively prepare for, respond to, and mitigate potential effects, which would be documented in the Emergency Preparedness and Response Program and Fire Protection Program.

This section complements Section 22, Assessment of Effects of the Environment on the Project. Effects of the environment on the Project are associated with risks of natural hazards (e.g., extreme weather events, wildfires, seismic events) on the Project.

[1] Uranium concentrate refers to triuranium octoxide [U_3O_8] that has been processed and is ready for shipment.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN BOUNDARY
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROJECT LOCATION
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

0 100 200

1:3,500,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LOCATION OF THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 21.1-1

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\21_Accidents_and_Malfunctions\8_5x11\20144150_Fig21_1-1_Location-of-the-RookI-Project_NoTitleblock_Rev0.mxd PRINTED ON: 2023-02-10 AT: 7:56:02 AM

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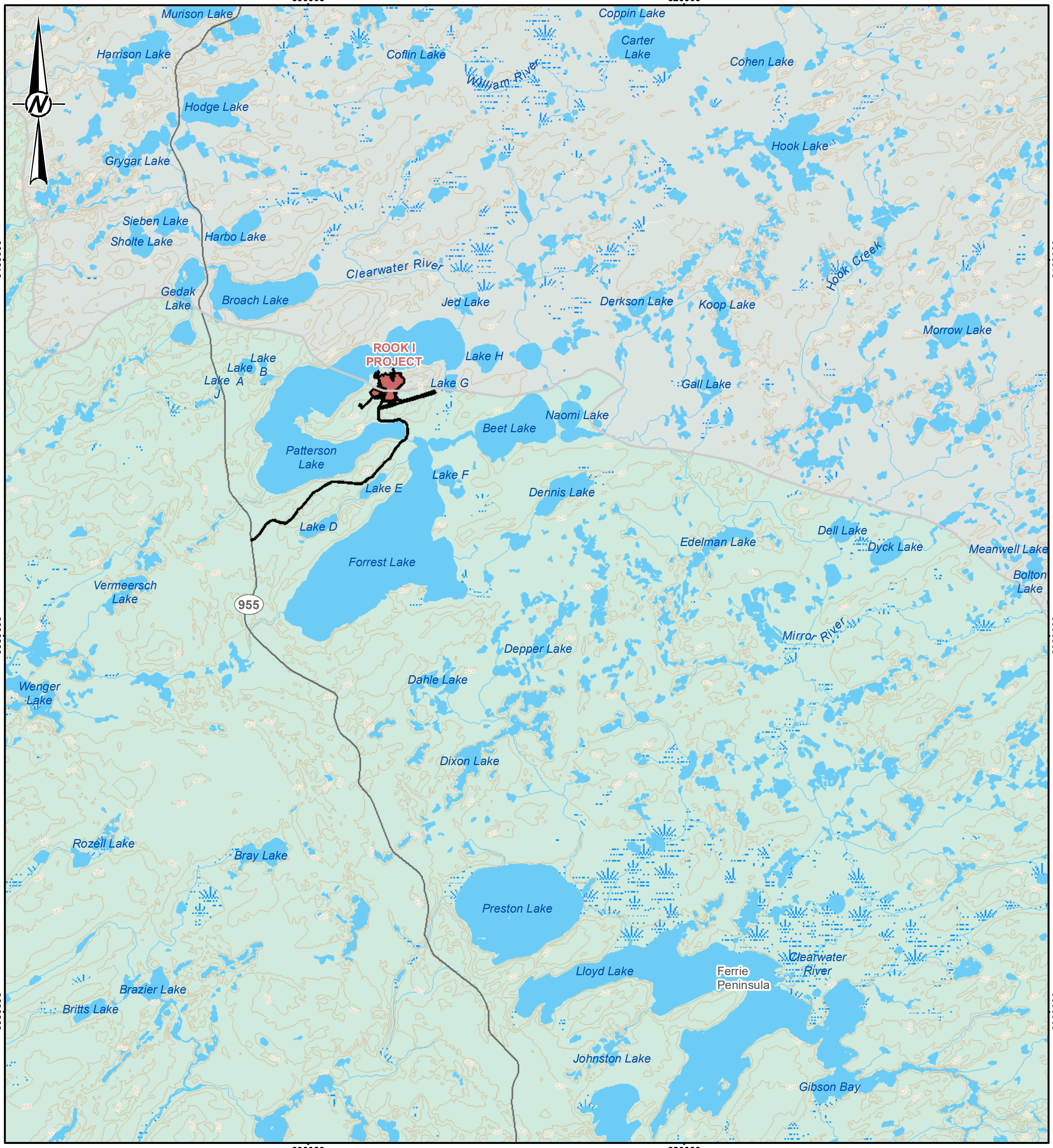

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN
- WATERBODY
- WETLAND
- WOODED AREA
- PROPOSED PROJECT FOOTPRINT

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT	PROJECT 20144150	SCALE AS SHOWN	REV. 0
wsp	**FIGURE 21.1-2**		

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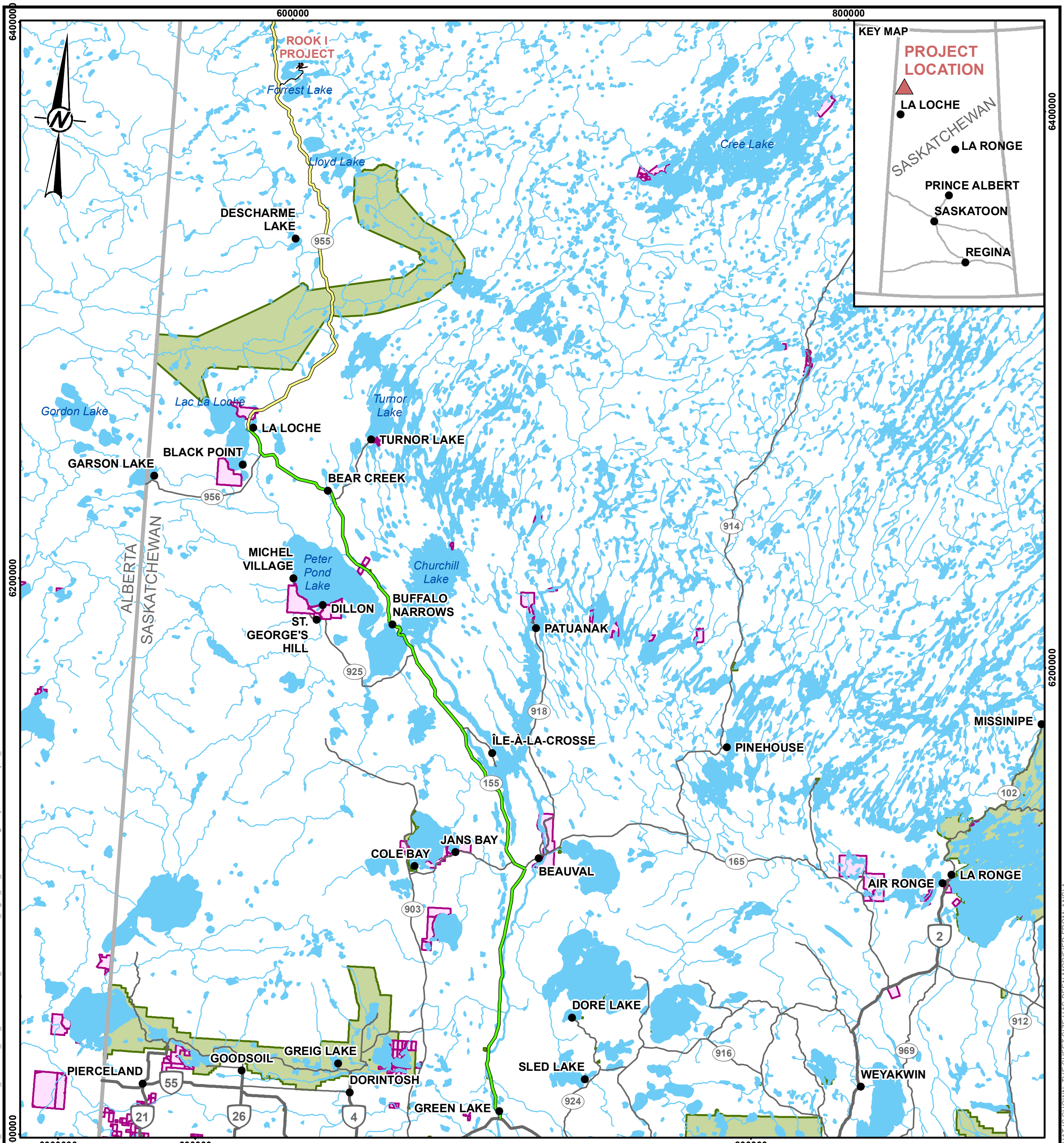

LEGEND

- POPULATED PLACE
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROPOSED PROJECT FOOTPRINT
- HIGHWAY 955
- HIGHWAY 155

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REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021 AND UPDATED JUNE 8, 2021 .
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3. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
PROVINCIAL HIGHWAYS IN RELATION TO THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT		20144150	PHASE 3314 - 6
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GIS	NO	2023-02-10	
CHECK	JMC	2023-02-10	FIGURE 21.1-3
REVIEW	MM	2023-02-10	

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25mm 0

21.2 Project Summary

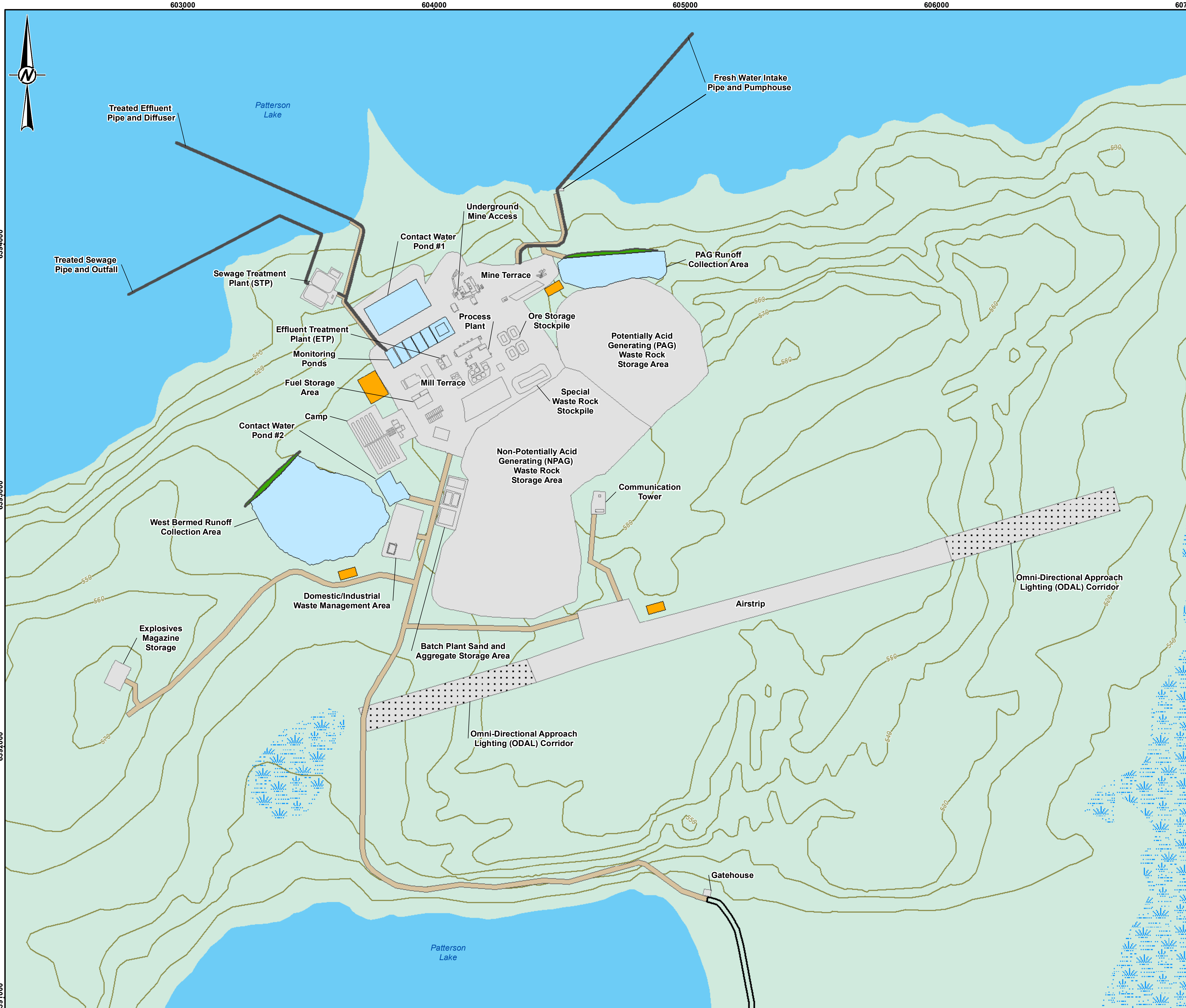
21.2.1 Key Support Facilities

The Project would include the following key facilities to support the extraction and processing of uranium from the Arrow deposit for transportation off site (Figure 21.2-1):

- underground mine development;
- process plant buildings, including uranium concentrate packaging facilities;
- paste tailings distribution system;
- underground tailings management facility (UGTMF);
- potentially acid generating (PAG) waste rock storage area (WRSA);
- non-potentially acid generating (NPAG) WRSA;
- special waste rock[2] and ore storage stockpiles;
- surface and underground water management infrastructure, including water management ponds, effluent treatment plant (ETP), and sewage treatment plant;
- conventional waste management facilities and fuel storage facilities;
- ancillary infrastructure, including maintenance shop, warehouse, administration building, and camp;
- airstrip and associated infrastructure; and
- access road to Project and site roads.

Project details referenced in this section are described in Section 5, Project Description, which includes additional engineering design and environmental considerations.

[2] Special waste rock is mine rock that is mineralized with insufficient grade to be considered ore (i.e., greater than 0.03% of triuranium octoxide [U_3O_8] and less than 0.26% U_3O_8). All special waste would be temporarily stored in the special waste rock stockpile.



LEGEND

- ELEVATION CONTOUR (10 m INTERVAL)
- WATERBODY
- WETLAND
- WOODED AREA
- INTAKE OR DISCHARGE PIPE
- ACCESS ROAD
- CONTACT WATER CONTAINMENT BERM
- OMNI-DIRECTIONAL APPROACH LIGHTING (ODAL) CORRIDOR
- PROJECT INFRASTRUCTURE
- SITE ROAD
- TOPSOIL STORAGE AREA
- WATER MANAGEMENT POND

0 0.5 1

1:15,500 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021 AND UPDATED JUNE 8, 2021 .
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LAYOUT OF INFRASTRUCTURE AND FACILITIES FOR THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 21.2-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

21.2.2 Transportation Route

For this assessment, the transportation route for the Project encompasses defined sections of Saskatchewan provincial Highway 955 and Highway 155 (Figure 21.1-3):

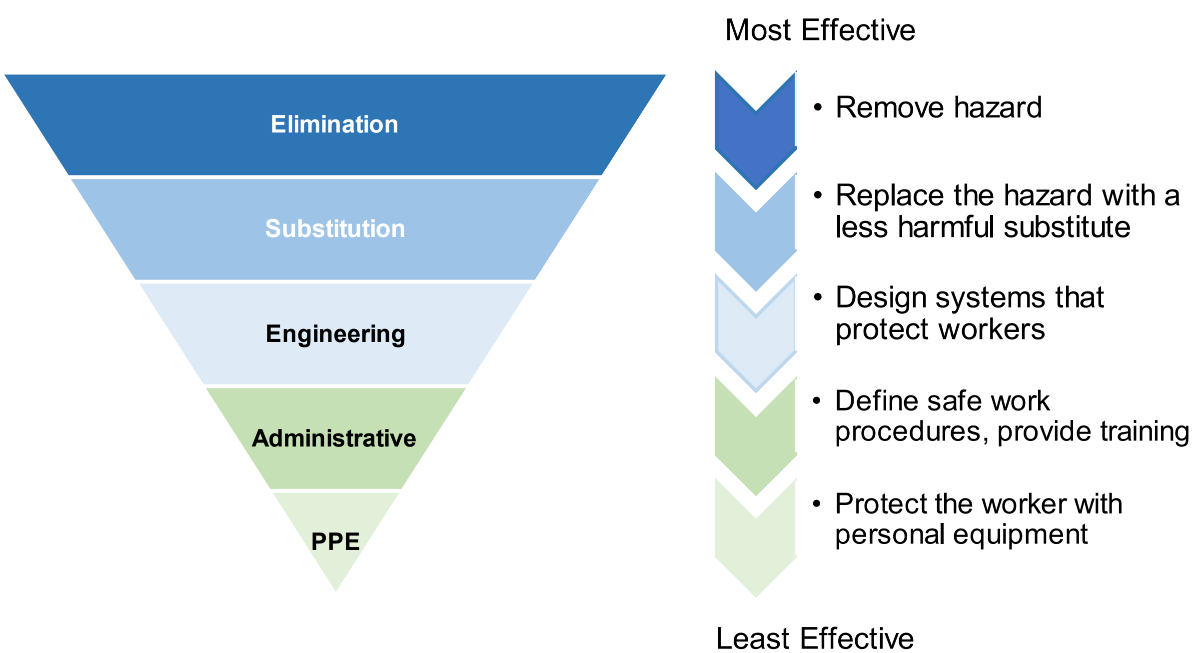
- The section of Highway 955 included in the transportation route spans from the intersection of the Project access road and Highway 955 to the intersection of Highway 955 and Highway 155 at La Loche.
- The section of Highway 155 included in the transportation route spans from the intersection of Highway 955 and Highway 155 to the intersection of Highway 155 and Highway 55 at Green Lake.

The transportation route is mainly located within the Boreal Plains Ecozone. It crosses or runs immediately adjacent to (i.e., within 30 m of) 33 waterbodies or watercourses, which range in size from small unnamed creeks to larger rivers and lakes. Communities located immediately adjacent to the transportation route include La Loche, Bear Creek, Buffalo Narrows, Beauval, and Green Lake.

21.2.3 Risk Management and Controls

NexGen's objectives for risk management are to reduce all health, safety, and environmental risks to acceptable levels and to keep radiological exposures to workers and the environment as low as reasonably achievable. Risks are assessed for likelihood and consequence and managed through the application of controls. Controls are implemented to mitigate hazards and the associated risks identified through risk assessment processes, and to lower the risks to acceptable levels. The controls applied are specific to the nature and commensurate with the level of the risk. Controls are documented, tracked, and routinely evaluated for effectiveness as outlined in the Integrated Management System Manual. When possible, a hierarchy of controls approach is followed when selecting controls to mitigate risk; NexGen prevents, eliminates, and reduces risks with multiple types and layers of controls (Figure 21.2-2).

Figure 21.2-2: Hierarchy of Controls



PPE = personal protective equipment.

The primary mitigation tools used to prevent or reduce the severity of potential adverse effects from accidents and malfunctions and transportation-related risks are sound engineering design and Project planning that incorporates current industry best practices and other preventative measures. Where potential adverse effects are identified, either from normal operating activities or from accidents, malfunctions, or transportation-related risks, feasible environmental design features and/or mitigation practices are implemented to avoid and minimize these effects. Applying mitigation follows the precautionary principle that "where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (*Canadian Environmental Protection Act, 1999*).

Adaptive management is a related process that may be initiated in response to identified risks. Adaptive management may be used to reduce the uncertainty associated with hazards or risks when systems are highly dynamic and when there are gaps in information or understanding, opportunities to learn and gain new information, and the ability to adjust activities or practices over time to realize improvements. Uncertainty is mitigated through the application of a rigorous and systematic approach to learning from experience, gaining knowledge, adapting planning, and improving confidence in an approach. Adaptive management employs sequential steps to:

1. assess and formulate the problem;
2. design and develop a solution to address the problem;
3. implement the solution;
4. monitor for outcomes and effects;
5. evaluate monitoring results against established criteria; and
6. adjust the approach with consideration for results.

In addition to the risk management objectives described above, NexGen has employed a failure modes and effects analysis (FMEA) process as an element of the overall risk management approach applied to the Project. An FMEA is a risk management process that examines possible events and mechanisms that can lead to a failure of a system, and thereby provides a basis to evaluate the risk of failure and the risk reduction that can be achieved by mitigating certain risks. A key feature of the FMEA process is that it can be used to identify uncertain or previously unforeseen risks before those risks manifest themselves. The process is generally held in a workshop setting that incorporates the input of specialists and experts involved in the Project planning process. Based on expert knowledge, case studies, and identification of plausible events, the causes of potential failures are discussed to evaluate the potential likelihood and consequence of adverse outcomes. Important outputs of the FMEA are the monitoring, controls, and responses that could be applied to reduce the risks. An FMEA is a screening exercise that can be supported by analytical work as necessary, rather than as a quantitative or standalone risk management tool.

The FMEA process employed by NexGen was used to support risk management and inform the engineering design for the Project. Workshops were held to investigate aspects of the Project design and to confirm or refine Project controls. These workshops complement the accidents and malfunctions assessment by informing the design as it progresses beyond the Environmental Impact Statement (EIS) stage.

21.3 Regulatory Context

The Environmental Assessment (EA) for the Project is being carried out under the C*anadian Environmental Assessment Act*, *2012* (CEAA 2012), as described in Section 1.3, Regulatory Framework. Section 19 (1)(a) of CEAA 2012 states that accidents and malfunctions shall be assessed in the EA. While there is no specific requirement under CEAA 2012 or the *Impact Assessment Act*, *2019* to provide a transportation risk assessment in the EA, an evaluation of transportation-related risks has been undertaken for the Project, consistent with the common practice for other assessments conducted by Canadian Nuclear Safety Commission (CNSC) under CEAA 2012.

This section meets the requirements of the CNSC *Generic Guidelines for the Preparation of an Environmental Impact Statement – Pursuant to the Canadian Environmental Assessment Act, 2012* (CNSC 2021b), REGDOC-2.9.1 Environmental Protection: Environmental Principles, Assessments and Protection Measures (CNSC 2020), and the Terms of Reference (NexGen 2019a) for the Project submitted to the Saskatchewan Ministry of Environment. The CNSC generic guidelines for the preparation of an EIS (CNSC 2021b) stipulate that the information in Appendix A.3.4 of REGDOC-2.9.1 (CNSC 2020) be used to assess the health and environmental effects from potential accident and malfunction scenarios. As per REGDOC-2.9.1 (CNSC 2020), the proponent is required to provide an assessment of the potential health and environmental effects that may occur as a result of radiological and conventional accidents and malfunctions. The EIS must also include mitigation such as monitoring, contingency, cleanup, or remediation work in the surrounding environment that would be required during or immediately following the postulated accident and malfunction scenarios (CNSC 2020). As per the Concordance Table for the Terms of Reference (Appendix 1A, Table 1A-2), the EIS must present a description of potential accidents and malfunction scenarios associated with the Project, the conditions under which they could occur and the potential effects of such scenarios on the environment. The level of risk associated with the identified scenarios must be evaluated with mitigation measures and/or contingency plans developed, where required, to minimize the risk associated with such scenarios.

In Canada, the primary legislation governing the transportation of dangerous goods, including Class 7 radioactive materials, is the Transportation of Dangerous Goods Regulations (SOR/2001-286), consolidated to include amendment SOR/2019-101 (Emergency Response Assistance Plan). Additionally, the CNSC (2015) issues licences and certificates for certain types of packaging and transport of nuclear substances as stipulated in the Packaging and Transport of Nuclear Substances Regulations, 2015. The primary Project activities that would be subject to these regulations include the transportation of dangerous goods to and from the Project and the shipment of radioactive materials from the Project.

21.4 Incorporation of Indigenous and Local Knowledge

Indigenous and Local Knowledge related to accidents and malfunctions and transportation-related risks was shared by potentially affected First Nations and Métis Groups (collectively referred to as Indigenous Groups) and local priority area (LPA)[3] community members through the Project engagement process. The overall approach and methods for the incorporation of Indigenous and Local Knowledge into the EA is discussed in detail in Section 3, Indigenous and Local Knowledge. Issues and concerns related to accidents and malfunctions and transportation-related risks raised by Indigenous Groups and LPA community members, and how these comments were addressed, are summarized in Appendix 2B, Summary of Issues and Concerns Identified by Indigenous Groups, and identified and addressed in this assessment, where applicable.

A key source of Indigenous and Local Knowledge is the Project-specific studies completed by Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, and Indigenous Rights and Knowledge studies (henceforth referred collectively as Indigenous Knowledge and Traditional Land Use Studies). The Indigenous Knowledge and Traditional Land Use Studies that were reviewed and referenced in the EIS as technical support documents (TSDs) are listed below:

- TSD II (BNDN), Birch Narrows Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;
- TSD III (BRDN), Buffalo River Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;
- TSD IV (MN-S), Métis Nation – Saskatchewan Northern Region 2 Traditional Land Use & Diet Study for the NexGen Rook I Project;
- TSD V.1 (CRDN), Preliminary Identification of Issues and Concerns Related to the Proposed NexGen Energy Ltd. Rook I Project in the Patterson Lake Area; A Review; Clearwater River Dene Nation; Traditional Land Use and Occupancy Mapping Interviews; 2010 – 2016;
- TSD V.2 (CRDN), 2021. Clearwater River Dene Nation Indigenous Rights and Knowledge Survey Related to the Proposed NexGen Energy Ltd. Rook 1 Project in the Patterson Lake Area;
- TSD V.3 (CRDN), Socio-economic and Harvest Study; Clearwater River Dene Nation; NexGen Rook 1 Project; and
- TSD VI (YNLR), Provision of Athabasca Denesųłiné Traditional Knowledge, Land Use and Occupancy Information for the NexGen Rook I Project Environmental Assessment.

Another key source of Indigenous and Local Knowledge was information shared by Indigenous Group representatives during Joint Working Group (JWG) meetings. The JWGs represent an agreed-upon primary engagement mechanism as outlined in the Study Agreements signed by each Indigenous Group and NexGen. More details regarding the JWGs can be found in Section 2, Indigenous, Regulatory, and Public Engagement, and Section 3, Indigenous and Local Knowledge. There are four JWGs with the Project's primary Indigenous Groups (Section 2.4.1, Identification of Indigenous Groups for Engagement):

- Clearwater River Dene Nation (CRDN) JWG;
- Métis Nation – Saskatchewan (MN-S) JWG representing MN-S Northern Region 2;

[3] The LPA consists of the local communities closest to the Project that would experience most of the Project effects and for which NexGen would prioritize local training, employment, and business opportunities for the Project. These communities are located along, or accessed via, Highways 155 and 955 north of the intersection of Highways 155 and 925.

- Birch Narrows Dene Nation (BNDN) JWG; and
- Buffalo River Dene Nation (BRDN) JWG.

The leadership of each Indigenous Group selected their JWG participants with consideration of group diversity; where possible, members included Elders, youth, different genders, a range of ages, and land users around Patterson Lake.

In addition to the Indigenous Knowledge and Traditional Land Use Studies and JWGs, Indigenous and Local Knowledge shared during specific engagement activities undertaken through the EA development process was incorporated into the assessment, where appropriate. These engagement activities included, but were not limited to:

- community information sessions held in four locations in 2019 (NexGen 2019b);
- site tours;
- comments from the CRDN (2019a) on the Cluff Lake Mine licence renewal;
- other formal and informal meetings;
- workshops with specific groups (e.g., Fur Block N-19 trapper's workshop); and
- environmental and socio-economic baseline data collection.

Comments submitted by Indigenous Groups on the Project Description (CRDN 2019b; MN-S 2019; YNLRO 2019; ACFN 2019; CNSC 2019) were also reviewed for applicable Indigenous and Local Knowledge.

Indigenous and Local Knowledge related to accidents and malfunctions was incorporated into the assessment by viewing the information as complementary and influential alongside scientific information. Where possible, knowledge from each potentially affected Indigenous Group or LPA community member was described separately and cited accordingly. Where information is described for multiple potentially affected Indigenous Groups they are collectively referred to as "Indigenous Groups" throughout the assessment.

Indigenous and Local Knowledge related to accidents and malfunctions is described below. Indigenous Groups have noted the inter-relationships between different biophysical components of the environment, and the vital role that air and water quality plays in contributing to a healthy aquatic and terrestrial environment, as well as to food safety and human health (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR).

> Most important thing because we drink that water and the fish lives on water. Creatures, they drink the water . . . . moose, caribou, everything, you know. That's the most important thing . . . we drink a lot of water ourselves, you know. (TSD II: BNDN)

> It just ties back to everything. I think of all the plants that we use for medicinal purposes. You know, like all the trees and stuff like that. And then the other animals that come to that lake [Patterson] to drink. And those are the animals we hunt and we eat. You know what I mean? Like that's a big area where people go moose hunting and everything in the fall time. I think that should be something that they [regulators and the Crown] have to consider. (TSD V.2: CRDN)

For example, the CRDN described how medicinal properties of plants are related to the quality of the grounds in which they grow, and that medicinal plants are not gathered from areas that have been disturbed (TSD V.1: CRDN; TSD V.2: CRDN). The CRDN noted that they assess the quality of soil, in addition to air and water, based on their close observations of vegetation quality (TSD V.2: CRDN). When fishing, the CRDN conduct an initial assessment of the health of the catch (e.g., size, number, anomalies, sores, internal organs) and waters (e.g., examination of stomach contents; TSD V.2: CRDN).

Indigenous Groups have emphasized the importance of having access to a healthy land base and high-quality, abundant resources for harvesting activities (TSD II: BNDN; TSD III: BRDN; TSD V.2: CRDN). For example, members of the MN-S, BNDN, and BRDN commented that "clean fresh air" is one of the things they appreciate the most about where they live and is important for community well being (BNDN-JWG 2020; BRDN-JWG 2020a; MN-S-JWG 2020a). The CRDN stated that "unclean air and water conditions from a Denesųłiné perspective ultimately and fundamentally affect all forms of life" and "clean water is therefore inextricably connected to CRDN livelihoods, practices, customs, and spirituality" (TSD V.2: CRDN). Members of the MN-S highlighted the importance of respecting the air and keeping it clean for human health, and for future generations (MN-S-JWG 2019a). Ya'thi Néné Lands and Resources commented on the importance of water to the community, noting, "I want this for the future generations. Water should be monitored, it should be kept clean, water is sacred for us" (TSD VI: YNLR). The BNDN noted that "water is the most important thing, vital to life" (BNDN-JWG 2019). The LPA community members also frequently noted that air and water quality, including the protection of water, were key interests and concerns and important VCs of the environment (NexGen 2019b).

Indigenous Groups and LPA community members also provided comments and expressed concerns about potential effects of Project-related accidents and malfunctions on air and water quality, aquatic and terrestrial health, and human health. Indigenous and Local Knowledge was shared based on past experiences and observations from the Cluff Lake Mine and the effects of contamination and radiation in general, as well as the potential effects of accidents and malfunctions to aquatic and terrestrial environmental health, and associated effects on the safety of wild foods and human health.

Specific references to Indigenous and Local Knowledge, and Project comments and concerns raised by Indigenous Groups and LPA community members, are included in the applicable subsections of this assessment.

21.5 Risk Assessment Approach

The assessment of accidents and malfunctions and transportation-related risks employed a risk assessment approach to characterize the potential effects on the environment and public safety. Residual effects for accidents and malfunctions and transportation-related events are defined in terms of risk, which can be characterized based on the likelihood of the postulated event and the effect or severity of the potential effects on the environment and public. The general approach for the assessment of accidents and malfunctions and transportation-related risks included the following steps: hazard identification; environmental design feature and mitigation evaluation; risk measurement, as a function of likelihood and consequence; and risk evaluation. These steps are discussed in detail in the subsections that follow (Section 21.5.1, Hazard Identification, through Section 21.5.4, Risk Evaluation).

The approach used to assess effects from potential accidents, malfunctions, and transportation-related risks differs from that used in effects assessments completed for biophysical, cultural, and socio-economic VCs. Those assessments present predictions that consider the effects from normal operating conditions and/or activities over the lifespan of the proposed Project. In contrast, the effects assessments for accidents and malfunctions and transportation-related risks present hypothetical outcomes for hazard scenarios that are not part of the normal activity or operation of a project as planned (CNSC 2020). Therefore, the potential effects on the environment and public safety from accidents and malfunctions and transportation-related events are an estimate of the residual risk to VCs and intermediate components.

The overall risk analysis framework (i.e., hazard identification, environmental design feature and mitigation evaluation, risk measurement, risk evaluation) applied in the accidents and malfunctions and transportation risk assessments is the same; however, the approach taken to assess each type of risk differed in certain elements of the methodology and scope. An overview of the approach taken for each assessment is provided below, with the details presented in the subsections that follow.

Accidents and Malfunctions

An overview of the risk analysis approach for the accidents and malfunctions assessment is provided in Figure 21.5-1. The assessment involved initially identifying a comprehensive list of hazard scenarios that represent physical situations with the potential to harm human health or the biophysical environment. This initial list was then screened qualitatively for the likelihood and consequence as well as the overall risk level using a risk matrix approach. Bounding scenarios were then selected from this initial list of hazard scenarios. Bounding scenarios represent an event for which the potential effects are considered to represent those associated with similar accident and malfunction scenarios; or, alternatively, the potential effects of scenarios that are bounded by another scenario are expected to fit within the scope of those associated with the bounding scenario. Utilizing the bounding scenario approach makes it possible to avoid duplication in the assessment process while certifying the evaluation is completed in a conservative manner. The subsequent analysis focused on evaluating the hypothetical effects associated with each bounding scenario. A revised risk evaluation that considered the results of the detailed assessment was then completed for each bounding scenario.

The scope of the accidents and malfunctions assessment included consideration of all Project phases (i.e., Construction, Operations, and Closure, as defined in Section 6.4.2, Temporal Boundaries) and the geographical extent of the Project footprint and associated access road to its junction with Highway 955. This area was included because it comprises the maximum physical extent of Project activities and components, and thus encompasses all potential Project-related sources of hazards and initiating events. An exception is the potential for transportation-related risks that could occur off site and along the Project's transportation route beyond the junction with Highway 955; these events were evaluated in the transportation risk assessment described below. While the scope of the hazard scenario identification process for accidents and malfunctions was limited to the Project footprint and associated access road, the potential effects may extend beyond this boundary, such as downstream of the Project in the case of a spill to a watercourse.

Section 21.5.1 through Section 21.5.5, Assessment of Bounding Scenarios for Accidents and Malfunctions, summarize the steps taken to conduct the initial identification of hazard scenarios, select bounding scenarios that are the focus of the detailed assessment for accidents and malfunctions, and estimate the overall risk level associated with each scenario; details such as calculations and input values are provided in TSD VIII and in TSD VIII, Appendix A, Hazard Identification for the Accidents and Malfunctions Assessment.

Transportation-Related Risks

An overview of the risk analysis approach used for the transportation assessment is provided in Figure 21.5-2. The assessment of transportation risks focused on selected traffic accident scenarios that could occur in association with the Project’s transportation route. The key difference in approach for the transportation assessment compared to the accidents and malfunctions assessment is that there was no initial hazard screening undertaken that informed the selection of transportation hazard scenarios. Rather, transportation hazard scenarios were selected based on an understanding of the Project’s hazardous materials transportation requirements (e.g., substances, quantities, transportation frequencies), characteristics of the associated transportation route, feedback from engagement, experience with similar projects, and professional judgment. Transportation hazard scenarios were carried through a similar risk analysis process as followed for accidents and malfunctions (Figure 21.5-2).

The scope of the transportation risk assessment included consideration of all Project phases and the geographical extent of the Project’s transportation route described in Section 21.2.2, Transportation Route. The geographical extent of the assessment was informed by evaluation of the existing traffic volumes, identification of incremental increases in traffic associated with the proposed Project and understanding of transportation emergency response times.

Section 21.5.1, Hazard Identification through Section 21.5.4, Risk Evaluation and Section 21.5.6, Assessment of Transportation-Related Hazard Scenarios, summarize the steps taken to select transportation hazard scenarios that are the focus of detailed assessment and estimate the overall risk level associated with each scenario; details are provided in TSD IX.

Figure 21.5-1: Overview of the Risk Analysis Approach Applied in the Accidents and Malfunctions Assessment

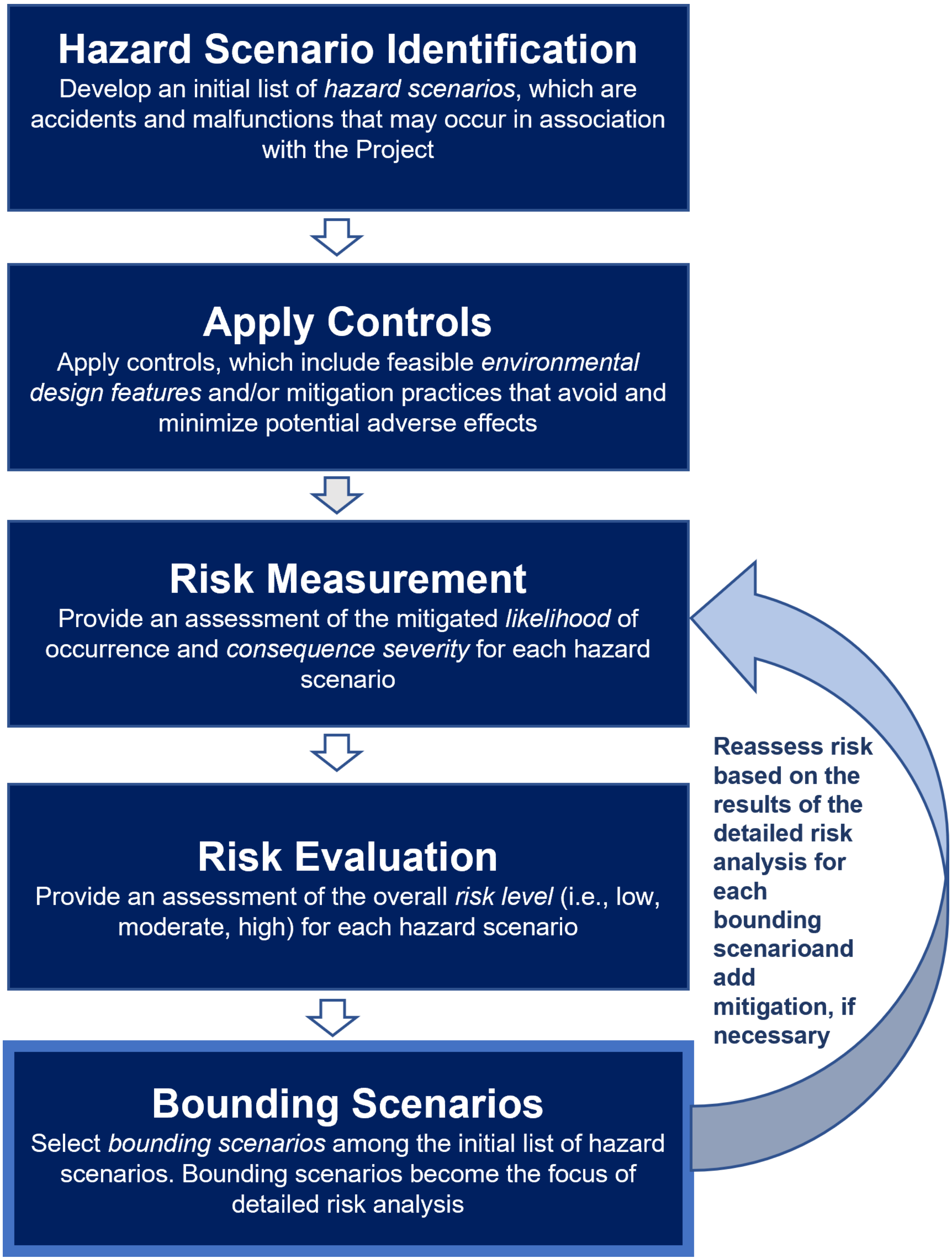


Figure 21.5-2: Overview of the Risk Analysis Approach Applied in the Transportation Risk Assessment

Identification of Transportation-Related Hazard Scenarios

↓

Apply Controls

Apply controls, which include feasible *environmental design features* and/or mitigation practices that avoid and minimize potential adverse effects

↓

Risk Measurement

Provide an assessment of the mitigated *likelihood* of occurrence and *consequence severity* for each transportation scenario

↓

Risk Evaluation

Provide an assessment of the overall *risk level* (i.e., low, moderate, high) for each transportation scenario

21.5.1 Hazard Identification

Accidents and Malfunctions

The assessment of accidents and malfunctions began with the initial identification of hazard scenarios. Hazard scenarios were identified using a systematic approach that considered the existence of sources of hazards and initiating events for the Project. The scenarios were identified for several potential events, such as releases of chemical and radiological constituents, fires, and explosions. This initial screening was based on information related to the Project description (Section 5); experience with similar projects, particularly those located in northern Saskatchewan; and professional judgment.

Based on a review of Project-related information, the following key Project components and activities were identified that form the basis of consideration for the identification of potential hazard scenarios:

- site preparation;
- shaft sinking;
- access road and land transportation;
- airstrip;
- mining;
- hoisting;
- mine dewatering system;
- process plant buildings;
- solvent extraction circuit;
- UGTMF and mining stopes;
- NPAG WRSA;
- special waste rock, ore stockpiles, and PAG WRSA;
- ETP;
- site runoff ponds and retention berms;
- gypsum precipitation, washing, and storage;
- acid plant;
- electrical system and power plant;
- fire protection system;
- low-level radioactive waste management system/incinerator;
- liquified natural gas (LNG) power plant; and
- mine ventilation system.

Further details for how each of these Project components and activities were considered in the initial hazard scenario identification are provided in TSD VIII, Appendix A, Hazard Identification for the Accidents and Malfunctions Assessment.

The storage and transportation of explosives and detonators was not included in the list of Project components and activities used for this evaluation. The transport, storage, and use of explosives and detonators are heavily regulated to minimize risks. Use and handling of explosives for the Project would be managed as per the *Explosives Act*, as well as the following standards:

- CAN/BNQ 2910-500/2015 Explosives – Magazines for Industrial Explosives (SCC 2015a); and
- CAN/BNQ 2910-510/2015 Explosives – Quantity Distances (SCC 2015b).

Additionally, in accordance with The Mines Regulations, 2018, the location of the explosive or detonator facility would be a minimum of 60 m from any work area, fire hazard, or other vulnerable area, and would not be located on any main travel way (e.g., access ramp). Risks for transport, storage, and use of explosives would always be considered ALARP given the regulatory framework and the controls required (e.g., explosives management planning); therefore, these risks were not evaluated in the hazard assessment. For this reason, further assessment of potential effects to the environment, human health, and worker safety is not required.

As outlined in Section 21.1, Introduction, the scope of the accidents and malfunctions assessment is focused on evaluating potential effects on the environment and public safety; occupational health risks are not the focus of this assessment. However, an exception was that the scope of the initial identification of hazard scenarios included consideration of potential occupational health risks in addition to environmental and public safety risks.

Transportation-Related Risks

The process taken to identify transportation hazard scenarios considered the potential for the release of chemical and radiological constituents to the aquatic, terrestrial, and atmospheric environments. These scenarios may also involve fire, which may result in emissions of toxic chemicals associated with smoke. In addition to the potential hazardous materials releases, the hazard scenario identification considered the potential for physical interaction with pedestrians and wildlife. Transportation hazard scenarios were selected based on an understanding of the Project's hazardous materials transportation requirements (e.g., substances, quantities, transportation frequencies), characteristics of the associated transportation route, feedback from engagement, experience with similar projects, and professional judgment.

21.5.2 Application of Environmental Design Features and Mitigation

Where potential adverse effects on the environment or public safety were identified from a potential accident and malfunction or transportation scenario, controls were implemented to address the hazards and associated effects. Controls included feasible environmental design features and/or mitigation practices that have been implemented to avoid and minimize potential adverse effects. NexGen's hierarchy of controls was applied in the hazard identification process to prevent, eliminate, and reduce hazards and mitigate the risks associated with the identified hazard scenarios (Figure 21.2-2). This hierarchy was applied to the Project design through the integration of engineering solutions that eliminated or substituted the hazard first before considering the application of other potential controls. Mitigation actions were identified for each hazard scenario and included prevention measures that would minimize the probability of the scenarios occurring, as well as control measures to mitigate the severity from an accident or malfunction or transportation scenario.

21.5.3 Risk Measurement

After identifying hazard scenarios and considering the implementation of environmental design features and/or mitigation practices, a risk measurement process was undertaken to characterize the risk associated with each scenario as a function of the likelihood and consequence. The likelihood refers to how often a hazard scenario might occur (Table 21.5-1). On a scale of increasing likelihood, hazard scenarios were categorized as highly unlikely, unlikely, likely, very likely, or almost certain (Table 21.5-1). Consequence refers to the overall magnitude or severity of the potential environmental or public health effects that may occur. The consequence index ranges from negligible to catastrophic (Table 21.5-2). Consequence includes the consideration of design-based mitigation, proposed management plans, and response plans.

The likelihood and consequence definitions and ratings used in this assessment were estimated based on industry and operational experience, including extensive experience with uranium mining and milling developments in northern Saskatchewan, Project-specific conditions, and the knowledge base of the Project team and risk assessment team. Additionally, the ratings applied in this assessment are generally consistent with those used in other accidents and malfunctions and transportation risk assessments submitted to regulatory agencies in Canada.

Table 21.5-1: Likelihood Index

Index	5 Almost Certain	4 Very Likely	3 Likely	2 Unlikely	1 Highly Unlikely
Events per year	>1 occurrence in 1 year	≤1 occurrence in 1 year and >1 occurrence in 10 years	≤1 occurrence in 10 years and >1 occurrence in 100 years	≤1 occurrence in 100 years and >1 occurrence in 1,000 years	≤1 occurrence in 1,000 years

> = greater than; ≤ = less than or equal to.

Table 21.5-2: Consequence Index

1 Negligible	2 Minor	3 Moderate	4 Major	5 Catastrophic
No measurable environmental effects, or medical treatment not required	Short-Term (i.e., <1 month in duration) on small area, or minor first aid injuries with no lost time	Reversible (i.e., <1 year in duration) or repairable effect off site, or reversible injuries with lost time	Long-Term (i.e., between 1 and 10 years in duration) extended-range effect off site, or severe injuries with long-lasting effects and/or disability	Long-Lasting (i.e., >10 years) or irreversible environmental effects, multiple disabilities, or fatalities

> = greater than; < = less than.

21.5.4 Risk Evaluation

The resulting risk levels associated with each hazard scenario were defined according to the Hazard Analysis Risk Matrix shown in Table 21.5-3. For this assessment, risks were identified as being low (green), moderate (yellow), or high (red). A qualitative description of each risk level is provided in Table 21.5-4. These risk levels were used to prioritize hazard scenarios for risk management and to facilitate implementation of the most effective risk mitigation options. After classifying each hazard scenario according to the risk matrix shown in Table 21.5-3, actions were assigned to each risk level (i.e., low, moderate, high) that define the circumstances under which further detailed assessment, including the identification of additional management activities, would be considered.

Table 21.5-3: Hazard Analysis Risk Matrix

Index		Consequence				
		1 Negligible	2 Minor	3 Moderate	4 Major	5 Catastrophic
Likelihood	**5 Almost certain**	Low	Moderate	Moderate	High	High
	4 Very likely	Low	Low	Moderate	High	High
	3 Likely	Low	Low	Moderate	Moderate	High
	2 Unlikely	Low	Low	Low	Moderate	High
	1 Highly unlikely	Low	Low	Low	Moderate	Moderate

Table 21.5-4: Description of Risk Priority Levels and Associated Actions

Risk Level		Description and Associated Actions
	High	High-risk scenarios have major to catastrophic consequence with the likelihood ranging from unlikely to almost certain. As the evaluation of the risk at this hazard identification stage was qualitative and subject to some uncertainty, the hazard scenarios identified as high risk were advanced for further detailed assessment so that a more detailed evaluation of risk and potential management activities could be considered.
	Moderate	Moderate-risk scenarios have minor to catastrophic consequence with the likelihood ranging from highly unlikely to almost certain. In many cases, risk-reduction activities would reduce the risk associated with these scenarios to ALARP. Under this condition, the risk may be characterized as tolerable.
	Low	Low-risk scenarios have negligible to moderate consequence with likelihood ranging from highly unlikely to almost certain. The likelihood of these scenarios can be effectively managed through application of planned controls, and/or the severity would be low in magnitude.

ALARP = as low as reasonably practicable.

21.5.5 Assessment of Bounding Scenarios for Accidents and Malfunctions

Based on the results of the initial screening process undertaken to identify hazard scenarios (Section 21.5, Figure 21.5-1, and TSD VIII, Appendix A), a subset of the identified scenarios was selected as the focus of the detailed risk analysis. These hazard scenarios represented the bounding scenarios considered in the accidents and malfunctions assessment. The assessment undertaken for each of the identified bounding scenarios consisted of a general description of the hypothetical event, characterization of the resulting release (e.g., contaminants, quantities), an assessment of probability (i.e., frequency of occurrence), and a description of the resulting potential effects on biophysical and human health VCs.

Based on the results of the detailed risk analysis for each bounding scenario, a revised risk evaluation that considered the results of the detailed assessment was then completed for each bounding scenario. This iterative process is illustrated schematically as the iterative loop in Figure 21.5-1. The estimation of risk defined in TSD VIII, Appendix A, was considered preliminary for the selected bounding scenarios as it was completed at the screening level using qualitative methods. The detailed assessment of each of the selected bounding scenarios resulted in a more in-depth, quantitative, and representative characterization of the risk associated with each scenario. Based on the detailed analysis, a revised risk rating is provided for each of the selected bounding scenarios per the risk measurement and evaluation matrices shown in Section 21.5.3, Risk Measurement, and Section 21.5.4.

21.5.6 Assessment of Transportation-Related Hazard Scenarios

The assessment undertaken for each of the identified transportation hazard scenarios was similar to that completed for bounding scenarios in the accidents and malfunctions assessment and consisted of a general description of the hypothetical event, characterization of the resulting release, assessment of probability, and a description of the resulting potential effects on biophysical and human health VCs and intermediate components. The overall risk level associated with each transportation hazard scenario is also provided following the same risk evaluation.

21.6 Assessment of Accidents and Malfunctions

21.6.1 Summary of Hazard Scenario Identification Results

Based on the screening process described Section 21.5.1, 93 hazard scenarios were identified and evaluated in the hazard identification analysis. A summary of the results of the initial hazard scenario identification process is provided in Table 21.6-1. The full list of hazard scenarios is presented in TSD VIII, Appendix A, which describes each scenario, the associated mitigation actions, and the outcome of the initial risk measurement and evaluation process. A summary of issues and concerns expressed by Indigenous Groups and LPA community members related to accidents and malfunctions is described below.

Indigenous Groups have expressed concerns about Project-related effects on air and water quality (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; BNDN-JWG 2019; BNDN-JWG 2021a; BRDN-JWG 2019a; BRDN-JWG 2020a; CRDN-JWG 2021; MN-S-JWG 2019b). Indigenous Groups commented on the potential for Project-related contaminants to enter the food chain within the Clearwater River watershed through effects on water quality in Patterson Lake, and associated effects on aquatic and terrestrial health, and in turn, the safety of wild foods, fresh water, and human health (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; BRDN-JWG 2019b; BRDN-JWG 2020a; BRDN-JWG 2021a; CRDN-JWG 2020a; CRDN-JWG 2021; MN-S-JWG 2019b). Trappers and community members from LPA communities also commented on the potential Project effects on water quality, fish, and wildlife in the area of the Project (NexGen 2019b).

A member of the CRDN commented on the increased risk of an operating uranium mine and process plant to contaminate surface and underground waters, including the Clearwater River watershed, from "radioactive stuff, heavy metals, and other toxic elements through industrial process water use and release, accidents, malfunctions, and other unplanned events" (TSD V.2: CRDN).

Specific concerns were raised about radiation from Project activities affecting aquatic, terrestrial, and human health, which are based, in part, on the experiences of Indigenous Groups with previous mining developments (i.e., the Cluff Lake Mine; TSD II: BNDN; TSD: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; CRDN 2019a; CRDN 2019b; BNDN-JWG 2019; BNDN-JWG 2020; BRDN-JWG 2019b; BRDN-JWG 2020a; CRDN-JWG 2020b; CRDN-JWG 2021; MN-S-JWG 2019a; MN-S-JWG 2019b; NexGen 2019b). For example, some members of the CRDN and BRDN have commented that they avoid harvesting in the Cluff Lake Mine area because of concerns about the health and safety of wildlife (TSD V.2: CRDN; BRDN-JWG 2021b; CRDN-JWG 2020a; CRDN-JWG 2020b; CRDN-JWG 2021).

Indigenous Groups expressed concerns about the human health risks from exposure to uranium in dust, air, water, wildlife, and vegetation (TSD II: BNDN; TSD IV: MN-S; TSD V.2: CRDN; MN-S-JWG 2019b). Specific concerns were raised about the safety of transport trucks on the road and the potential for accidents (e.g., roll over and catching on fire) and radioactive material or uranium affecting air, water, and sediment quality, with subsequent effects on plants and animals (TSD III: BRDN; TSD V.2: CRDN; BNDN-JWG 2019a; BRDN-JWG 2020b; NexGen 2019b). These concerns are based, in part, on previous observations of Indigenous Groups and LPA communities with spills associated with the Cluff Lake Mine, and the belief that these spills were not handled appropriately. The MN-S commented about traffic safety in the event of a haul truck spill (MN-S-JWG 2019a). Several concerns were raised about the procedures for spill containment, cleanup, and emergency response (BNDN-JWG 2020; BRDN-JWG 2021b; CRDN-JWG 2020c), and how spills would be communicated to communities (MN-S-JWG 2020b). Additional concerns were also expressed by the CRDN about chemical spills on the land and the shores of Patterson and Forrest lakes and how they would be handled (TSD V.2: CRDN).

Indigenous Groups raised concerns related to the general effects of mine waste and tailings, effects on surface and underground water quality, and risks to environmental and human health (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; BNDN-JWG 2019b; BNDN-JWG 2020; BNDN-JWG 2021b; BRDN-JWG 2021a; CRDN-JWG 2020c; CRDN-JWG 2020a; CRDN-JWG 2021; MN-S-JWG 2019a; NexGen 2019b). The MN-S raised specific concerns about the environmental and health risks of tailings and highlighted the importance of properly managing and containing tailings (TSD IV: MN-S).

NexGen understands the concerns raised by Indigenous Groups and LPA communities and has implemented controls to address the hazards and associated effects, including feasible environmental design features and/or mitigation practices that have been implemented to avoid and minimize potential adverse effects of accidents and malfunctions. The following bounding scenarios align with concerns expressed by Indigenous Groups and form the basis for mitigations to minimize such potential effects.

21.6.2 Selection of Bounding Scenarios

The results of the initial hazard scenario identification process (Section 21.6.1, Summary of Hazard Scenario Identification Results; TSD VIII, Appendix A) were reviewed to select bounding scenarios, which were subject to detailed risk analysis. A summary outlining the process by which the bounding scenarios were selected is provided below and in Figure 21.6-1, and a list of initial scenarios is provided in Table 21.6-1.

Of the 93 hazard scenarios identified, nine were characterized as high risk based on the results of the screening-level risk evaluation. Three of these were identified as requiring further detailed assessment for quantitative characterization of the associated risk:

- traffic accident (uranium concentrate and radioactivity);
- traffic accident (chemical); and
- solvent extraction fire or explosion.

Each of these three scenarios is associated with a release of contaminants to the environment, and the potential effects may be more far-reaching than can be adequately assessed by the screening assessment. Therefore, these three scenarios were selected as bounding scenarios in the additional, more quantitative evaluation.

Table 21.6-1: Summary of Hazard Scenario Identification Results

Project Component or Activity	Number of Hazard Scenarios	Accident or Malfunction
Site preparation	9	Fall/slip, vehicle and construction equipment accident, vehicle accident, fuel storage failure, refuelling accident, fuel storage, transfer fire, and explosion
Shaft sinking	4	Shaft wall failure, groundwater ingress, and surface flood
Access road and land transportation	8	Vehicle accident (including rollover, collision, and run off road), vehicle fire, and vehicle–wildlife collision
Airstrip	4	Fuel storage failure, refuelling accident, airplane crash, and plane de-icing chemical release
Mining	10	Mine back or wall failure, personnel falls into open ore/waste pass, uncontrolled explosion, vehicle accident, mine fire by any cause, fuel storage failure, refuelling accident, and failure of pipes and pumps for tailings transfer
Hoisting	1	Hoist failure

Table 21.6-1: Summary of Hazard Scenario Identification Results

Project Component or Activity	Number of Hazard Scenarios	Accident or Malfunction
Mine dewatering system	2	Main underground dewatering system failure and high flow – groundwater ingress and surface flooding
System, process plant buildings	11	Ore spill, process vessel and piping system failure, clarifier overflow, belt filter air exhaust to atmosphere, hydrogen peroxide spill, facility fire, process containment and gas cleaning and filtration system failure, calciner wet scrubber failure, hydrogen buildup in the in the leach tanks, and paste plant mixing error
Solvent extraction circuit	4	Process vessel and piping system failure, solvent fire/explosion, and dump tank leak
UGTMF and mining stopes	2	Failure of tailings cell containment and failure of reclaim water pipes and pumps
NPAG WRSA	4	Stockpile slope failure, stockpile erosion, and uncontrolled leachate/seepage release through runoff
Special waste rock, ore stockpiles, and PAG WRSA	4	Stockpile slope failure, stockpile erosion, uncontrolled leachate/seepage release through runoff, and uncontrolled leachate/seepage release through lining failure
ETP	3	Equipment/piping failure, effluent clarifier overflow, equipment, and control system failure
Site runoff ponds and retention berms	4	Pond overtopping, pond containment or embankment failure, pond lining failure and leakage, and surface flooding
Gypsum precipitation, washing, and storage	2	Loaded strip piping leakage and gypsum reactor failure
Acid plant	5	Truck, tanks, reactor, and storage vessels failure, sulphur spill during offloading, piping and piping component failure, sulphur burner and piping system failure, scrubber, absorber failure, and sulphur dioxide gas emission during plant start-up that spreads to other process plant areas
Electrical system and power plant	3	Substation transformer leak, transformer, turbine, generator fire/explosion, transformer, turbine, and generator fire/explosion
Fire protection system	2	Failure of fire pump or foam system and loss or lack of fire water
Low-level radioactive waste management system / incinerator	2	Hazardous waste spill and incinerator fire
LNG power plant	6	LNG transportation accident, LNG storage failure and release of gas, piping and piping component failure and release for gas, vaporization unit failure and release of gas, and pumps failure and release of gas
Mine ventilation system	3	Power outage, ventilation fans failure, and mine air heater fire

Note: Some accidents or malfunctions were associated with more than one hazard scenario.
UGTMF = underground tailings management facility; NPAG WRSA = non-potentially acid generating waste rock storage area; PAG WRSA = potentially acid generating waste rock storage area; ETP = effluent treatment plant; LNG = liquified natural gas.

The remaining six high-risk scenarios were not recommended for further detailed assessment because they are associated with occupational fatalities during site preparation activities. These scenarios were not advanced as bounding scenarios because NexGen's health and safety program would follow regulatory requirements and best practices, and therefore, in these cases, the risk is considered ALARP. Moreover, the focus of this assessment is on risks to biophysical and human health VCs and intermediate components.

Thirty-three of the scenarios evaluated were characterized as moderate risk based on the results of the screening-level risk evaluation. Of these, three moderate-risk scenarios were recommended for detailed assessment:

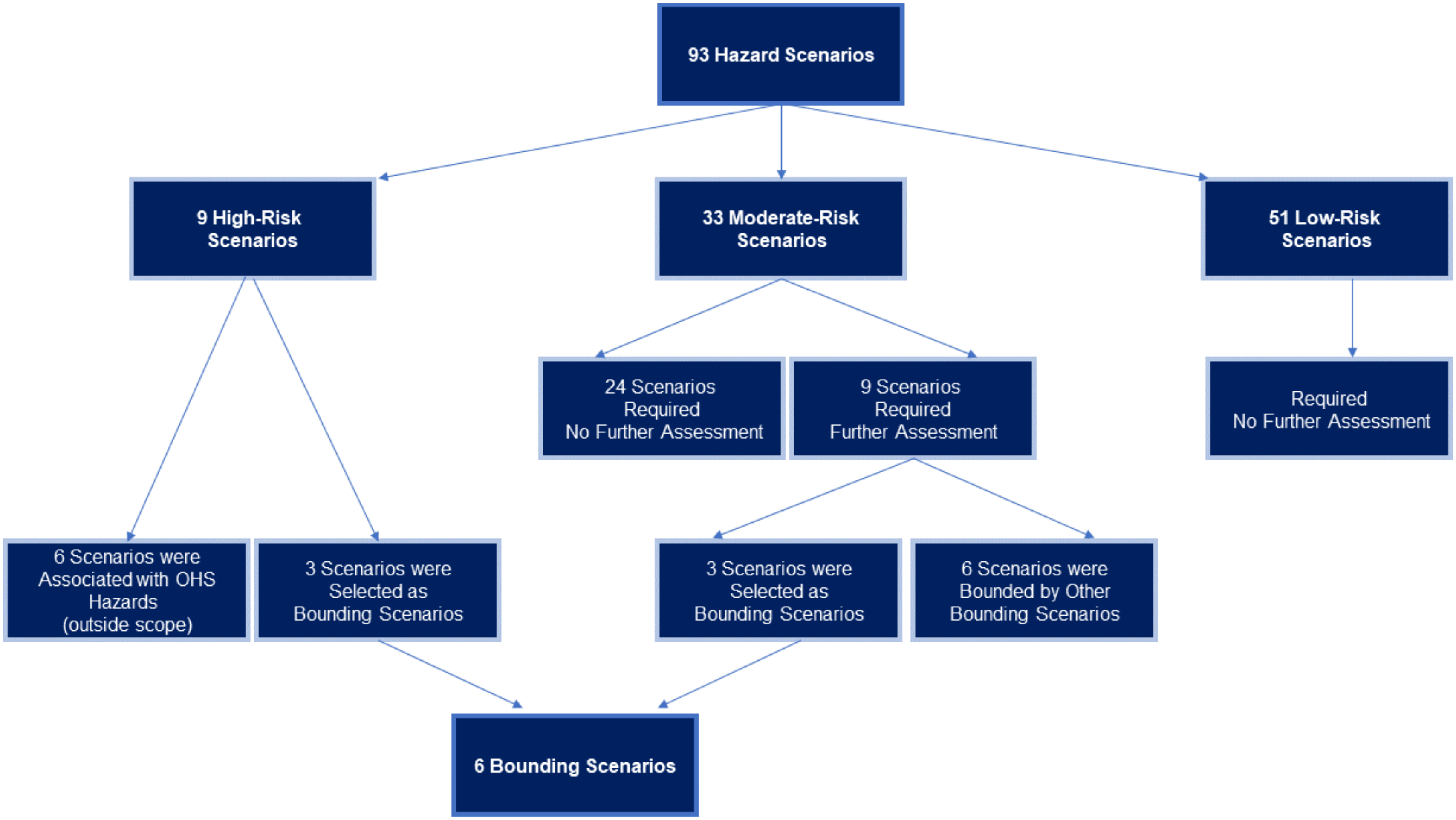
- tailings transfer pipe or pump failure;
- untreated effluent transfer pipe failure; and
- acid plant tail gas scrubber failure.

These scenarios are associated with a contaminant release to the environment with potential effects that may be more far reaching than can be adequately assessed by the screening assessment. Therefore, these three scenarios were selected as bounding scenarios in the additional, more quantitative evaluation.

The remaining 51 scenarios evaluated were characterized as low-risk scenarios based on their low likelihood of occurrence and/or consequence in consideration of the planned or existing safeguards and design features. Low-risk scenarios were not carried forward for more detailed analysis since the likelihood of these scenarios can be effectively managed through application of planned controls and/or the severity would be low in magnitude.

In total, six hazard scenarios were selected as bounding scenarios for more detailed risk analysis. These scenarios are summarized in Table 21.6-2, along with the associated environmental design features and mitigation actions that would be applied to address the hazards and associated effects. A summary of the results of the assessment for each bounding scenario is presented in Section 21.6.3, Bounding Scenario 1: Traffic Accident (Uranium Concentrate and Radioactivity), through Section 21.6.8, Bounding Scenario 6: Acid Plant Tail Gas Scrubber Failure. The detailed assessment of bounding scenarios or key accidents and malfunctions is provided in TSD VIII.

Figure 21.6-1: Selection of Bounding Scenarios



OHS = occupational health and safety.

Table 21.6-2: Bounding Scenarios Considered in the Accidents and Malfunctions Assessment and Associated Mitigations

Bounding Scenario	Accident or Malfunction	Location	Effect Pathway	Interactions with the Environment	Environmental Design Features and Mitigations
1	Traffic accident (uranium concentrate and radioactivity)	Access road and land transportation	Aquatic release of uranium concentrate and radioactivity	Potential for effects on surface water quality, fish and fish habitat, wildlife and wildlife habitat, and human health	▪ Upgrades to the existing access road from Highway 955 are planned to improve the safety of the road and limit the potential for accidents occurring during the Project lifespan. Changes to the existing road alignment are not planned; however, the road would be widened (i.e., surface width of 8 m) to support increased traffic volume and heavy vehicle/equipment use and allow for two-way traffic travel ▪ The current bridge design and capacity (5.7 m deck width, weight limit of 50 t) is suitable for use by most heavy equipment and traffic, including trucks transporting the uranium concentrate. The bridge is fitted with metal guards approximately 0.15 m high to guard the driver across the deck ▪ Use of the existing access road alignment would limit the potential for interaction between spills and the surface water environment. The existing road alignment minimizes the number of water features crossed and is set back from waterbodies and watercourses. At most locations, setback distances from Patterson Lake typically range between 300 m and more than 1 km. There are limited sections with a narrower setback distance, but the distance remains more than 30 m from the lake shoreline ▪ Speed limits would be in place for the access road and Clearwater River Bridge crossing (respectively) to reduce the potential for speed to contribute to or worsen the outcome of a potential accident scenario ▪ Potentially unsafe road conditions that could contribute to a traffic accident scenario (e.g., icy road conditions) would be addressed as quickly as possible (e.g., through snow removal or sanding), and if necessary, a no-travel order would be issued ▪ Signage would be used to warn drivers of the approaching Clearwater River bridge crossing, the reduced speed limit, the one-way traffic travel in place for the bridge, and other safety considerations (e.g., narrow road, bridge ices before road) ▪ Relevant staff or contractors would receive training on how to drive safely on site and on the access road, on defensive driving techniques, and on how to respond to emergency situations, such as an accident or spill ▪ An Environmental Protection Program and an Emergency Preparedness and Response Program would be implemented for the Project. These programs would include consideration of spill and emergency response processes that would be implemented in the event of an accidental release to the Clearwater River ▪ Any spill, release, or emergency that may harm the environment or pose a risk to public health or safety would be reported immediately, and managed and remediated in accordance with Saskatchewan's *Environmental Management and Protection Act, 2010* and The Saskatchewan Environmental Code ▪ The clean-up, treatment, and disposal of contaminated material, including affected soils and sediment associated with a potential release of uranium concentrate, would be handled by a certified specialized subcontractor. The spill would be cleaned up immediately and access to the affected area would be restricted, and fenced off if feasible, to limit access to the area by people and wildlife
2	Traffic accident (chemical)	Access road and land transportation	Aquatic release of fuel, hazardous chemicals	Potential for effects on surface water quality, fish and fish habitat, wildlife and wildlife habitat, and human health	
3	Solvent extraction fire or explosion	Solvent extraction building	Atmospheric release of uranium and radioactivity	Potential for effects on air quality and human health	▪ The design and operation of the solvent extraction process area would include provisions for fire safety. The building design and workings would minimize the use of potentially flammable materials and sources of static electricity ▪ The design and operation of the solvent extraction process area would minimize the probability of ignition leading to a fire. For example, all switches and motor controls would be explosion proof and designed not to create a source of ignition ▪ The fresh water intake proposed to be installed in Patterson Lake would be designed to provide adequate flow for both the mine area and for fire protection purposes, and would include a fire protection pump with a rated capacity of 16,045 L/min ▪ The solvent extraction building would be equipped with a fire suppression system that would be activated upon the detection of a fire in the building. This system would be tested regularly ▪ The process plant building or mixer-settler area would be fully contained. A concrete mixer-settler would be used to facilitate visual leak inspection ▪ The on-site fire protection system (consisting of a fresh water intake, fresh water pumps, break tanks, and fire protection pumps) would meet the fire water demand for fire-fighting purposes for a duration of two hours ▪ Emergency organic dump tanks fitted with fast-acting valves to transfer solvent extraction mixer-settlers would be used to reduce the potential for a fire ▪ The site would be equipped with a fire truck and fire-fighting capabilities to respond to a potential fire in the solvent extraction building ▪ Yard fire hydrants would be installed on site, including in the vicinity of the solvent extraction building ▪ Potential sources of ignition or static electricity would not be permitted in the solvent extraction building. For example, welding would not be permitted except under extremely controlled conditions and would include the use of a fire watch during and after the job in accordance with the required work permit ▪ A maintenance program that includes regular and preventative inspections and testing would be developed and implemented for the solvent extraction process area to identify and address any potential risks that could contribute to a fire ▪ An Emergency Preparedness and Response Program would be implemented for the Project. The Emergency Preparedness and Response Program would include mitigation and emergency response measures related to a fire in the solvent extraction building and a Fire Protection Program would describe fire safety controls ▪ In the event of a fire, ambient air quality monitoring would be used to assess the concentration and geographic extent of the release and to identify management actions that may be required to protect the public and the environment

Table 21.6-2: Bounding Scenarios Considered in the Accidents and Malfunctions Assessment and Associated Mitigations

Bounding Scenario	Accident or Malfunction	Location	Effect Pathway	Interactions with the Environment	Environmental Design Features and Mitigations
4	Tailings transfer pipe or pump failure	Tailings transfer conveyance pipes to UGTMF and mining stopes	Terrestrial release of uranium and radioactivity	Potential for effects on hydrogeology, terrain and soils, vegetation, and wildlife and wildlife habitat	▪ The design of the tailings transfer system would be completed in accordance with the American Society of Mechanical Engineers B31.2 - 2020, Process Piping code. American Society of Mechanical Engineers B31.3 is a mechanical code that deals mostly with mechanical safety to prevent sudden release of energy (e.g., pipe bursts) ▪ The tailings transfer system would consist of a carbon steel pipeline designed for the maximum anticipated flow and to account for thermal expansion and contraction ▪ The interconnecting pipeline corridor between the paste backfill plant and the underground would be designed to provide secondary containment in locations where a pipe rupture could release the material to surface ▪ The power generation and distribution infrastructure for the Project would include an emergency power system that would be activated in the event of a loss of power and would eliminate the potential for a power loss to result in a failure of the tailings transfer pump ▪ A wildlife fence and/or deterrents could be employed during spill clean-up to keep wildlife away from the area, if warranted (i.e., there is an identified risk of wildlife contact with contaminated materials or soils) ▪ A comprehensive pipeline monitoring and maintenance process would be established to verify that the operating and maintenance items of the pipeline stays within the limits of the design ▪ A maintenance and inspection program would be developed to monitor and address any potential issues related to the tailings transfer pipeline (e.g., corrosion) and pump that could contribute to a potential failure ▪ An Environmental Protection Program and an Emergency Preparedness and Response Program would be implemented for the Project and would include mitigation and emergency response measures related to the potential for a leak or spill associated with the tailings transfer pipe ▪ In the event of a leak or spill from the tailings transfer pipe, appropriate spill response measures would be implemented and would address site-specific conditions (e.g., soil type, chemical properties of the spill material) ▪ Any spill, release, or emergency that may harm the environment or pose a risk to public health or safety would be reported immediately and managed and remediated in accordance with Saskatchewan's *Environmental Management and Protection Act, 2010* and The Saskatchewan Environmental Code
5	Untreated effluent transfer pipe failure	Effluent treatment system	Terrestrial release of uranium and radioactivity	Potential for effects on hydrogeology, terrain and soils, vegetation, and wildlife and wildlife habitat	▪ The untreated effluent transfer pipe would be designed for the maximum anticipated flow and to account for thermal expansion and contraction. The pipe would be installed above ground to allow for visual inspections ▪ The interconnecting pipeline corridor between the process pond pad and the ETP on the mill terrace would be single-lined with high density polyethylene liner ▪ A comprehensive pipeline monitoring and leak detection system would be included in the design of the untreated effluent transfer piping system. This system would include flow detection instrumentation and flow reduction alarms with the ability to shut down flow immediately upon leak detection ▪ The power generation and distribution infrastructure for the Project would include an emergency power system that would be activated in the event of a loss of power and would eliminate the potential for a power loss to result in a failure of the effluent transfer pump ▪ A wildlife fence and/or deterrents could be employed during spill clean-up to keep wildlife away from the area, if warranted (i.e., there is an identified risk of wildlife contact with contaminated materials or soils) ▪ A maintenance and inspection program would be developed to monitor and address any potential issues related to the untreated effluent transfer pipeline (e.g., pipe integrity) and pump that could contribute to a potential failure ▪ An Environmental Protection Program and an Emergency Preparedness and Response Program would be implemented for the Project and would include mitigation and emergency response measures related to the potential for a leak or spill associated with the untreated effluent transfer pipe ▪ In the event of a leak or spill from the untreated effluent transfer pipe, appropriate spill response measures would be implemented and would address site-specific conditions (e.g., soil type, chemical and physical properties of the spill material)Any spill, release, or emergency that may harm the environment or pose a risk to public health or safety would be reported immediately, and managed and remediated in accordance with Saskatchewan's *Environmental Management and Protection Act, 2010* and The Saskatchewan Environmental Code
6	Acid plant tail gas scrubber failure	Acid plant	Atmospheric release of sulphur dioxide	Potential for effects on air quality and human health	▪ The acid plant would be equipped with a sulphur dioxide gas detection system that would identify elevated concentrations of sulphur dioxide ▪ A maintenance program that includes regular and preventative inspections and testing would be developed and implemented for the acid plant to identify and address any potential risks that could contribute to an upset event ▪ In the event of an accidental release of acid gas, ambient air quality monitoring would be used to assess the concentration and geographic extent of the release and to identify management actions that may be required to protect the public and the environment

= moderate risk; = high risk; UGTMF = underground tailings management facility; PAG WRSA = potentially acid generating waste rock storage area; ETP = effluent treatment plant.

21.6.3 Bounding Scenario 1: Traffic Accident (Uranium Concentrate and Radioactivity)

21.6.3.1 Scenario Description

A traffic accident involving a truck transporting uranium concentrate at or near the access road bridge crossing of the Clearwater River could result in a release of uranium concentrate to the surface water environment and the subsequent downstream transport of radioactive material (e.g., uranium, radionuclides). Such a release could alter surface water quality and sediment quality in the Clearwater River and adversely affect the health of aquatic and terrestrial biota, as well as people in the vicinity of the spill.

Vehicular access to the Project would be provided by an existing, approximately 13 km long, road from Highway 955 to the proposed Project footprint. The access road would be used to transport equipment, materials, and supplies to and from the Project, and for transporting uranium concentrate from the Project. There is one bridge crossing location along the existing access road at the Clearwater River, downstream of the Patterson Lake outflow. At the crossing location, the Clearwater River flows east toward Forrest, Beet, and Naomi lakes.

Uranium concentrate originating from the processing plant would be packed into standard 205 L (45 gallon) steel drums for shipment off site. The assumed output of uranium concentrate from the process plant would require an average of two trucked loads per day, each carrying 50 drums, weighing approximately 450 kg, for approximately 330 days of the year. The drums would be arranged in four rows across in a single layer, with no stacking. The speed of the truck would be less than 40 km/h near the access road bridge crossing and 10 km/hr on the bridge crossing; therefore, it was concluded that less than 25% of the drums would fail upon a traffic accident scenario. It is also assumed that 95% of the released uranium concentrate can be recovered from the released location after the accident. This assumption is based on the expectation that most of the uranium concentrate released would remain in relatively close proximity to the release location, given the high particle density of uranium concentrate that results in a high settling velocity (USDOE 2001) and the low water velocity and depth at the release location. The resulting estimated mass of uranium concentrate released to the Clearwater River in this accident scenario, along with an assessment of the probability of occurrence, is provided in Table 21.6-3. These values were used in the assessment of potential effects for Bounding Scenario 1 (Section 21.6.3.3).

Table 21.6-3: Summary of Release Characterization and Probability Assessment Results for Bounding Scenarios Considered in the Accidents and Malfunctions Assessment

	Bounding Scenario	Release Characterization	Assessment of Probability
1	Traffic accident (uranium concentrate and radioactivity)	Release of uranium concentrate: 5,625 kg	Between 5.3 × 10^{-05} and 1.7 × 10^{-04} per year
2	Traffic accident (chemical)	Release of fuel or other hazardous materials: ▪ diesel or gasoline = 30 m^3 ▪ organic solvents = 40 t ▪ LNG = 48 m^3 ▪ hydrogen peroxide = 11,350 L to 18,900 L ▪ molten sulphur = 25 t	Between 3.1 × 10^{-04} and 1.0 × 10^{-03} per year
3	Solvent extraction fire or explosion	Release of uranium for a confined fire: ▪ uranium concentrate = 2.4 g/s ▪ uranium = 2.05 g/s Release of uranium for an unconfined fire: ▪ uranium concentrate = 18.9 g/s ▪ uranium = 16 g/s	6 × 10^{-03} per year
4	Tailings transfer pipe or pump failure	Release of paste tailings: ▪ total volume = 14.9 m^3, containing: ▪ uranium concentrate = 3.8 kg ▪ radium-226 = 9.83 GBq	2 × 10^{-02} per year
5	Untreated effluent transfer pipe failure	Release of untreated effluent: ▪ total volume = 150 m^3, containing: ▪ uranium concentrate = 7.6 kg ▪ radium-226 = 90 MBq	2 × 10^{-02} per year
6	Acid plant tail gas scrubber failure	Release of sulphur dioxide gas: ▪ sulphur dioxide = 47 kg	1 × 10^{-01} per year

Note: Details on methods and information sources used to generate the summary values presented are included in TSD VIII and TSD IX.
GBq = gigabecquerel; MBq = megabecquerel; TSD = technical support document; LNG = liquified natural gas.

21.6.3.2 Environmental Design Features and Mitigation

Risks associated with a release of uranium concentrate to the surface water environment due to a traffic accident at the Clearwater River bridge crossing location would be managed through design criteria and management controls related to the access road (Table 21.6-2). Primary mitigation measures include planned upgrades to the existing access road to address increased use during the Project lifespan. To improve safety, traffic control measures such as setting the speed limits for the access road and bridge and spill and emergency response planning would be implemented.

21.6.3.3 Assessment of Potential Effects

The hypothetical effects of this hazard scenario are assessed for the following intermediate components and VC discipline groups: surface water quality, fish and fish habitat, wildlife and wildlife habitat, and human health. Effects were assessed in terms of the potential for the release to cause both toxicological and radiological effects on aquatic, terrestrial, and human receptors. Effects on fish habitat in the affected area of the Clearwater River were also considered.

Uranium concentrations in water were predicted based on an understanding of hydrologic conditions in the Clearwater River at the bridge crossing location and published information on the solubility of uranium in water. Based on this analysis, the hypothetical maximum uranium concentration in water for this scenario was predicted to be 2,184 µg/L or 27.2 Bq/L and would occur in the immediate vicinity of the release. Concentrations were predicted to attenuate with distance downstream and time after the release.

The assessment of effects on ecological and human receptors from exposure to radioactive material released as a result of an accident scenario followed the CSA Standard N288.6-22, which provides guidance for environmental risk assessments for Class I nuclear facilities and uranium mines and mills (CSA Group 2022). The following aquatic, semi-aquatic and terrestrial, and human receptors were considered in the risk assessment:

- **aquatic receptors:** macrophytes, phytoplankton, zooplankton, benthic invertebrates, lake whitefish (*Coregonus clupeaformis*), and northern pike (*Esox lucius*);
- **semi-aquatic and terrestrial receptors:** beaver (*Castor canadensis*), black bear (*Ursus americanus*), Canada goose (*Branta canadensis*), grey wolf (*Canis lupus*), grouse *(Falcipennis canadensis)*, little brown myotis (*Myotis lucifugus*; a bat), loon (*Gavia immer*), mallard (*Anas platyrhynchos*), mink (*Neovison vison*), moose (*Alces americanus*), muskrat (*Ondatra zibethicus*), red fox (*Vulpes vulpes*), rusty blackbird (*Euphagus carolinus)*, snowshoe hare (*Lepus americanus*), southern red-backed vole (*Myodes gapperi*), and woodland caribou (*Rangifer tarandus caribou*); and
- **human receptors:** subsistence harvester, subsistence harvester (one year old).

The selection of these receptors was based on a current understanding of how people use the land in the area surrounding the Project and incorporated information from Indigenous Knowledge and Traditional Land Use Studies, community information sessions, and JWG meetings. Ecological receptors were also selected to represent each major plant or animal group.

Potential toxicological effects on aquatic life and human health in the immediate vicinity of the release were assessed by comparing predicted uranium concentrations to Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of aquatic life (15 µg/L and 33 µg/L for long-term and short-term exposure, respectively; CCME 1987) and the Health Canada drinking water guideline for uranium (20 µg/L; Health Canada 2019). Based on the above-described water quality predictions, concentrations of uranium would exceed CCME and the Health Canada guidelines in the immediate vicinity of the release. These results indicate that toxicological effects on aquatic life are possible; however, the predicted maximum concentration would occur for a short period (i.e., less than an hour) in a localized area and would quickly dissipate to concentrations below both the guidelines for drinking water and protection of aquatic life. Additionally, exceedance of a benchmark does not indicate that effects on aquatic life are expected, rather, that effects are possible. Although the drinking water guideline is exceeded in this scenario, effects on human health are unlikely given that the affected area would be immediately isolated with restricted public access, thereby limiting the potential for exposure.

Canadian Standard Association N288.6-12 recommends that radiation dose benchmarks for quantitative effects assessment follow the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR 2008). Thus, the benchmarks used in Bounding Scenario 1 were 2.4 milligrays per day (mGy/d) for semi-aquatic and terrestrial receptors, and 9.6 mGy/d for aquatic receptors. The public dose limit for radiation protection is one millisievert in one year, as described in the Radiation Protection Regulations under the *Nuclear Safety and Control Act*, and as recommended in CSA N288.6-22.

The calculated total long-term radiation doses to aquatic and semi-aquatic and terrestrial receptors were much lower than the respective benchmarks of 9.6 mGy/d and 2.4 mGy/d. Radiation doses to ecological receptors in close vicinity to the release area could be higher and may exceed benchmarks; however, this exposure would be short-term and limited to a small geographic area of less than few hundred metres from the release location. If warranted and feasible, measures to keep wildlife away from the affected area (e.g., fencing off the area, using deterrents) could be employed and would limit potential health effects on wildlife VCs.

The calculated long-term doses to human receptors were much lower than the CNSC effective dose limits for the public of one millisievert in one year. Radiation doses to human receptors at close vicinity of the release area could be higher and may exceed benchmarks; however, it is expected that emergency response would isolate this area and prevent direct access to the release area, and therefore, exposure of human receptors (i.e., members of the public) to the release is considered unlikely.

Temporary and localized effects on fish habitat are also possible in this scenario, which would involve remediation works (e.g., cleanup of spilled material) below the high-water mark of Patterson Lake. The magnitude of effects would be contingent upon the size of the spill and the complexity of cleanup measures.

21.6.3.4 Risk Measurement and Evaluation

Table 21.6-4 characterizes the likelihood and consequence ratings for the scenario involving a traffic accident and aquatic release of uranium concentrate and radioactivity to the Clearwater River. With implementation of environmental design features and mitigation, and in consideration of the assessed probability for this accident scenario, the likelihood was assessed as **highly unlikely.** The consequence was assessed as **moderate** based on the prediction that estimated radiation doses to ecological and human receptors would be below relevant benchmarks, but that there remains some potential for short-term and localized exposure of ecological receptors to elevated radiation levels. The overall risk rating was assessed as **low**.

21.6.4 Bounding Scenario 2: Traffic Accident (Chemical)

21.6.4.1 Scenario Description

This scenario is similar to Bounding Scenario 1 (Section 21.6.3), with the main difference being that it results in the release of fuel or other hazardous chemicals at the site access bridge over the Clearwater River. A release of hazardous chemicals or fuel to the Clearwater River could alter surface water quality and sediment quality in the river and adversely affect the health of aquatic and terrestrial biota and people in the vicinity of the spill.

Fuel and hazardous chemicals transported to and from the Project could include diesel and gasoline, organic solvents, LNG, hydrogen peroxide, and molten sulphur. These substances would be transported to the site via tanker trucks with varying capacities and numbers of trips per day. The resulting estimated maximum size of the release to Clearwater River is summarized in Table 21.6-3 for each fuel and chemical type transported to and from the Project. Table 21.6-3 also provides an estimate of the probability of this accident scenario occurring.

21.6.4.2 Environmental Design Features and Mitigation

Risks associated with a potential release of fuel or other hazardous chemicals to the surface water environment would be managed through design criteria and management controls related to the access road (Table 21.6-2). Primary mitigation measures are the same as those defined for Bounding Scenario 1.

21.6.4.3 Assessment of Potential Effects

The assessment of effects from a potential spill of fuel and hazardous materials due to a traffic accident at the access road bridge crossing of the Clearwater River focused on the release of diesel. The release of diesel into the Clearwater River was deemed by the preliminary hazard assessment to have the greatest likelihood and severity in terms of potential adverse effects on aquatic and semi-aquatic biota among the fuel and chemical types that would be transported to or from the Project site. This assumption is based on the expected behaviour of diesel fuel in water and its potential for toxicity.

The hypothetical effects of this hazard scenario are assessed for the primary exposure pathway (i.e., the aquatic environment) based on the following intermediate components and VC discipline groups: surface water quality, fish and fish habitat, wildlife and wildlife habitat, and human health. Secondarily, consideration of potential effects on air-related emissions due to the release of diesel are also considered since as much as 45% of the material is expected to volatilize and be released to the atmosphere (NOAA 2023).

An analysis was undertaken to evaluate the potential spatial extent of a diesel fuel spill for the above-described scenario. The scenario assumes a release of up to 30 m^3 based on the capacity of a diesel tanker truck. Assuming 30 m^3 of diesel (i.e., the full capacity of a diesel tanker truck) spills to the Clearwater River and forms a floating sheen, the theoretical maximum size of the sheen is 30 km^2; however, due to evaporation and dissolution processes (Silver and Mackay 1984), the size of the sheen is likely to be much smaller, particularly in slow-moving surface waters. This is the case in the potentially affected area, where the water flow rate in the Clearwater River between Forrest Lake and Beet Lake is approximately 1 cm/s. At this velocity, a spill would travel less than 1 km in a day. Considering evaporation and dissolution processes, the diesel sheen would not be expected to travel beyond 2 km of the bridge on the access road. Thus, the affected areas would be limited to the northern end of Forrest Lake and Beet Lake Channel.

Diesel fuel is much lighter than water, and thus it is not possible for diesel to sink and accumulate on the sediment bed and cause contamination of sediments. Diesel dispersed in the water column can adhere to fine-grained suspended sediments that can then settle out (NOAA 2023), though this process is not likely to result in measurable sediment contamination (NOAA 2023).

Although the spatial extent and temporal duration of a diesel spill to the aquatic environment would be limited, the unplanned release of diesel has the potential to adversely affect aquatic organisms if they are exposed. Diesel spills to water could result in direct mortality and/or sublethal effects on fish (NOAA 2023); however, a spill in open water would be rapidly diluted, and therefore, fish kills are unlikely. Diesel toxicity can also impair the health of fish populations, depending on the extent of chemical or mechanical dispersion and life stage of the fish (Schein et al. 2009).

Effects from a diesel spill could also be harmful to semi-aquatic wildlife, particularly waterfowl that spend substantial time on the surface of the water where the slick would float (Leighton 1993). Diesel can impair the waterproofing and insulative qualities of a bird’s feathers, which can result in hyperthermia or hypothermia, a loss of buoyancy, and increased preening (King et al. 2021). Diesel is also toxic to birds, with exposure occurring through ingestion, inhalation, and/or dermal contact with petroleum hydrocarbons in diesel (King et al. 2021).

A portion (i.e., 45%) of the diesel fuel accidentally released to the Clearwater River as part of Bounding Scenario 2 is expected to volatilize and be liberated to the atmosphere. Such emissions would be transient in nature, localized, and likely dispersed rapidly by prevailing winds. Given these air-emission properties, wildlife and avian risks related to exposure to diesel components emitted to the atmosphere through volatilization are expected to be low, with avoidance being the most likely outcome, though toxicity through the inhalation pathway is still possible (King et al. 2021). Exposure of workers and crews dispatched to respond to the accidental release could also be at risk of exposure via inhalation. Such risks would be mitigated by risk management measures, such as personal protective equipment and adherence to appropriate safety protocols.

Overall, the effects of a diesel spill would be transient, with most of the effects occurring within one to two days; despite that, adverse effects to aquatic biota, and potentially birds, may occur within the affected area. Due to short-term exposure, irreversible population-level residual effects are not expected from the assumed scenario. Additionally, risks to accident responders are assumed to be mitigated by risk management measures that would be described in emergency response planning documentation developed as part of the Emergency Preparedness and Response Program.

21.6.4.4 Risk Measurement and Evaluation

Table 21.6-4 characterizes the likelihood and consequence ratings for the scenario involving a traffic accident and aquatic release of fuel or other hazardous materials to the Clearwater River. With implementation of environmental design features and mitigation and, in consideration of assessed probability for this accident scenario, the likelihood was assessed as **highly unlikely**. The consequence was assessed as **moderate** based on the potential for the release to cause toxicity to aquatic life and semi-aquatic receptors such as waterfowl. The overall risk rating was assessed as **low**.

21.6.5 Bounding Scenario 3: Solvent Extraction Fire or Explosion

21.6.5.1 Scenario Description

This bounding scenario involves damage to equipment or vessels containing uranium-bearing solutions in the solvent extraction building, resulting in fire and release of uranium to the environment. A fire that originates in the solvent extraction building and involves loaded solvent could release a large amount of uranium to the atmosphere. This release could result in changes in air quality and exposure of members of the public to airborne uranium.

In the solvent extraction building, uranium-bearing solutions would be stored or processed in tanks and transported through piping systems. A spill of these solutions could occur as a result of overflow or leaks/rupture of storage or process tanks, or failure of valves and piping system components and other process components. A fire may occur in association with a spill if combined with an ignition source and could spread to other process plant areas if not extinguished rapidly. The accumulated organic vapour could also form an explosive vapour cloud. Depending on weather conditions, the resulting release could be carried down-wind.

Two possible outcomes were considered for this scenario: an indoor fire and an unconfined fire. The scenario for an indoor fire assumed that the fire is contained inside the solvent extraction building and that the building envelope remains intact. The scenario for an unconfined fire assumed that the building envelope is breached. The estimated mass of uranium released to the atmosphere in this accident scenario, along with an assessment of the probability of occurrence, is provided in Table 21.6-3.

