CMD 25-H12-Ref2 - CNSC Staff Submission

Reference Package for CMD 25-H12 NexGen Energy Ltd Application for a Licence to Prepare Site and Construct the Rook 1 Uranium Mine and Mill

Classification	Unclassified
Type of CMD	References
CMD Number	25-H12
Original CMD	25-H12
Public hearing date	19 November 2025
PDF e-DOC #	7592966
Summary	This CMD includes all publicly available documents referenced in CNSC staff CMD 25-H12.
Actions required	There are no actions requested of the Commission. This CMD is in support of the actions and recommendations set out in CNSC staff CMD 25-H12

CMD 25-H12- Ref2 – Soumission par le personnel de la CCSN

Références liées au CMD H-12 NexGen Energy Ltd. Demande de permis pour la préparation du site et la construction de la mine et l'usine de traitement d'uranium Rook I

Classification	NON CLASSIFIÉ
Type de CMD	Références
Numéro de CMD	25-H12
CMD Original	25-H12
Date de l'audience	19 novembre 2025
Numéro e-Doc du PDF	7592966
Résumé	Ce CMD comprend tous les documents accessibles au public mentionnés dans le CMD 25-H12 du personnel de la CCSN.
Mesures requises	Aucune mesure n'est requise de la Commission. Le présent CMD appuie les mesures et les recommandations énoncées dans le CMD 25-H12 du personnel de la CCSN.

25 NexGen Energy Ltd., *Rook I Project Environmental Impact Statement -TSD XXI: Environmental Risk Assessment*, Version 0, November 2024

Rook I Project

Environmental Impact Statement

TSD XXI: Environmental Risk Assessment

ENVIRONMENTAL RISK ASSESSMENT FOR THE ROOK I PROJECT

TECHNICAL SUPPORT DOCUMENT

REPORT PREPARED FOR:

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Ref. 19-2574
18 November 2024

Ecometrix | Environmental INTELLIGENCE

ENVIRONMENTAL RISK ASSESSMENT FOR THE ROOK I PROJECT

TECHNICAL SUPPORT DOCUMENT

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EXECUTIVE SUMMARY

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 federal and provincial Environmental Assessment (EA) processes, and the Environmental Impact Statement (EIS) was prepared to support the EA. The environmental risk assessment (ERA) is used to inform the EA. The ERA encompasses a human health risk assessment (HHRA) and an ecological risk assessment (EcoRA), which have been prepared to be compliant with Canadian Standards Association Group (CSA) N288.6-22 *Environmental Risk Assessments for Class I Nuclear Facilities and Uranium Mines and Mills* (CSA 2022), and Canadian Nuclear Safety Commission Regulatory Document 2.9.1, *Environmental Principles, Assessments and Protection Measures* (CNSC 2020).

The ERA focused on constituents of potential concern (COPCs) that exceeded screening values in air and water based on predicted atmospheric releases and aqueous releases (e.g., mine effluent, sewage effluent, site runoff, and groundwater solute releases) from the Project. Based on the screening of atmospheric releases, no COPCs in air were advanced for further quantitative assessment in the ERA. Based on the screening of aqueous releases, arsenic, cobalt, copper, molybdenum, uranium, sulphate, and chloride were advanced for further quantitative assessment in the ERA. Radionuclides, including the uranium-238 series and radon, were included as COPCs because these constituents are of public interest.

An environmental transport and pathways model (IMPACT) was used to evaluate the effects of COPCs on the local environment including human and ecological receptors.

The ERA estimated dose and risk to human and ecological receptors for the Application Case, reasonable upper bound sensitivity scenario, and the Reasonably Foreseeable Development Case (RFD) for all phases of the Project (i.e., the Project lifespan) and the far-future projection.

The selection of human and ecological receptors was informed by Indigenous Knowledge and Traditional Land Use (IKTLU) Studies, information obtained during community information sessions, and Joint Working Group (JWG) meetings.

The HHRA focused on members of the public potentially exposed to low levels of airborne or waterborne constituents. The selected human health receptor groups included:

- camp worker at Patterson Lake camp residence;
- subsistence harvesters;
- seasonal residents/lodge operators; and
- future permanent resident.

The ecological receptors selected for the EcoRA were a subset of valued components identified for the EA so that the results from the ERA could be used in the effects assessments for fish, vegetation, wildlife, human health, Indigenous land and resource use, and other land and resource uses.

Non-radiological Human Health Risk Assessment

The potential effects on human receptors were evaluated by comparing the non-radiological exposures of receptors to recognized benchmarks, a dose-based toxicity reference value in the same units, for each COPC. For assessment of non-carcinogens, risk was estimated based on a Project hazard quotient (HQ). Project HQs were compared to a benchmark HQ value of 0.2 because exposures to background sources were not included. This approach is consistent with Health Canada's guidance on human health preliminary quantitative risk assessment (Health Canada 2021a).

No significant adverse effect on any human receptors, as a result of releases from the Project, was considered likely during all Project phases (Operations was considered the bounding Project phase) for the Application Case, reasonable upper bound sensitivity scenario, and RFD Case. The predicted Project HQs for all non-carcinogenic COPCs (cobalt, copper, molybdenum, and uranium) would remain below the acceptable risk level of 0.2 per pathway for all human receptors.

For assessment of risk for carcinogens (arsenic), the incremental risk of developing cancer over a lifetime (ILCR) was estimated and compared against the 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. 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.

Radiological Human Health Risk Assessment

The incremental radiation dose to all human receptors during all Project phases and the far-future projection were predicted to be below the regulatory public dose limit of 1 millisieverts per year (mSv/yr) for the Application Case, the reasonable 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 reasonable 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 decommissioned and reclaimed Project site following Closure would 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 were predicted to be below the public dose limit, no discernable health effects would be anticipated due to exposure of human receptors to radioactive releases from the Project.

Non-radiological Ecological Risk Assessment

The potential for ecological effects was assessed by comparing exposure levels to toxicological benchmarks and characterized quantitatively in terms of HQs. An HQ greater than 1 indicates adverse effects may be possible for a given ecological receptor and further investigation would be warranted.

No significant adverse effect on either aquatic or terrestrial populations or communities, as a result of releases from the Project, would be likely during all Project phases for the Application Case, reasonable upper bound sensitivity scenario, and RFD Case. All estimated HQs for all COPCs (chloride, sulphate, arsenic, cobalt, copper, molybdenum, and uranium) for all ecological receptors were predicted to remain below the HQ benchmark of 1.

For the far-future projection, once groundwater solutes reach Patterson Lake North Arm – West Basin, HQs would remain below the benchmark of 1 for all COPCs with the exception of copper for the Application Case, reasonable upper bound sensitivity scenario, and RFD Case. Exceedances of the HQ benchmark value of 1 for the far-future projection would be limited spatially to Patterson Lake and would be limited in magnitude to just above the benchmark of 1. Exceedances of the HQ benchmark were predicted for lake whitefish, benthic invertebrates, and zooplankton.

The toxicity reference value (TRV) for lake whitefish, benthic invertebrates, and zooplankton corresponds to the Canadian Council of Ministers of the Environment's (CCME) default water quality guideline for copper. The CCME water quality guideline is a conservative benchmark for copper below which adverse effects for most aquatic biota are not expected to occur. The most sensitive species include fresh water snails (*Lymnaea stagnalis* and *Pyrgulopsis robusta*), bivalves (*Villosa iris*), and water flea (*Daphnia magna*; ECCC 2021). The most sensitive endpoints for chronic exposure to copper include growth for benthic invertebrates, reproduction for zooplankton, and growth and reproduction for fish (ECCC 2021). The CCME water quality guideline is based on no or low effect levels for the most sensitive species; thus, the marginal TRV exceedances predicted by HQs just above 1 would indicate a possible slight reduction in growth or reproduction for exposed individuals of sensitive species in Patterson Lake North Arm – West Basin. However, since the HQ exceedance would be localized to Patterson Lake North Arm – West Basin, population level effects would not be expected.

Species at risk were assessed using surrogate species. The rusty blackbird and little brown myotis were identified as surrogate species at risk. Since no HQs above 1 were identified for these ecological receptors, individual species at risk would also be considered protected.

Radiological Ecological Risk Assessment

Radiation dose benchmarks of 9.6 milligrays per day (mGy/d) and 2.4 mGy/d (UNSCEAR 2008) were selected for the assessment of effects on aquatic biota and terrestrial biota, respectively, as recommended in CSA N288.6-22.

There were no predicted exceedances of the 9.6 mGy/d radiation dose benchmark for aquatic biota and 2.4 mGy/d radiation dose benchmark for terrestrial and riparian biota for the Application Case, the reasonable upper bound sensitivity scenario, and the RFD Case, during the Project phases and the far-future projection.

Since there were no predicted exceedances of the respective dose benchmarks for any of the aquatic or terrestrial receptors, individual species at risk would also be considered protected.

Monitoring and Follow-up

The HHRA and EcoRA were developed based on the best available information for the Rook I Project, including baseline monitoring data, assumptions on estimates of source terms, Traditional Food diet (consumption rates and food types), among others.

Monitoring would focus on collecting data to verify ERA model predictions as well as provide data to improve model predictions as the Project begins. Recommended monitoring would support NexGen's adaptive management framework with the goal of reducing uncertainty over time through an iterative process.

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ABBREVIATIONS AND UNITS OF MEASURE

Abbreviation	**Definition**
AAQC	ambient air quality criteria
ATSDR	Agency for Toxic Substances and Disease Registry
BAF	bioaccumulation factor
BC MECCS	British Columbia Ministry of Environment and Climate Change Strategy
BC MOE	British Columbia Ministry of Environment
BNDN	Birch Narrows Dene Nation
BRDN	Buffalo River Dene Nation
CAAQS	Canadian Ambient Air Quality Standards
CAC	criteria air contaminant
CCC	criterion continuous concentration
CCME	Canadian Council of Ministers of the Environment
CNSC	Canadian Nuclear Safety Commission
COPC	constituent of potential concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CRDN	Clearwater River Dene Nation
CSA	Canadian Standards Association
DCF	dose coefficient
EA	Environmental Assessment
EC	effect concentration
ECCC	Environment and Climate Change Canada
EcoRA	ecological risk assessment
Eco-SSL	ecological soil screening level
ECOTOX	ECOTOXicology database
EIS	Environmental Impact Statement
ENV	Saskatchewan Ministry of Environment
ERA	environmental risk assessment
ESL	effects screening level
FEQG	federal environmental quality guidelines
FNFNES	First Nations Food, Nutrition and Environment Study
HABISask	Hunting, Angling and Biodiversity Information of Saskatchewan
HHRA	human health risk assessment
HQ	hazard quotient
IC	inhibition concentration
ICRP	International Commission on Radiological Protection
IKTLU	Indigenous Knowledge and Traditional Land Use
ILCR	incremental lifetime cancer risk
ISQG	interim sediment quality guideline
JWG	Joint Working Group
LC	lethal concentration
LEL	lowest effect level

Abbreviation	Definition
LOAEL	lowest observed adverse effect level
LSA	local study area
MN-S	Métis Nation – Saskatchewan
NE2	no-effect
NexGen	NexGen Energy Ltd.
NOAEL	no observed adverse effect level
NPAG	non-potentially acid generating
OAAQC	Ontario Ambient Air Quality Criteria
OF	occupancy factor
PAG	potentially acid generating
PEL	probable effect level
PM	particulate matter
PM_{10}	particulate matter with a diameter of 10 microns or less
$PM_{2.5}$	particulate matter with a diameter of 2.5 microns or less
Project	Rook I Project
REF	reference
RFD	reasonably foreseeable development
RSA	regional study area
SAAQS	Saskatchewan Ambient Air Quality Standards
SAR	Species at Risk
SARA	*Species at Risk Act*
SEL	severe effect level
SEQG	Saskatchewan environmental quality guidelines
TF	transfer factor
TRV	toxicity reference value
TSD	Technical Support Document
TSP	total suspended particulates
UGTMF	underground tailings management facility
UL	upper intake level
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
USEPA	United States Environmental Protection Agency
VC	valued component
WHO	World Health Organization
WQO	water quality objective
YNLR	Ya'thi Néné Lands and Resources

Unit	Definition
%	percent
µm	micron
$\mu g/m^3$	micrograms per cubic metre
Bq/m^3	becquerels per cubic metre
dw	dry weight
fw	fresh weight
$g/m^2/yr$	grams per square metre per year
h	hour
h/yr	hours per year
kg/yr	kilograms per year
km	kilometre
km^2	square kilometre
m	metre
m/s	metres per second
mg $CaCO_3$/L	milligrams of calcium carbonate per litre
mg/kg/d	milligrams per kilogram per day
mg/L	milligrams per litre
mGy/d	milligrays per day
mGy/h	milligrays per hour
mo/yr	months per year
mSv/yr	millisieverts per year