21.6.5.2 Environmental Design Features and Mitigation

Risks associated with a fire in the solvent extraction building would be managed through design criteria and management controls (Table 21.6-2). Design criteria for the solvent extraction building incorporated fire protection as appropriate in accordance with the National Building Code of Canada (NRCC 2020a) and the National Fire Code of Canada (NRCC 2020b). Additionally, the solvent extraction building would be designed in accordance with local, provincial, and federal regulations, laws, and codes having jurisdiction in the province of Saskatchewan. Mitigation as outlined in Table 21.6-2 would be implemented to avoid and limit the potential effects of a fire in the solvent process area on worker and public safety and critical infrastructure.

21.6.5.3 Assessment of Potential Effects

The hypothetical effects of this accident scenario are assessed for the following intermediate component and VC: air quality and human health. To evaluate effects for this scenario, the Areal Locations of Hazardous Atmospheres (ALOHA) model was used. The ALOHA model was developed by the National Oceanic and Atmospheric Administration for the purpose of providing estimates of the spatial extent of common hazards associated with chemical spills or releases (NOAA 2013).

Concentrations of uranium in air versus distance were derived for a contained, indoor fire and an unconfined fire and expressed in terms of two weather conditions. These weather conditions included a worst-case condition, which assumed peak wind speeds and worst-case conditions for dispersion of released materials, and a typical weather condition, which assumed average wind speeds and average conditions for dispersion of released materials.

The modelling results were compared to the Emergency Response Planning Guidelines (ERPGs) to estimate potential adverse effects on the public caused by toxic chemical exposure. The ERPGs are defined for three levels according to severity of effects; however, only two levels are available for uranium. The ERPG-2 benchmark (10 mg/m^3) is the most widely used benchmark for emergency release. It represents the maximum airborne concentration below which nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects. The ERPG-3 represents the maximum airborne concentration below which nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

Based on the results of the ALOHA modelling, for a contained indoor fire, the ERPG-2 for uranium of 10 mg/m^3 would be exceeded within the first 176 m and 68 m of the solvent extraction building for the worst-case and typical weather conditions, respectively. For an unconfined fire, the ERPG-2 would be exceeded within the first 584 m and 214 m of the solvent extraction building for the worst-case and typical weather conditions, respectively. The latter estimates represent the more likely outcome of a fire originating from the solvent extraction building.

These results indicate that serious health effects on the public would not be expected because the spatial extent of airborne emissions exceeding the ERPG-2 would be limited to the Project footprint, within which all non-emergency response workers would be mustered at an upwind location immediately upon the initiation of the incident. Based on the modelling results, air quality conditions exceeding the ERPG-2 would extend a maximum of 584 m from the solvent extraction building for the most conservative scenario. This means that conditions exceeding the ERPG-2 would be limited to the Project footprint, which would not be accessible to the public.

Effects on other intermediate components and VC groups such as soils, vegetation, and wildlife are not expected for the assessed scenario. The atmospheric release during a fire would be of a short-term duration (less than a few hours), and therefore surface accumulation and extended exposure to vegetation and wildlife are not expected.

21.6.5.4 Risk Measurement and Evaluation

Table 21.6-4 characterizes the likelihood and consequence ratings for the scenario involving a fire or explosion in the solvent extraction building. With implementation of environmental design features and mitigation, and in consideration of the assessed probability for this accident scenario, the likelihood was assessed as **unlikely**. The consequence was assessed as **minor** to **moderate** based on the expectation that effects would be largely limited to the controlled area of the site, which would not be accessible to members of the public. The overall risk rating was assessed as **low**.

21.6.6 Bounding Scenario 4: Tailings Transfer Pipe or Pump Failure

21.6.6.1 Scenario Description

This bounding scenario involves the release of tailings from the tailings transfer pump or pipe at surface. Tailings are a by-product of the ore processed in the process plant and would be blended with a binder to form a paste for placement in the underground. A breach in the transfer pipes used to convey paste tailings to the mined-out stopes and UGTMF for permanent deposition, and/or failure of the associated pump, could result in the release of radioactivity to the environment, in turn resulting in potential adverse effects on groundwater, soils, vegetation, and wildlife.

The management of tailings on site would include the processing, delivery, and safe storage of paste tailings in the underground. As part of the milling process, ore would be leached, as required, at the process plant, and the resulting leach residue would be transferred to the tailings neutralization circuit where it would be dewatered before being conveyed to the paste backfill plant for processing into paste tailings. The paste delivery system would convey the paste tailings from the paste backfill plant to mined-out stopes and the UGTMF for permanent deposition.

A catastrophic failure of the transfer pipe used to convey paste tailings to the underground could result in an uncontrolled release of tailings at surface. The most probable location for surface release of tailings in this scenario would be in the vicinity of the solvent extraction and process plant where the tailings transfer pipelines run above ground for a short distance (i.e., less than 20 m) before being routed below ground. The estimated volume of paste tailings and associated mass of uranium released in this accident scenario, along with an assessment of the probability of occurrence, is provided in Table 21.6-3.

21.6.6.2 Environmental Design Features and Mitigation

Risks associated with a potential failure of the tailings transfer pipe and subsequent release of radioactivity at surface would be managed through design criteria and management controls (Table 21.6-2). The tailings transfer piping systems would primarily be routed underground and would be constructed of carbon steel piping, with only a limited section of pipe above ground; this design limits the potential for a release to surface. Secondary containment would be provided for the section of pipe that runs above ground and would contain or limit a spill at this location. These and other mitigations (Table 21.6-2) are expected to limit the potential effects of a failure of the tailings transfer pipe and subsequent release of radioactivity.

21.6.6.3 Assessment of Potential Effects

The hypothetical effects of this hazard scenario are assessed for the following intermediate components and VC discipline groups: hydrogeology, terrain and soils, vegetation, and wildlife and wildlife habitat.

In the event of a maximum release of up to 14.9 m^3, the released tailings would flow north, away from the solvent extraction and process plant. For Bounding Scenario 4, it was conservatively assumed that secondary containment associated with the tailings transfer piping would not collect any of the release. A characterization of the theoretical extent of a tailings spill was undertaken, and the analysis considered various factors that could mediate the transport of liquid materials released to surface, including the slope and permeability of the ground and the volume of the release. The analysis assumed that the spill would occur during unfrozen ground conditions when it could permeate into local soils. The results indicate that between 18.7 m^3 and 37.3 m^3 of soil could be contaminated, with the spill having an estimated surface area of between 20.8 m^2 and 59.2 m^2 and penetration depth of between 0.63 m and 0.9 m. These results indicate that the release would affect a small area that would be confined to the Project footprint, within the area contained by the perimeter contact water collection system for the site.

During the winter months, when the ground is frozen, no penetration of spilled tailings into the soil is expected as the frozen conditions would inhibit the release of materials into the ground. Therefore, no soil contamination is expected during frozen ground conditions; however, it is conceivable that the materials could spread over a larger surface area due to reduced absorption by the underlying soils. Although the theoretical extent of the spill may be larger, the spill would be confined to the Project footprint and the area contained by the perimeter contact water collection system.

There is potential that groundwater contamination may occur within the predicted area of soil contamination; however, groundwater-associated transport of contaminants to Patterson Lake is unlikely due to the low velocity of groundwater flow in the area, small size of the spill, and the distance (i.e., more than 600 m) to the lake. As the implementation of the spill response measures and associated cleanup would be expected to occur over a period of days, or at most weeks, no meaningful migration of contaminated groundwater outside the immediately affected area would be expected. If a spill were to occur, it would be immediately reported to the Saskatchewan Ministry of Environment as per the Saskatchewan Environmental Code, and NexGen would be required to complete a site assessment and implement a corrective action plan that achieves acceptable environmental endpoints.

It is unlikely that wet weather resulting in increased runoff would be a factor affecting the estimated area of soil contamination and transport of contaminants to Patterson Lake. Surface runoff interacting with the spill would be captured by the mine contact water management infrastructure and conveyed to a collection area or pond before being released to the environment (i.e., once it can be demonstrated that release criteria are met), or it would be absorbed by the soil, and thus would enter the local groundwater system. Therefore, no effects on surface water quality or the health of fish VCs in Patterson Lake are expected in this scenario.

Localized effects on soil quantity, distribution, and quality may occur as a result of a potential tailings spill released to the ground. However, as the spill would be confined to the Project footprint, no additional loss of soils would occur as an outcome of this scenario relative to the predictions described in the terrain and soils assessment, which considered the direct effects of development of the Project footprint on soil quantity and distribution (Section 12, Terrain and Soils). Soil contamination would be limited to the immediate area of the spill and remediated following measures outlined in the Environmental Protection Program and the Emergency Preparedness and Response Program. The remediation measures would consider the physical area affected, the soil type(s) present, and the chemical properties of the spilled material. Any contaminated materials would be handled in accordance with the Waste Management Program. Remediation measures would largely mitigate effects on soil quality; however, negligible residual changes to soil chemistry in the immediate area of the release are predicted.

An accidental release of tailings could result in localized contamination and/or damage to vegetation and wildlife habitat and could be toxic to wildlife. However, as the spill would be confined to the Project footprint, no additional loss of vegetation and associated wildlife habitat would occur as an outcome of this scenario relative to the predictions described in the vegetation (Section 13) and wildlife and wildlife habitat (Section 14) assessments. These assessments considered the direct effects of development of the Project footprint on vegetation ecosystem availability and habitat availability for wildlife VCs. Effects on the health of wildlife VCs due to exposure to radioactivity in spilled tailings would be mitigated by quickly cleaning up the spilled material and contaminated soils, and if required, by employing measures to keep wildlife away from the affected area (e.g., by fencing off the area or using deterrents), to the extent feasible.

21.6.6.4 Risk Measurement and Evaluation

Table 21.6-4 characterizes the likelihood and consequence ratings for the scenario involving a failure of the tailings transfer piping. With implementation of environmental design features and mitigation, and in consideration of the assessed probability for this accident scenario, the likelihood was assessed as **likely**. The consequence was assessed as **minor** based on the expectation that the spill would be limited to the Project footprint and contained within the perimeter contact water collection system, resulting in negligible effects on soils, vegetation, groundwater quality, and wildlife habitat. The overall risk rating was assessed as **low**.

21.6.7 Bounding Scenario 5: Untreated Effluent Transfer Pipe Failure

21.6.7.1 Scenario Description

This scenario is similar to Bounding Scenario 4 but involves a potential breach in the untreated effluent piping system at surface. The ETP developed for the Project would treat process plant effluents, mine water discharge, and site runoff from selected areas of the Project footprint, as required. A catastrophic failure of the untreated effluent piping could result in an uncontrolled release of radioactivity to the environment, which could adversely affect surficial groundwater, soils, vegetation, and wildlife.

Water management on site would include the collection, containment, conveyance, and treatment (as required) of contact water (i.e., potentially mine-affected water) on site. Contact water would be collected and directed to respective site runoff ponds or collection areas. This contained water would be tested prior to release to the environment based on regulatory requirements; water that does not meet specification would report to the ETP for treatment. Settling and monitoring ponds used in the effluent treatment process would be located north of the mill terrace. Untreated effluent would be conveyed to the ETP via a pipe between the settling ponds and ETP. Following treatment, effluent would either be recycled for use on site, or would be conveyed via a pipe to the effluent monitoring ponds, which would allow storage of treated effluent until water quality parameters are confirmed to meet discharge criteria, prior to discharging the water to Patterson Lake.

A breach in the untreated effluent piping at the surface is considered in this scenario. A catastrophic failure of the transfer pipe at the surface and release of radioactivity to the environment presents the bounding effect for this scenario. The estimated volume of untreated effluent and associated mass of uranium released at surface in this accident scenario, along with an assessment of the probability of occurrence, is provided in Table 21.6-3.

21.6.7.2 Environmental Design Features and Mitigation

Risks associated with a potential failure of the untreated effluent piping system and subsequent release of radioactivity at surface would be managed through design criteria and management controls (Table 21.6-2). The effluent piping system would be constructed for the maximum anticipated flow, and a comprehensive pipeline monitoring and leak detection system would be included in the design. An interconnecting pipeline corridor between the contact water process pond and the ETP on the mill terrace would be single-lined with high density polyethylene liner. These and other mitigations (Table 21.6-2) would be implemented to avoid and limit the potential effects of a failure of the untreated effluent transfer pipe and subsequent release of untreated effluent to the environment.

21.6.7.3 Assessment of Potential Effects

The hypothetical effects of this hazard scenario are assessed for the following intermediate components and VC discipline groups: hydrogeology, terrain and soils, vegetation, and wildlife and wildlife habitat. The evaluation of effects is similar to that described for Bounding Scenario 4.

Under this hypothetical scenario, the content of the isolated section of the effluent piping system releases within a few minutes, and therefore a 15-minute release scenario is conservative. Assuming a 15-minute release, the amount of release would be 150 m^3. In the event of a release, the released effluent would flow north, away from the source. For Bounding Scenario 5, it was conservatively assumed that secondary containment associated with the effluent transfer piping would not collect any portion of the released effluent. As outlined for Bounding Scenario 4, a characterization of the theoretical extent of an untreated effluent spill was undertaken for unfrozen ground conditions. The results of the analysis indicate that between 375 m^3 and 187.5 m^3 of soil could be contaminated, with the spill having an estimated surface area of between 208 m^2 and 595 m^2 and penetration depth of between 0.63 m and 0.9 m. These results indicate the release would affect a small area that would be confined to the Project footprint, within the area contained by the perimeter contact water collection system for the site. The behaviour of the spill during frozen ground conditions would be similar to that described for Bounding Scenario 4.

Similar to Bounding Scenario 4, there is potential that groundwater contamination may occur within the predicted area of soil contamination; however, groundwater-associated transport of contaminants to Patterson Lake is unlikely due to the very slow movement of groundwater in the area and distance to the lake (i.e., more than 600 m). Therefore, contamination of soil and shallow groundwater is expected to be contained within a small area near the release location, and no effects on surface water quality or the health of fish VCs in Patterson Lake are expected due to the potential occurrence of this scenario.

As described for Bounding Scenario 4, changes to soil quantity, distribution, and quality may occur as a result of a potential release associated with the untreated effluent transfer pipe, and there is potential for localized contamination and/or damage to vegetation and associated wildlife habitat, and toxicity to wildlife. However, as the spill would be confined to the Project footprint, no additional loss of soils, vegetation, or wildlife habitat would occur as an outcome of this scenario relative to the predictions described in the respective effects assessments for these disciplines. As described for Bounding Scenario 4, effects on the health of wildlife VCs due to exposure to radioactivity in spilled untreated effluent would be mitigated by quickly cleaning up the spilled material and contaminated soils, and if required, by employing measures to keep wildlife away from the affected area.

21.6.7.4 Risk Measurement and Evaluation

Table 21.6-4 characterizes the likelihood and consequence ratings for the scenario involving a failure of the untreated effluent transfer piping. With implementation of environmental design features and mitigation, and in consideration of the assessed probability for this accident scenario, the likelihood was assessed as **likely**. The consequence was assessed as **minor** based on the expectation that the spill would be limited to the Project footprint and contained within the perimeter water collection system, resulting in negligible effects on soils, vegetation, groundwater quality, and wildlife habitat. The overall risk rating was assessed as **low**.

21.6.8 Bounding Scenario 6: Acid Plant Tail Gas Scrubber Failure

21.6.8.1 Scenario Description

This scenario involves the accidental release of acid gas to the environment in the event of an acid plant upset. Accidental release of acid gas to the atmosphere due to acid plant upset conditions could adversely affect air quality in the area surrounding the accident location and result in exposure of members of the public to sulphur dioxide, which is a colourless, toxic gas that is produced as a chemical intermediate in the production of sulphuric acid.

The on-site acid plant would be located southwest of the mill building and would combust sulphur to produce sulphuric acid that would be used in the milling process and for effluent treatment. Molten sulphur would be fed to the acid plant where it would be burned to produce a sulphur dioxide gas stream that would be cooled and fed to a converter system where it would be converted into sulphur trioxide gas. The sulphur trioxide gas would be scrubbed with water to produce 94% to 98% production-grade sulphuric acid for use in the milling process. The tail gas from the process would be scrubbed in a wet scrubber system to remove the acid gases before being released into the atmosphere.

In this scenario, the most likely malfunction event that could result in accidental release of acid gas to the environment is the failure of the tail gas scrubber. This event would result in the release of tail gas to the atmosphere before scrubbing. The estimated mass of sulphur dioxide released to the atmosphere in this scenario, along with an assessment of the probability of occurrence, is provided in Table 21.6-3.

21.6.8.2 Assessment of Potential Effects

The hypothetical effects of this hazard scenario are assessed for the following intermediate component and VC: air quality and human health. The approach used to assess effects for this scenario is similar to Bounding Scenario 3. Concentrations of sulphur dioxide in air versus distance were estimated using the ALOHA model for the more likely scenario of a failure of the tail gas scrubber. The results were expressed in both worst-case and typical weather conditions, as described for Bounding Scenario 3 (Section 21.6.5, Bounding Scenario 3, Solvent Extraction Fire or Explosion). The model predictions were then compared to relevant benchmarks to assess the potential for adverse effects on workers and the public.

The applicable benchmarks in this scenario are the acute exposure guideline levels (AEGLs) for airborne chemicals (USDOE 2016). The AEGLs describe the human health effects from once-in-a-lifetime, or rare exposure to airborne chemicals and are used by emergency responders when dealing with chemical spills or other catastrophic exposures (USDOE 2016). Three levels are defined according to severity of effects. The AEGL-1 for sulphur dioxide (0.2 parts per million [ppm]) represents a level of exposure above which the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure. The AEGL-2 (i.e., 0.75 ppm) is the most widely used benchmark for emergency release and represents a level of exposure above which irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape may occur. The AEGL-3 (i.e., 9.6 ppm) represents a level of exposure above which life-threatening health effects may occur.

Based on the results of the ALOHA modelling, the AEGL-1 for sulphur dioxide of 0.2 ppm would be exceeded within 5,100 m of the acid plant for the worst-case weather condition, and within 1,700 m of the acid plant for typical weather conditions. The AEGL-2 for sulphur dioxide of 0.75 ppm would be exceeded within 2,500 m of the acid plant for the worst-case weather condition, and within 849 m of the acid plant for typical weather conditions. Lastly, the AEGL-3 for sulphur dioxide of 9.6 ppm would be exceeded within 261 m of the acid plant for the worst-case weather condition, and within 122 m of the acid plant for typical weather conditions.

These results indicate that serious or life-threatening health effects on the public are not expected as air quality conditions exceeding the AEGL-2 and AEGL-3 would be limited to the Project footprint or the immediate area surrounding the Project. Areas within the Project footprint would not be accessible to the public. There is some limited potential for effects consistent with an exceedance of the AEGL-1 on land users or members of the public who may be in the area of the Project at the time of an accident scenario (i.e., within 1.7 km for typical weather conditions or within 5.1 km for worst-case weather conditions); however, this outcome is unlikely or would be limited to a small number of people.

Effects on other intermediate components and VC groups such as soils, vegetation, and wildlife are not expected for the assessed scenario. The atmospheric release would be of a short-term duration (less than a few hours), and therefore, surface accumulation and extended exposure to soils, vegetation and wildlife are not expected.

21.6.8.3 Risk Measurement and Evaluation

Table 21.6-4 characterizes the likelihood and consequence ratings for the scenario involving a failure of the acid plant tail gas scrubber. With implementation of environmental design features and mitigation, and in consideration of the assessed probability for this accident scenario, the likelihood was assessed as **likely**. The consequence was assessed as **minor** to **moderate** based on the expectation that effects would be largely limited to the controlled area of the site, which would not be accessible to members of the public. The overall risk rating was assessed as **low to moderate** (Table 21.5-3).

21.6.9 Summary of Bounding Scenarios

The results of the risk assessment for accidents and malfunction bounding scenarios are summarized in Table 21.6-4. The overall risk ratings indicate that the traffic accident scenarios releasing uranium concentrate (Bounding Scenario 1) and chemicals (Bounding Scenario 2), solvent extraction fire or explosion (Bounding Scenario 3), failure of pipes and pumps for tailings (Bounding Scenario 4), and the untreated effluent transfer pipe failure (Bounding Scenario 5) have a low risk. The overall risk associated with tail gas scrubber failure (Bounding Scenario 6) has been determined to be low to moderate. Low to moderate risk scenarios were deemed to represent a tolerable level of risk in consideration of proposed safeguards and design features that reduce the risk level to ALARP.

Table 21.6-4: Risk Level Determination for Bounding Scenarios Considered in the Assessment of Accidents and Malfunctions

Bounding Scenario		Likelihood	Consequence	Risk Level	
1	Traffic accident (uranium concentrate and radioactivity)	Highly unlikely	Moderate	Low	
2	Traffic accident (chemical)	Highly unlikely	Moderate	Low	
3	Solvent extraction fire or explosion	Unlikely	Minor to moderate	Low	
4	Tailings transfer pipe or pump failure	Likely	Minor	Low	
5	Untreated effluent transfer pipe failure	Likely	Minor	Low	
6	Acid plant tail gas scrubber failure	Likely	Minor to moderate	Low	Moderate

21.7 Assessment of Transportation-Related Risks

21.7.1 Selection of Transportation Scenarios

Five transportation hazard scenarios were selected as the focus of the transportation risk assessment. A description of the scenarios selected for detailed assessment is presented in Table 21.7-1 along with the associated mitigation that would be applied to address the hazards and associated effects. A summary of the results of the assessment for each transportation hazard scenarios is presented in Section 21.7.2, Aquatic Release Scenario, through Section 21.7.5, Other Transportation Accident Scenarios. The detailed assessment of transportation hazard scenarios is provided in TSD IX.

- A summary of issues and concerns expressed by Indigenous Groups and LPA community members related to transportation accidents is as follows. As described in Section 21.6.1, Indigenous Groups and LPA community members expressed general concerns about Project-related effects on the environment, including from radiation, through changes in air and water quality, and subsequent effects on human health (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; BNDN-JWG 2019; BNDN-JWG 2021a; BRDN-JWG 2019a; BRDN-JWG 2020a; CRDN-JWG 2021; MN-S-JWG 2019b). Specific concerns were raised about the potential for Project-related contaminants to enter waterbodies and watercourses and the food chain, and associated effects on aquatic and terrestrial health, and in turn, the safety of wild foods, fresh water, and human health (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; BRDN-JWG 2019b; BRDN-JWG 2020a; BRDN-JWG 2021a; CRDN-JWG 2020a; CRDN-JWG 2021).
- Indigenous Groups also expressed concerns about the potential for accidents involving transport trucks (e.g., roll over and catching on fire) and radioactive material affecting air, water, and sediment quality, with subsequent effects on plants and animals (TSD III: BRDN; TSD V.2: CRDN; BRDN-JWG 2020b). The safety of yellowcake transport through communities was a key concern, as well as the potential release of yellowcake dust because of accidents or spills, which may lead to human health risks (TSD IV: MN-S; TSD V.2: CRDN; BNDN-JWG 2019; NexGen 2019b). Concerns related to potential human health risks of yellowcake are partly based on Indigenous Groups' past experiences with the Cluff Lake Mine and how spills were handled. The MN-S commented about traffic safety in the event of a haul truck spill (MN-S-JWG 2019a). Several concerns were raised about the procedures for spill containment, cleanup, and emergency response (BNDN-JWG 2020; BRDN-JWG 2021b; CRDN-JWG 2020c), and how spills would be communicated to the communities (MN-S-JWG 2020b).

NexGen understands the concerns raised by Indigenous Groups and LPA communities and has implemented controls to address the hazards and associated effects, including feasible environmental design features and/or mitigation practices that have been implemented to avoid and minimize potential adverse effects of transportation-related risks, as detailed in the following subsections.

Two of the five scenarios selected as the focus of the assessment (Table 21.7-1; Section 21.7.2, Aquatic Release Scenario and Section 21.7.3, Terrestrial Release Scenario), could be initiated by single vehicle or vehicle-vehicle accidents, or alternatively, by vehicle-human interactions. The assessment of these scenarios is focused on the potential environmental consequences and related public and wildlife risks. However, these scenarios could also result in direct injuries or fatalities to those involved in the accidents and/or members of the public, as highlighted in during JWG engagement (BRDN-JWG 2021c). A scenario specific to vehicle-human interaction has been assessed (Section 21.7.5, Other Transportation Accidents Scenarios). Although this scenario does not identify a specific location along the transportation route, it is assumed to be relevant at key locations such as those perceived to be of higher concern (i.e., the bridge crossing and sharp turn along Highway 155 in Buffalo Narrows).

As outlined in Section 21.5.3, overall risk is measured as a function of both probability and consequence; therefore, the assessment of transportation-related risks focussed on accidents rates that are used to derive probability as opposed to absolute accident numbers. Nevertheless, accident rates can be used to project the potential incremental increase in actual accident numbers that would be Project-related. To evaluate the overall risk associated with the identified transportation-related hazard scenarios, existing (baseline) and Project-related traffic and accident rates were estimated and considered in the assessment. Existing traffic data for the transportation route along Highways 955 and 155 were sourced from Saskatchewan Government Insurance (SGI 2018).

Existing annual travel on Highways 955 and 155 is 10 MVkm and 51 MVkm, respectively. The total number of accidents reported by SGI (2018) for Highway 955 and Highway 155 is 8 and 59, respectively; with accident rates of 0.8 / MVkm and 1.16 MVkm, respectively. To facilitate direct comparison to baseline data and determination of probability, Project-related traffic data (EIS Section 5.5.4, Traffic; Table 5.5-4 and Table 5.5-5) were converted to the MVkm basis and compared with the SGI (2018) data. The results indicate that there is the potential for a total of four Project-related traffic accidents on Highway 955 and two Project-related traffic accidents on Highway 155 over the life of the mine. These incremental numbers of accidents represent the total potential number of accidents that could occur and are not specific to any of the transportation-related hazard scenarios evaluated in Sections 21.7.2 to 21.7.5. The majority of the accidents that do occur are minor in scale and would not be expected to initiate release events such as those contemplated herein. Additionally, when considering the numeric probabilities derived for each scenario, there would generally be low expectation for an event occurrence in a given year.

21.7.1.1 Mitigation Measures

All transportation-related risks would be managed through the implementation of mitigation measures and policies related to safe travel along the Project's transportation route (Table 21.7-1). Primary mitigation measures include the implementation of traffic control measures, such as training for drivers, adherence to speed limits, adjusting speed according to conditions (e.g., wildlife in the area), spill and emergency response planning, and giving pedestrians, cyclists, and wildlife the right of way.

Table 21.7-1: Transportation Hazard Scenarios Considered in the Transportation Risk Assessment and Associated Mitigations

Transportation Scenario	Accident	Effect Pathway	Interaction with the Environment	Mitigations
Aquatic release scenario	Traffic accident (e.g., single vehicle, vehicle-vehicle, vehicle-human collision)	Aquatic release of uranium concentrate or other hazardous materials	Potential for effects on surface water quality, fish and fish habitat, wildlife and wildlife habitat, and human health	▪ Speed limits along the Project's transportation route would be posted to reduce the potential for speed to contribute to or worsen the outcome of a potential accident scenario ▪ A no-travel order may be issued in the event that potentially serious or unsafe road conditions could contribute to a traffic accident scenario (e.g., icy road conditions) ▪ Staff and contractors would receive training on how to drive safely along the transportation route, including training on defensive driving techniques ▪ Staff and contractors would be advised to adjust speed in accordance with conditions (e.g., road conditions, grade, weather, bridge crossings, loads on vehicle) ▪ Staff and contractors would receive training on how to respond to emergency situations, such as an accident or spill ▪ An Environmental Protection Program and an Emergency Preparedness and Response Program would be implemented for the Project. These programs would include consideration of spill and emergency response processes that would be implemented in the event of an accidental release of uranium concentrate ▪ Any spill, release, or emergency that may harm the environment or pose a risk to public health or safety would be reported immediately, and managed and remediated in accordance with Saskatchewan's *Environmental Management and Protection Act, 2010* and The Saskatchewan Environmental Code ▪ The clean-up, treatment, and disposal of contaminated material would be handled by a certified specialized subcontractor. The spill would be cleaned up immediately and access to the affected area would be restricted, and fenced-off if feasible, to limit access to the area by people and wildlife
Terrestrial release scenario		Terrestrial release of uranium concentrate or other hazardous materials	Potential for effects on hydrogeology, terrain and soils, vegetation, and wildlife and wildlife habitat	
Atmospheric release scenario		Atmospheric release of uranium concentrate or other hazardous materials	Potential for effects on air quality and human health	
Other transportation accident scenarios	Vehicle-pedestrian collision	Vehicle-human accident	Potential for effects on human health	▪ Speed limits along the Project's transportation route would be posted to reduce the potential for speed to contribute to or worsen the outcome of a potential vehicle-human or vehicle-wildlife collision ▪ A no-travel order may be issued in the event that potentially unsafe road conditions could contribute to a traffic accident scenario (e.g., icy road conditions) ▪ Staff, contractors, and visitors would be advised to take all reasonable precautions to avoid collisions with wildlife and humans, including pedestrians, cyclists, and other vehicles ▪ Pedestrians, cyclists, and wildlife would be provided with the right of way ▪ Major wildlife use areas and movement corridors/crossings along the transportation route would be identified and communicated to drivers ▪ In instances where wildlife or people are observed on the road, staff and contractors would be advised to reduce speed ▪ Emergency services would be contacted immediately in the event of any vehicle-human collision ▪ Relevant staff or contractors would receive training on how to respond to emergency situations, such as a human-vehicle collision ▪ Staff, contractors, and visitors would be advised to adjust speed limit in accordance with conditions (e.g., road conditions, grade, weather, pedestrian, wildlife use of road)
	Vehicle-wildlife collision	Vehicle-wildlife accident	Potential for effects on wildlife and wildlife habitat	

21.7.2 Aquatic Release Scenario

21.7.2.1 Scenario Description

This scenario involves the potential for a traffic accident and subsequent release of uranium concentrate or other hazardous materials to a surface waterbody or watercourse along the proposed Project's transportation route. A release of uranium concentrate or other hazardous materials to a surface waterbody could alter water quality and sediment quality and adversely affect the health of aquatic biota, wildlife, and people in the vicinity of the spill.

This scenario is similar to Bounding Scenarios 1 and 2 in the accidents and malfunctions assessment (Section 21.6.3 and Section 21.6.4, Bounding Scenario 2: Traffic Accident [Chemical]) but differs in that it addresses a potential release to a surface water feature along the Project's broader transportation route rather than the access road. Thirty-three water features are crossed by or occur in the direct vicinity of the Project's transportation route and range in size from small unnamed creeks to larger rivers and lakes.

Of the 33 water features present, 4 were selected as the focus of this scenario: the Clearwater River, the Canoe River, Beaver Lake, and Churchill Lake. The scenario considered the potential for a traffic accident at or near the bridge crossing locations for the Clearwater River at Highway 955, the Canoe River at Highway 155, and Beaver Lake at Highway 155; and along the section of Highway 155 immediately adjacent to Churchill Lake. These water features were selected for detailed analysis because they are representative of larger aquatic environments that could be affected by a transportation-related spill.

Uranium concentrate originating from the processing plant would be packed into drums for shipment off site as described for Bounding Scenario 1 (Section 21.6.3). Fuels and chemicals potentially transported to and from the Project could include diesel, gasoline, organic solvents, LNG, hydrogen peroxide, and molten sulphur. Based on the release characterization for the non-radiological contaminants considered, the consequences of the associated releases are bounded by the potential consequences of the diesel fuel release. Therefore, the release of diesel fuel to the aquatic environment was selected as a surrogate for the non-radiological contaminant scenarios. The estimated mass of uranium concentrate, and other hazardous materials potentially released to surface water in this accident scenario, along with an assessment of the probability of occurrence, is provided in Table 21.7-2.

Table 21.7-2: Summary of Release Characterization and Probability Assessment Results for Scenarios Considered in the Transportation Risk Assessment

Transportation Scenario	Release Characterization	Assessment of Probability
Aquatic release	Release of uranium concentrate: 5,625 kg Release of fuel or other hazardous materials: ▪ diesel or gasoline = 30 m^3 ▪ organic solvents = 40 t ▪ LNG = 48 m^3 ▪ hydrogen peroxide = 11,350 L to 18,900 L ▪ molten sulphur = 25 t	2.85×10^{-04} per year for release of uranium concentrate 8.55×10^{-04} per year for release of other hazardous materials
Terrestrial release		1.18×10^{-01} per year
Atmospheric release	Release of uranium concentrate for an accident without fire: 0.56 kg or 0.16 g/s Release of uranium concentrate or other hazardous materials for accident with fire: ▪ uranium concentrate = 14.1 kg or 3.9 g/s ▪ carbon monoxide = 1,037 kg/h ▪ PAHs = 69 g/h	2.94×10^{-03} per year
Vehicle-human accident	n/a	1.60×10^{-02} per year
Vehicle-wildlife accident	n/a	6.22×10^{-01} per year

Note: Details on methods and information sources used to generate the summary values presented here are included in TSD VIII and TSD IX.
n/a = not applicable; TSD = technical support document; PAH = polyaromatic hydrocarbon; LNG = liquified natural gas.

21.7.2.2 Assessment of Potential Effects

The hypothetical effects of this transportation hazard scenario are assessed for the following intermediate components and VC discipline groups: surface water quality, fish and fish habitat, wildlife and wildlife habitat, and human health. The potential outcomes of an accidental release of uranium concentrate and diesel fuel to surface water are considered as the focus of the aquatic release scenario. Effects were assessed in terms of the potential for the release to cause toxicological and, where relevant, radiological effects on aquatic, terrestrial, and human receptors.

Uranium concentrations in surface water were predicted based on an understanding of hydrologic conditions for the assessed water features and information on the solubility of uranium in water[4]. Predicted surface water concentrations at each of the four locations for the aquatic release scenario were developed under different flow conditions (i.e., minimum, mean, and maximum), different degrees of relative mixing in the receiving environment (i.e., 5%, 25%, and 100%), and varying durations (short term [i.e., seven days] and long term [i.e., post-remediation]). Predicted sediment concentrations were estimated based on the results of a particle dispersion analysis, which considered settling of particles in the water column to the sediments. Predicted sediment concentrations at each of the four locations for the aquatic release scenario were developed for different flow conditions (i.e., minimum, mean, and maximum). Predicted sediment porewater concentrations were based on weighted-average concentrations in sediment and using a sediment-to-water partition coefficient. Predicted sediment porewater concentrations at each of the four locations for the aquatic release scenario were developed for different flow conditions (i.e., minimum, mean, and maximum). The uranium concentrate fate and transport results numeric predictions associated with surface water, sediment, and sediment porewater for the aquatic release scenario are provided in Section 9.1.4.2, Section 9.1.5.2, Section 9.1.6.2, and Section 9.1.7.2 of TSD IX, respectively.

[4] Data obtained from Cameco Corporation during the assessment accidents and malfunctions for Millennium Mine project.

Similar to Bounding Scenario 1, the assessment of effects on aquatic receptors from exposure to uranium concentrate followed the CSA Standard N288.6-22, which provides guidance for environmental risk assessments for Class I nuclear facilities and uranium mines and mills (CSA Group 2022). The following aquatic, semi-aquatic and terrestrial, and human receptors were considered in the risk assessment:

- **aquatic receptors:** macrophytes, benthic invertebrates, forage and predatory fish;
- **semi-aquatic and terrestrial receptors:** sandpiper (*Calidris alpina*), moose (*Alces alces*), and meadow vole (*Microtus pennsylvanicus*); and
- **human receptors:** the driver of the vehicle that is the subject of the accident, the first responders attending the accident, and members of the public residing in the communities along the transportation route.

The toxicological and radiation dose benchmarks applied in aquatic release scenario are the same as those described for Bounding Scenario 1.

Overall, the results of the environmental risk assessment were similar for all four water features considered in the scenario. The results indicate that the aquatic release of uranium concentrate could result in short-term effects on aquatic biota at a limited spatial scale. Sediment contamination could have longer-term effects on aquatic biota, though the effects would be limited to small areas close to the release locations. The drinking water criterion would also be exceeded for a short period following a release of uranium concentrate to surface water. No effects on semi-aquatic and terrestrial receptors are expected due to short-term ingestion of contaminated water resulting from an accident. Similar to Bounding Scenario 1, temporary and localized effects on fish and fish habitat are possible due to the expectation that remediation works below the high-water mark of a waterbody or watercourse would be required to clean up the spill.

The hypothetical effects of a release of hazardous materials to surface water are the same as those described for a diesel spill in Bounding Scenario 2 (Section 21.6.4.3, Assessment of Potential Effects); however, the hypothetical maximum size of the diesel sheen, and distance the spill would travel downstream, differ among the four water features considered in this scenario. The hypothetical maximum size of the sheen is estimated to be 30 km^2 and the hypothetical maximum distance travelled is estimated to be 48 km, based on all water features considered in this scenario.

21.7.2.3 Risk Measurement and Evaluation

Table 21.7-3 characterizes the likelihood and consequence ratings for the scenario involving a traffic accident and aquatic release of uranium concentrate or other hazardous materials to surface water. With implementation of mitigation, and in consideration of the assessed probability for this accident scenario, the likelihood was assessed as **highly unlikely**. The consequence was assessed as **moderate** based on the potential for short-term and localized exposure of aquatic and terrestrial receptors to uranium concentrate or other hazardous materials. The overall risk rating was assessed as **low**.

21.7.3 Terrestrial Release Scenario

21.7.3.1 Scenario Description

This scenario involves the potential for a traffic accident and subsequent release of uranium concentrate or other hazardous materials to the terrestrial environment. A release of uranium concentrate, or other hazardous materials could adversely affect local soils and vegetation and the health of wildlife and people in the vicinity of the spill.

This scenario is similar to that described in Section 21.7.2 for an aquatic release but involves the potential for a release to the terrestrial environment. Thus, the assumptions related to the transportation of uranium concentrate and other hazardous materials along the Project's transportation route in this scenario are the same as those described for the aquatic release scenario (Section 21.7.2). The estimated mass of uranium concentrate, and other hazardous materials potentially released to the terrestrial environment in this accident scenario, along with an assessment of the probability of occurrence, is provided in Table 21.7-2.

21.7.3.2 Assessment of Potential Effects

The hypothetical effects of this hazard scenario are assessed for the following intermediate components and VC discipline groups: hydrogeology, terrain and soils, vegetation, and wildlife and wildlife habitat. The assessment of effects for the terrestrial release scenario considered the potential outcomes of both a release of uranium concentrate and of diesel fuel to the terrestrial environment.

The area affected by a terrestrial release of uranium concentrate is anticipated to be relatively small. Considering the maximum likely size of the release (5,625 kg) and given that uranium concentrate occurs in a solid state, the area affected by a spill would be expected to be on the order of tens of square metres. If the release occurred during a precipitation event, runoff interacting with the release would be expected to contaminate a larger area. However, contamination of groundwater is considered unlikely due to the low solubility of uranium concentrate in water.

A characterization of the theoretical extent of a maximum release of up to 30 m^3 diesel fuel was considered in this scenario. The analysis was similar to that undertaken for the accidents and malfunctions Bounding Scenarios 4 and 5 and assumed that the spill would occur during unfrozen ground conditions. The results indicate that between 37.5 m^3 and 75 m^3 of soil could be contaminated, with the spill having an estimated surface area of between 42 m^2 to 119 m^2 and penetration depth of between 0.63 m to 0.9 m. There is potential for diesel to locally contaminate groundwater; however, no major migration of groundwater would be expected due to the very slow movement of groundwater in the area, which is represented by level to gently rolling plains. The behaviour of the spill during frozen ground conditions would be similar to that described for Bounding Scenarios 4 and 5. The main difference would be that the spill in this scenario would be farther from site.

Changes to soil quantity, distribution, and quality may occur as a result of a potential release of uranium concentrate and of diesel fuel, and there is potential for localized contamination and/or damage to vegetation and associated wildlife habitat, and toxicity to wildlife. However, it is assumed that the contaminated site could be cleaned up to the background level or a safe level that would be developed as a post-accident cleanup criterion. Effects on the health of wildlife VCs due to exposure to uranium concentrate and diesel fuel would be mitigated by cleaning up the spilled material and contaminated soils, and if required, by employing measures to keep wildlife away from the affected area.

21.7.3.3 Risk Measurement and Evaluation

Table 21.7-3 characterizes the likelihood and consequence ratings for the scenario involving a traffic accident and terrestrial release of uranium concentrate or other hazardous materials to surface water. With implementation of mitigation, and in consideration of the assessed probability for this accident scenario, the likelihood was assessed as **likely**. The consequence was assessed as **minor** based on the expectation that the spill would be limited in size, and remediated quickly, resulting in negligible effects on groundwater, soils, vegetation, and wildlife habitat. The overall risk rating was assessed as **low**.

21.7.4 Atmospheric Release Scenario

21.7.4.1 Scenario Description

This scenario considers the potential for a traffic accident involving a transport truck and the subsequent release of uranium concentrate or other hazardous materials to the atmosphere. The scenario may also involve a fire. The release of uranium concentrate particles or other hazardous materials to the atmosphere following a traffic accident could adversely affect the air quality in the area surrounding the accident location and result in exposure of members of the public to these substances.

If uranium concentrate drums breach in an accident scenario, there is a potential for atmospheric release of uranium concentrate. In the presence of fire, the total amount of uranium concentrate released would be greater, because the quantity released to the atmosphere could not be recovered during clean up. If the fire involves released hydrocarbons (e.g., diesel, gasoline, solvent), smoke with its toxic components (e.g., carbon monoxide, polyaromatic hydrocarbons [PAHs]) would also be released to the atmosphere.

Two possible outcomes were considered in this scenario: an accident with fire and for an accident without fire. The estimated mass of uranium concentrate, carbon monoxide, and PAHs potentially released to the atmosphere in this accident scenario, along with an assessment of the probability of occurrence, is provided in Table 21.7-2.

21.7.4.2 Assessment of Potential Effects

The hypothetical effects of this hazard scenario are assessed for the following intermediate components and VC discipline groups: air quality and human health. The approach used to assess effects for this scenario is similar to Bounding Scenario 3. Concentrations of contaminants in air versus distance were estimated using the ALOHA model, applying the airborne source term described in Table 21.7-2. The results were expressed in terms of two weather conditions (i.e., typical and worst-case weather conditions), as described for Bounding Scenario 3 (Section 21.6.5). The model predictions were then compared to relevant benchmarks to assess the potential for adverse effects on the public. The applicable benchmarks in this scenario are the ERPGs and AEGLs, which are summarized in Bounding Scenarios 3 and 6, respectively.

The modelling results for an accident without a fire are as follows:

- **Uranium concentrate:** the AEGL-2 and ERPG-2 would be exceeded within 53 m of the release location for the worst-case weather condition, and within less than 10 m of the release location for typical weather conditions. The AEGL-3 and ERPG-3 would be exceeded within 23 m of the release location for the worst-case weather condition, and within less than 10 m of the release location for typical weather conditions.

The modelling results for an accident with fire are as follows:

- **Uranium concentrate:** the AEGL-2 and ERPG-2 would be exceeded within 245 m of the release location for the worst-case weather condition, and within 91 m of the release location for typical weather conditions. The AEGL-3 and ERPG-3 would be exceeded within 92 m of the release location for the worst-case weather condition, and within 44 m for typical weather conditions.
- **Carbon monoxide:** the AEGL-2 and ERPG-2 would be exceeded within 510 m of the release location for the worst-case weather condition and within 132 m of the release location for typical weather conditions. The AEGL-3 and ERPG-3 would be exceeded within 238 m of the release location for the worst-case weather condition, and within 66 m for typical weather conditions.

- **PAHs:** the AEGL-2 and ERPG-2 would be exceeded within 164 m of the release location for the worst-case weather condition, and within 30 m of the release location for typical weather conditions. The AEGL-3 and ERPG-3 would be exceeded within 11 m of the release location for the worst-case weather condition, and within less than 10 m for typical weather conditions.

The estimates for typical weather conditions represent the more probable outcome of a fire originating from a hazardous materials spill – the probability of the worst-case weather condition is less than 5% of the probability of the typical weather condition.

These results indicate that serious or life-threatening health effects on the public would be improbable to occur as a result of this scenario as air quality conditions exceeding the AEGL-2 and AEGL-3 would be limited to within approximately 500 m of the release location, even in consideration of the worst-case weather condition. Based on the length of the corridor and sparsity of population centres, the prospect of such a release close to a population centre is highly improbable. Potential exposure to uranium concentrate or hazardous materials, if any, would be more plausibly associated with first responders; however, exposure would be mitigated by following documented emergency response planning provisions that would include use of personal protective equipment (e.g., self-contained breathing apparatus).

Effects on other intermediate components and VC groups such as soils, vegetation, and wildlife habitat are not expected for the assessed scenario. The atmospheric release would be of a short-term duration (less than a few hours), and therefore, surface accumulation and extended exposure to soils, vegetation, and wildlife habitat are not expected.

21.7.4.3 Risk Measurement and Evaluation

Table 21.7-3 characterizes the likelihood and consequence ratings for the scenario involving an accident resulting in an atmospheric release of uranium concentrate or other hazardous materials. With implementation of mitigation, and in consideration of the assessed probability for this accident scenario, the likelihood was assessed as **unlikely** for the typical weather condition to **highly unlikely** for the worst-case weather condition. The consequence was assessed as **minor** for both weather conditions based on the transient nature of potential effects, the expectation that there would be little prospect of public exposure, and that those with the highest potential for exposure (i.e., first responders) would be protected by emergency response planning provisions. The overall risk rating was assessed as **low** for both weather conditions.

21.7.5 Other Transportation Accident Scenarios

21.7.5.1 Scenario Description

Other transportation accident scenarios that could occur along the Project's transportation route include the potential for vehicle-wildlife and vehicle-human collisions. Accidents along the transportation route could adversely affect individual animals as well as members of the public.

Traffic and safety were frequently mentioned as a key interest and concern in LPA communities (NexGen 2019b). Indigenous Groups, LPA community members, and trappers participating in the 2021 workshop expressed concerns about potential risks to human safety from increased traffic volumes and hauling trucks on the roads (including from large trucks), narrow roads, dust, and loose gravel (TSD IV: MN-S; TSD V.2: CRDN; MN-S-JWG 2019a; NexGen 2019b). The CRDN commented that spruce grouse that have been hit by vehicles are often observed on the side of the road (CRDN-JWG 2020b). The BNDN expressed concern about wildlife (i.e., bear and deer) mortality on the highways from increased traffic (BNDN-JWG 2021c). A collision between a Project vehicle and wildlife along the Project's transportation route could involve virtually any species found in the surrounding area. The most prominent species that occur in the area include timber wolf, black bear, moose, woodland caribou, mule deer (*Odocoileus hemionus*), elk, and beaver. Typical bird species include gray jay (*Perisoreus canadensis*), common loon, white-throated sparrow (*Zonotrichia albicollis*), American redstart (*Setophaga ruticilla*), Canada warbler (*Cardellina canadensis*), and ovenbird (*Seiurus aurocapilla*). Game birds found in the region include species of grouse, geese, ducks, and ptarmigan.

A collision involving a Project vehicle and a member of the public (e.g., pedestrian, cyclist) could hypothetically occur at any location along the Project's transportation route but would be more likely in more populated areas or near communities. While the transportation route does not traverse any cities or otherwise densely populated areas, several communities occur along the route including La Loche, Bear Creek, Buffalo Narrows, Beauval, and Green Lake.

21.7.5.2 Assessment of Potential Effects

The hypothetical effects of this hazard scenario are assessed for the following VC discipline groups: wildlife and wildlife habitat and human health.

Vehicle-wildlife collisions along the sections of Highways 155 and 955 considered in the aquatic release scenario are expected to increase during the Project as a result of a corresponding increase in Project-related traffic but are predicted to be relatively infrequent. The other transportation accident scenario is based on government data that showed no recorded collisions between 2014 and 2018 along Highway 955 (NexGen 2019c). However, it is acknowledged that collisions with wildlife are often not reported, and that those that are reported typically involve larger mammals such as deer or moose, which are more likely to cause damage to vehicles; collisions with small to medium-sized mammals and birds often are not reported (Oxley et al. 1974). Despite trends in reporting, vehicle mortality along the transportation route could potentially affect any wildlife species. Effects on wildlife can include injury or mortality of individuals in a population.

The frequency of wildlife-vehicle mortalities is often related to traffic volume and speed, and lower speeds have been shown to reduce the risk of vehicle-wildlife collisions (van Langevelde et al. 2009). Therefore, adherence to speed limits and adjusting speed according to conditions are important mitigations that would be emphasized as part of driver training for relevant staff and contractors. With implementation of these and other mitigations outlined above, the effects are expected to result in a minor increase in injury or mortality to individual animals from vehicle-wildlife collisions relative to existing conditions.

The potential for vehicle-human collisions along the Project's transportation route can pose a risk to members of the public, with the effects of a collision ranging from minor injury to death. However, preventative actions would be implemented, as described in Table 21.7-1, to proactively reduce the risk of accidents. Despite best efforts to mitigate risks to public health and safety as related to vehicle-human collisions, there is a limited possibility of these accidents occurring, creating potentially catastrophic effects at the individual level.

21.7.5.3 Risk Measurement and Evaluation

Table 21.7-3 characterizes the likelihood and consequence ratings for the scenarios involving vehicle-human and vehicle-wildlife collisions. With implementation of mitigation, and in consideration of the assessed probability for this accident scenario, the likelihood was assessed as **highly unlikely** for a vehicle-human collision and as **very likely** for a vehicle-wildlife collision. The severity of the consequence was assessed as **major** (or

catastrophic for a vehicle-human collision), and as **minor** for a vehicle-wildlife collision. The overall risk rating was assessed as **moderate** for a vehicle-human collision and **low** for a vehicle-wildlife collision.

21.7.6 Summary of Transportation Scenarios

The results of the risk assessment for transportation scenarios are summarized in Table 21.7-3. The overall risk ratings indicate that the aquatic release, terrestrial release, atmospheric release, and vehicle-wildlife accident scenarios have a low risk. The overall risk associated with vehicle-human accident scenario was determined to be moderate. Moderate risk scenarios were deemed to represent a tolerable level of risk in consideration of proposed safeguards that reduce the risk level to ALARP.

Table 21.7-3: Risk Level Determination for Bounding Scenarios Considered in the Transportation Risk Assessment

Transportation Scenario	Likelihood	Consequence	Risk Level
Aquatic release	Highly unlikely	Moderate	Low
Terrestrial release	Likely	Minor	Low
Atmospheric release	Unlikely to highly unlikely[1]	Minor	Low
Vehicle-Human accident	Highly unlikely	Major-Catastrophic	Moderate
Vehicle-Wildlife accident	Very likely	Minor	Low

1) Probabilities given for both the typical (unlikely) and worst-case (highly unlikely) weather scenarios. Consequence and overall risk are the same in both cases.

21.8 Key Findings

This accidents and malfunctions assessment considered a range of plausible scenarios, outside of day-to-day operations, that could result in effects on the environment and public safety, as well as environmental design features and mitigation measures that would be implemented to reduce such effects. It considered both on-site accidents and malfunctions and transportation risks along Highways 955 and 155.

From 93 potentially hazardous situations identified in an initial hazard identification for accidents and malfunctions, six scenarios were carried forward for detailed analysis including risk evaluation. Of these, five scenarios were determined to be low risk overall. The acid plant tail gas scrubber failure scenario was deemed to be low to moderate risk. Given that the risk would be managed to be ALARP, this risk was deemed to be tolerable, and no further mitigation was deemed necessary.

Similarly, the transportation risk assessment considered five main scenarios, including variations such as different waterbody locations of spills and accidents. Of these five main scenarios, four were deemed to be low risk and one was deemed to be moderate risk overall. The vehicle-human contact was found to be moderate risk, which represents a tolerable level of risk in consideration of proposed safeguards that reduce the risk level to ALARP.

Overall, it is anticipated that potential effects could largely be addressed through engineering design, and compliance with industry best practices that reduce risks associated with hazard scenarios to ALARP. Under this condition, the risks may be characterized as tolerable.

21.9 References

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Rook I Project

Environmental Impact Statement

Section 22 Assessment of Effects of the Environment on the Project

Submitted to:
Canadian Nuclear Safety Commission
Saskatchewan Ministry of Environment

Submitted by:
NexGen Energy Ltd.
3150-1021 W Hastings St
Vancouver, BC
V6E 0C3

November 2024

Executive Summary

Section Purpose

Section 22 of the Environmental Impact Statement (EIS) assesses effects on the Rook I Project (Project) that may occur in association with natural hazards (e.g., extreme weather events, wildfires, seismic events) and influences of nature, including climate change. The assessment included identification of mitigation measures that would be implemented to reduce or eliminate potential risks. The assessment of effects of the environment on the Project used a standard, structured risk assessment approach, and incorporated Indigenous and Local Knowledge.

Setting

At a regional scale, the Project would be located within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system, approximately 40 km east of the Saskatchewan-Alberta border and 640 km northwest of the city of Saskatoon.

The regional location and setting are key factors in the identification of natural hazards that may affect the Project. Seven natural hazard categories were deemed to have the potential to cause adverse effects on the Project:

- wildfire;
- drought;
- major precipitation events;
- severe snowstorms;
- tornadoes / severe thunderstorms;
- extreme temperatures; and
- seismic events.

With the exception of seismic events, climate change has the potential to alter the occurrence and severity of these natural hazards from changes in future precipitation and temperature regimes, which would modify how weather-related hazards could affect the Project. Therefore, understanding the current climate and predicting future climate trends in the regional setting was undertaken to support the evaluation of Project design parameters.

Risk Assessment Approach (Section 22.4)

The general approach for the assessment of effects of the environment on the Project included:

- natural hazard scenario identification;
- environmental design feature evaluation;
- risk measurement, as a function of likelihood and consequence; and
- risk evaluation.

Natural hazards in the regional setting of the Project were identified using publicly available information, the knowledge base of the Project team, and information received through engagement. The identification process entailed a review of published natural hazard frequencies, experience, and case studies at similar types of operations in similar environmental settings, and scientific judgement based on the regional environment.

The proposed environmental design features considered in the assessment were primarily proactive and preventative measures, and secondarily mitigation measures or administrative controls intended to reduce the risks throughout the Project lifespan. These design features and controls would be implemented to avoid or minimize potential adverse effects of natural hazards and climate change on the Project. After considering these environmental design features and mitigations, the residual risk associated with each hazard scenario was estimated as a function of likelihood (i.e., how often the hazard might occur) and consequence (i.e., severity of the hazard).

The likelihood and consequence of each hazard scenario were combined to assign an overall risk level to each scenario of either High, Moderate, or Low. For scenarios that were classified as a risk level of High, additional mitigation measures were required to lower the severity of the potential effects of the environment on the Project. For scenarios with a Moderate or Low risk level, the risk was considered tolerable if risk reduction activities would reduce the risk associated with these scenarios to As Low as Reasonably Practicable.

Assessment of Effects of Natural Hazards (Section 22.6)

The results of the assessment indicated that the overall risk level associated with most hazard scenarios was Low, except for three hazard scenarios where the overall risk levels were Moderate; these were associated with wildfires and extreme temperatures.

Wildfire

The specific wildfire hazard scenarios with a risk level of Moderate included:

- fire reaching primary fuel and liquified natural gas storage and the surface explosives magazine; and,
- damage to, or loss of, Project infrastructure.

The proposed Project layout has considered the safety of the locations for the primary fuel storage, liquified natural gas storage and the surface explosives magazine. At the site, fuel storage would be located in an area that minimizes the likelihood of exposure, even if a fire were to jump a Project fire break. The Emergency Response Plan would include the requirement to establish an emergency response team and provide training for rescue techniques, firefighting, and appropriate use of emergency response equipment in response to such an event. The on-site fire response team would be trained and equipped to respond to both industrial structure protection and wildfire situations. Despite these controls, a wildfire could cause Project infrastructure to be damaged or destroyed. Although the site infrastructure would be constructed primarily of concrete and steel, it is expected that there would be major damage that would require site activities to temporarily cease.

Extreme Temperature

The specific extreme temperature hazard scenario with a risk level of Moderate was:

- the freezing of pipes and equipment that may be used to manage air, fuel, water, sewage, and tailings.

Given the Project location, site infrastructure would be operated in a relatively cold climate; therefore, all Project infrastructure would be designed, constructed, and operated to be resilient to extreme cold. Pipes would be buried at depths below the frost line, or if above ground, would be insulated and heat traced. Project infrastructure would be inspected regularly and maintained to prevent or repair cold weather damage.

Conclusions (Section 22.7)

A structured and systematic risk assessment process identified natural hazards and potential effects on the Project. The process considered environmental design features and mitigation practices that would be implemented to avoid or minimize potential adverse effects following the hierarchy of controls. It is anticipated that potential effects could largely be addressed through engineering design, and compliance with codes and standards that provide sufficient margins of safety to prevent damage to Project infrastructure from environmental hazards. The potential risks of all environmental hazards on the proposed Project, and the effectiveness of mitigations, would continue to be assessed according to the risk management processes described in the Integrated Management System Manual and the Environmental Protection Program, and in accordance with provincial, Canadian Nuclear Safety Commission, and other regulatory requirements. Likewise, the potential risks associated with climate change would be considered in engineering and design as a part of the continual improvement process, and through implementation of the Climate Adaptation Framework.

Abbreviations and Units of Measure

Abbreviation	Definition
CNSC	Canadian Nuclear Safety Commission
EA	Environmental Assessment
EIS	Environmental Impact Statement
HVAC	heating, ventilation, and air conditioning
JWG	Joint Working Group
LPA	local priority area
NBCC	National Building Code of Canada
NexGen	NexGen Energy Ltd.
NPAG	non-potentially acid generating
PAG	potentially acid generating
PMP	probable maximum precipitation
Project	Rook I Project
WRSA	waste rock storage area
UGTMF	underground tailings management facility

Unit	Definition
%	percent
km	kilometre
km/h	kilometres per hour
m	metre

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22 ASSESSMENT OF EFFECTS OF THE ENVIRONMENT ON THE PROJECT

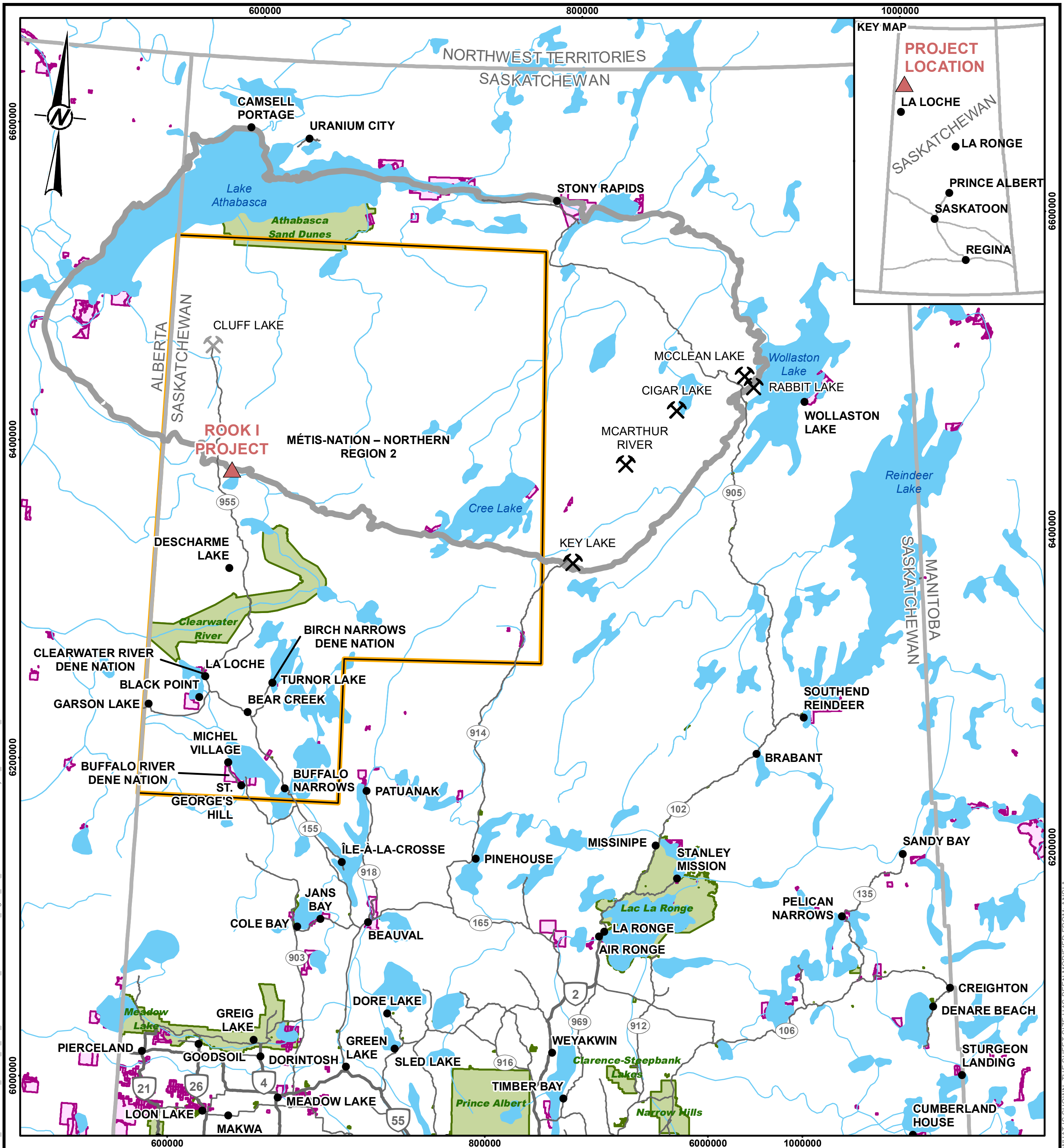
22.1 Introduction

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The Project would be located approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the Northern Village of La Loche, and 640 km northwest of the city of Saskatoon (Figure 22.1-1). The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Patterson Lake is at the interface of the Boreal Shield and Boreal Plain ecozones. Access to the Project would be from an existing road off Highway 955 (Figure 22.1-2), with on-site worker accommodation serviced by fly-in/fly-out access.

Effects of the environment on the Project are associated with risks of natural hazards (e.g., extreme weather events, wildfires, seismic events) and influences of nature, including climate change, on the Project. The assessment of potential effects of the environment on the Project includes identification of natural hazards deemed to have reasonably possible consequences for the proposed Project, and the mitigation measures that would be implemented to reduce or eliminate potential risks.

The assessment follows a structured approach through identifying hazards and considering scenarios that may affect Project infrastructure and activities, identifying environmental design features to avoid or minimize the risk of hazards, and classifying each hazard scenario according to the likelihood and consequence to arrive at an overall risk level.

This section complements the Environmental Impact Statement (EIS) Section 21, Accidents and Malfunctions. Accidents and malfunctions refer to events or conditions caused by industrial hazards that are not part of the normal activity or operation of a project as planned. Accident and malfunction scenarios are evaluated in Section 21.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN BOUNDARY
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROJECT LOCATION
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

0 100 200

1:3,500,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LOCATION OF THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 22.1-1

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\22_Effects_of_the_Environment\8_5x11\20144150_Fig22_1-1_Location-of-the-RookI-Project_NoTitleblock_Rev0.mxd PRINTED ON: 2023-02-10 AT: 8:02:42 AM

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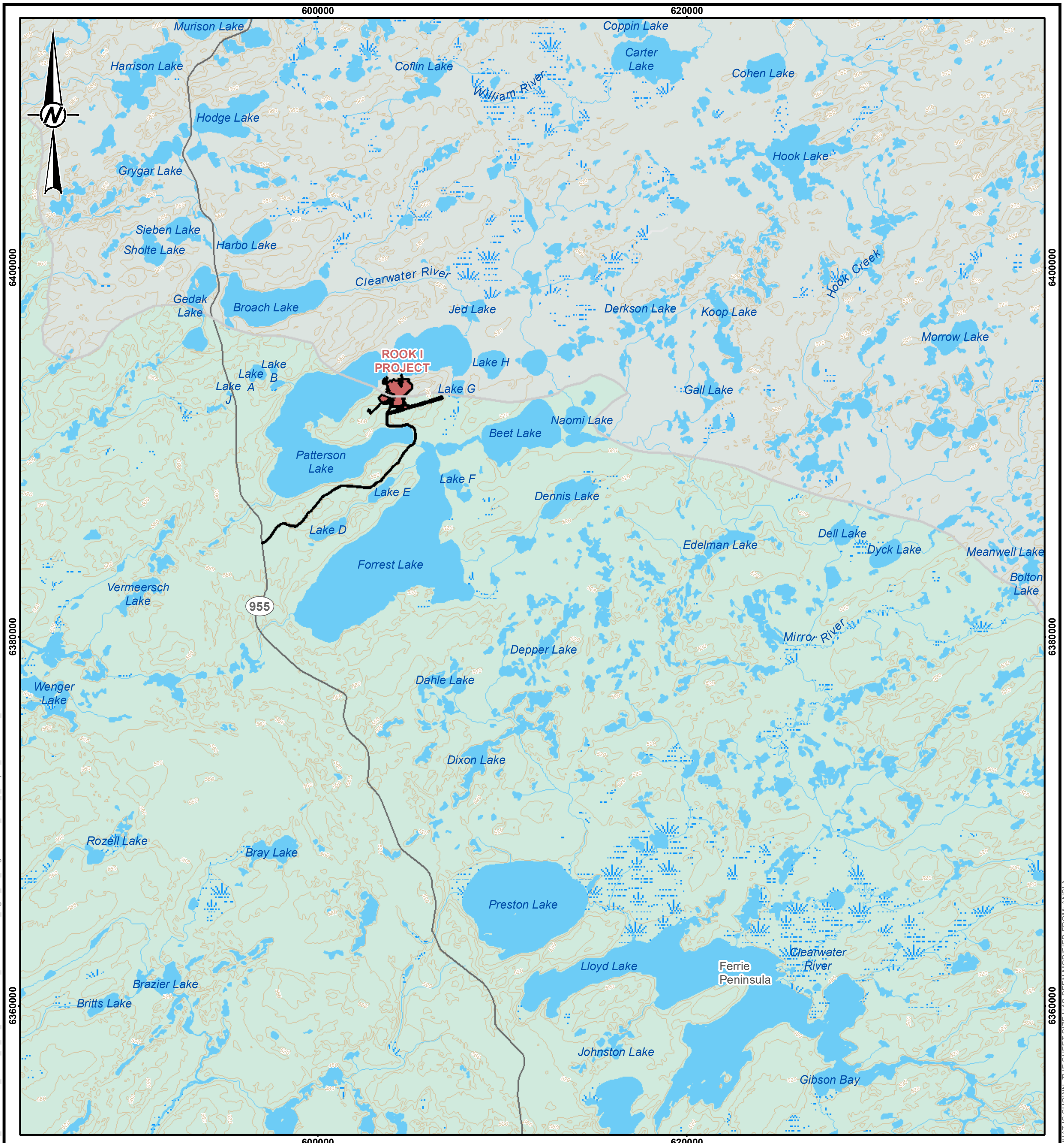
25mm



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN
- WATERBODY
- WETLAND
- WOODED AREA
- PROPOSED PROJECT FOOTPRINT

0 5 10
1:300,000 KILOMETRES

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 22.1-2

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\22_Effects_of_the_Environment\8_5x11\20144150_Fig22_1-2_Regional-Area_Rook_I_Project_NoTitleblock_Rev0.mxd PRINTED ON: 2023-02-10 AT: 8:03:07 AM

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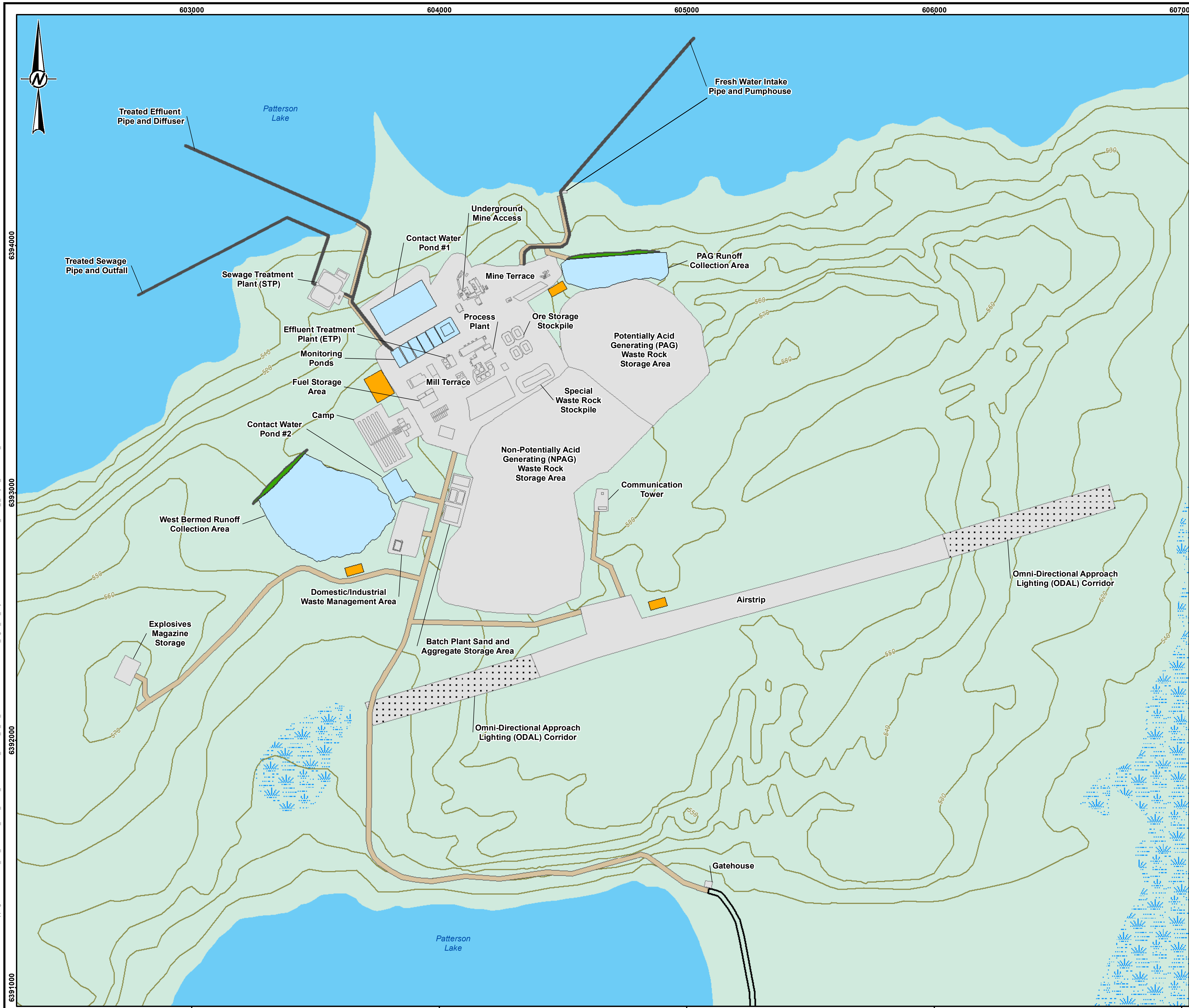
22.1.1 Project Summary

The Project would include the following key facilities to support the extraction and processing of uranium from the Arrow deposit for transportation off site (Figure 22.1-3):

- underground mine development;
- process plant buildings, including uranium concentrate packaging facilities;
- paste tailings distribution system;
- underground tailings management facility (UGTMF);
- potentially acid generating (PAG) waste rock storage area (WRSA);
- non-potentially acid generating (NPAG) WRSA;
- special waste rock[1] and ore storage stockpiles;
- surface and underground water management infrastructure, including water management ponds, effluent treatment plant, and sewage treatment plant;
- conventional waste management facilities and fuel storage facilities;
- ancillary infrastructure, including maintenance shop, warehouse, administration building, and camp;
- airstrip and associated infrastructure; and
- access road to Project and site roads.

[1] Special waste rock is mine rock that is mineralized with insufficient grade to be considered ore (i.e., greater than 0.03% of triuranium octoxide [U_3O_8] and less than 0.26% U_3O_8). All special waste would be temporarily stored in the special waste rock stockpile.



LEGEND

- ELEVATION CONTOUR (10 m INTERVAL)
- WATERBODY
- WETLAND
- WOODED AREA
- INTAKE OR DISCHARGE PIPE
- ACCESS ROAD
- CONTACT WATER CONTAINMENT BERM
- OMNI-DIRECTIONAL APPROACH LIGHTING (ODAL) CORRIDOR
- PROJECT INFRASTRUCTURE
- SITE ROAD
- TOPSOIL STORAGE AREA
- WATER MANAGEMENT POND

0 0.5 1

1:15,500 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021 AND UPDATED JUNE 8, 2021 .
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

LAYOUT OF INFRASTRUCTURE AND FACILITIES FOR THE ROOK I PROJECT

CONSULTANT

wsp

PROJECT	20144150	SCALE AS SHOWN	REV.	0

FIGURE 22.1-3

25mm

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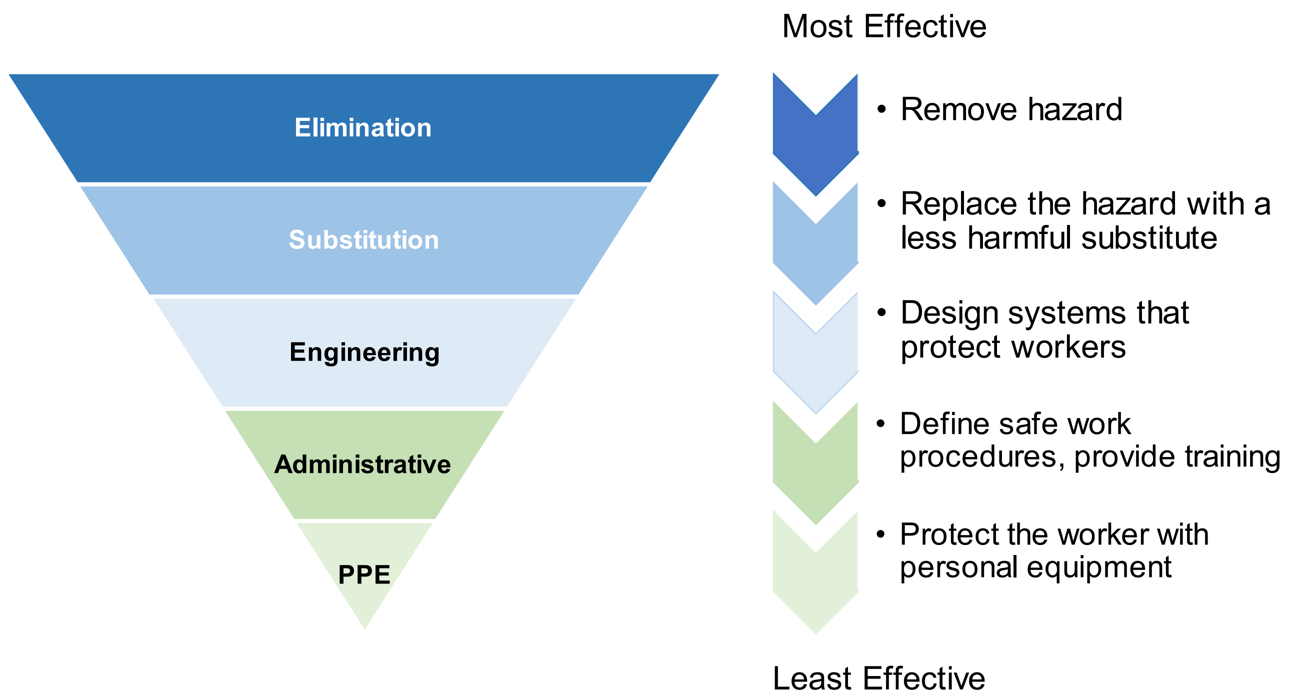
22.1.2 Risk Management

NexGen's objectives of risk management are to reduce all health, safety, and environmental risks to acceptable levels and to keep radiological exposures to workers and the environment as low as reasonably achievable. Risks are assessed for consequence and severity and managed through the application of controls. Controls are implemented to mitigate hazards and the associated risks identified through risk assessment processes and to lower the risks to acceptable levels. The controls applied are specific to the nature and commensurate with the level of the risk. Controls are documented, tracked, and routinely evaluated for effectiveness as outlined in the Integrated Management System Manual. When possible, a hierarchy of controls approach is followed when selecting controls to mitigate risk: NexGen prevents, eliminates, and reduces risks with multiple types and layers of controls (Figure 22.1-4).

Figure 22.1-4: Hierarchy of Controls



PPE = personal protective equipment.

Adaptive management is a related process that may be initiated in response to identified risks. Adaptive management may be used to reduce the uncertainty associated with hazards or risks when systems are highly dynamic and when there are gaps in information or understanding, opportunities to learn and gain new information, and opportunities to adjust activities or practices to realize improvements. Uncertainty is mitigated through application of a rigorous and systematic approach to learning from experience, gaining knowledge, adapting planning, and improving confidence in an approach. Adaptive management deploys sequential steps to:

1. assess and formulate the problem;
2. design and develop a solution to address the problem;
3. implement the solution;
4. monitor for outcomes and effects;
5. evaluate monitoring results against established criteria; and
6. adjust the approach with consideration for results.

These risk management objectives and processes provide the foundation for the assessment of effects of the environment on the Project.

22.2 Regulatory Context

Project details referenced in this section are further described in Section 5, Project Description, which includes additional engineering design and environmental considerations. The primary mitigation tools used to prevent or reduce the consequence of potential adverse effects of the environment are sound engineering design and planning (i.e., management practices) so that Project infrastructure would be able to withstand both typical and extreme environmental conditions. As discussed in the Section 5, the Project would incorporate design features to minimize effects of the Project on the environment and vice versa during all Project phases, including times when unexpected environmental conditions could occur at the site. Applying mitigation follows the precautionary principle, which states that “where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation” (*Canadian Environmental Protection Act, 1999*).

The Environmental Assessment (EA) for the proposed Project is being carried out under the C*anadian Environmental Assessment Act*, *2012*, as described in Section 1.3, Regulatory Framework. Section 19(1)(h) of the C*anadian Environmental Assessment Act*, *2012* indicates that the EA must consider “any change to the designated project that may be caused by the environment”, or in other words, how the environment could adversely affect the Project.

This section of Environmental Impact Statement (EIS) meets the requirements of the Canadian Nuclear Safety Commission (CNSC) *Generic Guidelines for the Preparation of an Environmental Impact Statement – Pursuant to the Canadian Environmental Assessment Act, 2012* (CNSC 2021), REGDOC-2.9.1 Environmental Protection: Environmental Principles, Assessments and Protection Measures (CNSC 2020), and the Terms of Reference (NexGen 2019) submitted to the Saskatchewan Ministry of Environment. The CNSC generic guidelines for the preparation of an EIS (CNSC 2021) stipulate that the information in Appendix A.3.9 of REGDOC-2.9.1 (CNSC 2020) be used to assess the potential effects of the environment on a project. As per REGDOC-2.9.1, the assessment should also consider any potential effects of climate change on a project, including an assessment of whether the project might be sensitive to changes in climate conditions during its lifespan. As per the Terms of Reference (EIS Appendix 1A, Concordance Tables), the assessment of the effects of the environment on the Project will be consistent with Section 5 of the *Canadian Environmental Assessment Act*, *2012*, which describes the effects as “the environmental effects that are to be taken into account in relation to an act or thing, a physical activity, a designated project . . . .”

Accordingly, this section of the EIS identifies changes to or effects on the Project that may be caused by natural hazards, the likelihood and severity of the changes or effects, and mitigation planned to avoid or limit the changes or effects, and includes climate change effects as they relate to the Project.

22.3 Incorporation of Indigenous and Local Knowledge

Indigenous and Local Knowledge included in the assessment of effects of the environment on the Project was shared by potentially affected First Nations and Métis Groups (collectively referred to as Indigenous Groups) and local priority area (LPA)[2] community members through the Project engagement process. The overall approach and methods for the incorporation of Indigenous and Local Knowledge into the EA is discussed in detail in Section 3, Indigenous and Local Knowledge. Issues and concerns related to the effects of the environment on the Project raised by Indigenous Groups and LPA community members, and how these comments were addressed, are summarized in Appendix 2B, Summary of Issues and Concerns Identified by Indigenous Groups, and identified and addressed in this assessment, where applicable.

A key source of Indigenous and Local Knowledge is the Project-specific studies completed by Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, and Indigenous Rights and Knowledge studies (henceforth referred to collectively as Indigenous Knowledge and Traditional Land Use Studies). The Indigenous Knowledge and Traditional Land Use Studies that were reviewed and referenced in the EIS as technical support documents (TSDs) are listed below:

- TSD II (BNDN), Birch Narrows Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited’s Proposed Rook I Project;
- TSD III (BRDN), Buffalo River Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited’s Proposed Rook I Project;
- TSD IV (MN-S), Métis Nation – Saskatchewan Northern Region 2 Traditional Land Use & Diet Study for the NexGen Rook I Project;
- TSD V.1 (CRDN), Preliminary Identification of Issues and Concerns Related to the Proposed NexGen Energy Ltd. Rook I Project in the Patterson Lake Area; A Review; Clearwater River Dene Nation; Traditional Land Use and Occupancy Mapping Interviews; 2010 – 2016;
- TSD V.2 (CRDN), Clearwater River Dene Nation Indigenous Rights and Knowledge Survey Related to the Proposed NexGen Energy Ltd. Rook 1 Project in the Patterson Lake Area;
- TSD V.3 (CRDN), Socio-economic and Harvest Study; Clearwater River Dene Nation; NexGen Rook 1 Project; and

[2] The LPA consists of the local communities closest to the Project that would experience most of the Project effects and for which NexGen would prioritize local training, employment, and business opportunities for the Project. These communities are located along, or accessed via, Highways 155 and 955 north of the intersection of Highways 155 and 925.

- TSD VI (YNLR), Provision of Athabasca Denesųłiné Traditional Knowledge, Land Use and Occupancy Information for the NexGen Rook I Project Environmental Assessment.

Another key source of Indigenous and Local Knowledge was information shared by Indigenous Group representatives during Joint Working Group (JWG) meetings. The JWGs represent an agreed-upon primary engagement mechanism as outlined in the Study Agreements signed by each Indigenous Group and NexGen. More details regarding the JWGs can be found in Section 2, Indigenous, Regulatory, and Public Engagement, and Section 3. There are four JWGs with the Project's primary Indigenous Groups (Section 2.4.1, Identification of Indigenous Groups for Engagement):

- Clearwater River Dene Nation (CRDN) JWG;
- Métis Nation – Saskatchewan (MN-S) JWG representing MN-S Northern Region 2 (NR2);
- Birch Narrows Dene Nation (BNDN) JWG; and
- Buffalo River Dene Nation (BRDN) JWG.

The leadership of each Indigenous Group selected their JWG participants with consideration of group diversity; where possible, members included Elders, youth, different genders, a range of ages, and land users around Patterson Lake.

In addition to the Indigenous Knowledge and Traditional Land Use Studies and JWGs, Indigenous and Local Knowledge shared during specific engagement activities undertaken through the EA development process was incorporated into the assessment, where appropriate. These engagement activities included, but were not limited to:

- community information sessions held in four locations in 2019 (NexGen 2019);
- site tours;
- comments from the CRDN (2019a) on the Cluff Lake Mine licence renewal;
- other formal and informal meetings;
- workshops with specific groups (e.g., Fur Block N-19 trapper's workshop); and
- environmental and socio-economic baseline data collection.

Comments submitted by Indigenous Groups on the Project Description (CRDN 2019b; MN-S 2019; YNLRO 2019; ACFN 2019; CNSC 2019) were also reviewed for applicable Indigenous and Local Knowledge.

Indigenous and Local Knowledge related to effects of the environment on the Project was incorporated into the assessment by viewing the information as complementary and influential alongside scientific information. Where possible, knowledge from each potentially affected Indigenous Group or LPA community member was described separately and cited accordingly. Where information is described for multiple potentially affected Indigenous Groups, they are collectively referred to as "Indigenous Groups" throughout the assessment.

Specific references to Indigenous and Local Knowledge, and Project comments and concerns related to effects of the environment on the Project raised by Indigenous Groups and LPA community members, are included in the applicable subsections of this assessment.

Issues, concerns, and comments received during community engagement and JWG meetings, as well as information from Indigenous Knowledge and Traditional Land Use Studies were considered in the design of the

Project and included topics such as potential effects of changing climatic conditions and extreme events (e.g., fire and flooding), as well as potential mitigation options. Many of the comments from Indigenous Groups were based on the effects of changes in the environment on wildlife and terrestrial ecology, as well as disturbance to cultural sites (i.e., cabins), which they have observed in the recent past in comparison to how things used to be based on their historical knowledge of their traditional territory.

22.4 Risk Assessment Approach

The assessment of the effects of the environment on the Project included a risk assessment of how natural hazards might affect Project infrastructure and activities during different phases of the Project. The general approach for the assessment of effects of the environment on the Project included: 1) natural hazard scenario identification; 2) environmental design feature evaluation; 3) risk measurement, as a function of likelihood and severity; and 4) risk evaluation.

22.4.1 Natural Hazard Scenario Identification

The assessment of the effects of the environment on the Project began by identifying natural hazards that could adversely affect the Project. Natural hazards were identified using the knowledge base of the Project team, including information received through engagement. The identification process entailed a review of published frequency of natural hazards, where available, experience and case studies at similar types of operations in similar environmental settings, and scientific judgement based on the regional environment. Rationale for the selection of each natural hazard included in the assessment is provided in Section 22.6.1, Wildfire, through Section 22.6.7, Seismic Events.

Natural hazards that have the potential to cause adverse effects on the Project include the following:

- wildfire;
- drought;
- major precipitation events;
- severe snowstorms;
- tornado/severe thunderstorms;
- extreme temperatures; and
- seismic events.

A hazard scenario identifies how a specific natural hazard may adversely affect the Project and provides a basic description of the potential effects to infrastructure and activities. Hazard scenarios for the Project, with the exception of seismic events, were developed based on climate-infrastructure interactions and climate vulnerabilities by Project activity presented in Appendix 22B, Climate–Infrastructure Interactions, and summarized in Section 22.5, Climate Change.

Where potential for adverse effects on the construction of the Project, infrastructure, or operational performance were identified, design features and mitigation practices were proposed to avoid and minimize potential adverse effects. The hierarchy of controls was applied to Project planning and design, such that feasible engineering solutions that would eliminate the potential hazard scenario were applied first. Potential effects of the environment would largely be addressed through engineering design and compliance with codes and standards that provide sufficient margins of safety to prevent damage to Project infrastructure from environmental forces (e.g., national building codes to protect against a seismic event).

22.4.2 Application of Environmental Design Features

As part of the risk measurement process, the assessment considered proposed environmental design features, planning (i.e., management practices), and other mitigation intended to reduce the risks throughout the life of the Project. This application of environmental design features followed the hierarchy of controls described in Section 22.1.2 (Figure 22.1-1) and considered those that are mainly proactive, preventative measures intended to prevent an occurrence or limit its effect, and mitigations, which are mainly administrative controls and reactive measures intended to reduce the effect of a hazard during or after its occurrence. After considering the environmental design features and mitigations, the residual hazard scenario (i.e., the overall triggering event and consequence, including mitigation) was assessed for risk.

22.4.3 Risk Measurement

The residual risk associated with each hazard scenario was estimated as a function of likelihood (i.e., frequency) and consequence (i.e., severity). Likelihood and consequence were estimated based on industry and operational experience, Project-specific conditions, and the knowledge base of the Project team.

Likelihood can be described as how often the hazard scenario might occur (Table 22.4-1). The likelihood applies to the entire scenario, which includes the triggering natural hazard (e.g., wildfire, extreme precipitation, seismic event) and the consequence (e.g., combustion of Project infrastructure overtopping of storage ponds). The likelihood index ranges from an “Almost Certain” event to a “Highly Unlikely” event and is more formally defined through the events per year value. As these categories are based on estimates of future occurrences, order-of-magnitude of events per year values are defined for each likelihood level. For example, the “Likely” level ranges from more than 1 event in 100 years up to 1 event in 10 years.

Table 22.4-1: Likelihood Index

Index	A Almost Certain	B Very Likely	C Likely	D Unlikely	E Highly Unlikely
Events per year	>1 occurrence in 1 year	≤1 occurrence in 1 year and >1 occurrence in 10 years	≤1 occurrence in 10 years and >1 occurrence in 100 years	≤1 occurrence in 100 years and >1 occurrence in 1,000 years	≤1 occurrence in 1,000 years

> = greater than; ≤ = less than or equal to.

The consequence index ranges from “Negligible” to “Catastrophic” (Table 22.4-2) for the hazard scenario. Consequence is informed by design-based mitigation, proposed management plans, and response plans.

Table 22.4-2: Consequence Index

1 Negligible	2 Minor	3 Moderate	4 Major	5 Catastrophic
No measurable effect, no stoppage in Project activity, negligible damage to, or failure of, Project components	Minor effect on Project component, no stoppage in Project activity, minor but repairable damage to, or failure of, infrastructure	Moderate effect on Project component or activity, short Project delay (i.e., less than a month), substantial damage to, or failure of, infrastructure	Major effect on Project component or activity, some Project delay (i.e., more than one month and less than 6 months), major damage to, or failure of, infrastructure	Catastrophic effect on Project, early closure, major damage to, and failure of, infrastructure

22.4.4 Risk Evaluation

After categorizing the residual likelihood and consequence of hazard scenarios, overall risk levels were assigned to each scenario. Overall risk levels were assigned according to the Project Risk Matrix (Table 22.4-3). The Project Risk Matrix is a resource for communicating results, prioritizing risks for risk management, and assessing the effectiveness of risk mitigation options. The colour ranking system for each risk level in the Project Risk Matrix and the associated management actions are shown in Table 22.4-4. The risks were ranked according to three priority levels: low (green), moderate (yellow), and high (red).

The risk levels for the hazard scenarios identified for each natural hazard are presented in Section 22.6.1 through Section 22.6.7. The residual risk levels shown at the end of each subsection reflect design features and mitigations that have been incorporated into the Project.

Table 22.4-3: Rook I Project Risk Matrix

Index		Consequence				
		1 Negligible	2 Minor	3 Moderate	4 Major	5 Catastrophic
Likelihood	A Almost Certain	Low	Moderate	Moderate	High	High
	B Very Likely	Low	Low	Moderate	High	High
	C Likely	Low	Low	Moderate	Moderate	High
	D Unlikely	Low	Low	Low	Moderate	High
	E Highly Unlikely	Low	Low	Low	Moderate	Moderate

Table 22.4-4: Risk Matrix Priority Levels

Risk Level	Management Action
High	High-risk scenarios have major to catastrophic severity with likelihood ranging from unlikely to almost certain. For high-risk scenarios, additional mitigation measures are required to lower the severity of the potential effects of the environment on the Project.
Moderate	Moderate-risk scenarios have minor to catastrophic severity with likelihood ranging from highly unlikely to almost certain. In many cases, risk reduction activities will reduce the risk associated with these scenarios to As Low as Reasonably Practicable.
Low	Low-risk scenarios have negligible to moderate severity with likelihood ranging from highly unlikely to almost certain. The likelihood of these scenarios can be effectively managed through application of planned controls and/or the consequence would be low in magnitude.

22.5 Climate Change

Climate change has the potential to change future precipitation and temperature regimes, which would modify how weather-related hazards could affect the proposed Project. Therefore, understanding the current climate and the future climate trends is important when evaluating Project design parameters. To support this understanding, a climate change dataset for the Project was developed (Appendix 22A, Climate Change Dataset Summary Report). This appendix summarizes the existing available local and regional climate data related to the current climate and projected future climate.

These climate change projections were carried forward to an evaluation of climate-infrastructure interactions that have been identified for the Project (Appendix 22B, Section 22B3, Climate-Infrastructure Interactions). Climate-infrastructure interactions include any potential interaction of a climate event (e.g., extreme precipitation, extreme temperatures, high winds, lightning, storms, changes in snowfall) with a given infrastructure component (including both surface and underground). Risks associated with these interactions are assessed in Section 22.6, along with mitigations to reduce risks. Climate vulnerabilities by Project activity have also been identified for the Project (Appendix 22B, Section 22B4, Climate Vulnerabilities by Project Activity). Climate vulnerabilities of planned Project activities are considered during the Project phases including Construction, Operations, and Decommissioning and Reclamation (i.e., Closure). The vulnerabilities expand on the climate-infrastructure interactions considered in Appendix 22B, Section 22B3 by considering how Project activities associated with infrastructure may be vulnerable to climate change.

It is worth noting that some members of Indigenous Groups have observed and experienced the effects of climate change on the environment, including shifts in ecology, weather, and natural cycles, and changes in the distribution and abundance of wildlife populations and vegetation, which has affected their ability to practice traditional activities across their territories (TSD II: BNDN; TSD III BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR).

Information from Appendix 22A and Appendix 22B is used to assess each of the weather-related hazards listed in Section 22.6.1 through Section 22.6.6. Given that climate change is occurring but there remains uncertainty in the future projections of climate change, NexGen would consider climate risks as a part of the continual improvement process, as outlined in TSD XXII, Climate Adaptation Framework.

22.6 Assessment of Effects of Natural Hazards

22.6.1 Wildfire

22.6.1.1 Hazard Scenario Identification

Wildfires occur when fuel (e.g., timber), weather (e.g., heat, humidity), and ignition factors successfully combine. Forest fire characteristics (i.e., occurrence and severity) are closely related to weather and climate. Wildfires are natural and common in the boreal forest; however, large, uncontrollable wildfires pose a risk to the Project, including to its workers and infrastructure. Heat waves, droughts, and regional weather patterns (e.g., high-pressure ridges) can increase the risk and alter the behaviour of forest fires and are anticipated to increase fire frequency (Hart et al. 2019).

Saskatchewan has one of the highest levels of forest fire activity in Canada (SRC 2018). Saskatchewan is over 50% forested, and most of this area is boreal forests (Brandt 2009). Boreal forests are well known as fire-prone ecosystems (Johnson 1992). The Project is located within the Boreal Plain Ecozone, near the boundary between

Boreal Plain and Boreal Shield ecozones. The estimated fire cycle for the Boreal Plain Ecozone is 263 years, and 99 years for the Boreal Shield Ecozone (Parisien et al. 2004). The timing of greatest forest fire risk to the area in which the Project would be located is during the late spring and summer months when dry conditions mix with persistent high temperatures (i.e., April through August). A characteristic feature of the area is the prevalence of forest fire activity and the related influence of this frequent fire regime on the vegetative communities.

Wildfire activity has occurred relatively recently in the vicinity of the proposed Project, as demonstrated by forests that are less than 40 years of age in the area near the Project site, and region in general. Figure 22.6-1 shows the wildfire history for Saskatchewan from 1945 to 2020 and highlights the recency of local fire activity (Saskatchewan Public Safety Agency [SPSA] 2021). This aligns with the experience of Indigenous Groups who have observed an increase in frequency and magnitude of forest fires in northern Saskatchewan in the recent past (TSD II: BNDN; TSD V.1: CRDN; TSD V.2: CRDN). Indigenous Groups have also reported that increasing wildfires in northern Saskatchewan, in addition to the Government of Saskatchewan's forest fire response policy in remote areas have led to the destruction of several cabins and productive harvesting areas that community members depend on (TSD III BRDN; TSD IV:MN-S; TSD V.1: CRDN; TSD V.2: CRDN).

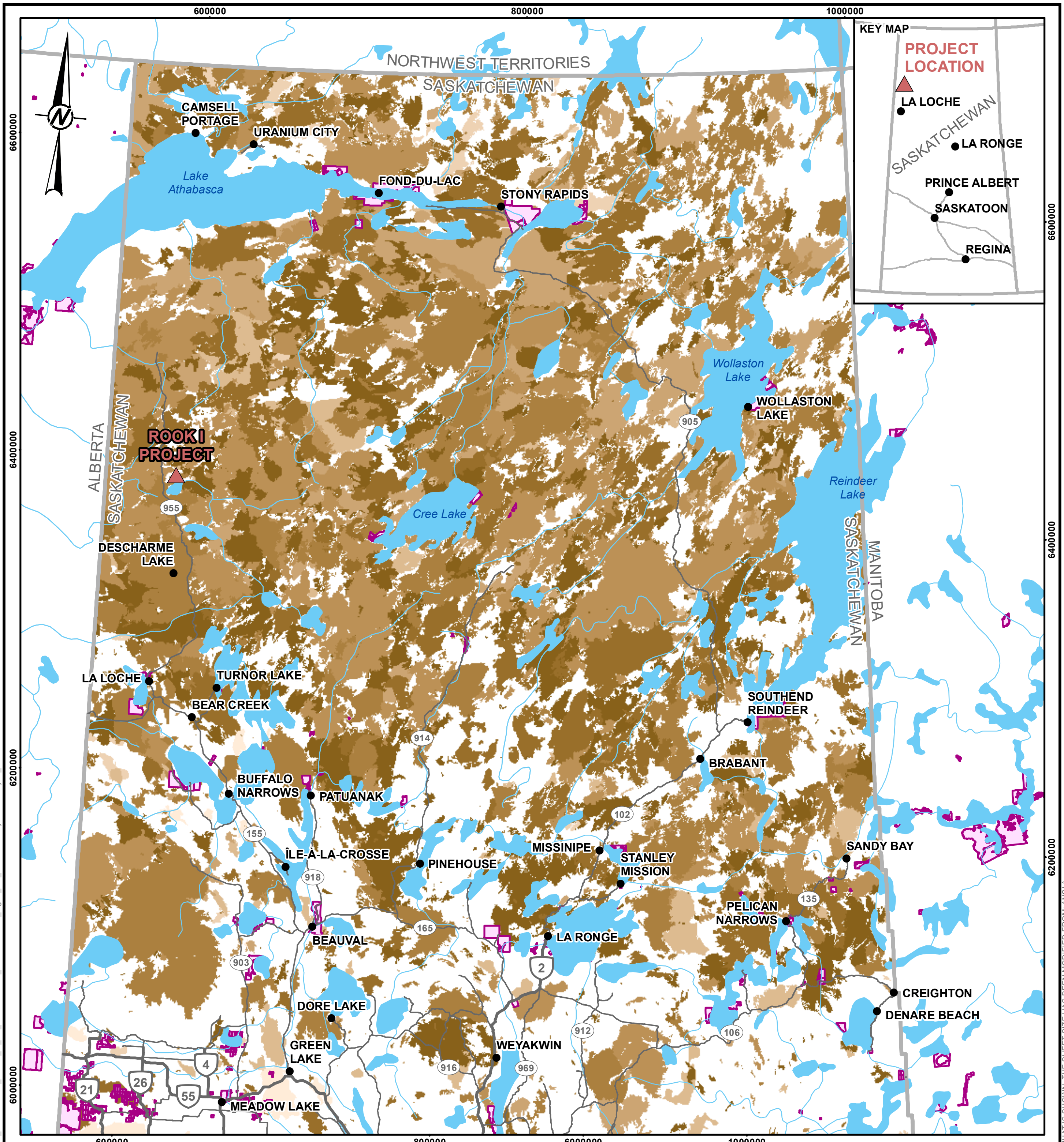
The projected future climate extreme values from the median (i.e., 50% exceedance probability) for the 2050s and 2080s indicate a future that is likely to be warmer and wetter on an annual basis. Temperature is projected to increase, resulting in increased warm nights and reduced ice and frost days. Precipitation is also projected to increase, resulting in increased annual total wet-day precipitation and very wet and extremely wet days. The overall effect of climate change on wildfires is difficult to predict, but it can be conservatively assumed that fire intensity may increase due to warmer temperatures, in addition to frequency increasing due to additional lightning storms and longer fire seasons each year.

Exposure to Smoke; Loss of Access

Wildfires could affect worker safety both underground (i.e., through air intakes) and at surface, and related smoke could reduce visibility and cause a need to restrict outdoor activities and to provide appropriate equipment to protect workers. Even in the case of distant fires, poor visibility from smoke could impede the movement of equipment and activities on site and restrict the landing/take-off of aircraft. Road access to and from the site could become limited or restricted.

Fire Reaching Fuel Storage Tanks / Surface Explosives Magazine; Damage to Infrastructure or Reclaimed Areas

In the event that a wildfire was to occur in close proximity of the Project, there would be a potential risk of contact with the primary fuel and liquified natural gas storage tanks and the surface explosives magazine, thereby potentially creating a risk of fire or explosion. A wildfire could cause Project infrastructure to be damaged or destroyed. A wildfire in the vicinity of the Project site could also result in a loss of reclaimed areas created during progressive reclamation (i.e., Operations) and at Closure.



LEGEND

- ● POPULATED PLACE
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- WATERBODY
- ▲ PROJECT LOCATION

WILDFIRE HISTORY

- 1945 -1949
- 1950 -1959
- 1960 -1969
- 1970 -1979
- 1980 -1989
- 1990 -1999
- 2000 - 2009
- 2010 - 2019
- 2020

0 100 200
1:3,500,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
3. WILDFIRE HISTORY OBTAINED FROM SASKATCHEWAN PUBLIC SAFETY AGENCY (SPSA)

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

SASKATCHEWAN WILDFIRE HISTORY, 1945 - 2020

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	JMC	2023-02-24	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-24		
CHECK	JMC	2023-02-24	**FIGURE 22.6-1**	
REVIEW	MM	2023-02-24		

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Environmental Design Features

The risks associated with wildfires would be managed through design criteria and management controls. Design criteria for Project infrastructure and ancillary facilities incorporated fire protection as appropriate in accordance with the National Building Code of Canada (NBCC; NRCC 2020a) and the National Fire Code of Canada (NRCC 2020b). The Project would be designed, constructed, operated, and decommissioned in accordance with the requirements outlined in *CSA N393 Fire Protection for Facilities That Process, Handle, or Store Nuclear Substances* (CSA Group 2013). The following are examples of environmental design features that would be implemented for the Project:

- Process facility structures would be constructed primarily of concrete and steel, which are less susceptible to fire.
- Fire separation distances between yard hydrants would be spaced a maximum of 90 m apart to provide proper building coverage and accessibility by fire truck.
- The camp would be designed with a perimeter roadway to allow the on-site fire truck access to all areas. This road would be located far enough from the camp to not hinder evacuation of users from the building.
- The design of infrastructure would incorporate fire protection services as required by applicable codes and federal/provincial legislation, as a minimum.
- Facilities would include the required fire protection services (e.g., manual break glass stations, thermal detectors, manual pull stations, smoke detectors, carbon monoxide detectors), as appropriate.
- A fire protection system, consisting of lake intake, fresh water pumps, break tanks, and fire protection pumps strategically spaced around the Project site, would be on site to provide water for firefighting purposes. The fire protection system would meet the fire water demand for firefighting purposes for a duration of two hours as per the National Fire Protection Agency requirements (NFPA 2020).
- Fuel bays would ventilate directly to an exhaust airway to minimize impact to operations in the event of a fire at site.
- Roll-up fire doors would be installed at the entrances to some structures to facilitate fire containment. Key buildings would also have fire-suppression sprinklers.
- Back-up generators would be available to run power to critical systems in the event that power supply from the primary power plant is interrupted.
- Fire breaks would be installed at the Project site that would both align with fire break requirement assessments that would be completed for the Project and consider any input provided by the SPSA.

Mitigation

Mitigation would be implemented to avoid and limit the potential effects of wildfires on worker safety and critical infrastructure, including but not limited to the following:

- NexGen would comply with fire hazard ratings and provincial restrictions and carefully manage activities that could potentially increase the risk of fire, especially during high-risk periods.
- As part of the Emergency Preparedness and Response Program, primary and secondary escape routes, defined muster points, and evacuation processes would be developed to make sure workers and other people on site can get out of the camp and surface facilities in a calm and controlled manner.

- A medical/emergency services area would be in a centralized location at site, which includes a first aid room, observation room, offices, and a fire truck and ambulance with a garage.
- The mine rescue team would be trained and certified in effective structural and wildland firefighting techniques.

The MN-S commented about the need for contingency plans for forest fires and whether NexGen would have a safety and response program for forest fires (MN-S-JWG 2019). During that JWG meeting, NexGen discussed that they would have an evacuation plan. The Fire Protection Program would describe the processes for effective fire prevention, control, and mitigation to maintain protection of human health and safety, the environment, and Project infrastructure. The Fire Protection Program would be supported by the Emergency Preparedness and Response Program, which would outline the processes for effective emergency prevention, preparedness, response, and mitigation. The Fire Protection Program and Emergency Preparedness and Response Program would include the information necessary to satisfy the wildfire prevention and preparedness planning requirements outlined in *The Wildfire Act, 2015* and The Wildfire Regulations.

22.6.1.2 Risk Measurement and Evaluation

Table 22.6-1 characterizes the likelihood of occurrence and consequence rankings of potential wildfire effects during Construction, Operations, and Closure. The context for each risk level is provided below.

Table 22.6-1: Wildfire Risk Level Determination for the Rook I Project

Hazard ID	Hazard Scenario	Project Phase	Likelihood	Consequence	Risk Level
FF-01	Danger to worker safety, discomfort, and unhealthy working conditions due to smoke inhalation	All phases	Likely	Minor	Low
FF-02	Loss of access to the site (i.e., roads and airstrip)	All phases	Likely	Minor	Low
FF-03	Fire reaching primary fuel and liquified natural gas storage tanks and the surface explosives magazine	All phases	Likely	Major	Moderate
FF-04	Damage to or loss of Project infrastructure	Construction Operations	Likely	Major	Moderate
FF-05	Loss of reclaimed areas	Operations Closure	Likely	Minor	Low

FF-01: Exposure to smoke

Wildfires could affect worker safety, and related smoke could reduce visibility and cause a need to restrict unnecessary outdoor activities, as well as mine and process plant operations, and/or provide appropriate equipment to protect workers. The proposed safety systems, Fire Protection Program, and Emergency Response Plan would provide capable and rapid detection and response to a wildfire threat. Fire protection systems would be established to protect key buildings and certify the safety of personnel. If required, worker evacuation would be initiated according to the evacuation plan as defined in the Emergency Response Plan. Combined with the likelihood of **Likely**, the consequence for danger to worker safety due to smoke inhalation is assessed as **Minor**, and the risk level is evaluated as **Low**.

FF-02: Loss of access

Given that there is only one main access road to the Project site, particular care would be taken to keep site access open by maintaining fire breaks around key Project infrastructure (e.g., access road, airstrip) as appropriate, in consultation with the SPSA. Secondary egress from the Project site would be available by water in the case that the access road or airstrip becomes incapacitated. The Emergency Response Plan would define primary and secondary escape routes, muster points, and evacuation processes to make sure all people can get out of the camp and surface buildings in a calm and controlled manner. NexGen personnel would maintain contact with the SPSA, particularly when there are active fires in the region, to confirm there is sufficient time to evacuate workers, if it's deemed necessary. Combined with the likelihood of **Likely**, the consequence for loss of access to the site is assessed as **Minor** and the risk level is evaluated as **Low**.

FF-03: Fire reaching fuel storage tanks or the surface explosives magazine

In the event that a wildfire was to occur in close proximity of the Project, there would be a potential risk of contact with the primary fuel and liquified natural gas storage tanks and the surface explosives magazine, thereby potentially creating a risk of fire or explosion with these products. The site layout has considered the safety of the proposed location for the primary fuel and liquified natural gas storage tanks and the surface explosives magazine. Fuel storage would be located within the site in a location that minimized the likelihood of exposure, even if a fire were to "jump" a Project fire break. The Emergency Response Plan would include the requirement to establish an emergency response team and provide training for rescue techniques, fire-fighting, and appropriate use of emergency response equipment in response to such an event. If a wildfire did contact the primary fuel and liquified natural gas storage tanks and surface explosives magazine, it is expected that there would be major damage to Project infrastructure that would require Project activities to temporarily cease. Combined with the likelihood of **Likely**, the consequence for contact with primary fuel and liquified natural gas storage tanks and the surface explosives magazine is assessed as **Major** and the risk level is evaluated as **Moderate**.

FF-04: Damage to infrastructure

A wildfire could cause Project infrastructure to be damaged or destroyed. Although the site infrastructure would be constructed primarily of concrete and steel, it is expected that there would be major damage that would require Construction or Operations to temporarily cease. The on-site fire response team would be trained and equipped to respond to both industrial structure protection and wildfire situations. Combined with the likelihood of **Likely**, the consequence for damage or loss of Project infrastructure is assessed as **Major** and the risk level is evaluated as **Moderate**.

FF-05: Damage to reclaimed areas

A wildfire in the vicinity of the Project site could result in a loss of reclaimed areas created during progressive reclamation (i.e., Operations) and at Closure. As described above, particular care would be taken in maintaining cleared fire breaks around the Project site, as appropriate. If there were a loss of reclaimed areas, additional reclamation efforts would be completed, unless the reclaimed area is mature enough such that fire constitutes part of a natural cycle. Combined with the likelihood of **Likely**, the consequence for loss of reclaimed areas is assessed as **Minor** and the risk level is evaluated as **Low**.

22.6.2 Drought

22.6.2.1 Hazard Scenario Identification

Droughts are extended periods of drier-than-normal conditions (Dingman 2002). Drought conditions would generally be considered a temporary, but prolonged, period of abnormally low precipitation over more than a season, rather than the normal seasonally dry conditions (Dingman 2002). Droughts are typically characterized in terms of severity (i.e., how dry it is), as well as duration (i.e., how long it lasts), and as either meteorological or hydrological drought. Persistent meteorological drought (i.e., deficit of precipitation) can, over time, lead to hydrological drought (i.e., deficit of water on the landscape). Hydrological drought is characterized by moisture regimes, water levels, and stream flows in the surrounding watershed being lower than the expected normal ranges for the area. These drought-like conditions can subsequently affect water availability that is required for Construction and Operations. Persistent drought conditions can also cause the area surrounding the Project to be more susceptible to wildfires (Section 22.6.1) during all phases of the Project.

During all Project phases, water demands would need to be met through a combination of capture of mine water and permitted withdrawal from Patterson Lake. The sustainability of the Patterson Lake water source, including under climate change scenarios, has been evaluated as part of the hydrology assessment (Section 9, Hydrology), which found that the Project's effects on the water balance of Patterson Lake would be very small and likely unmeasurable.

As discussed in Section 22.5, Climate Change, the projected future climate extremes indicate a warmer and wetter climate on an annual basis. Temperature is projected to increase, which may result in warm nights and reduced ice and frost days. Precipitation is also projected to increase, which may result in increased annual total wet-day precipitation, very wet days, and extremely wet days. Overall, climate change is anticipated to increase the water supply available in Patterson Lake over time.

Inadequate Water Supply

During Operations, adequate water availability would be required to meet processing (e.g., crushing, grinding, milling) and waste management (e.g., tailings storage) demands. Inability to meet water availability demands would impact mining and processing activities.

Drought Conditions Affecting Revegetation

During Operations (i.e., progressive reclamation activities) and Closure, adequate water availability in reclaimed areas would be a key component to successful reclamation, and drought conditions may affect the successful establishment of vegetation used in the reclamation of the site. Unsuccessful revegetation activities may result in reclamation activity delays, additional costs of adjusting or repeating revegetation, and increased erosion potential for the period while revegetation is unsuccessful.

Environmental Design Features

The risks associated with drought would be managed through design criteria and water management processes. Environmental design features for Construction include limiting the Project footprint to the extent practicable to minimize areas that would require reclamation. Water supply needed for all phases of the Project would be sourced from Patterson Lake. As a water source, Patterson Lake is less susceptible to drought because it has a large lake volume relative to the Project's water supply needs. Because much of the runoff to Patterson Lake moves through the shallow subsurface, the time for water generated during wet periods (i.e., spring runoff or rainfall events) to reach Patterson Lake is extended over a longer period compared to surface runoff. Process water for Operations would be recycled as much as possible to minimize the requirements for fresh water. Water management planning would be undertaken using a risk-based approach considering both routine and non-routine Project conditions and would be periodically re-evaluated throughout the Project lifespan to optimize water usage. During Construction and Operations, there would be an increase of water being returned to Patterson Lake (i.e., with more water being released to Patterson Lake than being withdrawn). This increase is on account of collecting and treating groundwater recovered from the underground mine workings.

Mitigation

During Construction and Operations, a Preliminary Decommissioning and Reclamation Plan would be developed updated at least every five years to reflect changing site-specific conditions. Prior to transitioning to Closure, a Detailed Decommissioning and Reclamation Plan would be developed to reflect mitigations necessary to avoid and limit the effects of drought on revegetation efforts, as required.

- During Operations, progressive reclamation and revegetation would be undertaken using native vegetation species appropriate for the conditions.
- At Closure, native vegetation, comprised in part of drought-resistant species, would be used for reclamation.
- During Operations and Closure, adaptive management would be applied to certify reclamation objectives are met.

22.6.2.2 Risk Measurement and Evaluation

Table 22.6-2 characterizes the likelihood of occurrence and consequence rankings of potential drought effects during Construction, Operations, and Closure.

Table 22.6-2: Drought Risk Level Determination for the Rook I Project

Hazard ID	Hazard Scenario	Project Phase	Likelihood	Consequence	Risk Level
DR-01	Inadequate water supply for Construction and Operations	Construction Operations	Highly Unlikely	Moderate	Low
DR-02	Drought results in conditions unsuitable for successful revegetation	Operations Closure	Unlikely	Negligible	Low

DR-01: Inadequate water supply

Water supply for all phases of the Project would be augmented with withdrawal from Patterson Lake, which has a large volume relative to projected withdrawals and a substantial subsurface baseflow component that moderates inflows throughout the year, making Patterson Lake less susceptible to drought. During Operations, use of recycled treated water would reduce the amount of fresh water required. The Project would result in a net increase in flows to Patterson Lake during Construction and Operations due to the dewatering of the underground mine. Results of the climate change modelling for hydrology (Section 9.4.1, Waterbody Water Surface Elevations) indicated that, on an annual basis, Patterson Lake is anticipated to have an increase to water surface elevation. Given the above rationale, the probability of drought conditions affecting water supply for Construction and Operations is assessed as **Highly Unlikely.** Combined with the consequence for the hazard scenarios associated with drought assessed as **Moderate**, the risk level is evaluated as **Low**.

DR-02: Drought conditions affecting revegetation

Native, drought-resistant vegetation species would be used for reclamation; however, drought conditions may still affect the successful establishment of some vegetation used in reclamation of the site, particularly if the drought corresponds to an immature standing crop. The probability of drought conditions affecting reclamation efforts is assessed as **Unlikely**, as adaptive management would be applied to certify reclamation objectives are met, and Closure would be managed for several years after mining ceases. The consequence for unsuccessful revegetation is assessed as **Negligible** as there would be no stoppage in Project activity and revegetation of disturbed areas would be repeated. The likelihood, combined with the consequence, results in the risk level being evaluated as **Low**.

22.6.3 Major Precipitation Events

22.6.3.1 Hazard Scenario Identification

A major precipitation event (e.g., severe rainstorms, snowmelts, or flooding) could result in water levels in a watershed being outside the predicted flow range and conditions being wetter than anticipated. For example, a 1:100-year flood is a flood event that has a 1 in 100 chance (1% probability) of being equalled or exceeded in any given year.

Precipitation is also projected to increase in the region due to climate change, which may result in increased annual total wet-day precipitation, very wet, and extremely wet days. The 1:100-year, one day rainfall events for the Project site, equivalent to 75.8 mm precipitation, are projected to increase by 2% relative to the modelled baseline period by the 2050s and 14% by the 2080s at the 50th percentile level. The annual precipitation in the 2050s is projected to increase by 7% at the 50th percentile. The projected highest monthly increases in the 2050s would occur in the late fall, winter, and spring, while small changes are expected in the summer. The 2080s annual precipitation is projected to increase by 8%, with the largest increases occurring in the fall, winter, and spring (Appendix 22A).

Probable maximum precipitation (PMP) is the greatest depth of precipitation for a given duration that is meteorologically possible for a watershed or a given storm area at a particular location and a particular time of year, with no allowance made for long-term climatic trends (WMO 1986). The one-day PMP values for the Project site, equivalent to 490 mm precipitation, are projected to increase by 12% relative to the baseline period by the 2050s and 16% by the 2080s at the 50th percentile.

Impeded Movement

Major precipitation events could result in worker safety issues, such as slippery surfaces and reduced visibility. Heavy downpours and runoff could increase the probability of a vehicle accident as a result of reduced visibility and poor road conditions on site as well as affect airport operations. Increased precipitation could impede the movement of equipment and activities on the Project site and cause road washouts that might limit access to the Project site. Major precipitation events may also cause flooding in the building areas and may result in structural damage of buildings or infrastructure.

Water Management Infrastructure

Major precipitation events have the potential to result in peak discharges of runoff from ore and waste rock storage facilities. Runoff from facilities that store mineralized materials such as special waste rock, PAG waste rock, and ore would be collected and self-contained before being directed to site runoff ponds. Self-containment for runoff from mineralized materials has been sized to contain PMP events. Runoff from the NPAG WRSA would be directed to a runoff pond.

Mine Inflow

Major precipitation events have the potential to cause a mine inflow event. A mine inflow event occurs when an unexpected surge in groundwater or surface water caused by a major precipitation event floods the mine shaft and/or underground workings. Mine flooding could be caused by a surface flood or ingress of groundwater. Underground flooding could occur due to water inflow from the host rock formations, water inflow from upper layers through a compromised shaft lining, and rockfall during stope and shaft development. The Project would be fully contained in the competent crystalline basement rocks. Groundwater flows in the vicinity of the Project would be primarily controlled by local shear and fault zones that are well characterized for lateral and vertical extent as well as hydraulic material properties. Mine inflows at the Project were estimated to be less than those measured at existing uranium operations in Saskatchewan.

Ore and Waste Rock Storage

Extreme precipitation may cause failure of slope stability of the PAG WRSA, NPAG WRSA, and the special waste rock and ore storage stockpiles during Operations. Slope stability failure is possible during and following Closure for the WRSAs. Extreme rainfall and snowmelt events could result in an increase in surface water runoff and, subsequently, erosion of the engineered cover systems for the WRSAs following Closure.

Environmental Design Features

The risks associated with major precipitation events would be managed through design criteria and management practices. The NBCC (NRCC 2020a) provides for factors of safety to account for possible extreme weather and would form the design basis for Project-related buildings and structures to prevent damage to infrastructure from such events.

For the access road, all existing culverts, where practicable, would be extended to maintain existing drainage patterns, or new culverts would be installed to accommodate the wider road constructed for the Project.

The Project would consider major precipitation events in the design of the water management infrastructure so that contact water (i.e., water that may have been physically or chemically altered by construction, mining, or processing activities) and non-contact water (i.e., water that has not been physically or chemically altered by construction, mining, or processing activities) can be appropriately managed to prevent uncontrolled releases to the environment. Site water infrastructure includes systems that collect and convey precipitation runoff. Site water infrastructure would be designed to maximize the diversion of non-contact surface runoff or natural site runoff water away from developed features during Construction and Operations.

Precipitation and snow melt runoff that come into contact with potentially contaminated areas would be captured, collected, directed to site runoff ponds or collection areas, followed by monitoring and treatment as required, prior to release. All ponds and collection areas for contact water that may be mineralized or radiologically contaminated would be designed to accommodate a PMP 24-hour event. The ponds and collection areas (e.g., special waste rock stockpile, PAG WRSA) would be self-contained such that they would retain initial precipitation events in associated ponds. These ponds are designed to limit their catchments to the specific mineralized source, so no precipitation from other sources would enter these features. An additional contingency pond, similar to the size of the monitoring pond, would be included in the Project design to provide flexibility for site water management.

Ditches and culverts that convey runoff would be sized to accommodate anticipated precipitation events. Collection ditches and culverts would convey water to site runoff ponds. Collection systems from mineralized zones would be sized to accommodate a PMP 24-hour event. Diversion ditches and perimeter berms would be designed to divert clean non-contact water away from any disturbed areas or facilities where that water may become contaminated. Non-contact water run-on from surrounding catchments would be captured in diversion ditches designed to withstand adjacent facility design events. The minimum standard for diversion ditches would be to size to accommodate 1:100 year, 24-hour precipitation event. Swales would be constructed on surface-graded pads where ditches are not possible, and where the initial anticipated contributing precipitation would not warrant a full ditch.

NexGen has incorporated mine inflow risks into the design and operation of the underground mine. For example, mine workings would be isolated from high-permeability strata with a hydrostatic liner (i.e., liner that is resistant to groundwater pressure) in shafts. Shaft siting and grading would be completed to avoid surface runoff accumulation that could flood the mine. The mine dewatering system would be designed, maintained, and monitored to control the amount of groundwater inflow. The exhaust shaft would be equipped with a secondary emergency escapeway system in the event of an emergency requiring secondary egress. Permanent refuge stations would be located underground within the fresh air circuit.

Extreme precipitation may cause failure of slope stability of the PAG and NPAG WRSAs, and the special waste rock and ore storage stockpiles. The special waste rock and ore storage stockpiles would be contained by perimeter berms to retain a PMP event. The berms would provide some protection from slope stability failures. The PAG and NPAG WRSAs would be constructed at the Closure WRSAs landform slope angle (i.e., nominally 4:1, subject to further stages of engineering), reducing the risk of slope stability failure. Nonetheless, localized channel and gulley erosion may occur at the surface, and this erosion would be repaired as necessary with minimal effect on the Project. Progressive reclamation of the WRSAs slopes would occur when possible, during Operations, and runoff generated on the NPAG and PAG landforms would be diverted from the slope toes to reduce the risk of slope stability failure.

During Closure, extreme rainfall events could result in an increase in surface water runoff and, subsequently, erosion of the PAG and NPAG cover systems. Snowmelt events could also lead to soil erosion of the cover systems. The risk of erosion is reduced by the Closure landform design slope of 4:1 and establishment of vegetation on the cover system. The final WRSAs landforms would be designed to shed runoff using well established landform design practices such as the inclusion of swales or geomorphic design. The erosion likely to occur in this scenario identification consists of portions of the cover system becoming eroded and requiring repair, rather than the complete removal of the surface cover, which is not deemed plausible.

Mitigation

Mitigation measures would be implemented during all phases of the Project to avoid and limit the effects from major precipitation events on site water infrastructure and underground mine workings, including but not limited to the following:

- Vehicle and aircraft traffic would be reduced or deferred during major precipitation events.
- Aircraft landings and takeoffs would be restricted during periods of low visibility per Canadian Aviation Regulations and Standards.
- To maintain channel integrity, both diversion ditches and collection ditches would be provided with erosion control measures reflective of ditch slopes and flows rates, where required.
- Routine inspection and maintenance of containment and conveyance structures (i.e., roadside ditches and culverts) would be conducted to limit the risk of road washout.
- Routine inspection and maintenance of local erosion of cover systems constructed as part of progressive reclamation and during Closure.
- The Emergency Preparedness and Response Program would include processes for responding to and mitigating the effects of major precipitation events as required. In addition, site water management processes would be developed and implemented that include direction for monitoring effectiveness of site water management infrastructure.
- As mine development and production advances into new mining areas, portable refuge stations would be placed in appropriate cut-outs to establish temporary refuge stations.
- During Construction and Operations, a Preliminary Decommissioning and Reclamation Plan would be developed and periodically updated to reflect changing site-specific conditions and effects of major precipitation events on engineered cover systems for the PAG and NPAG WRSAs, as required.
- Prior to transitioning to Closure, a Detailed Decommissioning and Reclamation Plan would be developed to reflect mitigations necessary to avoid and limit the effects of major precipitation events on revegetation efforts, as required.
- Possible erosion repair of the cover systems post-decommissioning and reclamation would be accounted for in the Detailed Decommissioning and Reclamation Plan and the financial assurances required for the long-term Institutional Control Program with the Province of Saskatchewan.

22.6.3.2 Risk Measurement and Evaluation

Table 22.6-3 characterizes the likelihood of occurrence and consequence rankings of potential effects of major precipitation events during Construction, Operations, and Closure.

Table 22.6-3: Major Precipitation Events Risk Level Determination for the Rook I Project

Hazard ID	Hazard Scenario	Project Phase	Likelihood	Consequence	Risk Level
PR-01	Increased precipitation impeding the movement of equipment and activities on the Project site and limiting access to the Project site	All phases	Very Likely	Minor	Low
PR-02	Flooding in the building areas resulting in structural damage of buildings	Construction Operations	Unlikely	Minor	Low
PR-03	Water Management Storage or Conveyance Overflow	Construction Operations	Unlikely	Moderate	Low
PR-04	A mine inflow event adversely affecting mine ground control and worker safety and preventing production	Construction Operations	Unlikely	Moderate	Low
PR-05	Slope Stability Failure	Operations Closure	Highly Unlikely	Minor	Low
PR-06	Erosion of the engineered cover system on the PAG and NPAG WRSAs	Operations Closure	Likely	Minor	Low

PAG = potentially acid generating; NPAG = non-potentially acid generating; WRSAs = waste rock storage areas.

PR-01: Impeded movement

Ditches and culverts would be sized to accommodate precipitation events (i.e., sized according to whether they carry mineralized or non-mineralized water, as described above), and the sizing includes consideration of climate change. Routine inspection and maintenance of containment and conveyance structures (i.e., roadside ditches and culverts) would be conducted to limit the risk of road washout. A major precipitation event is not expected to be severe enough to cause substantial damage to site and access roads that would result in Project delays. In the event that damage occurs, equipment would be available on site to complete repairs. It is considered **Very Likely** that a major precipitation event would impede the movement of equipment and activities on the Project site and limit site access. The consequence of a major precipitation event restricting access to and around the Project site is assessed as **Minor**. The likelihood, combined with the consequence, results in the risk level being evaluated as **Low**.

PR-02: Structural damage

The NBCC provides for factors of safety to account for major precipitation events and would form the basis of the design and construction of the Project-related buildings and structures to prevent structural damage to buildings from flooding. In the event of flooding in the building areas, it expected that water could be pumped out and minor damage would be repaired, without stoppage in Project activity. It is considered **Unlikely** that flooding from a major precipitation event would cause structural damage to buildings. Combined with a consequence of a major precipitation event causing structural damage to buildings because of flooding being assessed as **Minor**, the risk level was evaluated as **Low**.

PR-03: Water management storage or conveyance overflow

Design requirements for surface water management systems would include considerations for major precipitation events. These design requirements would be sufficiently conservative to account for extreme weather events and to consider increase in the frequency and/or severity of major precipitation events that might arise from climate change. A major precipitation event is not expected to be severe enough to cause substantial damage to these surface water management systems; however, damage to these systems could require the process plant to cease operations until the repairs have been completed (i.e., less than one month). The likelihood of a major precipitation event causing overflows of site runoff ponds or collection areas is assessed as **Unlikely**. Combined with a consequence assessed as **Moderate**, the risk level was evaluated as **Low**.

PR-04: Mine inflow

NexGen has incorporated mine inflow risks into the design and operation of the underground mine. For example, the mine dewatering system would be designed, maintained, and monitored to control the amount of groundwater inflow. The Project would be fully contained within the competent crystalline basement rocks. Groundwater flows in the vicinity of the Project would be primarily controlled by local shear and fault zones that are well characterized for lateral and vertical extent as well as hydraulic material properties. The exhaust shaft would be equipped with a secondary emergency escapeway system in the event of an emergency requiring secondary egress. Permanent refuge stations would be located underground within the fresh air circuit. The likelihood of a major precipitation event causing a mine inflow is assessed as **Unlikely**. Combined with the consequence being assessed as **Moderate**, the risk level was evaluated as **Low**.

PR-05: Slope stability failure

All stockpiles would be engineered to withstand PMP events and designed with appropriate water drainage, collection, and storage systems. None of these stockpiles would be used as water-retaining structures; they would all be designed to shed water at surface and through highly porous interstices (i.e., small spaces that allow water to flow through). Geotechnical monitoring would be in place to confirm design specifications are met, and regular inspections would alert NexGen to deficiencies or anomalies. It is considered **Highly Unlikely** that the PAG WRSA, NPAG WRSA, special waste rock, or ore storage stockpiles would undergo failure of the slope stability due to extreme precipitation events. At 4:1 slope, total failure of the PAG and NPAG WRSAs is not deemed plausible, though localized failure due to erosion may carry a **Minor** consequence as it could require repair. The combined likelihood and severity resulted in a risk level evaluated as **Low**.

PR-06: Erosion of covers

Depending on the timing, the major precipitation could affect areas of the PAG and NPAG WRSAs that have not been fully reclaimed or had covers installed, leading to the erosion of areas of the cover that are more vulnerable to erosion (i.e., areas where vegetation has not been well established). However, such erosion would be locally focused and not extensive to the full landform and could be repaired relatively quickly with no disruption to other Project activities or substantial damage to infrastructure. Erosion of NPAG and PAG WRSA cover systems is considered **Likely** in the event of a major precipitation event. Combined with the likelihood rating, the consequence assessed as **Minor**, the risk level was evaluated as **Low**.

22.6.4 Severe Snowstorms

22.6.4.1 Hazard Scenario Identification

Saskatchewan winters can span six to seven months in the northern portions of the province, though considerable variation occurs from year to year and region to region (Paul 2007). Winters tend to be dominated by cold, dry, stable air (Paul 2007). Normal winter weather includes a variety of precipitation types, including snow, rain, and freezing rain (EMO 2012), whereas winter weather extremes (i.e., blizzards, snowstorms, and freezing rain) can include all three events (SRC 2018).

Climate change is expected to result in wetter and warmer conditions. The modelled changes of snowmelt in the 2050s and 2080s for the 50th percentile suggest an increase in snowmelt in the future compared to the current conditions (Appendix 22A).

Impeded Movement

Severe snowstorms could affect vehicle operation at the Project site because of reduced traction and poor visibility and could increase the probability of vehicle accidents. Large snowfall events could impede the movement of equipment and activities on site. Access to the site by both vehicles and aircraft could become limited due to snowfall amounts and/or poor visibility due to blizzard conditions.

Pond Overflow

Extreme snowfall could contribute to unusual flooding during snowmelt and, combined with extreme rainfall events, could cause overflows of site runoff ponds or collection areas. The risk of water management system overflows is assessed in Section 22.6.3, Major Precipitation Events.

Building Collapse

Infrastructure may experience increased loads from snow accumulation, which could cause structural damage and limit utilization of affected Project infrastructure.

Environmental Design Features

The risks associated with severe snowstorms are managed through design criteria and management practices. Weather uncertainties have been accounted for, and risks associated with severe snowstorms and snow loads to facilities are managed through design criteria for the Project. For example, requirements for surface water management systems include considerations for snowfall accumulation on the ground. Site drainage would be designed to safely divert or collect water under 1:100-year flood or PMP events as appropriate to the facility, as described in Section 22.6.3. In addition, buildings would be designed according to the appropriate codes, such as Part 4 of the NBCC (NRCC 2020a), to withstand large accumulations of snow on rooftops.

Mitigation

Mitigation measures would be implemented during all phases of the Project to avoid and limit the effects from severe snowstorms on the Project, including but not limited to the following:

- Vehicle traffic would be reduced or deferred during severe snowstorms.
- Aircraft landings and takeoffs would be restricted during periods of low visibility or excessive snow accumulation per Canadian Aviation Regulations and Standards.

The Emergency Preparedness and Response Program would include emergency prevention and response processes for heavy snowfall events.

22.6.4.2 Risk Measurement and Evaluation

Table 22.6-4 characterizes the likelihood of occurrence and consequence rankings of potential heavy snowfall events during Construction, Operations and Closure.

Table 22.6-4: Heavy Snowfall Risk Level Determination for the Rook I Project

Hazard ID	Hazard Scenario	Project Phase	Likelihood	Consequence	Risk Level
SS-01	Severe snowstorms impeding the movement of equipment and restricting access to the Project site	All phases	Very Likely	Minor	Low
SS-02	Snowfall accumulation causing overflows of site runoff ponds or collection areas	Construction Operations	Unlikely	Moderate	Low
SS-03	Snowfall accumulation causing collapse or damage to Project infrastructure during snowmelt	Construction Operations	Unlikely	Minor	Low

SS-01: Impeded movement

Access to the site could become limited due to large snowfall amounts and/or poor visibility due to blizzard conditions. Given the local climate, it is considered **Very Likely** that extreme snowfall events that could impede the movement of equipment and activities on the Project site would occur during the life of the Project. The consequence is assessed as **Minor** due to activities such as regular snow removal and maintaining an airstrip with the equipment required to operate in adverse weather conditions. The likelihood, combined with the consequence, resulted in the risk level being evaluated as **Low**.

SS-02: Pond overflow

Design requirements for surface water management systems include considerations for snowfall accumulation during snowmelt. Snowfall accumulation causing overflows of site runoff ponds or collection areas during snowmelt is not expected to be severe enough to cause substantial damage to these surface water management systems; however, severe damage to these systems could require the process plant to cease operations until the repairs have been completed (i.e., less than one month). The likelihood of this hazard scenario is assessed as **Unlikely**, and the consequence as **Moderate**. Combined, the likelihood and consequence, resulted in the risk level being evaluated as **Low**.

SS-03: Building collapse

Buildings would be designed according to the appropriate codes, such as Part 4 of the NBCC (NRCC 2020a), to withstand large accumulations of snow on rooftops. Snow inspections would be completed as required throughout winter and excess snow would be removed. The likelihood of snowfall accumulation causing collapse or damage to Project infrastructure is assessed as **Unlikely**. This event is not expected to be severe enough to cause substantial damage to Project infrastructure, and the consequence is therefore assessed as **Minor**. The likelihood, combined with the consequence, resulted in the risk level being evaluated as **Low**.

22.6.5 Tornadoes / Severe Thunderstorms

22.6.5.1 Hazard Scenario Identification

A tornado is a strong vortex extending down from a cloud, resulting from the mixing of warm, humid air with cool air masses. In Canada, the highest tornado risks are in southern Saskatchewan, southern Manitoba, and southwestern Ontario (Environment Canada 2011a). Saskatchewan had 1,530 tornado sightings between 1880 and 2016, most of which were in the south-central portion of the province (SRC 2018). Most of the tornadoes (i.e., 1,001) were short-lived and produced little to no damage (i.e., F0 and F1 category; SRC 2018). Between 1970 and 2009, there were no reported tornadoes within hundreds of kilometres of the proposed Project site (Environment Canada 2011b).

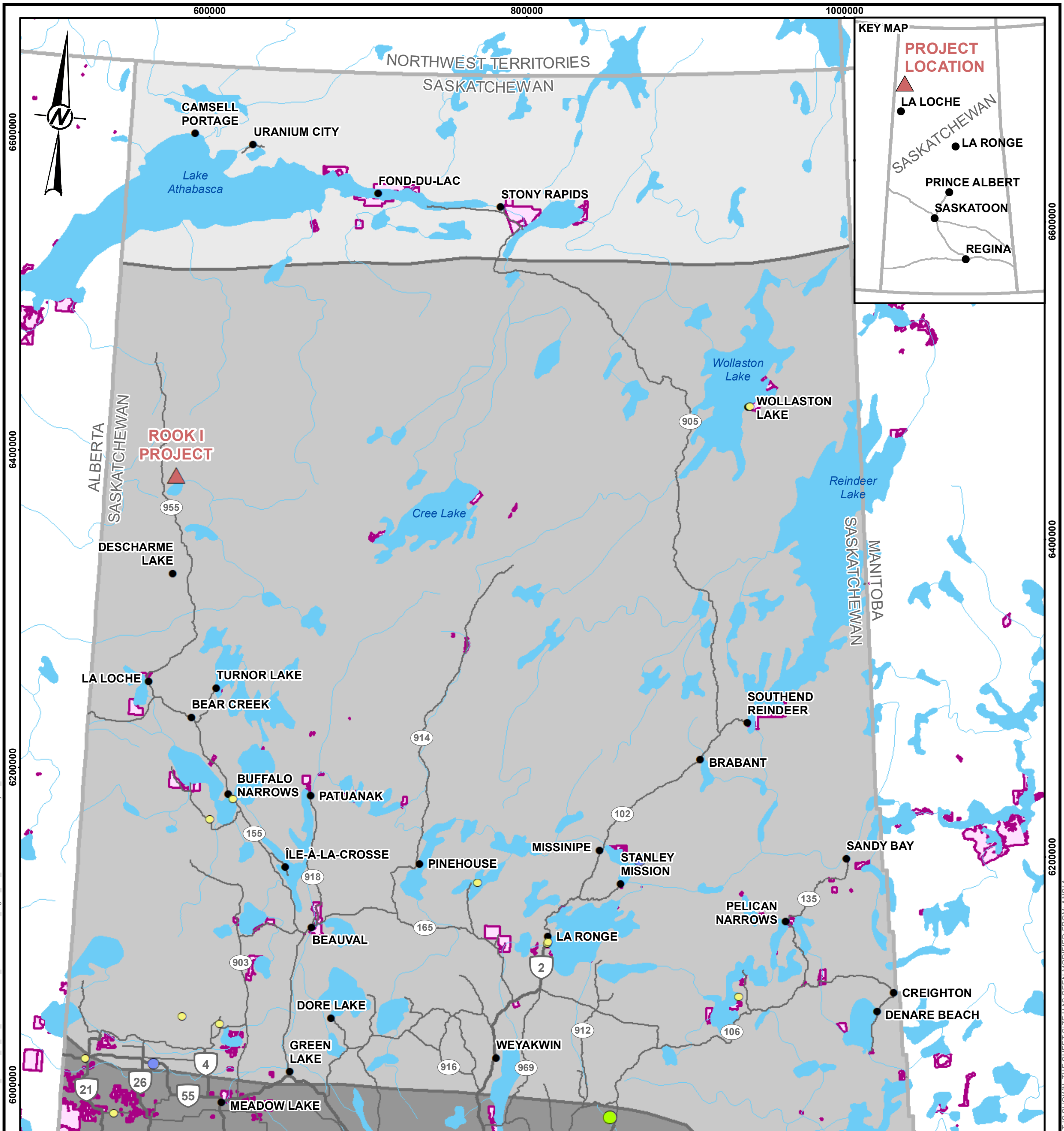
The wind speed and expected damage from tornadoes are shown in Table 22.6-5. The most common tornadoes are characterized as F0 to F1 on the Fujita scale and usually result in minor structural damage to barns, wood fences, roof shingles, and chimneys; the uprooting or snapping of tree limbs; and the downing of power lines. Less than 6% of tornadoes in Canada are rated F3 or higher in intensity, where wind speeds are in excess of 254 km/h (Table 22.6-5).

Table 22.6-5: Fujita Tornado Damage Scale

Scale	Wind Estimate (km/h)[(a)]	Frequency (%)[(b)]	Typical Damage
F0	64 to 116	44.14	Light damage. Some damage to chimneys, branches broken off trees, shallow-rooted trees pushed over, sign boards damaged.
F1	117 to 180	34.24	Moderate damage. The lower limit is the beginning of hurricane wind speed; peels surface off roofs, mobile homes pushed off foundations or overturned, moving automobiles blown off roads, attached garages may be destroyed.
F2	181 to 253	16.17	Significant damage. Roofs torn off frame houses, mobile homes demolished, boxcars overturned, large trees snapped or uprooted, high-rise windows broken and blown in, light-object projectiles generated.
F3	254 to 332	4.35	Severe damage. Roofs and some walls torn off well-constructed houses, trains overturned, most trees in forest uprooted, heavy cars lifted off the ground and thrown.
F4	333 to 418	1.01	Devastating damage. Well-constructed houses levelled, structures with weak foundations blown away some distance, cars thrown, and large projectiles generated.
F5	419 to 512	0.10	Incredible damage. Strong frame houses lifted off foundations and carried considerable distances to disintegrate, automobile-sized projectiles fly through the air in excess of 100 m, trees debarked, steel-reinforced concrete structures badly damaged and skyscrapers toppled.

a) Source: SPC-NOAA 1971.
b) Frequency refers to the proportion of total tornados. Source: SPC-NOAA n.d.

Figure 22.6-2 shows the frequency and magnitude of tornado zones in the Canadian Prairies during the period from 1980 to 2009 (Government of Canada 2021a) The Project site is located within the F0 to F1 zone, where the occurrence of tornadoes of magnitude greater than F1 is very rare as shown on Figure 22.6-2. Tornadoes classified as F0 or F1 are not expected to cause any significant damage to Project infrastructure.



600000 800000 6000000 1000000

0 100 200
1:3,500,000 KILOMETRES

LEGEND

- POPULATED PLACE
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- INDIAN RESERVE
- WATERBODY
- PROJECT LOCATION

TORNADO EVENTS (1980 - 2009)

- 2
- 1
- 0

TORNADO F-SCALE

- F2 - F5
- F0 - F1
- RARE

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
3. TORNADO DATA OBTAINED FROM GOVERNMENT OF CANADA, CANADIAN NATIONAL TORNADO DATABASE: VERIFIED EVENTS (1980-2009)

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

FREQUENCY AND MAGNITUDE OF TORNADOES IN THE CANADIAN PRAIRIES, 1980 TO 2009

CONSULTANT

wsp

PROJECT		20144150	PHASE 3314 - 6
DESIGN	JMC	2023-02-10	SCALE AS SHOWN REV. 0
GIS	NO	2023-02-10	
CHECK	JMC	2023-02-10	FIGURE 22.6-2
REVIEW	MM	2023-02-10	

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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

A thunderstorm is classified as 'severe' when it contains one or more of the following: produce one inch or larger diameter hail, winds gusting in excess of 90 km/h, or a tornado (NSSL 2021). In Saskatchewan, summer convective storm (i.e., thunderstorm) conditions can last from April to October, but the most severe generally occur in June, July, and August (SRC 2018). This period (i.e., April to October) is when humidity and warm temperatures generate convective storms that traverse the province (Paul 2007). These convective storms can become severe and result in heavy rain, hail, strong winds, and tornadoes (Paul and McInnis 2001).

There is concern that climate change will increase the frequency and severity of summer storms, including tornadoes, hailstorms, and lightning events (Peterson et al 2008). While it appears that these storms have already become more frequent based on comparison of the 1868 to 1990 and 1980 to 2009 data, it is uncertain whether the increase in reported tornadoes is due to increased storm frequency or due to improved detection and reporting.

Tornado Damage

The primary concerns related to severe winds or tornadoes are related to worker safety, flying debris, slippery surfaces, and collapse of, or damage to, Project infrastructure. High winds could also cause downed trees, which could block the access road and site roads. High winds during periods of below-freezing air temperatures would contribute to increased wind chill and blowing snow, which would in turn reduce visibility, limiting access to and from the Project site.

Lightning Damage

Lightning strikes could result in danger to personnel and damage to infrastructure, including energy transmission and communications systems. A lightning strike could also ignite a fire near the Project (Section 22.6.1).

Soil Erosion

High winds could cause soil erosion on the cover systems for the NPAG and PAG WRSAs following Closure, leading to water infiltration into the waste rock. High winds could also accelerate the spread of wildfires (Section 22.6.1).

Environmental Design Features

The risks associated with severe thunderstorms or tornadoes are managed through design criteria and management practices. Facilities would be designed according to the appropriate codes, such as the NBCC (NRCC 2020a). In the event of a power outage from a lightning strike, emergency generators would be used.

At Closure, the cover systems for the NPAG and PAG WRSAs would be vegetated to reduce the potential for soil erosion from wind and water.

Mitigation

Mitigation measures would be implemented during all phases of the Project to avoid and limit the effects from tornadoes and severe thunderstorms on the Project, including but not limited to the following:

- Safety processes would be in place to address worker safety and, if necessary, stop work orders would be issued.
- The Emergency Preparedness and Response Program would include emergency prevention and response procedures for tornadoes and severe thunderstorms.
- During Construction and Operations, a Preliminary Decommissioning and Reclamation Plan would be developed and periodically updated to reflect changing site-specific conditions and effects of high winds and severe thunderstorms on engineered cover systems for the PAG and NPAG WRSAs, as required.
- Prior to transitioning to Closure, a Detailed Decommissioning and Reclamation Plan would be developed to reflect mitigations necessary to avoid and limit the effects of drought, major precipitation events, or high winds on engineered cover systems for the PAG and NPAG WRSAs, as required.

22.6.5.2 Risk Measurement and Evaluation

Table 22.6-6 characterizes the likelihood of occurrence and consequence rankings of potential tornadoes and severe thunderstorms during Construction, Operations, and Closure.

Table 22.6-6: Tornadoes / Severe Thunderstorms Risk Level Determination for the Rook I Project

Hazard ID	Hazard Scenario	Project Phase	Likelihood	Consequence	Risk Level
TT-01	Structural damage and/or failure of infrastructure, and risk to worker safety due to a tornado.	All phases	Highly Unlikely	Minor	Low
TT-02	Structural damage and/or failure of infrastructure, and risk to worker safety due to a severe thunderstorm, including lightning.	All phases	Unlikely	Minor	Low
TT-03	Soil erosion on the engineered cover system for the PAG and NPAG WRSAs following Closure.	Closure	Likely	Minor	Low

PAG = potentially acid generating; NPAG = non-potentially acid generating; WRSAs = waste rock storage areas.

TT-01: Tornado damage

The Project site is located within the F0 to F1 zone, where the occurrence of tornadoes of magnitude greater than F1 are very rare; therefore, the likelihood of a tornado with a magnitude greater than F1 occurring near the Project site is assessed as **Highly Unlikely**. Infrastructure would be designed according to the appropriate building codes; therefore, the consequence of a F0 to F1 tornado-related incident at the Project site is assessed as **Minor**. The likelihood, combined with the consequence, resulted in the risk level being evaluated as **Low**.

TT-02: Lightning damage

Compliance with building codes would minimize the likelihood and consequence of structural damage and/or failure of infrastructure due to a severe thunderstorm, including lightning strikes. Safety processes would be in place to address worker safety and, if necessary, stop work orders would be issued. Damage to infrastructure would likely be relatively minor with no resulting shutdown to operations. The likelihood and consequence of structural damage and/or failure of infrastructure occurring was assessed as **Unlikely** and **Minor**, respectively, resulting in the risk level being evaluated as **Low**.

TT-03: Soil erosion

Similar to the water erosion described in Section 22.6.3.2, Risk Measurement and Evaluation, wind erosion of the NPAG and PAG WRSA cover systems could affect areas that have not been fully installed or reclaimed, leading to the erosion of areas of the cover that are more vulnerable to erosion. Such erosion would be limited in extent and could be repaired relatively quickly with no disruption to other Project activities or substantial damage to infrastructure. Given that the Project would be located within the F0 to F1 zone, such a wind event is considered **Likely**. Combining the likelihood with the consequence rating assessed as **Minor**, the resulting risk level was evaluated as **Low**.

22.6.6 Extreme Temperatures

22.6.6.1 Hazard Scenario Identification

Both extreme heat and cold can affect mining and milling operations through several mechanisms, as discussed below. Freeze-thaw cycles and temperature fluctuations may also pose risks to the Project. In the future, climate variability is expected to increase.

Extreme Cold

Extreme cold could lead to the freezing of pipes and equipment on the ground surface that are used to manage water or provide fresh air. Extreme cold could also impact the heating required for the fresh air supply to the mine workings.

Extreme cold and freeze thaw cycles may affect the roads and airstrip, causing cracks or potholes due to temperature fluctuations.

Extreme Heat

Roads and the airstrip may be vulnerable to the effects of extreme heat as it might cause surface softening.

Heat Fluctuations

Freeze-thaw weathering is a process of erosion that happens in cold areas where ice forms. This process can degrade concrete and pavement, and can lead to cracks in pipes, which could then lead to Project delays. The freeze-thaw cycles may also interact with the buildings and insulation, causing freeze weathering. Increasing freeze-thaw cycles may cause physical damage to the roofs, decreasing their life expectancy. Extreme temperature changes, including extreme heat and extended cold spells, could overwhelm the capacity of the heating, ventilation, and air conditioning (HVAC) systems of the buildings needed to support the facility's demands, causing thermal discomfort.

Extreme heat and cold, including temperature fluctuations, may increase the demand of the energy system, overwhelming the capacity of the power plant. Extreme cold and freeze-thaw cycles may cause physical damage to the power plant, causing loss of on-site heat and electricity.

Environmental Design Features

The risks associated with extreme temperatures are managed through design criteria and management practices. Design criteria, as specified in the ventilation design criteria documentation, include maximum working temperatures for the underground mine. Underground working conditions are modelled using ventilation modelling software and verified by ventilation engineers based on in situ rock conditions and equipment used.

All piping would be designed and installed to standards that are designed for regional weather. Pipes would be buried at depths below the frost line or insulated and heat traced if above ground.

The power plant would be designed for the site-specific climate and load requirements of all seasons, including peak loads during winter months.

Buildings would be designed for the climate; roofs would be designed to meet requirements associated with local climate, which would avoid damage caused from snowfall melt. Life expectancy of materials would be considered as part of the maintenance and replacement strategy for infrastructure. Similarly, roads and the airstrip would be designed for the site-specific climate and maintained accordingly.

The NPAG and PAG WRSA cover systems would be designed to withstand cold climates and increasing temperatures. They would follow design and construction recommendations in guidance manuals such as MEND Report 2.21.4A *Design, Construction, and Performance Monitoring of Cover Systems for Waste Rock and Tailings* (O'Kane 2004) and MEND Report 1.16.5c *Cold Regions Cover System Design* (MEND 2012).

Mitigation

Mitigation measures would be implemented during all phases of the Project to avoid and limit the effects from freeze-thaw cycles, including but not limited to the following:

- Mechanical equipment would be winterized appropriately to avoid damage and maintain function. Equipment would be inspected for damage after extreme temperature days.
- Infrastructure would be inspected for potential damage after major freeze/thaw events in the spring.
- Routine inspection and maintenance would be conducted for access roads and the airstrip, and repairs would be completed as necessary.
- Risks associated with thaws and sudden freezes would be mitigated as part of the risk management processes established within the Occupational Health and Safety Program.
- Following construction, the WRSAs landforms and cover systems would be inspected and maintained on a regular basis, and the cover systems would be repaired and revegetated after closure if freeze-thaw cycles are found to be causing any damage or failure.

22.6.6.2 Risk Measurement and Evaluation

Table 22.6-7 characterizes the likelihood of occurrence and consequence rankings of potential extreme temperatures during Construction, Operations, and Closure.

Table 22.6-7: Extreme Temperature Risk Level Determination for the Rook I Project

Hazard ID	Hazard Scenario	Project Phase	Likelihood	Consequence	Risk Level
ET-01	Freezing of pipes and equipment that may be used to manage air, fuel, water, sewage, and tailings.	Construction Operations	Likely	Moderate	Moderate
ET-02	Degradation of the roads and airstrip.	Construction Operations	Unlikely	Minor	Low
ET-03	Overwhelming the capacity of the HVAC systems or power supply.	Construction Operations	Unlikely	Negligible	Low
ET-04	Physical weathering causing cracks or exposure of the NPAG and PAG WRSAs and localized failure of slope stability.	Operations Closure	Likely	Minor	Low

HVAC = heating, ventilation, and air conditioning; NPAG = non-potentially acid generating; PAG = potentially acid generating; WRSAs = waste rock storage areas.

ET-01: Freezing of pipes and equipment

With the understanding that the Project would be constructed and operated in a relatively cold climate, all Project infrastructure would be designed, constructed, and operated to be resilient to extreme cold. Pipes would be buried at depths below the frost line or insulated and heat traced if above ground. Project infrastructure would be inspected regularly and maintained to prevent or repair cold weather damage. With these design and operational considerations, most cold-related hazards are considered to be **Likely**, as they could occur once between 10 and 100 years, and with **Moderate** severity as operations could be temporarily suspended, resulting in overall **Moderate** risk levels.

ET-02: Degradation of the roads and airstrip

Extreme heat is less likely in northern Saskatchewan but has been considered in design and mitigation. Routine inspection and maintenance would be conducted for access roads and the airstrip, and repairs would be completed as necessary. Inspections would be scheduled such that repairs could be completed without stoppage of operations or risk to safety. With these design features and mitigation, the likelihood of degradation of the roads and airstrip is considered to be **Unlikely** and with **Minor** severity, resulting in an overall **Low** risk level.

ET-03: Overwhelming capacity of HVAC and power systems

The Project design and engineering teams work with a robust climatological dataset that includes locally measured meteorology, long-term historical regional datasets, and long-term future climate predictions. This information, along with building codes and standards, would be used to design and construct the infrastructure appropriately for the local climate. Contingencies would be in place for power supply and human safety in the event of extreme heat above and below ground. The likelihood and consequence of failure of HVAC or power infrastructure occurring due to extreme cold or heat was assessed as **Unlikely** and **Negligible**, respectively, resulting in the risk level being evaluated as **Low**.

ET-04: Physical weathering of waste rock storage areas

Similar to the water erosion described in Section 22.6.3.2, temperature-related erosion of the NPAG and PAG WRSA cover systems could affect areas that have not been fully installed or reclaimed, leading to the erosion of areas of the cover that are more vulnerable to erosion. Such erosion would be limited in extent and could be repaired relatively quickly with no disruption to other Project activities or substantial damage to infrastructure. Given that the WRSAs would be designed and constructed following accepted practices for cold climates, such a failure is considered to be localized in nature and **Likely**. Combining the likelihood with the consequence rating assessed as **Minor**, the resulting risk level was evaluated as **Low**.

22.6.7 Seismic Events

22.6.7.1 Hazard Scenario Identification

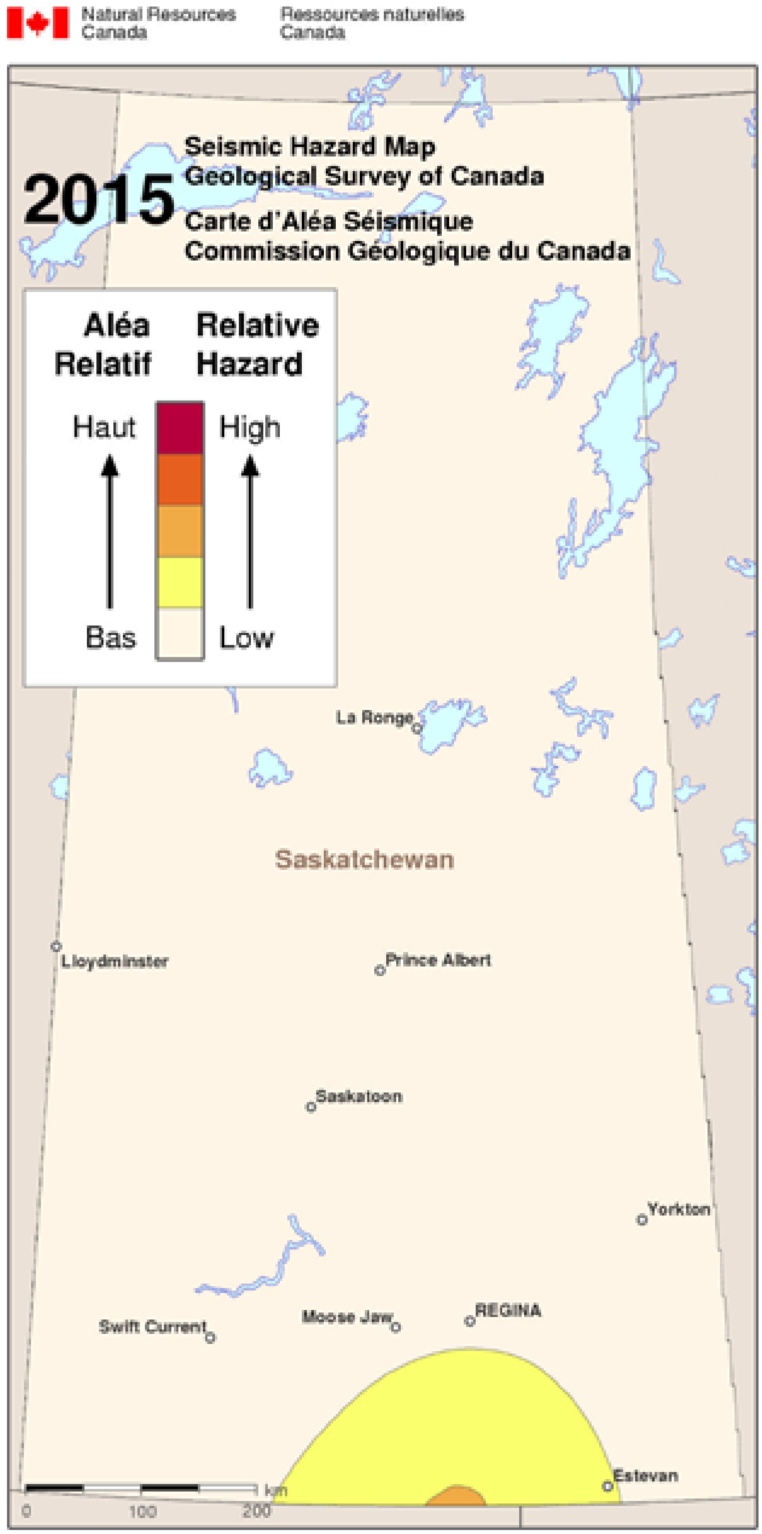
Seismic activity, such as earthquakes, can trigger natural hazards including ground vibrations, landslides, liquefaction of saturated sediments, and surface rupture. These natural hazards can affect underground mine workings and surface-engineered structures such as water diversions and WRSAs. Seismic activity can also result in work delays while stability is reassessed for the safety of the employees and continued production. Detailed information on earthquakes that have occurred in Canada is contained in publications of Earthquakes Canada of Natural Resources Canada and their predecessor organizations. A seismic zoning map for Canada has been developed on the basis of these studies and is used in the NBCC (NRCC 2020a) to help design and construct buildings that are appropriately earthquake proof for a given region.

According to the Government of Canada (2021b), the seismic hazard for northern Saskatchewan is rated as low (i.e., less than 1% chance significant damage will occur in 50 years). Figure 22.6-3 shows the Saskatchewan seismic hazard map. The most recent seismic map for Canada is shown in Figure 22.6-4. This figure indicates that the Project is located in a region of the lowest seismic activity in Canada. Moreover, in the past 400 years, there have been no earthquakes recorded with a magnitude greater than 3 in northern Saskatchewan (Figure 22.6-4; Government of Canada 2021c).

The Athabasca Basin is seismically inactive according to the NBCC. Numerical modelling has been completed for the Project, which included assessing the susceptibility of mine excavations and infrastructure to mine-induced stress over the Project lifespan. The estimated peak ground acceleration with a return period of 2,475 years is less than 0.036g at a probability of 2% over 50 years. The risk of naturally occurring seismic events is low. The mining is low to moderate depth; depths below surface range from 350 m to 710 m. Seismic events due to mining have been evaluated and are considered highly unlikely.

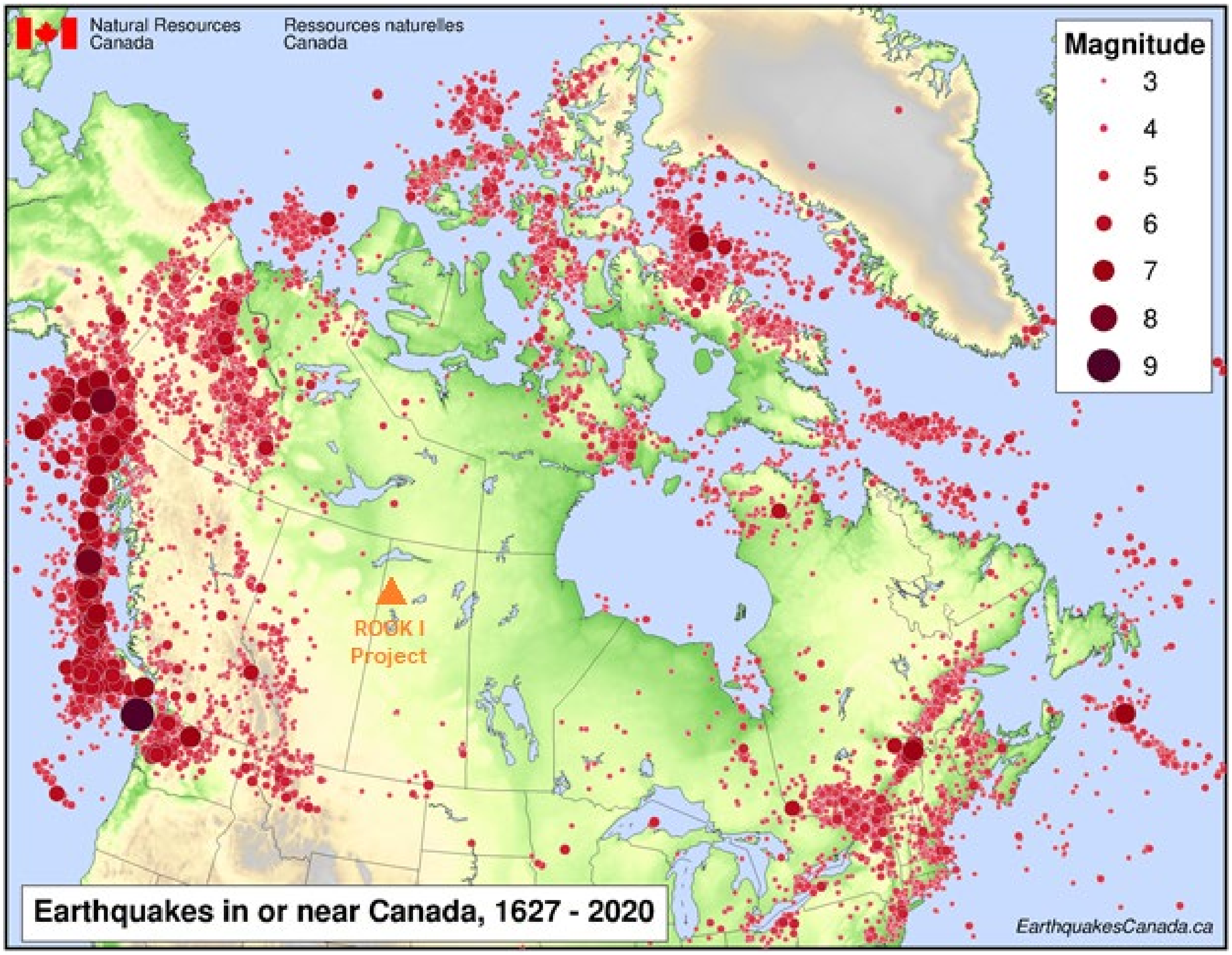
The Birch Narrows Dene Nation expressed a concern regarding the potential for a geological tectonic shift that could create cracks in the UGTMF, allowing water to enter and cause contamination (BNDN-JWG 2021). The location of the Project in the Canadian Shield away from near-field tectonic events and seismic stresses was discussed, as well as the design considerations for the UGTMF, which are also described in Section 5.

Figure 22.6-3: Saskatchewan Seismic Hazard Map



NOTE: Rook I Project is located in the Low Hazard Zone covered by the legend
Source: Government of Canada 2021b.

Figure 22.6-4: Seismic Map for Canada



Source: Government of Canada 2021c.

Environmental Design Features

The Project would incorporate seismic event risks into the design and operation of the mine. Project infrastructure would be designed to withstand extreme environmental conditions that pose risks to its integrity. All buildings on site would be designed according to the NBCC (NRCC 2020a). The NBCC incorporates technical requirements so that buildings are protected against earthquakes based on local seismic conditions. The underground mine development, WRSAs, and UGTMF design considered geotechnical stability.

Mitigation

Mitigation measures would be implemented during all phases of the Project to periodically assess geotechnical stability.

22.6.7.2 Risk Measurement and Evaluation

Table 22.6-8 characterizes the likelihood and consequence rankings of seismic event risks during Construction, Operations, and Closure.

Table 22.6-8: Seismic Events Risk Level Determination for the Rook I Project

Hazard ID	Risk Description	Project Phase	Likelihood	Consequence	Risk Level
SE-01	Damage to or failure of structural stability of Project infrastructure on surface.	Construction Operations	Highly Unlikely	Minor	Low
SE-02	Damage to or failure of structural stability of underground mine workings.	Construction Operations	Highly Unlikely	Moderate	Low
SE-03	Damage to or failure of structural stability of the WRSAs.	Operations Closure	Highly Unlikely	Minor	Low

WRSAs = waste rock storage areas.

SE-01: Damage to Project infrastructure on surface

The Project would be within an area with a low seismic hazard rating; therefore, the likelihood of a major seismic event in the immediate vicinity of the Project is **Highly Unlikely**. All buildings on site would be designed according to the NBCC (NRCC 2020a). Therefore, seismicity is considered not to have the potential to substantively damage Project infrastructure during all phases of the Project. The consequence for the effects of a seismic event on Project infrastructure on surface was assessed as **Minor** and, combined with the likelihood of **Highly Unlikely**, the risk level was evaluated as **Low**.

SE-02: Damage to underground mine workings

The Project would be within an area with a low seismic hazard rating; therefore, the likelihood of a major seismic event in the immediate vicinity of the Project is **Highly Unlikely**. The underground mine development and UGTMF design would consider geotechnical stability. Processes to monitoring geotechnical stability and mitigate risks would be implemented. As such, the consequence for the effects of a seismic event on underground mine workings is assessed as **Moderate**, which reflects the possibility that a temporary work stoppage could be required in the **Highly Unlikely** event of a magnitude 5 or 6 earthquake near the Project that would cause damage to infrastructure. The risk level is therefore evaluated as **Low**.

SE-03: Structural stability of waste rock storage areas

The Project would be developed in a seismically inactive zone, so the likelihood of such an event is considered **Highly Unlikely**. As noted in Section 22.6.3, a total failure to WRSAs is considered **Highly Unlikely** at a 4:1 slope. A localized failure as a result of a seismic event would carry a consequence of **Minor**. Therefore, the overall risk level is **Low**.

22.7 Conclusions

The assessment of effects of the environment on the Project identified potential changes to, or effects on, the Project that may occur in association with natural hazards or the influences of nature (e.g., climate change). The assessment included characterization of the anticipated likelihood and consequence of potential changes to, or effects on, the Project, and identification of environmental design features and mitigation practices that would be implemented to avoid or limit potential changes or effects. The assessment meets the requirements of the TOR for the Project (Appendix 1A) and CNSC REGDOC-2.9.1, which stipulate that the EIS must consider the potential effects of the environment, including climate change, on the Project.

The assessment of effects of the environment on the Project resulted in the identification of 7 natural hazard categories comprised of 26 hazard scenarios that were deemed to have reasonably possible consequences for the proposed Project. These natural hazards consisted of wildfire, drought, major precipitation events, severe snowstorms, tornadoes and severe thunderstorms, extreme temperatures, and seismic events.

The identification of environmental design features and mitigation practices that would be implemented to avoid or minimize potential adverse effects of natural hazards and climate change on the Project followed the hierarchy of controls. It is anticipated that potential effects can largely be addressed through engineering design and compliance with codes and standards that provide sufficient margins of safety to prevent damage to Project infrastructure from environmental hazards. This included identification of prevention measures that would minimize the probability of the hazard scenario from occurring and control measures that would mitigate the severity of consequence of the potential effect.

Table 22.7-1 provides a summary of the estimated risk level associated with natural hazards on the Project, after considering the potential effects of future climate change, and implementation of environmental design features and mitigation practices. This summary is based on the characterization of likelihood of occurrence and consequence rankings presented in Section 22.6.1 to 22.6.7 for the identified natural hazards. The results of the assessment indicate that the overall risk level associated with most hazards is **Low**, except for wildfires and extreme temperatures, where the overall risk level is **Moderate**. The specific hazard scenarios with risk level of **Moderate** include:

- FF-03: Wildfire reaching fuel storage tanks and the surface explosives magazine;
- FF-04: Damage to or loss of Project infrastructure; and
- ET-01: Freezing of pipes and equipment that may be used to manage air, fuel, water, sewage, and tailings.

The potential risks of all environmental hazards on the Project and the effectiveness of mitigations would continue to be assessed according to the risk management processes described in the Integrated Management System Manual and the Environmental Protection Program and to and in accordance with provincial, CNSC, and other regulatory requirements.

As per REGDOC-2.9.1, the assessment also considered the potential effects of future climate change on the Project and whether the Project might be sensitive to changes in climate conditions during its lifespan. The results of a site-specific analysis summarizing climate variables for the Project (Appendix 22A) indicate a future that is likely to be warmer and wetter on an annual basis. These projected changes may contribute to increases in the frequency and severity of wildfires, major precipitation events, summer storms (e.g., tornados, thunderstorms), and extreme heat events. The potential risks associated with natural hazards and future climate change would continue to be considered in engineering and design on an ongoing basis as a part of the continual improvement process and through implementation of the Climate Adaptation Framework (TSD XXII).

Table 22.7-1: Summary of Potential Effects of the Environment on the Rook I Project

Natural Hazard	Project Phase	Likelihood	Consequence	Risk Level
Wildfires	All phases	Unlikely to Likely	Minor to Major	Low to Moderate
Drought	All phases	Highly Unlikely to Unlikely	Negligible to Moderate	Low
Major precipitation events	All phases	Highly Unlikely to Very Likely	Minor to Moderate	Low
Severe snowstorms	All phases	Unlikely to Very Likely	Minor to Moderate	Low
Tornados / severe thunderstorms	All phases	Highly Unlikely to Likely	Minor	Low
Extreme temperatures	All phases	Unlikely to Likely	Negligible to Moderate	Low to Moderate
Seismic events	All phases	Highly Unlikely	Minor to Moderate	Low

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Appendix 22A Climate Change Dataset Summary Report

Abbreviations and Units of Measure

Abbreviation	Definition
2050s	Future climate projections covering the period from 2041 to 2070 used to form the multi-model ensemble, also representing mid-century climate projections
2080s	Future climate projections covering the period from 2071 to 2100 used to form the multi-model ensemble, also representing end-of-century climate projections
AR	assessment report
BCCAQv2	Bias Correction/Construction Analogues with Quantile mapping reordering version 2
ECCC	Environment and Climate Change Canada
ERAI	European Reanalysis Interim
GCM	global climate model
Golder	Golder Associates Ltd.
IDF	intensity-duration-frequency
IPCC	Intergovernmental Panel on Climate Change
MERRA-2	Modern-Era Retrospective analysis for Research and Applications, Version 2
PMP	probable maximum precipitation
Project	Rook I Project
R^2	Pearson correlation coefficient
RCP	representative concentration pathway
TSD	Technical Support Document
WMO	World Meteorological Organization

Unit	Definition
%	percent
°	degree
°C	degrees Celsius
d	day
km	kilometre
km^2	square kilometre
mm	millimetre
mm/d	millimetres per day
mm/yr	millimetres per year

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22A1 Introduction

Climate change has the potential to change future precipitation and temperature regimes, which can affect various aspects of the Rook I Project (Project), a proposed uranium mining and milling operation. Assessing the effects of climate change on the Project is a regulatory requirement under the 2012 *Canadian Environmental Assessment Act* (CEAA 2012) and the federal 2019 *Impact Assessment Act*. Through the development of a detailed climate change dataset in this report, the effects of climate change can be incorporated into the design of Project infrastructure and management systems throughout all phases and can also be incorporated into the assessment of valued components for the Environmental Assessment. This report summarizes current local and regional data related to the current and projected climate change scenarios, focussing on mean temperature and total precipitation, along with statements on extreme events.

WSP Canada Inc. (WSP; formerly Golder Associates Ltd.) has developed this detailed climate change dataset based on recent best guidance found in literature, including best guidance accepted by the Intergovernmental Panel on Climate Change (IPCC). The approach used is consistent with the guidance developed by the Mining Association of Canada (MAC 2021) by providing the necessary information for performing climate risk assessments. This dataset is intended to be used across disciplines as part of the Project Environmental Impact Statement where climate variables in current and future periods play a role. Additional climate variables and statistics (e.g., rainfall and snowmelt statistics) have been provided for use in design and planning phases outside of the Environmental Impact Statement. This is consistent with the continual improvement process for climate change as part of the Technical Support Document (TSD) XXII, Climate Adaptation Framework.

In this report, baseline climate statistics are established using the most representative data sources to provide a complete picture of the current climate conditions for which changes resulting from future projections can be made. Statistically downscaled[1] global climate model (GCM) outputs are then used to describe how current climate conditions may change in the future. Recognizing the inherent uncertainty with projections, the results in this report are based on projections from multiple climate models and scenarios, or a multi-model ensemble, as recommended by the IPCC (2013). The projections across the multi-model ensemble are summarized in terms of percentiles where the 50th percentile represents the median value and higher percentiles (i.e., 90th and 95th percentiles) represent extreme projections for the Project site.

The approach applied to the area of the Project, located adjacent to Patterson Lake in the southwestern Athabasca Basin region of northern Saskatchewan, aims to provide a description of the current climate conditions in the Project region and to provide projections of how the climate is likely to change under future climate conditions.

This document supports the effects of the Environmental Assessment for the Project and includes:

- **A review of the methods used to characterize the current climate and future climate conditions in the area of the Project** (Section 22A2, Data Sources and Approaches for Climate Change Projections): Descriptions of the data sources and approaches used for both the current climate baseline and the future climate projections are provided.

[1] Statistical downscaling encompasses the use of various statistics-based techniques to build relationships between large-scale climate patterns resolved by GCMs and observed local climate responses.

- **A discussion of the current climate baseline conditions and future projections for temperature and precipitation, including extreme indices** (Section 22A4, Current Climate, and Section 22A5, Future Climate): Discussions on precipitation include probable maximum precipitation (PMP), changes in rainfall statistics for various durations and return periods, evapotranspiration, and extreme rainfall and snowmelt.

22A2 Data Sources and Approaches for Climate Change Projections

The approach used by WSP for developing a detailed climate change dataset has been applied to the Project. Fundamental to this approach is understanding what the current climate conditions in the region of the Project are and understanding how these conditions are projected to change under future climate conditions. The discussion of climate vulnerability is focused on changes in temperature, as well as precipitation and rainfall events, rainfall statistics with different return periods and durations, evapotranspiration, and extreme rainfall and snowmelt statistics. Section 22A2.1, Current Climate Methods, and Section 22A2.2, Future Climate Methods, provide high-level overviews of the methods followed to develop the current climate and future projected climate datasets used in this report. More detailed information on each method is provided in Attachment 22A-1, Detailed Climate Change Methodology.

22A2.1 Current Climate Methods

The current climate baseline takes into consideration the available observations applicable to the Project site at a daily temporal resolution. Prior to incorporating any observations, a set of selection attributes (outlined in Attachment 22A-1, Section 22A-1-1.1.1, Data Sources for Current Climate) were assessed to filter only those that have a long, continuous record including recent years, are close to the site with similar geographical siting, and have a high data availability. Where suitable observations are not available, reanalysis data[2] were used to represent the current climate baseline (Section 22A4.1, Existing Conditions).

The current climate temperature and precipitation were used to calculate the annual and monthly current climate normals[3], along with 27 extreme indices focused on temperature and precipitation identified by the World Meteorological Organization (WMO; 2009a). WSP established trends for the annual and monthly climate, as well as climate extremes, to help provide a description of the current climate conditions. The trends were calculated using an accepted method further described in Attachment 22A-1 that is based on the most recent guidance found in literature and recommended by the IPCC. The trends were then used to assess changes in climate projected from long-term climate observations. This information forms the current climate baseline.

Using the daily current climate baseline precipitation, the PMP (theoretical highest possible precipitation) was calculated according to the Hershfield method (WMO 2009b) as described in Attachment 22A-1.

Using the same daily current climate baseline precipitation, rainfall statistics were calculated for various durations (one-day through 120-day) and return periods (1 in 2 years, 1 in 10 years, 1 in 100 years, 1 in 200 years, 1 in 500 years, 1 in 1,000 years, and 1 in 2,000 years). Probable maximum precipitation was calculated for one-day and three-day durations. The intensity-duration-frequency (IDF) curves for the current

[2] Reanalysis data combines past short-range weather forecasts with observations through data assimilation. The process mimics the production of day-to-day weather forecasts, which use an analysis of the current state of the Earth system as their starting point. The analysis is a physically consistent blend of observations with a short-range forecast based on the previous analysis.

[3] Climate normal refers to the average value of a climatological variable over a long period. In this report, a long period is defined as at least 30 years. It is used to characterize climate conditions for a given location. The current climate normal in this report is calculated over the selected observed baseline period (defined in Section 22A4.1.1).

climate were calculated by fitting a statistical distribution to the daily annual maximum series. The Gumbel distribution was adopted in this study and the parameters were estimated using the method of moments (Hogg et al. 1989), following the approach adopted by Environment and Climate Change Canada (ECCC). The evapotranspiration potential was estimated by the Hargreaves equation, which uses daily minimum and maximum temperature and solar radiation (based on the latitude) as inputs. The snowmelt model developed by ECCC was used to calculate the daily snowmelt, which was estimated using the degree-day equation proposed by Pysklywec et al. (1968). A detailed description of the listed methods is presented in Attachment 22A-1.

22A2.2 Future Climate Methods

Future climate is projected using GCMs that involve the mathematical representation of global land, sea, and atmosphere interactions over a long period of time. Future climate projections are important for understanding how climate is projected to change from the current climate baseline. The IPCC is generally considered to be the definitive source of information related to past and future climate change, as well as climate science. As an international body, the IPCC provides a common source of information relating to emission scenarios, provides third-party reviews of models, and recommends approaches to document future climate projections. Periodically, the IPCC issues assessment reports (ARs) summarizing the most current state of climate science. The Sixth Assessment Report (AR6; IPCC 2021) represents the most current complete synthesis of information regarding climate change. However, bias corrected, and downscaled projections are not yet available from AR6 for the site at the time of writing. Because of this, the future climate projections come from publicly available statistically downscaled daily future climate projections based on AR5.

The GCMs have been developed by various government and research agencies, but they share a number of common elements described by the IPCC. The IPCC does not run the models but acts as a clearinghouse for the distribution and sharing of the model forecasts. Future climate projection data are available from about 30 GCMs and four representative concentration pathways (RCPs; RCP 2.6, RCP 4.5, RCP 6.0, and RCP 8.5; IPCC 2013). The pathways are named after the radiative forcing (i.e., the change in energy balance in the atmosphere caused by natural and/or anthropogenic factors of climate change) projected to occur by 2100. These RCPs are described more fully by van Vuuren et al. (2011) in their paper on the subject and have been summarized in Attachment 22A-1, Table 22A-1-3.

The data used in this report were obtained from the climate portal ClimateData.ca, which is supported by the ECCC (ClimateData.ca 2019). This portal allows users to access, visualize, and analyze climate data, information, and tools to support adaptation planning. It provides access to high-resolution climate data at annual, monthly, or daily model outputs across Canada. This report focuses on analysis using the statistically downscaled daily data using the Bias Correction/Construction Analogues with Quantile mapping reordering version 2 (BCCAQv2) model. The IPCC identified four RCPs; however, this report focuses on the three RCPs (RCP 2.6, RCP 4.5, and RCP 8.5) currently available from ClimateData.ca for the BCCAQv2 model.

The statistically downscaled models provide daily Canada-wide climate scenarios, at a gridded resolution of 300 arc seconds (or roughly 10 km) for the simulated period of 1950 to 2100 (ClimateData.ca 2019). The climate variables available from this dataset include minimum temperature, maximum temperature, and total precipitation. The selection of these data for the Project is based on the available temporal and spatial resolution of the data. The availability of daily downscaled data allows better characterization of the climate extremes, especially for precipitation. The availability of high spatial resolution (approximately 10 km instead of hundreds of kilometres in GCMs) provides better representation for site-specific studies such as those conducted for the Project.

Future climate extremes were projected using the same 27 WMO extreme indices as in the current climate, using the temperature and precipitation projections from the available downscaled ClimateData.ca (2019) data. The future climate extremes were described in terms of an anomaly or change from the current climate baseline. As each model has a unique baseline, the calculations were first completed for each model, and then statistics were provided to describe the range of projections over the multi-model ensemble.

The IPCC recommends that climate change assessments use as many models and climate scenarios as possible, or a multi-model ensemble. For this reason, the multi-model ensemble approach was used to delineate the probable range of results and better capture the actual outcome, which is an inherent unknown. Further discussion of uncertainty and using the multi-model ensemble results is provided in Section 22A3.

Before beginning the future climate projections, the 72 potential members of the multi-model ensemble were reviewed to observe whether the general temperature and precipitation ranges reasonably matched the observed ranges of climate in the region of the Project. Monthly averages were used to capture potential changes in the known seasonality of the region.

The model projections can be summarized for magnitude of change from the model climate regime baseline for different time horizons. The following time horizons were applied to this study:

- 1981 to 2019 (modelled baseline);
- 2041 to 2070 (2050s); and
- 2071 to 2100 (2080s).

To understand how climate is projected to change in the area of the Project, derived climate statistics of PMP, rainfall statistics (across durations and return periods), evapotranspiration, and extreme rainfall and snowmelt events are provided, consistent with the current climate.

The PMP is defined as "the greatest depth of precipitation for a given duration meteorologically possible for a design watershed or a given storm area at a particular location at a particular time of year, with no allowance made for long term climatic trends" (WMO 2009b). The PMP is a theoretical value that represents the greatest amount of rain possible in an area, whereas a design storm represents the greatest amount of rain observed in an area.

The future projected changes in PMP were calculated using both statistical and meteorological methods corresponding to the Hershfield method (using the same approach as the current climate conditions), and the moisture maximization method[4], respectively. The moisture maximization method was not able to be performed on the current climate baseline due to data limitations regarding the specific humidity. This parameter is a key input to the moisture maximization method but is not available in the current climate baseline. In the future climate analysis, the change in relative humidity between the modelled baseline and future data was used as a surrogate, which allowed the percentage change in PMP to be estimated. Ensemble statistics are presented in terms of percentiles (Section 22A5.1, Future Temperature and Precipitation), which were calculated across the results obtained from both methods. The monthly evapotranspiration potential and the daily rain and snowmelt projected changes were calculated using the same method as for the current climate but applied to all ensemble members and presented using percentiles across the ensemble.

[4] The moisture maximization method calculates the ratio of baseline and future specific humidity from the climate projections to approximate potential changes in PMP. This method assumes that additional atmospheric moisture holding capacity from elevated temperatures will result in greater PMP amounts.

22A3 Using the Results

This climate dataset is based on the current available climate science. The climate dataset involves the use of multiple climate models and scenarios with substantial inherent uncertainly around any given data points as described in Section 22A5. Climate projection uncertainties stem from three main sources: natural variability in the climate system, climate model structural inaccuracies (response of climate system to radiative forcing), and the future trajectories of greenhouse gases (Charron 2016; IPCC 2021). Natural climate variability involves fluctuations in the climate system that are difficult to model but have lasting effects such as oscillation within the climate system (e.g., El Niño / Southern Oscillation). Structural inaccuracies refer to physical processes that are not captured or are unresolved. For example, small scale convective events occur on scales of 10 km to 100 km and often make up the highest short duration extreme rainfall events. Global climate models are not able to accurately capture this process due to lack of spatial resolution (hundreds of kilometres) and temporal resolution (daily time step; CSA 2019). Future trajectories of greenhouse gas scenarios rely on assumptions for socioeconomic development and climate change mitigation policies, which can vary greatly by the end of the century. The interactions between these sources of uncertainty can also be considered as and additional source of uncertainty (IPCC 2021).