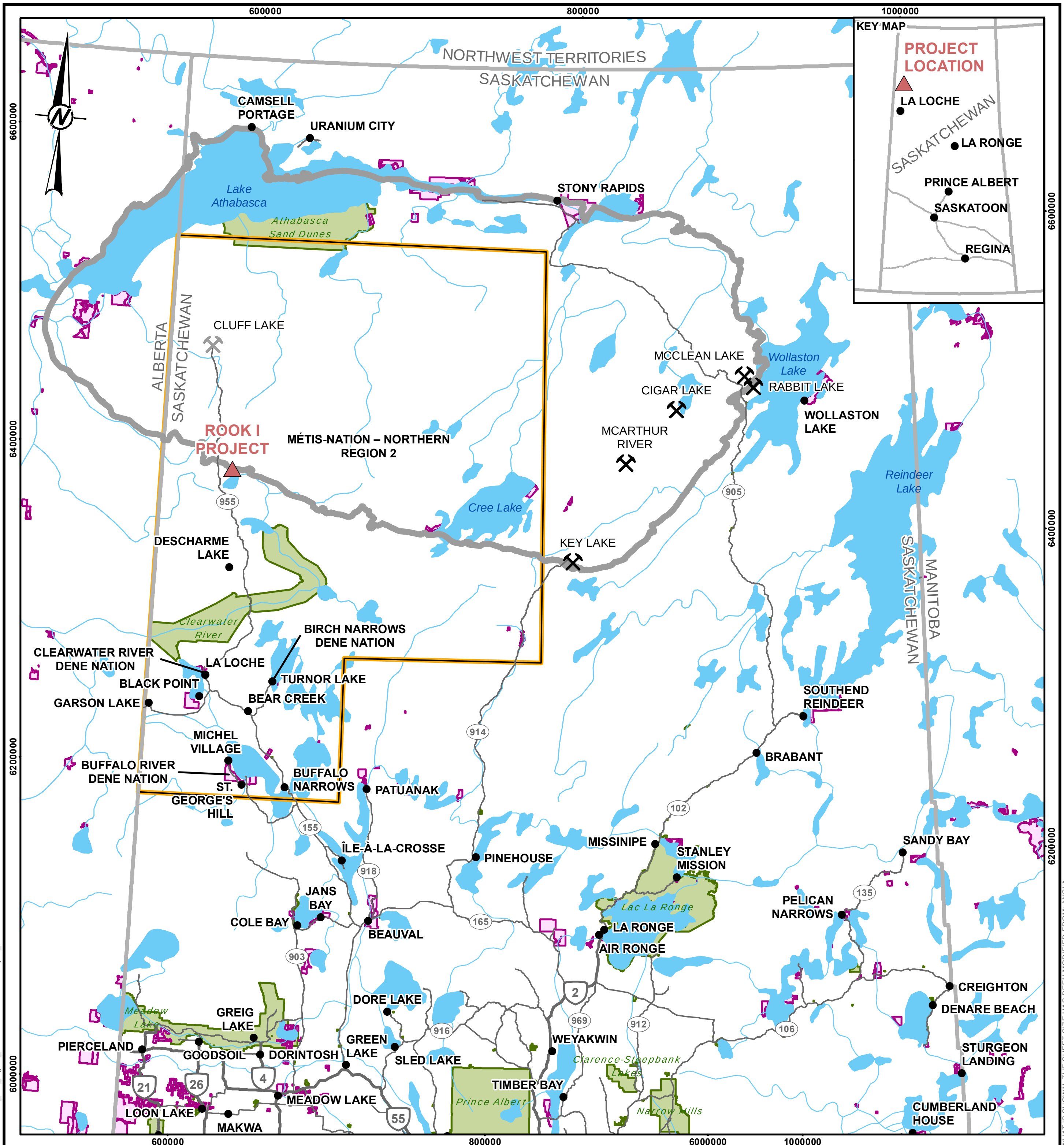
1.0 INTRODUCTION

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 town of La Loche, and 640 km northwest of the city of Saskatoon (Figure 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 1-2), with on-site worker accommodation serviced by fly-in/fly-out access.

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 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;
- non-potentially acid generating (NPAG) waste rock storage area;
- 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

- 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	PHASE 3314 - 6
DESIGN	JMC	2023-02-28	SCALE AS SHOWN REV. 0
GIS	NO	2023-02-28	FIGURE 1-1
CHECK	JMC	2023-02-28	
REVIEW	MM	2023-02-28	

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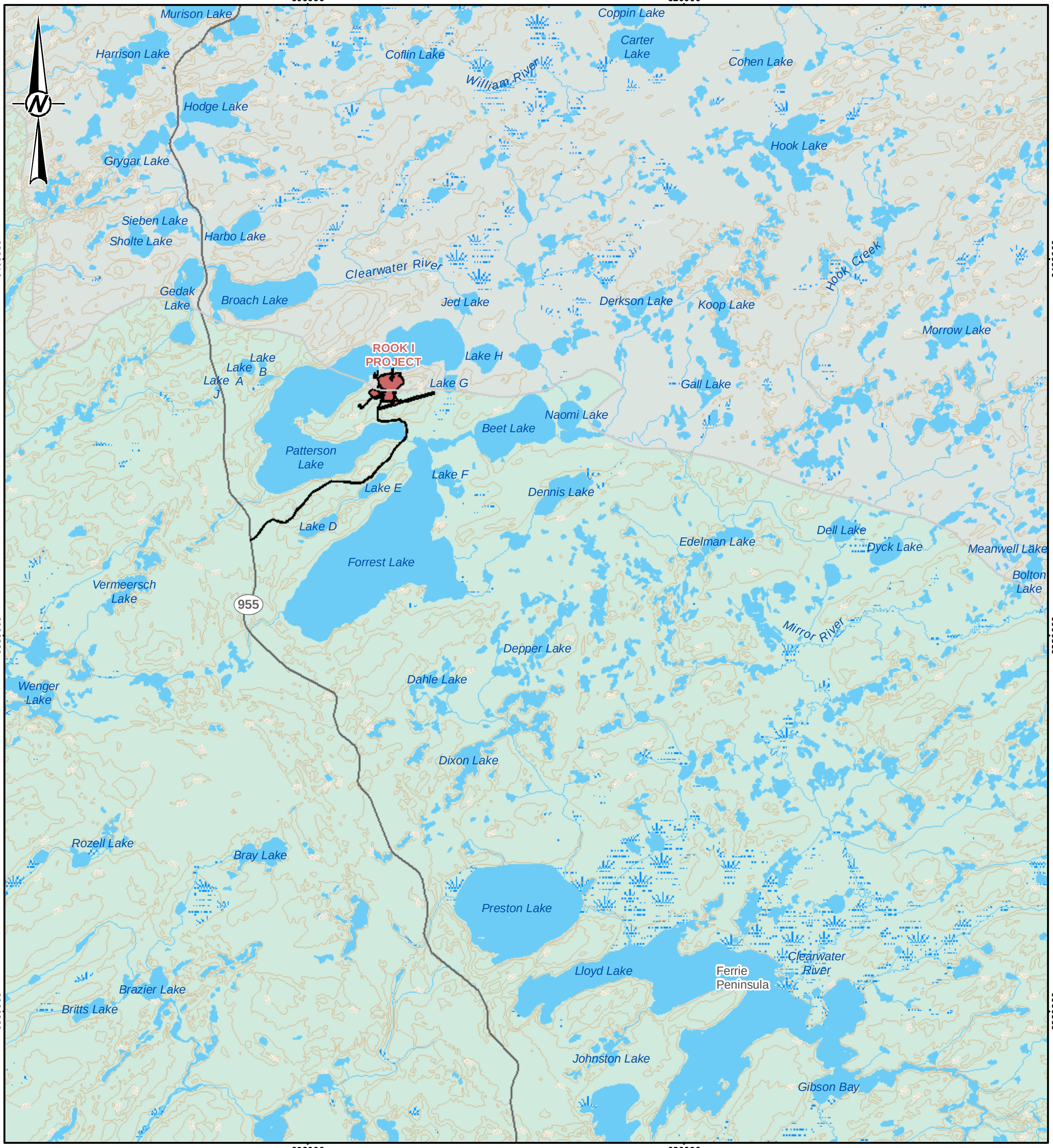

LEGEND

- 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	PHASE	3314 - 6
DESIGN	JMC	2023-02-28	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-28		
CHECK	JMC	2023-02-28	**FIGURE 1-2**	
REVIEW	MM	2023-02-28		

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\General\EIS_FIGURES_SECTION1\20144150_007_Fig1-2_Regional-Area_Rook_I_Project_Rev0.mxd PRINTED ON: 2023-02-28 AT: 1:28:00 PM

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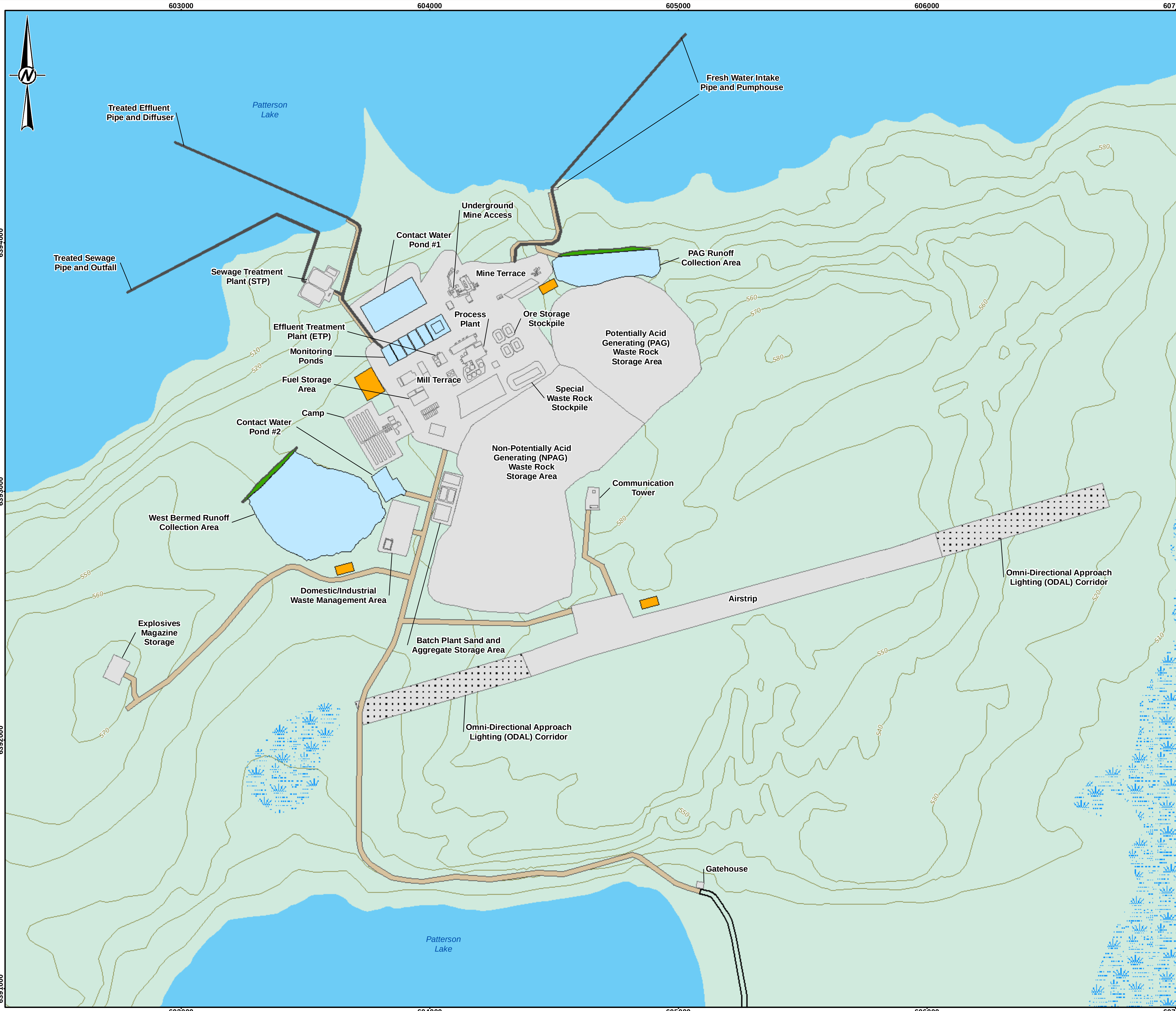


LEGEND

- 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	PHASE	3314 - 6
DESIGN	JV	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-28		
CHECK	JMC	2023-02-28	**FIGURE 1-3**	
REVIEW	MM	2023-02-28		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1.1 Regulatory Context

The proposed Project is subject to both federal and provincial Environmental Assessment (EA) processes, and the Environmental Impact Statement (EIS) was prepared to support the EA. This environmental risk assessment (ERA) encompasses a human health risk assessment (HHRA) and an ecological risk assessment (EcoRA), which have been prepared to be compliant with Canadian Standards Association Group (CSA) N288.6-22 *Environmental Risk Assessments for Class I Nuclear Facilities and Uranium Mines and Mills* (CSA 2022). It also meets the requirements for an ERA outlined in Section 4.1 of Regulatory Document-2.9.1, *Environmental Principles, Assessments and Protection Measures* (CNSC 2020). The ERA has been developed with current science and current regulatory attitudes in mind.

The ERA was used to inform other EA disciplines and to support the conclusions made in the EIS. The regulatory and guidance documents applicable to the EIS were discussed in the EIS.

1.2 Objectives

The objectives of this ERA were to:

- predict and assess the risk to representative human and ecological receptors resulting from exposure to radiological and non-radiological substances expected to be released to the environment throughout the phases of the Rook I Project;
- inform decision-making in the EIS; and
- inform prioritization of monitoring and mitigation measures.

1.3 Scope

The ERA used the expected sources of atmospheric and liquid releases to predict the transport of these constituents through the environment, exposure and dose to the public, and exposure and effects on representative ecological receptors.

The scope of the ERA encompassed both human and ecological health risks, and radiological and non-radiological constituents of potential concern (COPCs).