The uncertainty associated with any projections or forecasts is increased with the duration of the projected period and is subject to future developments; therefore, this work should be updated as new climate science is developed and after the release of downscaled climate projections from ClimateData.ca for the area of the Project following the AR6 by the IPCC (2021).

Uncertainty of future climate projections is described by providing a set of percentiles across the multi-model ensemble of projections (24 models and 3 scenarios of RCP2.6, RCP4.5, and RCP8.5) for each climate variable assessed. The projections at 50th percentile level represent the ensemble median projections, while the projections at the 95th percentile represent an outcome where 95% of projections are below this value. When considering the effect of future projected climate on current Project design parameters, percentiles may be selected to correspond with the requirements of the Project. The percentile represents the level of agreement in the multi-model ensemble. Selecting a higher percentile represents selecting more members of the ensemble that are at or below the projected value. Selection of future projections for climate change risk assessment should be based on a multi-criteria analysis that includes the balance between the extra investment and consequential risks.

It is recommended that the results in this report be used as follows:

- For the ensemble mean projections, the projections at the 50th percentile level should be selected as the starting point for Project consideration as a first step for risk assessment and planning and engineering design. At the 50th percentile level, half of the model projections are above the value and half are below the value, providing a reasonable screening assessment value.
- Consideration should be given to the Project lifespan and future level of service requirements and selection of the appropriate planning horizon for each infrastructure component (i.e., 2050s and 2080s).
- For critical infrastructure, selection of future projections percentiles should represent a greater agreement within the multi-model ensemble. For example, for critical infrastructure whose failure is considered unacceptable, a 95th percentile could be considered, representing the value at or below 95% of the projections as a way to address the uncertainty in the projections.
- To identify potential climate interactions with the Project infrastructure and Project activities.

- If a risk is identified for a Project infrastructure component, then a more refined analysis should be performed to further define the risks using the projections at different percentile levels.
- When considering action to address an identified potential risk, consideration should be given to selection of future projections at different percentile levels through a multi-criteria analysis.

22A4 Current Climate

Development of a current climate baseline dataset using the most representative available information is key to estimating current climate statistics from which future projected changes may be referenced. The following subsections outline the development of the current climate baseline dataset and the statistics, which are derived from this dataset method outlined in Section 22A2.1. First, a general description of the current climate is provided in Section 22A4.1, Existing Conditions, Section 22A4.2, Summary Comparison of MERRA-2 to On-Site and Regional Stations, and Section 22A4.3, Current Climate Normals and Trends. Second, more detailed descriptions related to the precipitation are provided in Section 22A4.4, Current Climate Extremes and Trends, Section 22A4.5, Current Probable Maximum Precipitation, and Section 22A4.6, Current Rainfall Statistics. A description of the current climate potential evapotranspiration is provided in Section 22A4.7, and extreme rainfall and snowmelt statistics are provided in Section 22A4.8. Results are summarized as part of the conclusions in Section 22A6.

22A4.1 Existing Conditions

To establish the existing conditions of the area of the Project, available climate observations from the on-site station and the closest regional climate stations (Section 22A4.1.1) and reanalysis data from MERRA-2 (Section 22A4.1.2) were obtained. The baseline period was established as the period of 1981 to 2019, to include the most recent observations while retaining a long continuous record to represent the current climate. At the time of analysis, only observations and reanalysis data were available up to the year 2019. Data availability for each of the stations was evaluated based on a set of selection attributes to filter observations for those that have a long, continuous record including recent years, are close to the Project site with similar geographical siting, and have a high data availability (fewer missing values). Further details on selection attributes used are provided in Attachment 22A-1. This was followed by a sensitivity analysis to compare the available data sources. Based on the poor data availability and limited long-term observations that did not meet the selection attributes, the current climate dataset was developed using reanalysis data from MERRA-2 to represent the current climate. The sensitivity analysis showed that the MERRA-2 data were able to capture regional climate patterns for maximum, minimum, and mean temperatures. Precipitation showed less agreement between MERRA-2 and the on-site and regional stations, which may be a result of the lack of proximity of the stations, different geographical influences, and poor precipitation records. Detailed discussion is provided in the following subsections.

22A4.1.1 On-Site and Regional Stations

One on-site station and three nearby regional climate stations (located within 200 km of the site) were considered for the development of the current climate baseline. Table 22A-1 describes the on-site climate station, Fort McMurray A (3062693), Cree Lake (4061861), and Cluff Lake (4061590).

Table 22A-1: Climate Station Properties

Station Name	Station ID	Latitude and Longitude	Elevation (masl)	Distance from Project footprint (km)	Years Available	Notes
Rook I Hill (on-site station)	n/a	57°40'25.71 N 109°15'14.56 W	523	n/a	2015-2020	Limited data availability during the desired period. Precipitation only available from 2018 onwards.
Fort McMurray A Fort McMurray CS	3062693 3062696	56°39'00" N 111°13'00" W	369.1	170	1953-2021	Farthest station away from Project and has different geographical characteristics.
Cree Lake	4061861	57°21'00" N 107°08'00" W	494.6	145	1969-1996	Does not include the most recent years.
Cluff Lake	4061590	58°22'00" N 109°31'00" W	330.1	81	1980-1999	Does not include the most recent years and is influenced by a large body of water.

Note: The latitude and longitude of the on-site climate station was assumed to be the centroid coordinates of the Project footprint.
masl = metres above sea level; N = north; W = west; n/a = not applicable for on-site station.

The on-site climate station has observations for the years 2015 to 2020, however, precipitation was only available after 2018. For the period of 2018 to 2020, only 44% of daily precipitation values were available with long periods of missing data including all days up to September 2018. Due to the need for a long continuous climate data record (Attachment 22A-1), the on-site data cannot currently be used to represent current climate at the Project site.

The observations from the regional stations had good data availability during the years available; however, only Fort McMurray CS station covered the most recent years of observations (i.e., observations in the last decade). This is due to decommissioning of regional climate stations before the most recent years of observations, thereby limiting the most recent observation availability. The Fort McMurray A station had data availability over 99% for the years 1953 to 2008, with two years below 90% (1993 and 2008). The Fort McMurray CS station also had a high data availability of 95% for mean temperature and 79% for precipitation (1996 to 2021). Although Fort McMurray A and Fort McMurray CS have good data availability and a long-combined data record, these stations are located the farthest away from the Project (170 km southwest) and had the most differing geographical characteristics compared to the area of Project. Unlike the Project, the Fort McMurray A station is not located adjacent to a waterbody, which may have effects on the overall climate.

The Cree Lake station had data availability over 88% for the years 1969 to 1996, with five years under 90% (1969, 1993 to 1996). The Cree Lake station is closer to the Project (145 km southeast) compared to Fort McMurray A; however, the station is still missing most of the recent years of observations and is located adjacent to a much larger waterbody compared to the Project, which may have a large influence on the climate in the area.

Finally, the Cluff Lake station had data availability of above 91% for the years 1980 to 1999, with only one year below 90% (1980). The Cluff Lake station is the closest regional station to the Project (81 km north); however, the station is still missing most of the recent years of observations, and is in close proximity to Lake Athabasca, which may have a large influence on the climate in the area compared to the area of the Project.

Based on the analysis of the regional climate stations, the available long-term observations did not meet the selection attributes (Attachment 22A-1) for including the most recent years of observations (no data available over the last decade). In addition, the regional climate stations are all located at large distances away from the Project site, and each had varying geographical characteristics that may not be representative of the conditions at the area of the Project. Reanalysis data provide a complete record for the site through the use of data assimilation (satellite and ground based) and bias correction, although limited by the spatial resolution provided (0.5° x 0.625°). With no suitable observations available for the area of the Project, reanalysis data were selected to represent the current climate conditions over the same period as the modelled baseline (1981 to 2019).

22A4.1.2 MERRA-2 Reanalysis Data

The MERRA-2 data include the most recent climate data for a baseline period from 1981 to 2019 and provide hourly data for mean temperature to complete the calculation of daily maximum and minimum temperatures for the climate extreme analysis. MERRA-2 combines modelled results from the Goddard Earth Observing System model and data assimilation data from microwave sounders, hyperspectral infrared radiance instruments, and other data sources. The analysis is performed at a horizontal resolution of 2/3-degree longitude and by 1/2-degree latitude and at 72 levels extending to 0.01 hectopascal (102 pascals) and simulates both the temperature and precipitation on an hourly basis (NASA 2021). The current climate baseline is established by using MERRA-2 reanalysis data as the climate stations on site and within the region did not meet the selection attributes outlined in Attachment 22A-1. In Gelaro et al. (2017), comparisons were made between different climate variables provided by MERRA-2 to various datasets of ground-based and satellite observations. Time average precipitation rates were found to be generally higher than observations at higher latitudes, with the prairie provinces showing the lowest differences across Canada.

Unlike the hydrological modelling completed for the Project, the current climate analysis could not use the ERAI reanalysis data from the European Centre for Medium-Range Weather Forecasts. The ERAI does not provide the appropriate temporal scale (i.e., hourly data) for mean temperature. The ERAI data are only available in six-hour intervals, preventing the calculation of daily maximum and minimum temperatures needed for the climate extreme analysis.

A comparison of MERRA-2 to historical observations from the regional climate stations was conducted over the period from 1981 to 2019 for the concurrent period (only considering data if available from both datasets for the same point in time). Visual comparisons between MERRA-2 and historical observations were made to annual and monthly aggregated values. Comparison of daily precipitation and temperature values were made through linear correlation (least squares and quantile regression). For linear correlation, both the slope and Pearson correlation coefficient (R^2) were considered.

The correlation between MERRA-2 and the regional stations (Fort McMurray A, Cree Lake, and Cluff Lake) was conducted for both the temperature and precipitation during the 38-year concurrent period. The daily maximum, minimum, and mean temperature data on a monthly scale showed reasonably high R^2 values, as shown in Table 22A-2, except for daily precipitation. Ideally, the R^2 value for daily precipitation would be above 0.8 for a good correlation, but the correlation is below 0.8 for all regional stations.

Table 22A-2: Daily R^2 from Correlation between MERRA-2 and Fort McMurray A, Cree Lake, and Cluff Lake, 1981 to 2019

Climate Variable	Daily R^2 for each Climate Station		
	Fort McMurray A	Cree Lake	Cluff Lake
Daily maximum temperature	0.958	0.962	0.947
Daily minimum temperature	0.951	0.947	0.963
Daily mean temperature	0.972	0.971	0.971
Daily precipitation	0.428	0.696	0.621

R^2 = Pearson correlation coefficient.

While the R^2 value is used as an indicator of goodness of fit, the slope of the linear correlation is used here as a measure of bias or tendency for MERRA-2 to over or underrepresent daily temperature and precipitation (Table 22A-3). In the case of daily temperatures, all slopes are close to 1, indicating only small amounts of bias for each climate station. For Fort McMurray A, the MERRA-2 daily temperatures are slightly lower than what is observed, while for Cluff Lake the opposite was found. For Cree Lake, the MERRA-2 daily temperatures are slightly higher than observations with the exception of the daily minimum temperature, which is close to a slope of 1. In the case of precipitation, all stations show under prediction of daily precipitation values.

Table 22A-3: Slope of Best Fit Line from Correlation between MERRA-2 and Fort McMurray A, Cree Lake, and Cluff Lake, 1981 to 2019

Climate Variable	Slope of Best Fit Line for each Climate Station		
	Fort McMurray A	Cree Lake	Cluff Lake
Daily maximum temperature	0.979	1.031	1.018
Daily minimum temperature	0.964	0.998	1.015
Daily mean temperature	0.988	1.035	1.032
Daily precipitation	0.630	0.634	0.439

MERRA-2 used data from available climate stations and satellite observations to correct for bias in precipitation. Despite this, lower correlation for daily precipitation was found. Modelled precipitation generally suffers from a low number of dry days resulting from too much drizzle (low precipitation amounts) and an inability to reproduce high precipitation events (Piani et al. 2010). This is due to limited spatial resolution as a large area (approximately 50 km for MERRA-2) is being covered by one grid cell, as well as low temporal resolution (one hour for MERRA-2) limiting the capture of singular convective precipitation events or nested convective precipitation events that can make up larger storms (CSA 2019).

The relationship between the reanalysis precipitation from MERRA-2 and the regional climate stations is examined further through quantile regression analysis using daily total precipitation. Using this approach, lines of best fit are established in the same way as linear correlation, with an added function for values above and below a given quantile (or percentile). The slope of each line over a range of percentiles is presented in Table 22A-4. Lower percentiles for daily precipitation would represent dry days or days with low amounts of precipitation. At the 25th percentile, the regression slopes are 0 or near 0. This indicates there are many days where some precipitation is provided by MERRA-2 and is not recorded in the observations. Higher percentiles such as the 90th show regression slopes greater than 1 and in the case of Cluff Lake under the 99th percentile, a value of 7.64 is given. This indicates that for extreme precipitation amounts (over the period of observations for each regional climate station), the observations are typically showing much greater values than what is provided by MERRA-2.

Table 22A-4: Regression Slopes of Quantile Regression between MERRA-2 and Fort McMurray A, Cree Lake, and Cluff Lake, 1981 to 2019

Regional Climate Station	Regression Slopes across Quantiles				
	0.25	0.5	0.75	0.9	0.99
Fort McMurray A	0.05	0.42	0.95	1.67	4.4
Cree Lake	0.03	0.37	0.91	1.55	4.42
Cluff Lake	0	0.28	0.88	1.75	7.64

Both the linear correlation and regression analyses focus on comparing concurrent values of daily total precipitation. However, due to the modelled nature of the MERRA-2 values, it is possible that most of the precipitation may fall on a different day (before or after what is recorded in the observations). To test this, the maximum daily precipitation is calculated for each month and averaged across calendar months, then compared between MERRA-2 and the regional climate stations (Table 22A-5). For most calendar months on average, maximum one-day precipitation amounts are relatively close; however, during the late spring and summer months when larger events generally occur, larger differences are present. For both Fort McMurray A and Cluff Lake stations, one-day maximum precipitation events are generally underestimated, while for Cree Lake the opposite was found. As shown in Table 22A-4 through quantile regression, the 75th percentile still shows slight overestimation from MERRA-2, while the 90th percentile shows underestimation. Because of this, the maximum one-day precipitation amounts for MERRA-2 compared to observations may be higher or lower based on the magnitude of precipitation amounts that make up the averaged maximum one-day precipitation in each calendar month.

Table 22A-5: Maximum 1-Day Precipitation Comparison between MERRA-2 and Fort McMurray A, Cree Lake, and Cluff Lake, 1981 to 2019

Calendar Month	Maximum 1-Day Precipitation (mm)					
	Fort McMurray A		Cree Lake		Cluff Lake	
	Observed	MERRA-2	Observed	MERRA-2	Observed	MERRA-2
January	4.73	5.21	6.12	6.25	5.12	4.92
February	3.77	4.67	4.76	5.49	5.30	5.32
March	5.75	6.58	6.25	7.44	7.09	6.17
April	7.50	10.63	8.83	9.50	6.66	9.36
May	10.82	15.74	10.96	13.64	10.13	15.09
June	21.60	22.23	19.92	20.80	18.31	17.51
July	25.12	20.01	21.74	28.17	26.98	25.37
August	19.31	15.92	20.24	17.27	19.93	17.28
September	15.92	15.58	15.78	16.19	16.61	15.42
October	9.94	10.11	10.63	12.30	9.37	8.36
November	5.21	6.07	8.84	7.22	8.34	6.73
December	4.64	6.71	5.79	6.79	6.29	6.47

In summary, on a daily scale, temperature was shown to be captured well by the MERRA-2 reanalysis dataset through very high linear correlation R^2 values and slopes that are very close to 1. Daily precipitation was not captured well through linear correlation, and quantile regression slopes for low percentiles show evidence of drizzle (frequent low precipitation amounts), while high percentiles showed an underestimation of extreme precipitation events. When comparing maximum one-day precipitation amounts between MERRA-2 and regional climate station observations, it was found that in most months MERRA-2 captures these events well on average; however, in the summer months there is more variation likely due to the presence of more extreme precipitation events.

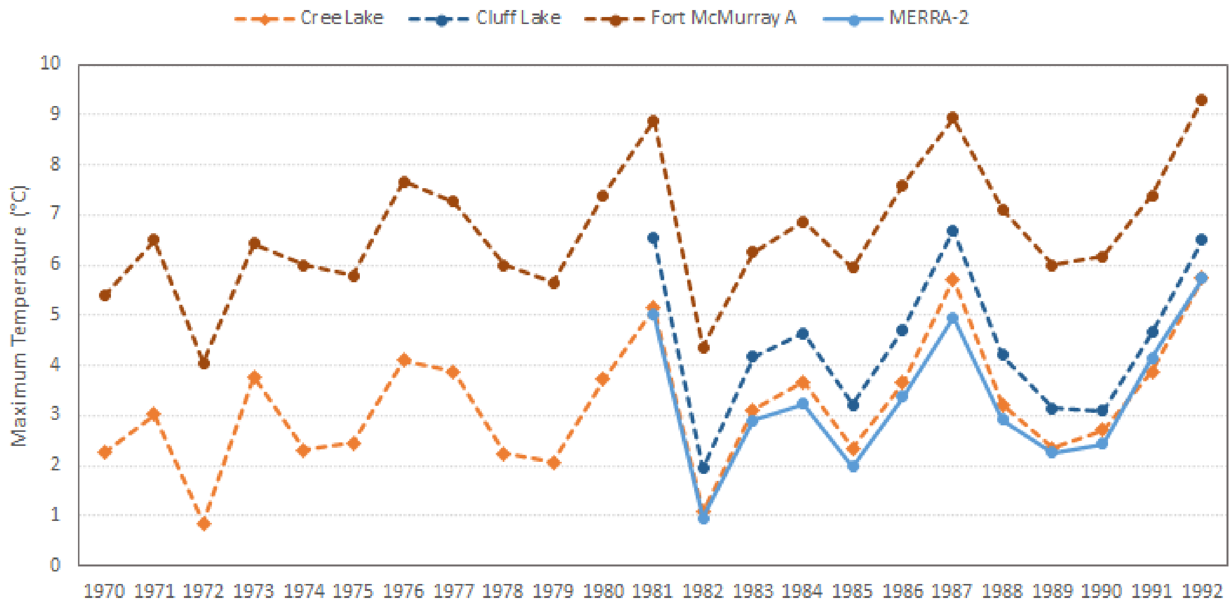
The MERRA-2 daily precipitation data were not bias corrected as on-site values were limited to the period of 2018 to 2020. As more on-site data are collected, bias correction of the MERRA-2 data may become possible in the future as part of a continual improvement process such as the framework outlined in TSD XXII. The current climate baseline should be revisited when sufficient data are available.

22A4.2 Summary Comparison of MERRA-2 to On-Site and Regional Stations

The MERRA-2 reanalysis data were compared to the nearby climate stations on a daily time scale through the analyses in Section 22A4.1.2. Here, a sensitivity analysis was used to compare the mean, maximum, and minimum temperatures and precipitation for the concurrent periods aggregated to monthly and annual time scales. The MERRA-2 reanalysis data for the grid cell nearest to the Project site are compared to the regional climate stations to gain a further understanding of regional climate variability. This comparison was accomplished through visual inspection of annual and monthly aggregated temperature and total precipitation, as well as through comparison of linear correlation and quantile regression parameters on a daily time scale.

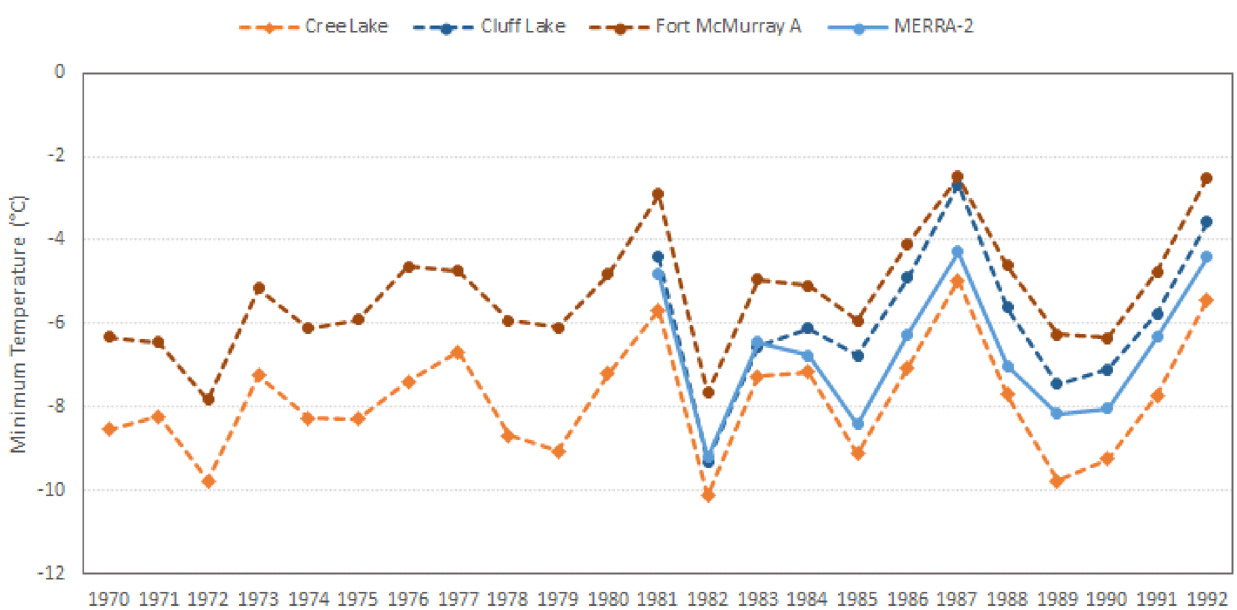
Figure 22A-1, Figure 22A-2, and Figure 22A-3 present the annual averaged temperatures for the Cree Lake, Cluff Lake, and Fort McMurray A stations and the MERRA-2 dataset. The temperature trends show a general correlation; however, the regional stations show warmer temperatures than the MERRA-2 dataset. The temperature differences can be attributed to the locations of the stations that are at differing latitudinal bands and are influenced by their surrounding geographical features (Section 22A4.1.1). The Fort McMurray A station is located the farthest south and is shown to have the highest temperatures compared to the other stations. Both the Cree Lake and Cluff Lake stations are at closer latitudes to the Project but are located near large bodies of water that may be influencing or moderating the local climates at those stations.

Figure 22A-1: Annual Averaged Maximum Temperatures for Cree Lake, Cluff Lake, and Fort McMurray A Climate Stations and MERRA-2 Reanalysis Data



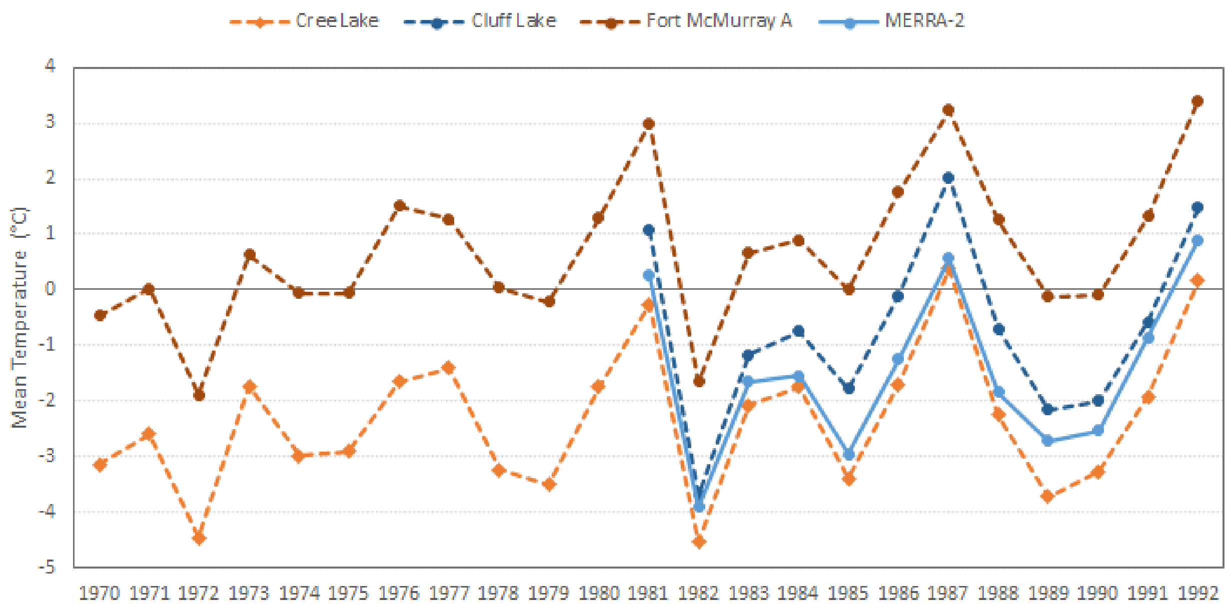
MERRA-2 = Modern-Era Retrospective analysis for Research and Applications, Version 2.

Figure 22A-2: Annual Averaged Minimum Temperatures for Cree Lake, Cluff Lake, and Fort McMurray A Climate Stations and MERRA-2 Reanalysis Data



MERRA-2 = Modern-Era Retrospective analysis for Research and Applications, Version 2.

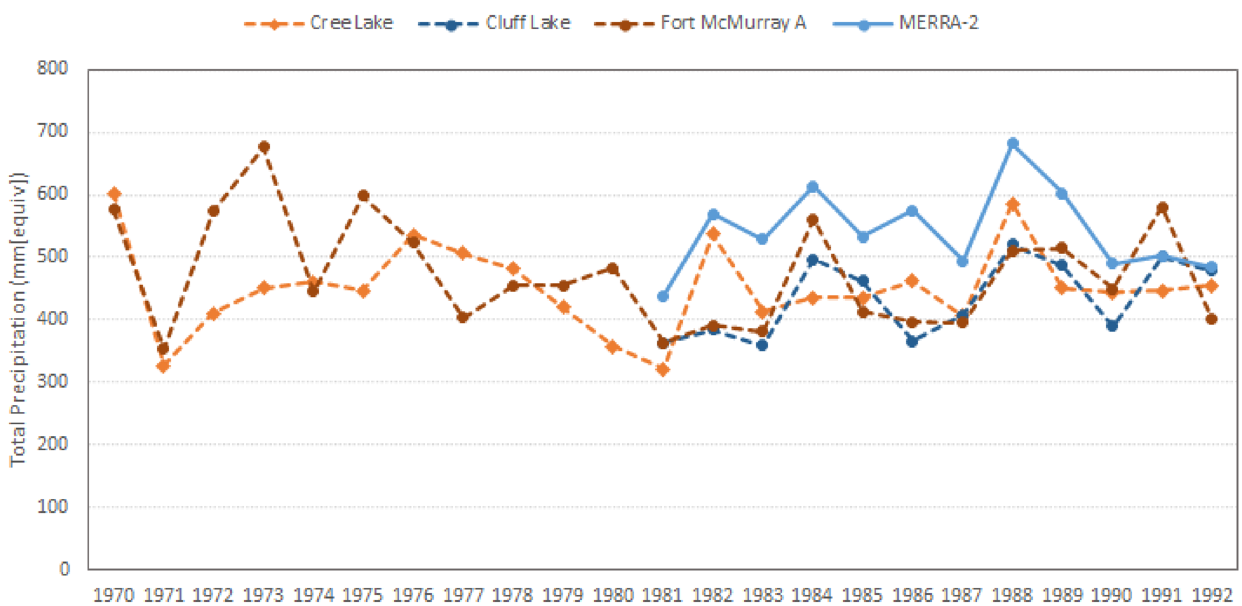
Figure 22A-3: Annual Averaged Mean Temperatures for Cree Lake, Cluff Lake, and Fort McMurray A Climate Stations and MERRA-2 Reanalysis Data



MERRA-2 = Modern-Era Retrospective analysis for Research and Applications, Version 2.

Figure 22A-4 presents the annual averaged total precipitation, which shows much less correlation between the regional stations and MERRA-2. These differences are likely because of drizzle (frequent low precipitation amounts), which have a considerable cumulative effect for total precipitation on an annual scale (Section 22A4.1.2). Another contributing factor to these differences may be a result of the large distances between the regional stations and the area of the Project, as well as the varying geographical influences (Section 22A4.1.1). For example, the local climate at the Cree Lake station is influenced and moderated by the large lake located adjacent to the station, while the Cluff Lake station would likely be influenced by both the lake near the station and Lake Athabasca to the north. The Fort McMurray A station is not located near a waterbody and has very different geographical features.

Figure 22A-4: Annual Averaged Total Precipitation for Cree Lake, Cluff Lake, and Fort McMurray A Climate Stations and MERRA-2 Reanalysis Data

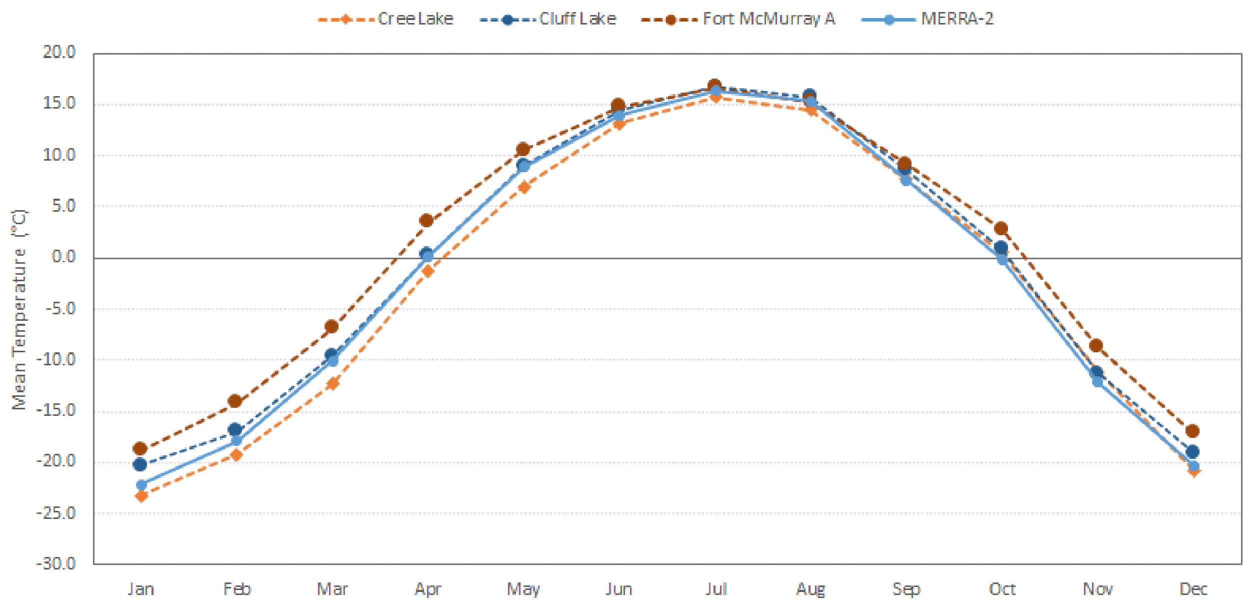


mm[equiv] = millimetre equivalent; MERRA-2 = Modern-Era Retrospective analysis for Research and Applications, Version 2.

In general, on an annual scale, the MERRA-2 precipitation data used to represent the Project site are higher in comparison to the other stations. This may be conservative for applications where greater volumes of precipitation amounts are important but may underestimate precipitation intensity as larger daily events may be underestimated (Section 22A4.1.2). Conversely, high volumes of precipitation may underrepresent water quality effects as greater water volumes would increase dilution of contaminants. The mean annual precipitation for the years 1981 to 2019 is estimated to be 563 mm using the MERRA-2 precipitation (Section 22A4.3, Table 22A-6).

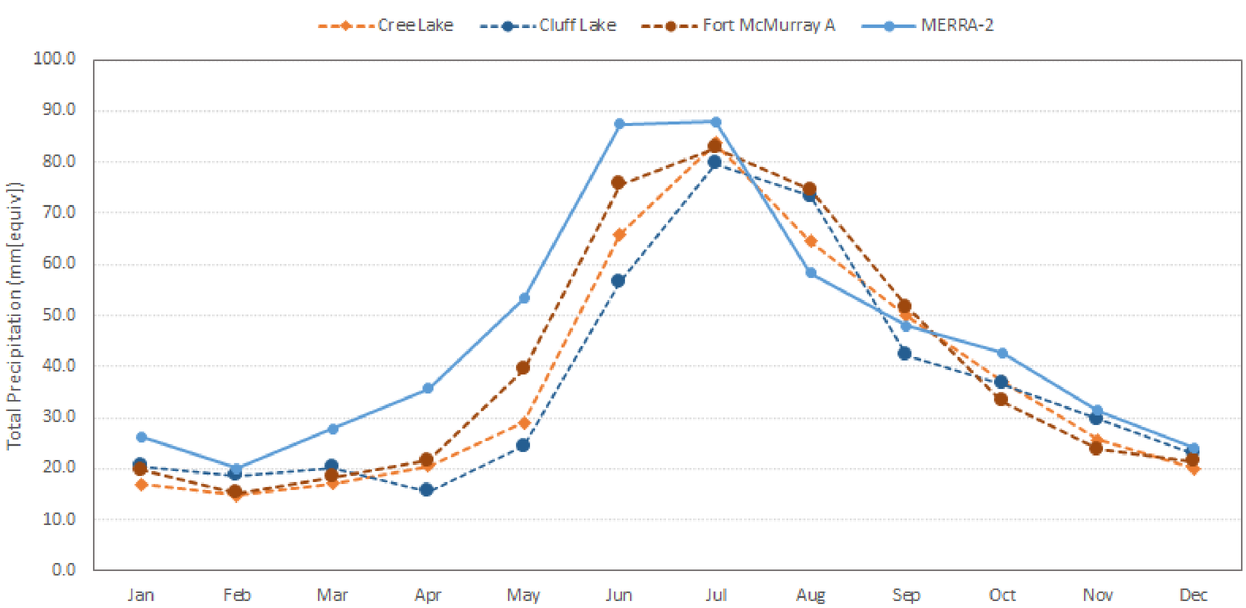
The annual averaged monthly mean temperature follows consistent seasonal patterns between the regional stations and MERRA-2 data used to represent the Project site, as shown in Figure 22A-5. However, in Figure 22A-6, the annual averaged monthly total precipitation for MERRA-2 compared to the regional stations shows an earlier onset and higher precipitation values in the spring and in early summer. This difference is important as it may influence estimates of spring freshet and snowmelt.

Figure 22A-5: Annual Averaged Monthly Mean Temperature for Cree Lake, Cluff Lake, and Fort McMurray A Climate Stations and MERRA-2 Reanalysis Data



MERRA-2 = Modern-Era Retrospective analysis for Research and Applications, Version 2.

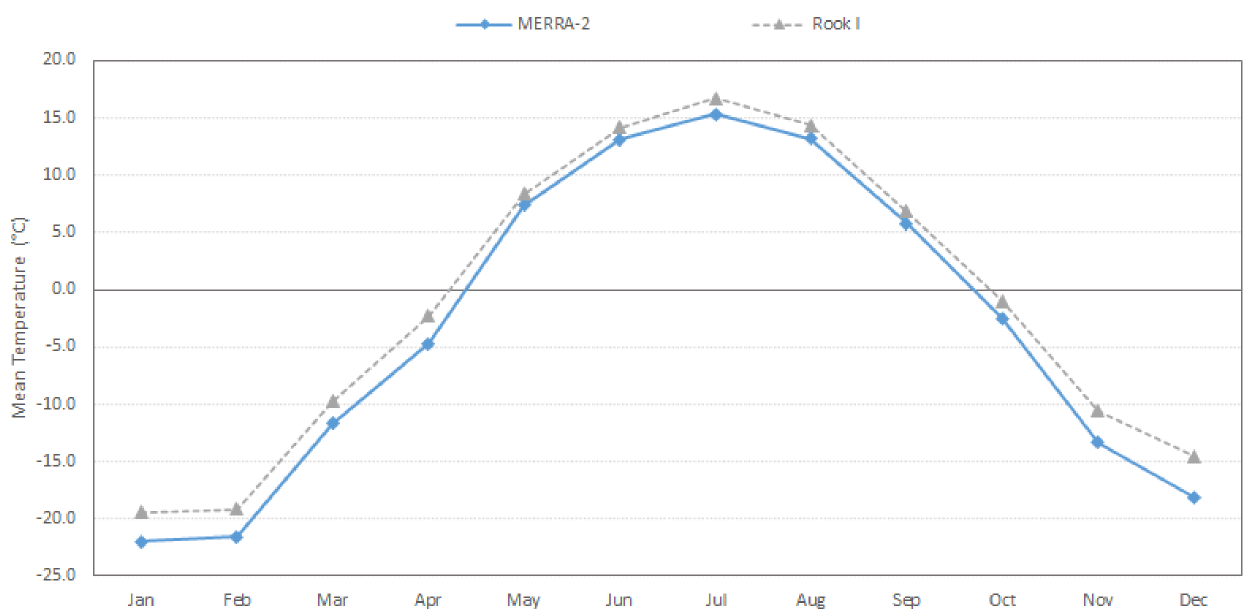
Figure 22A-6: Annual Averaged Monthly Total Precipitation for Cree Lake, Cluff Lake, and Fort McMurray A Climate Stations and MERRA-2 Reanalysis Data



mm[equiv] = millimetre equivalent; MERRA-2 = Modern-Era Retrospective analysis for Research and Applications, Version 2.

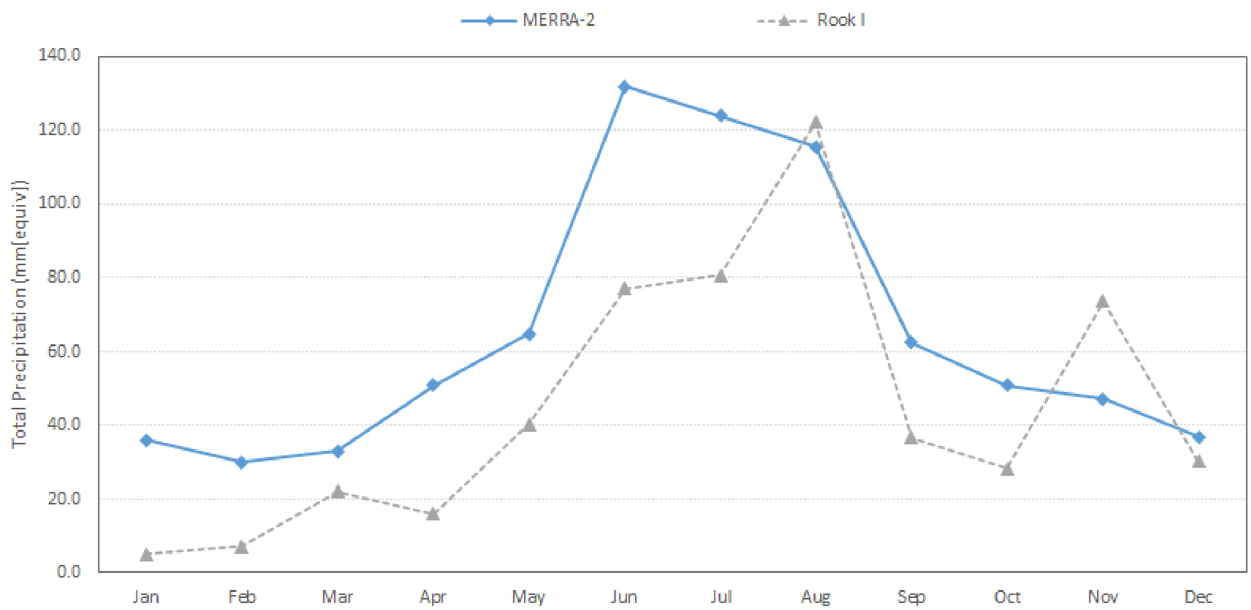
The MERRA-2 data were compared to the on-site station, which only had two years of observable data available for 2018 and 2020 (where both precipitation and temperature are recorded). In general, the annual averaged monthly mean temperatures show a strong correlation between the MERRA-2 data and the on-site station data (Figure 22A-7). The annual averaged monthly total precipitation (Figure 22A-8) follows consistent seasonal patterns, but MERRA-2 shows higher precipitation values for all months, especially during the spring and early summer months, similar to the regional climate stations. This difference is consistent with the comparison of the MERRA-2 precipitation data from the surrounding regional climate stations in Figure 22A-4, reinforcing that monthly precipitation estimates from MERRA-2 are typically higher than observed in the region. The MERRA-2 dataset may be considered conservative for applications where high precipitation volumes are a key consideration, while for applications where precipitation intensity or low water volumes are important, the MERRA-2 dataset may underestimate climate risks.

Figure 22A-7: Annual Averaged Monthly Mean Temperature for the On-Site Climate Station and MERRA-2 Reanalysis Data



MERRA-2 = Modern-Era Retrospective analysis for Research and Applications, Version 2.

Figure 22A-8: Annual Averaged Monthly Total Precipitation for the On-Site Climate Station and MERRA-2 Reanalysis Data



mm[equiv] = millimetre equivalent; MERRA-2 = Modern-Era Retrospective analysis for Research and Applications, Version 2.

As discussed in Section 22A4.1.1, the on-site station observations have insufficient data length and availability to represent the current climate baseline. Based on the review of regional climate stations in Section 22A4.1.1, it was found that available long-term observations did not meet the selection criteria attributes (Attachment 22A-1) as the climate stations were found to be located at large distances away from the Project footprint.

Reasons for the differences between MERRA-2 and the on-site Project data can only be inferred from the limited on-site record of 2018 to 2020. However, based on the comparison of MERRA-2 to the regional climate stations (Section 22A4.1.2), the differences may be attributed to evidence of drizzle (frequent low precipitation amounts), and underestimation of extreme precipitation events, discussed in Section 22A4.1.2, despite MERRA-2 including bias correction using satellite and ground-based observations from its predecessor, MERRA (Gelaro et al. 2017). These limitations should be considered when using the current climate precipitation provided through this work.

As more on-site data are collected, bias correction of the MERRA-2 data may become possible in the future to correct for the effect of drizzle and underestimation of extreme precipitation events as part of the continual improvement process outlined for climate change as part of TSD XXII.

22A4.3 Current Climate Normals and Trends

The current climate has experienced increasing temperature trends for the prairie provinces as a whole, with annual changes in mean temperature between 1948 and 2016 increasing by 1.9°C according to the 2019 ECCC Canada's Changing Climate Report (Bush and Lemmen 2019). The report also found observed changes in annual and seasonal precipitation increased by 7% between 1948 and 2016 (Bush and Lemmen 2019). Based on a set of gridded observations, the ClimateData.ca portal shows that the annual average temperatures at the regional stations have also increased. For example, the annual average temperature at the Cluff Lake station has increased from -2.1°C (between 1951 and 1980) to -0.8°C (between 1981 and 2010) and has increased at the Cree Lake station from -3.2°C to -2°C for the same time periods (ClimateData.ca 2019).

The current climate normals are defined in this report as the average value of a climatological variable over a recent period of at least 30 years. Climate trends were calculated in this report using the MERRA-2 data (nearest grid cell to the site) for the current climate baseline period (1981 to 2019) using a methodology developed by the Finnish Meteorological Institute (Salmi et al. 2002) to assess long term changes in climate. Both annual and monthly normals and trends were calculated for the average temperature and total precipitation. The analysis resulted in three pieces of information for each climate parameter:

- climate normal;
- climate trend; and
- statistical significance of the trend.

The analysis assessed the statistical significance at the 90th, 95th, 99th, and 99.9th percentile levels using a Mann Kendall test (Salmi et al. 2002). A trend that is assessed to be zero is classified as no apparent trend. A trend that is assessed to not be statistically significant at the 90th percentile is classified as being not significant (i.e., percentiles less than the 90th were not directly tested for significance). A trend is assessed to be statistically significant at the 95th percentile (i.e., there is a less than 5% chance that the observed trend does not exist if the statistical test conditions are met). The trend analysis is subject to the data quality and data availability, and caution should be exercised when using the trends.

The current climate normals and trends are presented in Table 22A-6 for the current climate baseline period.

In general, for the period of 1981 to 2019, the current climate normals and trends indicate a climate that has become wetter over time. The analysis shows that it is likely that total precipitation is increasing both annually and for selected months. Annual total precipitation shows an increasing trend statistically significant at the 99th percentile, along with increasing trends in January, February, and March (at the 95th percentile); November (at the 90th percentile); and December (at the 99th percentile). Decreasing trends were observed for May and July, but these trends were not statistically significant.

In contrast, the current climate trends indicate a decreasing decadal trend in the average annual temperature that was found to be not statistically significant at the 90th percentile. The monthly temperature trends fluctuate with decreasing trends during the later winter, spring, and summer months and increasing temperature trends in the early winter. Although there are both increasing and decreasing trends, it is important to note that the trends are relatively small in magnitude with multiple months of no trends observed. This indicates that it is likely difficult to distinguish changes in the current climate outside the year-to-year variability.

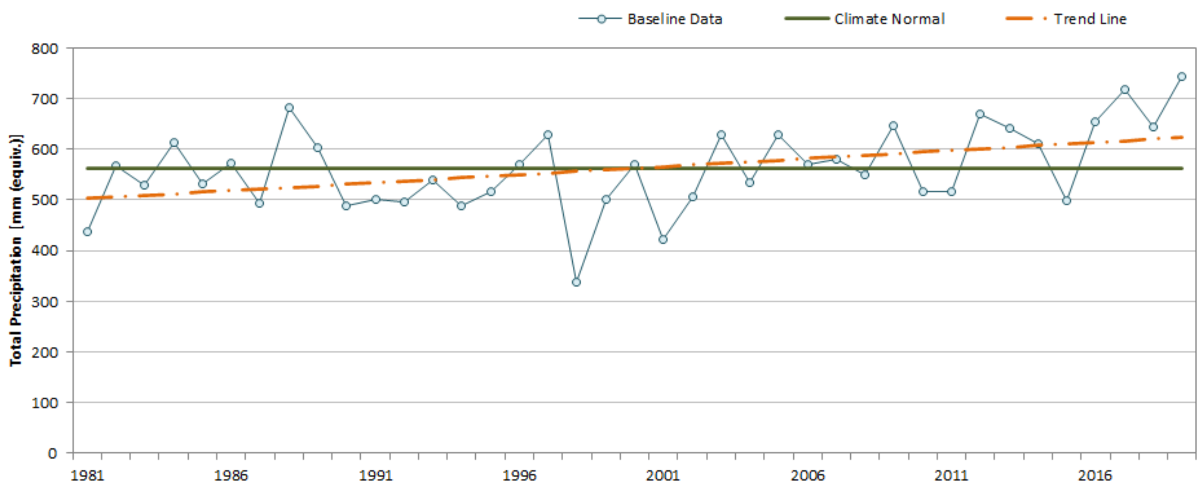
Table 22A-6: Current Climate Normals and Trends for the Current Climate Baseline Period, 1981 to 2019

Climate Indices	Normals	Decadal Trend	Statistical Significance
Average annual temperature (°C)	-1.5	-0.1	Not statistically significant
Average January temperature (°C)	-21.6	+0.2	Not statistically significant
Average February temperature (°C)	-17.9	-0.5	Not statistically significant
Average March temperature (°C)	-10.4	-0.5	Not statistically significant
Average April temperature (°C)	-0.4	-0.6	Not statistically significant
Average May temperature (°C)	8.4	-0.1	Not statistically significant
Average June temperature (°C)	14.0	0.0	No trend
Average July temperature (°C)	16.4	-0.1	Not statistically significant
Average August temperature (°C)	14.8	-0.4	Not statistically significant
Average September temperature (°C)	8.1	+0.2	Not statistically significant
Average October temperature (°C)	1.6	0.0	No trend
Average November temperature (°C)	-10.8	+0.1	Not statistically significant
Average December temperature (°C)	-19.4	+0.3	not statistically significant
Annual total precipitation (mm equiv)	562.9	+31.8	Significant at the 99th percentile
January total precipitation (mm equiv)	26.7	+3.5	Significant at the 95th percentile
February total precipitation (mm equiv)	22.2	+2.1	Significant at the 95th percentile
March total precipitation (mm equiv)	31.8	+3.3	Significant at the 95th percentile
April total precipitation (mm equiv)	39.8	+3.2	Not statistically significant
May total precipitation (mm equiv)	55.9	-1.1	Not statistically significant
June total precipitation (mm equiv)	90.9	+6.1	Not statistically significant
July total precipitation (mm equiv)	83.6	-1.8	Not statistically significant
August total precipitation (mm equiv)	61.9	+2.9	Not statistically significant
September total precipitation (mm equiv)	52.2	+5.1	Not statistically significant
October total precipitation (mm equiv)	40.1	+1.2	Not statistically significant
November total precipitation (mm equiv)	30.9	+3.0	Significant at the 90th percentile
December total precipitation (mm equiv)	26.9	+4.2	Significant at the 99th percentile

mm equiv = millimetre equivalent.

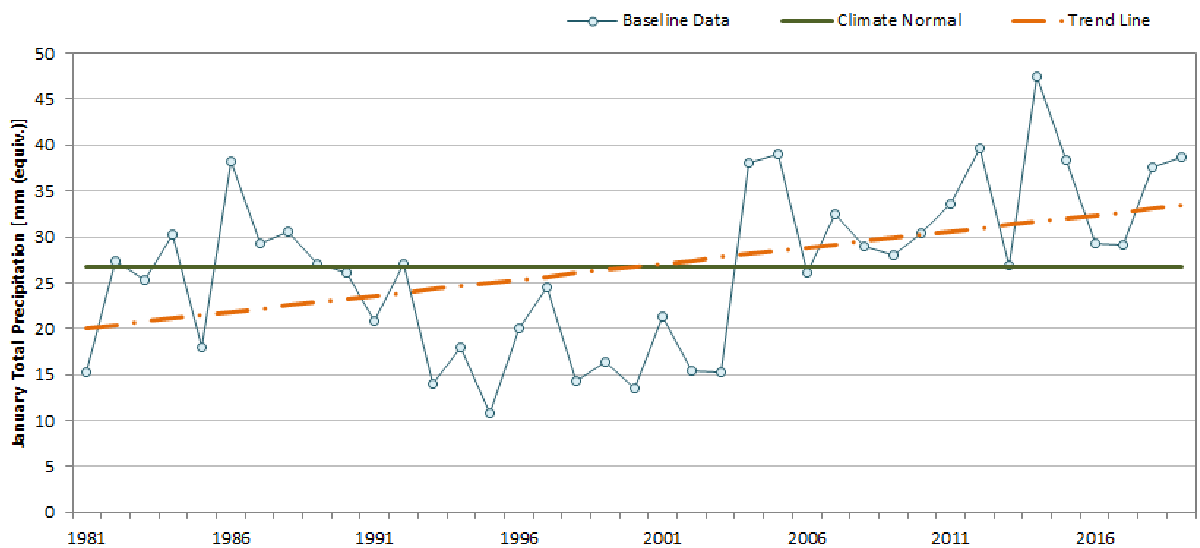
Figure 22A-9 presents the historical precipitation data and trends for the current climate baseline period. The graph shows the variation in year-to-year observations, along with the climate normal, and the trend derived from the current climate data. In Figure 22A-9, there is an increasing trend in average total precipitation at a rate of 31.8 mm (equivalent) per decade. The trend was identified as being statistically significant at the 99th percentile. Figure 22A-10 to Figure 22A-14 show similar data for the remaining trends identified as statistically significant to at least the 90th percentile.

Figure 22A-9: Current Climate Average Total Precipitation – Annual



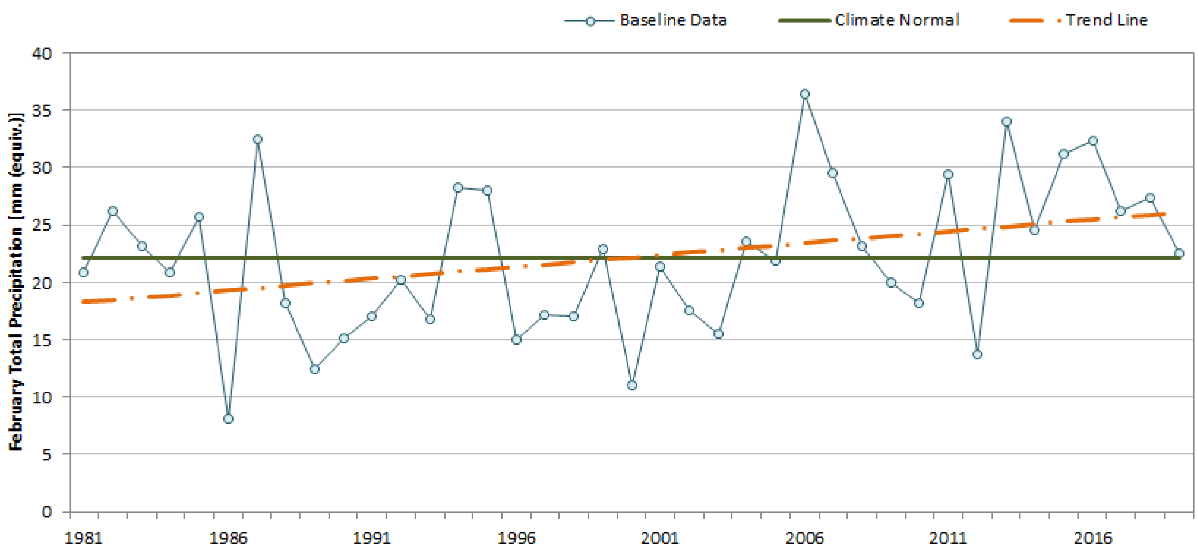
mm (equiv.) = millimetre equivalent.

Figure 22A-10: Current Climate Average Total Precipitation – January



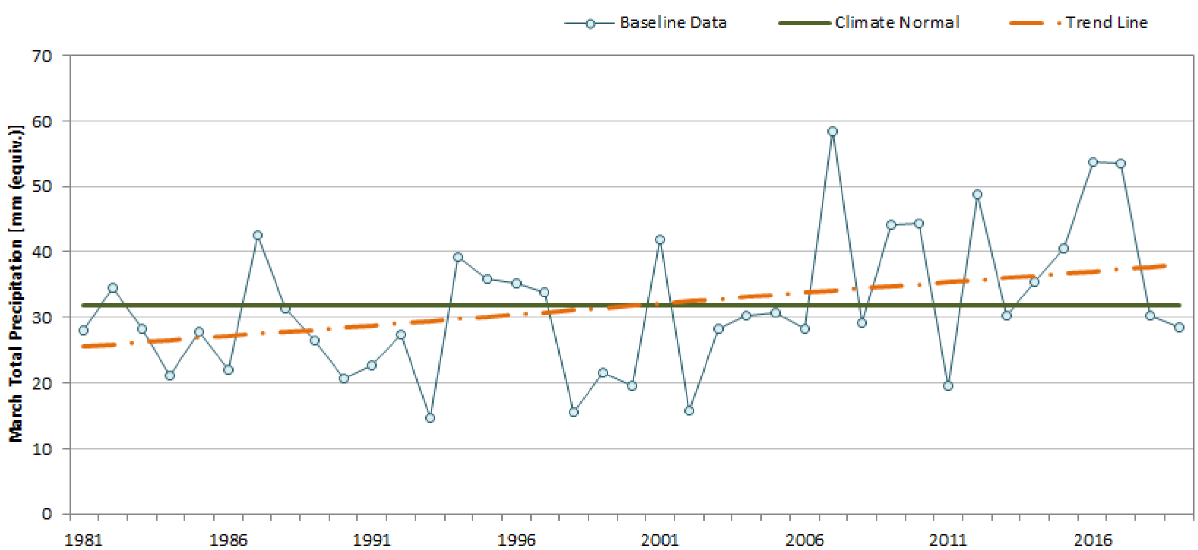
mm (equiv.) = millimetre equivalent.

Figure 22A-11: Current Climate Average Total Precipitation – February



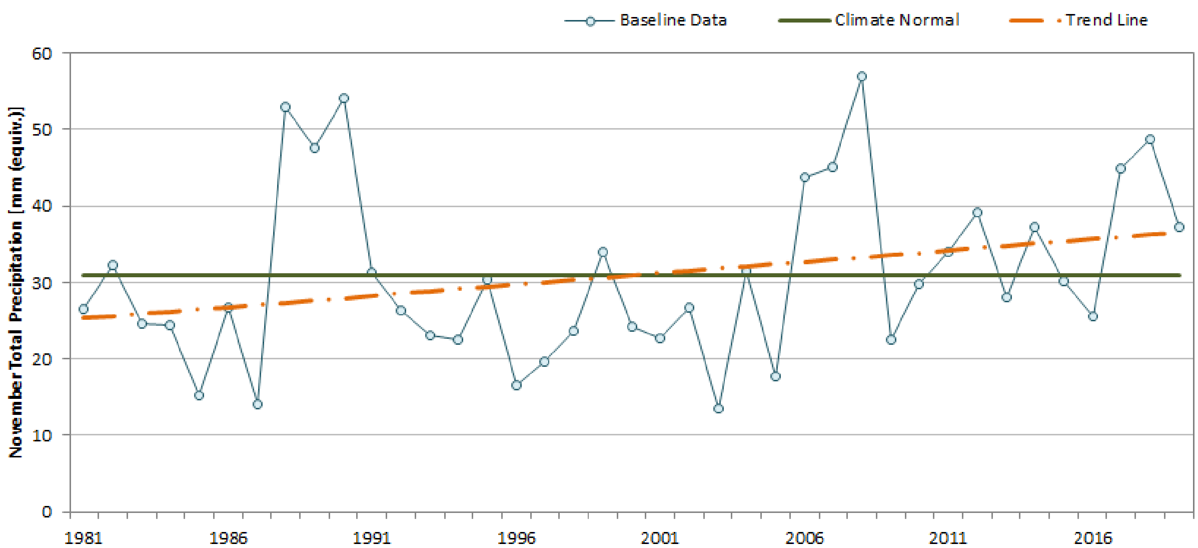
mm (equiv.) = millimetre equivalent.

Figure 22A-12: Current Climate Average Total Precipitation – March



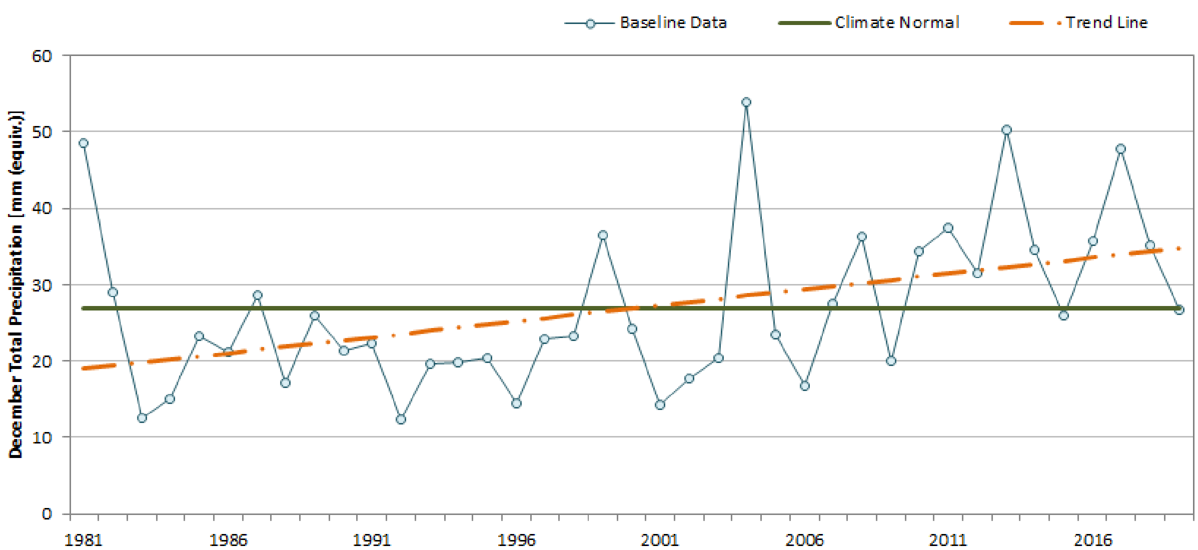
mm (equiv.) = millimetre equivalent.

Figure 22A-13: Current Climate Average Total Precipitation – November



mm (equiv.) = millimetre equivalent.

Figure 22A-14 Current Climate Average Total Precipitation – December



mm (equiv.) = millimetre equivalent.

The minimum and maximum annual and seasonal temperature trends are presented in Table 22A-7 and Table 22A-8, respectively. Minimum temperatures show increasing annual and seasonal trends in the fall and winter (not statistically significant), while the maximum temperature shows a decreasing annual trend (not statistically significant), and seasonal trends in the spring (statistically significant at the 95th percentile), summer (statistically significant at the 90th percentile), and winter (not statistically significant). The decreasing maximum temperature trends are slightly larger than the increasing minimum temperature trends, which may be causing the decreasing mean temperature annual and seasonal trends. Figure 22A-15 and Figure 22A-16 show the current average temperature trends for the spring and summer season, respectively.

Table 22A-7: Current Climate Normals and Trends – Current Climate Baseline Minimum Temperature, 1981 to 2019

Climate Indices	Normals	Decadal Trend	Statistical Significance
Average annual temperature (°C)	-6.4	+0.1	Not statistically significant
Average spring temperature (°C)	-6.4	-0.3	Not statistically significant
Average summer temperature (°C)	9.3	0.0	No trend
Average fall temperature (°C)	-4.7	+0.3	Not statistically significant
Average winter temperature (°C)	-24.3	+0.1	Not statistically significant

Table 22A-8: Current Climate Normals and Trends – Current Climate Baseline Maximum Temperature, 1981 to 2019

Climate Indices	Normals	Decadal Trend	Statistical Significance
Average annual temperature (°C)	3.1	-0.3	Not statistically significant
Average spring temperature (°C)	4.1	-0.6	Significant at the 95th percentile
Average summer temperature (°C)	20.4	-0.3	Significant at the 90th percentile
Average fall temperature (°C)	3.3	0.0	No trend
Average winter temperature (°C)	-15.7	-0.2	Not statistically significant

Figure 22A-15: Average Annual Temperature in the Spring – Current Climate Baseline, 1981 to 2019

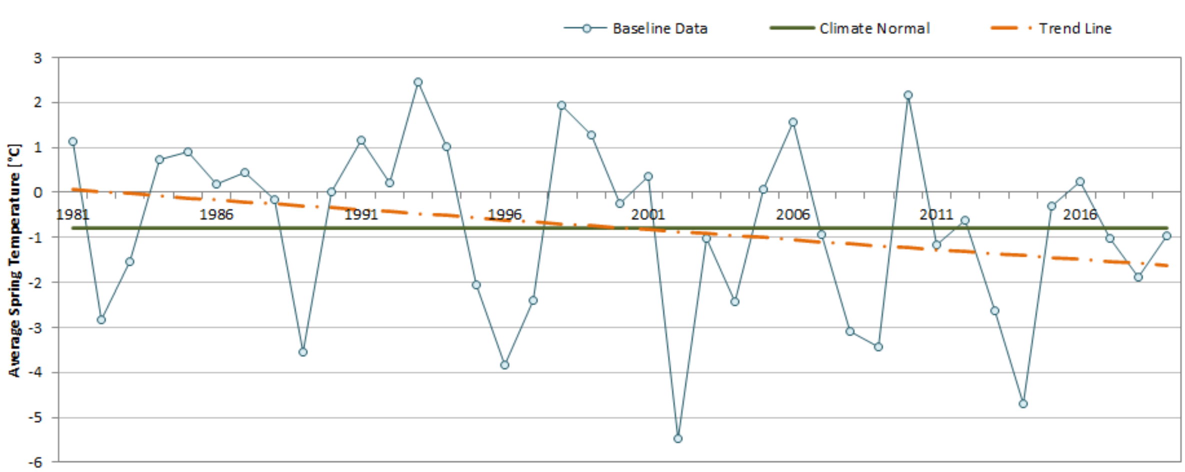
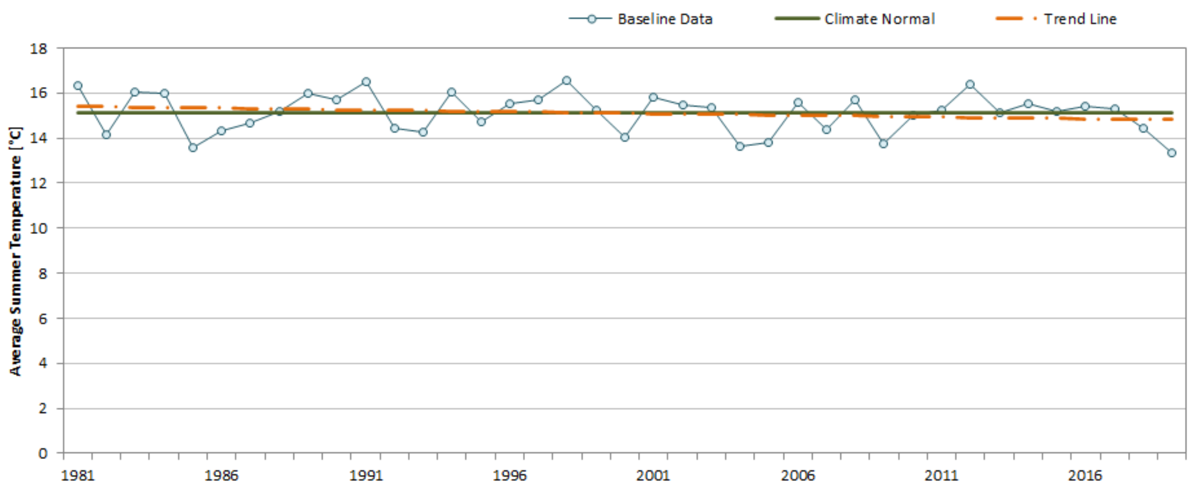


Figure 22A-16: Average Annual Temperature in the Summer – Current Climate Baseline, 1981 to 2019



The current climate precipitation trends are consistent with precipitation trends available through ClimateData.ca (ClimateData.ca 2019) and the 2019 ECCC Canada's Changing Climate Report (Bush and Lemmen 2019). However, the current climate temperature trends indicate both increasing and decreasing annual and monthly trends that appear inconsistent with the Bush and Lemmen (2019) report. The report found increasing temperature trends for the prairie provinces as a whole and does not capture local variations in climate, including those in the area of the Project. While there is reasonable expectation that the trends should be similar, the lack of statistical significance in the trends indicates the trends are weak or hard to distinguish. As well, the current climate baseline period used in this analysis considers more recent observations and uses a higher resolution reanalysis data to help capture local variations in temperature in the area of the Project.

22A4.4 Current Climate Extremes and Trends

The Expert Team on Climate Change Detection and Indices developed a set of 27 climate extreme indices as a means of summarizing daily temperature and precipitation statistics, focusing primarily on aspects of climate extremes. These indices are described in WMO (2009a) along with a set of recommendations for their calculation to allow comparison of climate conditions on an international basis. Overall, the ECCC report by Bush and Lemmen (2019) found that the annual highest daily maximum and lowest daily maximum temperatures have increased between 1948 and 2016. Hot days have increased annually by one to three days throughout Canada. In addition, there is a decreasing trend in the number of frost days and ice days, which is consistent with shortened winter seasons. Growing degree days (i.e., measure of heat accumulation used to estimate the growth and development of certain crops and pests during growing season) have increased as the length of the growing season has lengthened.

The current climate extremes were calculated for the current climate baseline period of 1981 to 2019 using the 27 indices, as described in Attachment 22A-1. According to the WMO (2009a) direction for calculating extreme indices, months with more than 3 days of missing records, or any year with over 15 days of missing records, should be set to zero. As described in Section 22A2.1, the dataset was complete with no missing periods due to the infilling of the data. As described in Attachment 22A-1, for the current climate extremes, two analyses were completed. For the first analysis, the minimum, maximum, mean (i.e., average), and median (i.e., 50th percentile) values for each of the 27 indices were calculated over the entire current climate baseline period. For the second analysis, the normals and trends were calculated based on the annual values of each of the indices. The results of the analyses are shown in Table 22A-9.

The minimum, maximum, mean, and median were calculated for the indices described in Attachment 22A-1, Table 22A-1-2, and are presented in Table 22A-9. In general, the number of very heavy precipitation days (R20; i.e., daily precipitation greater than 20 mm) was approximately one day per year, ranging from zero to five days during the current climate baseline period. For almost one day in every year examined, the daily precipitation could be above 25 mm. Maximum one-day (Rx1day) and five-day (Rx5day) precipitation events were 31.3 mm and 52.6 mm on average, respectively. The precipitation during the extremely wet days (R99p; i.e., the annual total precipitation when daily precipitation is greater than the 99th percentile) could be up to a maximum of 135.6 mm. The number of consecutive dry days ranged from 7 days to 32 days per year, with an average of 18.9 days. The maximum of daily maximum temperature is above 25.5°C every year, with a highest recorded maximum daily temperature of 36.3°C during the period of interest.

Table 22A-9: Current Climate Extremes for the Current Climate Baseline Period, 1981 to 2019

ID	Indicator Name	Unit	Minimum	Maximum	Mean	Median
CDD	Consecutive dry days	d	7.0	32.0	18.9	17.0
CSDI	Cold spell duration indicator	d	0.0	40.0	4.9	0.0
CWD	Consecutive wet days	d	3.0	17.0	7.4	6.0
DTR	Diurnal temperature range	°C	8.7	10.5	9.5	9.6
FD0	Frost days	d	200.0	240.0	219.2	219.0
GSL	Growing season Length	d	114.0	177.0	148.2	151.0
ID0	Ice days	d	128.0	178.0	151.6	151.0
PRCPTOT	Annual total wet-day precipitation	mm	267.0	653.3	493.2	499.4
R10	Number of heavy precipitation days	d	1.0	16.0	9.2	9.0
R20	Number of very heavy precipitation days	d	0.0	5.0	1.8	2.0
R95p	Very wet days	mm	0.0	252.5	118.6	122.6
R99p	Extremely wet days	mm	0.0	135.6	38.8	30.8
R25MM	Number of days above 25 mm	d	0.0	3.0	0.8	1.0
Rx1day	Maximum 1-day precipitation amount	mm	12.3	57.8	31.3	26.7
Rx5day	Maximum 5-day precipitation amount	mm	32.1	120.5	52.6	47.9
SDII	Simple daily intensity index	mm/d	2.7	5.4	4.1	4.0
SU25	Summer days	d	2.0	31.0	13.8	13.0
TN10p	Cool nights	% of days	2.9	21.3	10.3	9.6
TN90p	Warm nights	% of days	3.7	18.7	10.5	10.4
TNn	Minimum of daily minimum temperature	°C	-48.6	-34.5	-43.0	-43.3
TNx	Maximum of daily minimum temperature	°C	13.3	19.2	16.1	16.2
TR20	Tropical nights	d	0.0	0.0	0.0	0.0
TX10p	Cool days	% of days	2.9	21.4	10.2	9.5
TX90p	Warm days	% of days	4.6	19.8	10.6	10.7
TXn	Minimum of daily maximum temperature	°C	-38.9	-22.2	-33.3	-33.2
TXx	Maximum of daily maximum temperature	°C	25.5	36.3	29.6	29.5
WSDI	Warm spell duration indicator	d	0.0	22.0	4.6	0.0

The normals and trends over the current climate baseline period were calculated for the climate extremes using the method outlined in Attachment 22A-1. For each of the 27 indices, the climate normal, climate trend, and statistical significance of the trend were calculated. The analysis only assessed the statistical significance at the 90th, 95th, 99th, and 99.9th percentile levels. The normals and trends are presented in Table 22A-10.

Table 22A-10: Current Climate Extremes for the Current Climate Baseline Period, 1981 to 2019

Climate Indices	Units	Normals	Decadal Trend	Statistical Significance
Consecutive dry days	d	18.9	-0.5	Not statistically significant
Cold spell duration indicator	d	4.9	0.0	No trend
Consecutive wet days	d	7.4	0.0	No trend
Diurnal temperature range	°C	9.5	-0.3	Significant at the 99.9th percentile
Frost days	d	219.2	-6.8	Significant at the 99th percentile
Growing season length	d	148.2	0.0	No trend
Ice days	d	151.6	-2.0	Not statistically significant
Annual total wet-day precipitation	mm	493.2	+5.1	Not statistically significant
Number of heavy precipitation days	d	9.2	0.0	No trend
Number of very heavy precipitation days	d	1.8	0.0	No trend
Very wet days	mm	118.6	-10.1	Not statistically significant
Extremely wet days	mm	38.8	-3.7	Significant at the 90th percentile
Number of days above 15 mm	d	0.8	0.0	No trend
Maximum 1-day precipitation amount	mm	31.3	-1.4	Not statistically significant
Maximum 5-day precipitation amount	mm	52.6	+0.3	Not statistically significant
Simple daily intensity index	mm/d	4.1	-0.1	Not statistically significant
Summer days	d	13.8	0.0	No trend
Cool nights	% of days	10.3	-4.3	Significant at the 99.9th percentile
Warm nights	% of days	10.5	+2.2	Significant at the 95th percentile
Minimum Tmin	°C	-43.0	+0.6	Significant at the 90th percentile
Maximum Tmin	°C	16.1	+0.2	Not statistically significant
Tropical nights	d	0.0	0.0	No trend
Cool days	% of days	10.2	-2.7	Significant at the 95th percentile
Warm days	% of days	10.6	+0.6	Not statistically significant
Minimum Tmax	°C	-33.3	+0.8	Significant at the 95th percentile
Maximum Tmax	°C	29.6	-0.8	Significant at the 95th percentile
Warm spell duration indicator	d	4.6	0.0	No trend

Tmin = minimum temperature; Tmax = maximum temperature.

Figure 22A-17 through Figure 22A-25 illustrate each of the indices in Table 22A-10 identified as having statistically significant trends over the current climate baseline period. The figures show the variation in year-to-year observations, along with the climate normal (i.e., the average of the 38-year baseline period), and the trend derived from the current climate data.

Figure 22A-17: Climate Extremes Analysis for the Current Climate Baseline – Diurnal Temperature Range

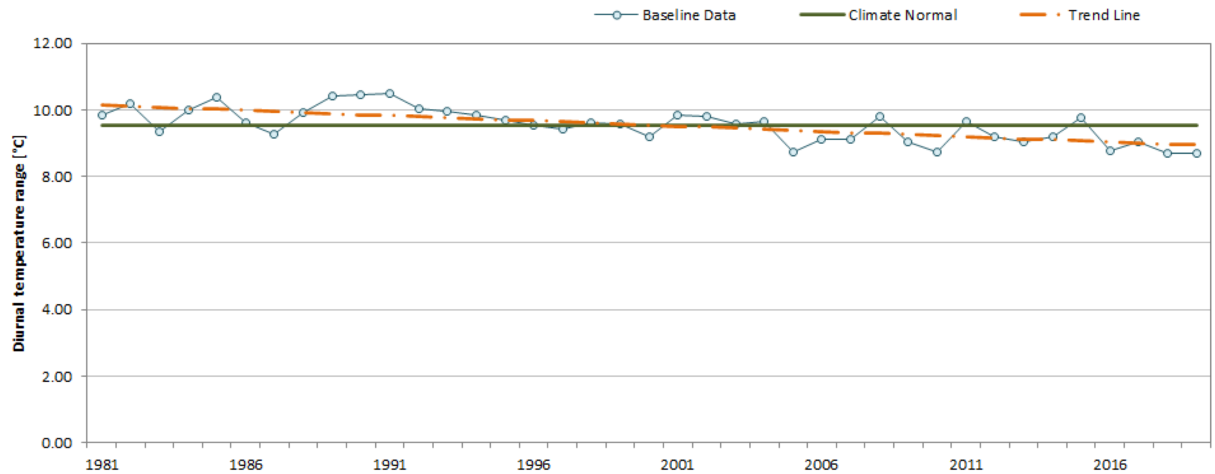


Figure 22A-18: Climate Extremes Analysis for Current Climate Baseline – Extremely Wet Days

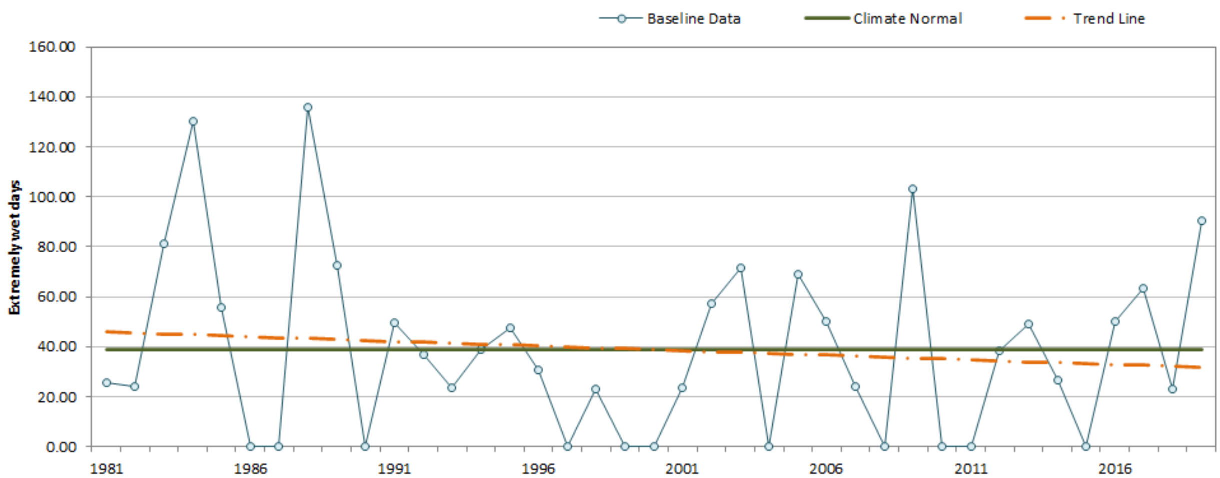


Figure 22A-19: Climate Extremes Analysis for Current Climate Baseline – Frost Days

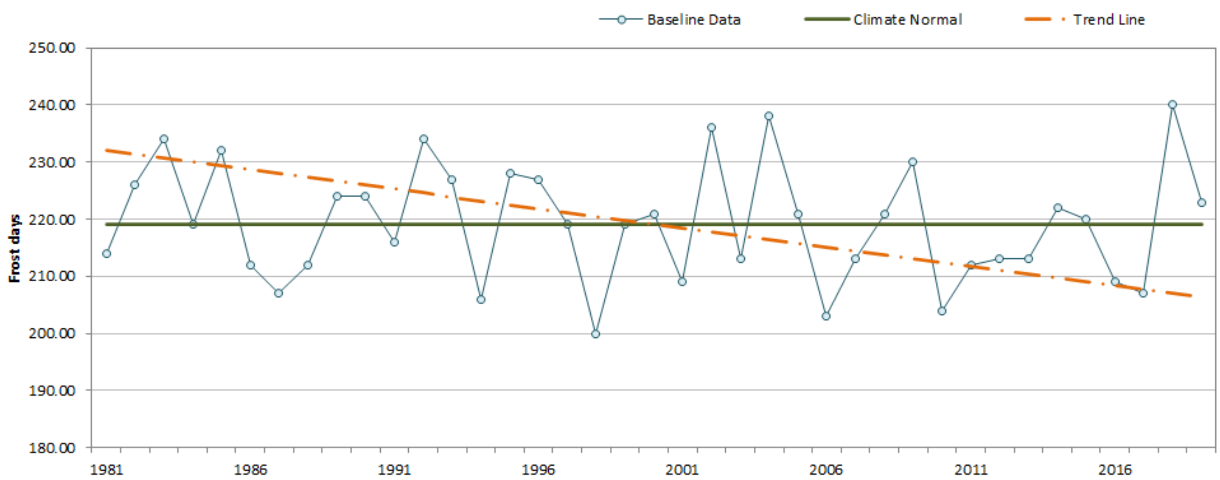


Figure 22A-20: Climate Extremes Analysis for Current Climate Baseline – Cool Nights

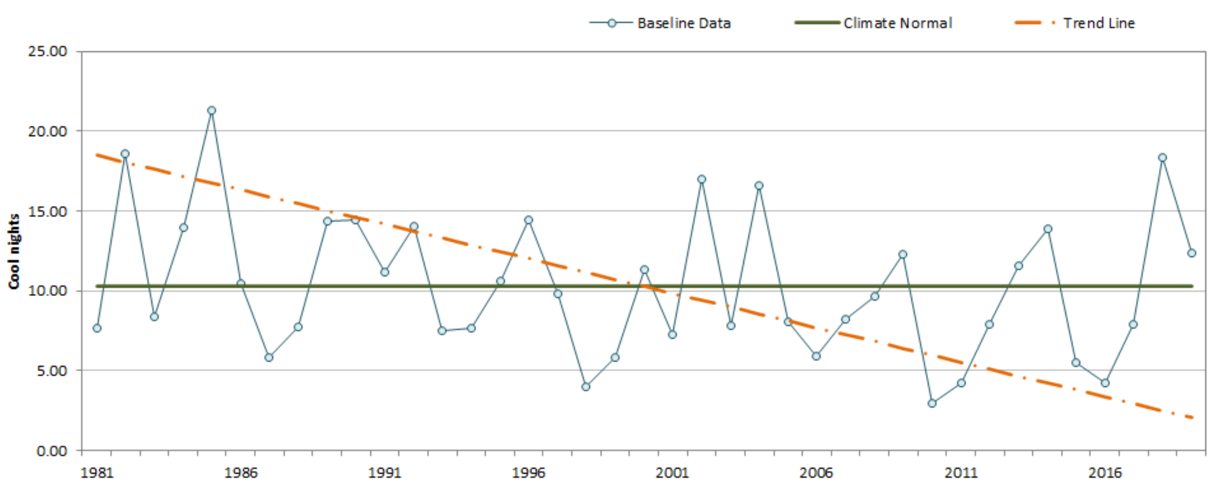


Figure 22A-21: Climate Extremes Analysis for Current Climate Baseline – Warm Nights

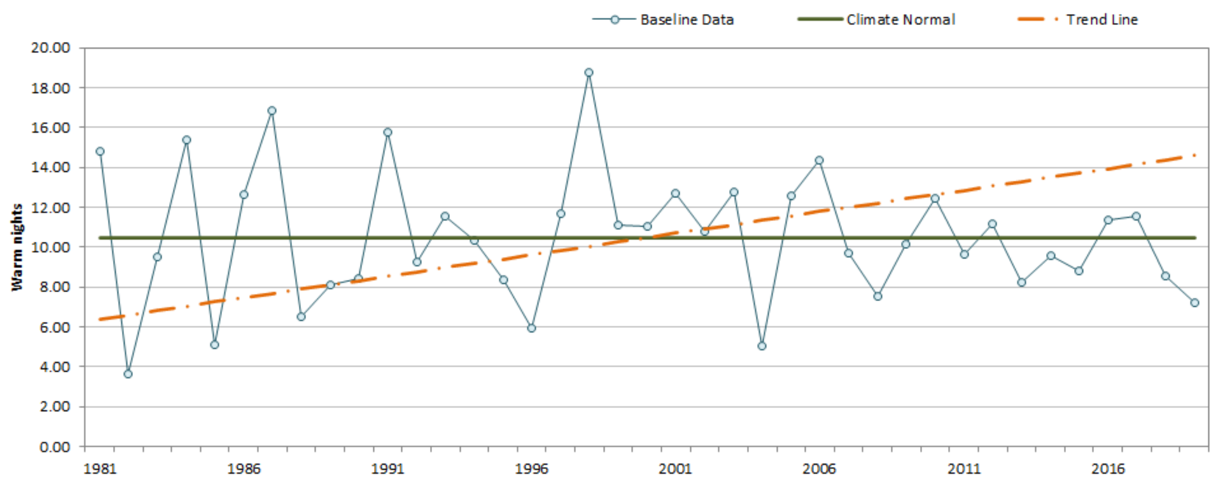
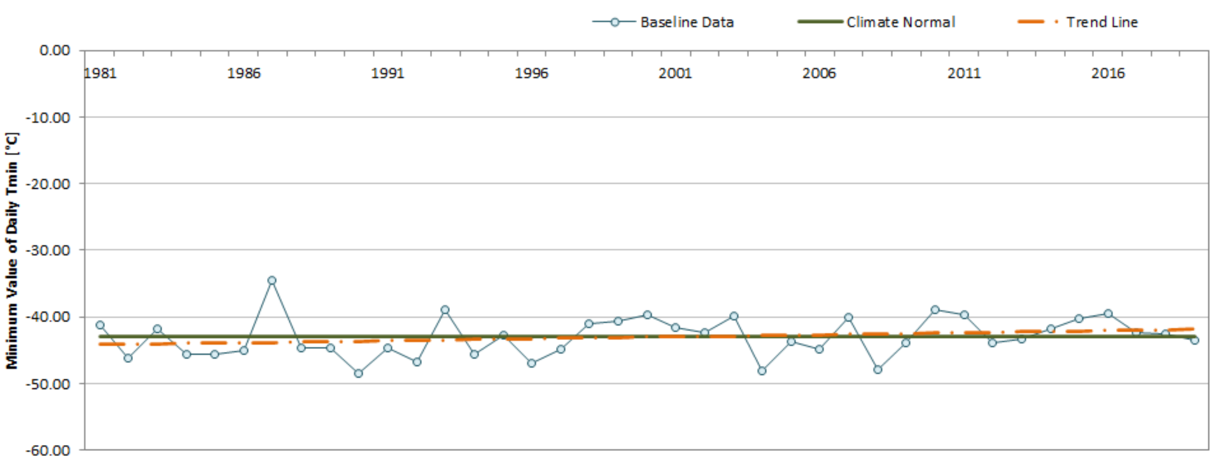


Figure 22A-22: Climate Extremes Analysis for Current Climate Baseline – Minimum Value of Daily Minimum Temperature



Tmin = minimum temperature.

Figure 22A-23: Climate Extremes Analysis for Current Climate Baseline – Cool Days

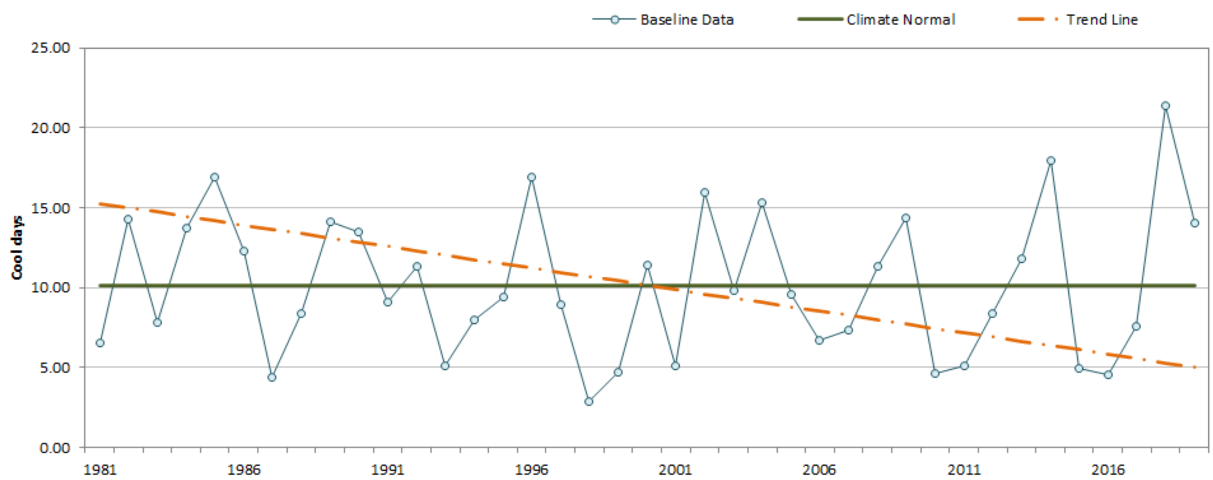
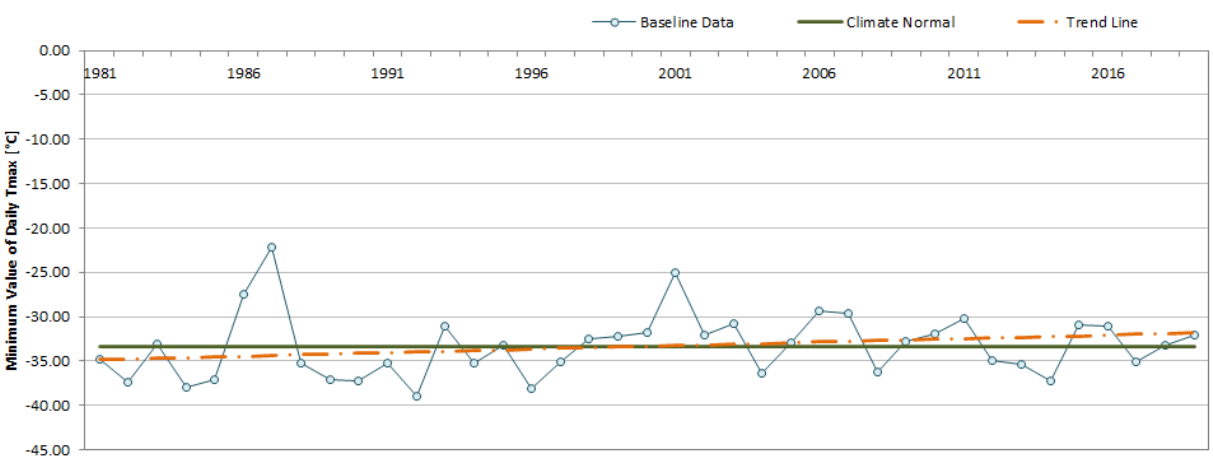
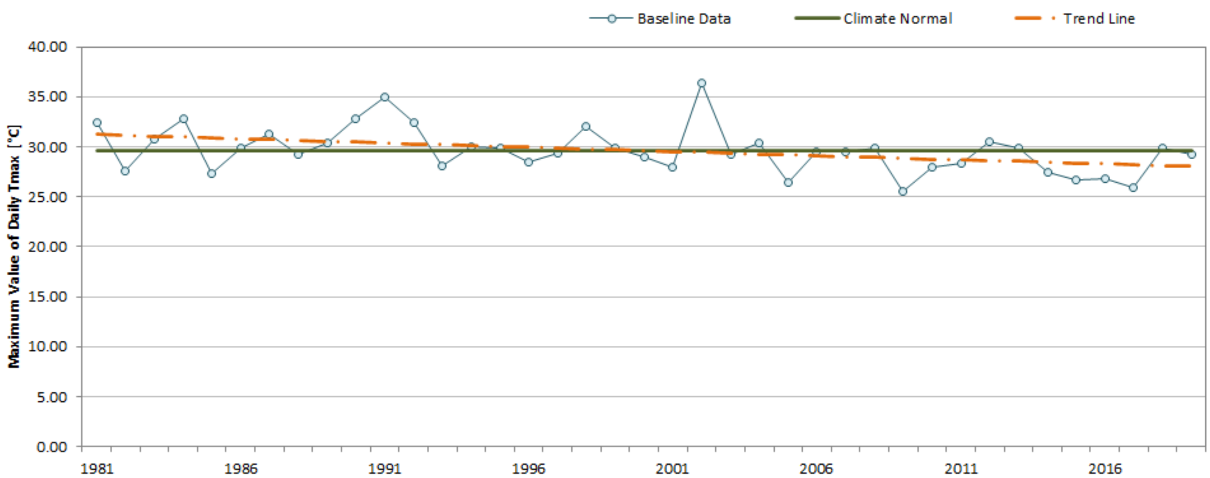


Figure 22A-24: Climate Extremes Analysis for Current Climate Baseline – Minimum Value of Daily Maximum Temperature



Tmax = maximum temperature.

Figure 22A-25: Climate Extremes Analysis for Current Climate Baseline – Maximum Value of Daily Maximum Temperature



Tmax = maximum temperature.

In general, the climate extremes related to precipitation correlate with the current climate normals and trends presented in Section 22A4.3. Increases in extremely wet days (statistically significant at the 90th percentile), the annual total wet-day precipitation (not statistically significant), number of heavy precipitation days (not statistically significant), and maximum one-day precipitation (not statistically significant) suggest increasing precipitation trends. As a result of the minimum and maximum temperature trends, the diurnal temperature range indicator (difference between maximum and minimum daily temperatures) is decreasing at the 99.9th percentile, which is consistent with these trends. Decreasing trends were observed for frost days, ice days, and cool nights as they were measured based on the daily minimum temperature, which was found to have increasing trends.

22A4.5 Current Probable Maximum Precipitation

Probable maximum precipitation is defined as “the greatest depth of precipitation for a given duration meteorologically possible for a design watershed or a given storm area at a particular location at a particular time of year, with no allowance made for long-term climatic trends” (WMO 2009b). Isolines (i.e., lines on a map or chart that correspond to constant values) have been developed by Hopkinson (1999) to provide point PMP for an area of 1.0 km^2 and rainfall durations of 1-, 6-, and 24-hour for the prairie provinces. The 24-hour PMP corresponding to the area of the Project is estimated to be 489.2 mm using the method developed by Hopkinson (1999).

The one-day and three-day PMP (Table 22A-11) was estimated for the Project using the current climate data for the current climate baseline period and the Hershfield statistical method (WMO 2009b), consistent with the method used to estimate future PMP in Section 22A5.3, Future Changes in Probable Maximum Precipitation. This method uses annual maximum rainfall events, in this case rainfall events from the MERRA-2 reanalysis dataset, to estimate a value for the PMP event based on statistics of the measured dataset.

Table 22A-11: Current Probable Maximum Precipitation for Daily Event for the Current Climate Baseline, 1981 to 2019

Design Storm Event	PMP (mm)
1-Day storm PMP	275
3-Day storm PMP	293

PMP = probable maximum precipitation.

The one-day PMP estimate using the Hershfield method is noticeably less than the 24-hour PMP estimate using the method from Hopkinson (1999). This is in part due to the one-day PMP being limited to a one-day interval with defined endpoints (i.e., between midnight of one day to the next), while the 24-hour PMP can span across days. Typically, a factor of 1.13 applied to the one-day PMP has been found to account for this difference (WMO 2009b). Additional reasons for the difference in PMP estimates could relate to differences in the data sources used, length and time span of the rainfall data under consideration, and the method used to determine the PMP. The estimate from Hopkinson (1999) is taken from isolines that were developed for the prairie provinces, which are influenced by precipitation over a broad region, while the estimates shown in Table 22A-11 use the current climate baseline dataset developed specifically for the area of the Project. In addition, Hopkinson (1999) does not include recent years of precipitation (includes up to 1999), while the current climate baseline dataset spans to the year 2019. The approach taken in this report may be deemed more accurate, however, a more conservative estimate can be used based on Hopkinson (1999).

22A4.6 Current Rainfall Statistics

The current rainfall statistics for various durations (one -day to 120-day) and return periods (1 in 2 years, 1 in 10 years, 1 in 100 years, 1 in 200 years, 1 in 500 years, 1 in 1,000 years, and 1 in 2,000 years) were calculated using the current climate baseline dataset. Daily rainfall statistics were derived by fitting the annual maximum series of daily rainfall to a Gumbel distribution with the method of moments, a standard statistical approach (Attachment 22A-1, Section 22A-1-1.1.5).

Annual maximum daily rainfall values were calculated for each year based on the daily precipitation from the current climate baseline dataset, the results of which are presented in Table 22A-12. No significant trends were found in the annual maximum series of daily rainfall. The Gumbel distribution was used to estimate different return periods of rainfall, as explained in Attachment 22A-1, Section 22A-1-1.1.5.

The current climate baseline data were used to estimate precipitation depths for events with durations between 1 day and 120 days. The Gumbel distribution was used to associate these events with their return period, or frequency at which they occur in the current climate baseline data. The results of this analysis are shown in Table 22A-13. The depth of precipitation increases with the return period and rainfall duration that is considered. Generally, the results suggest that for rainfall above a 10-day duration, the rainfall depth increases linearly with the number of days.

Table 22A-12: One-Day Annual Maximum Series Using the Current Climate Baseline

Year	Peak Annual Rainfall Depth (mm)
1981	25.69
1982	24.16
1983	56.53
1984	29.62
1985	30.48
1986	22.45
1987	17.35
1988	53.26
1989	47.25
1990	20.94
1991	26.84
1992	36.96
1993	23.63
1994	39.04
1995	47.40
1996	30.76
1997	20.06
1998	23.04
1999	21.57
2000	17.97
2001	23.52
2002	56.97
2003	47.21
2004	21.06
2005	37.98
2006	27.16
2007	23.87
2008	19.69
2009	57.77
2010	21.84
2011	21.67
2012	38.59
2013	24.97
2014	26.67
2015	12.30
2016	49.98
2017	33.21
2018	23.13
2019	36.69

Table 22A-13: Precipitation Statistics Using the Current Climate Baseline, 1981 to 2019

Return Period (years)	Precipitation Depth (mm)											
	1-Day	2-Day	3-Day	4-Day	5-Day	10-Day	20-Day	30-Day	50-Day	75-Day	90-Day	120-Day
2	29.2	39.3	44.0	46.6	49.8	66.5	96.7	122.4	168.5	221.6	248.6	303.3
5	40.4	51.8	57.4	60.6	64.9	84.5	118.8	151.0	207.3	266.3	299.1	361.8
10	47.8	60.0	66.2	70.0	74.9	96.5	133.5	169.9	233.0	296.0	332.6	400.5
20	54.9	68.0	74.6	78.9	84.5	107.9	147.5	188.0	257.6	324.4	364.7	437.7
50	64.2	78.2	85.6	90.5	97.0	122.8	165.7	211.5	289.4	361.2	406.2	485.7
100	71.1	85.9	93.7	99.1	106.3	133.9	179.3	229.1	313.3	388.7	437.3	521.8
200	78.0	93.5	101.9	107.8	115.6	144.9	192.9	246.6	337.1	416.2	468.3	557.7
500	87.1	103.6	112.7	119.2	127.8	159.6	210.8	269.7	368.5	452.4	509.3	605.0
1,000	93.9	111.3	120.8	127.8	137.1	170.6	224.4	287.2	392.2	479.8	540.2	640.8
2,000	100.8	118.9	129.0	136.4	146.3	181.6	237.9	304.7	415.9	507.2	571.1	676.6

22A4.7 Current Evapotranspiration Potential

The average current monthly potential evapotranspiration was estimated for the current climate baseline dataset using the Hargreaves method (Table 22A-14). This method requires only the daily minimum, maximum, and mean temperatures, and makes assumptions about the solar radiation (based on latitude), accounting for humidity (based on the difference between daily minimum and maximum temperatures), and assuming that the effect of wind is negligible. Using this method, the annual total potential evapotranspiration is estimated to be 578.4 mm/yr, while the monthly values show the largest values occurring between the months of May and September.

Table 22A-14: Potential Evapotranspiration Using the Hargreaves Method

Month	Potential Evapotranspiration (mm)
January	0.8
February	2.4
March	12.2
April	45.6
May	97.4
June	121.2
July	126.7
August	99.6
September	50.6
October	18.1
November	3.2
December	0.7
Annual	578.4

For comparison purposes, the annual potential evapotranspiration estimate was compared to that obtained for lake evaporation in Annex IV.1, Regional Meteorological and Hydrological Characterization Report, using a modified Priestley-Taylor method. In Annex IV.1, annual lake evaporation was estimated for the area of the Project as 514.0 mm/yr compared to 578.4 mm/yr as shown in Table 22A-14. These values are considered to be similar given the difference in methods. The Priestley-Taylor method uses radiation inputs, while the Hargreaves method used in this report is based on temperature inputs. The Hargreaves method is selected for this report as it allows for both current and future potential evapotranspiration to be estimated using the same method (only temperature and precipitation data available from future downscaled projections).

22A4.8 Current Extreme Rainfall and Snowmelt Statistics Estimates

The multi-day precipitation extremes were calculated to include the effects of snowmelt. Using the degree-day method mentioned in Section 22A2.1, snowfall, accumulation, and melt were simulated during the months of October to June. When the mean temperature is above zero, snowmelt occurs and precipitation is in the form of rainfall. Conversely, during periods of sub-zero temperatures, snow accumulation takes place and precipitation is now in the form of snowfall. The Gumbel distribution was fitted to the combined rainfall and snowmelt series. These results are shown in Table 22A-15.

Table 22A-15: Snowmelt Plus Rainfall Statistics for Current Climate Baseline, 1981 to 2019

Return Period (years)	Snowmelt Plus Rainfall (mm)											
	1-Day	2-Day	3-Day	4-Day	5-Day	6-Day	7-Day	10-Day	20-Day	30-Day	50-Day	75-Day
2	24.1	42.7	59.0	73.4	87.4	99.9	112.1	139.9	189.6	216.3	248.4	256.8
10	32.5	58.7	81.4	102.8	124.2	144.4	161.9	200.1	276.0	305.9	337.6	342.6
100	42.9	78.6	109.3	139.5	170.1	199.9	224.0	275.1	383.7	417.6	448.8	449.6
200	46.0	84.5	117.6	150.3	183.6	216.3	242.4	297.3	415.6	450.7	481.8	481.2
500	50.1	92.3	128.5	164.6	201.6	237.9	266.7	326.5	457.7	494.3	525.2	523.0
1,000	53.2	98.2	136.7	175.5	215.1	254.3	285.0	348.7	489.4	527.3	558.1	554.6
2,000	56.3	104.1	145.0	186.3	228.6	270.7	303.3	370.8	521.2	560.2	590.9	586.2

When comparing the combined snowmelt and rainfall statistics (Table 22A-15) with those of precipitation (Table 22A-13), there are key differences to consider based on the event duration. For the one-day duration, the values for precipitation are at least 20% higher than those of combined rainfall and snowmelt. At the three-day duration mark, the opposite becomes true, where combined rainfall and snowmelt show higher values than precipitation for all return periods. After the 30-day duration, the values for precipitation increase relative to the combined rainfall and snowmelt.

These results highlight the differences in the characteristics of extreme effective precipitation events as the duration changes. Lower duration events, such as that of one day, are more extreme when the effect of snow accumulation and melt is not considered because these are high-intensity events where snowmelt would only make up a small fraction of the total. Mid-range duration events are more extreme when snowmelt is considered, because the snowmelt would make up a larger fraction of the total due to less intense rainfall amounts. Finally, the longest duration events are more extreme when snowmelt is not considered due to snowpack being depleted and resulting in no snowmelt occurring. Because of the effects of event duration on the nature of the effective precipitation extremes, both results for precipitation and combined rainfall and snowmelt should be considered in the Project design.

22A5 Future Climate

This subsection builds on the current climate descriptions presented in Section 22A4 by providing the projected changes under future climate conditions for two future time horizons (2050s and 2080s). Section 22A5.1 and Section 22A5.2 provide a description of future projected conditions for temperature and precipitation. Sections 22A5.3 through Section 22A5.6 provide the projected changes in the detailed precipitation analysis. In all subsections, projections are provided in terms of percentiles measured over the 72-member multi-model ensemble. The focus of the results is on the 50th percentile. Results are summarized as part of the conclusions in Section 22A6.

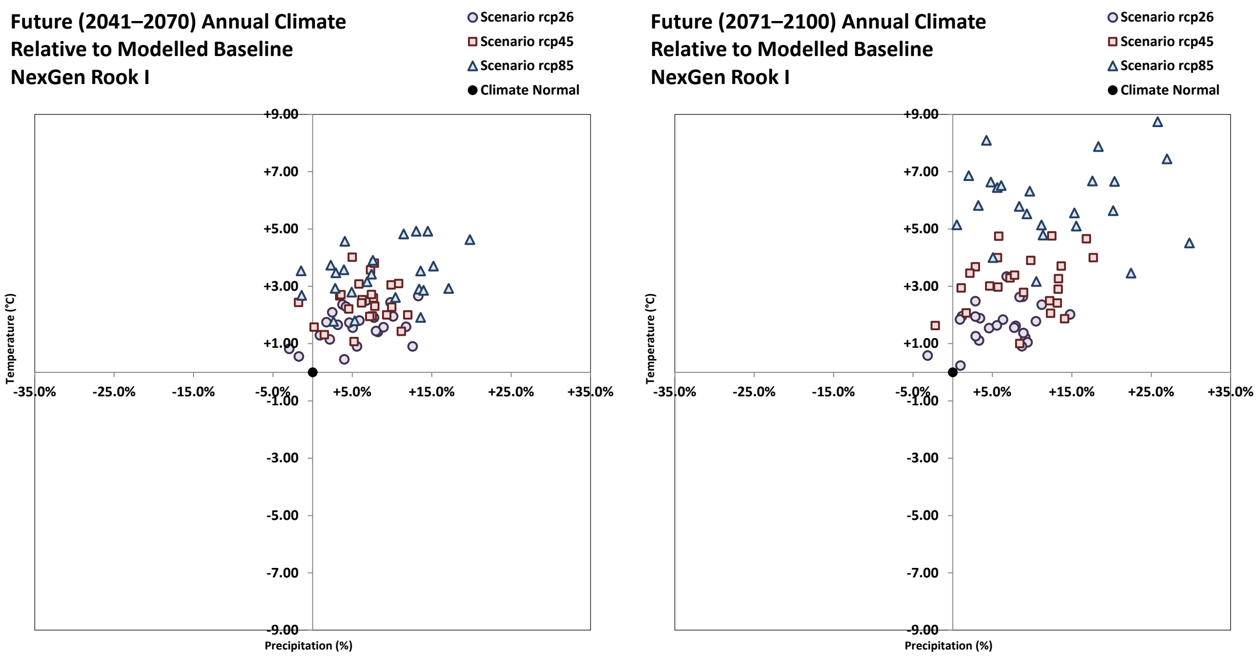
22A5.1 Future Temperature and Precipitation

This subsection provides the projected future mean temperature and precipitation for the area of the Project. The future climate projections are benchmarked against a modelled baseline and put in context of the results from Section 22A4.3.

22A5.1.1 Annual Projections

Comparisons of the future climate projections for the area of the Project for the 2050s and 2080s periods are shown as a scatter plot in Figure 22A-26. The plots illustrate the projected change in temperature (vertical axis) and precipitation (horizontal axis) from the modelled baseline (1981 to 2019, same as the current climate baseline) for each of the models and the four RCPs considered in IPCC's AR5 (IPCC 2013). For reference, the current climate is shown as a solid circle where the axes intersect. The model projections are in the upper right half of the plots, suggesting a future climate that will likely be warmer and wetter. There is a larger spread of future projected precipitations, with a majority of model runs projecting a wetter future climate. These projections agree with the current climate precipitation values presented in Section 22A4.3, which shows wetter trends. However, the projections show an increase in temperature trends, unlike the current climate that describes fluctuating trends (Section 22A4.3). Precipitation projections typically have larger uncertainty than temperature projections due to the challenge of capturing precipitation in the climate models (i.e., temperature is well understood).

Figure 22A-26: Scatter Plots Showing the Annual Temperature and Precipitation Projections for the Area of the Project, 2050s and 2080s



22A5.1.2 Monthly Projections

The figures in this subsection summarize the magnitude of model-projected changes during the 2050s and the 2080s from the modelled climate baseline. Figure 22A-27 and Figure 22A-28 depict the projected anomalies in monthly mean temperatures for the area of the Project for the 2050s and 2080s, respectively. The figures also show a dashed line, which represents the median of all the modelled projections. The dotted line in the figures represents the spread between the 5th percentile and the 95th percentile of the ensemble. The figures show projected increases in temperature for a majority of the months, with increased temperatures and a larger spread in the 2080s ensemble during the winter, spring, and late fall, and shows a good correlation in the summer months.

Figure 22A-27: Monthly Projected Temperature Anomalies for the Area of the Rook I Project, 2050s

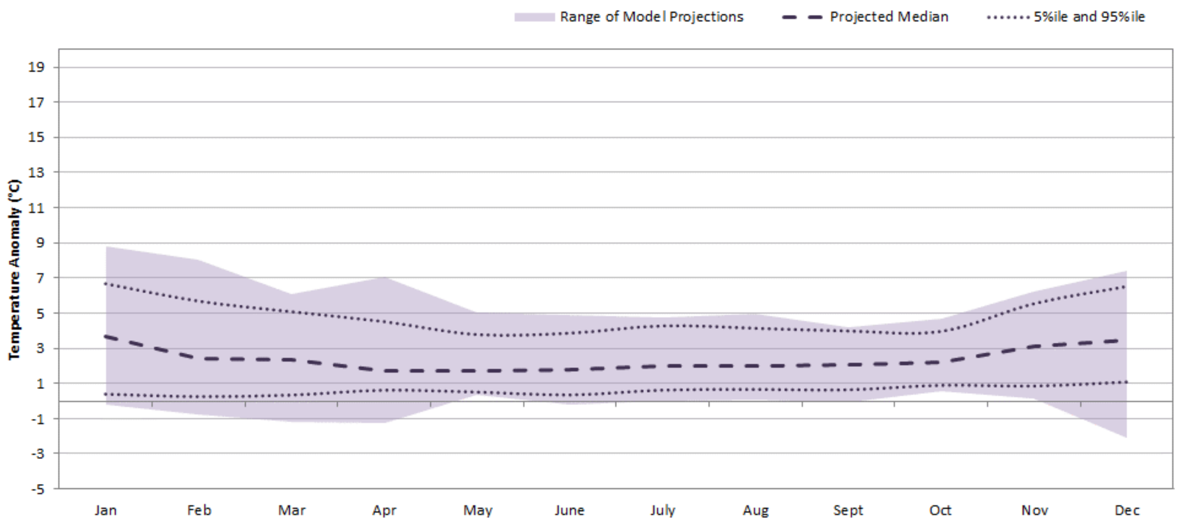


Figure 22A-28: Monthly Projected Temperature Anomalies for the Area of the Rook I Project, 2080s

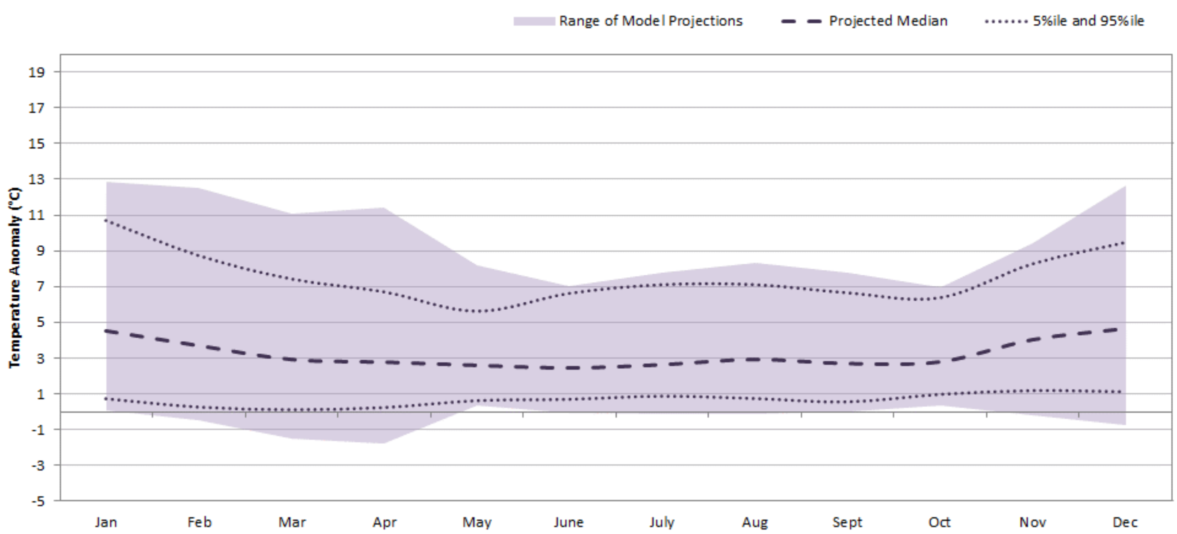


Figure 22A-29 and Figure 22A-30 present the monthly projected precipitation anomalies for the area of the Project for the 2050s and 2080s, respectively. The projected median (purple dashed line) indicates a slightly projected increase in precipitation throughout the year. There is less correlation during the 2080s, with the largest spread through the spring months (March through May).

Figure 22A-29: Monthly Projected Precipitation Anomalies for the Area of the Rook I Project, 2050s

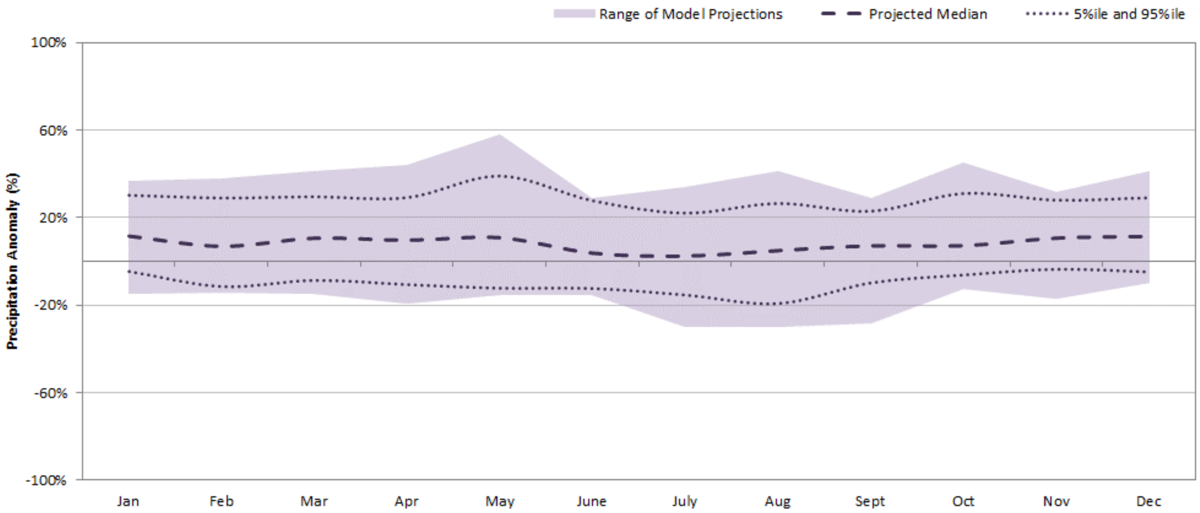
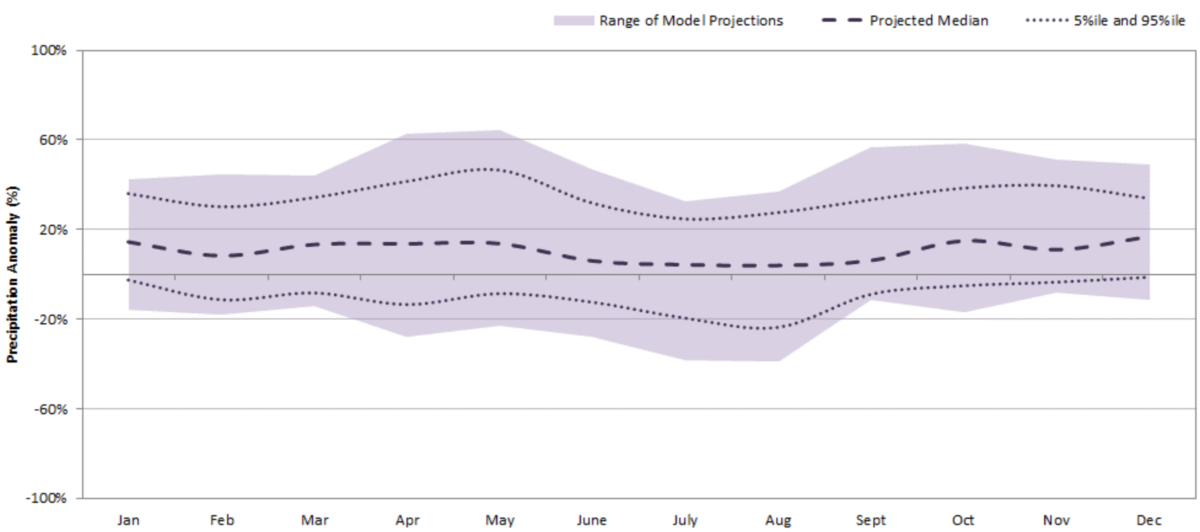


Figure 22A-30: Monthly Projected Precipitation Anomalies for the Area of the Rook I Project, 2080s



Overall, there is less variability within the ensemble during the 2050s and increased variability within the ensemble during the 2080s for both temperature and precipitation (see the increase in the purple shaded area between Figure 22A-27 and Figure 22A-28, and between Figure 22A-29 and Figure 22A-30). This is expected as the uncertainty in the future climate conditions and how they are represented in the model increases over the length of the model run. While the climate models start at similar points for the different RCP scenarios, the future projections diverge from each other based on assumptions made within the model and on how climate processes are represented within the model.

22A5.1.3 Summary of Annual and Monthly Projections

The projected future changes in the 2050s and 2080s from the modelled baseline period (1981 to 2019) in monthly and annual temperatures are summarized in Table 22A-16 and Table 22A-17. In the 2050s, at the 50th percentile, the annual temperature is projected to increase by 2.4°C, with the biggest monthly increase of 3.7°C in January and smallest monthly increase of 1.7°C in April and May. In the 2080s, at the 50th percentile, the annual temperature is projected to increase by 3.2°C, with the biggest monthly increase of 4.7°C in December, and smallest monthly increase of 2.4°C in June.

Table 22A-16: Projected Changes in Monthly and Annual Temperature (°C), 2050s

Month	Minimum	5%	10%	50%	75%	90%	95%	99%	Maximum	Mean	Standard Deviation
January	-0.2	0.4	1.2	**3.7**	4.6	6.2	6.6	7.9	8.8	3.6	1.9
February	-0.8	0.2	0.6	**2.4**	3.6	5.1	5.7	6.7	8.0	2.7	1.7
March	-1.2	0.3	0.9	**2.3**	3.3	4.2	5.1	5.8	6.1	2.4	1.4
April	-1.2	0.6	0.8	**1.7**	2.7	4.0	4.5	6.7	7.1	2.1	1.4
May	0.4	0.5	0.8	**1.7**	2.5	3.0	3.8	4.7	5.0	1.9	1.0
June	-0.2	0.3	0.7	**1.8**	2.6	3.3	3.8	4.5	4.9	1.9	1.1
July	0.0	0.6	0.8	**2.0**	2.9	3.6	4.3	4.6	4.7	2.2	1.1
August	0.1	0.7	0.8	**2.0**	2.9	3.7	4.1	4.7	5.0	2.2	1.1
September	-0.1	0.6	0.8	**2.1**	2.8	3.6	4.0	4.2	4.2	2.1	1.0
October	0.5	0.9	1.0	**2.2**	3.0	3.8	3.9	4.5	4.7	2.3	1.0
November	0.1	0.9	1.1	**3.1**	4.2	4.9	5.5	6.2	6.2	3.1	1.5
December	-2.1	1.1	1.6	**3.5**	4.9	5.9	6.5	7.2	7.4	3.5	1.8
Annual	0.4	0.9	1.3	**2.4**	3.1	3.8	4.6	4.9	4.9	2.5	1.1

Note: **Bold** and shaded values indicate the 50th percentile, selected to represent the ensemble median of the projections and the values generally discussed in the analysis.

Table 22A-17: Projected Changes in Monthly and Annual Temperature (°C), 2080s

Month	Minimum	5%	10%	50%	75%	90%	95%	99%	Maximum	Mean	Standard Deviation
January	0.1	0.7	1.3	**4.5**	6.8	8.4	10.7	12.0	12.8	4.9	2.9
February	-0.5	0.2	1.3	**3.7**	5.9	7.7	8.7	11.5	12.5	4.2	2.8
March	-1.5	0.1	0.8	**2.9**	5.2	6.9	7.4	9.3	11.1	3.5	2.4
April	-1.8	0.2	0.5	**2.8**	4.3	5.6	6.7	9.5	11.4	3.1	2.3
May	0.3	0.6	0.8	**2.6**	3.9	5.1	5.6	7.5	8.2	2.8	1.8
June	-0.1	0.7	1.0	**2.4**	4.0	5.6	6.6	6.9	7.0	2.9	1.8
July	-0.1	0.9	1.1	**2.6**	4.4	6.2	7.1	7.6	7.8	3.2	2.0
August	-0.1	0.7	1.0	**2.9**	4.5	6.4	7.1	8.2	8.3	3.2	2.1
September	0.0	0.5	0.8	**2.7**	4.2	6.0	6.6	7.2	7.7	3.0	1.9
October	0.4	1.0	1.1	**2.8**	4.6	5.6	6.4	6.8	6.9	3.2	1.7
November	-0.2	1.2	1.7	**4.0**	5.9	7.2	8.3	8.8	9.4	4.3	2.3
December	-0.8	1.1	1.6	**4.7**	6.9	8.9	9.5	11.8	12.6	4.9	2.9
Annual	0.2	1.0	1.3	**3.2**	5.1	6.6	7.1	8.3	8.7	3.6	2.1

Note: **Bold** and shaded values indicate the 50th percentile, selected to represent the ensemble median of the projections and the values generally discussed in the analysis.

The projected future changes in the 2050s and 2080s from the current climate baseline period (1981 to 2019) in monthly and annual precipitation are summarized in Table 22A-18 and Table 22A-19. The annual precipitation in the 2050s is projected to increase by 7% from the current climate baseline, at the 50th percentile. The projected highest monthly increases in the 2050s would occur in the late fall, winter, and spring, while small changes are expected in the summer. The 2080s annual precipitation is projected to increase by 8% from the modelled baseline, with the largest increases occurring in the fall, winter, and spring.

Table 22A-18: Projected Changes in Monthly and Annual Precipitation (mm), 2050s

Month	Minimum	5%	10%	50%	75%	90%	95%	99%	Maximum	Mean	Standard Deviation
January	-15	-5	0	**11**	20	27	30	36	36	12	11
February	-14	-12	-9	**7**	16	25	29	33	38	8	13
March	-15	-9	-7	**10**	20	25	30	41	41	10	13
April	-19	-11	-9	**9**	19	24	29	38	44	9	14
May	-16	-12	-9	**11**	21	33	39	50	58	12	16
June	-15	-12	-9	**4**	11	21	28	29	29	5	11
July	-30	-15	-13	**2**	12	17	22	29	34	3	12
August	-30	-19	-13	**5**	16	22	27	39	41	5	15
September	-28	-10	-8	**7**	15	20	23	28	29	6	11
October	-12	-6	-5	**7**	16	24	31	44	45	9	12
November	-17	-4	-2	**10**	15	23	28	31	32	10	10
December	-10	-5	-1	**11**	17	28	29	36	41	11	11
Annual	-3	-1	2	**7**	10	13	14	18	20	7	5

Note: **Bold** and shaded values indicate the 50th percentile, selected to represent the ensemble median of the projections and the values generally discussed in the analysis.

Table 22A-19: Projected Changes in Monthly and Annual Precipitation (mm), 2080s

Month	Minimum	5%	10%	50%	75%	90%	95%	99%	Maximum	Mean	Standard Deviation
January	-16	-2	0	**14**	25	32	36	39	42	16	13
February	-18	-11	-7	**8**	19	25	30	42	44	9	14
March	-14	-8	-2	**13**	26	31	34	41	44	14	13
April	-28	-13	-9	**14**	27	36	41	57	63	15	18
May	-23	-9	-4	**14**	27	41	46	64	64	16	18
June	-28	-12	-9	**6**	16	26	32	39	47	7	14
July	-38	-20	-15	**4**	16	23	25	28	32	5	15
August	-39	-24	-17	**4**	13	19	27	37	37	2	16
September	-12	-9	-7	**6**	13	27	33	43	57	8	13
October	-17	-5	-3	**15**	25	33	38	58	58	15	15
November	-8	-3	-2	**11**	21	36	39	48	51	14	14
December	-11	-1	2	**17**	25	29	34	45	49	16	12
Annual	-3	1	2	**8**	13	18	21	28	30	9	7

Note: **Bold** and shaded values indicate the 50th percentile, selected to represent the ensemble median of the projections and the values generally discussed in the analysis.

22A5.2 Future Climate Extremes

The projected future changes in climate extremes in the 2050s and 2080s, in terms of anomalies (i.e., differences) from the modelled baseline period (1981 to 2019) are provided in Table 22A-20 and Table 22A-21. These ensemble statistics were calculated based on the 72-member multi-model ensemble (Section 22A3).

Using the median (i.e., 50th percentile) provides an indication of the middle of the projected changes from the multi-model ensemble. The difference between the median and mean (i.e., mathematical average) provides an indication for how the projections are distributed within the range of projects. For example, if the mean is below the median, the majority of the ensemble members are projecting lower values than the median, with a few higher projections from a small number of ensemble members.

The future projected monthly climate described in Section 22A5.1.3, Summary of Annual and Monthly Projections, indicates the future climate for both the 2050s and the 2080s is likely to become warmer and wetter. This projection is in agreement with the current climate precipitation trends in Section 22A4.3, but differs from some of the annual and monthly average mean temperature trends for the current climate, indicating a likely shift in trends. From the median values for the 2050s and 2080s, the projected future climate extremes are indicating a future that is likely to be warmer and wetter on an annual basis. Temperature is projected to increase, resulting in more warm days and warm nights and fewer cool days and nights, as well as fewer ice and frost days. Cold spell durations are projected to be reduced, while warm spell durations are projected to increase. Along with the increases in temperature, the growing season also shows an increase in both the 2050s and the 2080s.

The number of consecutive wet days shows a slight increase in both the 2050s and 2080s, and the annual amount of total wet-day precipitation is increasing at the 50th percentile, which may indicate wetter conditions. However, there are increasing trends in both periods for the number of very heavy precipitation days and the amount of precipitation on very wet and extremely wet days, indicating a shifting wetter trend compared to the current climate period. With the potential for future distribution and amount of precipitation to change, it is important to understand future projected rainfall statistics and PMP events from a design and operation standpoint. These topics have been discussed in the following subsections.

The extreme trends are consistent with projections by ClimateData.ca and the Bush and Lemmen (2019) report. Both sources project increases in growing degree days, wet days, and maximum and minimum temperatures, and decreases in frost and ice days across all scenarios (ClimateData.ca 2019; Bush and Lemmen 2019).

Table 22A-20: Projected Changes in World Meteorological Organization Extreme Indices, 2050s

WMO Index	Min	5%	10%	50%	75%	90%	95%	99%	Max	Mean	Standard Deviation
Consecutive dry days (d)	-2.2	-1.6	-1.2	**-0.1**	0.9	1.9	2.3	2.7	2.8	0.1	1.2
Cold spell duration indicator (d)	-9.6	-8.7	-8.3	**-5.1**	-3.6	-1.8	-1.2	-0.3	-0.2	-5.1	2.4
Consecutive wet days (d)	-2.9	-2.4	-1.8	**0.2**	1.5	2.5	2.8	4.3	5.9	0.4	1.7
Diurnal temperature range (°C)	-0.6	-0.4	-0.4	**0.0**	0.1	0.2	0.3	0.5	0.5	-0.1	0.2
Frost days (d)	-83.1	-64.5	-61.3	**-47.3**	-37.5	-27.6	-23.3	-19.1	-12.7	-45.8	13.1
Growing season length (d)	10.9	13.0	15.6	**33.8**	48.1	61.4	66.9	74.7	84.5	37.4	17.1
Ice days (d)	-21.2	-17.7	-14.2	**-10.1**	-7.1	-4.2	-1.9	-1.0	-0.6	-9.8	4.3
Annual total wet-day precipitation (mm)	-92.4	25.1	63.5	**156.7**	223.7	270.4	318.0	350.1	373.4	161.0	91.2
Number of heavy precipitation days (d)	-3.2	-0.6	0.0	**4.5**	6.4	8.7	9.7	10.6	10.6	4.4	3.1
Number of very heavy precipitation days (d)	-1.9	0.8	1.3	**3.4**	5.2	6.5	7.3	8.3	8.5	3.7	2.0
Very wet days (mm)	-58.4	29.1	41.0	**128.7**	181.2	212.8	248.7	285.8	322.8	130.6	71.7
Extremely wet days (mm)	-17.1	-1.2	7.8	**55.8**	88.4	124.9	141.7	159.2	162.1	63.2	42.9
Number of days above 15 mm (d)	-2.0	0.2	0.7	**3.1**	4.2	5.1	5.8	6.3	6.7	3.1	1.7
Maximum 1-day precipitation amount (mm)	-8.3	-0.5	1.0	**6.1**	9.6	12.7	14.2	18.0	19.5	6.4	5.0
Maximum 5-day precipitation amount (mm)	-20.4	-5.0	-0.9	**13.5**	22.2	27.9	31.8	38.4	44.5	13.8	12.2
Simple daily intensity index (mm/d)	-0.2	0.2	0.4	**0.8**	1.0	1.3	1.5	1.7	1.9	0.8	0.4
Summer days (d)	0.4	2.4	4.1	**11.5**	16.9	22.0	25.2	30.2	33.9	12.3	7.0
Cool nights (% of days)	-10.3	-9.6	-9.2	**-7.8**	-6.7	-5.0	-4.4	-4.0	-3.9	-7.5	1.5
Warm nights (% of days)	5.7	8.4	10.4	**25.3**	35.1	44.7	53.9	58.7	61.6	27.0	13.7
Minimum Tmin (°C)	-0.1	0.9	1.2	**3.7**	4.8	6.8	7.4	9.3	9.3	3.8	2.1
Maximum Tmin (°C)	0.2	0.7	0.9	**2.2**	2.6	3.4	3.6	4.1	4.7	2.1	0.9
Tropical nights (d)	-0.1	0.0	0.0	**0.1**	0.2	0.3	0.4	0.9	1.9	0.1	0.2
Cool days (% of days)	-9.6	-9.2	-9.0	**-7.3**	-6.1	-4.5	-3.8	-3.2	-2.9	-7.0	1.6
Warm days (% of days)	2.9	4.6	6.2	**12.8**	18.0	24.7	27.8	29.4	32.2	14.1	7.0
Minimum Tmax (°C)	-1.1	0.3	1.4	**3.3**	4.5	5.8	6.6	7.8	8.3	3.4	1.9
Maximum Tmax (°C)	0.2	0.5	0.9	**2.2**	3.1	3.7	4.0	4.9	6.3	2.3	1.1
Warm spell duration indicator (d)	5.4	9.3	12.7	**29.9**	43.6	66.5	71.1	81.9	93.4	34.1	20.0

Note: Absolute changes in precipitation amounts are relative to the modelled baseline. The magnitude of the change under future climate conditions may be different when measured from the values presented in Section 22A4.3, Table 22A-6.
Bold and shaded values indicate the 50th percentile, selected to represent the ensemble median of the projections and the values generally discussed in the analysis.
WMO = World Meteorological Organization; Tmin = minimum temperature; Tmax = maximum temperature.

Table 22A-21: Projected Changes in World Meteorological Organization Extreme Indices, 2080s

WMO Index	Min	5%	10%	50%	75%	90%	95%	99%	Max	Mean	Standard Deviation
Consecutive dry days (d)	-2.5	-1.8	-1.4	**0.1**	0.9	2.3	2.8	4.2	4.4	0.2	1.4
Cold spell duration indicator (d)	-10.8	-9.5	-8.7	**-5.9**	-4.5	-2.5	-2.0	0.2	1.2	-5.8	2.4
Consecutive wet days (d)	-4.0	-2.2	-1.9	**0.1**	1.4	2.5	3.6	4.7	5.7	0.3	1.8
Diurnal temperature range (°C)	-0.9	-0.5	-0.4	**0.0**	0.1	0.4	0.5	0.7	1.0	0.0	0.3
Frost days (d)	-89.7	-83.1	-79.5	**-57.8**	-45.1	-33.4	-24.9	-17.1	-15.3	-56.7	17.8
Growing season length (d)	7.4	13.2	19.3	**50.9**	79.4	108.5	116.3	125.8	136.7	58.7	33.5
Ice days (d)	-27.7	-22.7	-21.1	**-12.9**	-9.6	-6.3	-4.4	-2.7	-2.3	-13.4	5.8
Annual total wet-day precipitation (mm)	25.7	48.1	69.8	**199.0**	307.1	433.6	466.6	540.3	680.7	225.6	138.0
Number of heavy precipitation days (d)	-1.1	-0.2	0.6	**6.1**	8.2	12.1	14.0	15.9	18.4	6.0	4.3
Number of very heavy precipitation days (d)	0.2	1.4	2.1	**5.0**	7.0	9.5	10.7	12.7	15.2	5.3	3.0
Very wet days (mm)	39.1	49.7	64.9	**182.9**	257.6	363.0	427.1	487.6	543.9	195.8	114.8
Extremely wet days (mm)	-27.1	15.8	21.4	**78.3**	127.5	188.4	218.4	280.1	311.4	92.0	69.9
Number of days above 15 mm (d)	0.1	0.8	1.4	**4.2**	6.1	8.1	9.6	11.2	12.3	4.5	2.7
Max 1-day precipitation amount (mm)	-4.5	-1.1	1.2	**8.5**	15.8	21.7	24.7	28.9	29.1	10.1	7.9
Max 5-day precipitation amount (mm)	-7.1	-4.4	2.7	**20.1**	32.1	42.3	49.9	57.0	58.0	20.9	16.6
Simple daily intensity index (mm/d)	0.2	0.4	0.4	**1.0**	1.6	2.1	2.4	3.0	3.7	1.2	0.7
Summer days (d)	2.1	3.7	5.0	**15.5**	28.1	42.8	51.3	61.8	68.3	20.3	15.5
Cool nights (% of days)	-10.7	-10.2	-10.1	**-8.9**	-7.4	-6.0	-5.0	-3.7	-2.8	-8.4	1.7
Warm nights (% of days)	5.0	10.1	10.8	**37.7**	56.2	71.0	75.6	81.4	83.6	40.0	22.0
Min Tmin (°C)	0.2	0.8	1.7	**5.2**	8.0	8.9	10.5	13.6	14.0	5.5	3.1
Max Tmin (°C)	0.5	0.9	1.0	**2.7**	4.0	5.3	6.1	6.6	7.2	2.9	1.7
Tropical nights (d)	-0.1	0.0	0.0	**0.1**	0.6	3.2	6.4	8.2	10.3	1.0	2.0
Cool days (% of days)	-10.6	-10.2	-10.0	**-8.6**	-7.0	-5.6	-4.6	-3.0	-2.4	-8.1	1.9
Warm days (% of days)	4.0	5.2	7.0	**18.7**	33.2	47.0	52.9	58.0	58.6	23.1	15.1
Min Tmax (°C)	0.0	0.6	1.2	**4.5**	6.9	8.4	9.7	10.9	12.1	4.9	2.8
Max Tmax (°C)	0.1	0.6	1.1	**2.8**	4.9	5.9	6.5	7.5	8.3	3.2	1.9
Warm spell duration indicator (d)	9.0	11.8	12.7	**47.8**	95.6	155.3	169.2	193.5	194.1	64.8	52.5

Note: Absolute changes in precipitation amounts are relative to the modelled baseline. The magnitude of the change under future climate conditions may be different when measured from the values presented in Section 22A4.3, Table 22A-6.
Bold and shaded values indicate the 50th percentile, selected to represent the ensemble median of the projections and the values generally discussed in the analysis.
WMO = World Meteorological Organization; Tmin = minimum temperature; Tmax = maximum temperature.

22A5.3 Future Changes in Probable Maximum Precipitation

The projected changes in future one-day PMP values are shown in Table 22A-22. The 50th percentile results suggest increases in the one-day PMP of 12% for the 2050s and 16% for the 2080s. The results agree with the expectation that as temperature increases under future climate conditions, precipitation is expected to increase as more moisture becomes available in the atmosphere (Kunkel et al. 2013), resulting in a rise in the projected PMP. The range of results (from -38% to +85% in 2050s and -32% and +101% in 2080s) suggest that operational flexibility is required in the future for site water management systems designed for the PMP event.

Table 22A-22: Projected Changes in One-Day Probable Maximum Precipitation

Ensemble Indices	1-Day Probable Maximum Precipitation (%)	
	2050s	2080s
Minimum	-38	-32
5%	-18	-17
10%	-13	-9
50%	**12**	**16**
75%	22	31
90%	35	49
95%	51	61
99%	70	92
Maximum	85	101
Mean	13	20
Standard deviation	20	24

Note: **Bold** and shaded values indicate the 50th percentile, selected to represent the ensemble median of the projections and the values generally discussed in the analysis.

22A5.4 Future Changes in Rainfall Statistics

The percent changes in the IDF curves, relative to the modelled baseline, were estimated for different durations of extreme rainfall events. Selected results for the 50th percentile of the multi-model ensemble are summarized in Table 22A-23 and Table 22A-24. In general, the 50th percentile results suggest an increase in one-day precipitation between 12% and 0% by the 2050s and between 8% and 16.5% by 2080. Generally, the longer durations show a smaller percentage increase, compared to the shorter durations, for both the 2050 and 2080 horizons.

The projected changes in the 50th percentile one-day IDF curves (i.e., 12% to 0% in the 2050s and 16.5% to 0% in the 2080s; Table 22A-23 and Table 22A-24) are comparable to the projected changes in the 50th percentile one-day PMP (i.e., 12% in the 2050s and 16% in the 2080s; Table 22A-22). The IDF projections indicate the occurrence of more frequent and extreme rainfall events in the future.

Table 22A-23: Summary of the 50th Percentile of Projected Changes in Rainfall, 2050s

Duration (days)	Return Period (year)									
	2	5	10	20	50	100	200	500	1,000	2,000
1	9.5%	7.6%	6.0%	4.5%	2.1%	2.2%	1.9%	1.8%	0.6%	-0.3%
2	7.4%	6.1%	6.4%	6.1%	5.3%	6.6%	5.6%	5.7%	5.5%	5.7%
3	7.1%	6.1%	5.2%	4.4%	7.4%	6.2%	4.4%	4.4%	4.4%	4.5%
4	7.4%	6.0%	5.3%	5.3%	5.3%	5.9%	6.7%	7.6%	8.0%	8.4%
5	8.1%	7.6%	7.1%	7.8%	8.2%	9.0%	8.4%	8.7%	8.1%	8.3%
6	7.9%	8.5%	9.7%	9.5%	10.6%	11.4%	11.8%	11.5%	10.4%	10.0%
7	6.7%	6.8%	7.6%	8.4%	9.2%	8.9%	9.6%	9.6%	10.7%	10.2%
10	6.4%	6.2%	6.6%	5.2%	4.5%	3.6%	2.8%	2.4%	2.2%	1.8%
20	5.4%	5.3%	5.2%	5.9%	6.9%	7.1%	6.7%	6.6%	6.5%	6.7%
30	5.2%	4.9%	5.2%	4.3%	5.9%	5.3%	5.5%	5.3%	4.7%	4.0%
50	4.7%	5.8%	5.2%	5.5%	5.1%	4.2%	3.6%	3.3%	3.8%	4.5%
75	4.7%	4.8%	5.1%	5.7%	6.8%	7.0%	7.6%	7.8%	8.7%	9.0%
90	4.7%	5.3%	5.3%	6.1%	6.3%	5.8%	5.7%	6.3%	6.8%	7.8%
120	4.9%	5.7%	6.3%	5.8%	5.5%	5.6%	6.0%	7.3%	8.6%	9.3%

Table 22A-24: Summary of the 50th Percentile of Projected Changes in Rainfall, 2080s

Duration (days)	Return Period (year)									
	2	5	10	20	50	100	200	500	1,000	2,000
1	9.6%	11.5%	11.4%	11.5%	11.9%	13.9%	14.0%	14.2%	14.0%	13.6%
2	9.3%	9.8%	11.8%	13.6%	14.4%	15.2%	15.8%	16.0%	16.2%	16.5%
3	9.8%	10.1%	11.1%	12.0%	12.7%	13.8%	14.1%	14.2%	14.4%	14.4%
4	9.3%	9.1%	11.2%	12.1%	13.5%	13.0%	13.7%	14.3%	14.4%	14.4%
5	8.5%	9.7%	11.0%	12.2%	12.2%	12.4%	13.1%	14.1%	13.9%	14.0%
6	8.9%	10.6%	12.2%	12.3%	11.9%	12.6%	13.1%	13.3%	13.6%	14.0%
7	8.3%	11.4%	12.3%	12.0%	12.4%	13.4%	14.1%	14.6%	15.0%	15.1%
10	8.4%	10.5%	12.0%	12.1%	12.8%	13.5%	13.8%	14.1%	14.1%	13.9%
20	8.7%	9.8%	10.9%	11.4%	12.1%	12.3%	12.4%	8.6%	9.2%	8.8%
30	7.2%	8.3%	8.9%	9.8%	9.8%	9.9%	10.7%	9.3%	7.4%	10.4%
50	7.2%	8.4%	8.7%	8.9%	10.3%	10.7%	10.4%	9.4%	8.4%	10.6%
75	7.4%	8.2%	8.1%	7.7%	8.0%	8.4%	8.6%	8.8%	8.3%	10.3%
90	7.5%	8.4%	8.7%	8.7%	8.9%	9.5%	9.9%	9.0%	8.7%	10.6%
120	8.0%	7.8%	9.0%	9.0%	10.1%	10.7%	11.5%	8.8%	8.7%	10.6%

22A5.5 Future Changes in Evapotranspiration Potential

The projected changes of monthly and annual evapotranspiration relative to the modelled baseline period using Hargreaves method are shown in Table 22A-25. At the 50th percentile level, the annual potential evapotranspiration is projected to increase by 7.4% for the 2050s and 13.6% for the 2080s using the Hargreaves method. The percentage changes between 2050s and 2080s are larger in cold months of the year, November to April.

The average annual value represents the percentage change in the total potential evapotranspiration for the year. This value is much lower than that for the winter months, but this difference is due to relatively low absolute values for potential evapotranspiration during this period. The overall trend of future projection potential evapotranspiration is increasing.

As presented in Section 22A4.3, the total annual precipitation under future climate conditions is projected to increase by 7% and 8% in the 2050s and 2080s at the 50th percentile. Thus, the potential evapotranspiration appears to be increasing faster than the annual precipitation.

Table 22A-25: Monthly and Annual Change in Potential Evapotranspiration (%) for the 50th Percentile

50th Percentile Change in Potential Evapotranspiration (%)		
Month	2050s	2080s
	Hargreaves	Hargreaves
January	69.1	83.1
February	87.1	105.9
March	44.1	56.4
April	21.6	27.6
May	4.7	6.7
June	10.4	11.8
July	4.7	6.8
August	3.6	5.5
September	4.0	6.5
October	17.9	22.4
November	54.3	62.0
December	106.2	132.7
Annual	7.4	13.6

22A5.6 Future Changes in Extreme Rainfall and Snowmelt Events

The changes of rainfall and snowmelt in the 2050s and 2080s for the 50th percentile, compared to the modelled baseline period, are shown in Table 22A-26 and Table 22A-27. Overall, the results suggest an increase in rainfall plus snowmelt in the future. The projected change for the one-day, 100-year return period for the 2050s is 0.4%, while the projected change for the one-day, 100-year return period for the 2080s is 3.9%.

Changes in extreme rainfall and snowmelt are dependent on changes in both precipitation and temperature over the winter and spring, leading to results that are varied across durations and return periods (both increasing and decreasing amounts are possible). The greatest projected changes generally occur for durations of 75 days and above. When compared with the future changes in the IDF curves for precipitation (Table 22A-23 and

Table 22A-24), the projected changes are generally smaller across durations and return periods. This may be due to less available snowpack for melting over the late winter and spring months.

Table 22A-26: Summary of the 50th Percentile of Projected Percent Changes (%) in Rainfall Plus Snowmelt, 2050s

Return Period (Years)	Snowmelt Plus Rainfall (%)													
	1-Day	2-Day	3-Day	4-Day	5-Day	6-Day	7-Day	10-Day	20-Day	30-Day	50-Day	75-Day	90-Day	120-Day
2	3.1	1.4	0.6	0.4	-0.6	-1.8	-2.1	-1.6	-1.0	-0.1	-0.3	1.1	2.1	3.8
10	0.7	0.9	0.8	0.4	0.5	-0.3	-1.3	-0.9	0.1	0.5	1.2	4.0	3.3	3.7
100	-0.4	-0.2	-0.3	1.0	0.3	-0.1	0.9	-2.2	0.6	0.9	2.7	4.7	4.5	3.7
200	-0.6	-0.3	-0.3	1.0	0.2	-0.1	0.7	-2.1	0.5	1.2	2.8	5.0	4.5	3.8
500	-0.5	-0.4	-0.5	0.9	-0.1	0.1	0.2	-2.3	0.5	1.2	2.9	5.5	4.6	3.9
1,000	-0.4	-0.5	-0.8	0.7	-0.2	0.3	0.1	-1.9	0.5	1.1	2.9	5.6	4.6	4.0
2,000	-0.4	-0.5	-1.0	0.6	-0.4	0.5	0.3	-1.8	0.4	1.1	2.9	5.8	4.6	4.1

Table 22A-27: Summary of the 50th Percentile of Projected Changes (%) in Rainfall Plus Snowmelt, 2080s

Return Period (Years)	Snowmelt Plus Rainfall (%)													
	1-Day	2-Day	3-Day	4-Day	5-Day	6-Day	7-Day	10-Day	20-Day	30-Day	50-Day	75-Day	90-Day	120-Day
2	4.3	0.7	-0.4	-1.1	-0.9	-1.1	-1.9	-3.3	-2.4	-2.6	-2.0	1.5	3.2	4.7
10	5.0	2.0	1.2	-0.1	-0.3	0.8	0.1	-2.9	-2.6	-1.0	-1.1	4.6	5.0	4.9
100	3.9	3.3	2.2	0.5	0.5	1.2	0.1	-2.7	-1.6	0.4	2.1	6.0	5.5	5.7
200	4.2	3.4	2.5	0.8	0.7	1.3	0.2	-2.7	-0.9	0.5	2.9	6.1	6.0	5.3
500	4.5	3.5	2.6	1.4	1.1	1.3	0.3	-2.9	-0.2	0.8	3.2	6.3	5.9	5.2
1,000	4.7	3.7	2.7	1.5	1.4	1.6	0.6	-2.6	0.1	0.9	3.0	6.3	5.8	5.1
2,000	4.7	3.8	2.9	1.6	1.3	2.0	0.8	-2.6	0.1	1.3	2.9	6.4	5.7	5.0

22A6 Conclusions

The mean annual rainfall is about 562.9 mm, and the mean annual temperature is about -1.5°C in the area of the Project during the current climate baseline period (1981 to 2019) based on the MERRA-2 dataset. During this period, annual and monthly mean temperatures have fluctuated slightly, with both decreasing and increasing trends that were not statistically significant. However, the annual and monthly minimum temperatures have shown increasing trends (not statistically significant) that have influenced the increases in some of the WMO indices. Statistically significant increasing trends were observed for total annual precipitation and monthly precipitation for January, February, March, November, and December. The current climate extreme indices are consistent with the current climate trends, showing warming minimum temperature trends and likely wetter conditions.

The current one-day and three-day PMP values were estimated to be 275.0 mm and 293.0 mm based on the rainfall data from the MERRA-2 dataset. The rainfall depth was estimated at 87.7 mm for the one-day duration and 100-year return period. The average annual potential evapotranspiration was estimated to be 852.7 mm using the Hargreaves method for the current climate baseline period.

The observed trends in the current climate baseline period are consistent with the future climate projections. The annual temperatures are projected to increase by 2.4°C and 3.2°C, in 2050s and 2080s, respectively, at the

50th percentile level. Annual projections of precipitation at the 50th percentile level are projected to increase by 7% and 8%, in both the 2050s and 2080s, with increases in precipitation observed during all months.

Similarly, the future climate extreme projections are consistent with the current climate and the future climate temperature and precipitation trends. From the median (50th percentile) values for the 2050s and 2080s, the projected future climate extremes are indicating a future that is likely to be warmer and wetter on an annual basis. Temperature is projected to increase, resulting in increased warm nights and reduced ice and frost days. Precipitation is also projected to increase, resulting in increased annual total wet-day precipitation, very wet and extremely wet days.

The one-day PMP values are projected to change between approximately -32% and +85% in the 2050s with an increase of 12% for the 50th percentile level. The corresponding range of PMP change for the 2080s is between approximately -32% and 101% with an increase of 16% for the 50th percentile level. The 100-year, one-day rainfall events are projected to increase by 2% over the modelled baseline period by the 2050s and 14% by the 2080s at the 50th percentile level. Estimates for future potential evapotranspiration using the Hargreaves method suggests an 11.1% increase in annual potential evapotranspiration by the 2050s and an 13.6% increase in annual potential evapotranspiration by the 2080s at the 50th percentile level.

The comparison of precipitation statistics versus those of combined rainfall and snowmelt highlighted key differences over the range of durations included (i.e., 1- to 7-, 10-, 20-, 30-, 50-, 75-, 90-, and 120-day). It was found that lower-duration events, such as that of one-day, are more extreme when the effect of snow accumulation and melt is not considered, because these are high-intensity events where snowmelt would only make up a small fraction of the total. Mid-range duration events are more extreme when snowmelt is considered, because the snowmelt would make up a larger fraction of the total due to less intense rainfall amounts. Finally, the longest duration events are more extreme when snowmelt is not considered due to snowpack being depleted and resulting in no snowmelt occurring. Because of the effects of event duration on the nature of the effective precipitation extremes, both results for precipitation and combined rainfall and snowmelt should be taken into consideration for design purposes. It is recommended that the most conservative value between either the rainfall statistics (Section 22A4.6) and extreme rainfall and snowmelt (Section 22A4.8) be used for designs that consider extreme rainfall. For designs considering management high runoff volumes, the greater of the two should be selected for a given duration and return period.

22A7 Limitations

The nature of the work undertaken is stochastic, with substantial inherent uncertainly around any given data points. The reader acknowledges that the uncertainty associated with any projections or forecasts is increased with the duration of the projected period and is subject to future developments or intervening acts, which may manifest in the interim period.

The information in this report was prepared using published data and information, technical journals, and articles, as well as professional judgment and experience. No sampling or fieldwork was conducted in the course of this work.

22A8 References

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Attachment 22A-1 Detailed Climate Change Methodology

Abbreviations and Units of Measure

Abbreviation	Definition
EQM	equidistance quantile matching
GCM	global climate model
IDF	intensity-duration-frequency
IPCC	Intergovernmental Panel on Climate Change
MERRA-2	Modern-Era Retrospective Analysis for Research and Applications
PMP	probable maximum precipitation
Project	Rook I Project
RCP	representative concentration pathway
SRES	Special Report on Emissions Scenarios
WMO	World Meteorological Organization

Unit	Definition
%	percent
°C	degrees Celsius
mm	millimetre
km	kilometre
W/m^2	watts per square metre

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22A-1-1 Introduction

This document describes the approach used to develop a detailed climate change dataset for the Rook I Project (Project) and documents the most recent guidance found in literature. This standardized approach for completing a climate change dataset is developed based on recommended guidance accepted by the Intergovernmental Panel on Climate Change (IPCC) and other scientific bodies as referenced in the subsections below. This approach combines information about the current climate conditions and publicly available projections of how the climate may change under future climate conditions, to describe a range of projections on how the current climate may change in the future at the site of interest.

The following subsections provide detailed methods used to develop a current climate baseline (Section 22A-1-1.1, Current Climate Baseline Development) and future climate projections (Section 22A-1-1.2, Future Climate Projections Development) for the area of the Project.

22A-1-1.1 Current Climate Baseline Development

Understanding the current climate and climate trends is important when evaluating Project design parameters and developing the exceedance probability using future climate projections. The current climate baseline is typically grounded in data from local stations. Based on the information provided by the on-site station and available regional stations, the on-site and regional stations were not included in the baseline development due to the lack of available and continuous data. However, the regional climate stations were compared and correlated to reanalysis[1] data from the National Aeronautics and Space Administration Modern-Era Retrospective analysis for Research and Applications Version 2 (MERRA-2).

MERRA-2 combines modelled results from the Goddard Earth Observing System model and assimilation data from microwave sounders, hyperspectral infrared radiance instruments, and other data sources. The analysis is performed at a horizontal resolution of 2/3-degree longitude and by 1/2-degree latitude and at 72 levels extending to 0.01 hectopascal (102 pascals) and simulates both the temperature and precipitation on an hourly basis. The current climate baseline is established by using MERRA-2 reanalysis data as the climate stations on site and within the region did not meet the selection attributes outlined in Section 22A-1-1.1.1, Data Sources for Current Climate.

22A-1-1.1.1 Data Sources for Current Climate

Based on the information provided, there were limited long-term, on-site, and nearby regional weather station data that met selection criteria. Data from climate stations were obtained from Environment and Climate Change Canada (Government of Canada 2019). The following selection attributes were used to identify the climate station that best represents the area of the Project, meteorologically:

- the length of record (minimum 30 years of data);
- availability of a continuous record;
- proximity to the area of interest;
- age of observations compared to the currently accepted normal period;

[1] Reanalysis combines past short-range weather forecasts with observations through data assimilation. The process mimics the production of day-to-day weather forecasts, which use an analysis of the current state of the Earth system as their starting point. The analysis is a physically consistent blend of observations with a short-range forecast based on the previous analysis.

- latitude;
- elevation of station;
- geographic siting; and
- monthly data availability threshold of 90% for all years.

The available climate data from each station were compared to, and pass, the selection criteria for the current climate baseline period (1981 to 2019). To establish the existing conditions in the area of the Project, available climate observations from the on-site station and the closest regional climate stations and reanalysis data from MERRA-2 were obtained. Data availability for each of the stations was evaluated based on the selection criteria and was followed by a sensitivity analysis to compare the available data sources.

22A-1-1.1.2 Quantifying Current Climate Normals and Trends

The current climate temperature and precipitation were used to calculate the annual and monthly current climate normals and trends using the definitions provided in Table 22A-1-1.

Table 22A-1-1: Definition of Current Climate Indices

Climate Indices	Definition	Units
Total precipitation	Calculated as the sum of all the observed total precipitation during the selected annual period. Each annual value is averaged over the period of the climate normal.	mm
Monthly precipitation	Calculated as the sum of all the observed total precipitation during the selected month. Each annual value is averaged over the period of the climate normal.	mm
Average annual temperature	Calculated as the average of all the observed daily mean temperatures during the selected annual period. Each annual value is averaged over the period of the climate normal.	°C
Monthly temperature	Calculated as the average of all the observed mean temperatures during the selected month. Each annual value is averaged over the period of the climate normal.	°C

The reviewed data was used to calculate selected climate normals and trends (Table 22A-1-1) using a methodology developed by the Finnish Meteorological Institute (Salmi et al. 2002) to assess climate changes predicted from long-term climate observations. Both annual and seasonal climate normals and trends were calculated for the mean temperature and total precipitation. The climate normal was calculated as the average of a given climate parameter over the selected period, and the climate trend was calculated as the average change in the climate parameter per decade (i.e., the decadal trend or change). Potential trends in temperature and precipitation were evaluated by fitting a model to the data using the Sen's nonparametric model (Sen 1968). The statistical significance of the observed trends was determined using the Mann Kendall test. The Mann Kendall test is applicable to the detection of a monotonic trend of a time series with no seasonal cycle. The analysis uses a two-tail test to determine statistical significance at the 90th, 95th, 99th, and 99.9th percentile levels.

22A-1-1.1.3 Quantifying Current Climate Extremes and Trends

In addition to the annual and monthly current climate indices, climate extremes were calculated. The Expert Team on Climate Change Detection and Indices developed a set of 27 climate extreme indices as a means of summarizing daily temperature and precipitation statistics, focusing primarily on aspects of climate extremes. These indices are described in World Meteorological Organization (WMO; 2009a) along with a set of recommendations for their calculation to allow comparison of climate conditions on an international basis. The detailed definitions for these 27 indices, quality control procedures and calculation software are provided by Expert Team on Climate Change Detection and Indices (ETCCDI 2017). In addition to the normals and trends (calculated using the methods described in Section 22A-1-1.1.2, Quantifying Current Climate Normals and Trends), the minimum, maximum, mean, and median for each of the 27 indices were calculated using the annual values provided for each index during the current climate baseline period (1981 to 2019). A summary of these indices and their definitions are provided in Table 22A-1-2.

Table 22A-1-2: List of World Meteorological Organization Recommended 27 Extreme Indices

ID	Indicator Name	Definitions	Units
CDD	Consecutive dry days	Maximum number of consecutive days with daily precipitation amount less than 1 mm (RR<1 mm)	d
CSDI	Cold spell duration indicator	Annual count of days with at least 6 consecutive days when daily minimum temperatures are less than the 10th percentile (TN<10th percentile)	d
CWD	Consecutive wet days	Maximum number of consecutive days with daily precipitation amount greater than or equal to 1 mm (RR>/=1 mm)	d
DTR	Diurnal temperature range	Monthly mean difference between the daily minimum temperature (TN) and the daily maximum temperature (TX)	ºC
FD0	Frost days	Annual count when the daily minimum temperature is less than 0°C (TN<0ºC)	d
GSL	Growing season length	Annual (1 January to 31 December in northern hemisphere, 1 July to 30 June in southern hemisphere) count between first span of at least 6 days with ground temperatures greater than 5°C (TG>5ºC) and first span after 1 July (1 January in southern hemisphere) of 6 days with ground temperatures less than 5°C (TG<5ºC)	d
ID0	Ice days	Annual count when the daily maximum temperature is less than 0° (TX<0ºC)	d
PRCPTOT	Annual total wet-day precipitation	Annual total precipitation (PRCP) in wet days where the daily precipitation is greater than or equal to 1 mm (RR>/=1 mm)	mm
R10	Number of heavy precipitation days	Annual count of days when precipitation is greater than or equal to 10 mm (PRCP>/=10 mm)	d
R20	Number of very heavy precipitation days	Annual count of days when precipitation is greater than or equal to 20 mm (PRCP>/=20 mm)	d
R95p	Very wet days	Annual total precipitation (PRCP) when the daily precipitation is greater than the 95th percentile (RR>95th percentile)	mm
R99p	Extremely wet days	Annual total precipitation (PRCP) when the daily precipitation is greater than the 99th percentile (RR>99th percentile)	mm
Rnn	Number of days above nn mm	Annual count of days when precipitation is greater than or equal to a user defined threshold (PRCP>/= “nn” mm, “nn” is user defined threshold)	d
RX1day	Max 1-day precipitation amount	Monthly maximum 1-day precipitation	mm
Rx5day	Max 5-day precipitation amount	Monthly maximum consecutive 5-day precipitation	mm
SDII	Simple daily intensity index	Annual total precipitation divided by the number of wet days (defined as PRCP>/=1.0 mm) in the year	mm/d
SU25	Summer days	Annual count when the daily maximum temperature is greater than 25°C (TX>25ºC)	d
TN10p	Cool nights	Percentage of days when the daily minimum temperature is less than the 10th percentile (TN<10th percentile)	% of days
TN90p	Warm nights	Percentage of days when the daily minimum temperature is greater than the 90th percentile (TN>90th percentile)	% of days
TNn	Min Tmin	Daily minimum value of daily minimum temp	ºC
TNx	Max Tmin	Daily maximum value of daily minimum temp	ºC
TR20	Tropical nights	Annual count when the daily minimum temperature is greater than 20°C (TN>20ºC)	d
TX10p	Cool days	Percentage of days when the daily maximum temperature is less than the 10th percentile (TX<10th percentile)	% of days

Table 22A-1-2: List of World Meteorological Organization Recommended 27 Extreme Indices

ID	Indicator Name	Definitions	Units
TX90p	Warm days	Percentage of days when the daily maximum temperature is greater than the 90th percentile (TX>90th percentile)	% of days
TXn	Min Tmax	Daily minimum value of daily maximum temp	ºC
TXx	Max Tmax	Daily maximum value of daily maximum temp	ºC
WSDI	Warm spell duration indicator	Annual count of days with at least 6 consecutive days when the daily maximum temperature is greater than the 90th percentile (TX>90th percentile)	d

RR = daily precipitation amount (mm); TX = maximum temperature (°C); TN = minimum temperature (°C); TG = ground temperature (°C); PRCP = precipitation amount (mm); < = less than; > = greater than.

22A-1-1.1.4 Quantifying Current Probable Maximum Precipitation

Probable maximum precipitation (PMP) is defined as "the greatest depth of precipitation for a given duration meteorologically possible for a design watershed or a given storm area at a particular location at a particular time of year, with no allowance made for long-term climatic trends" (WMO 2009a). The PMP is a theoretical value that represents the greatest amount of rain possible in an area, whereas a design storm represents the greatest amount of rain observed in an area. The WMO acknowledges that there is considerable uncertainty regarding PMP calculations and recommends that a comparison of reported values be conducted.

There are two widely accepted approaches to estimate the PMP: meteorological (moisture maximization) and statistical (Hershfield). The meteorological approach maximizes the moisture content or precipitable water of rainfall storm events, while the statistical approach utilizes the historical annual maximum rainfall events to estimate the PMP. The precipitable water of rainfall storm events were not available for this location, so the statistical approach was used to estimate the current value.

The statistical approach following the Hershfield Method (WMO 2009b) is as follows:

$$\boldsymbol{PMP = X_n + KS_n} \qquad \textbf{Equation 1}$$

Where X_n and S_n are the mean and standard deviation, respectively, of the annual maximum 1-day precipitation, and K is a frequency factor that is a function of X and rainfall intervals. In computing PMP with Equation 1, various adjustments were made, including:

- adjustment of X_n and S_n for the maximum observed events;
- adjustment of X_n and S_n for sample size;
- adjustment for fixed observational time intervals; and
- adjustment for the area.

The one-day and three-day PMP storm were estimated using daily current climate baseline precipitation data on a daily time step using the Hershfield Method.

22A-1-1.1.5 Quantifying Current Rainfall Statistics

Extreme rainfall events for multiple durations and return periods were calculated according to the methods presented in the following subsections.

22A-1-1.1.5.1 Daily Precipitation

The peak one-day duration rainfall events were estimated for each year of the current climate baseline period. The method of moments was used to estimate parameters for the Gumbel Distribution (Hogg et al. 1989), which is used by Environment and Climate Change Canada to describe the annual return period precipitation depths for the one-day rainfall duration. The analysis included the results for various return periods (2, 5, 10, 20, 50, 100, 200, 500, 1,000, and 2,000 years).

22A-1-1.1.5.2 Multi-Day Precipitation

Multi-day precipitation depths were estimated by deriving multi-day running totals for precipitation (using 1, 2, 3, 4, 5, 10, 20, 30, 50, 75, 90, and 120-day durations) and then applying the method described in Section 22A-1-1.1.5.1, Daily Precipitation, for the annual maximum and Gumbel distribution.

22A-1-1.1.6 Quantifying Current Potential Evapotranspiration

Evapotranspiration is the combined process of evaporation and transpiration over a vegetated surface. The principal weather parameters affecting evapotranspiration are air temperature, extraterrestrial radiation, humidity, wind speed, and vegetation parameters. Potential evapotranspiration represents the maximum actual evapotranspiration expected from a given area with no moisture limitations. As only the observed minimum temperature, maximum temperature, and total precipitation are available from the daily current climate dataset (no infilled observations of radiation, humidity, and wind speed are produced), an air temperature-based formula (the Hargreaves equation; FAO 2006) was used.

The Hargreaves equation was developed as an alternative to the more complicated energy-balance approach of the Penman-Monteith equation Food and Agriculture Organization (FAO 2006). The Penman-Monteith method requires many climate variables including incoming solar radiation, wind speed, and humidity, which are often not available. By contrast, the Hargreaves equation requires only the daily minimum, maximum, and mean temperatures. The Hargreaves equation builds a more complete model by making assumptions about the solar radiation (based on latitude), accounting for humidity (based on the difference between daily minimum and maximum temperatures), and assuming that the effect of wind is negligible. The Food and Agriculture Organization has noted that for potential evapotranspiration (ETo):

> "Temperatures methods remain empirical and require local calibration to achieve satisfactory results. A possible exception is the 1985 Hargreaves' method, which has shown reasonable ETo results with a global validity." (FAO 2006)

The Hargreaves estimate of daily potential evapotranspiration is arrived at by the following formula:

$$\boldsymbol{E = 0.0023(T_{mean} + 17.8)(T_{max} - T_{min})^{0.5} R_a} \qquad \textbf{Equation 2}$$

where T_{mean} is the average temperature, T_{max} and T_{min} are daily maximum and minimum temperatures, and Ra is the extraterrestrial radiation. The Ra is calculated as:

$$R_a = \frac{24(60)}{\pi} G_{sc} d_r [w_s sin(\varphi) sin(\delta) + cos(\varphi) cos(\delta) sin(w_s)] \quad \textbf{Equation 3}$$

Where: G_{sc} = the solar constant: 0.0820 MJ/m^2/min;

d_r = the inverse relative distance Earth-Sun: $d_r = 1 + 0.033cos\left(\frac{2\pi}{365}J\right)$;

ws = the sunset hour angle: $w_s = arccos[-tan(\varphi)tan(\delta)]$;

φ = the latitude of the site in radians;

δ = the solar declination in radians: $\delta = 0.409sin\left(\frac{2\pi}{365}J - 1.39\right)$; and

J = the Julian day.

22A-1-1.2 Future Climate Projections Development

Future climate projections are important for understanding how climate is projected to change from the current climate baseline. The future climate projections come from publicly available statistical downscaled future climate projections on a daily scale. Recognizing the inherent uncertainty with projections, multiple projections from multiple models and scenarios were included in the analysis. The future projections were provided in terms of percentiles or exceedance probabilities.

22A-1-1.2.1 Data Sources for Future Climate

In 1988, the IPCC was formed by the WMO and the United Nations Environment Program to review international climate change data. The IPCC is generally considered to be the definitive source of information related to past and future climate change as well as climate science. As an international body, the IPCC provides a common source of information relating to emission scenarios, provides third party reviews of models, and recommends approaches to document future climate projections. Periodically, the IPCC issues assessment reports summarizing the most current state of climate science. The Fifth Assessment Report (IPCC 2013) represents the most current complete synthesis of information regarding climate change.

22A-1-1.2.2 Global Climate Projections

Future climate is typically projected using global climate models (GCMs) that involve the mathematical representation of global land, sea, and atmosphere interactions over a long period of time. These GCMs have been developed by various government agencies, but they share many common elements described by the IPCC. The IPCC does not run the models, but acts as a clearinghouse for the distribution and sharing of the model forecasts.

Future climate projection data are available from about 30 GCMs and four representative concentration pathways (RCPs; RCP 2.6, RCP 4.5, RCP 6.0, and RCP 8.5) in the Fifth Assessment Report. The model projections can be summarized for magnitude of change from the climate regime baseline for different time horizons. The following time horizons were applied to this assessment:

- 1954 to 2018 (baseline);
- 2041 to 2070 (2050s); and
- 2071 to 2100 (2080s).

Global climate models require extensive inputs to characterize the physical processes and social development paths that could alter climate in the future. To represent the wide range of the inputs possible to GCMs, the IPCC has established a series of RCPs that help define the future levels of radiative forcing terms. The IPCC's four RCPs are named after the radiative forcing projected to occur by 2100. These four RCPs are described more in Table 22A-1-3, which also links the RCP scenarios to the Special Report on Emissions Scenarios (SRES) used in the IPCC's Fourth Assessment Report (2007). While the IPCC identified four RPCs, this report focuses on the three (RCP 2.6, RCP 4.5, and RCP 8.5) available from ClimateData.ca (ClimateData.ca has not made RCP 6.0 projections available).

Table 22A-1-3: Characterization of Representative Concentration Pathways

Pathways	Radiative Forcing in 2100	Characterization
RCP 2.6	2.6 W/m²	"Peak and decline" scenario where the radiative forcing first reaches 3.1 W/m² by mid-century and returns to 2.6 W/m² by 2100. This is achieved through a substantial reduction in greenhouse gases over time through stringent climate policy.
RCP 4.5	4.5 W/m²	Total radiative forcing is stabilized shortly after 2100, without overshoot. This is achieved through a reduction in greenhouse gases over time through climate policy; and comparable to SRES B1 scenario.
RCP 6.0	6.0 W/m²	Without additional efforts to constrain emissions (baseline scenarios); and comparable to SRES B2 scenario.
RCP 8.5	8.5 W/m²	Increasing greenhouse gas emissions over time, with no stabilization, representative of scenarios leading to high greenhouse gas concentration levels; and comparable to the SRES A2/A1FI scenarios.

Source: van Vuuren et al. (2011).
RCP = representative concentration pathway; SRES = Special Report on Emissions Scenarios.

22A-1-1.2.2.1 Regional Climate Change Projections

ClimateData.ca provides statistically downscaled daily Canada-wide climate scenarios, at a gridded resolution of 300 arc seconds (or roughly 10 km) for the simulated period of 1950 to 2100 (ClimateData.ca 2019). The climate variables available from ClimateData.ca include minimum temperature, maximum temperature, and precipitation. The selection of ClimateData.ca data for this Project is based on the available temporal and spatial resolution of the data. The availability of daily downscaled data allows for better characterization of the climate extremes, especially for precipitation. The availability of high spatial resolution (10 km instead of hundreds of kilometres in GCMs) provides better representation for site-specific studies.

Two methods that can be used to downscale the projections from the GCMs to a finer resolution are Bias Correction Spatial Disaggregation (Wood et al. 2004) and Bias Correction/Constructed Analogues with Quantile mapping reordering (ClimateData.ca 2019). These downscaling methods are statistical algorithms that disaggregate the GCM outputs to a finer spatial and temporal resolution. The methods use the gridded data and to calculate values that reflect the local conditions that cannot be simulated by the GCM. Bias Correction Spatial Disaggregation interpolates spatially to a finer scale monthly, while the Bias Correction/Constructed Analogues with Quantile mapping reordering interpolates daily. Therefore, it is anticipated that Bias Correction/Constructed Analogues with Quantile mapping reordering will better represent the extreme weather conditions than Bias Correction Spatial Disaggregation.

These downscaled outputs are based on GCM projections from the Coupled Model Intercomparison Project Phase 5 (Taylor et al. 2012) and historical daily gridded data from Canada (Mckenney et al. 2011; Hopkinson et al. 2011), and are available for a subset of 12 GCMs. These 12 GCMs are selected to provide the widest spread in projected future climate for smaller subsets of the full ensemble following Cannon (2015).

Since no one model or climate scenario can be viewed as completely accurate, the IPCC recommends that climate change assessments use as many models and climate scenarios as possible, or a “multi-model ensemble”. For this reason, the multi-model ensemble approach was used to delineate the probable range of results and better capture the actual outcome (an inherent unknown).

Seventy-two potential members of the multi-model ensemble were reviewed to confirm whether the general temperature and precipitation ranges reasonably matched the observed ranges of climate for the region. Monthly averages were used to capture the known seasonality of the region.

The downscaled data have daily temporal resolution (GCMs typically have monthly temporal resolution) that allowed for the characterization of future climate extremes. In addition, the improved horizontal resolution of 10 km in the downscaled data could better improve the representation of the Project, given the complex terrain around the Project site.

22A-1-1.2.2.2 Uncertainty of Climate Change Downscaling Methods

The spatial and temporal resolution difference between GCMs outputs and the data requirement of climate change risk assessment presents a challenge. Therefore, it is necessary to perform some post-processing to minimize the differences. Consequently, dynamic downscaling and statistical downscaling have been developed to meet these requirements (Chen et al. 2011). Dynamic downscaling employs more detailed regional climate models that are run at finer spatial and temporal resolutions. As a result, the main challenge for dynamic downscaling is the computing cost, so it is limited for selected regions and scenarios, and mainly at the research stage. Statistical downscaling techniques have been developed to overcome these challenges, and typically fall into four categories: transfer function, weather typing, weather generators, and climate change factor (Wilby and Wigley 1997). Transfer function approaches establish statistical linear or nonlinear relationships between observed local climate variables and GCM outputs. Weather typing relates a group of local climate variables to different classes of atmospheric circulation. Weather generators perturb its parameters based on empirical distributions and relative changes projected by GCMs. The climate change factor adjusts the baseline conditions by adding the differences or multiplying the ratios between future and current climates as simulated by the regional climate models or GCMs. Each approach has pros and cons. In its Fourth Assessment Report, the IPCC (2007) supported the conclusions on statistical downscaling methods and dynamical downscaling with regional climate models. Both methods produce comparable results in simulating current climate and should thus be considered complementary approaches for downscaling regional climate (CSA 2010).

For the future projected daily temperature and precipitation, the publicly available statistically downscaled projections from ClimateData.ca described in Section22A-1-1.2.1, Data Sources for Future Climate, were used.

22A-1-1.2.2.3 Projecting Future Climate Extremes

Future climate extremes were projected using the 27 WMO extreme indices described in Section 22A-1-1.1.3, Quantifying Current Climate Extremes and Trends, using the temperature and precipitation projections from the available downscaled ClimateData.ca data described in Section 22A-1-1.2.1. The future climate extremes were described in terms of an “anomaly” or change from the current climate baseline. As each model has a unique baseline, the calculations were first completed for each model and then statistics were provided to describe the range of projections over the multi-model ensemble.

The 27 WMO extreme indices are calculated for each of the 72 multi-model ensemble members for each year of the current climate baseline (1981 to 2019) and each year of the two desired future periods (2050s and 2080s). This created the unique baseline and future projections for each model that was used as a basis to calculate the anomaly. Before calculating the anomaly, for each ensemble member, each index was averaged over all the annual values contained in each period considered, including the current climate baseline and the two future periods, creating three values for each index for each model (i.e., mean value for the baseline, the 2050s, and the 2080s). Finally, the anomalies were calculated as the difference between each future period and the current climate baseline for each index (i.e., mean 2050s less mean baseline and mean 2080s less mean baseline) and each ensemble member. This provides one anomaly per index per ensemble member for each future period. This information was summarized using statistics to describe the range in projected anomalies across the ensemble members (min, max, mean, median, percentiles, and standard deviation).

22A-1-1.2.3 Projecting Future Changes in Probable Maximum Precipitation

Consistent with all future projections, the ensemble approach has been used. The method selected to estimate the PMP is the Hershfield method, which is calculated for both the current climate baseline and future periods. Both the meteorological and statistical PMP approaches from Section 22A-1-1.1.4, Quantifying Current Probable Maximum Precipitation, have been used to project the future PMP. The moisture maximization approach can be estimated by:

$$PMP = P_s \times \frac{W_{max}}{W_{storm}} = P_s \times r \qquad \textbf{Equation 4}$$

Where P_s is the observed precipitation of a large storm, W_{max} is the maximum precipitable water at the same time of year in the same location, W_{storm} is the precipitable water of the observed storm, and r is the moisture maximization ratio. Precipitable water is the amount of water from condensation of all water vapour in an atmospheric column. The future moisture content is projected using readily available data from the ensemble GCMs as a proxy. Ideally, the precipitable water can be calculated for each combination of GCMs and RCPs for every day by:

$$W_{i,j,k} = \frac{1}{g}\int_{p_s}^{p_t} Q(p)dp \qquad \textbf{Equation 5}$$

Where *i, j,* and *k* represent the combination of the i^{th} RCP, j^{th} GCM, and kt^{h} day, g is gravitational acceleration, p_s and p_t are the pressures at the surface and top levels of atmosphere column, and Q(*p*) is the specific humidity at pressure level *p*, can be calculated as:

$$Q(p) = \frac{r_v}{1 + r_v} \approx r_v = \frac{0.622e}{p - e} \qquad \textbf{Equation 6}$$

Where r_v is the saturation water vapor mixing ratio and e is the saturation vapor pressure, which can be calculated by Clausius-Clapeyron equation:

$$\boldsymbol{e = 6.112exp\left(\frac{17.67T_{dew}}{T_{dew} + 243.5}\right)}$$ **Equation 7**

$$p = \rho RT$$ **Equation 8**

Where T_{dew} is the dew point temperature, T is the mean temperature, ρ is the air density and R is gas specific constant.

The ClimateData.ca dataset has only daily precipitation, minimum and maximum temperatures at one level, but not the moisture content at multiple levels. Accordingly, the daily minimum temperature was used as a proxy for the dew point temperature, and surface specific humidity as a proxy for the precipitable water:

$$\boldsymbol{W_{i,j,k} \sim Q(p_s)}$$ **Equation 9**

The maximum precipitable water, using Equation (5) to Equation (9) can be calculated for the observational period and future period. The future PMP (PMPF) for the i^{th} RCP and j^{th} GCM is projected to be:

$$\boldsymbol{PMPF_{i,j} = \frac{Wf_{i,j}}{Wb_{i,j}} PMP}$$ **Equation 10**

Where W_f and W_b are the maximum precipitable water in the future period and baseline period, respectively. Current research (Rouhani 2016) indicates that using the 100-year precipitable water instead of the maximum precipitable water yields more robust results.

Using Equation (10), the future PMP can be projected for all combinations of RCPs and GCMs.

The second approach follows the Hershfield method. The PMP is calculated for the baseline period and future period by:

$$\boldsymbol{PMP_{i,j}^{m} = X_n(i,j) + K(i,j)S_n(i,j)}$$ **Equation 11**

Where i and j represent one combination of i^{th} RCP and j^{th} GCM, and m represents the periods. The projected percentage change is calculated as the difference between the future modelled period and modelled baseline period.

The projected change, in terms of percentage, from each method was calculated for each model, resulting in an ensemble of percentage differences. Percentile statistics have been calculated over the ensemble of projected changes including both methods, which will result in one set of projected changes.

22A-1-1.2.4 Projecting Future Rainfall Statistics

Data downscaling of coarse regional climate projections available from the GCMs to a local scale with a fine degree of resolution in both space and time is essential in the development of the future intensity-duration-frequency (IDF) statistics. Although the data used from ClimateData.ca are already statistically downscaled, an additional downscaling step is necessary to properly account for the local rainfall distribution. This step allows for the extreme rainfall events to be more accurately captured for the calculation of IDF statistics.

Multiple methods were available to estimate the impact of climate change on IDF curves using future climate projections, while no one method is currently accepted as standard practice. As indicated by Canadian Standards Association (CSA 2010):

> In an effort to derive quantitative future short-duration rainfall estimates to better suit the needs of design, water resource and stormwater management practitioners, a number of various statistical downscaling and analysis techniques have been developed. However, there is no standard or accepted research methodology to determine how future sub-daily extreme rainfall could change in intensity and frequency at point locations or over a small area in the future climate.

For this climate change assessment, two different methods were used to account for this uncertainty. These methods were applied to all combinations of GCMs and RCPs to project the future IDF statistics. The results of both methods were used to represent the IDF statistics at different probability exceedance levels. The two proposed methods are equidistance quantile matching (EQM) method (Srivistav et al. 2014) and Ratio Method.

The method used for simultaneously downscaling the precipitation data and generating the IDF statistics is the EQM method of Srivastav et al. (2014). The EQM method has two components:

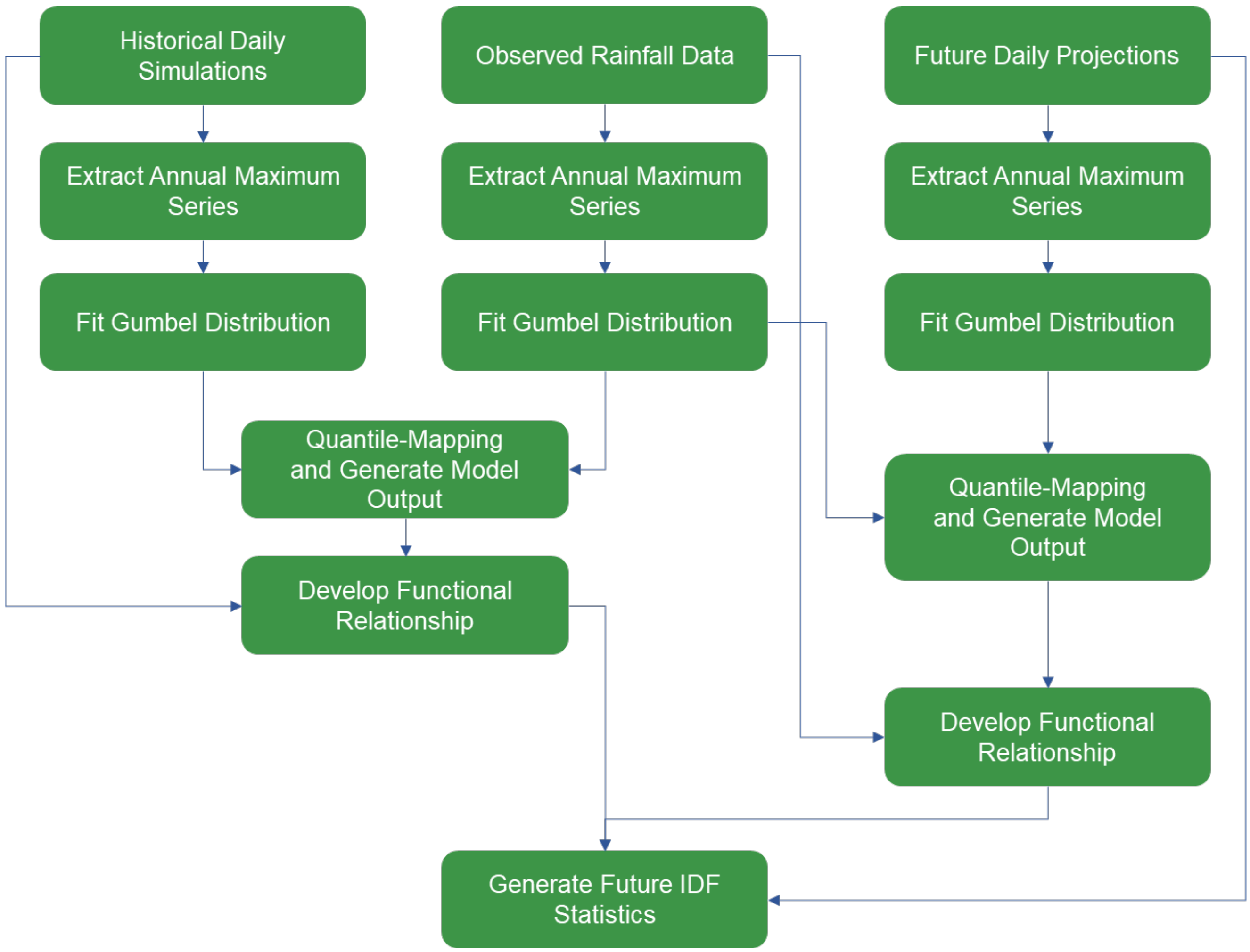
1. Spatial downscaling relating concurrent GCM daily simulation and historical observations at a station of interest using quantile-mapping functions; and
2. Temporal downscaling relating the GCM daily simulation for the observational period to future GCM projection using quantile-mapping functions.