The EIS assessed valued components (VCs) which 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 receptors selected for the ERA included a subset of VCs identified for the EIS, so that the results from the ERA could be used in the effects assessments for fish, vegetation, wildlife, human health, Indigenous land and resource use, and other land and resource use.

Physical stressors were considered in the assessments of other VCs in the EIS, outside of the ERA. The assessment of VCs in the EIS included a pathways analysis to determine how Project activities may interact with the environment. For primary pathways resulting in a potential effect after mitigation, a residual effects analysis was conducted. Physical stressors were considered in the assessments of fish and fish habitat (EIS Section 11) and wildlife and wildlife habitat (EIS Section 14). With respect to the assessment of fish and fish habitat, EIS Section 11.4.1 (No Pathways) and Section 11.4.2 (Secondary Pathways) identified multiple pathways with the potential to create physical stressors on the fish and fish habitat VCs. However, these pathways were deemed to have negligible or measurable but minor effects and were not assessed further. With respect to the assessment of wildlife and wildlife habitat, EIS Section 14.4.2 (Secondary Pathways) also identified multiple pathways with the potential to create physical stressors on the wildlife and wildlife habitat VCs. However, these pathways were deemed to have measurable but minor effects and were not assessed further. In addition, sensory disturbance (e.g., lights, dust, smells, noise) to wildlife was identified as a primary pathway, which was then assessed for wildlife and wildlife habitat VCs in EIS Section 14.5 (Residual Effects Analysis) and three species at risk not selected as VCs in EIS Appendix 14A (Species at Risk Screening Assessment).

The ERA is supported by the IMPACT Model Report (Appendix A), which presents the structure and functioning of the IMPACT model as implemented for the Project. The model was used to evaluate the transport and effects of COPCs on the local environment and receptors, including humans and non-human biota.

1.3.1 Spatial Boundaries

The spatial boundaries of the ERA were consistent with the boundaries defined in the EIS for the aquatic and terrestrial environment, and included the site study area (Project footprint), the local study area (LSA) and a larger regional study area (RSA; Figure 1-4, Table 1-1). The RSA spatial boundary 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:

- **Site Study Area (Project footprint):** The Project footprint includes the camp where workers reside while at work.
- **Local study area (LSA):** 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. 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.
- **Regional study area (RSA):** 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 reasonably foreseeable developments.

Table 1-1: Spatial Boundaries for the ERA

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	107,000 ha (1,070 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.

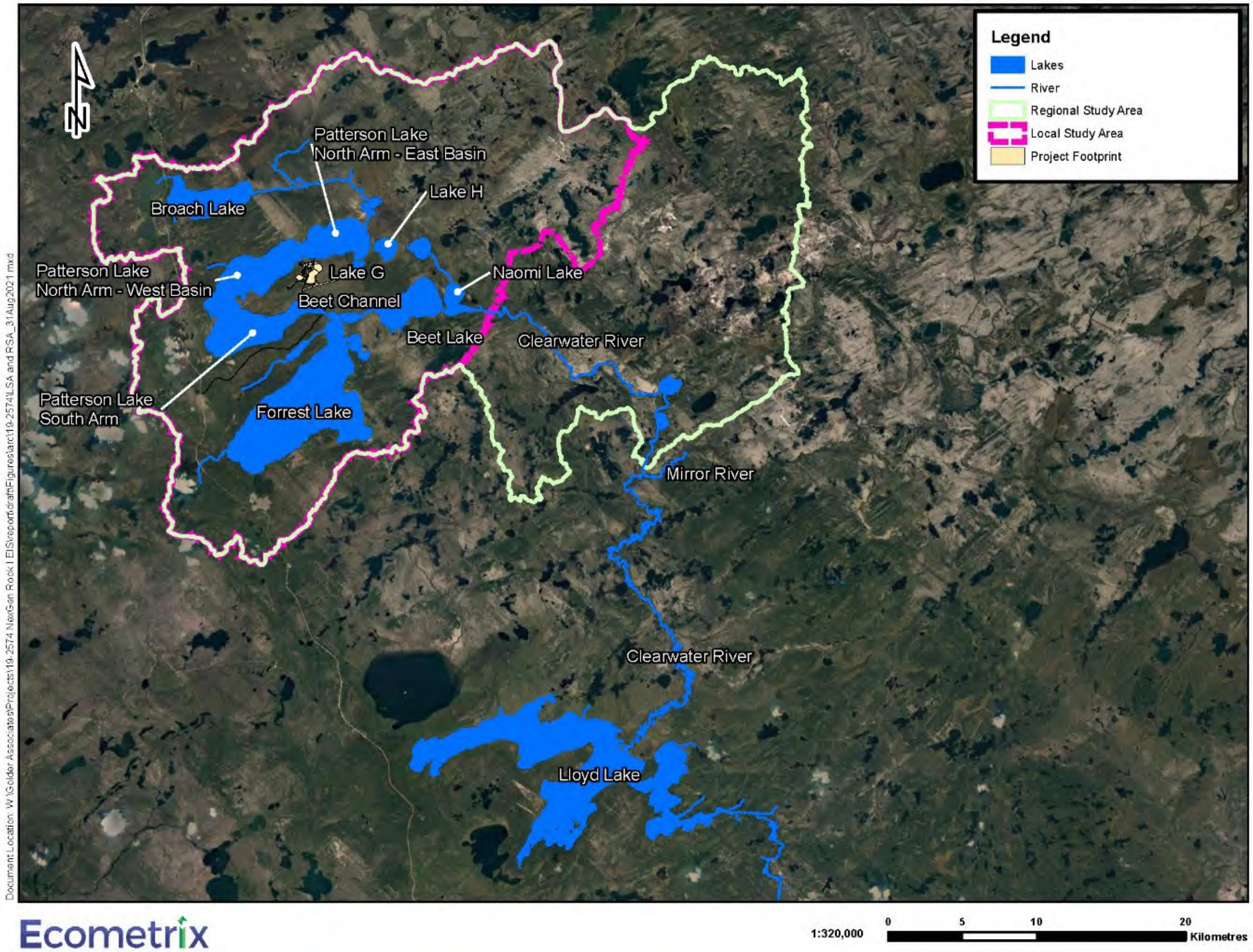


Figure 1-4: Rook I Project Local Study Area and Regional Study Area Boundaries

1.3.2 Temporal Boundaries

The ERA assessed three phases: Construction, Operations, and Decommissioning and Reclamation (i.e., Closure), as well as a far-future projection, as described in Table 1-2. The Rook I Project is anticipated to last 43 years, after which time closure performance criteria would be fully demonstrated.

Construction is anticipated to last four years. Operations are anticipated to last 24 years. Closure is anticipated to last 15 years, which consists of the Active Closure Stage and the Transitional Monitoring Stage. The far-future projection represents the period after the closure performance criteria have been fully demonstrated.

Table 1-2: Project Phases Assessed in the Environmental Risk Assessment

Phase	Description
Project lifespan (43 years total)	**Construction Phase (4 years)**: 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 the Operations Phase commences.
	Operations Phase (24 years): includes all activities associated with mining and processing ore; tailings management; management of mine rock, domestic waste, and hazardous materials; water management; release of treated effluent; surface storage of clean material; site maintenance; progressive reclamation; and transportation of staff and materials to and from the Project.
	Decommissioning and Reclamation (i.e., Closure) Phase (15 years): includes two stages: Active Closure Stage and Transitional Monitoring Stage: • **Active Closure Stage (5 years)**: includes active decommissioning and reclamation activities post-Operations such as backfilling mine workings, removal of physical infrastructure, recontouring and revegetating disturbed areas, waste disposal or removal, water management and treated effluent discharge (if required), 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. • **Transitional Monitoring Stage (10 years)**: may take longer than 10 years; this stage will 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. This stage is nominally 10 years; however, NexGen acknowledges this is dependent on the achievement of performance criteria.

Phase	Description
Far-Future projection (not a Project phase)	The far-future projection encompasses the long-term timeframe during which extremely slow migration of COPCs from the UGTMF and waste rock storage area to the environment are anticipated. The far-future projection is applicable to groundwater and surface water quality intermediate components, and human health VCs and ecological receptors, which are assessed through the ERA. Far-future is a projection of the long-term return to steady-state conditions.

CNSC = Canadian Nuclear Safety Commission; VC = valued component; ERA = environmental risk assessment; COPC = constituents of potential concern; UGTMF = underground tailings management facility.

1.3.3 Assessment Cases

Assessment cases distinguish between existing, proposed, and future projects. Consistent with the EIS, the assessment cases included a Base Case, an Application Case, and a Reasonably Foreseeable Development (RFD) Case:

- The **Base Case** is represented by existing conditions. The Base Case describes the existing environment in the LSA and RSA before the application of the proposed Project to provide an understanding of the current physical, biological, economic, social, and cultural conditions that may be influenced by the Project.
- The **Application Case** represents predictions of the combined effects of the Base Case plus the effects from the proposed Project. This case also assesses incremental, Project-specific changes that are predicted to occur to human and ecological receptors:
    - A sensitivity scenario was developed as part of the Application Case. It was representative of reasonable upper bound, or 95th percentile, 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 source-term inputs from the site wide water balance model (SWWBM) and the groundwater solute transport model.
- The **RFD Case** includes the combined effects of developments under the Base Case and Application Case, and RFDs that have not yet been approved:
    - The RFD Case includes the Fission Patterson Lake South Property, which is planned to be located on the west shore of Patterson Lake, at the most westerly point where the North Arm and South Arm meet. 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. Public information describes a projected three-year construction period and seven-year operating period (production and processing) (Fission 2019, 2021).

1.4 Statement of Limitations

This report has been prepared by Ecometrix Incorporated (Ecometrix) and includes environmental conclusions. In preparing the report, Ecometrix relied in good faith on data, information collected, and modelling results by others and made available to Ecometrix. Ecometrix did not independently confirm such information, unless specifically stated, and does not accept responsibility for any deficiencies, inaccuracies or misstatements in the work of others as provided, nor for conditions or issues outside of the scope of work.

Any and all conclusions made by Ecometrix in the report represent Ecometrix's professional judgement, and are based on understanding of the site conditions as described by the information made available at the time of and relied upon for the report preparation. The report is to be read in its entirety; sections or parts are not to be taken out of the context of the whole report.

Ecometrix prepared the report exercising the same standard of care, skill and diligence required by the professional practices and procedures that would normally be provided in the preparation of similar projects under similar conditions. Nothing in this report is intended to provide or constitute a legal opinion.

This report has been prepared for the sole and exclusive use of NexGen. Any use of, reliance on, or decision made by a third party on the basis of this report is the sole responsibility of such third parties. Ecometrix does not accept any responsibility for damages, if any, that are suffered by third parties because of their reliance on or use of this report to make decisions or take actions.

2.0 SITE DESCRIPTION

2.1 Project Description

The Project would include underground mining to access the uranium ore of the Arrow deposit. A process plant would be located on surface directly above the mine to process the ore on site. Tailings from the processed ore would be returned below ground to the UGTMF, which represents a key environmental design feature of the Project that avoids the permanent removal of land and associated risks to the environment.

2.2 Description of the Natural and Physical Environment

The proposed Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. The Project site would be located within the Patterson Lake Watershed, which is within the larger Clearwater River Watershed that drains to the Mackenzie River Watershed via the Athabasca and Slave rivers.

Climatic conditions at the proposed Project site are considered sub-arctic with temperatures ranging from warmer than 30°C in the summer to colder than -40°C during the winter. The proposed Project site is covered by 30 m to 100 m of glacial drift over Cretaceous mudstone, which are fine-grained clay particles that have been compressed by overlying material over a long time. The glacial drift is comprised primarily of sand with gravels, cobbles, and boulders. Drumlins, lakes, wetlands, rivers, streams, and muskegs are common in the Project vicinity. Elevations in the region range from 583 metres above sea level (masl) at the crest of major drumlins to 480 masl for some of the lowland lakes. The Project site is dominated by sandstone (i.e., sand-sized grains of rock material), with some bedrock outcroppings (i.e., rock that rises above the surface).

The broader regional area of the proposed Project intersects the Boreal Shield and Boreal Plain ecozones. At a smaller more local scale, the proposed Project is located within the Boreal Plain Ecozone of the Mid-Boreal Uplands Ecoregion. The area surrounding the proposed Project consists of recent burns with residual stands of jack pine (*Pinus banksiana*) and some black spruce (*Picea mariana*), with shrub and lichen as ground cover. Provincial wildfire data indicate that large areas in the region have been burned over the last 40 years.

The broader regional area surrounding the proposed Project is largely undisturbed by human activities and infrastructure; approximately 0.5 percent (%) of the regional area (1,000 square kilometres [km^2]) encompassing the Patterson Lake Watershed has been influenced by human developments. Most human-related disturbances in this regional area include linear features such as Highway 955, cutlines, seismic lines, and trails, with some cleared areas.

2.3 Uncertainty in Site Characterization

The Project LSA and RSA are well characterized with regards to biophysical data. Baseline monitoring has been ongoing since 2018, which has provided sufficient baseline information to support the EIS and ERA. No residual uncertainties in the site characterization have been identified. Information from the baseline studies and Indigenous Knowledge and Traditional Land Use (IKTLU) Studies were used to inform the assumptions of the ERA and underlying models. Assumptions were also validated through discussions during community information sessions, Joint Working Group (JWG) meetings, and regulatory meetings, which resulted in refinements and changes to previously made assumptions.