The quantile-mapping functions are based on the Gumbel distribution, which is fitted to the annual maximum precipitation series. A flow chart of the EQM method is shown in Figure 22A-1-1.

The Ratio Method does not directly input the observed rainfall data into the GCM projections; rather, it uses the climate projections to produce the IDF statistics during the historical observation period and future period. The ratio of the future period to the historical period is then applied to the existing IDF statistics to project the future IDF curves. A flow chart is shown in Figure 22A-1-2.

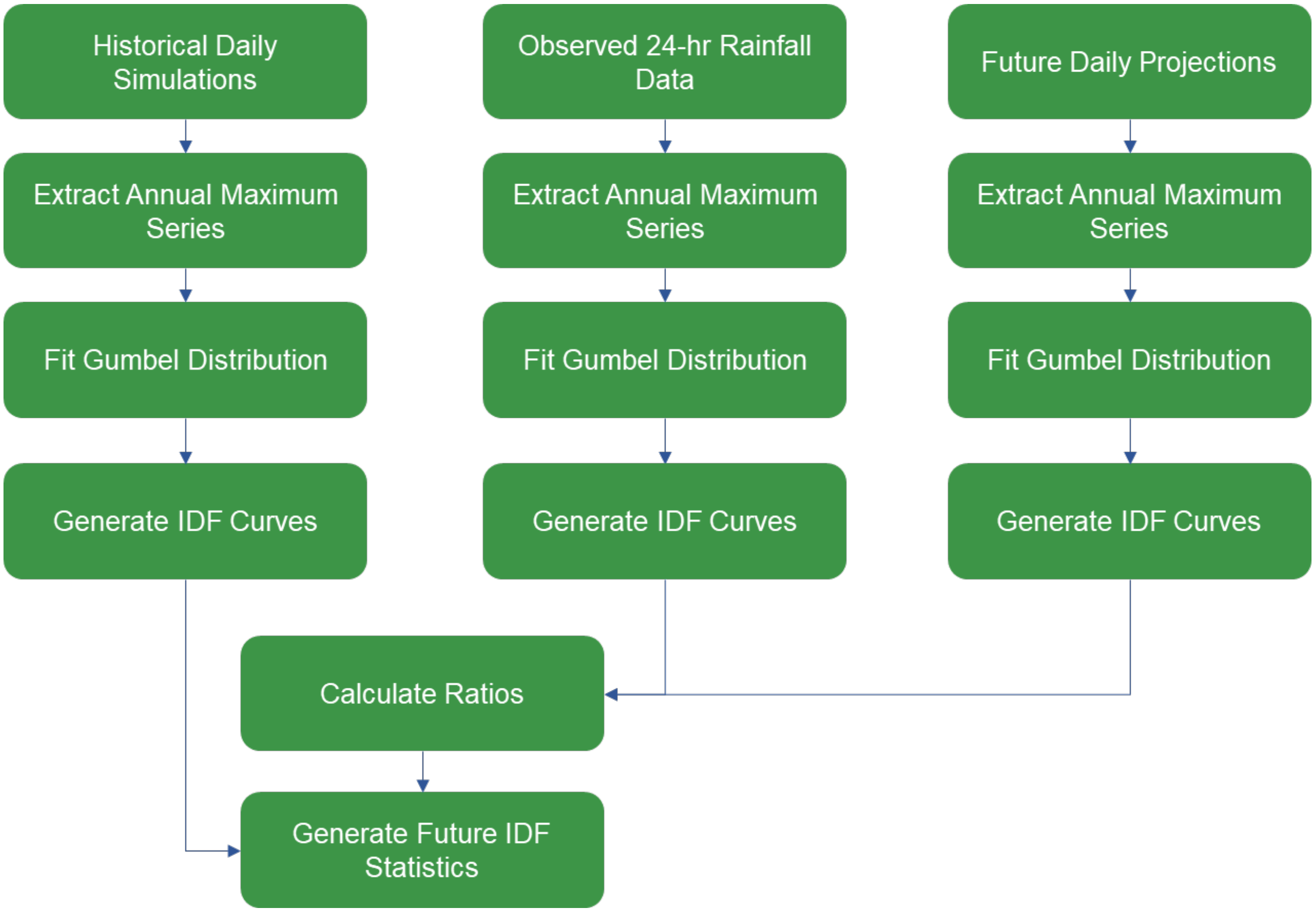
Using both methods allows for a better estimate of uncertainty in the projected future IDF statistics.

Figure 22A-1-1: Flow Chart of Equidistance Quantile Matching Method



IDF = intensity-duration-frequency.

Figure 22A-1-2: Flow Chart of Intensity-Duration-Frequency



IDF = intensity-duration-frequency.

22A-1-1.2.4.1 Daily Precipitation

Consistent with all future projections, the ensemble approach was used. A one-day rainfall amount for return periods of 2, 5, 10, 50, 100, 200, 500, 1,000, and 2,000 years in the future periods at different probability exceedance levels are presented. The methods described in Section 22A-1-1.2.4, Projecting Future Rainfall Statistics, were used to generate future one-day IDF statistics for the specified return period.

22A-1-1.2.4.2 Multi-day Precipitation

Consistent with all future projections, the ensemble approach was used. Consecutive rainfall amounts of 1, 2, 3, 4, 5, 10, 20, 30, 50, 75, 90, and 120 days is presented for return periods of 2, 5, 10, 50, 100, 200, 500, 1,000, and 2,000 years in the future periods at different probability exceedance levels. The methods described in Section 22A-1-1.1.5.2, Multi-Day Precipitation, were used to first create the multi-day annual maximum precipitation series for which the methods described in Section 22A-1-1.2.4, were applied to generate future multi-day IDF statistics.

22A-1-1.2.5 Projecting Future Potential Evapotranspiration

The methods described in Section 22A-1-1.1.6, Quantifying Current Potential Evapotranspiration, for the current climate potential evapotranspiration were applied to the daily future climate dataset. The daily evapotranspiration results using both methods were calculated for all of the 72 ensemble members for the modelled baseline period (1981 to 2019) and future modelled periods (2050s and 2080s) using the maximum and minimum daily future climate temperature dataset. The projected percentage change is calculated as the difference between the future modelled period and modelled baseline period. The 50% exceedance probability (or median) of the projected percentage changes is taken and presented from the ensemble.

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Appendix 22B Climate-Infrastructure Interactions

Abbreviations and Units of Measure

Abbreviation	Definition
NexGen	NexGen Energy Ltd.
Project	Rook I Project

Unit	Definition
%	percent
°C	degrees Celsius
mm	millimetre

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22B1 Introduction

An assessment of climate-infrastructure interactions was completed for the Rook I Project (Project), a new uranium mining and milling operation project located adjacent to Patterson Lake in the southern Athabasca Basin in northern Saskatchewan. Climate-infrastructure interactions include any potential interaction of a climate event (e.g., extreme precipitation, extreme temperatures, high winds, lightning, storms, and changes in snowfall) with a given infrastructure component or Project activities. The presented climate-infrastructure interactions are based on the detailed climate dataset developed for NexGen that describes the current and projected changes in mean temperature and precipitation, along with background information on changes in the extreme weather events.

The assessment includes a high-level risk assessment of how current and projected climate might affect the Project infrastructure (climate-infrastructure interactions) and Project activities (climate interactions by Project activity) during different stages of the Project lifespan.

To complete this assessment, Section 22B is organized as follows:

- Section 22B2, Summary of Detailed Climate Dataset, provides a summary of the current and future climate projections for the mid-term and long-term. These climate change projections have been used in identifying the climate risks for Project infrastructure and Project activities during different stages of the Project lifespan.
- Section 22B3, Climate-Infrastructure Interactions, provides a summary of the interactions of potential climate events with the Project infrastructure, which is composed of a range of surface and underground infrastructure. These interactions are based on the Detailed Climate Dataset and does not consider any mitigation measures that are in place for the Project. Based on the resilient Project infrastructure design, some interactions that would be unlikely are eliminated from further assessment. All other interactions are considered for further assessment of vulnerabilities in Section 22B3.
- Section 22B4, Climate Vulnerabilities by Project Activity, identifies the climate vulnerabilities of planned Project activities during the Project phases, including the Construction, Operations, and Decommissioning and Reclamation (i.e., Closure). The vulnerabilities expand on the climate-infrastructure interactions considered in Section 22B3 by considering how the Project activities associated with the pieces of infrastructure may be vulnerable to climate. A range of potential mitigation measures to help reduce identified vulnerabilities is also provided. The identification of vulnerabilities and mitigation measures is the first stage of climate change risk ranking process. The identified vulnerabilities and mitigation measures from Section 22B4 have been used for the climate change risk ranking in EIS Section 22, Assessment of Effects of the Environment on the Project.
- Section 22B5, Summary of Climate Interactions, provides a summary of climate-infrastructure interactions listed in Section 22B3, and summarizes climate vulnerabilities based on the Project activity listed in Section 22B4. As a part of the continual improvement process, these interactions and risks can be managed at different Project phases by implementing the monitoring and surveillance activities that have been outlined in Technical Support Document (TSD) XXII, Climate Adaptation Framework.

22B2 Summary of Detailed Climate Dataset

To support the ongoing climate strategy development and ongoing climate risk assessments, available climate model datasets were used to describe the current and future climate conditions. The dataset provides a description of the current climate conditions using the most representative local observation data and a description of the future climatic conditions using publicly available climate projections in terms of percentiles across an ensemble. The climate change projections methodology and findings are provided in Appendix 22A, Climate Change Dataset Summary Report. The Appendix identifies the potential climatic changes that can be incorporated in hydrological modelling, Project design, and sensitivity analysis. The report summarizes regional data related to the current and projected climate change scenarios. The report focuses on mean temperature and precipitation, along with information on extreme weather events. Understanding the current climate and the future climate trends is important when evaluating the Project design parameters.

For the 39-year current climate baseline period (1981 to 2019), the mean annual temperature is about -1.5°C and mean annual rainfall is about 562.9 mm at the Project location. During the current climate baseline period, the annual and monthly mean temperatures have slightly fluctuated, with increasing and decreasing trends, that are not statistically significant. The annual and monthly minimum temperatures have shown an increasing trend, that is not statistically significant, and has influenced some of the World Meteorological Organization indices. Statistically significant increasing trends were observed for the total annual and monthly precipitation for January, March, November, and December. The current climate extreme indices are consistent with the current climate trends, showing warming minimum temperature trends and likely wetter conditions.

From the 2050s and 2080s median values, the projected future climate extremes are indicating a warmer and wetter climate on an annual basis. Temperature is projected to increase, which may result in warm nights and reduced ice and frost days. Precipitation is also projected to increase, which may result in increased annual total wet-day precipitation, very wet, and extremely wet days. For example, the 100-year, 1 day rainfall events are projected to increase by 2% over the baseline period by the 2050s and 14% by the 2080s at the 50th percentile.

22B3 Climate-Infrastructure Interactions

The Project surface and underground infrastructure mostly includes the process plant, the mine, and supporting infrastructure.

The climate-infrastructure interactions include changes in climate variables (e.g., temperature, precipitation, extreme events) that may potentially interact with different components of the surface and underground infrastructure of the Project.

The climate-infrastructure interactions for surface infrastructure are summarized in Table 22B-1 and the climate-infrastructure interactions for underground infrastructure are summarized in Table 22B-2. The interactions with a blue checkmark identify vulnerabilities for climate conditions based on the type of infrastructure design. These interactions have been considered for identification of vulnerabilities and require implementation of environmental design features and mitigation to eliminate or reduce potential effects on the Project. The interactions with a green checkmark are unlikely to impact the infrastructure based on the type of infrastructure design.

Table 22B-1: Climate-Infrastructure Interactions for Surface Infrastructure

Infrastructure Components	Climate Event								Climate-Infrastructure Interactions
	Temperature			Precipitation		Extreme Events			
	Extreme Heat	Extended Cold Spell	Freeze-Thaw Cycles	Major Precipitation Events	Severe Snowstorms	Droughts	High Winds[a]	Wildfire	
Buildings									
Process plant building, SX building, effluent treatment building, acid plant building, drum storage building, domestic waste incinerator building	✓	✓	✓	✓	✓	n/c	✓	✓	Extreme temperature changes, including extreme heat and extended cold spells, may overwhelm the capacity of the HVAC systems of the buildings needed to support the facility demands, causing thermal discomfort and unsuitable working conditions. Increased temperatures and extreme heat could cause degradation of buildings and insulation, which would reduce the life expectancy of the buildings. The freeze-thaw cycles may interact with the building structures and insulation causing freeze weathering. Likelihood of interaction of freeze-thaw cycles would be low as the buildings have a completely enclosed steel structure. Increasing extreme precipitation and heavy snowfall events may result in structural damage of buildings because of corrosion. Likelihood of interaction of heavy precipitation and snowfall would be low on these buildings as they have completely enclosed steel structures with ridged sloping roofs. Increased precipitation and snowmelt may cause flooding in the building areas. Buildings may be vulnerable to extreme weather events, including high winds and tornadoes, that may cause structural damage to the roofs. Likelihood of interaction of storms would be low on these buildings as they have completely enclosed steel structures with ridged sloping roofs. Buildings might be vulnerable to the effects impact of wildfires. Wildfires could cause temporary suspension of activities because of danger to worker safety, discomfort, and unhealthy working conditions due to smoke inhalation. Severe thunderstorms could cause structural damage to the buildings and impact worker safety.
SAG mill feed conveyor building, surface explosives magazine, maintenance and warehouse building, wash bay building, administration building, analytical and metallurgical laboratory, mine dry valve houses	✓	✓	✓	✓	✓	✓	✓	✓	Extreme temperature changes, including extreme heat and extended cold spells, may overwhelm the capacity of the HVAC systems of the buildings needed to support the facility demands, causing thermal discomfort. Increased temperatures and extreme heat could cause degradation of buildings and insulation, which would reduce the life expectancy of the buildings. The freeze-thaw cycles may interact with the building structures and insulation causing freeze weathering. Increasing freeze-thaw cycles may cause physical damage to the roofs, decreasing their life expectancy. Increasing extreme precipitation events including high intensity rainfall and associated storm events may result in structural damage of buildings including roofs, windows, and other exterior elements. Increased precipitation and snow melt may lead to water retention on roofs and cause potential run-off into walls. Increased precipitation may cause flooding in the building areas. Heavy snowfall events could cause structural damage to the buildings. Drought-like conditions could cause inadequate water availability that is required to meet the demands for cooling, crushing, grinding, and milling. Buildings may be vulnerable to extreme weather events, including high winds, tornadoes, and increased snow loads, that may cause structural damage to the foundations and roofs. Increased wind-speeds may likely put additional load on building structures including roofs and windows. High winds, along with cold spells, may cause air leakage through windows, causing heating problems. Buildings may be vulnerable to the effects of wildfires. Wildfires could cause temporary suspension of activities because of danger to worker safety, discomfort, and unhealthy working conditions due to smoke inhalation. Severe thunderstorms could cause structural damage to the buildings and impact worker safety.
Surface Drainage Infrastructure									
Site runoff pond 1	n/c	n/c	n/c	✓	✓	n/c	n/c	✓	Site runoff pond 1 may be affected by heavy precipitation causing overflow. Changes to the flow of water through the Project site as a result of changes in snowfall may damage water management infrastructure and containment structures. Infrastructure may be vulnerable to the effects of wildfires.
Site runoff pond 2	n/c	n/c	n/c	✓	✓	n/c	n/c	✓	Site runoff pond 2 may be affected by heavy precipitation causing overflow. Changes to the flow of water through the Project site as a result of changes in snowfall may damage water management infrastructure and containment structures. Infrastructure may be vulnerable to the effects of wildfires.
Ditching and swales	n/c	n/c	n/c	✓	✓	n/c	n/c	✓	Heavy precipitation events may affect ditches and swales causing overflow and structural damage. Changes to the flow of water through the Project site as a result of changes in snowfall may damage water management infrastructure and containment structures. Infrastructure may be vulnerable to the effects of wildfires.
West bermed runoff collection area	n/c	n/c	n/c	✓	✓	n/c	n/c	✓	West bermed runoff collection area may be affected by heavy precipitation causing overflow. Changes to the flow of water through the Project site as a result of changes in snowfall may damage water management infrastructure and containment structures. Infrastructure may be vulnerable to the effects of wildfires.
Site Access									
Off-Site roads	✓	✓	✓	✓	n/c	n/c	✓	✓	Roads may be vulnerable to the effects of extreme heat as it might cause pavement softening. Extreme cold and freeze thaw cycles may affect the roads causing cracks or potholes due to temperature fluctuations. Increased precipitation could cause road washouts, that might limit access to the Project site. Heavy snowfall events could restrict road access to the site. Extreme weather events including high winds and storms may lead to accumulation of debris on the roads, affecting access to the facility. Forest fires may affect site access using roads.

Table 22B-1: Climate-Infrastructure Interactions for Surface Infrastructure

Infrastructure Components	Climate Event								Climate-Infrastructure Interactions
	Temperature			Precipitation		Extreme Events			
	Extreme Heat	Extended Cold Spell	Freeze-Thaw Cycles	Major Precipitation Events	Severe Snowstorms	Droughts	High Winds[a]	Wildfire	
On-site roads	✔	✔	✔	✔	✔	n/c	✔	✔	Roads may be vulnerable to the effects of extreme heat as it might cause pavement softening. Extreme cold and freeze thaw cycles may affect the roads causing cracks or potholes due to temperature fluctuations. Increasing extreme precipitation events including high intensity rainfalls and storms may cause flooding on the roads, limiting the access to the site. Severe snowstorms could affect vehicle operation at the site because of reduced traction and visibility and could increase the probability of vehicle accidents. Extreme weather events including high winds and storms may lead to accumulation of debris on the roads, affecting access to the facility. Road access to and from the site could become limited or restricted due to debris from wildfires.
Airstrip and apron	✔	✔	✔	✔	n/c	n/c	✔	✔	Airstrips and apron may be vulnerable to the effects of extreme heat as it might cause pavement softening. Extreme cold and freeze thaw cycles may have an affect on airstrips and apron causing cracks or potholes due to temperature fluctuations. Increasing extreme precipitation events including high intensity rainfalls and storms may cause flooding on the airstrip and apron, limiting the access to the site. Heavy snowfall events could impact the airstrip and restrict access to the site. Wildfires might cause debris on the airstrip. However, likelihood of interaction of storms on the airstrip would be low because of the clearing of all vegetation, bushes, and trees that are within the 100 m limit. Extreme weather events including high winds and storms may lead to accumulation of debris on the airstrip and apron, affecting access to the facility. Wildfires might cause debris on the airstrip. However, likelihood of interaction of wildfires on the airstrip would be low because of the clearing of all vegetation, bushes, and trees that are within the 100 m limit.
Site Support Infrastructure									
LNG power plant and facilities	✔	✔	✔	n/c	n/c	n/c	✔	✔	Extreme heat and cold may increase the demand of the energy system overwhelming the capacity of the power plant. Extreme cold and freeze-thaw cycles may cause physical damage to the power plant causing loss of on-site heat and electricity. LNG power plant and facilities may be vulnerable to extreme weather events including high winds, tornadoes, and wildfires that may cause structural damage to the systems.
Ventilation fans	✔	n/c	n/c	n/c	n/c	n/c	✔	✔	Extreme heat may increase dust generation and affect dust mitigation activities. Extreme heat may affect water availability and cause on-site water imbalance. Reduction in water may affect dust mitigation activities. Extreme heat may reduce the efficiency of the ventilation systems due to higher temperatures. Ventilation fans may be vulnerable to extreme weather events, including high winds, tornadoes, and wildfires that may cause structural damage to the systems. Increased winds may increase the dust generation activities and affect the efficiency of ventilation fans.
Ore and Waste Storage Areas									
Ore storage stockpile	n/c	n/c	✔	✔	n/c	n/c	n/c	n/c	Freeze-thaw cycles may cause physical weathering causing cracks or exposure of new surfaces. Extreme precipitation may cause failure of slope stability.
Special waste rock stockpile	n/c	n/c	✔	✔	n/c	n/c	n/c	n/c	Freeze-thaw cycles may cause physical weathering causing cracks or exposure of new surfaces. Extreme precipitation may cause failure of slope stability.
PAG WRSA	✔	n/c	✔	✔	n/c	✔	n/c	n/c	Extreme heat may accelerate the weathering of acid-generating waste rock and cause earlier onset and increased volume of acidic drainage. Extreme heat may influence the effectiveness of closure strategies for mine waste (e.g., performance of cover systems). Freeze-thaw cycles may cause physical weathering causing cracks or exposure of new surfaces. Extreme precipitation may accelerate the weathering of acid-generating waste rock and cause earlier onset and increased volume of acidic drainage. Extreme precipitation may cause failure of slope stability. Extreme precipitation events could also cause erosion of the engineered cover system on the PAG WRSA. Drought conditions may reduce the effectiveness of engineered cover for the PAG WRSA. Severe thunderstorms could cause soil erosion on the engineered cover system for the PAG WRSA following Closure, leading to water infiltration into the waste.
NPAG WRSA	n/c	n/c	✔	✔	n/c	n/c	n/c	n/c	Freeze-thaw cycles may cause physical weathering causing cracks or exposure of new surfaces. Extreme precipitation may cause failure of localized slope stability.
Ancillary Facilities									
Batch plant and aggregate stockpiles	n/c	n/c	n/c	n/c	n/c	n/c	✔	n/c	Increased winds and storms can result in deposition of dust from the aggregate stockpiles on surface waterbodies in the region.
Communication tower	n/c	n/c	n/c	✔	n/c	n/c	✔	n/c	Increasing extreme precipitation events including high intensity rainfall and associated storm events may result in structural damage of communication towers. Increasing weather events including winds, hailstorms, tornadoes, lightning may result in structural damage of communication towers.

Table 22B-1: Climate-Infrastructure Interactions for Surface Infrastructure

Infrastructure Components	Climate Event								Climate-Infrastructure Interactions
	Temperature			Precipitation		Extreme Events			
	Extreme Heat	Extended Cold Spell	Freeze-Thaw Cycles	Major Precipitation Events	Severe Snowstorms	Droughts	High Winds[a]	Wildfire	
Gatehouse	✓	✓	✓	✓	✓	n/c	✓	✓	Extreme temperatures changes, including extreme heat and extended cold spells may overwhelm the capacity of the HVAC systems of the gatehouse needed to support the facility demands, causing thermal discomfort. The freeze-thaw cycles may interact with the building structure and insulation causing freeze weathering. Increasing freeze-thaw cycles may cause physical damage to the roofs, decreasing their life expectancy. Increasing extreme precipitation events, including high intensity rainfall and associated storm events, may result in structural damage of the gatehouse including roofs, windows, and other exterior elements. Increased precipitation and snow melt may lead to water retention on the roof and can cause potential run-off into the walls. Increased precipitation may cause flooding in the building areas. The gatehouse may be vulnerable to extreme weather events including high winds, tornadoes, and increased snow loads that may cause structural damage to the foundation and roofs. Increased wind-speeds can likely put additional load on the building structure including roofs and windows. High winds along with cold spells, may cause air leakage through windows, causing heating problems. The gatehouse may be vulnerable to the effects of wildfires.
Conventional waste management area	✓	n/c	n/c	✓	✓	n/c	n/c	✓	Extreme heat and drought-like conditions may influence the effectiveness of mine waste management strategies (e.g., need to maintain saturated conditions to prevent acidic drainage), which may in turn affect water management and treatment needs. Extreme precipitation and increasing snowmelt may affect hydrology and soil moisture, which may affect the ability of waste containment structures to prevent contamination of surrounding land and groundwater. Conventional waste management area may be vulnerable to the effects of wildfires.
Sewage treatment facilities	✓	✓	✓	✓	n/c	n/c	n/c	✓	Extreme heat and increasing temperatures may affect the sewage treatment facilities by affecting the water availability and water quality, causing odour issues. Increasing cold spells may cause water main breaks causing treatment challenges. Increasing freeze-thaw cycles may cause physical damage to the pipes and sewage treatment facility's infrastructure. Increased precipitation may cause increased load on the sewage treatment facilities, may lead to increased probability of sewer flooding, overflow, and spills. Sewage treatment facilities may be vulnerable to the effects of wildfires.

a) For example: winds, hailstorms, tornadoes, lightning, droughts.
Blue checkmarks are likely interactions and have identified vulnerabilities for climate conditions based on the type of infrastructure design.
Green checkmarks are unlikely interactions and have unlikely impact of climate hazard on the infrastructure based on the type of infrastructure design.
n/c = no climate-infrastructure interaction; PAG WRSA= potentially acid generating waste rock stockpile; NPAG WRSA = non-potentially acid generating waste rock stockpile; HVAC = heating, ventilation, and air conditioning; LNG = liquified natural gas; SAG = semi-autogenous grinding; SX = solvent extractor.

Table 22B-2: Climate-Infrastructure Interactions for Underground Infrastructure

Infrastructure Components	Potential Climate Hazards								Climate-Infrastructure Interactions
	Temperature			Precipitation		Extreme Events			
	Extreme Heat	Extended Cold Spell	Freeze-Thaw Cycles	Major Precipitation Events	Severe Snowstorms	Droughts	High Winds [a]	Wildfire	
Refuge stations and sanitary systems	✔	✔	✔	n/c	n/c	n/c	n/c	n/c	Extreme heat may lead to operational shutdowns due to higher underground temperatures and will increase energy demand to cool underground refuge stations. Freeze-thaw events may interact with underground refuge stations and sanitary systems. However, refuge stations and sanitary systems will be located well below the depth of the freeze-thaw effects for a meaningful interaction.
Rock breaker facilities	n/c	n/c	✔	n/c	n/c	n/c	n/c	n/c	Freeze-thaw events may interact with underground rock breaker facilities. However, rock breaker facilities will be located well below the depth of the freeze-thaw effects for a meaningful interaction.
Vibratory feeders and conveyor	n/c	n/c	✔	n/c	n/c	n/c	n/c	n/c	Freeze-thaw events may interact with underground vibratory feeders and conveyor. However, vibratory feeders and conveyor will be located well below the depth of the freeze-thaw effects for a meaningful interaction.
Mine dewatering system	n/c	n/c	✔	✔	n/c	n/c	n/c	n/c	Freeze-thaw events may interact with mine dewatering system. However, the mine dewatering system will be located well below the depth of the freeze-thaw effects for a meaningful interaction. Increased precipitation may cause wall movement and pit wall failure related to the dewatering of the pit. Increased precipitation may increase energy requirements for increased dewatering and water movement (pumping) activities.
Maintenance facilities	✔	n/c	✔	n/c	n/c	n/c	n/c	n/c	Extreme heat may lead to operational shutdowns due to higher underground temperatures and will increase energy demand to cool underground maintenance facilities. Freeze-thaw events may interact with the maintenance facilities. However, the facilities will be located well below the depth of the freeze-thaw effects for a meaningful interaction.
Fuel and lubricant facilities	n/c	n/c	✔	n/c	n/c	n/c	n/c	n/c	Freeze-thaw events may interact with underground fuel and lubricant facilities. However, the facilities will be located well below the depth of the freeze-thaw effects for a meaningful interaction.
Explosives and detonators storage facilities	n/c	n/c	✔	n/c	n/c	n/c	n/c		Freeze-thaw events may interact with underground explosives and detonators storage facilities. However, the facilities will be located well below the depth of the freeze-thaw effects for a meaningful interaction.
Mine services (water and compressed air)	n/c	n/c	✔	n/c	n/c	n/c		n/c	Freeze-thaw events may interact with underground mine services. However, the underground mine services will be located well below the depth of the freeze-thaw effects for a meaningful interaction.
Personnel and material movement	✔	n/c	✔	n/c	n/c	n/c	n/c	n/c	Extreme heat may lead to operational shutdowns due to higher underground temperatures. Freeze-thaw events may interact with underground personnel and material movement system, causing physical damage. However, activities will be located well below the depth of the freeze-thaw effects for a meaningful interaction. Extreme heat may lead to operational shutdowns due to higher underground temperatures.
Electrical infrastructure	n/c	n/c	✔	n/c	n/c	n/c	n/c	n/c	Higher temperatures may reduce the capacity of underground transmission lines. Freeze-thaw events may interact with underground electrical infrastructure. However, the underground electrical infrastructure will be located well below the depth of the freeze-thaw effects for a meaningful interaction.
Underground communications and automation	n/c	n/c	✔	n/c	n/c	n/c	n/c	n/c	Freeze-thaw events may interact with underground communications and automation. However, the underground communications and automation system will be located well below the depth of the freeze-thaw effects for a meaningful interaction.

a) For example: winds, hailstorms, tornadoes, lightning, droughts.
Blue checkmarks are likely interactions and have identified vulnerabilities for climate conditions based on the type of infrastructure design.
Green checkmarks are unlikely interactions and have unlikely impact of climate hazard on the infrastructure based on the type of infrastructure design.
n/c = no climate-infrastructure interaction.

22B4 Climate Vulnerabilities by Project Activity

Climate change could potentially impact Project activities, beyond the climate-infrastructure interactions discussed in Section 22B3, during Construction, Operations, and Closure. Impacts of climate change on Project activities need to be considered as they could halt the Project operations and impact the operation schedules.

The Project has estimated Construction of 4 years (2023 to mid-2026) and Operations of 24 years (mid-2026 to mid-2049) followed by Closure, which would take approximately 15 years. Construction would take place in a short time frame, which would result in reduced potential for meaningful interactions with the climate trends outside of the normal seasonal variation experienced in the region. There would be a greater potential for meaningful interactions with the projected climate trends in both the climate mean and extreme weather events during Operations and Closure, as well as the longer-term effects that extend beyond Closure. The interactions with a blue check mark in Table 22B-1 have a likely climate-infrastructure interaction. These identified interactions could impact the Project activities. Table 22B-3 provides an overview of the identified vulnerabilities by physical work or activity associated with the Project. The vulnerabilities have been identified for climate events based on available and projected climate conditions from Appendix 22A for Construction, Operations, and Closure and the identified climate-infrastructure interactions from Section 22B3.

NexGen Energy Ltd.

Table 22B-3: Climate Vulnerabilities by Rook I Project Activity

Physical Work or Activity	Climate Event	Description of Identified Vulnerabilities	Mitigation Measures
Construction			
▪ Site preparation ▪ Mine, process plant, and additional infrastructure development ▪ Transportation of people and materials to and from the Project ▪ All activities associated with commissioning the Project up until Operations commences	All hazards	Construction takes place during a short time frame, which has a smaller potential for meaningful interactions with the climate trends outside of the normal seasonal variation experienced in the region	▪ Limiting the Project footprint to the extent practicable to minimize areas that would require reclamation ▪ The Emergency Preparedness and Response Program will include emergency prevention and response procedures for current climate extremes ▪ The Fire Protection Program will be implemented to provide the highest level of fire and life safety to all NexGen employees and facilities
Operations			
▪ Mining and processing ore ▪ Tailings management ▪ Management of waste rock, domestic waste, and hazardous materials ▪ Release of treated effluent ▪ Surface storage of clean material ▪ Site maintenance ▪ Progressive reclamation ▪ Transportation of the staff and materials to and from the Project	Temperature and humidity	The projected increase in temperatures could increase the following vulnerabilities: ▪ create unsuitable working conditions for personnel working in buildings and in underground operations ▪ cause operational shutdowns due to higher underground temperatures ▪ overwhelming the capacity of the HVAC systems ▪ increased energy demand to cool underground refuge stations and maintenance facilities causing temporary suspension of Operations ▪ freezing of pipes and equipment that may affect on-site management of water, treated sewage, and tailings ▪ degradation of buildings and insulation, reducing the life expectancy of the buildings that could cause temporary suspension of Operations ▪ structural damage to roads and airstrips due to temperature changes, causing loss of access to the site and affecting transportation of materials and staff ▪ accelerate the weathering of acid-generating waste rock and cause earlier onset and increased volume of acidic drainage	▪ Mechanical equipment would be inspected for damage after extreme temperature days ▪ Routine inspection and maintenance would be conducted for access roads and the airstrip, and repairs would be completed as necessary ▪ Inspect infrastructure for potential damage after major freeze/thaw events in the spring ▪ Awareness of the risks of thaws and sudden freezes would be incorporated into occupational health and safety management planning to promote worker safety and effective Project operations ▪ All piping will be designed and installed to standards that are designed for regional weather. Pipes will be buried at depths below the frost line or insulated and heat traced if above ground ▪ The power plant would be designed for the site-specific climate and load requirements of all seasons, including peak loads during winter months ▪ Following Construction, the waste rock storage areas landforms and cover systems would be inspected and maintained on a regular basis, and the cover systems would be repaired and revegetated after closure if freeze-thaw cycles are found to be causing any damage or failure
	Forest fire	The projected increase in wildfires could increase the following vulnerabilities: ▪ temporary suspension of activities because of danger to worker safety, discomfort, and unhealthy working conditions due to smoke inhalation ▪ loss of access to the Project site, affecting transportation of materials and staff ▪ contact with fuel storage tanks and the surface explosives magazine that could cause temporary suspension of Operations ▪ structural damage to the Project infrastructure; that could cause temporary suspension of Operations ▪ loss of reclaimed areas created during progressive reclamation	The identified risks due to wildfires would be reduced through: ▪ Process facility structures would be constructed primarily of concrete and steel, which are less susceptible to fire ▪ Fire separation distances between yard hydrants would be spaced a maximum of 90 m apart to provide proper building coverage and accessibility by fire truck ▪ The camp has been designed with a perimeter roadway to allow the on-site fire truck access to all areas. This roadway would be located far enough from the camp to not hinder evacuation of users from the building ▪ Firebreaks would be considered around the Project, in consultation with Saskatchewan Wildfire Management ▪ The design of infrastructure would incorporate fire protection services as required by applicable codes and federal/provincial legislation ▪ Facilities would include the required fire protection services (e.g., manual break glass stations, thermal detectors, manual pull stations, smoke detectors, and carbon monoxide detectors), as appropriate ▪ A fire protection system, consisting of lake intake, fresh water pumps, break tanks, and three fire protection pumps strategically spaced around the Project site would be on site to provide water for firefighting purposes. The fire protection system would meet the fire water demand for firefighting purposes for a duration of two hours as per the National Fire Protection Agency requirements (NFPA 122, Clause 13.7.2) ▪ Fuel bays would ventilate directly to an exhaust airway to minimize impact to Operations in the event of a fire at site ▪ Roll-up fire doors would be installed at the entrances to some structures to facilitate fire containment. Key buildings would also have fire-suppression sprinklers ▪ Back-up generators would be available to run power to critical systems in the event that power supply from the primary power plant is interrupted

Table 22B-3: Climate Vulnerabilities by Rook I Project Activity

Physical Work or Activity	Climate Event	Description of Identified Vulnerabilities	Mitigation Measures
▪ Mining and processing ore ▪ Tailings management ▪ Management of waste rock, domestic waste, and hazardous materials ▪ Release of treated effluent ▪ Surface storage of clean material ▪ Site maintenance ▪ Progressive reclamation ▪ Transportation of the staff and materials to and from the Project	Drought	Projected increase in extreme heat and drought-like conditions could increase the following vulnerabilities: ▪ inadequate water availability required to meet the demands for processing (e.g., crushing, grinding, milling) and waste management (e.g., tailings storage), impacting Operations ▪ adequate water availability in reclaimed areas is a key component to successful reclamation, and drought conditions could affect the successful establishment of vegetation used in reclamation of the site ▪ unsuccessful revegetation activities could result in a delay in reclamation activities, additional costs adjusting or repeating revegetation, and potential for erosion during the period while the revegetation is unsuccessful	The identified risks due to droughts would be reduced through: ▪ Water supply needed for all phases of the Project would be sourced from Patterson Lake ▪ Process water would be recycled as much as possible to minimize the requirements for fresh water ▪ Water management planning used a risk-based approach that considered both routine and non-routine Project conditions and would be periodically re-evaluated throughout the Project lifespan to optimize water usage ▪ There would be an increase of water being returned to Patterson Lake from dewatering the underground mine, with more water being released than taken due to groundwater recovered from underground ▪ Limiting the Project footprint to the extent practicable to minimize areas that would require reclamation ▪ Where practical and applicable, progressive reclamation and revegetation would be implemented for disturbed areas no longer required ▪ Native, drought-resistant vegetation species would be used for reclamation ▪ A Preliminary Decommissioning and Reclamation Plan will be developed that will be adaptive to changing site-specific conditions ▪ Monitoring of reclaimed areas would be adaptive to allow for modifications in response to changes in site-specific conditions
▪ Mining and processing ore ▪ Tailings management ▪ Management of waste rock, domestic waste, and hazardous materials ▪ Release of treated effluent ▪ Surface storage of clean material ▪ Site maintenance ▪ Progressive reclamation ▪ Transportation of the staff and materials to and from the Project	Major precipitation events	Projected increase in major precipitation events could increase the following vulnerabilities: ▪ slippery surfaces, reduced visibility and road washouts that might limit site access and impede the movement of equipment (e.g., site traffic) and activities (e.g., airport operations) ▪ flooding in area of the Project resulting in structural damage of buildings or infrastructure and temporary suspension of activities ▪ changes to the water flow that might affect water management, including site drainage, site runoff ponds and collection areas ▪ management of peak discharges of runoff from waste storage facilities, such as the ore stockpile or the PAG WRSA ▪ mine inflow event, impacting operations ▪ failure of slope stability of the PAG WRSA, NPAG WRSA, and the special waste rock and ore storage stockpiles	The identified risks due to major precipitation events would be reduced through: ▪ Site water infrastructure would be designed to maximize the diversion of non-contact surface runoff or natural site runoff water away from site-developed features ▪ Precipitation and snow melt runoff that come into contact with potentially contaminated areas would be captured, collected, and directed to site runoff ponds or collection areas ▪ All ponds and collection areas for contact water that may be mineralized or radiologically contaminated would be designed to accommodate a PMP 24-hour event ▪ The ponds and collection areas (e.g., special waste rock stockpile, PAG WRSA) would be self-contained such that they would retain initial precipitation events in associated ponds ▪ The settling and monitoring ponds would be self-contained with respect to precipitation events. The ponds would be designed to retain a PMP 24-hour precipitation event, in addition to the anticipated water volumes generated under routine and non-operating conditions ▪ Ditches and culverts that convey runoff would be sized to accommodate anticipated precipitation events ▪ Diversion ditches and perimeter berms would be designed to divert clean non-contact water away from any disturbed areas or facilities where that water may become contaminated ▪ Swales would be constructed on surface-graded pads where ditches are not possible, and where the initial anticipated contributing precipitation would not warrant a full ditch ▪ The special waste rock and ore stockpiles would be contained by perimeter berms to confirm the PMP event is retained ▪ Mine workings would be isolated from high-permeability strata with a hydrostatic liner ▪ The PAG and NPAG WRSAs would be constructed at the Closure WRSA landform slope angle reducing the risk of slope stability failure ▪ Progressive reclamation of the WRSA slopes would occur when possible, during Operations, and runoff generated on the NPAG and PAG landforms would be diverted from the slope toes to reduce the risk of slope stability failure ▪ To maintain channel integrity, both diversion ditches and collection ditches would be provided with erosion control measures reflective of ditch slopes and flows rates, where required ▪ Routine inspection and maintenance of containment and conveyance structures (i.e., roadside ditches and culverts) would be conducted to limit the risk of road washout

Table 22B-3: Climate Vulnerabilities by Rook I Project Activity

Physical Work or Activity	Climate Event	Description of Identified Vulnerabilities	Mitigation Measures
▪ Mining and processing ore ▪ Tailings management ▪ Management of waste rock, domestic waste, and hazardous materials ▪ Release of treated effluent ▪ Surface storage of clean material ▪ Site maintenance ▪ Progressive reclamation ▪ Transportation of the staff and materials to and from the Project	Severe snowstorms	Projected increase in heavy snowfall events could increase the following vulnerabilities: ▪ structural damage to buildings and infrastructure; causing suspension of activities ▪ vehicle operation at the site because of reduced traction and visibility and could increase the probability of vehicle accidents ▪ impede the movement of equipment and activities ▪ restrict access to the site affecting transportation of materials and staff	The identified risks due to heavy snowfall would be reduced through: ▪ Weather uncertainties have been accounted for, and risks associated with severe snowstorms and snow loadings to facilities are managed through design criteria for the Project ▪ Building structures have been designed according to the relevant requirements regarding withstanding large accumulations of snow, such as Part 4 of the NBCC (NRCC 2020) ▪ Site drainage would be designed to safely divert or collect water under 1:100-year flood or PMP events as appropriate to the facility ▪ Aircraft landings and takeoffs would be restricted during periods of low visibility or excessive snow accumulation per Canadian Aviation Regulations and Standards ▪ The Emergency Preparedness and Response Program would include emergency prevention and response procedures for heavy snowfall events ▪ Safety procedures would be in place to address worker safety, and would include reducing traffic speeds, addressing road conditions (e.g., snow removal, sanding) as quickly as possible, and if necessary, issuing work-stop orders
	Severe thunderstorms	Projected increase in high wind events could increase the following vulnerabilities: ▪ structural damage and/or failure of infrastructure, and worker safety due to a tornado ▪ structural damage and/or failure of infrastructure, and worker safety due to a severe thunderstorm, including lightning ▪ disruption to energy transmission pathways, affecting Operations	The identified risks due to high winds would be reduced through: ▪ The risks associated with severe winds or tornadoes are managed through design criteria and management practices. Facilities would be designed according to the appropriate codes, such as the NBCC (NRCC 2020) ▪ Safety procedures would be in place to address worker safety and, if necessary, work-stop orders would be issued ▪ The Emergency Preparedness and Response Program will also include emergency prevention and response procedures for tornadoes and thunderstorms
Closure			
▪ Backfilling mine workings ▪ Removal of physical infrastructure ▪ Recontouring and revegetating disturbed areas ▪ Any other activities deemed necessary to achieve decommissioning objectives and return the site to a safe and stable condition prior to post-closure activities	Temperature	Projected increase in temperatures could increase the following vulnerabilities: ▪ reduced effectiveness of engineered cover for the PAG WRSA	The identified risks due to increasing temperatures would be reduced through: ▪ The NPAG WRSA and PAG WRSA cover systems would follow design and construction recommendations in guidance manuals such as MEND Report 2.21.4A *Design, construction and performance monitoring of cover systems for waste rock and tailings*
	Wildfire	Projected increase in temperatures could increase the following vulnerabilities: ▪ danger to worker safety, discomfort and unhealthy working conditions due to smoke inhalation ▪ contact with fuel storage tanks and the surface explosives magazine causing temporary suspension of activities ▪ loss of access to the site (i.e., roads and airstrip) affecting transportation of staff ▪ loss of reclaimed areas	The identified risks due to wildfires would be reduced through: ▪ Firebreaks would be designed around the Project ▪ Fire separation distances between yard hydrants would be spaced a minimum of 90 m apart to provide proper building coverage and accessibility by fire truck ▪ The camp has been designed with a perimeter roadway to allow the on-site fire truck access to all areas. This roadway would be located far enough from the camp to not hinder evacuation of users from the building ▪ All facilities would include the required fire protection services (e.g., manual break glass stations, thermal detectors, manual pull stations, smoke detectors, and carbon monoxide detectors) ▪ A fire protection system, consisting of lake intake, fresh water pumps, break tanks, and three fire protection pumps strategically spaced around the Project site would be on site to provide water for firefighting purposes. The fire protection system would meet the fire water demand for firefighting purposes for a duration of two hours as per the National Fire Protection Agency requirements (NFPA 122, Clause 13.7.2) ▪ Fuel bays would ventilate directly to an exhaust airway to minimize impact to operations in the event of a fire at site ▪ A fire plan with primary and secondary escape routes, defined muster points, and evacuation procedures would be developed in future phases to confirm all users can get out of the camp in a calm and controlled manner ▪ Back-up generators would be available to run power to critical systems in the event that power supply from the primary power plant is interrupted ▪ The mine rescue team would be trained and certified in effective structural and wildland firefighting techniques ▪ Firefighting training would be provided to on-site personnel, as deemed appropriate

Table 22B-3: Climate Vulnerabilities by Rook I Project Activity

Physical Work or Activity	Climate Event	Description of Identified Vulnerabilities	Mitigation Measures
▪ Backfilling mine workings ▪ Removal of physical infrastructure ▪ Recontouring and revegetating disturbed areas ▪ Any other activities deemed necessary to achieve decommissioning objectives and return the site to a safe and stable condition prior to post-closure activities	Drought	Projected increase in drought could increase the following vulnerabilities: ▪ Adequate water availability in reclaimed areas is a key component to successful reclamation, and drought conditions could affect the successful establishment of vegetation used in reclamation of the site ▪ Unsuccessful revegetation activities could result in a delay in reclamation activities, additional costs adjusting or repeating revegetation, and potential for erosion during the period while the revegetation is unsuccessful	The identified risks due to drought would be reduced through: ▪ Where practical and applicable, progressive reclamation and revegetation would be implemented for disturbed areas no longer required ▪ Native, drought-resistant vegetation species would be used for reclamation ▪ Monitoring of reclaimed areas would be adaptive to allow for modifications in response to changes in site-specific conditions ▪ A Preliminary Decommissioning and Reclamation Plan will be developed that will be adaptive to changing site-specific conditions
	Major precipitation events	Projected increase in major precipitation events could increase the following vulnerabilities: ▪ increased precipitation impeding the movement of equipment and activities on the Project site and limiting access to the Project site ▪ failure of slope stability of the PAG WRSA, NPAG WRSA, and the special waste rock and ore storage stockpiles ▪ erosion of the engineered cover system on the PAG WRSA	The identified risks due to major precipitation events would be reduced through: ▪ A Preliminary Decommissioning and Reclamation Plan will be developed that would be adaptive to changing site specific conditions and include monitoring of reclaimed areas ▪ The risk of erosion is reduced by the Closure landform design slope of 4:1 and establishment of vegetation on the cover system. The final waste rock storage areas landform will be designed to shed runoff using well established landform design practices
	Heavy snowfall	Projected increase in heavy snowfall events could increase the following vulnerabilities: ▪ restrict access to the site affecting transportation of staff	The identified risks due to heavy snowfall would be reduced through: ▪ The Emergency Preparedness and Response Program would include emergency prevention and response procedures for heavy snowfall events ▪ Safety procedures would be in place to address worker safety, and would include reducing traffic speeds, addressing road conditions (e.g., snow removal, sanding) as quickly as possible, and if necessary, issuing work stop orders
	Severe thunderstorms	Projected increase in high winds could increase the following vulnerabilities: ▪ soil erosion on the engineered cover system for the PAG WRSA following Closure, leading to water infiltration into the waste	The identified risks due to high winds would be reduced through: ▪ The cover systems for the NPAG and PAG WRSAs would be vegetated to reduce the potential for soil erosion from wind and water ▪ As part of the Preliminary Decommissioning and Reclamation Plan, monitoring of the engineered cover system against performance criteria will be completed. The Preliminary Decommissioning and Reclamation Plan will be adaptive to allow for modifications in response to changes in site-specific conditions

HVAC = heating, ventilation, and air conditioning; PAG WRSA = potentially acid generating; NPAG WRSA = non-potentially acid generating; PMP = probable maximum precipitation.

22B5 Summary of Climate Interactions

A range of climate change events have been identified that could impact the surface and underground Project infrastructure. Some of these climate events include extreme precipitation, extreme temperatures, high winds, lightning, storms, and changes in snowfall.

In terms of Project activities, Operations and Closure could be vulnerable to the extreme climate events. Increases in extreme climate events may result in a potential impact to the Project activities, as strong winds, heavy rainfall, and wildfires can physically affect equipment and can cause not only delays and disruptions but also a complete shutdown of operations. The Project would implement environmental design features and mitigation measures so that infrastructure would be able to withstand both typical and extreme environmental conditions, and projected climate conditions, which would reduce the identified vulnerabilities. The assessment of vulnerabilities and mitigation measures from Section 22B4 is used for the climate change risk ranking process in Environmental Impact Statement Section 22, Assessment of the Effects of the Environment on the Project.

Although the mitigation measures have the potential to reduce climate risks, the measures need to be monitored for their performance through an ongoing monitoring and surveillance process. As a part of the continual improvement process, NexGen is developing the Climate Adaptation Framework to consider climate risks, including monitoring and surveillance activities. TSD XXII, Climate Adaptation Framework, forms the basis of a plan developed to document ongoing monitoring and continual improvement related to climate change, as well as to outline the decision-making process for when action needs to be taken to improve climate resilience.

As part of monitoring and follow-up, NexGen will develop an adaptive management plan that would be updated through an ongoing process over the lifetime of the Project to create a living document. The results from the monitoring programs would be integrated into the adaptive management process to test the effectiveness of resilience and mitigation actions and manage the unexpected outcomes. The Climate Adaptation Framework would be used to support future climate risk assessments for the Project and provide operational and financial decision-making support. NexGen has committed to identify and manage the projected climate risks as a part of their continual improvement process for Operation and Closure through TSD XXII. Hence, for Operations and Closure, climate change risk will be managed through TSD XXII.

22B6 References

Literature Cited

NRCC (National Research Council of Canada). 2020. National Building Code of Canada, Volume 1. Canadian Commission on Building and Fire Codes. ISBN 978-0-660-37912-8.

Rook I Project

Environmental Impact Statement

Section 23 Summary of Mitigation, Monitoring, and Follow-Up Programs

Submitted to:
Canadian Nuclear Safety Commission
Saskatchewan Ministry of Environment

Submitted by:
NexGen Energy Ltd.
3150-1021 W Hastings St
Vancouver, BC
V6E 0C3

November 2024

Abbreviations and Units of Measure

Abbreviation	Definition
EA	Environmental Assessment
EIS	Environmental Impact Statement
ERA	environmental risk assessment
HDPE	high-density polyethylene
IMS	Integrated Management System
ISO	International Organization for Standardization
LPA	local priority area
NexGen	NexGen Energy Ltd.
NPAG	non-potentially acid generating
PAG	potentially acid generating
Project	Rook I Project
UGTMF	underground tailings management facility
VC	valued component
WRSA	waste rock storage area

Unit	Definition
%	percent
km	kilometre
m	metre

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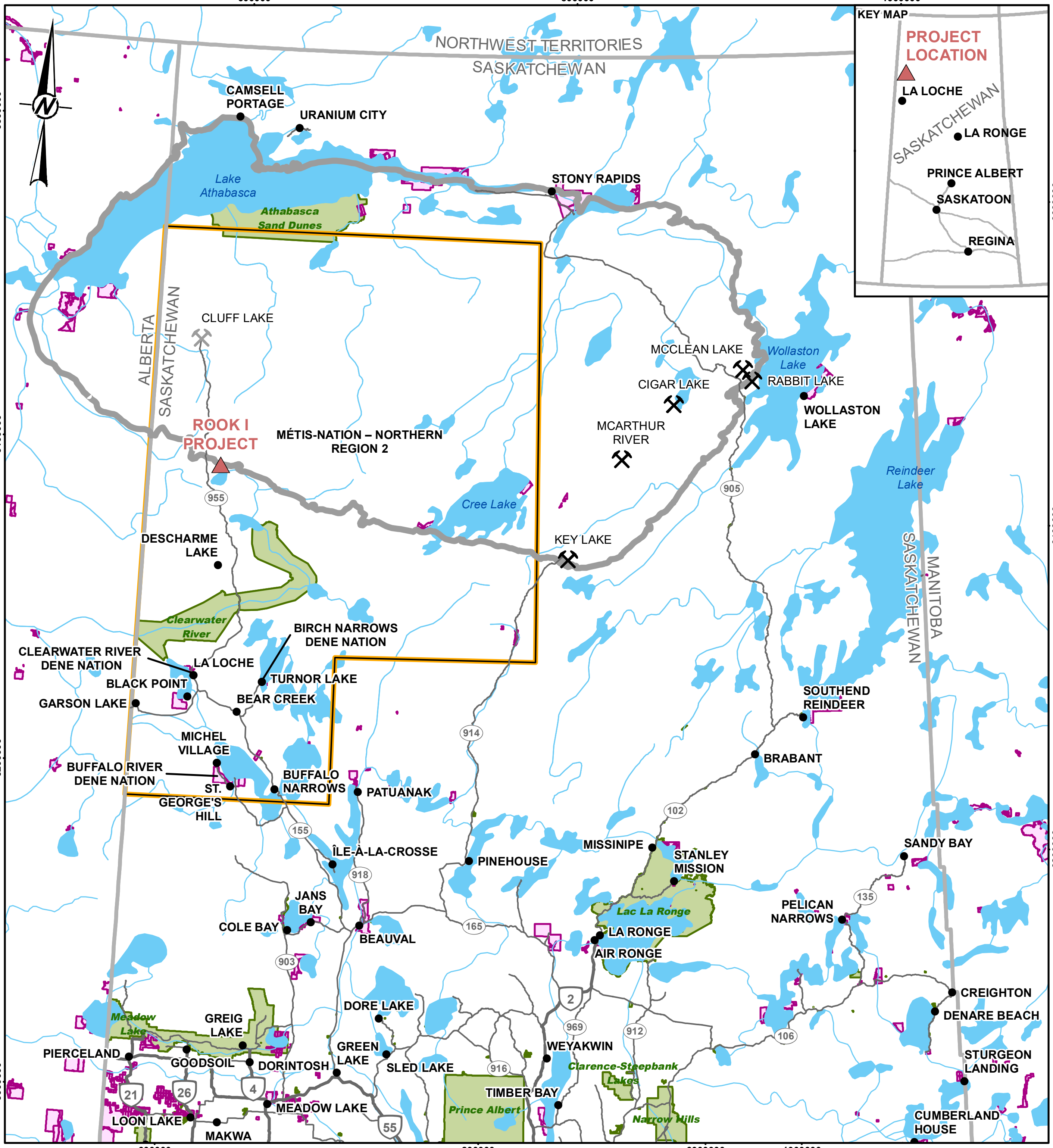
23 SUMMARY OF MITIGATION, MONITORING, AND FOLLOW-UP PROGRAMS

23.1 Introduction

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The Project would be located approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the Northern Village of La Loche, and 640 km northwest of the city of Saskatoon (Figure 23.1-1). The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Patterson Lake is at the interface of the Boreal Shield and Boreal Plain ecozones. Access to the Project would be from an existing road off Highway 955 (Figure 23.1-2), with on-site worker accommodation serviced by fly-in/fly-out access.

An Environmental Assessment (EA) has been undertaken to identify and evaluate the potential adverse effects and benefits of the Project associated with the biophysical (e.g., habitat loss), cultural (e.g., disturbance of archaeological sites), and socio-economic (e.g., employment, contract opportunities) environments. The EA regulatory process (Section 1.3, Regulatory Framework) is a tool for proponents to integrate environmental and social factors, including Indigenous Knowledge, into project planning and decision making. Additional goals of the EA process are to engage Indigenous communities, government agencies, and the public; to assess whether a project is likely to have significant adverse effects after mitigation measures are implemented; and to promote the sustainable development of natural resources. The EA process serves as a planning and consultation tool with Indigenous Peoples and the public and facilitates informed decision making by regulatory agencies regarding whether a project should be approved to proceed. The EA for the proposed Project is documented within the Environmental Impact Statement (EIS).

In the EIS, NexGen outlines the Project design features and mitigation measures that would be implemented, as well as proposed monitoring and follow-up programs so that the Project could be constructed, operated, and decommissioned and reclaimed (i.e., closed) in a manner that avoids or minimizes adverse effects on the biophysical and socio-economic environments while maximizing the benefits to local Indigenous (i.e., First Nations and Métis) Groups and communities, Saskatchewan, and Canada.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN BOUNDARY
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROJECT LOCATION
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

0 100 200
1:3,500,000 KILOMETRES

REFERENCE(S)
1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
LOCATION OF THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 23.1-1

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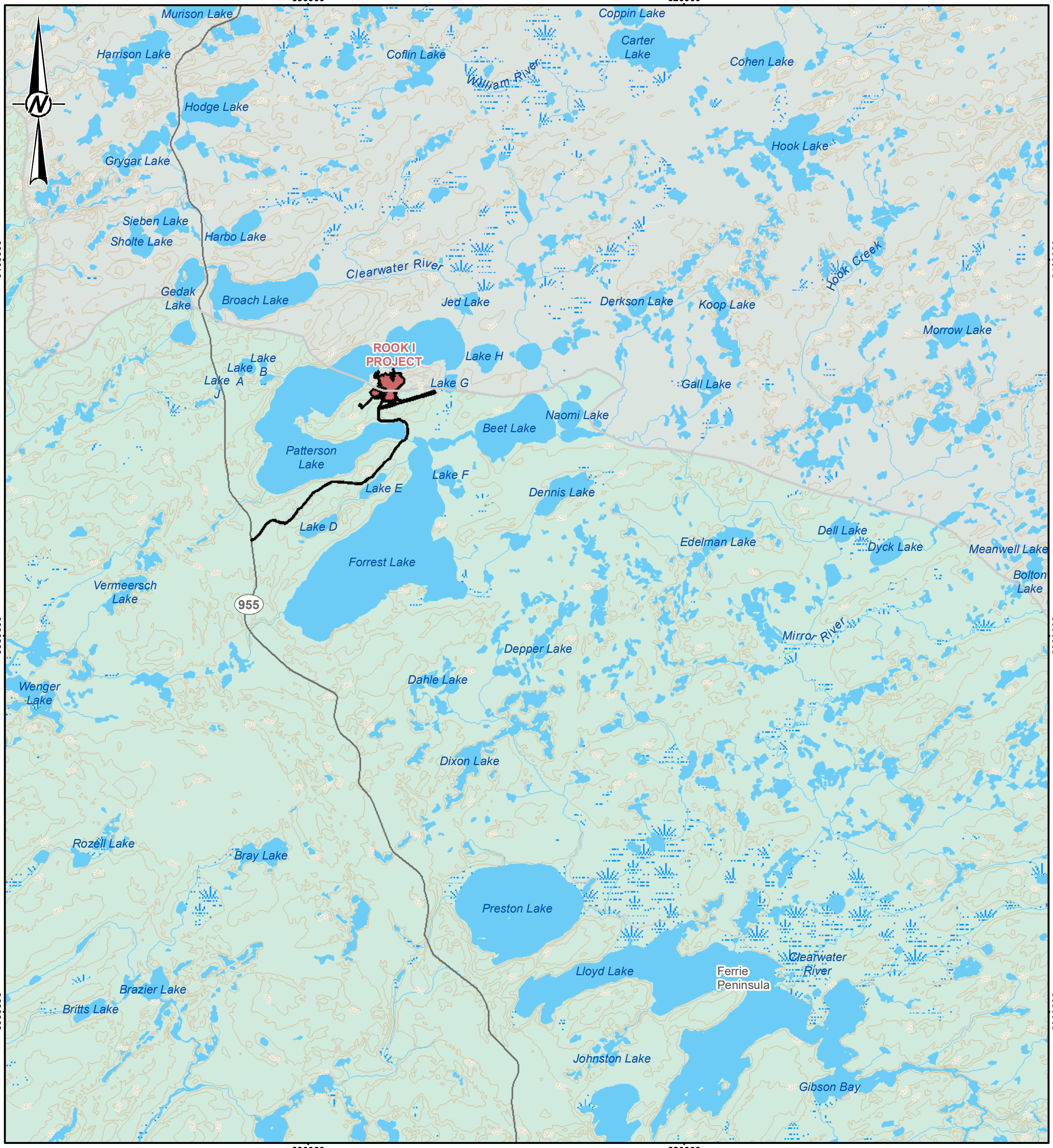

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN
- WATERBODY
- WETLAND
- WOODED AREA
- PROPOSED PROJECT FOOTPRINT

0 5 10
1:300,000 KILOMETRES

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd.
ROOK I PROJECT

TITLE
REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 23.1-2

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23.1.1 Section Purpose

The purpose of Section 23, Summary of Mitigation, Monitoring, and Follow-Up Programs of the EIS is to summarize (for ease of reference) the Project design features, mitigation measures, management programs and plans, and monitoring and follow-up programs and to provide an associated list of Project commitments proposed by NexGen. This section also outlines how mitigation was incorporated within the pathway analysis, and how monitoring and follow-up programs would verify effects predictions and mitigation effectiveness (i.e., performance), address uncertainties associated with the effects predictions, identify any unanticipated effects, and provide feedback for the implementation of adaptive management, if necessary, to further limit effects.

NexGen is committed to the continual improvement of the Project's environmental performance through its management systems, as described in Section 5.7, Integrated Management System. Important aspects of the Project's management, monitoring, and follow-up programs are identified and discussed in Section 23. Other important aspects of the management system that would be incorporated as the system is developed include engagement, communication, assignment of responsibilities, data management, auditing, review, updating, and reporting. These elements would be components of the Plan-Do-Check-Act management framework that leads to continual improvement.

23.1.2 Temporal Boundaries

Mitigation, monitoring, and follow-up programs would be implemented and maintained throughout all phases of the proposed Project. The temporal scope of the assessment focuses on the 43-year period from initial Construction to the end of Decommissioning and Reclamation (i.e., Closure) as defined by the following Project phases:

- **Construction Phase (Construction):** includes site preparation; mine, process plant, and additional infrastructure development; transportation of people and materials to and from the Project; and all activities associated with commissioning the Project up until Operations commences. The duration of Construction is expected to be four years.
- **Operations Phase (Operations):** includes all activities associated with mining and processing ore; tailings management; management of waste rock, domestic waste, and hazardous materials; water management; release of treated effluent; site maintenance; progressive reclamation; and transportation of staff and materials to and from the Project up until Decommissioning and Reclamation commences. The duration of Operations is expected to be 24 years.
- **Decommissioning and Reclamation Phase (Closure):** includes two stages expected to occur over 15 years:
  - **Active Closure Stage:** includes active decommissioning and reclamation activities that occur post-Operations, such as backfilling mine workings, removal of physical infrastructure, recontouring and revegetating disturbed areas, waste disposal and removal, and any other activities required to achieve decommissioning objectives and return the site to a safe and stable condition prior to the Transitional Monitoring Stage. The duration of the Active Closure Stage is expected to be five years.

- **Transitional Monitoring Stage:** includes monitoring and reporting activities that occur post-Active Closure that would continue until monitoring and reporting verifies that the performance criteria have been met. Once performance criteria have been fully demonstrated, an application to be released from the Canadian Nuclear Safety Commission (CNSC) licence would be submitted to the CNSC for approval. Once that is achieved, and upon Provincial approval, the land would be transferred under Provincial management through the Institutional Control Program. The duration of the Transitional Monitoring Stage is nominally 10 years; however, NexGen acknowledges this duration would be dependent on the achievement of performance criteria.

23.2 Engagement and Communication

As described throughout the EIS, NexGen has been and remains committed to providing clear, ongoing, and timely information as it relates to Project activities throughout all phases of the Project. Moving forward, the Indigenous and Public Engagement Program would provide a platform for two-way dialogue and meaningful engagement with the goal of disclosing information and maintaining relationships with local Indigenous Groups and communities, as well as other people and groups interested in the Project. The Indigenous and Public Engagement Program would build on the programs carried out to date as described in Section 2.5, Engagement Approach.

NexGen recognizes that Indigenous Groups and the public have an interest in understanding and participating in decisions that affect them, and would continue to proactively seek, engage in, and support meaningful discussion on issues and opportunities related to the Project throughout all phases.

The Indigenous and Public Engagement Program would contain a grievance mechanism to monitor and respond to complaints or concerns. Measures could then be developed and implemented as part of follow-up monitoring to mitigate concerns.

Where uncertainties associated with effects predictions and mitigations exist, adaptive management would be used to improve knowledge over time through an iterative process that provides the information required to increase confidence to make decisions that reduce uncertainty and improve risk management outcomes. The adaptive management process would include defined stages where engagement can be sought on particular issues. As an example, if resource users raised concerns about dust deposition due to construction and road traffic, the reason for the concern would be investigated and additional dust control measures implemented, if required. Follow-up measures could include increased frequency of application of dust suppressants or the construction of wind breaks. Engagement may also be sought with Indigenous and other land and resource users for input and feedback on the revised dust management measures. The process for determining when, how, and where adaptive management should be used would be described within the Integrated Management System (IMS) Manual. Additional information on the adaptive management framework is provided in Section 23.5.3, Adaptive Management.

23.3 Environmental Design Features and Mitigation Measures

Environmental design features and mitigation measures represent Project design characteristics, policies, and actions that are put in place to help prevent or decrease potentially adverse effects on the environment and people from the Project. Mitigation involves measures to eliminate, reduce, control, or offset the adverse effects of a project, and it includes restitution for any damage caused by those effects through replacement, restoration, compensation, or other means (IAAC 2020). Under the *Canadian Environmental Assessment Act, 2012*, these measures are to be technically and economically feasible.

A summary of environmental design features, mitigation measures, and commitments developed during the provincial and federal EA review processes for the Project are provided in Appendix 23A, Summary of Project Environmental Design Features and Mitigation Measures. This summary also includes linkages to the high-level overarching management and monitoring programs and plans, where appropriate.

23.3.1 Overview of Mitigation Selection Hierarchy

The Saskatchewan Ministry of Environment (ENV 2018) describes mitigation as a stepwise progression of actions to avoid, minimize, and offset adverse effects. Other reference documents (IFC 2012; BBOP 2018) include reclamation as a mitigation and define the following hierarchies of mitigation, with the most preferable actions/measures listed first. This hierarchical progression was used in each EA discipline for the selection of mitigation for the relevant Project activities and components:

- **Avoid:** To the extent practicable, proponents should avoid effects on the environment by modifying the design of a proposed project. Avoidance and minimization are widely recognized as the most important strategies for biodiversity conservation (BBOP 2018). Avoidance of sensitive areas, such as wetlands, is a key mitigation action. The Project design has incorporated key environmental design features to avoid potential environmental effects in a number of areas; specific details of these key features have been provided in Section 23.3.2.1, Environmental Design Features.
- **Minimize:** Proponents should limit effects that cannot be avoided through best available technology economically achievable and best management practices (e.g., sediment and erosion control). When avoidance is not possible, efforts should be made to minimize the extent of the effects caused by the proposed project activity.
- **Reclamation, Rehabilitation, and Restoration:** Proponents should reclaim and rehabilitate affected areas to set them on a possible trajectory towards restoration of previous conditions, end land use, or land capability. Reclamation returns the land to a useful and productive state (e.g., covering and revegetating a surface facility). Rehabilitation aims to restore basic ecological functions and/or ecosystem services (e.g., providing erosion protection), while restoration tries to return an area to the original ecosystem that was present before the effects from a project. Reclamation, rehabilitation, and restoration include actions taken to improve ecosystems following exposure to effects that cannot be completely avoided or minimized. Most reclamation, rehabilitation, and restoration actions typically take place towards the end of a project's lifespan, and there is usually uncertainty in the timelines for the effects to be reversed, which requires monitoring to verify performance measures are trending towards targets and objectives. The reclamation measures for the proposed Project would be included in the Preliminary Decommissioning and Reclamation Plan and finalized in the Detailed Decommissioning and Reclamation Plan prior to transition to Closure.

- **Offset:** Proponents should offset effects that cannot be fully mitigated through avoidance, minimization, and reclamation measures, or when temporal losses to the environment would compromise the viability or function of aspects of the environment. Offsetting measures typically counterbalance this loss through positive contributions to the environment. Offsets may include compensation or community enhancement. Offsetting requirements are determined through regulatory processes and engagement, and monitoring is needed to determine effectiveness. For the proposed Project, an example of offsetting would be the Caribou Mitigation and Offsetting Plan, which would be developed through engagement with regulators and Indigenous Groups to meet the woodland caribou management objectives for the SK2 West Caribou Administration Unit. Fish habitat and wetlands would be offset if there are residual effects identified in final design and during acquisition of permits and authorizations, if the Project is approved.

23.3.2 Development of Environmental Design Features and Project Mitigation Measures

Project environmental design features, environmental best practices, management policies and procedures, and mitigation actions were developed through an iterative process between an integrated group of subject matter experts including members of the project development, environmental, and socio-economic teams for the Project. This process combined Project-specific input from engagement with other interested parties, including direct and indirect input from local Indigenous Groups and communities and feedback from regulatory agencies. Environmental design features and mitigation measures were selected considering their effectiveness for implementation and maintenance, as well as their appropriateness within the context of the effects pathways identified for the Project.

Certain forms of mitigation that are best practices, standard operating procedures, or industry-wide regulatory requirements are included in Section 5, Project Description, and assumed in the EA without requiring an iterative process to determine the need for such standards. For example, the Project would implement management system programs approved by the CNSC as part of licensing for the Project; these programs would include monitoring to protect the health and safety of workers, the public, and aquatic and terrestrial ecosystems from radioactive and non-radioactive constituents of potential concern.

In accordance with the mitigation hierarchy and industry and regulatory standards, as well as considerations made through the iterative Project design process (including the assessment of technical and economic feasibility of mitigation features), the Project would incorporate the following general measures to avoid, minimize, reclaim, and then offset adverse effects:

- Limit the area of the Project footprint (e.g., optimizing surface infrastructure layout to the extent practicable through clustering of buildings and maximizing use of existing road infrastructure).
- Design the Project to avoid or minimize effects (e.g., placement of facilities away from sensitive features, design and use of the underground tailings management facility [UGTMF]).
- Implement programs, plans, procedures, practices, and management policies to limit effects (e.g., use of dust suppression on roads).
- Incorporate progressive reclamation and a Detailed Decommissioning and Reclamation Plan at the end of Operations.
- Implement compensation, where required, to offset effects remaining after avoidance, minimization, and reclamation.

23.3.2.1 Environmental Design Features

A key principle in the management of potential adverse environmental effects for all phases of the Project is to practise avoidance and minimization through developing and implementing industry-leading environmental design features. The development and implementation of environmental design features represents an important mechanism to spatially and/or temporally eliminate or reduce the potential for adverse effects on the biophysical, cultural, and socio-economic environments resulting from a project.

Key environmental design features that have been incorporated into the Project to mitigate effects to valued components (VCs) include the elements listed below. Additional design details are presented in Section 5, and details on how Indigenous and Local Knowledge influenced Project design are presented in Section 3.7, Influence on Project Planning and Design. The design features were integrated into the effects assessment for VCs.

Further environmental design features are listed in Section 22, Assessment of Effects of the Environment on the Project. These environmental design features are not summarized in this section because they are intended to protect the Project rather than protecting biophysical, cultural, or socio-economic VCs. Similarly, Section 21, Accidents and Malfunctions includes a number of environmental design features and emergency response provisions that are intended to protect against potential accidents and malfunctions that are outside of day-to-day operations. Both Section 21 and Section 22 include engineering design elements that would continue to be refined through future stages of engineering design, CNSC licensing, and engagement with communities.

Underground Tailings Management Facility

All tailings generated from the Project would be placed underground for permanent deposition, either as cemented paste backfill in mined areas (e.g., stopes) or as cemented paste tailings in chambers of the UGTMF. The UGTMF would avoid potential adverse environmental effects and challenges that are often associated with surface tailings storage facilities (e.g., loss of larger areas of wildlife habitat, management of long-term physical and chemical stability, seepage containment, tailings dust dispersion). The storage of tailings from processed ore is an important design and operational component of any mining project and often results in tailings being stored in a surface impoundment behind a tailings dam or in another form of tailings management facility.

Returning the tailings underground as cemented paste reduces the Project footprint at surface (e.g., no tailings dam, no storage of tailings in open pits) and substantially minimizes the associated risks to the environment throughout Operations and well beyond Closure. The underground storage location avoids the removal of surface habitats, terrain and soils, and the resultant effects on vegetation, wildlife, water, fish, and Indigenous and other land and resource use. Underground disposal of tailings in the form of a cemented paste product also contributes to progressive reclamation, as the materials are stored in final form during Operations. Local Indigenous Groups and community members have indicated they prefer the placement of tailings underground as opposed to the long-term storage of tailings on surface.

The technology used to develop a UGTMF has precedent for the controlled deposition of cemented paste backfill. The tailings placement underground complies with the CNSC regulatory requirements and includes designs and plans that conform with Principles 4 to 7 of the *Global Industry Standard on Tailings Management* (Global Tailings Review 2020).

Project Footprint, Access Road Realignment, and Setbacks

Limiting the area of the Project footprint was identified as the highest priority measure in the application of principles and hierarchies of mitigation because in doing so, multiple potential effects would be avoided or minimized. Key feedback received from local Indigenous Groups and community members was a preference for designs that reduced the size of the Project footprint, and therefore the subsequent potential effects on the land, vegetation, wildlife, and user access to these resources.

The previously mentioned UGTMF accounted for a substantial reduction in the Project footprint. Furthermore, the Project site design and arrangement have been optimized to condense the layout and limit potential adverse effects on the land, vegetation, and wildlife habitats, which would be larger with a more expansive or fragmented design.

The access road between the gatehouse and the mine terrace would be realigned to avoid an adjacent wetland area. Alignments for the existing site roads and new site roads would be set back from the Patterson Lake shoreline at most locations; typical distances for new site roads from the lake would range between 300 m and more than 1 km. In doing so, effects to most riparian habitat would be avoided. There would be limited sections with a narrower setback distance (i.e., less than 300 m); however, the distance would remain more than 30 m from nearby waterbodies or watercourses, except for ramps and roads needed for installation and maintenance of pipelines and foreshore and lake infrastructure. In addition, access to the underground mine would be located approximately 300 m from the edge of Patterson Lake. No surface blasting is planned for the Project; if this changes, blasting would be located farther away from Patterson Lake than the Fisheries and Oceans Canada recommended setback distances to avoid harm to fish. Setbacks from nearby waterbodies or watercourses would be included in the Project design and would provide a buffer to prevent effects from Construction and Operations on downstream fish-bearing environments and reduce potential adverse effects on riparian ecosystems.

Containment Design of Project Features including the Waste Rock Storage Areas and Surface Water Management Ponds

Different waste rock storage areas (WRSAs) would be required for the various types of waste rock produced at the Project, including potentially acid generating (PAG) waste rock and non-potentially acid generating (NPAG) waste rock. Non-mineralized waste rock (i.e., less than 0.03% triuranium octoxide) with greater than 0.1% sulphur content would be categorized as PAG waste rock. Clean waste rock (i.e., non-mineralized waste rock with less than 0.1% sulphur content) would be categorized as NPAG waste rock. Stockpiles for ore and special waste rock (i.e., mineralized material with insufficient grade to be considered ore) would also be required for the Project. Details about the composition and characterization of ore, special waste, and waste rock are presented in Section 5.4.4, Mine Rock Management. The environmental design features and considerations for these storage areas are described below, and include lined containment, water management systems, sufficient runoff storage capacity for high precipitation events, and final closure cover systems.

The ore storage stockpile area would have a high perimeter berm and a dual high-density polyethylene (HDPE) liner system to prevent non-contact water from entering the ore storage stockpile area. The stockpile would be self-contained and capable of accommodating probable maximum precipitation events. Other liner design features would include perforated leak detection piping routed to leak detection monitoring wells.

The special waste rock stockpile would consist of both a pile and a runoff collection area. This stockpile would also be dual HDPE-lined, self-contained, capable of accommodating probable maximum precipitation events, and would be instrumented with primary and secondary leak detection systems and monitoring wells.

The PAG WRSA would consist of a single HDPE liner, internal WRSA source control layering, and a cover system over the final landform. A PAG waste rock runoff collection area would capture and contain runoff for precipitation and seepage from the PAG WRSA. The perimeter of the PAG WRSA and runoff collection area would be a combination of berms, collection ditching, and diversion ditching, dependent on location.

The NPAG waste rock is categorized as clean waste rock and would not require a liner system. The runoff collection system for the NPAG WRSA would direct water to a site runoff pond for monitoring. Similar to the PAG WRSA, the perimeter of the NPAG WRSA would be a combination of berms, collection ditching, and diversion ditching, dependent on location.

At Closure, any residual special waste rock or ore on surface would be processed and backfilled underground as cemented paste. The PAG WRSA would have an engineered store-and-release cover system to minimize water and air ingress to the waste rock and to provide a substrate for revegetation. The NPAG WRSA would be covered with borrow material to assist with revegetation. The final designs would support the long-term physical and chemical stability of the WRSAs and minimize potential adverse effects.

Settling and monitoring ponds used in the effluent treatment process would be double lined for primary and secondary containment. The containment system would have perforated leak detection piping for both the primary and secondary liners, along with interconnecting buried HDPE piping to leak detection monitoring wells. The interconnecting pipeline corridor between the settling and monitoring ponds and the effluent treatment plant on the mill terrace would also be single lined with HDPE.

23.3.2.2 Mitigation Measures

Confidence in and selection of mitigation measures is influenced by the level of complexity and control required to protect the environment. Complex mitigation systems, or those that require sophisticated technological inputs, introduce more potential failure modes, whereas more straightforward and simple applications require less maintenance, verification monitoring, and surveillance. For example, limiting the steepness of slopes on disturbed areas and stockpiles is a less complex mitigation to prevent slope instability than implementing a geotechnical stability monitoring program that would be required for a steep slope. The duration of a potential environmental effect also influences mitigation selection in favour of those measures that may be less complex and require limited lasting control and maintenance during Operations, during Closure, and beyond.

Each discipline of the EIS (i.e., Section 7, Air Quality, Noise, and Climate Change, to Section 19, Community Well-Being) incorporated industry standard general practices and procedures and identified Project-specific mitigation measures that would be implemented during Construction, Operations, and Closure.

Project mitigation measures are summarized in Appendix 23A, including information on the mitigation hierarchy level, effectiveness of the measure, and mitigation effectiveness rationale. Enhancement measures have also been identified in Appendix 23A. Although enhancement is not mitigation, these measures have been included to show NexGen’s commitment to the biophysical, cultural, and socio-economic environments surrounding the Project. Disciplines for which each mitigation measure apply are included by mitigation for ease of reference. Mitigations in Appendix 23A are organized in the following groupings:

- high-level overarching programs and plans;

- general mitigations;
- mitigations pertaining to air, noise, and climate change;
- mitigations pertaining to water and aquatic resources;
- mitigations pertaining to terrestrial resources; and
- socio-economic mitigations.

Assignment of the mitigation hierarchy class uses the stepwise progression outlined in Section 23.3.1, Overview of Mitigation Selection Hierarchy to classify the mitigation (i.e., avoid, minimize, reclamation, offset).

The mitigation measure effectiveness is categorized as high, medium, or uncertain based on the level of confidence or certainty in implementing the proposed mitigation measure and reducing unavoidable adverse effects on a given environmental factor or value, as follows:

- Mitigation measures considered to have **high** effectiveness include those that are industry-accepted best available technology and economically achievable or best management practices or are mitigation measures required under legislation or in applicable management standards (e.g., programs approved by the CNSC, Fisheries and Oceans Canada's standards and codes of practice). Highly effective mitigation may be supported and proven by numerous case studies with full-scale implementation in relevant industrial settings through publicly available information or extensive professional experience. Highly effective mitigation measures are those where NexGen has full control over the implementation and outcomes (e.g., the design and maintenance of Project infrastructure and equipment).
- Mitigation measures considered to have **medium** effectiveness include those that may be supported by fewer case studies confirming the desired reduction in risk to the given environmental factors or values. Medium effectiveness mitigation measures are those that may only be supported by limited evidence, such as pilot studies, or application on sites or for industries that may have limited applicability relative to the Project or proposed application. Medium effective mitigation measures are those where NexGen has less than full control over the implementation and outcomes, relative to high effectiveness measures (e.g., providing first preference to local businesses that meet or exceed procurement process requirements).
- Mitigation measures considered to have **uncertain** effectiveness include those where NexGen has incomplete control of the outcome. These measures may also include those with limited duration of application on mine sites or that may not have been specifically used in the proposed application, climatic region, or environment. Mitigation measures with uncertain effectiveness include those with no supporting professional experience, contain several conflicting opinions on the results, or are based on a large number of assumptions.

Follow-up monitoring and adaptive management measures are most important for mitigation measures with lower estimations of effectiveness where there is more uncertainty or where the technology has not been widely implemented. Despite inherent uncertainty due to lack of proven applications, new technologies with high potential effectiveness are essential for driving continual improvement in environmental protection. Adaptive management is ideally suited to be applied to such mitigation because it allows for progressive learning while maintaining the flexibility to respond to unexpected conditions or lower-than-anticipated performance.

23.3.3 Environmental Assessment Approach and Incorporation of Mitigation

The EA approach, methods, and the integration of mitigation are described in Section 6, Environmental Assessment Approach and Methods. The main steps of the EA process included assessment scoping, pathway analysis, residual effects analysis and classification, and determination of significance. Environmental design features and mitigation that would be implemented for the Project were incorporated within the pathway analysis step of this process. The purpose of including mitigation within this step is to avoid or limit the effects on VCs and intermediate components. The VCs are aspects of the natural and human environment that have importance in terms of their scientific, social, cultural, economic, historical, archaeological, or aesthetic values (e.g., moose, human health, Indigenous land and resource use, economy). Intermediate components are also included and were analyzed to support the assessment of the VCs. Intermediate components include physical components such as air quality, groundwater, hydrology, surface water quality, terrain, and soils that support VCs. Indigenous and Local Knowledge provided guidance and verification on the identification and selection of VCs and intermediate components.

23.4 Management Programs and Plans

Management programs and plans are required to effectively implement the mitigation measures identified through the biophysical, cultural, and socio-economic effects assessment process. These programs and plans also need to be consistent with provincial and federal regulatory requirements for uranium mines and mills. Section 23.4.1, Environmental Management, and Section 23.4.2, Socio-economic Management, present the management frameworks for implementation of the Project's environmental and socio-economic mitigation measures, respectively.

NexGen is responsible for and committed to providing for the health and safety of workers and the public and the protection of the environment. NexGen would implement an IMS for the Project, which would form a common framework for the management of all Project activities and include reference to the applicable provincial, CNSC, and Canadian Standards Association Group (CSA Group) requirements, as well as appropriate guidance documents (e.g., International Organization for Standardization [ISO] 9001 Quality Management, ISO 14001 Environmental Management, ISO 45001 Occupational Health and Safety). This unified framework would include processes for fostering a culture in which protecting the health and safety of workers and preserving the environment are principal considerations guiding decisions and actions, as well as processes for implementing compliance measures and enabling continual improvement. The IMS would apply to all on-site Project-related licensed activities during Construction, Operations, and Closure and to all Project workers (including contractors) and visitors. Contract terms would include requirements for contractors to conform to applicable IMS requirements, and the IMS would include auditing processes to verify conformance.

Provincial and federal regulatory requirements are generally linked to environmental management programs. However, some socio-economic management commitments are linked to Project licensing, including the Indigenous and Public Engagement Program and specific environmental management programs with community health, safety, and cultural considerations. The remaining socio-economic management initiatives are not generally regulated by CNSC licensing; therefore, the socio-economic management structure shown in Section 23.4.2 is presented separately and would be implemented by NexGen to minimize potential adverse socio-economic effects and enhance the potential benefits identified in the EIS. The socio-economic management framework would also support the Benefit Agreements NexGen has with primary Indigenous Groups.

23.4.1 Environmental Management

NexGen would develop monitoring and management plans within NexGen's IMS related to environmental protection for the Project. These monitoring and management plans would demonstrate compliance with NexGen's standards and regulatory commitments related to the environment. NexGen would be responsible for implementing the various monitoring and follow-up programs, which would be developed to include monitoring requirements documented within this EIS, and to comply with approval conditions, permits, or authorizations for the Project.

Monitoring and follow-up programs and management plans would be further developed as the Project, if approved, progresses through the permitting and licensing processes. Further Project refinements may influence the nature, frequency, and locations of monitoring required. In addition, input from Indigenous Groups, regulatory agencies, and the public would be considered. These programs and plans would then become "living" documents throughout the Project lifespan and would be altered, as required, as the mine development progresses through Operations and Closure. The future revisions of these programs and plans would specify the responsible and accountable parties within each respective plan, as well as the scope for each functional area or individual. The programs and plans would include sufficient information on the type, quantity, and quality of information required to reliably verify predicted effects and confirm the effectiveness of mitigation. Monitoring and follow-up programs proposed for the Project are further discussed in Section 23.5, Monitoring, Follow-up, and Adaptive Management.

23.4.1.1 Environmental Protection Program

The Environmental Protection Program implemented under the IMS would outline a systematic and risk-based approach to protecting and preserving the environment. The Environmental Protection Program would include but would not be limited to: descriptions of environmental aspects; risk assessment; release mechanisms (routine and non-routine) to all environmental media; pollution prevention and environmental protection measures; responding to unplanned environmental releases; monitoring of effluents, emissions, and environmental media; inspection and evaluation of critical structures and systems; and performance tracking and reporting.

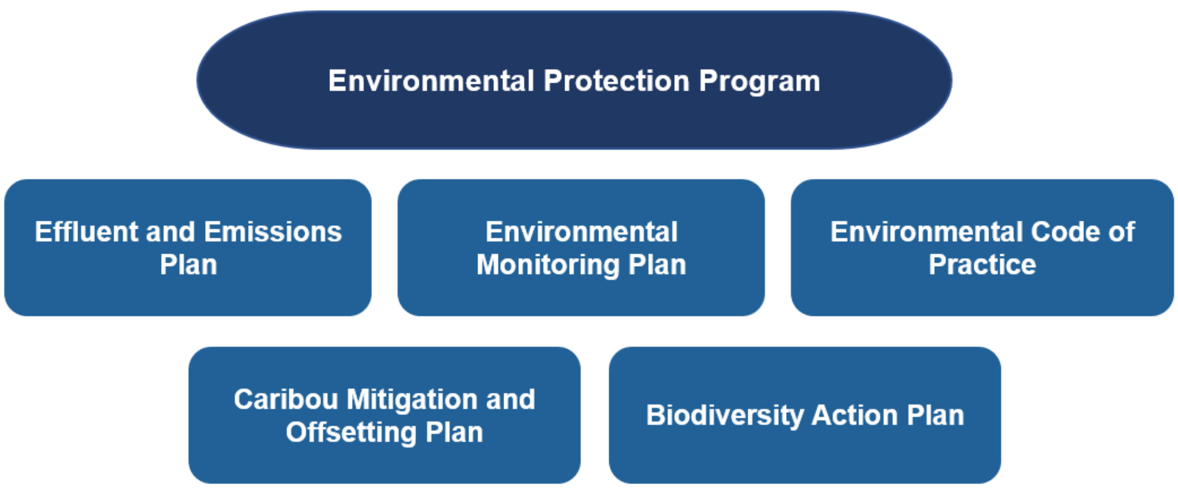
NexGen recognizes the importance of protecting and preserving the environment and biodiversity throughout the Project lifespan and for future generations and would adopt a comprehensive approach to environmental protection including incorporating Indigenous and Local Knowledge to enhance understanding of the biophysical and human environment. This approach to environmental protection would be reflected in the following Environmental Protection Program principles:

- protecting and promoting the health, safety, and well-being of workers, the public, and the environment through all aspects and phases of the Project;
- establishing a culture of environmental protection that is periodically assessed and continually improved;
- keeping releases to the environment as low as reasonably achievable;
- respecting the principle of pollution prevention;
- applying best available technology economically achievable and best management practices;
- monitoring and assessing against indicators and targets based on sound science and Indigenous and Local Knowledge;

- confirming that all workers have the knowledge, skills, and tools to implement environmental protection processes;
- proactively engaging with Indigenous Groups and local communities;
- complying with all applicable requirements; and
- continually monitoring and improving Program performance.

The Environmental Protection Program framework for environmental protection would be based on supporting environmental monitoring and management plans and an associated Environmental Code of Practice (Figure 23.4-1). Supporting plans would include the Effluent and Emissions Plan, and Environmental Monitoring Plan. In addition, a Caribou Mitigation and Offsetting Plan and Biodiversity Action Plan would be developed to support the Environmental Protection Program. Together, these environmental plans and the Environmental Code of Practice would outline specific requirements for protecting air, groundwater, surface water, fish, aquatic biota, caribou and other wildlife, and biodiversity.

Figure 23.4-1: Context of Plans in the Environmental Protection Program



Effluent and Emissions Plan

Effluent and emissions monitoring would address the airborne (i.e., emission) and waterborne (i.e., effluent) discharges generated from the Project facilities. Effluent and emissions monitoring activities, including effluent streams monitored, frequency of monitoring, and sampling arrangements for constituents of potential concern, would be described in the Effluent and Emissions Plan. The Effluent and Emissions Plan would also establish air quality objectives and standards and an assessment of conformance to these standards; air emissions reporting requirements; an overview of air emission, maintenance, and mitigation requirements for air emission sources; and emergency response strategies for upset conditions.

With respect to effluent and emissions, the Effluent and Emissions Plan would facilitate the overall Environmental Protection Program through:

- demonstrating compliance with authorized release limits and any other applicable regulatory requirements (e.g., action levels);

- demonstrating adherence to internal objectives and targets set on release amounts, for purposes of effluent and emission control;
- confirming the adequacy of controls on releases from the source;
- providing an indication of unusual or unforeseen conditions that may require corrective action or additional monitoring;
- providing data to assess the level of risk on human health and safety, as well as the potential biological effects on the environment from substances of concern released from a facility;
- providing data to verify the predictions made by the environmental risk assessment (ERA), refining the models used in the ERA, or reducing the uncertainty in the predictions made by the ERA; and
- measuring the quantity of materials released to the environment.

The Effluent and Emissions Plan would be informed by both Indigenous and scientific knowledge and would be prepared in accordance with applicable requirements, which would include, but not be limited to:

- REGDOC-2.9.1, Environmental Protection: Environmental Principles, Assessments and Protection Measures (CNSC 2020);
- CSA N288.5-11 Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills (CSA Group 2011);
- Metal and Diamond Mining Effluent Regulations; and
- Industrial Source (Air Quality) chapter of the Saskatchewan Environmental Code; and
- licences, approvals, and permits.

Environmental Monitoring Plan

Environmental monitoring, including environmental effects monitoring, would address potential releases to the receiving environment to identify any negative consequences or effects due to Project facilities, activities, or processes and would validate the overall effectiveness of the protective measures implemented for the Project. Environmental monitoring activities would be described in the Environmental Monitoring Plan. The Environmental Monitoring Plan would detail a risk-based approach to monitoring the environmental effects of the Project. The Environmental Monitoring Plan would be developed to maintain regulatory compliance, enable continual improvement, and foster a culture where worker and environmental protection, and local public and Indigenous engagement, are principal considerations guiding decisions and actions. Specifically, the Environmental Monitoring Plan would capture surveillance monitoring of the ambient air and aquatic and terrestrial environments in contact with the Project. The Environment Monitoring Plan would support the overall Environmental Protection Program through:

- assessing the level of risk to human health and safety, as well as the potential biological effects on the environment, from the contaminants and physical stressors of concern arising from the Project;
- providing data to verify the predictions made by the ERA, refining the models used in the ERA, or reducing the uncertainty in the predictions made by the ERA;
- demonstrating compliance with any applicable limits on the concentration and/or intensity of contaminants and physical stressors in the environment or their effect on the environment; and

- verifying, independently of effluent monitoring, the effectiveness of containment and effluent control, and providing public assurance of the effectiveness of containment and effluent controls.

The Environmental Monitoring Plan would be informed by both Indigenous and scientific knowledge and would be prepared in accordance with applicable requirements, which would include, but not be limited to:

- REGDOC-2.9.1, Environmental Protection: Environmental Principles, Assessments and Protection Measures (CNSC 2020);
- CSA N288.4-19 Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills (CSA Group 2019);
- CSA N288.7-15 Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills (CSA Group 2015);
- Metal and Diamond Mining Effluent Regulations; and
- licences, approvals, and permits.