3.0 INTEGRATION OF INDIGENOUS AND LOCAL KNOWLEDGE

The Project would be located within Treaty 8 territory, which is an area spanning 840,000 km^2 and covers parts of Saskatchewan, Alberta, British Columbia, and the Northwest Territories. Primary Indigenous Groups, as identified by the CNSC and the Saskatchewan Ministry of Environment (ENV), and corroborated by NexGen early engagement, who have Study Agreements with NexGen in 2019 include (in alphabetical order):

- Birch Narrows Dene Nation (BNDN);
- Buffalo River Dene Nation (BRDN);
- Clearwater River Dene Nation (CRDN); and
- Métis Nation – Saskatchewan (MN-S), including as on behalf of the Locals of MN-S Northern Region 2.

In addition to the primary Indigenous Groups, the Ya'thi Néné Lands and Resources (YNLR), which represents the Fond du Lac Denesųłiné First Nation and the Black Lake Denesųłiné First Nation, also signed a Study Funding Agreement in 2020 and developed an Interim Report IKTLU Study that informed the ERA.

Indigenous Knowledge and Traditional Land Use Studies include all different forms of studies developed by Indigenous Groups who have completed IKTLUs for the proposed Project; these include Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, and Indigenous Rights and Knowledge studies.

Based on information from IKTLU Studies, the Patterson Lake area is used by these Indigenous Groups for resource use activities such as hunting, fishing, trapping, and gathering (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR). Feedback from engagement, JWGs, and IKTLU Studies have also identified several important themes that require consideration:

- importance of maintaining safety and health of water and fish in Patterson Lake, including consideration of potential cumulative effects from the Project and the Fission Patterson Lake South Property;
- ability to access land and resource use during and after the lifespan of the mine, and if the land would be safe to use after the mine closes;
- risks to human safety from traffic and spills due to increases in traffic and subsequent effects on the roads;
- benefits of training, employment, and contracting, but understanding the challenges (or barriers) to acquiring jobs and the negative effects associated with increased income (e.g., time away from families, loss of connection with the land); and

- importance of historical and cultural context, which includes a deep connection to the water and land for the necessities of life.

Indigenous Knowledge, as documented in the IKTLU Studies and JWG meeting minutes, continues to play a key role in developing the assumptions for the ERA, including the specific human and ecological receptors selected for the assessment, and locations and characteristics of these receptors. Where Indigenous Knowledge has been used, this is documented in the relevant section of the ERA report.

A summary of the forum for gathering Indigenous Knowledge from community information sessions, JWG meetings, and IKTLU Studies is outlined below.

3.1 Community Information Sessions

Community information sessions were hosted by NexGen in June 2019. The objectives of the sessions were to:

- inform local communities of the nature of proposed activities at the Project;
- answer questions and receive initial feedback specific to the Project for consideration during the EA, including feedback on VCs;
- provide information about the EA process; and
- introduce NexGen and the Project to the broader community.

Table 3-1 outlines the date, location and communities invited to the four community information sessions.

Table 3-1: Dates and Locations of June 2019 Community Information Sessions

Location	Date	Communities Notified of the Event
La Loche Community Hall, La Loche, SK	Monday 24 June 2019	• La Loche, SK • CRDN • Descharme Lake, SK • Bear Creek, SK • Black Point, SK • Garson Lake, SK
Birch Narrows Arena, BNDN	Tuesday 25 June 2019	• BNDN • Turnor, SK
Buffalo River Arena, BRDN	Wednesday 26 June 2019	• BRDN • Dillon, SK • Michelle Village, SK • St. George’s Hill, SK
Lakeview Complex, Buffalo Narrows, SK	Thursday 27 June 2019	• Buffalo Narrows, SK

SK = Saskatchewan; BNDN = Birch Narrows Dene Nation; BRDN = Buffalo River Dene Nation; CRDN = Clearwater River Dene Nation.

The community information sessions used a drop-in format, with a series of ten poster presentations, which were staffed by NexGen representatives. Copies of the posters were available in pamphlet form for participants to keep. The poster stations contained information about NexGen, the Project, by-product management, reclamation, water, radiation, the EA, valued components, commitment to communities land uses, and next steps.

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 LSA and RSA area relative to existing or previous uses.

A total of 266 participants signed in to the four sessions, with Table 3-2 outlining the participants at each session.

Table 3-2: Participation at the Community Information Sessions

Location	Date	Signed Attendance
La Loche	Monday, 24 June 2019	163
BNDN	Tuesday, 25 June 2019	32
BRDN	Wednesday, 26 June 2019	27
Buffalo Narrows	Thursday, 27 June 2019	44

BRDN = Buffalo River Dene Nation; BNDN = Birch Narrows Dene Nation.

3.2 Joint Working Groups

Joint Working Groups were assembled from representatives of the respective Indigenous Groups and NexGen and are an important engagement platform to allow for ongoing collaboration to enable the incorporation of Indigenous Group views and Indigenous and Local Knowledge into the Project.

The JWGs were formed through the Study Agreements established with each Indigenous community in 2019 and have been implemented as the agreed-upon engagement pathway for the advancement of the EA. The four JWGs are CRDN-JWG, BNDN-JWG, BRDN-JWG, and the MN-S-JWG representing Northern Region 2.

Key objectives of the JWGs are to:

- develop protocols for using and protecting Indigenous Knowledge;
- identify VCs for the Project EIS;
- identify and address community-specific information in the EA process;
- discuss potential Project effects and mitigation of those effects; and
- identify other topics that are important to the local Indigenous Groups and communities.

Indigenous Groups selected JWG participants with consideration of diverse representation, including Elders, youth, men and women, business owners, and traditional land users in the Patterson Lake area.

The ERA was initially introduced to the JWGs on the following dates:

- BNDN on 25 October 2019 and again on 4 December 2019;
- BRDN on 1 November 2019;
- MN-S on 29 October 2019; and
- CRDN on 19 February 2020.

It was understood through the Indigenous Knowledge shared at the JWG meetings that Patterson Lake, Forrest Lake, Clearwater River, and other waterbodies and watercourses in the region are important to the local Indigenous Groups for the use of water, fish, and wildlife, cultural connections to the land, and community well-being (TSD II: BNDN; TSD III: BRDN; MN-S 2019; TSD IV: MN-S; CRDN 2019a,b; TSD V.1: CRDN; TSD V.2: CRDN, YNLRO 2019; TSD VI YNLR). Key highlights from the JWG meetings strengthened the assertion that the protection of local waterbodies is paramount to the security of Indigenous well-being:

> Water is the most important thing, vital to life… ensuring water remains safe is the biggest concern with the project. (BNDN-JWG 2019a)

> The best lake in Saskatchewan is right here – we don't need to buy water. (BRDN-JWG 2019a)

> 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)

Additionally, discussions throughout the JWG meetings allowed Indigenous community members to share their knowledge and observations about the perceived deterioration of the environment and the local ecosystem due to increasing industrial development within the immediate and wider Athabasca Basin region. Indigenous Knowledge also indicated concerns about the cumulative effects from human development and policies on climate change in the area (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; MN-S 2019; CRDN 2019a,b; TSD V.1: CRDN; TSD V.2: CRDN; YNLRO 2019; TSD VI: YNLR). The MN-S, in particular, identified concerns that they do not want Patterson Lake to become like Lake Athabasca, which they claim has been impacted by industry to the point where the fish are inedible. They have noticed changes in the water quality and flow, aquatic life, and terrestrial life in the areas farther north of the Project and within the study areas of this assessment (i.e., RSA), due to cumulative effects of industry in the area. Some of the significant changes noted by the communities during the JWG discussions include:

- Population decline:
  - "In the last few years, I notice that change in the nature. Around NexGen and Fission, the animals are changing – there used to be a lot of rabbits and chickens. The last few years I've been hunting in fall, and there's not many anymore. The animals are not there like they used to be" (MN-S-JWG 2020).
- Deteriorating game quality:
  - "Community members have noticed a change in the quality of meat and pelts. Members have noted increased contamination in the food, especially from further north; others expressed a fear of eating fish, rabbits and moose from the north. It was further noted that rabbits around Patterson Lake are diseased, having white spots when opened; likewise, the moose are diseased, glowing when opened" (TSD IV: MN-S).
- Changes in herd migration and distribution:
  - "You see that migration routes change when infrastructure is put in. Even power lines, caribou won't cross. Communities that used to see caribou, no longer see them come through" (BRDN-JWG 2019b).

3.3 Indigenous Knowledge and Traditional Land Use Studies

Indigenous Knowledge and Traditional Land Use Studies were used to inform initial assumptions for human health receptors (i.e., people) who consume Traditional Foods or fish, hunt or gather Traditional Foods in terms of locations, residency times, and components of the Traditional Foods diet.

The following IKTLU Studies were used to inform assumptions:

- 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 (YNLRO), Provision of Athabasca Denesųłiné Traditional Knowledge, Land Use and Occupancy Information for the NexGen Rook I Project Environmental Assessment.

These IKTLU 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 local Indigenous communities for food, medicine, and other traditional uses.

4.0 MODEL INTEGRATION AND EVALUATION OF SOURCES

4.1 Model Integration

The ERA integrated inputs and sources from other disciplines, as demonstrated at a high level in Figure 4-1. In general, the ERA received information directly from the site water balance, site water quality, solute transport model, and atmospheric modelling. These are described in more detail in the EIS Sections 7 to 10 and Appendices.

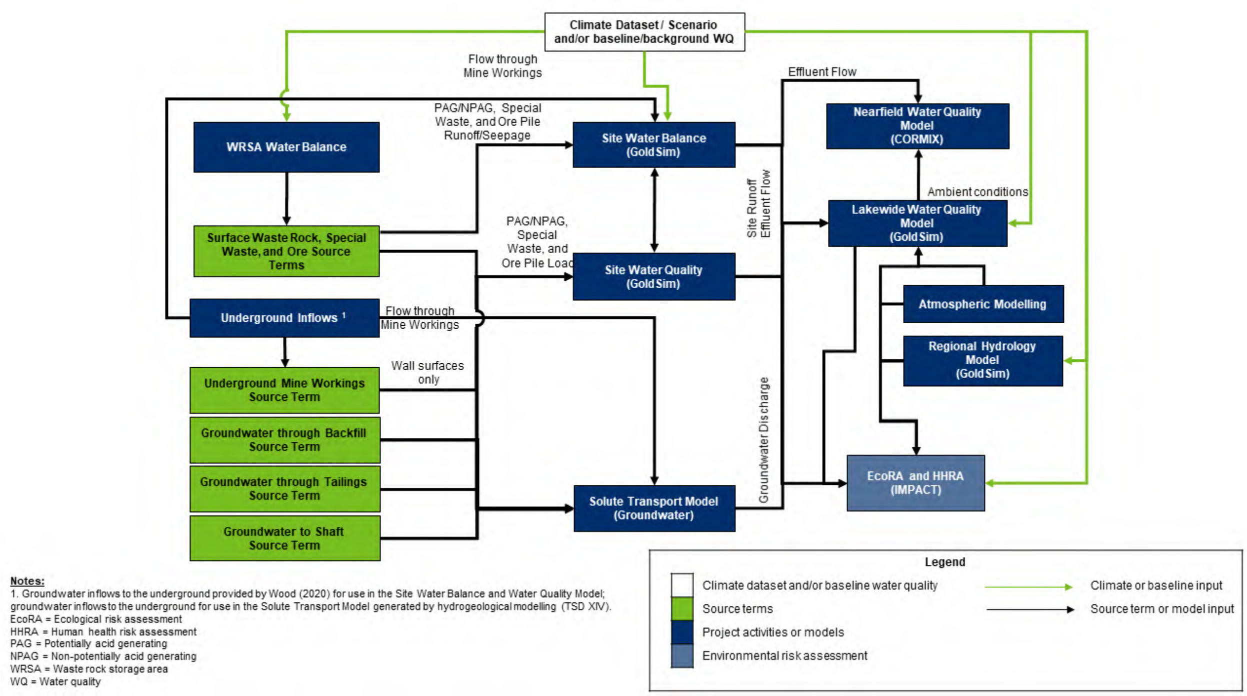


Figure 4-1: Model Integration Diagram

4.2 Aqueous Sources

4.2.1 Project-Related Aqueous Releases

Aqueous releases to Patterson Lake would include:

1. releases from the effluent treatment plant to Patterson Lake North Arm – West Basin;
2. releases from the sewage treatment plant to Patterson Lake North Arm – West Basin;
3. non-contact site runoff to Patterson Lake North Arm – East Basin and to Patterson Lake North Arm – West Basin; and
4. groundwater releases through the overburden and bedrock to Patterson Lake North Arm – West Basin.

The effluent treatment plant would process water that would either be released to the environment through a diffuser, or further used in mill processes or underground. The effluent treatment plant would treat process plant effluents, mine water discharges, and site runoff from mineralized areas. The effluent treatment plant would involve a two-stage chemical treatment process designed to neutralize and remove metals from the effluent stream prior to pumping to the treated effluent water tank. The treated effluent water tank would overflow into one of four monitoring ponds to allow for storage of treated effluent until monitoring results confirm acceptable treated effluent quality and discharge criteria are met. Should approvals be received, and the Project be constructed and operated, treated effluent would be discharged in batches to Patterson Lake North Arm – West Basin via a diffuser.

The sewage treatment plant would be fed by the sewage collection system and the camp sewage system. The sewage collection system for the mine and process plant areas would consist of piped, underground collection systems from each building that would discharge to individual sewage holding tanks. The tank contents would be collected and hauled to the sewage treatment plant receiving station. Treated sewage from the treatment facility would be discharged to Patterson Lake North Arm – West Basin via an outfall parallel to but separate from the treated effluent diffuser.