Environmental Code of Practice

The Environmental Code of Practice would identify action and administrative levels for chemical and radiological parameters in treated effluent discharge that, if reached, may indicate a loss of control. Exceeding an action level signals a potential reduction in effectiveness of the control measure(s) and may indicate a deviation from planned operations. Exceeding an action level is not a non-compliance but triggers a requirement for specific actions to be taken.

The Environmental Code of Practice would describe the corresponding actions to be taken to maintain control and protect the receiving environment. The Environmental Code of Practice would be prepared in accordance with applicable requirements, which would include, but not be limited to:

- REGDOC-2.9.2, Controlling Releases to the Environment (CNSC 2021); and
- CSA N288.8-17 Establishing and Implementing Action Levels for Releases to the Environment from Nuclear Facilities (CSA Group 2017).

Wildlife and Habitat Management

Project activities would result in interactions with, and effects on wildlife and wildlife habitat. Operational controls are intended to minimize these effects and manage wildlife interactions for the safety of both the wildlife and workers.

The Environmental Protection Program would provide specific wildlife control and habitat protection processes. These processes would address avoiding, minimizing, and documenting wildlife interactions (including wildlife-vehicle collisions, requirements and restrictions for land clearing, and disturbances to aquatic and terrestrial habitat), and requirements for documenting wildlife sightings. Additional controls for caribou would be outlined in a specific Caribou Mitigation and Offsetting Plan.

A Biodiversity Action Plan would be informed by both Indigenous and scientific knowledge and would be implemented to address threatened species and habitats and to protect biological systems and ecosystems over the lifespan of the Project. Decommissioning and reclamation of areas of the Project would restore biological systems during and after Closure.

Progressive reclamation (e.g., recontouring, seeding disturbed areas to reduce soil erosion, encouraging regrowth, creating habitat) would be completed prior to Closure, as and when appropriate. The objective of progressive reclamation is to facilitate site closure in a planned and timely manner and to minimize post-closure care and maintenance by completing reclamation activities prior to Closure. The Preliminary Decommissioning and Reclamation Plan would provide a conceptual overview of the proposed decommissioning and reclamation objectives, criteria, methods, and monitoring requirements for the proposed Project.

23.4.1.2 Decommissioning and Reclamation

NexGen's intent is to leave areas disturbed by Project activities in a condition that is free from access restrictions, safe for traditional land use, and in an ecological condition that is functional, does not require routine maintenance or controls, and integrates with the surrounding physical and biological environment. The Preliminary Decommissioning and Reclamation Plan would reflect NexGen's commitment to progressive reclamation and to designing, constructing, and operating for responsible closure and would incorporate feedback received from local Indigenous Groups and communities and apply industry best practices.

23.4.2 Socio-economic Management

NexGen is committed to protecting the health and safety of and benefitting the Indigenous Peoples and communities potentially affected by the Project. This subsection describes the socio-economic management framework that is being developed for the Project.

NexGen is committed to continued engagement with local Indigenous Groups and communities on appropriate and effective socio-economic management initiatives, and to evolving such initiatives over the Project lifespan to reflect areas of importance to Indigenous Groups and communities. NexGen's approach allows for collaboration with each Indigenous Group and community to develop an effective socio-economic management approach while also recognizing the specific interests and areas of importance to each Indigenous Group and local community.

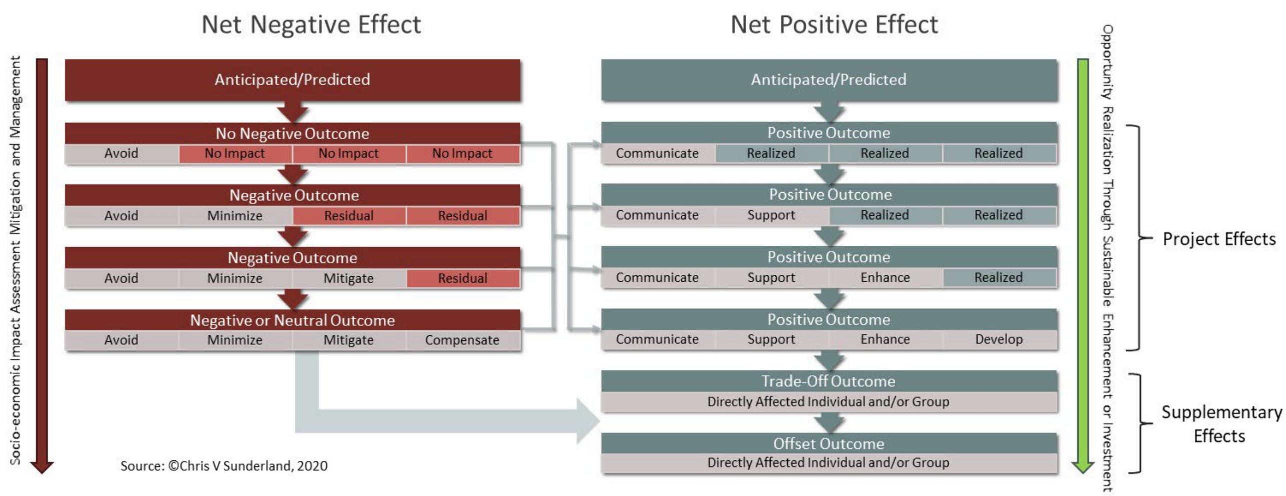
In support of this commitment, NexGen has established a local priority area (LPA)[1] for prioritizing education, training, employment, and business opportunities from the Project. The socio-economic framework will be enhanced through the establishment of formal Benefit Agreements with the primary Indigenous Groups for the Project (i.e., the Clearwater River Dene Nation [CRDN], Métis Nation – Saskatchewan [MN-S] Northern Region 2, Birch Narrows Dene Nation [BNDN], and Buffalo River Dene Nation [BRDN]). NexGen has signed individual Benefit Agreements with the identified primary Indigenous Groups (i.e., the CRDN, MN-S, BNDN, and BRDN). The Benefit Agreements have been developed and negotiated to define the environmental, cultural, economic, training, employment, business opportunities, and other benefits to be provided to the Indigenous Groups by NexGen and to confirm the consent and support of those Indigenous Groups for the Project. Where applicable, the socio-economic management initiatives would support and be integrated into Benefit Agreement mechanisms with each primary Indigenous Group.

NexGen examines potential socio-economic effects in terms of their positive and negative attributes. This process of assessing Project effects uses the socio-economic net outcome model as outlined in Figure 23.4-2. The socio-economic net outcome model is a tool for concurrently examining the positive and negative attributes

[1] The LPA consists of the local communities closest to the Project that would experience most of the Project effects and for which NexGen would prioritize local training, employment, and business opportunities for the Project. These communities are located along, or accessed via, Highways 155 and 955 north of the intersection of Highways 155 and 925.

of potential Project socio-economic effects. The objective is to evaluate the balance between the positive and negative attributes of effects.

Figure 23.4-2: Socio-economic Net Outcome Model



For the net negative effect side of the model, following the mitigation hierarchy from avoidance to minimization, mitigation, and finally compensation, the first step is preferred, and compensation is only used after all other steps are exhausted. Most Project effects can be screened out by avoiding the effect; for example, the optimization of the Project footprint (Section 23.3.2.1) would avoid effects related to loss of land available for resource users.

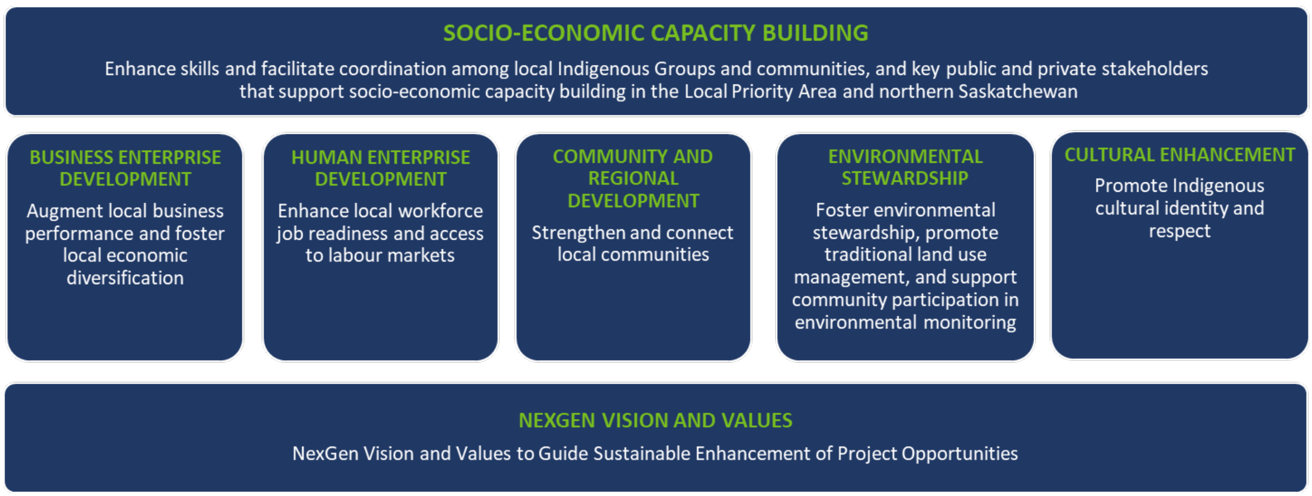
The net positive side of the model follows a similar pattern to the mitigation hierarchy for the net negative effect side of the model shown in Figure 23.4-2. The ultimate objective of net positive effects is sustainable opportunity realization, which means that people obtain the benefits from the Project in a manner that sustains itself long term, well after the Project lifespan. The positive effects hierarchy starts with communication (i.e., making people aware of the effect); followed by support for communities, organizations, businesses, and individuals (i.e., providing assistance to promote the positive effect); followed by enhancement (i.e., improving existing conditions to enable better outcomes); and finally, where necessary, developing benefits (e.g., investing in or creating new programs and services). It is important to note that positive effects are not the sole responsibility of the proponent, and in many cases, support by the affected group or community can produce the best results, including shared responsibility to achieve sustainable positive outcomes.

The goal in all positive opportunity realization efforts is a sustainable outcome capable of providing lasting benefits to the target communities, groups, or individuals.

Socio-economic Capacity Building Framework

NexGen's philosophy for socio-economic effects management is based on building socio-economic capacity in the LPA communities. Figure 23.4-3 outlines the Project socio-economic capacity building framework, which is designed to enhance skills and facilitate coordination among local Indigenous Groups and communities and key public and private potentially affected parties that support socio-economic capacity building in the LPA and northern Saskatchewan. The socio-economic capacity building framework is being developed to optimize Project value. Details that arise through the framework development would be discussed with local Indigenous Groups and communities and key public and private stakeholders to verify the framework meets its intended goals.

Figure 23.4-3: Socio-economic Capacity Building Framework



As outlined in Figure 23.4-3, there are five pillars within the socio-economic capacity building framework, which are described below:

- **Business enterprise development:** Sustainably support business development in the LPA and northern Saskatchewan for indirect (i.e., contracting and supplier) opportunities to support the Project, and stimulate induced business opportunities.
- **Human enterprise development:** Sustainably support existing institutions and programs to enhance education and training and skills development for direct employment, which in turn can stimulate indirect and induced employment opportunities across the LPA communities.
- **Community and regional development:** Support existing initiatives and help identify new opportunities to enhance community and regional development across the LPA by strengthening communities and shared infrastructure and resources.
- **Environmental stewardship:** Explore opportunities to enhance and foster environmental stewardship and promote shared land use initiatives through the enhancement and support of existing programs and the exploration of new initiatives and opportunities in the LPA communities.
- **Cultural enhancement:** Work collaboratively with local Indigenous Groups and communities to promote Indigenous and northern culture and support cultural programs.

From the Project socio-economic capacity building framework, and in consideration of the socio-economic sections within the EIS (i.e., Section 15 to Section 19), NexGen has identified several initiatives that are designed to manage potential negative (i.e., adverse) effects through a hierarchy of controls while enhancing positive effects (i.e., benefits) through a hierarchy of sustainable opportunity realization measures. Figure 23.4-4 presents potential initiatives aligned with the socio-economic capacity building framework, highlighting key commitments from the EIS. As with the socio-economic capacity building framework, the initiatives are governed by NexGen's vision and values, and include a grievance process to enable meaningful feedback and provide a response mechanism and a monitoring, reporting, and review process to promote transparency. As with the socio-economic capacity building framework, the socio-economic management initiatives are currently being explored by NexGen and are subject to change or modification as they are further developed, including consideration of feedback from local Indigenous Groups and communities and key public and private stakeholders. This collaborative approach is designed to enable community input opportunities into the design of these initiatives.

Figure 23.4-4: Socio-economic Initiatives

NEXGEN VISION AND VALUES

NexGen vision and values to guide sustainable enhancement of Project opportunities.

BUSINESS ENTERPRISE DEVELOPMENT

KEY COMMITMENTS

Augment local business performance and foster local economic diversification.

- Local business and industry procurement
- Economic opportunity in Local Priority Area

KEY DOCUMENTS

- Business opportunities workplan
- Local business registry

HUMAN ENTERPRISE DEVELOPMENT

KEY COMMITMENTS

Enhance local workforce job readiness and access to Project opportunities.

- Local workforce development
- Recruitment
- Workforce health and well-being

KEY DOCUMENTS

- Human Resource Development Plan

COMMUNITY AND REGIONAL DEVELOPMENT

KEY COMMITMENTS

Improve Indigenous Group and community health and well-being through enhancement of service delivery capacity and capability, and improved access to education and training opportunities.

- Community education and training
- Employee and Family Assistance Program

ENVIRONMENTAL STEWARDSHIP

KEY COMMITMENTS

Foster environmental stewardship, promote traditional land use management, and support community participation in environmental monitoring.

- Land
- Air
- Water

Manage the potential negative socio-economic impacts of mine closure and support the realization of potential benefits for local communities.

- Community participatory planning process

KEY DOCUMENTS

- Caribou Offsetting and Mitigation Plan
- Decommissioning and Reclamation Plan
- Environmental Protection Program

CULTURAL ENHANCEMENT

KEY COMMITMENTS

Promote Indigenous cultural identity and respect.

- Culturally sensitive employment policies.
- Cultural initiatives and opportunities.

INDIGENOUS AND PUBLIC ENGAGEMENT PROGRAM

KEY COMMITMENTS

Leverage Project opportunities for, and manage potential impacts to:

- Indigenous communities
- Employees and families
- Public and private sector stakeholders

GRIEVANCE MECHANISM

MONITORING, REPORTING, AND REVIEW

23.5 Monitoring, Follow-Up, and Adaptive Management

23.5.1 Environmental Assessment Follow-Up Monitoring

Environmental assessment predictions about future conditions have a level of uncertainty that cannot be reduced to zero; therefore, monitoring and follow-up programs are implemented to verify predicted effects, evaluate the effectiveness of mitigation, and to measure compliance with permit conditions and statutory requirements. Monitoring is used to address uncertainties associated with effects predictions, identify any unanticipated effects, and provide input into corrective actions or adaptive management to limit those effects. Collectively, these actions improve the overall environmental performance of a project.

Typically, monitoring includes one or both of the following categories that may be applied during the Project lifespan:

- **Regulatory compliance monitoring:** monitoring activities and programs undertaken to confirm the implementation of approved design standards, mitigation, approval conditions, and NexGen commitments (e.g., inspecting construction equipment for cleanliness prior to arriving on site, inspecting noise suppression [mufflers] on vehicles to make sure they are functioning properly).
- **Follow-up monitoring:** programs designed to test the accuracy of effects predictions, reduce or address uncertainties, determine the effectiveness of mitigation, or provide appropriate feedback to operations for modifying or adopting new mitigation designs, policies, and practices (e.g., implementation of adaptive management). Results from these programs can be used to increase the certainty of effect predictions in future EAs.

Where relevant, conceptual monitoring programs would be proposed to confirm predictions and to address the uncertainties associated with the effects predictions and mitigation, and upon Project approval, would be included in the IMS.

Eventually, the monitoring programs would include post-closure transitional monitoring to confirm that reclamation is proceeding as planned and predicted and to demonstrate to the CNSC and the Province of Saskatchewan that the site is geotechnically, geochemically, and radiologically stable before release of the property from a CNSC licence and transfer to the provincial Institutional Control Program. Communities would be included in the post-closure transitional monitoring as part of ongoing independent environmental monitoring.

The ultimate responsibility for the operation of the Project would lie with the NexGen executive. The relevant members of the senior management team would then be delegated responsibility for the implementation of Project policies, management programs, and plans. For the effective management of the Project, appropriate personnel and financial resources must be in place. NexGen responsibilities would include confirming that such resources are available to implement the monitoring and follow-up programs required.

Each discipline of the EIS (i.e., Section 7 to Section 19) identified monitoring and follow-up programs and plans that would be implemented during Construction, Operations, and Closure. All such programs and plans would be managed under the Project's IMS (Section 23.4, Management Programs and Plans). The preliminary monitoring and follow-up program is presented in Appendix 23B, Environmental Assessment Monitoring and Follow-Up Programs Proposed for the Project.

Conceptual figures depicting Project treated effluent discharge and WRSA seepage monitoring locations are provided below.

A conceptual map of water quality and hydrometric monitoring locations is shown in Figure 23.5-1. This figure shows a conceptual overview of monitoring that would be applied to measure and assess potential effects associated with effluent discharge and water use for the Project. The following should be noted with regard to this map:

- The figure shows a minimum level of monitoring anticipated for the Project specific to water use and effluent discharge. Additional monitoring would be added, including biological Environmental Effects Monitoring as per the Metal and Diamond Mining Effluent Regulations.
- Monitoring program details may change as a result of engagement with regulatory agencies and Indigenous Groups.
- Final monitoring locations, frequencies, and parameters will be defined in the Effluent and Emissions Plan and Environmental Monitoring Plan as part of CNSC licensing and provincial permitting. Similarly, additional sites, including reference stations and far-field downstream stations, would be included in these plans; these additional sites are not shown in Figure 23.5-1.

A conceptual map of groundwater monitoring locations is shown in Figure 23.5-2. This figure shows a conceptual overview of monitoring that would be applied to measure and assess potential effects associated with shallow groundwater water flow originating from the NPAG and PAG WRSAs.

Constituents in groundwater that are anticipated to be monitored are pH, temperature, specific conductivity, turbidity, oxidation reduction potential, chloride, ammonia (as N), phosphorus, alkalinity, bicarbonate, carbonate, colour, hydroxide, sum of ions, hardness, total suspended solids, total organic carbon, dissolved organic carbon, calcium, chloride, fluorine, magnesium, potassium, sodium, sulphate, total dissolved solids, nitrate + nitrite, nitrate as nitrogen, total Kjeldahl nitrogen, dissolved metals (i.e., aluminum, arsenic, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, strontium, uranium, vanadium, and zinc), lead-210, polonium-210, radium-226, thorium-230, and water level. The following should be noted with regard to this map:

- The figure shows conceptual locations of groundwater monitoring wells anticipated for the Project that are specific to groundwater flows originating from the NPAG and PAG WRSAs.
- Monitoring program details may change as a result of engagement with regulatory agencies and Indigenous Groups.
- Final groundwater monitoring locations, frequencies, and parameters will be defined in the Environmental Monitoring Plan as part of CNSC licensing and provincial permitting. Similarly, additional monitoring wells that are intended to measure other potential groundwater interactions would be included in this plan; these additional monitoring wells are not shown in Figure 23.5-2.

LEGEND

- BATHYMETRY CONTOUR ELEVATION (10 m INTERVAL)
- FLOW DIRECTION
- ELEVATION CONTOUR (10 m INTERVAL)
- LAKE BASIN DIVISION
- WATERCOURSE
- WATERBODY
- WETLAND
- WOODED
- INTAKE OR DISCHARGE PIPE
- PROJECT INFRASTRUCTURE
- SITE ROAD
- WATER MANAGEMENT POND
- EFFLUENT TREATED PIPE DIFFUSER
- SEWAGE TREATED PIPE OUTFALL
- PROPOSED REGULATED MIXING ZONE

CONCEPTUAL MONITORING LOCATION

- DISCHARGE (FLOW) RATE
- IN SITU LIMNOLOGICAL PROFILES
- WATER QUALITY
- WATER LEVEL

CONCEPTUAL

0 1.5 3
1:50,000 KILOMETRES

NOTE(S)

1. WATER SURFACE ELEVATION ESTIMATED TO BE 498.79 MASL ASSOCIATED WITH MEAN ANNUAL FLOOD.
2. LAKE VOLUME ON JUNE 6-8, 1981:
- SOUTH ARM BASIN = 236,049,630 M^3
- NORTH ARM - WEST BASIN = 234,880,210 M^3
- NORTH ARM - EAST BASIN = 65,405,551 M^3
3. CONCEPTUAL FIGURE DEVELOPED IN SUPPORT OF THE EIS; FINAL MONITORING LOCATION WILL BE INFORMED THROUGH ADVANCEMENT OF PROJECT APPROVALS.

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. BATHYMETRY CONTOURS DERIVED FROM DATA COLLECTED BY NEXGEN, 2016.
3. PRELIMINARY LOCATIONS FOR MONITORING EFFLUENT DISCHARGE PROVIDED BY NEXGEN.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd.

ROOK I PROJECT

TITLE

CONCEPTUAL LOCATIONS FOR MONITORING EFFLUENT DISCHARGE

CONSULTANT

wsp

PROJECT		22522691	PHASE	3105 - 3
DESIGN	RP/JV	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	NO	2023-05-26		
CHECK	LJ	2023-05-26	**FIGURE 23.5-1**	
REVIEW	JF	2023-05-26		

PATH: I:\CLIENTS\NexGen\22522691\Mapping\Products\Hydrology\22522691_Fig23_5-1_PattersonLake_PotentialMonitoring_Rev0.mxd PRINTED ON: 2023-05-26 AT 8:38:27 AM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

LEGEND

- SIMULATED GROUNDWATER FLOW CONTOUR – PLAN VIEW (m)
- SIMULATED GROUNDWATER FLOW PATHWAY
- SURFACE WASTE FACILITIES (SOURCE AREA)
- SURFACE MINE INFRASTRUCTURE
- ⊕ CONCEPTUAL GROUNDWATER MONITORING LOCATION

CONCEPTUAL

NOTES:

1) ARROWS INDICATE DIRECTION OF GROUNDWATER FLOW PATHWAY
2) SIMULATED GROUNDWATER HEAD CONTOURS REFLECT LONG-TERM POST-CLOSURE CONDITIONS.
3) CONCEPTUAL FIGURE DEVELOPED IN SUPPORT OF EIS; FINAL MONITORING LOCATIONS WILL BE INFORMED THROUGH ADVANCEMENT OF PROJECT APPROVAL.
4) WRSA = WASTE ROCK STORAGE AREA; PAG = POTENTIALLY ACID GENERATING; NPAG = NON-POTENTIALLY ACID GENERATING.

CLIENT
NexGen Energy Ltd.

CONSULTANT
wsp

YYYY-MM-DD	2024-11-07
PREPARED	AC
DESIGN	NB
REVIEW	JL
APPROVED	JL

PROJECT
NEXGEN ENERGY LTD.
ROOK I PROJECT

TITLE
CONCEPTUAL GROUNDWATER MONITORING LOCATIONS FOR ASSESSING WASTE ROCK STORAGE AREA SEEPAGE

PROJECT No.	PHASE	Rev.	FIGURE
CA00226400.3030		0	23.5-2

NexGen has committed in the Benefit Agreements with each primary Indigenous Group to establish an Implementation Committee. The Implementation Committee is tasked with the responsibility of facilitating an effective ongoing working relationship between NexGen and the Indigenous Groups to verify that all commitments made within the Benefit Agreements are realized. The Implementation Committee would provide a forum for regular communication and information exchange and for the early resolution of issues and/or disputes that may arise. The Implementation Committees may also be tasked with implementing processes and monitoring progress against commitments under the Benefit Agreements, including those established for employment, business (e.g., contracting), and education and training programs. Adaptive management plans may also be developed to address the uncertainties associated with the effects predictions and mitigation measures. The process for determining when, how, and where to use adaptive management would be described within the IMS Manual. Section 23.5.3, Adaptive Management, presents an overview of the principles of the adaptive management process.

23.5.2 Indigenous Monitoring

In addition to environmental monitoring programs typically implemented for projects (i.e., as noted above), NexGen is working with local Indigenous Groups to implement independent environmental monitoring. In combination with standard Project monitoring processes, independent Indigenous monitoring would be used to verify Project performance and to determine if mitigations and controls are effective in protecting the receiving environment. The implementation of robust and long-term environmental testing and monitoring has been requested by Indigenous Groups to verify protection of the environment, including community-led monitoring during Construction and Operations of the proposed Project (TSD IV: MN-S; TSD V.2: CRDN; TSD VI: Ya'thi Néné Lands and Resources).

NexGen commits to providing funding for the life of the Project for a full-time independent Indigenous Monitor from each primary Indigenous Group, and to provide unrestricted environmental monitoring opportunities, including independent environmental sampling related to the Project, subject to the Indigenous Monitor complying with appropriate health and safety and other reasonable site-specific policies. The Indigenous Monitor would report openly and without restriction to Indigenous Group community members on the performance of the Project.

23.5.3 Adaptive Management

Adaptive management has been identified as a key element of the Project's approach to risk management. Adaptive management is a planned and systematic approach to improving knowledge over time through an iterative process that provides the information required to increase confidence to make decisions that reduce uncertainty and improve risk management outcomes. This iterative process is required when there is an insufficient understanding of the effect a project may have and an inability to confidently make such predictions using available information. It is an intentional, "learning by doing" method that incorporates continually updated data, technology, and knowledge. Among other things, adaptive management involves the implementation of new or modified mitigation measures over the lifespan of a project to address unanticipated environmental effects (CNSC 2021).

Adaptive management provides a structured approach to decision making that emphasizes accountability and explicitness, but also allows for flexibility to identify and implement new mitigation measures or to modify existing measures during the lifespan of a project. Adaptive management requires careful analysis, planning, implementation, monitoring, evaluation of results, and adjustment of objectives and practices if and as needed over the lifespan of a project. The process for determining when, how, and where adaptive management should be used would be described within the IMS Manual. Guidance from regulators on adaptive management would be integrated into the process and followed as applicable.

NexGen Adaptive Management Plan

An adaptive management plan is a tool that lays out a specific approach to risk management by following an established adaptive management process. NexGen's adaptive management process for the Project would be described in the IMS Manual and would be used as a guide to developing and applying adaptive management plans. For example, if environmental monitoring detects environmental changes that are different from predicted changes, the adaptive management framework in the relevant management plan would be implemented to determine if and what actions are needed to meet the underlying objectives of minimizing adverse effects and reducing uncertainty. Actions stemming from adaptive management may include more intensive or focused monitoring, specific studies to better understand a particular change in measurement indicators and associated environmental effects, improved or modified Project design, experimental treatments at small scales prior to full-scale implementation, or additional mitigation measures.

Adaptive management is context specific and would differ for each risk that needs to be managed. However, the adaptive management process would generally consist of the following sequential steps, which are the framework for NexGen's adaptive management process.

- **Assess:** Properly bounding the problem to the adaptive management process, and accurately and thoughtfully articulating the problem in the planning phase, is more likely to enable positive outcomes. Methods in this initial assessment step include:
  - setting goals for the adaptive management plan;
  - developing a conceptual model;
  - identifying risks;
  - identifying sources of uncertainty and risk;
  - stating the assumptions and limitations of the adaptive management plan;
  - identifying government organizations, Indigenous Groups, and public (i.e., stakeholders) that would be involved or engaged; and
  - assigning roles and responsibilities for the adaptive management plan.
- **Design:** Once the problem has been assessed and defined, an adaptive management plan can be designed to address the problem. This step is where implementation strategies are defined. Methods in this design step include:
  - developing and stating a hypothesis about the premise of the problem and the intended results;
  - identifying measurable indicators for the system being managed;
  - identifying actionable thresholds;
  - developing a monitoring plan to determine how the indicators would be assessed in terms of compliance with thresholds;
  - applying lessons learned within the process; and
  - defining timelines for monitoring, evaluation, and reporting.

- **Engage with Indigenous Groups and local community members:** Engagement may be required for parts of the process and provides an opportunity for key groups to provide feedback and support.
- **Implement:** Once the design phases are complete and relevant approvals obtained, the solution or strategy can be put into practice.
- **Monitor:** After the adaptive management plan has been implemented, information would be collected to understand outcomes and effects.
- **Evaluate:** Monitoring results, thresholds, mitigation, or goals would be compared against established criteria.
- **Adjust or terminate:** If the uncertainty becomes resolved, the adaptive management program can be discontinued. If the process did not meet the desired outcomes, informed adjustments to any part of the process can be made in the next iteration.

As an example, NexGen is developing an adaptive management plan to manage the specific issue of copper loading from the PAG WRSA to Patterson Lake in the far future. Adaptive management would be used to refine source terms, reduce uncertainty in future predictions, and adapt the level of mitigation in response to operational datasets. Monitoring seepages and runoff quality at the PAG and NPAG WRSAs during Operations and incorporating adaptive management into mitigation planning would be expected to result in reduced mass loading compared to what was conservatively predicted in the far-future surface water quality assessment.

Adaptive management is supplemental and complementary to the continual improvement processes outlined in the IMS Manual. NexGen is committed to achieving continual improvement in environmental performance through the management systems that would be implemented for the Project. NexGen would manage Project-environment interactions through the Environmental Protection Program.

23.5.4 Information Management and Reporting

Information management and reporting would be fundamental components of the IMS. Information collected through the environmental management programs would need to be efficiently managed, checked, reported, and reviewed regularly (internally and externally) to meet the objective of continual improvement. Processes for managing data collected as part of socio-economic management programs would be subject to the same general principles and requirements as data collected as part of the IMS.

Processes that define environmental data management storage, standards, and responsible roles would be described as part of the Environmental Protection Program. Data collected would meet the required guidelines for collection and quality assurance and control. NexGen would store information generated from the monitoring and follow-up programs in a robust database for future analysis and reporting.

Analysis of results from the monitoring and follow-up programs would be reported and submitted to the relevant regulatory agencies, as required, following the required schedule.

Reports from monitoring would be publicly available through the independent environmental monitoring and compliance reporting to government, as applicable. Other stakeholders would have access to publicly available information.

23.6 References

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Appendix 23A Summary of Project Environmental Design Features and Mitigation Measures

Abbreviations and Units of Measure

Abbreviation	Definition
EA	Environmental Assessment
EIS	Environmental Impact Statement
ERA	environmental risk assessment
HDPE	high-density polyethylene
IMS	Integrated Management System
ISO	International Organization for Standardization
LPA	local priority area
NexGen	NexGen Energy Ltd.
NPAG	non-potentially acid generating
PAG	potentially acid generating
Project	Rook I Project
UGTMF	underground tailings management facility
VC	valued component
WRSA	waste rock storage area

Unit	Definition
%	percent
m	metre

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List of Tables

Table 23A-1: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Including Linkages to Management and Monitoring Programs and Plans

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Implement a Project-specific **Environmental Protection Program**.	Avoid Minimize	High	Best management practice.	Hydrology Fish and Fish Habitat Wildlife and Wildlife Habitat Human Health Vegetation Terrain and Soils Surface Water Quality Other Land and Resource Use Air Quality Cultural and Heritage Resources and Indigenous Land and Resource Use
Implement site water management procedures under an **Environmental Protection Program** that include monitoring seepage from waste rock storage area and applying adaptive management, if necessary.	Minimize	High	Best management practice.	Terrain and Soils Vegetation Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Implement a Project-specific **Environmental Protection Program**, which includes actions to prevent, detect, and control areas with prohibited, noxious, and nuisance weed / invasive species (e.g., along the access road, airstrip, and loading or staging site), following best practice guidance.	Avoid Minimize	High	Best management and design practice. Measure required under licence or legislation. Wide application in various industry settings.	Vegetation Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Implement an **Environmental Protection Program** that includes **no harassing, feeding, or approaching wildlife**.	Avoid Minimize	High	Best management and design practice. Wide application in various industry settings. Wide application in region.	Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Implement an **Environmental Protection Program** with restricted activity periods to limit effects on denning animals and nesting migratory birds during sensitive time periods (e.g., per Nesting Zone B6 [ECCC 2018] guidelines and the *Migratory Birds Convention Act, 1994*). If sensitive periods cannot be avoided, pre-clearing wildlife sweeps will be completed by qualified professionals and buffers applied, as required.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings. Wide application in region. Measure required under licence or legislation.	Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Implement an **Environmental Protection Program,** which includes the following mitigation measures to minimize the risk of injury or mortality to wildlife: ▪ **advising workers (e.g., staff contractors) and visitors** to take all reasonable precautions to avoid wildlife collisions ▪ **providing wildlife with the right-of-way** ▪ **identifying wildlife use areas and migration corridors/crossings** along the access road and providing appropriate signage in high wildlife use areas (including consideration of Canadian toad) ▪ maintaining gaps in the road berms and snowbanks to facilitate wildlife crossing and escape routes ▪ **stopping and reporting/communicating when wildlife is observed on or adjacent to the road** and allow animals to move away before continuing to drive ▪ **reporting any wildlife collisions** observed along any road immediately ▪ **adjusting speed limit** in accordance with conditions (e.g., wildlife use of road, road conditions, grade, weather, and loads on vehicle)	Avoid Minimize	High	Best management and design practice. Wide application in various industry settings. Wide application in a similar climatic setting.	Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use

Table 23A-1: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Including Linkages to Management and Monitoring Programs and Plans

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Implement a Project-specific **Environmental Protection Program**, which includes processes for the following: ▪ prohibition against feeding wildlife ▪ lined contact water ponds would either be fenced or fit with animal egress matting or ramps ▪ other measures for deterring wildlife from site would be applied, where needed, for human and wildlife protection, including the use of cannons or bangers including prior to and during the nesting periods for Zone B6 (late April to mid August; ECCC 2018) and the northern and southern migration periods ▪ regular monitoring would be conducted to evaluate effectiveness of deterrents and water quality, and adaptive management would be applied, as necessary	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings. Wide and successful application in region.	Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Implement a Project-specific **Environmental Protection Program** that would include process for wildlife and bird deterrents around contact water ponds (e.g., fences, cannons, sonic guns), including prior to and during the nesting periods for Zone B6 (late April to mid August; ECCC 2018) and the northern and southern migration periods.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings. Wide and successful application in region.	Wildlife and Wildlife Habitat
Implement a Project-specific **Environmental Monitoring Plan** that includes monitoring for hydrology, water quality, sediment quality, aquatic organisms, fish, and wildlife, and applying adaptive management, if necessary.	Minimize	High	Best management practice.	Hydrology Fish and Fish Habitat Wildlife and Wildlife Habitat Human Health Vegetation Terrain and Soils Surface Water Quality Other Land and Resource Use Cultural and Heritage Resources and Indigenous Land and Resource Use
Implement a Project-specific **Environmental Monitoring Plan** that includes monitoring in the receiving environment in the vicinity of the Project, as required, in accordance with licence requirements and the federal Metal and Diamond Mining Effluent Regulations to monitor the potential effects of Project discharges on water and sediment quality, and on the fish population and benthic invertebrate community.	Avoid Minimize	High	Best management and design practice. Measure required under licence and legislation. Wide and successful application in various industry settings.	Fish and Fish Habitat Other Land and Resource Use Cultural and Heritage Resources and Indigenous Land and Resource Use
Implement a Project-specific **Environmental Monitoring Plan** that includes monitoring for soil quality to determine if Project activities (e.g., dust generation, other air particulate generation) are influencing soil chemistry.	Minimize	High	Best management practice.	Terrain and Soils Vegetation
Implement a Project-specific **Effluent and Emissions Plan**.	Minimize	High	Best management practice.	Wildlife and Wildlife Habitat Human Health Surface Water Quality Other Land and Resource Use Cultural and Heritage Resources and Indigenous Land and Resource Use
Implement a Project-specific **Effluent and Emissions Plan**.	Avoid Minimize	High	Best management practice.	Air Quality Surface Water Quality Fish and Fish Habitat Vegetation Wildlife and Wildlife Habitat Human Health Terrain and Soils Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Implement a Project-specific **Environmental Monitoring Plan**.	Minimize	High	Best management practice.	Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Implement an **Indigenous and Public Engagement Program** to share information on Project plans and activities. Summaries of relevant Project information will be translated and provided in audio format for sharing with Indigenous Groups, as relevant, and use of these additional communication methods will be based on discussions with Indigenous Groups.	Minimize	High	Best management practice.	Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use

Table 23A-1: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Including Linkages to Management and Monitoring Programs and Plans

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Implement an **Indigenous and Public Engagement Program** that includes, among other activities, sharing monitoring results with local communities, engagement of trappers and Indigenous land users to share Project information and address any issues as they arise, and sharing of environmental monitoring results with local communities.	Avoid Minimize	High	Best management practice.	Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Implement an **Indigenous and Public Engagement Program** to effectively engage with communities on Project activities, effects, mitigation, and monitoring to keep people informed and provide opportunities to provide feedback for continual improvement through a grievance mechanism.	Avoid Minimize	High	Best management practice.	Community Well-Being
Implement a Project-specific **Health and Safety Program**.	Avoid Minimize	High	Best management practice.	Noise
Implement a **Security Program** to provide safe and coordinated access via the access road to locations where other land and resource use is practiced.	Avoid Minimize	High	Best management practice.	Other Land and Resource Use Cultural and Heritage Resources and Indigenous Land and Resource Use
Identify Indigenous land users in **Security Program** and supporting documentation and outline the process to allow continued access to areas of importance.	Minimize	High	Best management practice. Wide and successful application in various industry settings.	Cultural and Heritage Resources and Indigenous Land and Resource Use
Implement a **Radiation Protection Program** to keep worker and visitor radiological exposures as low as reasonably achievable.	Minimize	High	Best management practice.	Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Implement a Project-specific **Conventional Waste Management Plan**.	Minimize	High	Best management practice.	Wildlife and Wildlife Habitat Climate Change Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Implement a Project-specific **Waste Management Program**.	Minimize	High	Best management practice.	Climate Change Human Health Other Land and Resource Use
Implement a Project-specific **Mine Waste Management Plan**.	Minimize	High	Best management practice.	Hydrogeology Fish and Fish Habitat Terrain and Soils Vegetation Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Implement a Project-specific **Mine Waste Management Plan** and site water management procedures.	Minimize	High	Best management practice.	Surface Water Quality Hydrology Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Develop and implement a **Preliminary Decommissioning and Reclamation Plan**.	Minimize Reclamation	High	Best management practice.	Hydrogeology Hydrology Surface Water Quality Fish and Fish Habitat Vegetation Terrain and Soils Wildlife and Wildlife Habitat Human Health Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use Community Well-Being
Develop a **Ground Transportation Emergency Response Plan** to address traffic safety on the access road, including education of workers (e.g., staff contractors).	Minimize	High	Best management practice.	Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use Community Well-Being

Table 23A-1: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Including Linkages to Management and Monitoring Programs and Plans

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Develop an **Emergency Response Assistance Plan** for the transportation of uranium concentrate from the mine site.	Minimize	High	Best management practice.	Other Land and Resource Use
Implement a Project-specific **Environmental Protection Program** and a Project-specific **Environmental Monitoring Plan** that includes adaptive management, if necessary.	Minimize	High	Best management practice.	Hydrogeology
Implement **Environmental Protection Program,** and **Caribou Mitigation and Offsetting Plan**.	Avoid Minimize Reclamation Offset	High	Best management practice.	Cultural and Heritage Resources and Indigenous Land and Resource Use
Controls would be implemented, and their effectiveness monitored to **prevent accidents and malfunctions via management system processes** defined in topic-specific programs which include, but may not be limited to the following: ▪ Integrated Management System Manual ▪ Health and Safety Program ▪ Radiation Protection Program ▪ Environmental Protection Program ▪ Waste Management Program ▪ Emergency Preparedness and Response Program ▪ Fire Protection Program ▪ Security Program ▪ Training Program ▪ Contractor Management Program ▪ Indigenous and Public Engagement Program ▪ Construction Management Program ▪ Commissioning Management Program ▪ Asset Management Program	Avoid Minimize	High	Best management practice.	Accidents and Malfunctions Applies to all disciplines
Develop a **Ground Transportation Emergency Response Plan** to mitigate safety risks related to the transportation of materials and equipment to and from the Project site. The Ground Transportation Emergency Response Plan would specifically include: ▪ transportation planning and management ▪ driver training ▪ traffic control, such as speed limits and signage ▪ radiation exposure monitoring and protection ▪ spill and emergency response ▪ environmental monitoring ▪ regulatory notification and external communication ▪ transportation emergency response ▪ provisions for mitigating the impacts effects of surface water, terrestrial, and atmospheric release emergencies as well as remediation and recovery provisions	Minimize	High	Best management practice.	Accidents and Malfunctions Other Land and Resource Use
Develop a **Fire Protection Program** that, in accordance with **Section 35 of *The Wildfire Act,*** includes frequently checking mobile equipment or machinery throughout its daily use for any accumulation of combustible material, with any accumulation found being removed and disposed of safely.	Avoid Minimize	High	Best management practice.	Accidents and Malfunctions

Table 23A-2: Summary of General Environmental Design Features and Mitigation Measures Proposed for the Rook I Project

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Limit the Project footprint to the extent practical using practices such as: ▪ designing an efficient infrastructure footprint (i.e., buildings clustered together) ▪ optimizing the use of cleared areas for Project activity ▪ using existing road infrastructure, including existing access road and bridge crossing ▪ storing tailings underground ▪ maximizing water diversion away from site facilities through design and the establishment of berms and grading	Avoid Minimize	High	Best management and design practice. Wide and successful application in mining industry.	Hydrology Surface Water Quality Fish and Fish Habitat Terrain and Soils Vegetation Wildlife and Wildlife Habitat Human Health Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use Community Well-Being
Locate the communications tower away from wetlands and other high suitability habitats for species at risk	Avoid Minimize	Medium	Best management and design practice.	Wildlife and Wildlife Habitat
Minimize areas of vegetation clearing and soil disturbance.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings (e.g., mining, aggregate extraction, or construction).	Hydrology Surface Water Quality Fish and Fish Habitat Terrain and Soils Vegetation Wildlife and Wildlife Habitat Human Health Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Implement **progressive reclamation and revegetation** of disturbed areas no longer required.	Reclamation	High	Best management and design practice. Wide and successful application in various industry settings.	Hydrology Surface Water Quality Terrain and Soils Vegetation Wildlife and Wildlife Habitat Human Health Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use Community Well-Being
Reclaim and revegetate areas where non-permanent Project facilities have been decommissioned.	Reclamation	High	Best management and design practice. Wide application in various industry settings.	Hydrology Surface Water Quality Fish and Fish Habitat Terrain and Soils Vegetation Wildlife and Wildlife Habitat Human Health Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use Community Well-Being
Install fire breaks at the Project site that would both align with fire break requirement assessments that would be completed for the Project and consider any input provided by the Saskatchewan Public Safety Agency.	Avoid Minimize	High	Best management and design practice. Wide application in various industry settings.	Accidents and Malfunctions

Table 23A-3: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Pertaining to Air, Noise, and Climate Change

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Limit idling of vehicles and equipment to the extent practical.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Air Quality Climate Change Surface Water Quality Fish and Fish Habitat Terrain and Soils Wildlife and Wildlife Habitat Human Health
Limit vehicle speed on unpaved site roads to reduce fugitive dust during Construction and Operations.	Minimize	High	Best management and design practice. Wide application in various industry settings.	Air Quality Surface Water Quality Terrain and Soils Vegetation Wildlife and Wildlife Habitat Human Health Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Evaluate opportunities to **reduce fuel combustion requirements** of infrastructure and equipment, to the extent practical, during detailed design.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Air Quality Climate Change Surface Water Quality Fish and Fish Habitat Terrain and Soils Vegetation Human Health
Use Tier 4 diesel mobile equipment for underground operations, whenever practical, with applicable mine ventilation airflow rates specified by Canada Centre for Mineral and Energy Technology, when available.	Minimize	High	Best management and design practice. Measure identified under guidance or management standard. Wide and successful application in mining industry.	Air Quality
Recover heat from the liquified natural gas power plant exhaust and use to heat other process and ancillary buildings, to the extent practical.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Air Quality Climate Change
Use and maintain emissions control devices on combustion-based equipment.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings (e.g., mining, aggregate extraction, or construction).	Air Quality Climate Change Surface Water Quality Fish and Fish Habitat Terrain and Soils Vegetation Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Use **pollution control technology** on process plant exhaust stacks with preventative maintenance and stack testing, as well as adaptive management, if necessary.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Air Quality
Identify and implement **procurement criteria** to confirm stationary and mobile engines meet applicable performance standards.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Air Quality Surface Water Quality Fish and Fish Habitat Climate Change Terrain and Soils Human Health Vegetation Wildlife and Wildlife Habitat

Table 23A-3: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Pertaining to Air, Noise, and Climate Change

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Maintain mobile mining equipment and vehicles and operate the equipment within parameters for engine exhaust system design.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings (e.g., mining, aggregate extraction, or construction).	Air Quality Climate Change Surface Water Quality Terrain and Soils Vegetation Human Health
During the Project lifespan, NexGen will **continue to evaluate monitoring and mitigation measures to track and minimize air pollution** and, where practical, implement any newly identified mitigation measures that are technically and economically feasible.	Minimize	Medium	Best management and design practice.	Air Quality Human Health
Install noise dampening structures in power plant generator facilities; install silencers in surface and underground large vent fans.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Noise Cultural and Heritage Resources and Indigenous Land and Resource Use
Implement procedures to **reduce noise, dust, and light** levels such as: ▪ **enclose or dampen equipment in process buildings** where the total sound power level is expected to be more than approximately 80 A-weighted decibels, where feasible ▪ **use noise suppression (mufflers) on vehicles** and inspect regularly to make sure they are functioning properly ▪ **limit light pollution** to the extent practical for built infrastructure	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Noise Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Maintain roads to minimize ruts and consequently reduce noise emissions from vehicles.	Minimize	Medium	Best management and design practice. Wide application in various industry settings (e.g., mining, aggregate extraction, or construction).	Noise Cultural and Heritage Resources and Indigenous Land and Resource Use
Primarily **use liquified natural gas for power generation**.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Air Quality Fish and Fish Habitat Climate Change Surface Water Quality Terrain and Soils Vegetation Wildlife and Wildlife Habitat Human Health Cultural and Heritage Resources and Indigenous Land and Resource Use
Optimize haul routes to reduce fuel consumption and emissions from equipment.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings (e.g., mining, aggregate extraction, or construction).	Air Quality Climate Change Surface Water Quality Fish and Fish Habitat Terrain and Soils Vegetation Human Health Cultural and Heritage Resources and Indigenous Land and Resource Use
Use excess steam generated from the acid plant to heat other process buildings, to the extent practical.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Climate Change
Use energy efficient LED lighting and other similar efficiencies to reduce electrical demand, where practical.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Climate Change
Where required, **remove merchantable trees and the majority of the woody debris with soils that are salvaged (where not planned for use in future reclamation activities)**, to maintain the carbon stocks and avoid release of carbon through decomposition.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Climate Change

Table 23A-3: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Pertaining to Air, Noise, and Climate Change

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Conduct **regular equipment maintenance**.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Air Quality Terrain and Soils Fish and Fish Habitat Vegetation Wildlife and Wildlife Habitat Human Health Climate Change Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Implement **energy management strategy** for measuring and evaluating thermal and electrical energy use.	Minimize	High	Best management practice.	Climate Change
Implement **a net-zero framework** and periodically re-assess alternative technologies and practices to responsibly manage energy use and GHG emissions.	Minimize	High	Wide and successful application of the framework. Effectiveness of new technologies to be determined.	Climate Change
Implement **greenhouse gas management strategy** to reduce emissions to the extent practical.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Climate Change

LED = light-emitting diode; GHG = greenhouse gas.

Table 23A-4: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Pertaining to Water and Aquatic Resources

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Isolate mine workings from groundwater inflows that could occur through high permeability strata with a hydrostatic liner in the shaft.	Avoid Minimize	High	Best management and design practice. Wide and successful application in mining industry.	Hydrogeology
Design and maintain a mine dewatering system to manage the flow of **groundwater inflow**.	Minimize	High	Best management and design practice. Wide and successful application in mining industry.	Hydrogeology Vegetation
Use **engineered cemented paste backfill and tailings** to control source concentrations.	Minimize	High	Best management and design practice. Wide and successful application in mining industry.	Hydrogeology Surface Water Quality Fish and Fish Habitat Vegetation Wildlife and Wildlife Habitat Human Health
Apply binder to reduce permeability in cemented paste backfill and tailings.	Minimize	High	Best management and design practice. Wide and successful application in mining industry.	Hydrogeology Surface Water Quality Fish and Fish Habitat Vegetation Wildlife and Wildlife Habitat Human Health
Segregate PAG material from NPAG material and store separately.	Minimize	High	Best management and design practice. Wide and successful application in mining industry.	Hydrogeology Surface Water Quality Terrain and Soils Fish and Fish Habitat Vegetation Wildlife and Wildlife Habitat Human Health
Contain and divert runoff and seepage from PAG waste rock, special waste rock, and ore to the effluent treatment plant.	Minimize	High	Best management and design practice. Wide and successful application in mining industry.	Hydrogeology Surface Water Quality Terrain and soils Vegetation Human Health
Install **engineered cover system** on PAG and NPAG material during reclamation.	Avoid Minimize	High	Best management and design practice. Wide and successful application in mining industry.	Fish and Fish Habitat Hydrogeology Surface Water Quality Wildlife and Wildlife Habitat Vegetation Human Health
Use **engineered containment and conveyance of PAG waste rock runoff** and seepage to the PAG Runoff Collection Area.	Avoid	High	Best management and design practice. Wide and successful application in mining industry.	Hydrology Wildlife and Wildlife Habitat
Implement **sedimentation and erosion control** best practices and standard mitigation (e.g., temporary sediment ponds, silt curtains, sediment traps) during all Project phases.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Hydrology Vegetation Wildlife and Wildlife Habitat Human Health
Use **erosion control measures** as required.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Hydrology Fish and Fish Habitat Vegetation Terrain and Soils Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use

Table 23A-4: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Pertaining to Water and Aquatic Resources

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Avoid placing soil stockpiles near waterbodies (i.e., maintaining a 150 m buffer from waterbodies and watercourses), and near natural drainage features, unless required for temporary storage.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings (e.g., mining, aggregate extraction, or construction).	Hydrology Surface Water Quality Fish and Fish Habitat Terrain and Soils Wildlife and Wildlife Habitat Human Health
Minimize steepness and length of slopes of disturbed areas and stockpiled soils.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings (e.g., mining, aggregate extraction, or construction).	Hydrology Fish and Fish Habitat Terrain and Soils Vegetation Wildlife and Wildlife Habitat Human Health Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Recycle and reuse process water to reduce fresh water intake and release to Patterson Lake, to the extent practical.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Hydrology Surface Water Quality Fish and Fish Habitat Human Health Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Provide **adequate contact water storage capacity** to allow controlled rate of release during both routine and non-routine operation scenarios.	Minimize	High	Best management and design practice. Measure required under guidance or management standard. Wide and successful application in various industry settings.	Hydrology Fish and Fish Habitat Terrain and Soils Wildlife and Wildlife Habitat Human Health
Perform maintenance of **water containment and conveyance structures** (i.e., roadside ditches and culverts) to limit the risk of road wash-out or sediment release to the environment.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Hydrology Surface Water Quality Fish and Fish Habitat Terrain and Soils Wildlife and Wildlife Habitat Human Health
Provide **adequate contact water storage capacity** to manage runoff and seepage from Project infrastructure and disturbed areas.	Avoid Minimize	High	Best management and design practice. Measure required under guidance or management standard. Wide and successful application in various industry settings.	Surface Water Quality Human Health
To the extent practical, **work in sensitive areas** (i.e., erosive soils, wetland features, and fish habitats) would be scheduled **to avoid periods that may result in high flow volumes and/or increase erosion and sedimentation** (e.g., spring freshet).	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Surface Water Quality Fish and Fish Habitat Terrain and Soils Vegetation Wildlife and Wildlife Habitat Human Health Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
To the extent practical, construct work areas to **avoid critical or sensitive habitat** (e.g., riparian zones) following best practices and regulatory requirements.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use

Table 23A-4: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Pertaining to Water and Aquatic Resources

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Apply DFO's *Measures to Avoid Causing Harm to Fish and Fish Habitat* (DFO 2019) to minimize potential adverse effects on aquatic resources.	Minimize	High	Best management and design practice. Measure identified under guidance or management standard. Wide and successful application in various industry settings.	Fish and Fish Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Design and **install appropriate site drainage** and water containment and conveyance structures on site.	Minimize	High	Best management and design practice. Measure required under guidance or management standard. Wide and successful application in various industry settings.	Fish and Fish Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Install and operate an effluent treatment plant and a sewage treatment plant to reduce release of constituents of potential concern (e.g., major ions, metals, radionuclides) to the environment and discharge treated effluent and treated sewage to Patterson Lake.	Minimize	High	Best management and design practice. Measure required under licence and legislation. Wide and successful application in various industry settings.	Surface Water Quality Fish and Fish Habitat Human Health Vegetation Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Design new roads such that road alignments **minimize the number of water features crossed and avoid sensitive areas** to the extent feasible.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Maintain mobile mining equipment and vehicles and monitor for leaks.	Avoid Minimize	High	Best management and design practice. Wide and successful application in mining industry.	Fish and Fish Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Confirm **heavy equipment (e.g., crane) used on site is properly maintained** and is free of leaks. ▪ Inspect loads to be moved across the Clearwater River for leaks	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Establish **appropriate site drainage**: ▪ where feasible, **preserve natural drainage** features to minimize alteration to drainage conditions in the area ▪ minimize interaction between the surface water system and erodible soils	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Where possible, **schedule in-water activities** to avoid work during DFO's *Saskatchewan Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat* (DFO 2013). Restricted activity periods for fish are as follows: ▪ all/winter spawning fish in northern Saskatchewan with lake trout present (1 September to 15 July) ▪ spring spawning fish in northern Saskatchewan within lake sturgeon (1 May to 15 July)	Minimize	High	Best management and design practice. Measure required under licence and legislation. Wide and successful application in various industry settings.	Fish and Fish Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Design in-water developments so that the structures minimize adverse effects on fish and fish habitat and avoid a harmful alteration disruption or destruction of fish habitat, as defined by the federal *Fisheries Act*, to the extent practical. **If required, develop a fish habitat offsetting plan** in consultation with DFO and with engagement of the local Indigenous communities.	Minimize Offset (if required)	High	Best management and design practice. Measure required under licence and legislation. Wide application in various industry settings.	Fish and Fish Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Design in-water components of site water management infrastructure (i.e., proposed fresh water intake, treated effluent diffuser, and treated sewage outfall) to minimize the potential for adverse effects on the aquatic environment and such that discharged flow does not interact with sediment, to the extent practical.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat Surface Water Quality Vegetation Wildlife and Wildlife Habitat Human Health

Table 23A-4: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Pertaining to Water and Aquatic Resources

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Design and locate shoreline developments (e.g., site roads, shoreline infrastructure, physical footprints of the conveyance pipes for the fresh water intake, treated effluent diffuser, and treated sewage outfall) to **minimize riparian vegetation loss and/or disturbance**, to the extent practical. Revegetate temporarily disturbed areas with suitable, native species after construction activities are complete.	Minimize	Medium	Best management and design practice. Wide application in various industry settings.	Fish and Fish Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
The **final treated effluent diffuser design** would avoid effects on ice cover.	Avoid	High	Best management and design practice. Wide and successful application in various industry settings (e.g., mining, aggregate extraction, or construction).	Cultural and Heritage Resources and Indigenous Land and Resource Use
Minimize the physical footprint of in-water developments (i.e., fresh water intake, treated effluent diffuser, and treated sewage outfall) to the extent practical.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Employ construction methods that **avoid or minimize the potential to cause injury or mortality to fish or disturb nearby habitats**, to the extent practical. Assemble in-water structures on shore, where practical, and float into position in Patterson Lake, and then submerge and anchor to the lake bottom.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Locate the fresh water intake in an area and depth of water that avoids sensitive or unique fish habitats, to the extent practical.	Avoid	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Design and **install a fish screen** on the fresh water intake in Patterson Lake to avoid or reduce entrainment or impingement of fish. Pump intake screens would be designed in accordance with DFO's *Freshwater Intake End-of-Pipe Fish Screen Guideline* (DFO 1995).	Avoid Minimize	High	Best management and design practice. Measure required under licence and legislation. Wide and successful application in various industry settings.	Fish and Fish Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Use existing roads, where feasible. Development of new public roads would not be required; the existing road from Highway 955 would be upgraded (i.e., widened to a surface width of 8 m) to support increased traffic volume and heavy vehicle/equipment use, allow for two-way traffic travel, and improve safety.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat Accidents and Malfunctions Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Transport employees and contractors to site by aircraft, or by bus from La Loche until the on-site airstrip is operational, to **limit the opportunity for people to fish along the access road for the Project**.	Minimize	High	Best management and design practice. Wide application in region. Wide application in mining industry.	Fish and Fish Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Install a gate at the site entrance (i.e., gatehouse) to control public access.	Minimize	High	Best management and design practice. Wide application in region. Wide application in mining industry.	Fish and Fish Habitat Vegetation Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Work with local Indigenous Groups and communities to **develop fishing policies** that consider both fisheries protection and traditional use activities.	Minimize	High	Best management and design practice. Wide application in region. Wide application in mining industry.	Fish and Fish Habitat Other Land and Resource Use Cultural and Heritage Resources and Indigenous Land and Resource Use

Table 23A-4: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Pertaining to Water and Aquatic Resources

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Confirm discharge (i.e., contact water, treated effluent, treated sewage) meets **discharge quality criteria** prior to release to the environment.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Hydrology Surface Water Quality Fish and Fish Habitat Vegetation Wildlife and Wildlife Habitat Human Health Other Land and Resource Use Cultural and Heritage Resources and Indigenous Land and Resource Use
Locate proposed treated effluent diffuser **away from sensitive or unique habitats**, to the extent practical.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Surface Water Quality Fish and Fish Habitat Vegetation Wildlife and Wildlife Habitat Human Health Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Design the treated effluent diffuser and treated sewage outfall to **provide effective mixing and dilution of the effluent** to limit the area of the receiving environment affected by mine discharge.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Surface Water Quality Fish and Fish Habitat Vegetation Wildlife and Wildlife Habitat Vegetation Human Health Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Adhere to guidance from regulators such as DFO as to the **allowable rate and timing of water withdrawals from the point of supply**.	Avoid Minimize	High	Best management and design practice. Measure required under legislation. Wide and successful application in various industry settings.	Hydrology Fish and Fish Habitat
Design cross-drainage structures to provide a conveyance for the maximum instantaneous flow resulting from a 1:100-year 24-hour storm event.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Hydrology Fish and Fish Habitat
Break drainage areas into **smaller catchment areas** to limit large areas of runoff and reduce the potential erosive energy.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Hydrology
Base **ditch geometry and erosion protection** on analysis of predicted peak flows and incorporate climate change effects so that the channels have sufficient capacity.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Hydrology
Discharge **water that meets acceptable discharge criteria** to Patterson Lake.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Hydrology
Monitor the flows before and after Construction at the outlet of Patterson Lake to quantify the change of flow and its effects on the aquatic environment.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Hydrology

Table 23A-4: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Pertaining to Water and Aquatic Resources

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Inspect and maintain **road embankments, ditches, ponds, and cross-drainage structures.**	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Hydrology
Discharge water to the watershed of origin, to the extent practical.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Hydrology
Treat sewage to **appropriate release limits** in accordance with provincial standards and licence/permit conditions	Avoid Minimize	High	Best management and design practice. Measure required under licence and legislation. Wide and successful application in various industry settings.	Surface Water Quality
Revegetate NPAG and PAG waste rock storage areas during reclamation to limit total suspended solids in surface runoff.	Minimize Reclamation	Medium	Best management and design practice. Wide application in mining industry.	Fish and Fish Habitat
Employ a crane to move heavy equipment and infrastructure across the Clearwater River in instances where loads exceed the legal rating or capacity of the bridge and options for reducing load size/weight are not feasible or practical (e.g., dismantling equipment, breaking down a load into smaller units).	Avoid	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat
Minimize the footprint of work areas adjacent to the Clearwater River and associated ingress/egress to limit the area of disturbance. Fording of the Clearwater River, or activities that could result in a direct disturbance to the bed or banks of the river, would not occur.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat
If an upgrade to the existing Clearwater River bridge is required, **avoid any permanent disturbance** below the high water mark of the Clearwater River.	Avoid	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat
Monitor water flows in the downstream aquatic environment at the outlet of Patterson Lake and apply adaptive management if changes in flows are larger than predicted and are affecting fish habitat.	Minimize	High	Best management and design practice. Wide application in various industry settings.	Fish and Fish Habitat
Minimize timeframes for site clearing and activities that expose soils, to the extent practical.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat
Construct in-water developments in **adherence with the conditions of any permits or authorizations** that may be issued for the Project from the appropriate regulatory agencies.	Minimize	High	Best management and design practice. Measure required under licence and legislation. Wide and successful application in various industry settings.	Fish and Fish Habitat
Locate the intake screen above the bottom of the waterbody to prevent entrainment of sediment and aquatic organisms associated with the bottom area.	Avoid	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat
Limit seepages from the special waste storage area with double liner and leak detection system.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat
Design stream crossing structures to **limit the area disturbed** and in a manner that protects the banks from erosion and maintains the flows.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat

Table 23A-4: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Pertaining to Water and Aquatic Resources

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Inspect culverts regularly and perform maintenance, as required, to prevent blockages from forming and causing ponding or backwater effects.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Fish and Fish Habitat
Follow DFO's *Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters* (Wright and Hopky 1998) for setback distances from Patterson Lake. If setback distances are approached, develop site-specific operating mitigations in consultation with DFO.	Minimize	High	Best management and design practice. Measure required under licence and legislation. Wide and successful application in mining industry.	Fish and Fish Habitat

NPAG = non-potentially acid generating; PAG = potentially acid generating; DFO = Fisheries and Oceans Canada.

Table 23A-5: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Pertaining to Terrestrial Resources

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
As part of reclamation activities, complete **contouring of disturbed areas** to minimize erosion, re-establish drainage, and encourage the growth of vegetation.	Minimize Reclamation	High	Best management and design practice. Wide and successful application in various industry settings.	Vegetation Wildlife and Wildlife Habitat Hydrology
Use stockpiled overburden and NPAG mine rock as fill to meet decommissioning requirements. Fill and **contour the site to blend with the natural surrounding topography**, to the extent practical**.**	Minimize Reclamation	High	Best management and design practice. Wide and successful application in various industry settings.	Vegetation Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Use **native species** or non-aggressive, non-native species appropriate for the conditions for revegetation.	Minimize Reclamation	High	Best management and design practice. Wide and successful application in various industry settings.	Vegetation Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Adhere to the *Federal Policy on Wetland Conservation* (Government of Canada 1991) to have **no net loss of wetland functions.**	Avoid Minimize Offset	High	Best management and design practice. Measure required under licence or legislation. Wide application in various industry settings.	Vegetation Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Implement best management practices and mitigation such as **spill prevention**.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Vegetation Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Promote natural propagation and regeneration to enhance reclamation along the access road and other Project rights-of-way.	Reclamation	Medium	Best management and design practice. Wide application in various industry settings.	Vegetation Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Work with government and Indigenous communities to develop caribou mitigation and offsetting actions.	Minimize Reclamation Offset	Medium	Best management and design practice. Wide application in various industry settings. Wide application in region.	Wildlife and Wildlife Habitat
Where practical, **maintain overflight altitudes of >300 m above ground level**.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Do not allow hunting by employees in areas within the Project footprint.	Avoid	High	Best management and design practice. Wide application in various industry settings. Wide application in region.	Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Apply water and/or suppressants to site roads, access road, and airstrip, as necessary. Use dust suppressants that minimize environmental risk and are government-approved for use.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Air Quality Surface Water Quality Fish and Fish Habitat Terrain and Soils Vegetation Wildlife and Wildlife Habitat Human Health Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use

Table 23A-5: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Pertaining to Terrestrial Resources

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Snow clearing along the access road to incorporate road pull-outs at regular intervals to provide refuge for wildlife.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings. Wide and successful application in a similar climatic setting.	Wildlife and Wildlife Habitat Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Align the fibre optic line **right-of-way adjacent to existing highway and access road**.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Vegetation Wildlife and Wildlife Habitat
Inspect construction equipment prior to arriving at site and clean, if required. Utilize maintenance shop to support cleaning, once constructed and as required.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Vegetation Wildlife and Wildlife Habitat
Site access road between gatehouse and mine terrace realigned during Project design to avoid a wetland.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Wildlife and Wildlife Habitat Terrain and Soils Vegetation
Use clearing equipment that minimizes surface disturbance, soil compaction, and topsoil loss (e.g., equipment with low ground pressure tracks or tires, blade shoes, brushes), where feasible.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Terrain and Soils Vegetation Wildlife and Wildlife Habitat
Where soils are prone to wind erosion, **tackify, cover, seed, and/or apply water during periods of high erosion potential** (e.g., summer and fall).	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Terrain and Soils
Design slopes for long-term stability.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Terrain and Soils
Mark clearly with an applicable **set-back distance and avoid known rare plants,** where feasible. Where disturbance to rare plants is unavoidable, compensation would be considered following discussion with and guidance from regulators.	Avoid Minimize	High	Best management and design practice. Measure required under licence or legislation. Wide and successful application in various industry settings.	Vegetation
Procure clean construction materials and procure seed mixes that work to **avoid the introduction of noxious weeds.**	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Vegetation
Design power lines to **meet avian-safe standards** in compliance with applicable laws, regulations, and permits, to prevent electrocutions (e.g., cover jumper wires, conductors and equipment), discourage perching and prevent collisions (e.g., install markers to enhance the visibility of lines in key movement corridors and staging areas).	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Wildlife and Wildlife Habitat
To avoid and limit attraction of wildlife to the Project site, collect domestic (e.g., food) and industrial (e.g., used oil and lubricants) waste and temporarily store in wildlife-proof containers, incinerated on site, transported off site for recycling, or disposed at a licensed disposal facility, as appropriate.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings. Wide and successful application in region.	Wildlife and Wildlife Habitat

Table 23A-5: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Pertaining to Terrestrial Resources

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Conduct wildlife patrols regularly during waterbird nesting periods (Zone B6: late April to mid-August; ECCC 2018) and the northern and southern migration periods to monitor effectiveness of deterrents and apply adaptive management, as necessary.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings. Wide and successful application in region.	Wildlife and Wildlife Habitat
Implement source control (i.e., construction using engineered layers) and installation of liner for the PAG waste rock storage area.	Avoid Minimize	High	Relatively new technology, however the application has been proven in pilot and full-scale piles.	Wildlife and Wildlife Habitat
Design above-ground infrastructure so that the need for wildlife crossing structures is minimized (e.g., small to moderate diameter pipeline conveyance systems directly along the ground, often through low points such as small ditches).	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Wildlife and Wildlife Habitat
If sensitive species are confirmed in the Project footprint, **apply activity restriction guidelines for sensitive species** established by the Government of Saskatchewan (ENV 2017) to the Project as required.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings. Wide application in region. Measure required under licence or legislation.	Wildlife and Wildlife Habitat
If in specific situations where the setback distance(s) cannot practically be applied, contact the ENV early in the planning stage to **minimize effects on sensitive species**.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings. Wide application in region. Measure required under licence or legislation.	Wildlife and Wildlife Habitat
Minimize habitat creation and human-wildlife interactions for the Project through design; specifically, by evaluating opportunities to include screening on vents and entranceways to rafters/attics.	Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Wildlife and Wildlife Habitat
If bats or birds are observed nesting, roosting, or hibernating, **do not disturb** them, to the extent practicable. **Contact the ENV and Environment and Climate Change Canada (ECCC) to discuss measures for the removal/relocation** and to identify further measures that could prevent future access. Damage or danger permits may be obtained, if required.	Minimize	High	Wide application in region. Measure required under licence or legislation.	Wildlife and Wildlife Habitat
For worker protection and prevention of the spread of rabies and white nose syndrome, **contact the ENV and ECCC if any sick, injured, or dead bats are observed.** Only trained and rabies-vaccinated staff or contractors would be allowed to handle bats. Submit bat carcasses for testing of rabies and/or white nose syndrome, as appropriate, based on communications with the ENV and ECCC.	Avoid Minimize	High	Best management and design practice. Wide application in region. Measure required under licence or legislation.	Wildlife and Wildlife Habitat
To the extent practical, **skirt buildings and stairs to the ground** to limit opportunities for use as shelter by wildlife.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Wildlife and Wildlife Habitat
To **minimize bird and bat collisions** with the communication tower: ▪ **limit the tower lighting** to only what is required for aviation safety (e.g., flashing light on the top of the tower); ▪ **minimize guy wires** on the communication tower and install markers to enhance the visibility of any guy wires that may be required; and ▪ **follow avian-safe standards** in compliance with applicable laws, regulations, permits, and best management practices to prevent electrocution (e.g., cover jumper wires, conductors, equipment) and avoid attraction by lights.	Minimize	Medium	Best management and design practice. Wide and successful application in various industry settings.	Wildlife and Wildlife Habitat

Table 23A-5: Summary of Environmental Design Features and Mitigation Measures Proposed for the Rook I Project Pertaining to Terrestrial Resources

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Other than where required to comply with regulatory guidelines (e.g., aviation safety) or worker health and safety, the **following guidance will be used for Project lighting** design when migratory birds may be present: ▪ **limit the use of decorative lighting and solid burning or slow pulsing warning lights**; ▪ to the extent possible, **orient lights downward or use shielded fixtures and limit light use** to areas where Project activities are occurring (Dick 2016); ▪ to the extent feasible, **use the amber light [spectrum >500 nanometre], limit blue spectral light, and do not use white light**, (Dick 2016); and ▪ **turn off lights when not in use** (e.g., use timers, motion sensors) (Dick 2016).	Minimize	Medium	Best management and design practice. Wide and successful application in various industry settings.	Wildlife and Wildlife Habitat
If vegetation removal is required during the black bear denning/hibernation periods, conduct bear den presence/absence surveys and wildlife tree surveys prior to clearing activities.	Avoid Minimize	High	Best management and design practice. Wide and successful application in various industry settings.	Wildlife and Wildlife Habitat

> = greater than; NPAG = non-potentially acid generating; PAG = potentially acid generating.

Table 23A-6: Summary of Mitigation and Enhancement Measures Proposed for the Rook I Project Pertaining to the Socio-Economic Environment

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Implement Benefit Agreements, including: ▪ funding and human resources to support community-related initiatives including but not limited to cultural and traditional values ▪ the establishment of an Implementation Committee to communicate regularly and to reach early resolution of issues and/or disputes that may arise	Minimize	High	Best management practice. Wide application in various industry settings.	Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Establish an **Environmental Committee** to monitor environmental performance of the Project.	Minimize	High	Best management practice.	Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Provide funding for **full-time independent Indigenous Monitors** to enable unrestricted environmental monitoring, subject to the Indigenous Monitor complying with appropriate health safety and other reasonable site-specific requirements.	Minimize	High	Best management practice.	Cultural and Heritage Resources and Indigenous Land and Resource Use Other Land and Resource Use
Implement a chance find procedure during land clearing activities.	Minimize	Medium	Best management and design practice. Wide application in various industry settings (e.g., mining, aggregate extraction, or construction).	Cultural and Heritage Resources and Indigenous Land and Resource Use
Develop and maintain a **business opportunities workplan** that describes the steps NexGen and each primary Indigenous Group would take to achieve the desired outcomes of the respective Benefit Agreement.	Enhance Minimize	Medium	Best management practice.	Economy Community Well-Being
Implement provisions of **Benefit Agreements** related to culture, traditional values, employment, training, and economic development.	Enhance Minimize	High	Best management practice.	Economy Community Well-Being
Establish an **Implementation Committee** to provide a forum for regular communication and information exchange between NexGen and communities for effective management of the Benefit Agreement commitments and for the early resolution of issues and/or disputes that may arise.	Avoid Minimize	High	Best management practice.	Community Well-Being
Develop and implement **pre-Construction communications process** to raise public awareness in communities of potential Project opportunities and effects.	Avoid Minimize Enhance	High	Best management practice.	Community Well-Being
Provide **advance notice** of business opportunities.	Minimize	High	Best management practice.	Economy
Provide a **first preference to local businesses** that meet or exceed procurement process requirements.	Enhance	High	Best management practice.	Community Well-Being
Work with local communities to **maintain a local business registry**.	Enhance	High	Best management practice. Wide application in various industry settings.	Economy Community Well-Being
Establish a long-term aspirational target of **30% of external spending** being awarded to LSA and RSA businesses.	Enhance	Medium	Best management practice.	Economy Community Well-Being
Design procurement practices to increase involvement of local businesses within the LSA and RSA including providing information to communities on the size and timing of contracting opportunities.	Enhance	High	Best management practice.	Community Well-Being
Pre-qualify each Indigenous business listed in the business registry and provide feedback to any Indigenous business that does not successfully pre-qualify.	Minimize	High	Best management practice.	Economy
Develop and implement a **single source process and a preferred competitive bid process** to facilitate the success of capable and suitably qualified Indigenous businesses.	Minimize	High	Best management practice.	Economy
Use best efforts to provide qualified local residents with a **first preference for employment and training opportunities**.	Enhance	Medium	Best management practice. Wide application in various industry settings.	Economy Community Well-Being
Support and promote Indigenous community **participation and employment** in the traditional economy.	Enhance	Medium	Best management practice.	Economy
Work with local communities to **develop culturally-sensitive employment policies** to address both recruitment and retention barriers.	Minimize Enhance	Medium	Best management practice.	Economy
Work with local communities to **develop culturally-sensitive employment policies** to facilitate involvement in resource harvesting activities.	Minimize	Medium	Best management practice.	Community Well-Being
Set a long-term aspirational target of **75% of the Project's workforce** being composed of LSA residents.	Enhance	Medium	Best management practice.	Economy Community Well-Being
Prioritize **advancement** of qualified local residents into increasingly senior positions.	Enhance	Medium	Best management practice.	Economy Community Well-Being

Table 23A-6: Summary of Mitigation and Enhancement Measures Proposed for the Rook I Project Pertaining to the Socio-Economic Environment

Environmental Design Features and Mitigation	Mitigation Hierarchy of Control	Level of Mitigation Effectiveness	Mitigation Effectiveness Rationale	Discipline
Implement a tailored **local workforce recruitment strategy** to confirm that LSA residents are fully aware of and understand access to Project employment opportunities.	Minimize Enhance	Medium	Best management practice.	Economy Community Well-Being
Develop and implement **human resource policies** (e.g., employee and family assistance program) to assist workers in finding information and referral services for family-related resources, as required.	Minimize	High	Best management practice.	Community Well-Being
Provide **employment readiness training** for employees.	Minimize	High	Best management practice.	Community Well-Being
Establish a **mentoring program** to support long-term participation of LSA residents in the Project workforce.	Minimize Enhance	High	Best management practice.	Economy Community Well-Being
Work with relevant training institutions to facilitate delivery of **certified and accredited training and recruitment programs for construction and mining-related skills** targeted at employment opportunities for LSA residents and continue to provide scholarship and summer student opportunities.	Minimize Enhance	Medium	Best management practice.	Economy Community Well-Being
Provide **dedicated space for Elders** to be available to support employees to assist with employee retention.	Enhance	High	Best management practice.	Economy Community Well-Being
Hold discussions, as required, with the Government of Saskatchewan on **provincial road use, maintenance, and upgrades to inform provincial planning purposes**.	Minimize	Medium	Best management practice.	Community Well-Being
If required, develop a **fish habitat offsetting plan** in consultation with DFO and with engagement of the local Indigenous Groups.	Offset	High	Best management practice.	Cultural and Heritage Resources and Indigenous Land and Resource Use
Maintain ongoing communication with employees and contractors about future workforce and contracting needs and the schedule for Decommissioning and Reclamation (i.e., Closure).	Avoid Minimize	High	Best management practice.	Economy Community Well-Being
Implement a **workforce transition plan** to address reduction in employment and training opportunities during slowdowns and shutdowns associated with care and maintenance and Closure.	Minimize Enhance	Medium	Best management practice.	Economy Community Well-Being
Establish a **Project feedback and grievance mechanism** to record and action issues identified by local priority area residents (or other members of the public).	Minimize	High	Best management and design practice. Wide and successful application in various industry settings. Wide and successful application in region.	Other Land and Resource Use

DFO = Fisheries and Oceans Canada; LSA = local study area; RSA = regional study area.

Table 23A-7: Summary of Commitments Developed during the Provincial Environmental Assessment Review Process

Commitment
As part of the Permit to Operate a Pollutant Control Facility, NexGen will provide an analysis showing the predicted noise effects (after the incorporation of design features and mitigations) on workers staying in the on-site Project camp.
NexGen will hold discussions with the Saskatchewan Ministry of Highways, as required, regarding the development of road upgrade and maintenance cost-sharing agreements between NexGen and the Government of Saskatchewan for Highway 955.

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23A1 REFERENCES

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Appendix 23B Environmental Assessment Monitoring and Follow-Up Programs Proposed for the Project

Abbreviations and Units of Measure

Abbreviation	Definition
NexGen	NexGen Energy Ltd.
Project	Rook I Project

Unit	Definition
m	metre

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Table 23B-1: Environmental Assessment Monitoring and Follow-Up Programs Proposed for the Rook I Project

EIS Section	Valued Component	Project Phase and Potential Effects	Monitoring Objectives	Conceptual Monitoring Activities	Suggested Duration	Implementing Program/Plan/Study
Section 7.2 Air Quality	n/a (intermediate component)	**All Project phases:** ▪ Emissions of criteria air contaminants from Project activities could affect air quality	▪ Verify predictions in the assessment ▪ Verify compliance with Saskatchewan Ambient Air Quality Standards ▪ Evaluate the effectiveness of mitigation ▪ Identify unanticipated negative effects and need for additional mitigation	▪ An Effluent and Emissions Plan would be implemented that sets out criteria for emission monitoring and reporting (e.g., reporting to the National Pollutant Release Inventory). Monitoring activities would include: o incinerator stack testing o calciner stack testing o acid plant stack testing o ongoing passive or active monitoring for sulphur dioxide, nitrogen dioxide, radon, particulates, radionuclides o ongoing meteorological monitoring	During all Project phases	▪ Environmental Protection Program ▪ Environmental Monitoring Plan ▪ Effluent and Emissions Plan
Section 7.3 Noise	n/a (intermediate component)	**All Project phases:** ▪ Noise emissions from Project equipment and activities would increase noise levels	▪ Verify predictions in the assessment ▪ Verify monitoring results against regulatory noise thresholds considered in the EIS (Environment Canada 2009; Health Canada 2017; AER 2007) ▪ Confirm absence of clear tonal components in Project noise emissions ▪ Identify unanticipated negative effects and need for additional mitigation	▪ Follow-up noise monitoring would be conducted in accordance with methods from AER Directive 038 (AER 2007) ▪ Noise levels would be measured at a minimum of three receptors for a period of not less than 24 hours using integrating sound level meters. Monitoring data would be post-processed to obtain representative $L_{eq,day}$ $L_{eq,night}$ and L_{dn} values for each receptor ▪ Representative $L_{eq,day}$, $L_{eq,night}$, and L_{dn} values would be compared to model predictions from the EIS and to regulatory thresholds. If noise monitoring shows compliance with regulatory thresholds, then additional noise monitoring would not be required unless and until there were substantial changes to noise-emitting activities (e.g., addition of new equipment that was not modelled or assessed in the EIS)	Once during Construction, and once during Operations	▪ Discipline-specific follow-up study
Section 7.4 Climate Change	Climate Change	**All Project phases:** ▪ Greenhouse gas emissions from Project components and activities would contribute to climate change	▪ Verify estimates in the assessment are reasonable and conservative ▪ Evaluate the effectiveness of mitigation ▪ Track progress toward Net-Zero emissions	▪ Project GHG emissions would be quantified annually ▪ Project GHG emissions would be reported annually to applicable regulatory reporting program, which is Canada's Greenhouse Gas Reporting Program (ECCC 2019) ▪ Implement energy management strategy for measuring and evaluating thermal and electrical energy use	During all Project phases	▪ Environmental Protection Program ▪ Energy management strategies ▪ Waste Management Program ▪ Conventional Waste Management Plan

Table 23B-1: Environmental Assessment Monitoring and Follow-Up Programs Proposed for the Rook I Project

EIS Section	Valued Component	Project Phase and Potential Effects	Monitoring Objectives	Conceptual Monitoring Activities	Suggested Duration	Implementing Program/Plan/Study
Section 8 Hydrogeology	n/a (intermediate component)	**All Project phases:** ▪ Groundwater inflow to the underground mine may affect surface water elevations and flow rates ▪ Seepage from the WRSAs may cause changes and alter groundwater, surface water, and sediment quality in Patterson Lake **Closure:** ▪ Groundwater seepage from the WRSAs to Patterson Lake may adversely affect groundwater, surface water, and sediment quality after Closure ▪ Groundwater seepage from the UGTMF and backfilled production stopes to Patterson Lake may adversely affect groundwater, surface water, and sediment quality after Closure	▪ Verify predictions in the assessment are reasonable and conservative ▪ Evaluate effectiveness of mitigation and reclamation ▪ Identify unanticipated negative effects and need for additional mitigation	The plan for monitoring groundwater quantity and quality as a part of the Project, including continued monitoring of background wells located upgradient of the Project footprint, would be detailed in the Environmental Monitoring Plan. Provisions of the Environmental Monitoring Plan would include: ▪ groundwater elevation measurements to determine groundwater flow direction and gradients ▪ sampling to confirm groundwater quality to detect potential releases of COPCs and to support continued refinement of the conceptual site model (e.g., risk of effects from the Project) A focus of the Environmental Monitoring Plan would be the establishment of monitoring systems to evaluate the effectiveness of groundwater protection controls. Groundwater monitoring targets would be selected under the plan to achieve the identified monitoring objectives. These targets would include monitoring of groundwater elevations and groundwater quality in the bedrock and overburden to monitor the effects of the following: ▪ dewatering during construction and development of the shaft, underground mine, and UGTMF ▪ seepage from the WRSAs ▪ seepage from the process and mine terrace areas, including the fuel and reagent storage areas and equipment such as diesel fuel generators ▪ seepage from the area of the effluent treatment ponds	Groundwater monitoring would continue through all Project phases. The need for and duration of monitoring would be re-evaluated based on an annual review of monitoring data	▪ Environmental Protection Program ▪ Environmental Monitoring Plan ▪ Mine Waste Management Plan
Section 9 Hydrology	n/a (intermediate component)	**All Project phases:** ▪ Project activities and footprint may divert site runoff from its natural course and change drainage areas ▪ Project activities may affect basin yields, and in turn affect waterbody water surface elevations and watercourse flows, through changes in water balance and hydrological processes in the upstream contributing area **Construction and Operations:** ▪ Changes in watercourse flows from Project activities may cause erosion downstream, alter stream channel sediment transport and stream channel parameters, and affect shoreline integrity	▪ Verify predictions in the assessment are reasonable and conservative ▪ Evaluate the effectiveness of mitigation and reclamation ▪ Identify unanticipated negative effects and need for additional mitigation	Hydrometric monitoring and data collection initiated for baseline studies would continue. Selected hydrometric stations would also be monitored during the Project phases using remotely operated telemetry stations, which could be used to verify the receiving environment predictions of minimal changes in flows and water levels during the proposed Project duration in the future. Proposed remotely operated stations being considered include the following: ▪ Clearwater River below Patterson Lake ▪ Clearwater River below Beet Lake ▪ Clearwater River below Naomi Lake ▪ Clearwater River above the confluence with the Mirror River ▪ Clearwater River below Broach Lake	During all Project phases. The need for and duration of monitoring would be re-evaluated based on an annual review of monitoring data	▪ Environmental Protection Program ▪ Environmental Monitoring Plan

Table 23B-1: Environmental Assessment Monitoring and Follow-Up Programs Proposed for the Rook I Project

EIS Section	Valued Component	Project Phase and Potential Effects	Monitoring Objectives	Conceptual Monitoring Activities	Suggested Duration	Implementing Program/Plan/Study
Section 10 Surface Water Quality and Sediment Quality	n/a (intermediate component)	**Construction, Operations, and Active Closure Stage:** ▪ Project activities may result in deposition of fugitive dust emissions (e.g., particulate matter, metals, radionuclides), and criteria air contaminant emissions (e.g., particulate matter, sulphur, nitrogen oxides) on local and regional waterbodies and watercourses may adversely affect surface water quality ▪ Direct discharge of treated effluent and sewage during Construction, Operations, and Closure may affect surface water quality in Patterson Lake and in downstream waterbodies and watercourses **Construction and Operations:** ▪ Seepage from the WRSAs may affect groundwater quality and affect surface water quality in Patterson Lake and in waterbodies and watercourses farther downstream **Following Closure:** ▪ Runoff and seepage from the WRSAs and groundwater flow from the UGTMF may affect groundwater quality and surface water quality in Patterson Lake	▪ Verify the predictions of the EIS and confirm that the aquatic ecosystem in the receiving environment is protected, and that the site contact water management infrastructure is operating as designed ▪ Confirm the adequacy of the study areas (i.e., confirm that effects do not extend beyond boundaries) ▪ Track the trajectories of COPCs that were identified in sensitivity analyses, such as chloride, cobalt, copper, and phosphorus, so that these COPCs can be proactively and adaptively managed ▪ Evaluate the effectiveness of the surface water protection controls in place, and the effectiveness of reclamation and other mitigation actions ▪ Identify unanticipated negative effects, including possible accidents and malfunctions, and need for additional mitigation	**Site Contact Water and Operational Discharge Monitoring during Construction, Operations, and the Active Closure Stage** (includes the monitoring of Project processes, the area affected by the Project footprint, and treated effluent). Site contact water monitoring would be described in documentation for the Environmental Protection Program, along with the controls and monitoring of the on-site water management infrastructure. This monitoring would also generate information regarding water quality from each of the sources that contribute to site water to be managed and the effectiveness of mitigation to manage the water quality of site contact water. Such sources would include runoff chemistry from WRSAs. This information will be critical to reducing uncertainty in the far future water quality predictions through adaptive management and in the design of the receiving environment monitoring in the far future. The Effluent and Emissions Plan would include the sampling and analysis of treated effluent in ponds and confirmation that these waters meet release targets prior to release to the environment. The monitoring in the Effluent and Emissions Plan would also include monitoring components to meet MDMER requirements at the final point of discharge as well as other release criteria that are derived through licensing. The site-wide water balance and water quality models would be refined and updated to reflect site conditions and supporting information changes. Water quality monitoring would be required prior to release of non-mineralized contact water, treated contact water (i.e., treated effluent), and treated sewage to the environment. **Surface Water Quality Receiving Environment Monitoring** The surface water quality monitoring established for baseline data collection in Patterson Lake and the downstream waterbodies and watercourses in the LSA would form the basis for monitoring in the receiving environment throughout the Project lifespan. The majority of the receiving environment surface water quality monitoring stations would be located within the LSA (i.e., 14 of 16 proposed monitoring locations would be located within the LSA), including locations in Broach Lake, Patterson Lake (i.e., North Arm East Basin, North Arm West Basin, and South Arm), Forrest Lake, Beet Lake, and Naomi Lake. The stations outside of the LSA would include monitoring location in the Clearwater River downstream of Naomi Lake and in the Clearwater River at the boundary of the RSA. Sediment quality monitoring would also be conducted at these stations. Surface water quality receiving environment monitoring would take place seasonally (i.e., four times per year), with the frequency of monitoring at the exposure/reference stations for MDMER as prescribed in the regulations. Sediment quality monitoring would be conducted once a year, most likely in late summer or fall. A comprehensive list of water quality and sediment quality constituents would be measured in samples collected from the field and submitted for laboratory analyses, including general parameters, the identified COPCs, and constituents prescribed by the MDMER for metal and mining EEM. The Environmental Monitoring Plan would include surface water quality monitoring at the edge of the RMZ. This monitoring would meet MDMER requirements in the receiving environment where water is exposed to effluent (i.e., the exposure area; RMZ monitoring in Patterson Lake North Arm – West Basin). Surface water quality receiving environment monitoring would take place at Broach Lake and data collected would be used as reference for where waters are not exposed to the discharge. Sediment quality monitoring would also be conducted at the RMZ stations to confirm EIS predictions and to inform EEM requirements per the MDMER. Surface water quality monitoring would be conducted at four small lakes (i.e., Lake C, Lake D, Lake E, Unnamed Lake 1, and Unnamed Lake 2) to evaluate effects of the deposition of air emissions. Monitoring in these lakes would be limited to the open water season (e.g., following freshet and in fall). To confirm the prediction of negligible effects on wetlands, NexGen would conduct water level, water quality, and sediment quality sampling and monitoring of wetlands within and adjacent to the Project footprint and representative wetlands within the LSA. From the results of these surveys, a detailed recommendation for follow-up monitoring during the life of the Project would be developed, if necessary.	The conceptual monitoring as described would apply for Construction and Operations, which may be re-evaluated based on an annual review of the monitoring data For Closure and following Closure, the conceptual monitoring and duration would be developed based on the site contact water and receiving environment monitoring data collected near the end of Operations and during Closure	▪ Environmental Protection Program ▪ Environmental Monitoring Plan ▪ Effluent and Emissions Plan

Table 23B-1: Environmental Assessment Monitoring and Follow-Up Programs Proposed for the Rook I Project