Surface drainage refers to systems that collect or convey precipitation runoff. Surface drainage would discharge to the Patterson Lake North Arm – West Basin and Patterson Lake North Arm – East Basin. During Operations, the West Surface Runoff Discharge would include non-contact water from downstream of the mine-controlled area as well as non-mineralized contact water that has been tested and confirmed to be acceptable for release. During Operations, the East Surface Runoff would consist of non-contact water from outside the mine-controlled area. Following Closure, runoff from reclaimed, covered, and revegetated surfaces within the former mine-controlled area would be routed to the East Perimeter Diversion and discharged to the Patterson Lake North Arm – East Basin. Efforts would be made to divert natural site runoff away from site features. If water from precipitation events came in contact with contaminated areas or contact zones, the water would be captured, collected, and directed to respective site runoff points or collection areas. Contained water would be tested before release to the environment based on regulatory requirements; water that does not meet specification would report to the effluent treatment plant for treatment.

The fresh water supply intake would draw water from Patterson Lake North Arm – East Basin and would provide water for the mine area and for fire protection. Fresh water would be distributed through the fresh water pump station. Water for potable use would be pumped to the water treatment plant and then to the mine area administration building. The fresh water system would serve the mine and process plant dry areas, the wash bay, and the camp.

During Decommissioning and Reclamation, infrastructure would be removed from the site and the water management system would transition to a passive system that drains the remaining above-ground WRSAs. The active water treatment described above would be operated until passive treatment is deemed adequate to release surface water to Patterson Lake while protecting the environment and meeting applicable discharge criteria.

In the far-future projection, mine-affected groundwater would reach Patterson Lake North Arm – West Basin through groundwater flow pathways from the underground and at-grade sources. Groundwater originating at the UGTMF and stope backfill source areas is expected to migrate vertically upward, primarily through the fault and shear zones, then laterally through the sandstone, before discharging within Patterson Lake North Arm – West Basin. Based on the hydraulic gradients, hydraulic conductivities, pathway dimensions, and effective porosity values applied to the pathways (i.e., 0.015 for the fault zone and 0.098 for the sandstone), the advective groundwater travel time from the upper horizon of the mine to the discharge location at Patterson Lake is estimated to be approximately 1,000 years, as predicted by solute transport modelling completed for the EIS.

Groundwater originating beneath the waste rock area would travel through the overburden bidirectionally to the north and south, ultimately discharging in Patterson Lake for both pathways. The approximate advective groundwater travel time from the waste rock piles to Patterson Lake was estimated at 43 years to the north and 77 years to the south.

4.2.2 Aqueous Sources

In this context, sources refer to Project-related volume and mass inputs to the IMPACT model. Sources for the aquatic environment were obtained from the following models:

- Rook I site-wide water balance model for the release of runoff and treated effluent to Patterson Lake North Arm – West Basin during Project phases;
- near-field water quality model for water quality in the immediate area of the Project at the boundary of the mixing zone during Project phases;
- groundwater solute transport model for the release of soluble constituents from mine sources (mine workings, UGTMF, and surface waste rock piles) to Patterson Lake North Arm – West Basin in the far-future projection; and
- regional surface water quality model for water quality after the addition of groundwater solute transport in the far-future projection.

4.2.3 Screening for Constituents of Potential Concern in Aquatic Environment

4.2.3.1 Screening Value Selection

The predicted concentrations of constituents released to Patterson Lake were compared against water quality objectives (WQOs) based on the hierarchy of water quality guidelines outlined in Figure 4-2, and the selected screening values are shown in Table 4-1. The most restrictive federal or provincial guideline for surface water quality, based on the Canadian Council of Ministers of the Environment (CCME 2021a) Canadian water quality guidelines for the protection of fresh water aquatic life, the federal environmental quality guidelines (FEQG), and the Saskatchewan environmental quality guidelines (SEQG; ENV 2021), were selected as the screening values for most surface water COPCs. Applicable guidelines were adjusted for pre-operational hardness and pH, where applicable.

For molybdenum, Saskatchewan Water Security Agency published an updated WQO for the protection of aquatic life based on current understanding of aquatic toxicity of molybdenum to fresh water aquatic organisms (WSA 2017). The WQO is based on the 5th percentile of the species sensitivity distribution and follows the CCME protocol (CCME 2007). The WQO for molybdenum of 7.6 milligrams per litre (mg/L) from BC MOE (2021) was adopted for the Project in preference over the CCME WQO of 0.073 mg/L.

Canadian drinking water quality guidelines were included for protection of human health (Health Canada 2020). These guidelines are based on current, published scientific research related to human health effects, aesthetic effects, and operational considerations. Health-based guidelines are established on the basis of a comprehensive review of the known health effects associated with each contaminant, on exposure levels, and on the availability of treatment and analytical technologies. Aesthetic effects (e.g., taste or odour) were taken into account when these play a role in determining whether consumers would consider the water drinkable, as is the case with copper. Where no Canadian drinking water quality guidelines were available, guidelines were obtained from the World Health Organization (WHO 2017) or British Columbia Ministry of Environment and Climate Change Strategy (BC MECCS 2020).

Major ions such as calcium, magnesium, and sodium were not considered COPCs. There is no evidence of adverse health effects from these major ions in drinking water (Health Canada 2020), and they were considered to be essentially non-toxic for aquatic biota. These major ions are effectively regulated on the cellular level and have not been associated with adverse effects in aquatic biota at environmental concentrations. Therefore, calcium, magnesium, and sodium were not carried forward as COPCs for further assessment in the ERA.

Phosphorus was not considered a COPC for the ERA. Phosphorus is present in the aquatic environment as phosphate, where it acts as a nutrient rather than a toxicant. The water quality guideline selected for screening is the interim Ontario Provincial Water Quality Objective, which was set to avoid nuisance concentrations of algae in lakes and is not relevant to ecological health. Therefore, phosphorus was not considered a COPC for ecological health; however, it was considered in the surface water quality section (EIS Section 10, Surface Water Quality and Sediment Quality) as a nutrient affecting primary productivity.

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

The screening was based on the predicted concentrations of constituents released to Patterson Lake in treated effluent or groundwater, based on the models identified in Section 4.2.2, Aqueous Sources. To verify that the screening process was sufficiently conservative, predicted upper bound concentrations were screened against WQOs based on the process outlined in Figure 4-3. As a first pass, 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 then compared against WQOs. 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. Additionally, if upper bound concentrations of COPCs in runoff exceeded the WQOs, but did not exceed in the treated effluent, they were not considered COPCs in the ERA.

After the completion of Project phases (43 years total), it is assumed that groundwater solutes would start to make their way from mine-related sources (mine workings, UGTMF, and surface waste rock piles) to Patterson Lake North Arm – West Basin. A secondary screening of predicted upper bound water quality after the addition of groundwater solute loadings was performed to determine if concentrations of any additional COPCs exceeded WQOs. Maximum upper bound concentrations were used for comparison against WQOs.

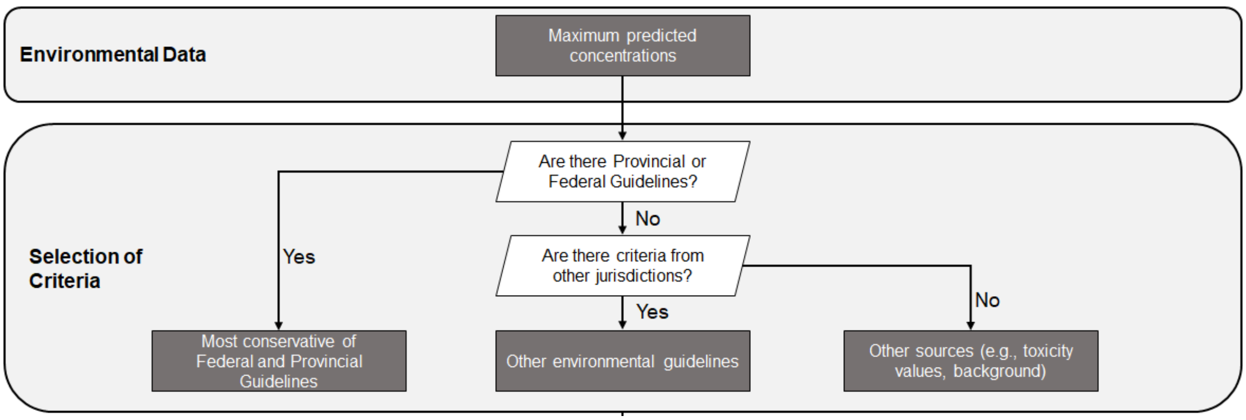


Figure 4-2: Selection of Surface Water Screening Values for Constituents of Potential Concern for the Environmental Risk Assessment

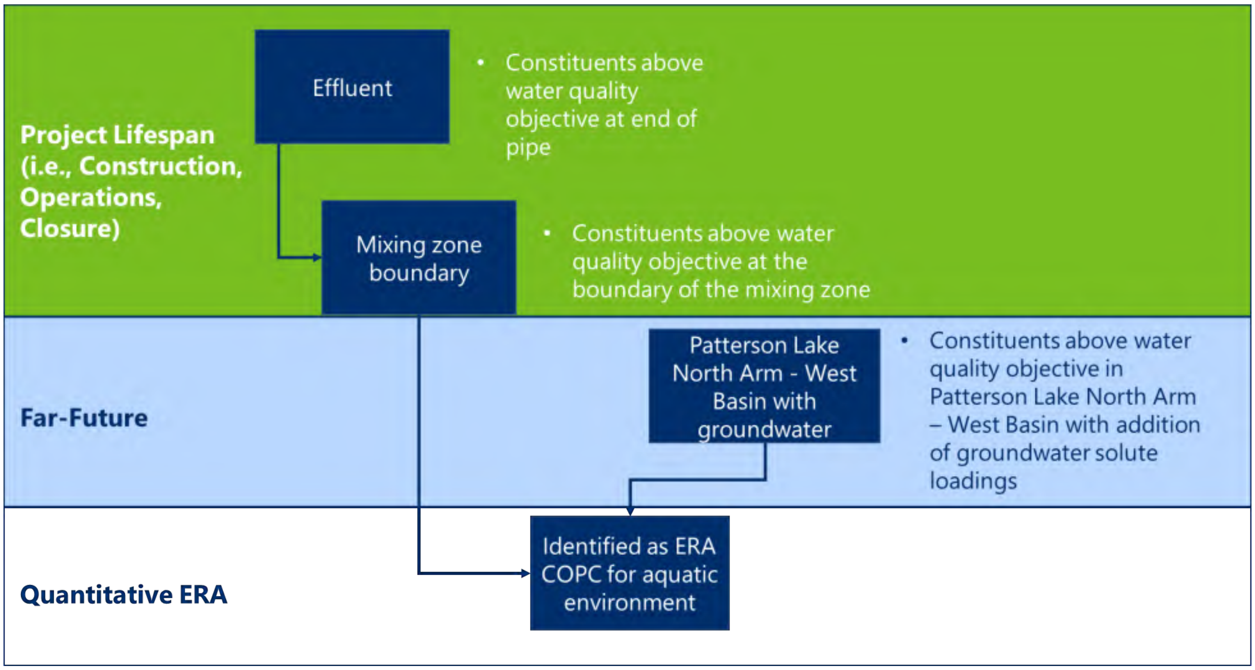


Figure 4-3: Screening Process for Selection of Constituents of Potential Concern for the Environmental Risk Assessment

ERA = environmental risk assessment; COPCs = constituents of potential concern.

Table 4-1: Screening Values for the Selection of Surface Water Quality Constituents of Potential Concern for the Environmental Risk Assessment

Constituent	Units	CCME Protection of Aquatic Life		Federal Environmental Quality Guidelines (FEQG)		Saskatchewan Environmental Quality Guidelines (SEQG) [a]		Other		Drinking Water Guidelines			Selected Screening Value	Source
		Long Term	Note	Long Term	Note	Long Term	Note	Long Term	Note	Health Canada [p]	Other Source	Note		
General Parameters														
Total suspended solids	mg/L	Background + 5	n/a	n/a	n/a	Background + 5	n/a	n/a	n/a	n/a	n/a	n/a	Background + 5	SEQG/CCME
Major Ions														
Chloride	mg/L	$1.20 \times 10^{+02}$	(f)	n/a	n/a	$1.20 \times 10^{+02}$	n/a	n/a	n/a	None required	n/a	n/a	$1.20 \times 10^{+02}$	SEQG
Sulphate	mg/L	n/a	n/a	n/a	n/a	n/a	n/a	$1.28 \times 10^{+02}$	(l)	$5.00 \times 10^{+02}$	n/a	n/a	$1.28 \times 10^{+02}$	BC MOE
Nutrients														
Ammonia as nitrogen	mg/L	$5.74 \times 10^{+00}$	(d)	n/a	n/a	$5.74 \times 10^{+00}$	(d)	n/a	n/a	None required	n/a	n/a	$5.74 \times 10^{+00}$	SEQG/CCME
Un-ionized ammonia as nitrogen	mg/L	1.56×10^{-02}	n/a	n/a	n/a	1.56×10^{-02}	n/a	n/a	n/a	None required	n/a	n/a	1.56×10^{-02}	SEQG/CCME
Nitrate as nitrogen	mg/L	$3.00 \times 10^{+00}$	n/a	n/a	n/a	$3.00 \times 10^{+00}$	n/a	n/a	n/a	$1.00 \times 10^{+01}$	n/a	n/a	$3.00 \times 10^{+00}$	SEQG/CCME
Metals and Metalloids														
Aluminum	mg/L	1.00×10^{-01}	(e)	n/a	n/a	1.00×10^{-01}	n/a	n/a	n/a	1.00×10^{-01}	n/a	n/a	1.00×10^{-01}	SEQG/CCME
Arsenic	mg/L	5.00×10^{-03}	n/a	n/a	n/a	5.00×10^{-03}	n/a	n/a	n/a	1.00×10^{-02}	n/a	n/a	5.00×10^{-03}	SEQG/CCME
Calcium	mg/L	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	None required	n/a	n/a	None required	n/a
Cadmium	mg/L	4.00×10^{-05}	n/a	n/a	n/a	4.00×10^{-05}	n/a	n/a	n/a	7.00×10^{-03}	n/a	n/a	4.00×10^{-05}	SEQG/CCME
Cobalt	mg/L	n/a	n/a	7.78×10^{-04}	(j)	n/a	n/a	n/a	n/a	n/a	1.00×10^{-03}	(p)	7.78×10^{-04}	FEQG
Chromium	mg/L	1.00×10^{-03}	n/a	n/a	n/a	1.00×10^{-03}	n/a	n/a	n/a	5.00×10^{-02}	n/a	n/a	1.00×10^{-03}	SEQG/CCME
Copper	mg/L	2.00×10^{-03}	(g)	n/a	n/a	2.00×10^{-03}	(b)	n/a	n/a	$2.00 \times 10^{+00}$	n/a	n/a	2.00×10^{-03}	SEQG/CCME
Iron	mg/L	3.00×10^{-01}	n/a	n/a	(s)	n/a	n/a	n/a	n/a	3.00×10^{-01}	n/a	n/a	3.00×10^{-01}	CCME
Mercury	mg/L	2.60×10^{-05}	n/a	n/a	n/a	2.60×10^{-05}	n/a	n/a	n/a	1.00×10^{-03}	n/a	n/a	2.60×10^{-05}	SEQG/CCME
Magnesium	mg/L	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	None required	n/a	n/a	None required	n/a
Manganese	mg/L	2.60×10^{-01}	(c)	n/a	n/a	n/a	n/a	n/a	n/a	1.20×10^{-01}	n/a	n/a	1.20×10^{-01}	Health Canada
Molybdenum	mg/L	7.30×10^{-02}	n/a	n/a	n/a	$3.10 \times 10^{+01}$	n/a	7.6×10^{00}	(r)	n/a	7.00×10^{-02}	(q)	$7.60 \times 10^{+00}$ (Eco) 7.00×10^{-02} (HH)	BC MOE WHO
Sodium	mg/L	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	None required	n/a	n/a	None required	n/a
Nickel	mg/L	2.50×10^{-02}	(h)	n/a	n/a	2.50×10^{-02}	(b)	n/a	n/a	n/a	7.00×10^{-02}	(q)	2.50×10^{-02}	SEQG/CCME
Phosphorus	mg/L	n/a	n/a	n/a	n/a	n/a	n/a	2.00×10^{-02}	(m)	n/a	1.00×10^{-02}	(p)	2.00×10^{-02}	Ontario PWQO
Lead	mg/L	1.00×10^{-03}	(h)	n/a	n/a	1.00×10^{-03}	(b)	n/a	n/a	5.00×10^{-03}	n/a	n/a	1.00×10^{-03}	SEQG/CCME
Selenium	mg/L	1.00×10^{-03}	n/a	n/a	n/a	1.00×10^{-03}	n/a	n/a	n/a	5.00×10^{-02}	n/a	n/a	1.00×10^{-03}	SEQG/CCME
Strontium	mg/L	n/a	n/a	$2.50 \times 10^{+00}$	(k)	n/a	n/a	n/a	n/a	$7.00 \times 10^{+00}$	n/a	n/a	$2.50 \times 10^{+00}$	FEQG
Uranium	mg/L	1.50×10^{-02}	n/a	n/a	n/a	1.50×10^{-02}	n/a	n/a	n/a	2.00×10^{-02}	n/a	n/a	1.50×10^{-02}	SEQG/CCME
Vanadium	mg/L	n/a	n/a	1.20×10^{-01}	(n)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.20×10^{-01}	FEQG
Zinc	mg/L	7.00×10^{-03}	(i)	n/a	n/a	3.00×10^{-02}	n/a	n/a	n/a	$5.00 \times 10^{+00}$	n/a	n/a	7.00×10^{-03}	CCME

Constituent	Units	CCME Protection of Aquatic Life		Federal Environmental Quality Guidelines (FEQG)		Saskatchewan Environmental Quality Guidelines (SEQG) (a)		Other		Drinking Water Guidelines			Selected Screening Value	Source
		Long Term	Note	Long Term	Note	Long Term	Note	Long Term	Note	Health Canada (p)	Other Source	Note		
Radionuclides														
Uranium-234	Bq/L	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	$1.00 \times 10^{+00}$	(q)	n/a	n/a
Uranium-238	Bq/L	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	$1.00 \times 10^{+01}$	(q)	n/a	n/a
Thorium-230	Bq/L	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	$1.00 \times 10^{+00}$	(q)	n/a	n/a
Radium-226	Bq/L	n/a	n/a	n/a	n/a	1.10×10^{-01}	n/a	n/a	n/a	5.00×10^{-01}	$1.00 \times 10^{+00}$	(q)	n/a	n/a
Lead-210	Bq/L	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.00×10^{-01}	1.00×10^{-01}	(q)	n/a	n/a
Polonium-210	Bq/L	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.00×10^{-01}	(q)	n/a	n/a

(a) Saskatchewan Water Quality Objectives, SEQG on-line (**https://envrbrportal.crm.saskatchewan.ca/seqg-search/**), SEQG for the protection of aquatic life were selected, based on total concentrations, a temperature of 15°C and a pH of 7.0.
(b) Hardness dependent WQOs are for very soft water (hardness <25 mg $CaCO_3$/L). Site-specific baseline hardness is 15 mg/L.
(c) Scientific Criteria Document for the Development of the Canadian Water Quality Guidelines for the Protection of Aquatic Life - Manganese, Appendix B - Canadian Water Quality Guidelines Calculator (pH = 7.5, hardness = 15 mg/L). Guideline is based on dissolved manganese.
(d) Total ammonia-N calculated from the total ammonia guideline for a temperature of 15°C and a pH of 7.0.
(e) Based on a pH of >6.5.
(f) Based on water hardness >0 to <17 mg/L..
(g) Based on water hardness >0 to <82 mg/L.
(h) Based on water hardness >0 to ≤60 mg/L.
(i) Guideline is based on dissolved zinc.
(j) Environment Canada 2017. Federal Environmental Quality Guidelines, Cobalt, May. Based on equation and the lowest hardness (52 mg/L) applicable to the guideline.
(k) ECCC 2020. Federal Environmental Quality Guidelines Strontium. July.
(l) BC MECCS 2021. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. **https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf.**
(m) MOE 1994: Water management: policies, guidelines, provincial water quality objectives.
(n) Environment Canada 2016. Federal Environmental Quality Guidelines, Vanadium. May.
(o) Health Canada 2020. Guidelines for Canadian Drinking Water Quality Summary Table. September. **https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/pdf/pubs/water-eau/sum_guide-res_recom/summary-table-EN-2020-02-11.pdf**.
(p) BC MECCS 2020. Source Drinking Water Quality Guidelines, Guideline Summary Ministry of Environment & Climate Change Strategy Water Protection & Sustainability Branch.
(q) WHO 2017. Guidelines for Drinking Water Quality. Fourth Edition Incorporating The First Addendum.
(r) BC MOE (B.C. Ministry of Environment and Climate Change Strategy). 2021. Molybdenum Water Quality Guidelines for the Protection of Freshwater Aquatic Life, Livestock, Wildlife and Irrigation. Water Quality Guideline Series, WQG-07. Prov. B.C., Victoria B.C.
(s) Since the completion of the screening originally conducted as part of the Project EA, an updated FEQG was published in May 2024 (ECCC 2024). Further information may be found in Appendix D, Iron Exposure Assessment.
Bq/L = becquerels per litre; $CaCO_3$ = calcium carbonate; CCME = Canadian Council of Ministers of the Environment; SEQG = Saskatchewan environmental quality guidelines; HH = human health; WHO = World Health Organization; PWQO = provincial water quality objective; FEQG = federal environmental quality guidelines; BC MECCS = British Columbia Ministry of Environment and Climate Change Strategy; WQO = water quality objective; > = greater than; < = less than; ≤ = less than or equal to; n/a = value not available or not applicable.

4.2.3.2 Constituents in Surface Water

The step-by-step and final results of the surface water screening are shown in Table 4-2. Based on the screening process, chloride, cobalt, and sulphate in treated effluent end-of-pipe and at the mixing zone boundary exceeded the screening values. Since the upper bound concentration of arsenic at the boundary of the mixing zone was only marginally below the screening value, it was also considered as a COPC as a precautionary measure. With the addition of groundwater solutes in the far-future projection to Patterson Lake North Arm – West Basin, copper was identified as an additional COPC.

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

Upper bound concentrations of uranium did not exceed the screening value. However, since uranium was evaluated as part of the radiation dose assessment and uranium-238 was estimated from the uranium concentration, uranium was also evaluated as a non-radiological COPC, because it is more chemically toxic than radiotoxic.

Radon-222 was not considered a COPC in surface water for the ERA. Radon is expected to volatilize rapidly to air. Health Canada (2020) considers that the health risk from ingesting radon-contaminated drinking water is negligible. 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 calculating derived release limits for radioactive material in airborne or liquid effluents for normal operation of nuclear facilities*, 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. Doses from noble gases released with treated effluent are expected to be negligible. Radon released directly to air is considered in Section 4.3, Atmospheric Sources.

Table 4-2: Surface Water Screening of Constituents of Potential Concern for the Environmental Risk Assessment

Constituent	Units	Upper-Bound Concentrations[a]				Selected Screening Value	Source	Is Concentration in Releases to Patterson Lake Greater than Selected Screening Value? (Y/N)	Edge of Mixing Zone - Upper Bound	Is Upper Bound Edge of Mixing Zone Concentration Greater than Selected Screening Value? (Y/N)	Patterson Lake North Arm – West Basin – Max Upper Bound (with Groundwater Solutes)[b]	Is Upper Bound Patterson Lake Concentration Greater than Selected Screening Value? (Y/N)	Final Selection as COPC? (Y/N)
		West Runoff	Treated Effluent	Sewage	East Runoff								
General Parameters													
Total suspended solids	mg/L	n/a	15	25	n/a	Background +5 mg/L	SEQG/CCME	Y	1.4	N	n/a	n/a	N
Major Ions													
Chloride	mg/L	$3.33 \times 10^{+00}$	$3.31 \times 10^{+03}$	5.71×10^{-01}	$1.49 \times 10^{+00}$	$1.20 \times 10^{+02}$	SEQG	Y	$1.66 \times 10^{+02}$	Y	$9.34 \times 10^{+01}$	Y	**Y**
Sulphate	mg/L	$4.46 \times 10^{+00}$	$3.42 \times 10^{+03}$	$1.45 \times 10^{+00}$	$1.95 \times 10^{+00}$	$1.28 \times 10^{+02}$	BC MOE	Y	$2.91 \times 10^{+02}$	Y	$2.00 \times 10^{+02}$	Y	**Y**
Nutrients													
Ammonia as nitrogen	mg/L	4.19×10^{-01}	$1.50 \times 10^{+01}$	$3.62 \times 10^{+02}$	1.98×10^{-01}	$5.74 \times 10^{+00}$	SEQG/CCME	Y	4.98×10^{-01}	N	3.59×10^{-01}	N	N
Un-ionized ammonia as nitrogen[c]	mg/L	1.14×10^{-03}	4.09×10^{-02}	9.85×10^{-01}	5.38×10^{-04}	1.56×10^{-02}	CCME	Y	1.36×10^{-03}	N	9.77×10^{-04}	N	N
Nitrate as nitrogen	mg/L	5.00×10^{-01}	$1.82 \times 10^{+01}$	$7.00 \times 10^{+02}$	5.00×10^{-01}	$3.00 \times 10^{+00}$	SEQG/CCME	Y	5.38×10^{-01}	N	3.48×10^{-01}	N	N
Metals and Metalloids													
Aluminum	mg/L	1.10×10^{-01}	1.23×10^{-01}	3.83×10^{-03}	5.24×10^{-02}	1.00×10^{-01}	SEQG/CCME	Y	1.77×10^{-02}	N	6.09×10^{-02}	N	N
Arsenic	mg/L	1.25×10^{-03}	4.23×10^{-02}	9.46×10^{-05}	5.93×10^{-04}	5.00×10^{-03}	SEQG/CCME	Y	3.98×10^{-03}	Y (marginally below)	2.73×10^{-03}	N	**Y**
Calcium	mg/L	$4.00 \times 10^{+00}$	$9.89 \times 10^{+02}$	$3.56 \times 10^{+00}$	$4.00 \times 10^{+00}$	None required	n/a	N (non-toxic)	$5.51 \times 10^{+01}$	N (non-toxic)	$3.43 \times 10^{+01}$	N (non-toxic)	N (non-toxic)
Cadmium	mg/L	1.04×10^{-04}	1.11×10^{-05}	4.88×10^{-06}	4.94×10^{-05}	4.00×10^{-05}	SEQG/CCME	Y (runoff only)	9.54×10^{-06}	N	1.22×10^{-05}	N	N
Cobalt	mg/L	2.04×10^{-03}	4.36×10^{-03}	5.00×10^{-05}	9.87×10^{-04}	4.65×10^{-04}	FEQG	Y	4.47×10^{-04}	N	2.22×10^{-03}	Y	Y
Chromium	mg/L	6.63×10^{-04}	3.84×10^{-04}	1.98×10^{-04}	5.00×10^{-04}	1.00×10^{-03}	SEQG/CCME	N	2.82×10^{-04}	N	2.99×10^{-04}	N	N
Copper	mg/L	5.62×10^{-04}	3.99×10^{-03}	1.24×10^{-04}	5.00×10^{-04}	2.00×10^{-03}	SEQG/CCME	Y	4.85×10^{-04}	N	3.59×10^{-03}	Y	**Y**
Iron	mg/L	4.61×10^{-01}	7.66×10^{-02}	8.59×10^{-02}	4.61×10^{-01}	3.00×10^{-01}	CCME	Y (runoff only)	5.44×10^{-02}	N	8.84×10^{-02}	N	N
Mercury	mg/L	1.03×10^{-05}	3.71×10^{-04}	1.39×10^{-06}	4.49×10^{-06}	2.60×10^{-05}	SEQG/CCME	Y	1.98×10^{-05}	N	1.30×10^{-05}	N	N
Magnesium	mg/L	$1.40 \times 10^{+00}$	$1.16 \times 10^{+02}$	$1.23 \times 10^{+00}$	$1.40 \times 10^{+00}$	None required	n/a	N (non-toxic)	$7.02 \times 10^{+00}$	N (non-toxic)	$4.55 \times 10^{+00}$	N (non-toxic)	N (non-toxic)
Manganese	mg/L	1.99×10^{-01}	1.50×10^{-02}	2.08×10^{-02}	8.95×10^{-02}	1.20×10^{-01}	Health Canada	Y (runoff only)	2.55×10^{-02}	N	2.90×10^{-02}	N	N
Molybdenum	mg/L	2.33×10^{-04}	2.78×10^{-01}	5.32×10^{-05}	1.00×10^{-04}	$7.60 \times 10^{+00}$ (Eco) 7.00×10^{-02} (HH)	BC MOE WHO	Y (HH – exceeds drinking water guideline only)	4.84×10^{-03}	N	2.96×10^{-02}	N	N
Sodium	mg/L	$1.50 \times 10^{+00}$	$1.04 \times 10^{+03}$	$1.38 \times 10^{+00}$	$1.50 \times 10^{+00}$	None required	n/a	N (non-toxic)	$8.95 \times 10^{+01}$	N (non-toxic)	$6.19 \times 10^{+01}$	N (non-toxic)	N (non-toxic)
Nickel	mg/L	2.77×10^{-03}	1.08×10^{-02}	7.26×10^{-05}	1.29×10^{-03}	2.50×10^{-02}	SEQG/CCME	N	1.08×10^{-03}	N	2.03×10^{-03}	N	N