EIS Section	Valued Component	Project Phase and Potential Effects	Monitoring Objectives	Conceptual Monitoring Activities	Suggested Duration	Implementing Program/Plan/Study
Section 11 Fish and Fish Habitat	▪ Lake trout (*Salvelinus namaycush*) ▪ Lake whitefish (*Coregonus clupeaformis*) ▪ Walleye (*Sander vitreus*) ▪ Northern pike (*Esox lucius*)	**Construction, Operations, and Active Closure Stage:** ▪ Project activities and discharge (e.g., treated effluent and treated sewage discharge, runoff from the Project footprint, air and dust emissions, runoff and seepage from the WRSAs) may cause changes to water and sediment and adversely affect fish habitat availability, survival, and reproduction ▪ Project activities and discharge (e.g., treated effluent and treated sewage discharge, runoff from the Project footprint, air and dust emissions) may change nutrient concentrations in the aquatic receiving environment, and affect fish habitat availability, survival, and reproduction ▪ Physical loss or alteration of fish habitat in Patterson Lake from the Project footprint, including the fresh water intake, treated effluent diffuser, treated sewage outfall, may affect fish habitat availability **After Closure, and into the far future:** ▪ Runoff and seepage from the WRSAs and groundwater flow from the UGTMF may alter surface water quality in Patterson Lake and adversely affect fish habitat availability, survival, and reproduction	▪ Verify the predictions of the EIS and confirm that the aquatic ecosystem in the receiving environment is protected ▪ Monitor for changes to fish and fish habitat, including lower trophic level community conditions (e.g., benthic invertebrates) in the receiving environment as a result of Project activities ▪ Evaluate the effectiveness of mitigation measures and modify or enhance as necessary through monitoring and developing updated mitigation, if needed ▪ Identify unanticipated negative effects, including from possible accidents and malfunctions, and need for additional mitigation	The Environmental Monitoring Plan would be implemented to monitor effects on fish and fish habitat during the Project lifespan and apply adaptive management, where necessary. Monitoring results would be used to adjust or adapt mitigation measures or reclamation approaches used to minimize Project effects on fish. The key components of the aquatic ecology elements of the Environmental Monitoring Plan are expected to include monitoring of benthic invertebrates and fish. Monitoring during the Project lifespan is proposed to be undertaken every three years, and would be carried out in accordance with the MDMER, EEM requirements (Environment Canada 2012), and with conditions identified through the licensing processes. The monitoring program for benthic invertebrates and fish would be designed to integrate the requirements of an EEM biological monitoring study (Environment Canada 2012), as required under the MDMER. The results of the water and sediment quality surveys described above would provide supporting information for benthic invertebrate and fish monitoring programs. Monitoring stations for benthic invertebrates and fish would be strategically located within the LSA, and especially in Patterson Lake, to capture any potential effects in receiving waters as well as in reference waters. These stations would be identified under guidance of MDMER, Saskatchewan Ministry of Environment, and Canadian Nuclear Safety Commission within the licensing process, and would be co-located with water and sediment quality sampling stations. The final study design for the Environmental Monitoring Plan and EEM would be determined through the permitting process and detailed planning, which would include engagement with regulatory agencies and local Indigenous communities. To the extent possible, monitoring and sampling techniques and analysis procedures would be consistent with methods used during the baseline survey period. In compliance with MDMER, the federal *Fisheries Act*, the Canadian Nuclear Safety Commission operating licence, and the Saskatchewan Ministry of Environment operating licence requirements, results of biological monitoring in the receiving environment would be reported in EEM reports on the schedule required by licences and regulations.	During all Project phases. The need for and duration of monitoring would be re-evaluated based on an annual review of monitoring data	▪ Environmental Protection Program ▪ Environmental Monitoring Plan
Section 12 Terrain and Soils	n/a (intermediate component)	**All Project phases:** ▪ Alteration of soil and terrain conditions (i.e., quantity, quality, and distribution) may adversely affect soil productivity and the types of ecosystems that can be reclaimed on the landscape	▪ Evaluate the effectiveness of the environmental protection measures (e.g., soil erosion, stockpiling soil for reclamation) and modify or enhance as necessary through monitoring and updating mitigation measures, if needed ▪ Identify unanticipated negative effects, including possible accidents and malfunctions	Slope monitoring to assess terrain stability would be completed during land clearing, site preparation works, and the construction of facilities. To minimize disturbances of soil quality and quantity, soils would be monitored during site clearing, contouring, and excavation activities for signs of admixing, compaction, and erosion.	During all Project phases. The need for and duration of monitoring will be revaluated based on an annual review of monitoring data	▪ Environmental Protection Program

Table 23B-1: Environmental Assessment Monitoring and Follow-Up Programs Proposed for the Rook I Project

EIS Section	Valued Component	Project Phase and Potential Effects	Monitoring Objectives	Conceptual Monitoring Activities	Suggested Duration	Implementing Program/Plan/Study
Section 13 Vegetation	▪ Upland ecosystems ▪ Wetland ecosystems ▪ Riparian ecosystems ▪ Traditional use plant species	**All Project phases:** ▪ Direct loss, alteration, and fragmentation of upland, wetland, and riparian ecosystems and traditional use plants could occur as a result of the Project ▪ Alteration of final terrain, soil conditions, and/or plant species composition could change the types of ecosystems and traditional use plants that can be reclaimed on the landscape, adversely affecting vegetation ecosystem availability, distribution, and condition	▪ Evaluate the effectiveness of the environmental protection measures (e.g., preventing soil erosion, stockpiling soil for reclamation, preventing the introduction of invasive weeds) ▪ Assess the success of plant community establishment following reclamation ▪ Identify unanticipated negative effects, including possible accidents and malfunctions, and need for additional mitigation	Surveillance would be completed to identify and manage new occurrences of species designated by the *Weed Control Act* as prohibited, noxious, and nuisance weeds within the Project footprint. Monitoring and follow-up during Construction would be required to delineate potential activity restriction guideline setbacks (ENV 2017; 30 m setback) to mitigate direct disturbance to provincially tracked vascular plants (if any). Where disturbance to rare plants is unavoidable, the Saskatchewan Ministry of Environment would be consulted to determine the most appropriate course of action. Monitoring requirements for reclamation would be outlined in the Detailed Decommissioning and Reclamation Plan and would include details on reclamation treatments to be used during revegetation, schedules for the frequency of monitoring, and action levels where adaptive management may be required. To confirm the prediction of negligible effects on wetlands, NexGen would conduct water level, water quality, and sediment quality sampling and monitoring of wetlands within and adjacent to the Project footprint and representative wetlands within the LSA. From the results of these surveys, a detailed recommendation for follow-up monitoring during the life of the Project would be developed, if necessary. If monitoring is required, any wetlands that could be affected by the Project would be monitored during Construction and Operations to understand the potential Project-specific effects on wetland function and to adhere to the Federal Policy on Wetland Conservation (Government of Canada 1991) of no net loss of wetland function. Post-reclamation wetland surveys would be conducted to understand if reclaimed wetlands (if any) are achieving similar functions.	During all Project phases. The need for and duration of monitoring would be re-evaluated based on an annual review of monitoring data	▪ Noxious and nuisance weeds surveillance follow-up study ▪ Rare and tracked vascular plants surveillance follow-up study (if required) ▪ Environmental Protection Program ▪ Environmental Monitoring Plan ▪ Detailed Decommissioning and Reclamation Plan ▪ Wetland function surveys (if required)
Section 14 Wildlife and Wildlife Habitat	▪ Woodland caribou (*Rangifer tarandus caribou*) ▪ Moose (*Alces alces*) ▪ Grey wolf (*Canis lupus*) ▪ Black bear (*Ursus americanus*) ▪ Beaver (*Castor canadensis*) ▪ Little brown myotis (*Myotis lucifugus*) ▪ Olive-sided flycatcher (*Contopus cooperi*) ▪ Rusty blackbird (*Euphagus carolinus*) ▪ Common goldeneye (*Bucephala clangula*) ▪ Mallard (*Anas platyrhynchos*) ▪ Canadian toad (*Anaxyrus hemiophrys*)	**All Project phases:** ▪ Changes in habitat availability and animal use of habitat could occur as a result of the Project ▪ Changes in habitat distribution could occur as a result of the Project ▪ Changes in survival and reproduction (i.e., abundance) could occur as a result of the Project	▪ Evaluate the effectiveness of the environmental protection measures (e.g., construction monitoring, mitigation to avoid destruction of migratory bird nests and birds) ▪ Identify unanticipated negative effects, including possible accidents and malfunctions, and need for additional mitigation ▪ Assess the success of plant community establishment following reclamation	Surveillance completed as part of the Environmental Protection Program would be used to determine the efficacy of mitigation measures and to guide any future measures that should be implemented in subsequent Project phases. For example, waste management and site surveillance would be completed to avoid attraction of wildlife to the Project and associated risks of adverse human-wildlife interactions. Surveillance would be undertaken as part of the Project, which could lead to the implementation of targeted mitigation measures in areas to limit human-wildlife conflicts. Wildlife surveillance monitoring of the mine site and access road would include a wildlife observation log and wildlife incident log. A Caribou Mitigation and Offsetting Plan would be developed and implemented for the Project, whereby offsets would be used to reduce the residual effects on woodland caribou and provide a net increase in functional caribou habitat. Monitoring would be defined in the Caribou Mitigation and Offsetting Plan through engagement with regulatory agencies and local Indigenous communities.	During all Project phases. The need for and duration of monitoring would be re-evaluated based on an annual review of monitoring data	▪ Environmental Protection Program ▪ Caribou Mitigation and Offsetting Plan

Table 23B-1: Environmental Assessment Monitoring and Follow-Up Programs Proposed for the Rook I Project

EIS Section	Valued Component	Project Phase and Potential Effects	Monitoring Objectives	Conceptual Monitoring Activities	Suggested Duration	Implementing Program/Plan/Study
Section 15 Human Health	▪ Human health	**All Project phases:** ▪ Project activities may cause emission and deposition of fugitive dust and radon ▪ Project activities may cause emission and deposition of criteria air contaminants and suspended solids ▪ Discharge of treated effluent may cause changes in surface water and sediment quality ▪ Site runoff may cause changes in surface water and sediment quality ▪ Seepage from the WRSAs may cause changes to groundwater and surface water and sediment quality **After Closure:** ▪ Runoff and seepage may occur from the WRSAs and UGTMF, causing changes to surface water and sediment quality	▪ Verify the predictions made by the ERA and refine the models used in the ERA ▪ Support ongoing management of Project activities to protect human health ▪ Refine risk assessment models to inform future management and mitigation	The ERA would be refined based on the Environmental Monitoring Plan and Effluent and Emissions Plan, which, as identified in rows above, would include collection of air quality, surface water, sediment, and soil samples, as well as fish tissue samples, benthic invertebrate tissue samples, and country foods such as blueberries. Monitoring would focus on collecting data to verify ERA model predictions, as well as provide data to improve model predictions as the Project begins. Monitoring would support NexGen's adaptive management framework with the objective of reducing uncertainty over time through an iterative process. NexGen would work with local Indigenous Groups in an effort to complete a targeted Traditional Foods study to help validate or modify the dietary assumptions made in the human health risk assessment.	During all Project phases. The need for and duration of monitoring would be re-evaluated based on an annual review of monitoring data	▪ Environmental Protection Program ▪ Environmental Monitoring Plan ▪ Effluent and Emissions Plan ▪ Traditional Foods follow-up study
Section 16 Cultural and Heritage Resources and Indigenous Land and Resource Use	▪ Indigenous land and resource use	**All Project phases:** ▪ Changes to access and area available for Indigenous land and resource use ▪ Changes to the availability of fish, plants, and wildlife for harvesting ▪ Changes to the quality of the Indigenous land use experience	▪ Evaluate the effectiveness of mitigation measures and modify or enhance, as necessary, through monitoring and developing updated mitigation, if needed ▪ Identify unanticipated negative effects, including possible accidents and malfunctions, and need for additional mitigation ▪ Contribute to the overall continual improvement of the Project	Participation in the CVMPP, a multi-stakeholder group that includes mine operators, health authorities, and the provincial government. Participation in research initiatives on topics related to quality of life in northern Saskatchewan as defined through the CVMPP. Evaluate the results of the monitoring conducted by the independent Indigenous Monitors and suggest modifications to monitoring plans, as required, to conduct adaptive management and foster continual improvement. Evaluate how the objectives of the Security Program were met using measurable indicators and modify the plan as needed to foster continual improvement. Regular meetings with potentially affected Indigenous land users, as applicable, independently and as part of the Indigenous and Public Engagement Program, to review the previous season and understand any issues or concerns that could be addressed. Conduct follow up, as needed. Establishment of a Project feedback and grievance mechanism to record and action issues identified by local priority area residents. Indigenous land and resource use issues would be tracked and addressed as they arise and periodically analyzed through management reviews. Implementation success of the commitments made under Benefit Agreements would be tracked. Monitoring success of regional mitigation strategies. Completion of perception surveys to better understand local priority area residents' thoughts and understanding of uranium mining. The perception surveys would be designed for documenting current and ongoing community perceptions of the mining in the RSA to inform future engagement and mitigation based on community issues, concerns, and opportunities.	During all Project phases. The need for and duration of monitoring would be re-evaluated based on an annual review of monitoring data	▪ CVMPP ▪ Environmental Monitoring Plan ▪ Ground Transportation Emergency Response Plan ▪ Emergency Response Assistance Plan ▪ Security Program ▪ Independent Indigenous monitoring program ▪ Indigenous and Public Engagement Program

Table 23B-1: Environmental Assessment Monitoring and Follow-Up Programs Proposed for the Rook I Project

EIS Section	Valued Component	Project Phase and Potential Effects	Monitoring Objectives	Conceptual Monitoring Activities	Suggested Duration	Implementing Program/Plan/Study
Section 17 Other Land and Resource Use	▪ Other land and resource use	**All Project phases:** ▪ Changes to access to and area available for land and resource use ▪ Changes to the quality of land and resource use experience	▪ Evaluate the effectiveness of mitigation measures and modify or enhance, as necessary, through monitoring and developing updated mitigation, if needed ▪ Identify unanticipated negative effects, including possible accidents and malfunctions, and need for additional mitigation ▪ Contribute to the overall continual improvement of the Project	Participation in the CVMPP, a multi-stakeholder group that includes mine operators, health authorities, and the provincial government. Participation in research initiatives on topics related to quality of life in northern Saskatchewan as defined through the CVMPP. Conduct meetings with community members, commercial trappers, outfitters, and other potentially affected land users, as applicable, both independently and as part of the Indigenous and Public Engagement Program to review land use activities conducted and understand if land users experienced any issues or concerns that could be addressed. Conduct follow-up, as needed. Conduct discussions and/or agreements with potentially affected lodge and outfitting operations and continue ongoing communications on an as-needed basis. The focus of discussions is anticipated to include access management, safety, and management of other potential interactions with the Project. Evaluate the results of the monitoring conducted by the independent Indigenous Monitors and suggest modifications to monitoring plans, as required, to conduct adaptive management and foster continual improvement. Evaluate how the objectives of the Security Program were met using measurable indicators and modify the plan as needed to foster continual improvement. Meet with other mining operations active in the region to collaboratively identify concerns and develop effective responses to mitigate identified concerns.	During all Project phases. The need for and duration of monitoring would be re-evaluated based on an annual review of monitoring data	▪ CVMPP ▪ Ground Transportation Emergency Response Plan ▪ Emergency Response Assistance Plan ▪ Security Program ▪ Independent Indigenous Monitoring Program ▪ Indigenous and Public Engagement Program
Section 18 Economy	▪ Economy	**All Project phases:** ▪ Changes in employment, income, and training opportunities ▪ Changes in business and contracting opportunities ▪ Changes in participation and employment in the traditional economy ▪ Project activities generating provincial and federal tax revenue and payments to Indigenous Groups ▪ Population migration as a result of the Project	▪ Evaluate the effectiveness of mitigation measures and modify or enhance, as necessary, through monitoring and developing updated mitigation, if needed ▪ Identify unanticipated negative effects and need for additional mitigation ▪ Contribute to the overall continual improvement of the Project	Participation in the CVMPP, a multi-stakeholder group that includes mine operators, health authorities, and the provincial government. Participation in research initiatives on topics related to quality of life in northern Saskatchewan as defined through the CVMPP. It is anticipated the Project's Mineral Surface Lease Agreement would include a Human Resources Development Agreement and a rolling Annual Human Resources Development Plan that would require reporting on efforts to meet socio-economic commitments. Typically, mining operations report to the province on indicators including the following: ▪ total employment and employment of residents of the RSA ▪ employment by gender and Indigenous identity ▪ total wages (i.e., in dollars) and percentage of the total wages for residents of the RSA ▪ external training partnerships and in-house employee development ▪ northern procurement volumes (i.e., in dollars) and percentages of total procurement ▪ community involvement including school awards, scholarships, outreach, and information sharing with northern residents (Government of Saskatchewan 2018)	During all Project phases. The need for and duration of monitoring would be re-evaluated based on an annual review of monitoring data	▪ CVMPP ▪ Human Resources Development Plan ▪ Business opportunities workplan
Section 19 Community Well-Being	▪ Community well-being	**All Project phases:** ▪ Access restrictions as a result of the Project ▪ Participation in the worker rotation system	▪ Evaluate the effectiveness of mitigation measures and modify or enhance, as necessary, through monitoring and developing updated mitigation, if needed ▪ Identify unanticipated negative effects, including possible accidents and malfunctions, and need for additional mitigation ▪ Evaluate the overall well-being of communities across well-being elements (i.e., measurement indicators) ▪ Contribute to the overall continual improvement of the Project	Participation in the CVMPP, a multi-stakeholder group that includes mine operators, health authorities, and the provincial government. Participation in research initiatives on topics related to quality of life in northern Saskatchewan as defined through the CVMPP. Work with local Indigenous Groups and communities to develop and implement a community well-being monitoring program that addresses the various elements that make up community well-being. The specific indicators would be developed in consultation with Indigenous Groups and stakeholders. NexGen would track usage of on-site programs related to health and wellness (e.g., Elder counsellors, mentors) and conduct periodic surveys to determine if on-site services and programs are meeting employee needs.	During all Project phases. The need for and duration of monitoring would be re-evaluated based on an annual review of monitoring data	▪ CVMPP ▪ Ground Transportation Emergency Response Plan ▪ Emergency Response Assistance Plan ▪ Security Program ▪ Indigenous and Public Engagement Program ▪ Perception Surveys ▪ Traditional Diet Surveys

n/a = not applicable; GHG = greenhouse gas; EIS = Environmental Impact Statement; AER = Alberta Energy Regulator; WRSA = waste rock storage area; UGTMF = underground tailings management facility; COPC = constituent of potential concern; ERA = environmental risk assessment; $L_{eq,day}$ = energy equivalent sound levels for each daytime period; $L_{eq,night}$ = energy equivalent sound levels for each nighttime period; L_{dn} = day-night sound level; MDMER = Metal and Diamond Mining Effluent Regulations; LSA = local study area; RSA = regional study area; RMZ = regulatory mixing zone; EEM = environmental effects monitoring; CVMPP = Community Vitality Monitoring Partnership Program.

23B1 REFERENCES

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Rook I Project

Environmental Impact Statement

Section 24 Conclusions

Submitted to:
Canadian Nuclear Safety Commission
Saskatchewan Ministry of Environment

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Abbreviations and Units of Measure

Abbreviation	Definition
CNSC	Canadian Nuclear Safety Commission
EA	Environmental Assessment
EIS	Environmental Impact Statement
ENV	Saskatchewan Ministry of Environment
GHG	greenhouse gas
HHRA	human health risk assessment
IMS	Integrated Management System
LPA	local priority area
LSA	local study area
MDMER	Metal and Diamond Mining Effluent Regulations
NexGen	NexGen Energy Ltd.
PAG	potentially acid generating
Project	Rook I Project
RFD	reasonably foreseeable development
RSA	regional study area
SK2 West	SK2 West Administration Unit
U_3O_8	triuranium octoxide
UGTMF	underground tailings management facility
VC	valued component
WRSA	waste rock storage area

Unit	Definition
%	percent
$	Canadian dollars unless otherwise stated
Bq/m^3	becquerels per cubic metre
mSv/yr	millisieverts per year
µm	micron
ha	hectare
km	kilometre
m	metre

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24 CONCLUSIONS

24.1 Introduction

NexGen Energy Ltd. (NexGen) has developed this Environmental Impact Statement (EIS) to meet the regulatory requirements under the *Canadian Environmental Assessment Act,* 2012 and *The Environmental Assessment Act* (Saskatchewan) for the proposed development of a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The EIS described the Project and the existing environmental conditions and assessed the potential effects of the Project on the biophysical and human environments, considering the mitigation that would be in place. The EIS also included an assessment of potential cumulative effects of the Project in combination with other previous, existing, or reasonably foreseeable developments (RFDs).

The main sections, associated appendices, and technical support documents in this EIS were completed to meet the Canadian Nuclear Safety Commission (CNSC) *Generic Guidelines for the Preparation of an Environmental Impact Statement – Pursuant to the Canadian Environmental Assessment Act, 2012* (CNSC 2021), the Terms of Reference for the Project submitted to the Saskatchewan Ministry of Environment (ENV), and the expectations and feedback expressed to NexGen by Indigenous communities.

Section 24, Conclusions, provides a summary of the conclusions of the EIS, with a focus on findings related to valued components (VCs). The section is organized to provide brief summaries of the following information:

- NexGen (Section 24.1.1, Summary of NexGen) and the Project (Section 24.1.2, Rook I Project Summary);
- NexGen's approach to engagement and Indigenous and Local Knowledge (Section 24.2);
- the scope and approach of the Environmental Assessment (EA; Section 24.3);
- the main conclusions of the EA under the categories of atmosphere, water, land, and people (Section 24.4);
- next steps for the proposed Project following the submission of this EIS (Section 24.5, Next Steps), including CNSC licensing and provincial permitting processes (Section 24.5.1), establishment of Environmental Committees and independent Indigenous monitoring (Section 24.5.2), and ongoing engagement (Section 24.5.3); and
- a closing statement (Section 24.6).

24.1.1 Summary of NexGen

NexGen is a Canadian corporation focused on the acquisition, exploration, and development of Canadian uranium projects. Founded on the belief that natural resource development can be successfully attained in a sustainable and responsible manner resulting in prosperity and opportunity for multiple generations, NexGen is positioned to deliver a technically and environmentally elite Project and prospective portfolio in northern Saskatchewan's Athabasca Basin and long-term economic, social, and environmental benefits for Saskatchewan, Canada, and the world.

NexGen's vision is to become a world leader in delivering clean energy solutions for current and future generations. Since inception, NexGen's values of honesty, respect, resilience, and accountability have served as the company's roadmap to optimizing outcomes and creating as much positivity for as many people as possible.

NexGen takes a highly driven, disciplined, and objective approach across all aspects of the organization. The company sets and maintains a standard of excellence in planning and execution, combining innovation with low technical risk, and continually evaluates and optimizes across all areas of the business. NexGen's approach is focused on sustainable development and founded on transparent environmental and social governance and ethics, with a commitment to diversity, equity, and inclusion.

24.1.2 Rook I Project Summary

The proposed Project represents a substantial source of uranium for meeting the expected growing global demand for electricity. The Project could meaningfully contribute to the Government of Canada's ability to meet its environmental obligations and commitments with respect to climate change by displacing high-greenhouse gas (GHG) intensity fossil fuel (e.g., coal, natural gas) electricity generation in favour of low-GHG emitting, green energy. Providing a source of uranium would also support Saskatchewan's objective of developing lower carbon emission electricity generation over the next decade (Government of Saskatchewan 2019). While uranium is not the only option to support these local and global endeavours, the demand for uranium is increasing, and this energy source can be an important part of the solution as the world moves towards more sustainable measures to mitigate climate change.

In addition to supporting national environmental objectives and commitments, the proposed Project would generate socio-economic benefits and opportunities for local Indigenous Groups (i.e., First Nations and Métis groups), communities, the Province of Saskatchewan, and Canada, including increased direct local and national employment, tax and royalty revenue, and associated indirect economic benefits and employment at local to national scales. The proposed Project possesses favourable economics, would be fully self-funded, and would not require any financial support from governments. Additional benefits of the Project are described in Section 24.4.2.2, Project Benefits.

The Project would be located approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the Northern Village of La Loche, and 640 km northwest of the city of Saskatoon. The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Patterson Lake is at the interface of the Boreal Shield and Boreal Plain ecozones. Access to the Project would be from an existing road off Highway 955, with on-site worker accommodation serviced by fly-in/fly-out access.

The Project would include underground mining to access the uranium ore from the Arrow deposit, a land-based, basement-hosted, high-grade uranium deposit. The Project is 100% owned by NexGen. The process plant is planned to process an average of 1,300 tonnes of ore per day with an annual production capacity of up to 30 million pounds per year of uranium concentrate. The Project would span a 43-year period from the beginning of Construction, through Operations, to the end of Decommissioning and Reclamation (i.e., Closure).

The Project would include the following key facilities to support the extraction and processing of uranium from the Arrow deposit for transportation off site:

- underground mine development;
- process plant buildings, including uranium concentrate packaging facilities;
- paste tailings distribution system;
- underground tailings management facility (UGTMF);
- potentially acid generating (PAG) waste rock storage area (WRSA);

- non-potentially acid generating (NPAG) WRSA;
- special waste rock[1] and ore storage stockpiles;
- surface and underground water management infrastructure, including water management ponds, effluent treatment plant, and sewage treatment plant;
- conventional waste management facilities and fuel storage facilities;
- ancillary infrastructure, including maintenance shop, warehouse, administration building, and camp;
- airstrip and associated infrastructure; and
- access road to Project and site roads.

An alternatives assessment compared a range of feasible alternatives to select those that best meet environmental, technical, economic, and social considerations. The overall proposed Project design and the way that key components and infrastructure would fit together to achieve key objectives reflects evaluations made within the alternatives assessment. NexGen would continue to review alternative means throughout the Project lifespan; optimization of alternatives would be pursued through Project design, planning, and into Operations, with the intent that any potential design iterations and mitigations would be improvements on, and within the current considerations of, the assumptions carried within the EA (i.e., within the scope of the Project as defined for assessment).

The Project has been designed to be safe for the public and workers and to meet or exceed applicable regulatory requirements and industry best management practices. The Project would operate in well-regulated provincial and federal jurisdictions. NexGen's objectives for risk management are to reduce all health, safety, and environmental risks to acceptable levels and to keep radiological exposures to workers and the environment as low as reasonably achievable. The primary mitigation tools used to prevent or reduce the severity of potential accidents and malfunctions, as well as potential adverse effects on the Project that may be caused by natural hazards, are sound engineering design and Project planning, backed by a comprehensive Integrated Management System (IMS) with a structured and systematic risk management process.

24.2 Engagement and Indigenous and Local Knowledge

Transparent discussion and meaningful collaboration are at the core of NexGen's approach to Indigenous, regulatory, and public engagement. Encouraging progressive, broader thinking, balanced with technical competence and a deep and abiding respect for local Indigenous Peoples' and communities' understanding of the local area, site specifics, and industry best practice, is key to this approach.

Engagement with local Indigenous Groups, local communities, businesses, organizations, land users, and regulatory authorities is foundational to the responsible development of the Project. NexGen values and respects the culture, interests, and aspirations of the communities where it operates. With a focus on Saskatchewan's north, aspects of the Project are constantly evaluated with the goal to advance economic benefits and opportunities for local communities, drive economic capacity building, and support entrepreneurs across the province.

[1] Special waste rock is mine rock that is mineralized with insufficient grade to be considered ore (i.e., greater than 0.03% of triuranium octoxide [U_3O_8] and less than 0.26% U_3O_8). All special waste would be temporarily stored in the special waste rock stockpile.

NexGen has worked closely with the communities local to the Project since 2013 to help develop impactful community programs that focus on youth, with an emphasis on education, health and wellness, and building economic capacity. NexGen's engagement activities have continually evolved to understand and incorporate Indigenous and Local Knowledge[2] and feedback from regulatory agencies and the public in a manner that provides the opportunity for effective information exchange and dialogue specific to each stage of the Project. This holistic approach to engagement has been consistent since NexGen's was formed and will remain a priority for the company throughout all phases of the Project.

Indigenous Group and stakeholder identification represented a primary step in the development of engagement approaches. A key focus of the Indigenous Group and stakeholder identification process was to understand the individuals and groups that would most likely be affected by the proposed Project. Identification of potentially affected or interested Indigenous Groups and local communities was informed through direct correspondence and discussion with Indigenous leaders, community members, and other organizations in the region; review of publicly available information; and information included within letters provided to Indigenous Groups by the CNSC and ENV. The primary Indigenous Groups identified for full engagement are the Clearwater River Dene Nation, Métis Nation – Saskatchewan Northern Region 2, Birch Narrows Dene Nation, and Buffalo River Dene Nation. Other Indigenous Groups identified for information sharing are English River First Nation, Athabasca Chipewyan First Nation, and Ya'thi Néné Lands and Resources – representing Fond du Lac Denesųłiné First Nation and Black Lake Denesųłiné First Nation. A local priority area (LPA)[3] was also established, which includes the key communities engaged on the Project.

Indigenous Groups and members of communities within the LPA have shared Indigenous and Local Knowledge and feedback with NexGen through a variety of engagement activities and sources of information. In general, sources of Indigenous Knowledge were identified through methods associated with the signed individual Study Agreements (e.g., Joint Working Groups, Indigenous Knowledge and Traditional Land Use Studies) with each primary Indigenous Group and through the Study Funding Agreement with Ya'thi Néné Lands and Resources. The majority of Local Knowledge was shared through EA baseline activities or other formal or informal individual and community events, including the community information sessions held in 2019. Indigenous and Local Knowledge was also shared by the Indigenous Groups in forms such as individual presentations describing important historical information, cultural practices, and knowledge.

24.3 Scope and Approach of the Environmental Assessment

This EA has been used as a planning tool to ensure that the Project was considered in a careful and precautionary manner to avoid or mitigate possible environmental effects. Section 6, Environmental Assessment Approach and Methods outlines the general approach and methods applied for the Project EA that were designed to meet both the CNSC *Generic Guidelines for the Preparation of an Environmental Impact Statement – Pursuant to the Canadian Environmental Assessment Act, 2012* (CNSC 2021) and Terms of Reference for the Project.

[2] Indigenous Knowledge can generally be understood as the unique and collective knowledge of a group of Indigenous People that is built up through generations of living in close contact with the land and natural environment. Local Knowledge is a more general term and, for the purposes of the EA, represents information from a citizen or community representative, but without Indigenous Group/Elder sanction. Further details on the definition and use of these terms are provided in Section 3.4, Defining Indigenous and Local Knowledge.

[3] The LPA consists of the local communities closest to the Project that would experience most of the Project effects and for which NexGen would prioritize local training, employment, and business opportunities for the Project. These communities are located along, or accessed via, Highways 155 and 955 north of the intersection of Highways 155 and 925.

The EA approach was applied to individual disciplines in the following sections of the EIS:

- air quality, noise, and climate change (Section 7);
- hydrogeology (Section 8);
- hydrology (Section 9);
- surface water quality and sediment quality (Section 10);
- fish and fish habitat (Section 11);
- terrain and soils (Section 12);
- vegetation (Section 13);
- wildlife and wildlife habitat (Section 14);
- human health (Section 15);
- cultural and heritage resources and Indigenous land and resource use (Section 16);
- other land and resource use (Section 17);
- economy (Section 18); and
- community well-being (Section 19).

Valued components or intermediate components were selected for each of the above disciplines. Valued components are identified to be of concern by the proponent, scientists, government agencies, Indigenous Peoples, or the public (CEA Agency 2018). The selection of appropriate VCs allows an EA to be focused on those aspects of the biophysical and socio-economic environments that are of greatest importance to both society and species conservation. Valued components were selected using the results from baseline studies and Indigenous Knowledge and Traditional Land Use Studies and feedback from engagement with Indigenous Groups, regulators, and the public. Intermediate components of the biophysical environment were also assessed to support VC assessments.

The individual discipline sections predicted Project-specific residual effects for each VC or intermediate component as well as residual cumulative effects from the Project, other previous and existing projects and activities, and RFDs, where applicable. The assessment considered the Project design elements and mitigation measures that would be implemented such that the Project can be constructed, operated, and decommissioned and reclaimed (i.e., closed) in a manner that would avoid or minimize adverse effects on the biophysical and socio-economic environments, while maximizing the benefits to local Indigenous communities, Saskatchewan, and Canada.

NexGen took an inclusive approach to the EA by considering multiple types of knowledge to produce a comprehensive understanding of the potential effects of the Project and to identify ways to mitigate potential adverse effects and enhance positive effects. Indigenous and Local Knowledge was incorporated into the EIS by integrating the results from Indigenous Knowledge and Traditional Land Use Studies and from engagement with Indigenous Groups and community members.

The residual effects were classified and tabulated, and significance determinations were completed for VCs. Key uncertainties were identified, and monitoring and follow-up activities were proposed to address key sources of uncertainty, verify the predicted residual effects, and evaluate the effectiveness of planned mitigation designs, policies, and practices.

24.4 Summary of Environmental Assessment Conclusions

The EIS has been summarized below according to the following elements of the assessment:

- Summary of Technical Discipline Assessments (Section 24.4.1).
- Summary of Significant Residual Effects and Benefits (Section 24.4.2).
- Assessment Confidence (Section 24.4.3).
- Overview of Management Programs and Plans (Section 24.4.4).
- Overview of Monitoring, Follow-Up, and Adaptive Management (Section 24.4.5).

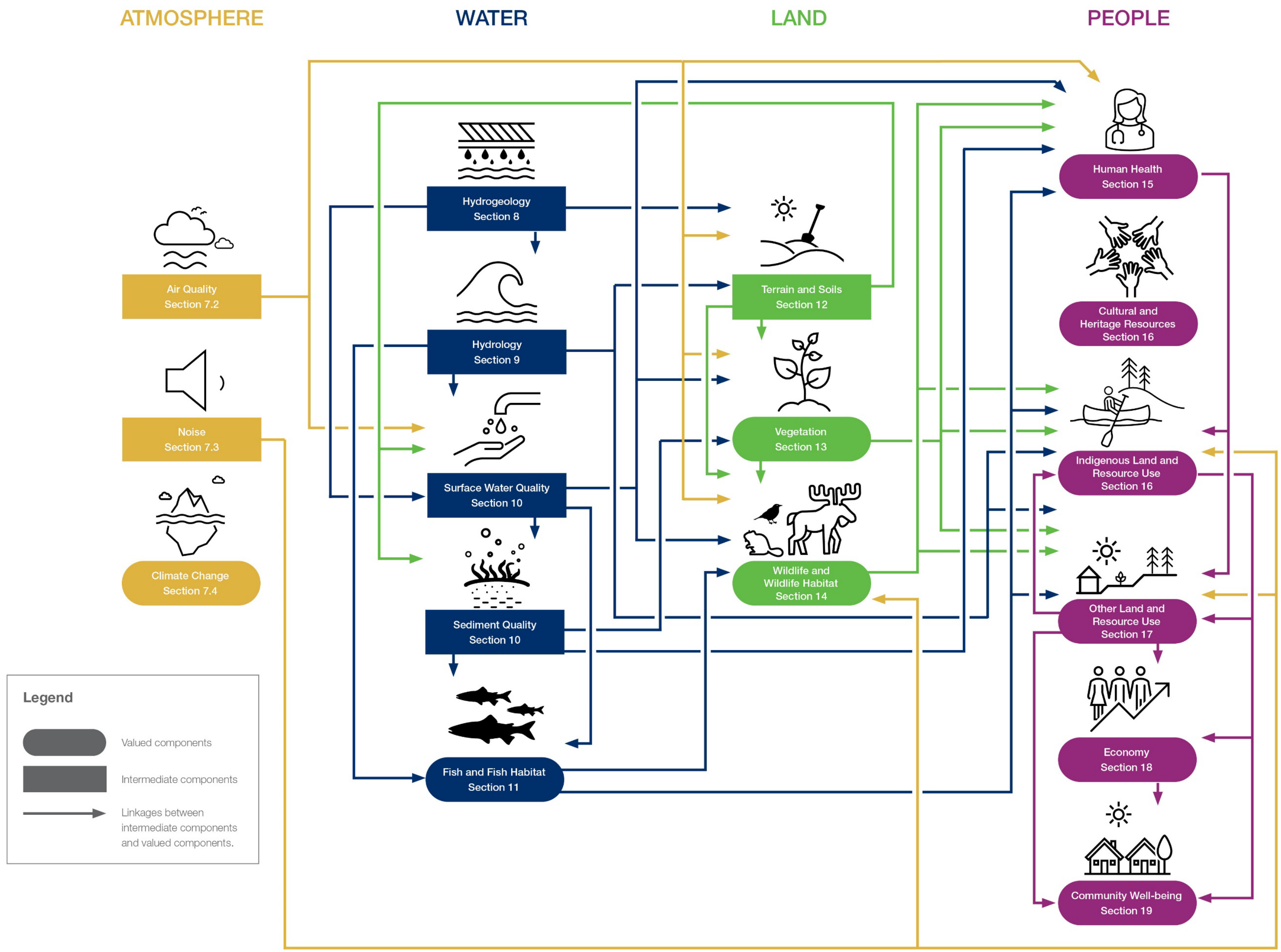
24.4.1 Summary of Technical Discipline Assessments

This subsection summarizes the key findings from each of the individual disciplines included in the EIS. The assessment of intermediate components and VCs is summarized within the following four categories:

- **atmosphere**: air quality, noise, climate;
- **water**: hydrogeology, hydrology, surface water quality and sediment quality, fish and fish habitat;
- **land**: terrain and soils, vegetation, wildlife and wildlife habitat; and
- **people**: human health, cultural and heritage resources, Indigenous land and resource use, other land and resource use, economy, community well-being.

A linkage diagram, Figure 24.4-1, illustrates how these components of the EA are interconnected. Following the summary of key findings by discipline, overall Project summaries for significance of residual effects, benefits, assessment confidence, and monitoring and follow-up plans are provided.

Figure 24.4-1: Environmental Assessment Technical Discipline Linkage Diagram



24.4.1.1 Atmosphere

Components of the atmospheric environment included in the overall assessment were air quality, noise, and climate change. Key findings and conclusions from each component are presented in Section 24.4.1.1.1 to Section 24.4.1.1.3.

24.4.1.1.1 Air Quality

Air quality was selected as an **intermediate component** based on the connection to soil and water and the health of vegetation, wildlife, and people.

The residual effects analysis used a dispersion modelling approach to predict concentrations of criteria air contaminants for the Application Case and RFD Case and then compared the predictions to baseline conditions and relevant air quality criteria. Project activities that would have the potential to affect air quality during the Project lifespan include combustion of fossil fuels in stationary, mobile, and heavy equipment; handling and stockpiling of waste rock, special waste rock, and ore; underground drilling and blasting; and waste incineration. Mitigation measures, such as optimizing haul route distances and limiting idling of vehicles and equipment, were identified to reduce the potential for effects on air quality.

After mitigation measures were considered, most of the criteria air contaminants were predicted to remain compliant with the Saskatchewan Ambient Air Quality Standards throughout all phases of the Project within the regional study area (RSA). Short-term concentrations of 24-hour particulate matter with a diameter of 10 micron (µm) or less and 24-hour total suspended particulates were predicted to be above the Saskatchewan Ambient Air Quality Standards for both the Application Case and RFD Case, but the exceedance frequencies remain low, and the exceedance areas would be localized to the Project.

The current baseline monitoring program that monitors meteorological parameters would be continued through all phases of the Project, likely with some modification through the federal licensing and provincial permitting processes. The Environmental Protection Program, Effluent and Emissions Plan, and Environmental Monitoring Plan would be used to verify effects predictions and compliance with the Saskatchewan Ambient Air Quality Standards.

24.4.1.1.2 Noise

Noise was selected as an **intermediate component** due to influence on Indigenous land and resource use and other land and resource use and sensitivity of some wildlife to noise.

Computer models were developed for the Application Case and RFD Case and applied to predict noise levels at receptor locations near the Project. Noise emissions from equipment and mining-related activities such as land clearing, site preparation, construction of facilities and infrastructure, underground mine development, power plant operation, airstrip traffic, milling and underground operations, and decommissioning and reclamation activities were assessed at these locations. The assessment considered Project environmental design features and mitigation to limit noise effects including designs to attenuate noise from certain structures and equipment, proper maintenance of Project roads, and the implementation of the Health and Safety Program.

Considering these noise sources and mitigations, noise from the Application Case and the RFD Case is predicted to result in detectable changes from existing conditions. However, cumulative noise levels are predicted to be of low magnitude and would remain below the thresholds set by Environment and Climate Change Canada, Health Canada, and Alberta Energy Regulator at all receptors considered in the assessment.

To identify and mitigate the potential noise-related effects of the proposed Project, NexGen would implement a discipline-specific program. Follow-up noise monitoring would be conducted at receptors in the area of the Project to obtain representative daytime and nighttime noise values for each receptor, which would then be compared to model predictions from the EIS and regulatory thresholds to understand whether additional noise mitigation is necessary.

24.4.1.1.3 Climate Change

Climate change is a dynamic process that can affect how projects interact with the environment over the long term. Climate change can modify the potential environmental effects of a project by altering thermal and hydrologic regimes. Projects can affect the climate by emitting GHGs, and in turn, the climate can affect the resiliency of projects by changing the frequency and magnitude of extreme weather events. Therefore, climate change has been incorporated throughout the EIS in the following three ways:

- identifying potential effects of the Project on climate change through the assessment of the climate change VC;
- identifying potential effects of climate change on the Project; and
- consideration of climate change on the biophysical and socio-economic environments by discipline.

Climate Change Valued Component Assessment

Climate change was selected as a **VC** based on the socio-economic and cultural importance of climate change, federal and provincial commitments to decrease GHG emissions, and the potential for Project GHG emissions to contribute to climate change.

To assess climate change as a VC, Project components and activities that could contribute to climate change were quantified. A specific assessment of the RFD Case was not completed as the Application Case provides all required information for the federal government to consider the Project relative to the cumulative effects of historical, existing, and future projects.

The main Project-related sources of GHG emissions would include electricity generation, on-site mobile equipment, heating, land use changes, stationary combustion, waste incineration, industrial processes, and explosive emissions. Operations is anticipated to have the largest annual GHG emissions due to the number and size of sources present. Proposed mitigation measures to avoid or minimize the generation of GHGs included the use of liquid natural gas for primary power generation, heat recovery systems for heating certain site processes and buildings, and the efficient management of energy and equipment for the Project.

Based on the planned Project activities and mitigations, the maximum annual Project GHG emissions were estimated and compared to the most recent available estimates for provincial, national sector, and federal levels. From this comparison, Project GHG emissions were predicted to have an adverse effect on climate change due to the global and permanent nature of GHG emissions; however, total Project emissions would be less than 0.3% of total annual provincial emissions and less than 0.02% of total annual federal emissions. The assessment determined that the Project GHG emissions would not meaningfully affect Canada's and Saskatchewan's ability to reach climate change commitments within the current regulatory framework. Therefore, **residual adverse effects on the climate change VC as a result of the Project are predicted to be not significant**. Moreover, due to the low GHG emissions associated with nuclear power generation compared to coal and natural gas power generation, the downstream effects of the Project are anticipated to increase Canada's ability to meet the national emission reduction targets. Additionally, the Project may support Canada's transition to a low carbon economy by providing the country with the fuel needed from cleaner energy sources.

A Net-Zero Framework is provided with the EIS. Considering the early stage of Project development, the Net-Zero Framework provides a preliminary assessment of potential alternative technologies and practices that could be used to reduce Project GHG emissions during the Project lifespan. Considerations for future decision making on the implementation of alternative technologies and practices have been identified, and it is expected that the framework would evolve as the Project design advances.

Effects of Climate Change on the Project

Climate change has the potential to alter the occurrence and severity of natural hazards from changes in future precipitation and temperature regimes, which would modify how weather-related hazards could affect the Project. Therefore, potential effects of climate change on the Project were assessed along with other effects of the environment on the Project. Characterizing the current climate and predicting future climate trends in the regional setting was undertaken to support the evaluation of Project design parameters. To align with NexGen's vision and values and to support the continual improvement process for climate change adaptation, the Climate Adaptation Framework was prepared to monitor and manage risks as an ongoing process.

Effects of Climate Change on the Biophysical and Social Environments by Discipline

Climate change projections developed for the Project were applied to the individual discipline sections (Section 7 to Section 19), where applicable, to identify the effects of climate change on the VC or intermediate component. The approach for incorporation of climate change differed within the individual discipline sections based on the potential for climate change to influence the VC or intermediate component.

24.4.1.2 Water

Components of the water environment that were included in the overall assessment include hydrogeology, hydrology, surface water quality, sediment quality, and fish and fish habitat. Key findings and conclusions from each component are presented in Section 24.4.1.2.1 to Section 24.4.1.2.4.

24.4.1.2.1 Hydrogeology

Hydrogeology was selected as an **intermediate component** based on the connection with hydrology and surface water quality and the associated influence on the health of aquatic and terrestrial ecosystems and people.

The hydrogeology assessment relied upon a three-dimensional numerical groundwater flow model to interpret the conceptual hydrogeological conditions and to predict potential effects for the Application Case and RFD Case. Project activities that have a potential to influence hydrogeological conditions in the area of the Project include underground shaft/mine development and operations; handling and storage of waste rock, special waste rock, and ore; and storage of cemented paste tailings in the UGTMF and cemented paste backfill in the mine stopes. Key environmental design features and mitigation measures to reduce the potential for effects include isolation of mine workings from groundwater inflows that could occur through high permeability strata with a hydrostatic liner in shafts; segregation and separate storage of PAG material and NPAG material; inclusion of engineered source control layering the PAG WRSA; use of engineered cemented paste tailings and backfill to control source concentrations; and the design, maintenance, and monitoring of the mine dewatering system to control the flow of groundwater discharge.

During Operations, seepage to the mine would result in a reduction in groundwater elevation (i.e., groundwater drawdown). The groundwater drawdown would be confined to the basement rock and would not affect Patterson Lake water levels. In addition, the groundwater seepage collected from the underground mine during Operations would be treated, monitored, and discharged to Patterson Lake, after meeting discharge criteria. Therefore, there would be no change to the overall water balance of the surface water system as a result of groundwater interactions.

After Closure, seepage from beneath the WRSAs was predicted to infiltrate vertically into the groundwater table, then flow laterally towards Patterson Lake. Groundwater originating at the UGTMF and production stope backfill source areas would migrate vertically upward primarily through the fault and shear zones, then laterally through the sandstone, before discharging within Patterson Lake.

Potential effects to hydrogeology would be managed through the implementation of the Environmental Protection Program, Mine Waste Management Plan, and Environmental Monitoring Plan. Seepage from the WRSAs after Closure would be managed through the development of an Adaptive Management Plan that would be implemented in the near term to reduce uncertainty and refine Project design during Operations, if necessary, to mitigate Closure conditions.

24.4.1.2.2 Hydrology

Hydrology was selected as an **intermediate component** based on the connection to human use, fish and fish habitat, and healthy and functioning aquatic and terrestrial ecosystems.

A regional hydrological model and a fluvial sediment transport model were developed to evaluate potential effects of the Project such as land clearing, site preparation, construction of facilities and infrastructure, handling and storage of ore and waste rock, discharge of treated effluent and treated sewage, underground operations, and the final removal of infrastructure. Proposed mitigation measures to reduce these potential effects included the use of erosion control, ground contouring of disturbed and restored areas, and the implementation of progressive reclamation and revegetation of disturbed areas.

Considering potential effects and planned mitigations, Project activities are predicted to result in a small net increase in discharge of water to Patterson Lake from Construction to the Active Closure Stage, which is predicted to result in undetectable increases in water surface elevations and watercourse flow rates in the receiving environment. The magnitude of changes to water surface elevations and flows along the Clearwater River is predicted to be within the range of natural seasonal and annual variability and is not expected to affect navigation. These changes would diminish downstream of Patterson Lake as the watershed area and ambient flows increase.

The RFD Case indicated that increases are expected in water surface elevations and in watercourse flow rates on the Clearwater River downstream of Patterson Lake. However, Clearwater River water surface elevations and flow rates are predicted to remain within the range of natural seasonal and annual variability, and are not expected to impede the ability of people to navigate the waters. Changes in the RFD Case would also likely be undetectable.

Climate change is predicted to have larger effects on water surface elevations and flow rates than the combined effects of the Project and RFDs. Flow in the Clearwater River below Patterson Lake is predicted to increase by 5.6% as a result of climate change, which is mainly expressed in the channel as an increase in channel wetted width of about 0.2 m and an increase in average water depth of 0.02 m, both of which are within the range of natural variability.

Predicted increases in daily flows for the Clearwater River reach between Patterson Lake and Forrest Lake resulted in corresponding increases in erosion and sedimentation; however, these changes would not be detectable.

Hydrometric monitoring and data collection initiated for baseline studies would continue. Selected hydrometric stations would also be monitored during the Project phases using remotely operated telemetry stations, which could be used to verify the receiving environment predictions of minimal changes in flows and water levels. These potential effects would be managed through the implementation of the Environmental Protection Program and Environmental Monitoring Plan.

24.4.1.2.3 Surface Water Quality and Sediment Quality

Surface water quality and sediment quality were selected as **intermediate components** based on how changes in surface water quality and sediment quality could influence the health of fish, plants, wildlife, and the people that use natural resources.

Water quality models were developed and applied to predict potential effects of the Project and RFDs and to assess potential effects on surface water quality, drinking water quality, and productivity status. The assessment considered how Project activities such as handling and storage of waste rock, special waste rock, and ore; runoff and seepage from the WRSAs; groundwater flow from the UGTMF; deposition of fugitive dust emissions; and treated effluent and treated sewage discharges could affect surface water quality and sediment quality. Project environmental design features such as the UGTMF and the engineered cemented paste tailings were designed to minimize the Project's potential effects on surface water quality and sediment quality. In addition, the Project would include the design, construction, and operation of infrastructure such as an effluent treatment plant, sewage treatment plant, and respective diffuser and outfall to reduce the discharge of constituents of potential concern to the aquatic environment and promote rapid dispersion in the receiving environment. Proposed mitigations such as recycling and reuse of process water, robust site water management processes, and the implementation of Project-specific management plans would also reduce effects on surface water quality and sediment quality.

Model-predicted constituent concentrations were compared to their respective Project thresholds. The analysis indicated that water quality constituent concentrations are predicted to be below Project thresholds in the receiving environment downstream of the Project during Construction and Operations in the Application Case and the RFD Case. Of the 21 modelled ions, metals, and radionuclides, all were predicted to remain below Project thresholds except cobalt and copper after Closure, primarily as a result of groundwater seepage from the PAG WRSA. These results were also applied to a sensitivity analysis that included possible effects of climate change. All results were carried forward to a more detailed assessment on fish health.

Site contact water monitoring would be described in documentation for the Environmental Protection Program, along with the controls and monitoring of the on-site water management infrastructure. This monitoring would also generate information regarding water quality from each of the sources that contribute to site water to be managed on site and the effectiveness of mitigation to manage the water quality of site contact water. The Effluent and Emissions Plan would include the sampling and analysis of treated effluent in ponds and confirmation that these waters meet release targets prior to release to the environment. The monitoring in the Effluent and Emissions Plan would also include monitoring components to meet Metal and Diamond Mining Effluent Regulations (MDMER) requirements at the final point of discharge, as well as other release criteria that are derived through licensing. Water quality monitoring would be required prior to release of non-mineralized contact water, treated contact water, and treated sewage to the environment. This monitoring would include the collection ponds on site, as well as the treated water ponds.

In the receiving environment, the surface water quality monitoring established for baseline data collection in Patterson Lake and the downstream waterbodies and watercourses in the local study area (LSA) would form the basis for monitoring throughout the Project lifespan. In addition to this monitoring, the Environmental Monitoring Plan would establish surface water quality monitoring at the edge of the regulatory mixing zone.

24.4.1.2.4 Fish and Fish Habitat

Fish and fish habitat included multiple species as **VCs** based on the importance of fish in the healthy functioning of aquatic and terrestrial food webs, and the value of fish as a resource culturally, economically, and traditionally to local Indigenous communities. Effects on fish and fish habitat were assessed for four VCs: lake trout (*Salvelinus namaycush),* lake whitefish (*Coregonus clupeaformis*), walleye (*Sander vitreus*), and northern pike (*Esox lucius*).

The fish and fish habitat assessment considered Project activities that were assessed for the air quality, hydrogeology, hydrology, and surface water and sediment quality intermediate components. In addition, it considered sediment release during in-water construction and direct physical habitat loss and disturbance associated with the fresh water intake, treated effluent diffuser, and treated sewage outfall in Patterson Lake. Effects on fish VCs would be minimized by diverting water generated from undisturbed catchments (i.e., non-contact water) around the site, and by collecting water that may have been altered by Project activities and treating, as required, those waters at the effluent treatment plant and sewage treatment plant prior to release to the environment. Proposed mitigations such as limiting the area of disturbance associated with Project footprint components, the implementation of erosion and sediment control best management practices, and reclaiming and revegetating disturbed areas, are expected to reduce effects on fish and fish habitat. Additionally, Project components such as the fresh water intake, treated effluent diffuser, and treated sewage outfall would be designed to minimize the physical footprint and associated habitat loss or disturbance in Patterson Lake resulting from construction and operation of this infrastructure. As required by Fisheries and Oceans Canada (DFO), any residual fish habitat lost or altered because of the developments would be offset with habitat created, restored, or enhanced as defined in a plan that would be developed through discussions with DFO and engagement with Indigenous Groups. Water management infrastructure would also be located to avoid sensitive or unique habitats in Patterson Lake, to the extent feasible.

Based on these Project activities and mitigations, residual effects on fish VCs were assessed for habitat availability, habitat distribution, and survival and reproduction. Although changes to fish VC habitat availability, habitat distribution, and survival and reproduction are possible, the predicted effects would be within the resilience and adaptability limits for the four fish VCs. Therefore, the assessment concluded that **residual adverse effects on fish and fish habitat VCs are predicted to be not significant**.

The Environmental Protection Program and the supporting Environmental Monitoring Plan would be implemented to monitor for effects on fish and fish habitat during the Project lifespan and apply adaptive management, where necessary. The key components of the aquatic ecology elements of the Environmental Monitoring Plan are expected to include monitoring of benthic invertebrates and fish. Monitoring during the Project lifespan is proposed to be undertaken every three years, but would be carried out in accordance with the MDMER and Environmental Effects Monitoring requirements, and with conditions identified through the licensing processes. The monitoring program for benthic invertebrates and fish would be designed to integrate the requirements of an Environmental Effects Monitoring biological monitoring study, as required under the MDMER.

The results of the surface water quality and sediment quality surveys described in Section 24.4.1.2.3 would provide supporting information for benthic invertebrate and fish monitoring programs.

24.4.1.3 Land

Components of the land environment that were included in the assessment include terrain and soils, vegetation, and wildlife and wildlife habitat. Key findings and conclusions from each component are presented in Section 24.4.1.3.1 to Section 24.4.1.3.3.

24.4.1.3.1 Terrain and Soils

Terrain and soils were selected as **intermediate components** based on the potential for terrain and soils to influence the establishment of plant species and vegetation communities and associated wildlife habitat and species over time.

A residual effects analysis considered the quantity and distribution of terrain units, the quantity and distribution of soil map units, and soil quality, which focused on soil suitability for reclamation. Project activities such as land clearing, site preparation, construction of facilities and infrastructure, handling of ore and waste rock, changes to air and water quality, and other typical mining construction, operation, and decommissioning and reclamation activities would have the potential to affect terrain and soils. As these activities do not have the potential to overlap with the Fission Patterson Lake South Property, only the potential effects of the Project were considered in the assessment.

Project environmental design features such as the UGTMF and site road alignment were designed, in part, to avoid removal of vegetation and wetland organic soils. In addition, the proposed Project footprint has been optimized and would be limited to the extent practicable to minimize disturbance to terrain and soils. Proposed mitigation measures, such as the stripping and stockpiling of topsoil, would provide materials for future use in reclamation, and erosion-control techniques would minimize soil loss. Additionally, progressive reclamation would be employed throughout Operations; disturbed areas would be reclaimed to support similar functions as natural ecosystems.

Given the potential Project activities and mitigations, the assessment concluded that there was negligible potential for cumulative effects on terrain and soils from the Project. Although there would be a permanent change to natural terrain units and soil map units disturbed by the Project that are covered by permanent features (e.g., WRSAs), progressive reclamation during Operations and reclamation during Closure are predicted to reverse effects and provide productive soils to support the establishment and succession of vegetation communities with similar function to natural ecosystems not influenced by the Project.

The Environmental Protection Program and Environmental Monitoring Plan would be implemented to manage effects on terrain and soils. Monitoring requirements for reclamation would be outlined in the Decommissioning and Reclamation Plan and would include details to achieve successful long-term reclamation of terrain and soils to support the establishment of vegetation communities and to provide functional wildlife habitat.

24.4.1.3.2 Vegetation

Vegetation, including three ecosystems (i.e., upland ecosystems, wetland ecosystems, and riparian ecosystems) and traditional use plants, represents a collection of **VCs** based on the importance of vegetation to ecological services (e.g., wildlife habitat), socio-economic/cultural importance, and the importance that vegetation represents as both traditional and other food sources for people and wildlife.

A residual effects analysis was conducted to determine the potential effects on upland, wetland, and riparian vegetation ecosystems and traditional use plants under the Application Case and RFD Case. Land clearing, site preparation, construction of facilities and infrastructure, handling of ore and waste rock, and changes to water and air quality would have the potential to affect upland, wetland, and riparian ecosystems and traditional use plants. Project environmental design features such as the UGTMF and site road alignment were designed, in part, to minimize Project effects on vegetation ecosystems and traditional use plants. In addition, the proposed Project footprint was optimized and would be limited to the extent practicable to minimize disturbance to vegetation. Proposed mitigation measures, such as progressive reclamation and revegetation of disturbed areas and areas where non-permanent Project components have been removed, would reduce effects on vegetation ecosystems and traditional use plants.

For all upland, wetland, and riparian ecosystems and traditional use plants, the Project is predicted to contribute to a loss of ecosystems, which would be confined to the Project's maximum disturbance area. The distribution of ecosystems would mostly remain abundant and well connected across the RSA. Effects to wetlands would be considered permanent, though these effects would be small. Cumulative fragmentation of ecosystems from the Project and Fission Patterson Lake South Property would be limited and localized to the area around Patterson Lake and a portion of the RSA already influenced by existing disturbances.

Based on several lines of evidence, **residual adverse effects, including potential adverse effects from climate change, are predicted to be not significant on upland ecosystem, wetland ecosystem, riparian ecosystem, or traditional use plant species VCs**.

Annual monitoring would be completed to identify and manage new occurrences of species designated by Saskatchewan's *The Weed Control Act* as prohibited, noxious, and nuisance weeds within the Project footprint. Monitoring and follow-up during Construction would be undertaken to delineate potential activity restriction guideline setbacks to mitigate direct disturbance to provincially tracked vascular plants. The Environmental Protection Program and Environmental Monitoring Plan would be implemented to monitor effects on vegetation. Monitoring requirements for reclamation would be outlined in the Decommissioning and Reclamation Plan and would include details on reclamation treatments to be used during revegetation, schedules for the frequency of monitoring, and action levels where adaptive management may be required. Monitoring and follow-up would be implemented to verify that reclamation was trending towards the successful regeneration and succession of vegetation ecosystems that are functionally similar to natural plant communities in the region.

24.4.1.3.3 Wildlife and Wildlife Habitat

Wildlife and wildlife habitat represents a collection of **VCs** based on the importance of wildlife and wildlife habitat to ecological services, socio-economic/cultural importance, and the importance that wildlife represents both as a traditional and other food source for people and other wildlife. Criteria for selecting VCs included: indicator, umbrella, or keystone species; conservation status; ecosystem and species life history; and Indigenous considerations. Final wildlife VCs selected included: woodland caribou (*Rangifer tarandus caribou*), moose (*Alces americanus*), grey wolf (*Canis lupus*), black bear (*Ursus americanus*), beaver (*Castor canadensis*), little brown myotis (*Myotis lucifugus*), olive-sided flycatcher (*Contopus cooperi*), rusty blackbird (*Euphagus carolinus*), common goldeneye (*Bucephala clangula*), mallard (*Anas platyrhynchos*), and Canadian toad (*Anaxyrus hemiophrys*).

An analysis was completed to evaluate Project and RFD components and activities that could potentially affect wildlife and wildlife habitat. For woodland caribou, the RFD evaluation also included a qualitative analysis of anticipated effects from forestry in the southern unit of the SK2 West Administration Unit (SK2 West). For both the Project and RFDs, activities that would have the potential to affect wildlife and wildlife habitat include land clearing, site preparation, construction of facilities and infrastructure, handling of ore and waste rock, changes to water and air quality, and other supporting mining construction, operation, and decommissioning and reclamation activities. The main mitigations for habitat loss are minimizing the Project footprint, re-aligning the site road within the Project footprint west of the airstrip to avoid a wetland, minimizing sensory disturbance, and progressive and final reclamation. During Operations and Closure, habitats would be restored to the extent possible through progressive and final reclamation.

Development of the Project site was predicted to result in habitat loss, habitat alteration, and sensory disturbance for all VCs during all Project phases. Some residual effects would be irreversible, such as potential changes to wetlands and permanent alteration of the landscape from the WRSAs. Residual effects associated with all other reclaimed habitat would be reversible, with the duration of effects being VC-specific and dependent on the time required to establish functional habitat. The magnitude of loss of wildlife habitat from the proposed Project would be less than 1.5% of suitable habitats in the RSA for all VCs. Cumulative habitat loss in the RFD Case would be less than 3.5% of suitable habitat in the RSA for all VCs.

Habitat distribution for all VCs except woodland caribou in the Application Case and the RFD Case would remain well connected throughout the RSA. For woodland caribou, habitat distribution is anticipated to remain unchanged; however, habitat is not well connected under existing conditions. Proposed mitigations designed to preserve habitat distribution include wildlife encounter protocols, limiting snowbank heights along the access road, enforced speed limits, and erecting signage to minimize potential disruption of connectivity and movement around and across Project infrastructure. Further mitigations such as scheduling work to avoid sensitive areas/periods, enclosing equipment, using noise suppression equipment, and enacting wildlife protection policies would minimize sensory disturbance to wildlife. These measures, combined with minimizing habitat loss, would limit effects on survival and reproduction of wildlife.

Given these mitigations, **all VC populations would be expected to remain self-sustaining and ecologically effective except woodland caribou, which is not self-sustaining under existing conditions. For all wildlife VCs except woodland caribou, the residual adverse effects from habitat disturbance, habitat alteration, and sensory disturbance from the physical footprint and associated Project activities in both the Application Case and RFD Case are considered not significant**. Woodland caribou are discussed further in Section 24.4.2.1, Significance of Residual Effects.

Surveillance completed as part of the Environmental Protection Program would be used to determine the efficacy of mitigation measures and to guide any future measures that should be implemented in subsequent Project phases. Potential risk areas at the Project would be identified as part of surveillance, which could lead to the implementation of targeted mitigation measures in these areas to limit human-wildlife conflicts. Preliminary surveillance would include a wildlife incident log, breeding bird follow-up studies, and remote camera follow-up studies. A Caribou Mitigation and Offsetting Plan would be developed and implemented for the Project, whereby offsets would be used to reduce the residual effects to woodland caribou and provide a net increase in functional woodland caribou habitat. Ongoing monitoring would be defined in the plan through engagement with regulatory agencies and local Indigenous communities.

24.4.1.4 People

Components that were included in the overall assessment of people include human health, cultural and heritage resources, Indigenous land and resource use, other land and resource use, economy, and community well-being. Key findings and conclusions from each component are presented in Section 24.4.1.4.1 to Section 24.4.1.4.6.

24.4.1.4.1 Human Health

Human health was included as a **VC** based, in part, on NexGen's core value of protection of human health and on the relationship between Indigenous and non-Indigenous residents in the LSA and the natural environment, particularly relating to the consumption of Traditional Foods. Human health represents a key interest identified by communities and regulators as it reflects the importance of hunting, trapping, fishing, and gathering to subsistence, survival, and livelihood, and as a key aspect of traditional and other food source security.

Potential adverse effects on human health during all Project phases and the far-future projection were evaluated through completion of a human health risk assessment (HHRA) for four potential receptors (i.e., camp workers, subsistence harvesters, seasonal residents, and future permanent residents). The HHRA evaluated both the Application Case and RFD Case. Human health could be affected by exposure to contaminants of potential concern that may be directly inhaled or ingested from Project emissions or indirectly ingested through the food chain. The mitigation measures put in place to limit effects on emissions and discharges as discussed for the atmospheric, water, and land intermediate components and VCs listed above would also minimize risks to human health.

The key findings of the residual effects analysis are as follows:

- For the assessment of non-carcinogens, no significant adverse effect on any human receptors as a result of releases from the Project would be likely during the Project lifespan for the Application Case or RFD Case.
- For assessment of risk for carcinogens (i.e., arsenic) for the Project, the incremental lifetime cancer risk was estimated and compared against the negligible cancer risk level of 1 in 100,000 recommended by Health Canada (2021). The incremental lifetime cancer risk of 4 in 100,000 was predicted to exceed the negligible cancer risk level of 1 in 100,000 for the subsistence harvester at Patterson Lake South Arm just outside the Project footprint but is not expected to exceed the negligible cancer risk within the RSA farther from the Project. This risk level is based on the conservative assumption of high consumption of Traditional Foods, including fish and terrestrial animals in the LSA. The predicted incremental risks for both the Application Case and RFD Case are in the negligible to very low category.
- The incremental radiation doses from all radionuclides in the U-238 decay chain including radon to all human receptors at all times were predicted to be below the regulatory public dose limit of 1 millisievert per year (mSv/yr). Overall, since the radiation dose estimates are below the public dose limit, no discernable health effects are anticipated due to exposure of these receptors to radioactive releases from the Project.

Overall, the HHRA results indicate that **residual adverse effects on the human health VC are predicted to be not significant.**

The Environmental Risk Assessment would be refined based on the Environmental Monitoring Plan and Effluent and Emissions Plan, which would include monitoring of air quality, surface water quality, sediment, soil, fish tissue, benthic invertebrate tissue, and Traditional Foods. Monitoring would focus on collecting data to verify environmental risk assessment model predictions as well as providing data to improve model predictions as the Project proceeds. Monitoring would support NexGen's adaptive management framework with the objective of reducing uncertainty over time. NexGen would work with local Indigenous Groups to complete a targeted Traditional Foods study to validate or modify the dietary assumptions made in the HHRA.

24.4.1.4.2 Cultural and Heritage Resources

Cultural and Heritage Resources was included as a **VC** based on its importance to Indigenous Groups and because archaeological sites are protected under Saskatchewan's *The Heritage Property Act.*

No heritage resources were found in field studies, and no further studies are required by the Heritage Conservation Branch. A chance find procedure would be implemented to manage any unanticipated archaeological materials or features discovered during any land clearing activities. Therefore, **residual adverse effects on the cultural and heritage resources VC are predicted to be not significant**.

24.4.1.4.3 Indigenous Land and Resource Use

Indigenous Land and Resource Use was included as a **VC** based on the importance of the area of the Project for traditional land and resource use, and to fulfil the requirement under Section 5(1) of *CEAA* 2012. Traditional activities associated with Indigenous land and resource include fishing, gathering, hunting, trapping, and other cultural activities. Occupancy and habitation are important aspects of Indigenous land and resource use, as are access and travel routes.

Indigenous land and resource use was assessed based on changes to access and area available for Indigenous land and resource use; availability of fish, plants, and wildlife for harvesting; and quality of the Indigenous land use experience. Project activities that could affect these intermediate components and VCs are listed in the atmosphere (Section 24.4.1.1), water (Section 24.4.1.2), and land (Section 24.4.1.3) subsections. Project environmental design features such as limiting the Project footprint to the extent practical and using the underground workings to store tailings were designed to minimize Project effects on Indigenous land and resource use. The mitigation measures put in place to limit emissions and discharges, as discussed for the intermediate components and VCs included above, would protect the fish, plants, and wildlife for harvest. Sensory disturbances including noise and light would be mitigated with design features that minimize emissions. The Ground Transportation Emergency Response Plan and Security Program would be in place to protect land users around the Project and along the access road. There would be limited measures to address resource user traffic safety on Highway 955 due to this roadway being under provincial purview; however, road upgrade and maintenance cost-sharing agreements would include provisions for safe and ploughed pullouts. The Decommissioning and Reclamation Plan would be developed and implemented to meet Indigenous land use objectives after Closure.

Perceptions about mining in the region have been formed based on experience with the Cluff Lake Mine and mineral exploration activity. Perceptions about potential contaminants from mining and changes to the cultural landscape would be mitigated through the implementation of an independent Indigenous monitoring program, communication through the Indigenous and Public Engagement Program, development of regional strategies to address effects on Indigenous land and resource use, and Benefit Agreements with primary Indigenous Groups. Benefit Agreements have been signed between NexGen and all four primary Indigenous Groups: the Clearwater River Dene Nation, Métis Nation – Saskatchewan, Birch Narrows Dene Nation, and Buffalo River Dene Nation.

Given these mitigations, there is expected to be continued ability to participate in Indigenous land and resource use activities. **The residual adverse effects on the Indigenous land and resource use VC are predicted to be not significant.**

Monitoring programs would be established to confirm the mitigation effectiveness for the land and resources that Indigenous Peoples rely upon and for aspects of the Project that may affect the experience of being out on the land. These monitoring programs would be developed through the Environmental Protection Program and associated follow-up studies. The success of regional mitigation strategies would be monitored, and perception surveys would be used to understand LPA residents' thoughts and understanding of uranium mining to guide future engagement and monitoring programs.

The establishment of the Environmental Committees and hiring of a independent Indigenous monitors with each primary Indigenous Group would be key for Indigenous Groups to stay actively involved in monitoring the environmental performance of the Project and to verify the parties are implementing the regulatory and environmental commitments made in respect of the Project.

The results of the monitoring conducted by the independent Indigenous monitors and NexGen would be evaluated and modifications to monitoring plans would be made, as required, to support adaptive management and foster continual improvement.

NexGen would continue to engage with, and have ongoing communication with, potentially affected Indigenous land users, both independently and as part of the Indigenous and Public Engagement Program. NexGen would also continue to share Project information, address issues and concerns as they arise, and share environmental monitoring results with local Indigenous Groups and communities.

NexGen has committed in the Benefit Agreements with each primary Indigenous Group to establish an Implementation Committee. The Implementation Committee is tasked with the responsibility of facilitating an effective ongoing working relationship between NexGen and the Indigenous Groups to verify that all commitments made within the Benefit Agreements are realized.

24.4.1.4.4 Other Land and Resource Use

Other Land and Resource Use was included as a **VC** based on the commercial and recreational land and resource uses that represent key economic activities and central features of the social setting in northern Saskatchewan. Commercial resource use includes activities in which people from both Indigenous and non-Indigenous communities may participate: commercial fishing and trapping; lodges, outfitting, and ecotourism; forestry; and mining. Recreational uses include use of parks and protected areas by Indigenous or non-Indigenous peoples, as well as fishing and hunting activities that are conducted by non-Indigenous people under provincial licences.

Other land and resource use was assessed based on changes to access and area available for land and resource use and quality of the resource use experience. The land users mainly consist of trappers and lodge and outfitting owners and clientele. Other groups such as recreational hunters and recreational and commercial fish harvesters are either not active or only nominally active in the other land and resource use LSA.

Mitigations that are intended to protect the biophysical environment would also mitigate the effects of Project activities on other land and resource use. Project environmental design features such as limiting the Project footprint to the extent practical and using the underground workings to store tailings were designed to minimize Project effects on other land and resource use. In addition, the Project would be reclaimed after Closure. Sensory disturbances including noise and light would be mitigated with design features that minimize emissions. In addition to the programs intended to monitor and manage biophysical effects, other measures to further reduce effects on other land and resource use are the Ground Transportation Emergency Response Plan and Security Program to provide safe and coordinated access via the access road, and an Indigenous and Public Engagement Program that includes engaging trappers, outfitters, and other land users to share Project information and address issues, and sharing environmental monitoring results with local communities.

There is expected to be continued opportunities for other land and resource use due to the negligible to small magnitude of local and reversible effects and the limited number of resource users that have the potential to be affected. Therefore, **residual adverse effects on the other land and resource use VC are predicted to be not significant**.

Environmental Committees composed of NexGen and Indigenous Group representatives would be established to act in an oversight manner to monitor the environmental performance of the Project and verify the parties are implementing the regulatory and environmental commitments made in respect of the Project. A Project feedback and grievance mechanism would also be implemented to record and action issues identified by other land and resource users.

24.4.1.4.5 Economy

Economy was included as a **VC** as the Project is predicted to create employment, contracting, and training opportunities for the local community workforce and businesses, and generate taxes, royalties, and other payments that may increase the revenues of provincial and federal governments. In addition, Indigenous Groups emphasized the importance of the traditional or subsistence economies, which were considered in the economic assessment.

Project characteristics that have the potential to affect the economy include the following:

- estimated capital expenditures of $1.3 billion over the four years of Construction;
- a peak Construction workforce of approximately 350 workers, with actual on-site labour requirements varying throughout the construction period;
- typical annual operating spending of $167 million;
- an Operations workforce, including a forecasted 486 direct jobs during the operating peak and approximately 425 direct jobs during a typical operating year;
- spending during Closure; and
- targets established by NexGen for hiring workers and procurement of goods and services from LSA communities.

Proposed mitigation and enhancement measures, such as the delivery of certified and accredited training and recruitment programs, the development of culturally sensitive employment policies, increasing involvement of local businesses within the LSA, and the implementation of items agreed to in Benefit Agreements would reduce adverse effects and enhance beneficial effects on the economy.

The analysis determined that all potential adverse economic pathways from the Project could be mitigated. Overall, the Project is expected to result in substantial net positive economic outcomes, which would have flow-on effects on a range of socio-economic variables including community well-being. Therefore, the **residual adverse effects on the economy VC are predicted to be not significant**.

It is anticipated the Project's Mineral Surface Lease Agreement would include a Human Resources Development Agreement and a rolling Annual Human Resources Development Plan that would require reporting on efforts to meet socio-economic commitments. In addition to this reporting, NexGen has committed to establishing an Implementation Committee in the Benefit Agreements with each primary Indigenous Group. The Implementation Committee would facilitate an effective working relationship between NexGen and the Indigenous Groups to verify that all commitments made within the Benefit Agreements are realized.

24.4.1.4.6 Community Well-Being

Community well-being was included as a **VC** based, in part, on the importance of well-being to local community members. Community members shared those aspects of their home communities that made life good, including freedom to access the land, the bonds between family members and community members at large, and a clean environment that can supply everything they need to live well. Detracting from community well-being were the lack of community facilities and services, mental health challenges and addictions, and the encroachment of industry and government policies on their freedoms and the land.

The community well-being assessment used the social determinants of health as a framework for describing the existing conditions and evaluating the potential effects of the Project on the community well-being VC. The assessment focussed on effects from access restrictions and avoidance of areas near the Project to cultural continuity, effects of the worker rotation system on social adaptability, and the subsequent changes to demand for community infrastructure and services.

For both the Application Case and the RFD Case, there is expected to be a potential local loss of cultural continuity for some individuals, including transmission of knowledge tied to areas around Patterson Lake that would no longer be accessible. This effect, along with additional strain placed on family dynamics from participation in the worker rotation system, are expected to increase demand for community infrastructure and services within LSA communities. These changes may expand to the RSA communities as some RSA residents would likely be employed to meet the combined Project and Fission Patterson Lake South Property labour source requirements. However, these changes would not likely be measurable due to the number of communities in the RSA and the much larger labour force pool.

Participation in the worker rotation system is also expected to adversely affect social adaptability for some individuals or their families by placing increased stress on family dynamics. The extent to which these effects are experienced would vary by Indigenous community and by individual community member. Mitigation would occur on site through inclusive human resources policies, provision of a dedicated space for Elders to be available to support employees, an Employee and Family Assistance Program, and a grievance mechanism through the Indigenous and Public Engagement Program. Mitigation is also anticipated in LSA communities through the Benefit Agreements.

The Project is anticipated to cause incremental and cumulative effects on community well-being. However, changes to cultural continuity from access restrictions, social adaptability from the inclusion of the worker rotation system, and subsequent changes in demand for community infrastructure and services are not expected to adversely affect those values considered important by community members to a degree where community well-being can no longer be maintained.

The Project, through employment and procurement opportunities and Benefit Agreements, would have the opportunity to support and enhance well-being for residents of northern Saskatchewan communities. Project benefits are further described in Section 24.4.2.2, Project Benefits. When all the well-being elements are considered together, the Project is anticipated to result in a positive outcome for the LSA, particularly if mitigation and enhancements are implemented effectively.

For both the Application Case and the RFD Case, **the residual adverse effects on the community well-being VC are predicted to be not significant**.

NexGen recognizes that Project effects can result in positive and negative outcomes for individuals and communities and is committed to working with local Indigenous Groups and communities to aim for overall improvement to community well-being. Effective monitoring of community well-being measurement indicators would be important to properly identify the positive and negative attributes of Project-induced changes, and to develop additional mitigation, management approaches, or sustainable enhancements, as applicable. NexGen would work with local Indigenous Groups and communities to develop effective monitoring to address the well-being indicators including societal and cultural, health, neighbourhood and physical environment, educational, and economic well-being. NexGen would also work with local authorities on issues related to potential stress on infrastructure and services.

NexGen has committed in the Benefit Agreements with each primary Indigenous Group to establish an Implementation Committee. The Implementation Committee would facilitate an effective working relationship between NexGen and the Indigenous Groups to verify that all commitments made within the Benefit Agreements are realized.

24.4.2 Summary of Significant Residual Effects and Benefits

24.4.2.1 Significance of Residual Effects

As indicated in Section 24.4.1, Summary of Technical Discipline Assessments, no significant residual adverse effects on biophysical and socio-economic VCs were predicted for the Project or for the Project in combination with RFDs, with the exception of the woodland caribou VC.

The wildlife and wildlife habitat assessment concluded that **effects on woodland caribou in the Base Case are already significant, as the amount of disturbance in the SK2 West is greater than the 35% threshold value as described in the federal woodland caribou recovery strategy (ECCC 2020)**. **Therefore, any amount of incremental habitat loss from any development**, including potential residual losses of habitat associated with the proposed Project, **is considered significant for woodland caribou**. However, the Project is predicted to contribute little to the existing cumulative effects on woodland caribou.

In the Application Case, the Project is expected to result in a loss of 32.4 ha of suitable woodland caribou habitat, representing less than 0.1% of available habitat in SK2 West and 0.6% of available habitat in the caribou home range study area. Habitat loss from the Project may displace a few individual woodland caribou but is unlikely to have a demographic effect at the population level. Effects from habitat loss are predicted to be reversible

40 years after the Active Closure Stage when reclaimed areas have reached defined critical habitat for woodland caribou. In the RFD Case, the Project and the Fission Patterson Lake South Property would combine to reduce the amount of suitable woodland caribou habitat in SK2 West by less than 0.1%. Additional disturbance of habitat in the SK2 West south sub-unit would result from forest industry activities. Overall, the combined amount of suitable habitat loss due to the Project and the Fission Patterson Lake South Property is predicted to have a negligible effect on the woodland caribou population as it accounts for less than one woodland caribou home range.

NexGen is committed to reclaiming habitat disturbed by the Project footprint and offsetting the incremental loss of woodland caribou habitat to help achieve self-sustaining and ecologically effective woodland caribou populations. Importantly, **NexGen's commitment to implementing a Caribou Mitigation and Offsetting Plan is expected to provide a net increase in functional woodland caribou habitat**. It is also anticipated that other future developments would implement similar mitigation actions to support woodland caribou conservation. Therefore, with the implementation of the Caribou Mitigation and Offsetting Plan that would achieve net increases in functional caribou habitat, the contribution of Project-specific residual adverse effects to woodland caribou would be **not significant**.

24.4.2.2 Project Benefits

As indicated in Section 24.1.2, the proposed Project represents a substantial and consistent source for meeting the growing global demand for electricity and need for expansion of low-GHG emitting energy options in a manner that is well regulated and respects all of Canada's security and nuclear safeguard commitments. Due to the low GHG emissions associated with nuclear power generation compared to coal and natural gas power generation, the downstream effects of the Project were predicted to increase Canada's ability to meet the national emission reduction targets. Additionally, the Project would support Canada's transition to a low carbon economy by providing the country with the fuel needed for nuclear power.

As described in Section 24.4.1.4.5, Economy, the Project would provide increased employment opportunities for local communities and other Canadians. The Project would benefit local communities and broader Saskatchewan and Canadian society in the following ways:

- **Employment:** Specific benefits include increased employment opportunities for local residents. During Construction, the peak workforce is expected to be approximately 350 workers, and the Project could result in between 8,200 and 10,500 direct, indirect, and induced full-time equivalent positions across Canada over a four-year period. During Operations, the peak employment is expected to total approximately 490 positions on payroll, with a long-term aspirational target of 75% of hiring from the LPA. Direct, indirect, and induced employment is estimated to range between 950 and 1,200 full-time equivalent positions across Canada during a typical operating year. Employment would continue during Closure but at a decreased level compared to Operations.
- **Income:** The Project would provide a substantial positive benefit through increased income opportunities for local residents. Construction labour costs are estimated to make up approximately $384 million or 30% of the total capital cost of $1.3 billion. The total direct, indirect, and induced labour income across Canada for Construction could range between $730 million and $885 million. Operations direct labour spending is estimated to be approximately $55 million during a typical operating year. The total direct, indirect, and induced labour income for a typical operating year could range between $94 million and $112 million. Income opportunities would continue during Closure but at a decreased level compared to Operations.
- **Education and Training:** The Project would provide a positive benefit for educational attainment in the LPA through increased education and training opportunities for local residents. NexGen would provide

training opportunities, which would result in a higher-skilled local workforce, allow employees to advance to more senior and higher-income employment within the organization, and improve local residents' ability to obtain other employment in the future.

- **Broader economic benefits:** Overall, the Project is estimated to have a direct, indirect, and induced impact on national gross domestic product of up to $1.3 billion over the course of Construction and up to $1.1 billion in a typical year of Operations. The Project would also generate benefits through the payment of royalties to the governments of Saskatchewan and Canada. These government revenue sources include uranium royalties, resource surcharges, mineral surface lease payments, corporate income tax, and individual income tax. The total estimated direct payments to government for a typical operating year were estimated at $288.5 million for Saskatchewan and $103.9 million for Canada.
- **Specific enhancement measures:** Commitments made in Benefit Agreements with primary Indigenous Groups and programs developed and implemented jointly between NexGen and local communities, with involvement from other interested stakeholders, could help enhance income opportunities for local residents. Enhancement and monitoring measures are proposed to sustainably maximize economic opportunities related to the Project. Specific measures would include:
  - Working with local communities to develop culturally sensitive employment policies including addressing potential barriers to employment.
  - Providing a dedicated space for Elders to be available to support employees.
  - Operating training and recruitment programs for construction and mining-related skills targeted at employment opportunities for local residents and continuing to provide scholarship and summer student opportunities.
  - Prioritizing advancement opportunities for qualified local residents into increasingly senior positions.
  - Working with local communities to establish and maintain a business registry for local businesses.

NexGen has signed Benefit Agreements with the Clearwater River Dene Nation, Métis Nation – Saskatchewan, Birch Narrows Dene Nation, and Buffalo River Dene Nation. These agreements are premised on principles described in NexGen's IMS Policy, including proactively engaging with local communities, supporting the educational and economic participation of affected communities, and seeking to provide opportunities resulting in sustainable, lasting benefits to local communities beyond the Project lifespan.

To enhance personal income and community revenue opportunities for community members in the LPA, NexGen is committed to a long-term aspirational target of 30% of the Project's external spending being awarded to local businesses (i.e., within the Northern Saskatchewan Administration District). Further to this aim, the Benefit Agreements include a pillar for economic participation, which includes commitments about employment, training, and contracting opportunities.

24.4.3 Assessment Confidence

In the EIS, future conditions of the biophysical and socio-economic environments were predicted as a result of the Project, previous and existing developments, and RFDs. Given that biophysical and socio-economic environments change naturally and continuously through time and across space, assessments of effects and predictions about future conditions embody some degree of uncertainty (CEA Agency 2018). Each discipline section of the EIS (i.e., Section 7 to Section 19) identified the key sources of uncertainty within their assessment and described how uncertainty was addressed to increase the level of confidence that effects would not be larger than predicted.

While uncertainty is an inherent aspect of any predictive exercise, there were no knowledge gaps that would affect the overall conclusions of the EIS. Considering the precautionary approach and using conservative assumptions where necessary, there is a moderate to high level of confidence that the effects on intermediate components and VCs have not been underestimated. Monitoring has been proposed in the EIS in part to address uncertainties associated with the effects predictions, as described in Section 24.4.5, Overview of Monitoring, Follow-Up, and Adaptive Management.

24.4.4 Overview of Management Programs and Plans

Management programs and plans are required to effectively implement the mitigation measures identified through the biophysical and socio-economic effects assessment process. NexGen is responsible for and committed to providing for the health and safety of its workers and the public and the protection of the environment. NexGen would develop an IMS for the Project, which would form a common framework for the management of all Project activities and would be developed with reference to the applicable provincial, CNSC, and Canadian Standards Association Group requirements, as well as appropriate guidance documents. This unified framework would include processes for fostering a culture in which protecting the health and safety of workers and preserving the environment are principal considerations guiding decisions and actions, as well as processes for implementing compliance measures and enabling continual improvement.

NexGen would be responsible for implementing the various monitoring and follow-up programs, which would be developed to include monitoring requirements documented within this EIS, and to comply with any Project approval conditions, permits, or authorizations. Monitoring and follow-up programs and management plans would be further developed as the Project, if approved, progresses through the permitting and licensing processes. Further Project refinements may influence the nature, frequency, and locations of monitoring required. In addition, input from Indigenous Groups, regulatory agencies, and the public would be considered. These programs and plans would then become “living” documents throughout the Project lifespan and would be altered, as required, as the Project progresses through Operations and Closure.

NexGen is committed to continued engagement with local Indigenous Groups and communities on appropriate and effective socio-economic management initiatives, and to evolving such initiatives over the Project lifespan to reflect areas of importance to Indigenous Groups and communities for each phase of the Project. NexGen’s approach allows for collaboration with each Indigenous Group and community to develop effective socio-economic management while more broadly recognizing the specific interests and areas of importance to each Indigenous Group and local community.

24.4.5 Overview of Monitoring, Follow-Up, and Adaptive Management

Monitoring and follow-up programs would be implemented to verify predicted effects, evaluate the effectiveness of mitigation, and measure compliance with future permit and licence conditions and statutory requirements. Monitoring would also be used to address uncertainties associated with effects predictions, identify any unanticipated effects, and provide input into corrective actions or adaptive management to limit those effects. Collectively, these actions would improve the overall environmental performance of the Project.

Adaptive management has been identified as a key element of the Project’s approach to risk management. Adaptive management is a planned and systematic approach to improving knowledge over time through an iterative process that provides the information required to increase confidence to make decisions that reduce uncertainty and improve risk management outcomes. Adaptive management provides a structured approach to decision making that emphasizes accountability and explicitness, but also allows for flexibility to identify and implement new mitigation measures or to modify existing measures during the lifespan of a project.

NexGen's adaptive management process for the Project would be described in the IMS Manual and would be used as a guide to developing and applying adaptive management plans. For example, if environmental monitoring detects environmental changes that are different from predicted changes, the adaptive management framework in the relevant management plan would be implemented to determine if and what actions are needed to meet the underlying objectives of minimizing adverse effects and reducing uncertainty.

Adaptive management is supplemental and complementary to the continual improvement processes outlined in the IMS Manual. NexGen is committed to achieving continual improvement in environmental performance through the management systems that would be implemented for the Project. NexGen proposes to manage Project-environment interactions through the Environmental Protection Program.

24.5 Next Steps

24.5.1 Licensing and Permitting

The proposed Project is subject to both a federal and provincial EA process, and would also require federal and provincial licences, approvals, and permits. Activities related to the site preparation, construction, operation, decommissioning and reclamation, and release from licensing of uranium mines and mills in Canada must be licensed under the *Nuclear Safety and Control Act* and applicable regulations. NexGen is implementing an integrated approach to the EA and licensing processes for the Project whereby information to support the licence application is submitted to the CNSC in a staged manner to ensure alignment between the EA and licensing documentation. Under the integrated approach, CNSC staff conduct technical reviews of information contained in the EIS and the licence application at the same time; however, the licensing decision cannot be made until after the EA decision has been rendered. Once a licence is issued, the CNSC maintains ongoing oversight of the licensed activities to confirm compliance through focused inspections and audits, reporting requirements, and annual updates to the Commission.

In addition to the CNSC licensing approvals, the Project would require permits and approvals issued by provincial agencies. Ministerial Approval for the Project EA was received on 8 November 2023, with other relevant approvals required prior to the commencement of Project-related activities. To protect the environment and human health, mining activities are regulated under The Mineral Industry Environmental Protection Regulations, 1996, which dictate the primary permitting requirements that would be required for the Project. Under these regulations, the Project would require an approval to construct, install, alter, or extend a pollutant control facility; an approval to operate a pollutant control facility; and eventually, an approval to permanently decommission a pollutant control facility. These regulations also specify requirements for the maintenance of decommissioning and reclamation plans and financial assurance instruments during Operations.

24.5.2 Establishment of Environmental Committees and Independent Indigenous Monitoring

As part of the evaluation of Project performance, monitoring and adaptive management are expected to represent key aspects of Project development and would provide further opportunities for inclusion of Indigenous and Local Knowledge. NexGen has formed an Environmental Committee with each of the four primary Indigenous Groups (i.e., Clearwater River Dene Nation, Métis Nation – Saskatchewan, Birch Narrows Dene Nation, and Buffalo River Dene Nation). Each Environmental Committee is composed of representatives from the Indigenous Group and representatives from NexGen and would act as an oversight committee to monitor the environmental performance of the Project and to verify the parties (i.e., NexGen and the Indigenous Group) are implementing the regulatory and environmental commitments made in respect of the Project. The Environmental Committee would be fully funded by NexGen for the lifespan of the Project. In addition to the Environmental Committee, NexGen has proposed funding full-time, independent Indigenous Monitors chosen by each of the primary Indigenous Groups. The intent of these positions is to provide unrestricted environmental monitoring opportunities (subject to the Indigenous Monitor complying with appropriate health and safety and other reasonable site-specific policies), including independent environmental sampling, for the lifespan of the Project. The Indigenous Monitors would also participate in annual community meetings to report openly and without restriction on the environmental performance of the Project to community members.

24.5.3 Ongoing Engagement

NexGen views ongoing engagement and knowledge sharing as a critical success factor for the Project; this practice would continue throughout the EIS review and into all future Project phases. As NexGen proceeds through the regulatory process and advances development of the Project, engagement activities would evolve as necessary to include Indigenous Groups and local communities in a manner that provides the opportunity for effective information exchange and dialogue specific to each stage of the Project. NexGen would take an adaptive approach to engagement to allow for adequate opportunity to respond to the needs of local communities as new information becomes available, while also respecting specific government policy and/or legislation. NexGen is committed to ongoing engagement throughout the Project lifespan with Indigenous Groups, regulators, and the public to safely and responsibly manage the Project resource in a way that benefits society.

24.6 Closing Statement

NexGen's vision is to become a world leader in delivering clean energy solutions for current and future generations in a manner that provides lasting benefits to local communities. With this in mind, the company has approached the proposed Project with consideration of current and future generations. NexGen is focused on the responsible and optimal development of the Project, incorporating environmental stewardship, social advancement, and sustainable long-term economic benefits for local Indigenous Groups and stakeholders.

NexGen has worked closely with the communities local to the Project since 2013, and engagement activities have continually evolved to promote the inclusion of Indigenous and Local Knowledge and feedback from regulatory agencies and the public. The proposed Project has been designed to meet applicable regulatory requirements and industry best management practices, and to be safe for the public and workers. The Project would also operate in well-regulated provincial and federal jurisdictions.

No significant adverse effects on biophysical and socio-economic VCs were predicted for the Project or for the Project in combination with RFDs, with the exception of woodland caribou. Effects on woodland caribou are already significant under existing conditions, and NexGen's commitment to implementing a Caribou Mitigation and Offsetting Plan is expected to provide a net increase in functional woodland caribou habitat. Therefore, the contribution of Project-specific residual adverse effects to woodland caribou would be not significant.

The proposed Project possesses favourable economics, would be fully self-funded, and would not require any financial support from governments. The Project would generate benefits through royalty and tax payments to the governments of Saskatchewan and Canada; the total estimated direct payments to government for a typical operating year are estimated at $288.5 million for Saskatchewan and $103.9 million for Canada.

The proposed Project represents a substantial and consistent potential source of uranium for meeting the growing global demand for electricity and could meaningfully contribute to the Government of Canada's ability to meet its environmental obligations and commitments with respect to climate change. In addition to supporting national environmental objectives and commitments, the proposed Project would generate socio-economic benefits and opportunities for local Indigenous Groups and communities, the Province of Saskatchewan, and Canada, including increased direct local and national employment, tax and royalty revenue, and associated indirect economic benefits and employment at local to national scales. NexGen would continue to prioritize training, employment, and business opportunities for the local communities closest to the Project.

24.7 References

Acts and Regulations

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