Constituent	Units	Upper-Bound Concentrations[(a)]				Selected Screening Value	Source	Is Concentration in Releases to Patterson Lake Greater than Selected Screening Value? (Y/N)	Edge of Mixing Zone - Upper Bound	Is Upper Bound Edge of Mixing Zone Concentration Greater than Selected Screening Value? (Y/N)	Patterson Lake North Arm – West Basin – Max Upper Bound (with Groundwater Solutes)[(b)]	Is Upper Bound Patterson Lake Concentration Greater than Selected Screening Value? (Y/N)	Final Selection as COPC? (Y/N)
		West Runoff	Treated Effluent	Sewage	East Runoff								
Lead	mg/L	1.33×10^{-04}	7.68×10^{-05}	4.72×10^{-05}	1.00×10^{-04}	1.00×10^{-03}	SEQG/CCME	N	7.68×10^{-05}	N	2.34×10^{-04}	N	N
Selenium	mg/L	1.33×10^{-04}	6.58×10^{-04}	4.72×10^{-05}	1.00×10^{-04}	1.00×10^{-03}	SEQG/CCME	N	1.08×10^{-04}	N	2.55×10^{-04}	N	N
Strontium	mg/L	3.24×10^{-02}	$2.55 \times 10^{+01}$	3.00×10^{-02}	3.21×10^{-02}	$2.50 \times 10^{+00}$	FEQG	Y	$1.30 \times 10^{+00}$	N	7.40×10^{-01}	N	N
Uranium	mg/L	1.33×10^{-04}	3.07×10^{-01}	5.07×10^{-05}	1.00×10^{-04}	1.50×10^{-02}	SEQG/CCME	Y	5.46×10^{-03}	N	3.45×10^{-03}	N	Y (evaluated for toxicity and radiotoxicity)
Vanadium	mg/L	5.62×10^{-04}	2.07×10^{-03}	1.50×10^{-04}	5.00×10^{-04}	1.20×10^{-01}	FEQG	N	2.80×10^{-04}	N	2.21×10^{-04}	N	N
Zinc	mg/L	7.99×10^{-03}	2.05×10^{-03}	7.97×10^{-04}	3.49×10^{-03}	7.00×10^{-03}	CCME	N	9.03×10^{-04}	N	2.32×10^{-03}	N	N

Grey shading and **bold text** indicate constituent considered a COPC for the ERA.
a) Upper-Bound concentrations for the treated effluent and runoff obtained from the site wide water balance model to the EIS (TSD XVIII Site-Wide Water Balance and Water Quality Modelling Report).
b) Maximum Upper-Bound concentrations from Patterson Lake North Arm – West Basin in the far-future projection with groundwater solutes added was obtained from the surface water quality model (EIS Appendix 10A, Surface Water Quality Modelling Report).
c) A pH of 7 and a temperature of 15^{0}C were assumed to convert total ammonia to un-ionized ammonia in accordance with CCME (2002).
CCME = Canadian Council of Ministers of the Environment; SEQG = Saskatchewan environmental quality guidelines; HH = human health; PWQO = provincial water quality objective; FEQG = federal environmental quality guidelines; BC MOE = British Columbia Ministry of Environment; WHO = World Health Organization; WQO = water quality objective; N = no; Y = yes; ERA = environmental risk assessment; COPC = constituent of potential concern; n/a = value not available or not applicable.

4.2.3.3 Constituents in Sediment

Predicted maximum concentrations of constituents of interest in sediment were compared against sediment quality guidelines for the protection of aquatic life and other relevant screening values. Sediment concentrations were predicted from surface water concentrations using IMPACT according to the equations outlined in the IMPACT model (Appendix A).

Sediment quality screening values were selected based on the following of sources:

a) reference (REF) and no-effect (NE2) sediment quality values from Burnett-Seidel and Liber (Burnett-Seidel and Liber 2013);

b) lowest effect levels (LELs) and severe effect levels (SELs) from Thompson et al. (Thompson et al. 2005); and

c) Canadian interim sediment quality guidelines (ISQGs) and probable effect levels (PELs) from the CCME (CCME 1999a).

Burnett-Seidel and Liber (2013) was selected as the preferred source, as the reported NE2 and REF values are specifically applicable to Saskatchewan waterbodies. The REF values refer to locations upstream of mining or milling activities or located within separate but nearby drainages. Exceedances of REF values indicate that sediments downstream of predicted discharges contain elevated metal concentrations compared to natural background conditions. The NE2 values refer to exposed (lightly contaminated) areas with elevated concentrations but no significant effect on benthic invertebrate abundance, richness, and evenness. Concentrations below the NE2 values indicate that benthic invertebrate community metrics (abundance, richness, and evenness) downstream of discharges are not expected to differ significantly (less than 20% difference) from those observed at natural background conditions.

Two tiers of sediment quality guidelines are defined by Thompson et al. (2005): LELs and SELs. The CCME also provides two tiers of guidelines in sediments: ISQGs and PELs. If a predicted COPC concentration in sediment is less than the LEL or ISQG, adverse effects on benthic invertebrate communities are not anticipated for that constituent. Predicted concentrations in sediments that exceed the LEL or ISQG would not necessarily indicate that adverse effects are occurring but suggest that further investigation is warranted. These levels were, therefore, used for screening levels where there were no available REF levels.

An exceedance of a PEL or SEL is more likely to be associated with ecological effects. The SEL has been interpreted by some practitioners to be the specific COPC concentration in sediment that the majority of benthic organisms are not expected to tolerate (Persaud et al. 1993). The PEL is defined as the concentration of a COPC above which adverse effects are expected to occur frequently (more than approximately 50% of adverse effects occur above the PEL; CCME 1995).

The sediment screening (Table 4-3) focused on COPCs identified in the surface water screening as exceeding values, as well other constituents of interest from other uranium mining and milling operations. Based on comparison of maximum predicted sediment quality in Patterson Lake North Arm – West Basin in the Application Case and Upper Bound sensitivity scenario against the REF values from Burnett-Seidel and Liber (2013), arsenic and molybdenum would exceed the REF values; however, they do not exceed the NE2 values. Arsenic would exceed the REF value in Operations, while molybdenum would exceed the REF value in the far-future projection for the reasonable upper-bound sensitivity scenario.

There is no sediment screening value for cobalt; however, cobalt has already been identified as a COPC in surface water and was carried forward for further quantitative assessment in the ERA. Predicted concentrations of all other COPCs, including molybdenum, selenium, and nickel, do not exceed sediment quality guidelines and therefore were not considered sediment COPCs for further quantitative assessment in the ERA.

The maximum predicted upper bound concentrations of lead-210 and polonium-210 in sediment in Patterson Lake North Arm – West Basin exceeded the LEL values from Thompson et al. (2005); however, they did not exceed the SEL values. While exceeding the LEL does not necessarily indicate that adverse effects would occur, it indicates that further assessment is warranted. Radionuclides in the uranium-238 decay series (uranium-238, uranium-234, thorium-230, radium-226, lead-210, polonium-210) were considered sediment COPCs for further quantitative assessment in the ERA.

Table 4-3: Sediment Quality Screening for the Rook I Project

Constituent	Units	Predicted Sediment Concentrations (Patterson Lake North Arm – West Basin)(a)				Sediment Quality Guidelines						Selected Sediment Screening Value	Is Concentration Greater than Selected Screening Value? (Y/N)	Final Selection as COPC for Aquatic Environment? (Y/N)
		Maximum - Application Case	Maximum - Upper Bound	Maximum - Application Case (Far-Future Projection)	Maximum - Upper Bound (Far-Future)	Burnett-Seidel and Liber(b)		Thompson et al.(c)		CCME(d)				
						REF	NE2	LEL	SEL	ISQG	PEL			
Metals and Metalloids														
Arsenic	**mg/kg dw**	**30.50**	**31.00**	**10.60**	**10.93**	**21**	**522**	**9.8**	**346**	**5.9**	**17**	**21**	**Y**	**Y**
Cadmium	mg/kg dw	0.27	0.27	0.29	0.30	n/d	n/d	n/d	n/d	0.6	3.5	0.6	N	N
Cobalt	mg/kg dw	1.88	1.90	3.56	4.68	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/a	Y (based on surface water)
Copper	mg/kg dw	2.93	2.94	6.51	8.52	9.1	11.3	22	269	35.7	197	9.1	N	Y (based on surface water)
Lead	mg/kg dw	10.16	10.16	10.33	11.27	16.3	19.7	37	412	35	91.3	16.3	N	N
Molybdenum	**mg/kg dw**	**1.74**	**3.97**	**14.53**	**53.94**	**23**	**245**	**14**	**1,239**	**n/d**	**n/d**	**23**	**Y**	**Y**
Nickel	mg/kg dw	5.67	5.74	7.39	9.79	21	326	23	484	n/d	n/d	21	N	N
Selenium	mg/kg dw	0.56	0.57	0.95	1.37	3.6	30	1.9	16	n/d	n/d	3.6	N	N
Uranium	mg/kg dw	6.33	14.20	19.30	19.32	97	2,296	104	5,874	n/d	n/d	97	N	Y (evaluated for toxicity and radiotoxicity)
Vanadium	mg/kg dw	9.48	9.51	9.17	9.18	35	32	35	160	n/d	n/d	35	N	N
Zinc	mg/kg dw	11.57	11.63	15.71	18.03	n/d	n/d	n/d	n/d	123	315	123	N	N
Radionuclides														
Uranium-234	Bq/kg dw	62	47	39	67	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/a	Y (radionuclide)
Uranium-238	Bq/kg dw	62	47	39	66	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/a	Y (radionuclide)
Thorium-230	Bq/kg dw	116	76	76	22	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/a	Y (radionuclide)
Radium-226	Bq/kg dw	104	106	85	83	n/d	n/d	600	14,400	n/d	n/d	600	N	Y (radionuclide)
Lead-210	**Bq/kg dw**	**492**	**984**	**402**	**376**	**n/d**	**n/d**	**900**	**20,800**	**n/d**	**n/d**	**900**	**Y**	**Y (radionuclide)**
Polonium-210	**Bq/kg dw**	**500**	**1002**	**409**	**382**	**n/d**	**n/d**	**800**	**12,100**	**n/d**	**n/d**	**800**	**Y**	**Y (radionuclide)**

Note: **Bold** and Grey shading indicates sediment concentration exceeds the REF or LEL value.

(a) Sediment concentrations predicted based on release of aqueous source-terms to Patterson Lake North Arm – West Basin and interaction with sediment. Modelling performed in IMPACT according to the equations outlined in Appendix A IMPACT Model Report.
(b) Burnett-Seidel and Liber (2013) – Sediment quality values derived for application at Saskatchewan uranium operations; reference (REF) values based on reference sites unaffected by mining and milling (representing background), and no-effect level (NE2) values based on sites with no significant (difference in benthic invertebrate community effects criteria of abundance, richness and evenness between reference and exposure locations.
(c) Thompson et al. (2005) – Sediment quality guidelines derived for application to uranium ore bearing regions of northern Saskatchewan and Ontario; lowest effect levels (LELs) and severe effect levels (SELs) from the “weighted method”.
(d) CCME – Canadian Sediment Quality Guidelines for the Protection of Freshwater Aquatic Life (CCME 1999a; updated September 2007; accessed July 2021: http://ceqg-rcqe.ccme.ca/).
REF = reference; NE2 = no effects; LEL = lowest effect level; SEL = severe effect level; CCME = Canadian Council of Ministers of the Environment; ISQG = Interim Sediment Quality Guideline; PEL = probable effect level; n/d = no guideline or data available; n/a = not applicable; Y = yes; N = no; dw = dry weight; Bq/kg = becquerels per kilogram.

4.2.4 Evaluation of Selenium in Fish Tissue

In 2016, the United States Environmental Protection Agency (USEPA) developed an aquatic criterion for selenium based on the scientific advancement that selenium toxicity in the aquatic environment is primarily from bioaccumulation of selenium in the aquatic food chain and not only from exposure to selenium in water. As such, although predicted selenium concentrations in water are below the selected water quality guideline, it is appropriate to compare predicted fish tissue concentrations in Patterson Lake North Arm – West Basin against the selenium fish tissue criterion. Fresh water fish are considered more sensitive to selenium compared to other aquatic organisms.

The recommended criterion for selenium in fish tissue is 11.3 mg/kg dry weight (dw) muscle or 8.5 mg/kg dw whole body (USEPA 2021). The whole body and muscle tissue concentrations are based on effect concentration (EC_{10}) values for selenium in egg/ovary, which caused reproductive effects in fresh water fish. The EC_{10} is the effect concentration at which 10% effect based on the endpoint is observed. The USEPA used species-specific conversion factors to convert from egg/ovary concentrations to whole body and muscle tissue concentrations.

Environment and Climate Change Canada (ECCC; 2022) published a selenium in fish tissue criterion of 6.7 mg/kg dw whole body, which represents the 5th percentile hazard concentration of the species sensitivity distribution of whole body selenium concentrations. Environment and Climate Change Canada indicates that this value is similar to that derived by the USEPA (2021). The USEPA criterion has been adopted for the Project over the ECCC criterion as the ECCC criterion is for whole body fish tissue, whereas the USEPA criterion is for fish tissue muscle as well. The fish assessed in the ERA are large-bodied fish (i.e., northern pike and lake whitefish); therefore, a fish tissue muscle guideline is preferred over the whole body guideline.

The recommended criterion for selenium in fish tissue of 11.3 mg/kg dw muscle was used for large-bodied fish included in this assessment (i.e., northern pike and lake whitefish). To compare against predicted selenium fish tissue concentrations that are in fresh weight, the criterion needed to be adjusted from a dry weight to a fresh weight basis based on the moisture content of the fish. The dry weight (dw) to fresh weight (fw) ratio of 0.25 to 1.0 from CSA N288.1-20 was used to convert the selenium criterion to a fresh weight basis.

Fish Tissue Criterion (mg/kg fw) = Fish Tissue Criterion (mg/kg dw) * 0.25 (kg dw/kg fw)

Therefore, the recommended criterion for selenium in fish tissue on a fresh weight basis is 2.83 mg/kg fw muscle.

Predicted fish tissue concentrations of selenium in northern pike and lake whitefish over the Project phases for both the Application Case and Upper Bound sensitivity scenario are shown in Figure 4-4, along with a comparison against the selenium criterion. The selenium bioaccumulation factor (BAF) for northern pike is a non-linear BAF where BAF = $949x^{0.827}$ (x is in units of µg/L) and the BAF for lake whitefish is 5.94E+03 L/kg fw based on publicly available regional data from other uranium mine sites in northern Saskatchewan. Regional measured fish tissue data (Table 49 to Table 56 of Appendix C of Annex V.1, Aquatic Environment Baseline Report) and measured water concentrations (Table 3.3-1 of Section 3.3.2.3 of Annex V.1) were used to develop the BAFs (Figure 4-5), which incorporate the selenium bioaccumulation through the food chain. Large- and small-bodied fish tissue data were considered separately because selenium concentrations are based on different tissue analyses for these two groups: wet weight muscle and wet weight whole body, respectively. Tissue data were available for northern pike, cisco, lake trout, longnose sucker, lake whitefish, white sucker, lake chub, and spottail shiner. The data comparisons resulted in the following conclusions:

- The same BAF can be applied to a fish species at different lakes.
- The BAF values for longnose sucker, cisco, and lake trout were not significantly different from those for northern pike; therefore, data from these species were combined to derive a BAF for northern pike.
- The BAF values for lake whitefish and white sucker were significantly different ($p<0.05$) from that for northern pike.
- The BAF values for lake chub and spottail shiner were not significantly different ($p>0.05$) from each other; therefore, data for these two species were combined to derive a BAF for small-bodied fish.

Using the regionally derived lake whitefish BAF, the maximum predicted upper bound selenium concentration is 0.19 mg/kg fw in lake whitefish in Patterson Lake North Arm – West Basin compared to the criterion of 2.83 mg/kg fw. Selenium concentrations in fish at the maximum location in Patterson Lake North Arm – West Basin are all well below the recommended criterion.

Based on the above conclusions, selenium was not considered for further quantitative assessment in the ERA.

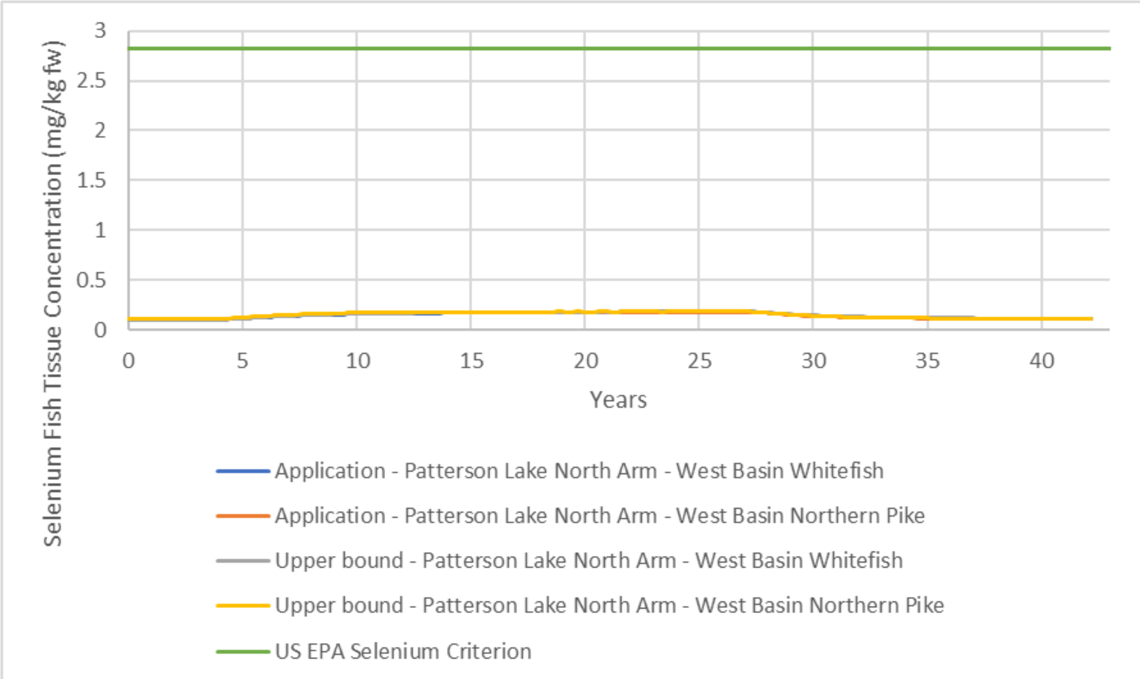


Figure 4-4: Comparison of Predicted Selenium Fish Tissue Concentrations against Criterion

Note: The predicted selenium concentrations in fish tissue for lake whitefish and northern pike are indistinguishable from each other on the figure.
USEPA = United States Environmental Protection Agency; fw = fresh weight.

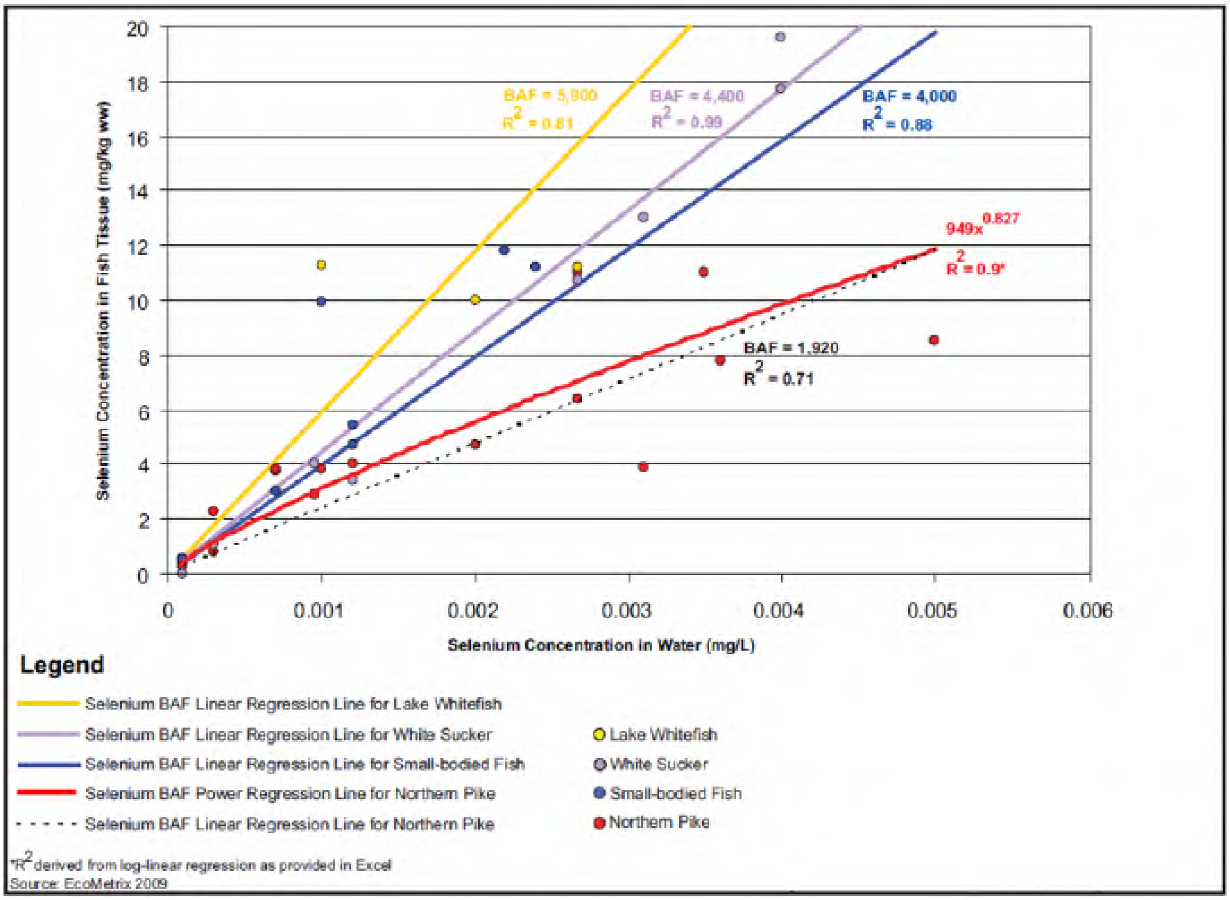


Figure 4-5: Development of Regional Bioaccumulation Factors for Selenium in Saskatchewan

4.2.5 Water Quality Constituents for Further Evaluation in the Environmental Risk Assessment

In summary, following the screening process for surface water quality (in combination with the sediment quality screening and selenium in fish tissue discussion), the following COPCs in the aquatic environment were carried forward for further quantitative assessment in the ERA for both human and ecological health:

- major ions: chloride and sulphate;
- metals and metalloids: arsenic, cobalt, copper, molybdenum, uranium; and
- radionuclides: uranium-238, uranium-234, thorium-230, radium-226, lead-210, polonium-210.

4.3 Atmospheric Sources

4.3.1 Project-Related Atmospheric Releases

The Project has the potential to change air quality through the emission of gases and particulates and deposition of particulates generated by Project activities. For emission to the atmosphere, the ERA focused on Construction and Operations when effects on air quality are expected to be the greatest due to the intensity and number of Project-related activities. 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.

The Project-related atmospheric releases considered in the ERA were consistent with the air emissions inventory detailed in the Air Dispersion Modelling Report for Project Construction and Operations (EIS Section 7.2.5, Residual Effects Analysis; EIS Appendix 7A, Air Dispersion Modelling Report). The major air emission sources considered for the ERA included:

- 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, lime silo baghouses); and
- solid waste incinerators.

Project-related atmospheric releases would include criteria air contaminants (CACs; nitrogen oxides [assessed as nitrogen dioxide, sulphur dioxide, sulphuric acid, carbon monoxide, total suspended particulates [TSP], and particulate matter [PM_{10} and $PM_{2.5}$]), fugitive dust, dioxins and furans, metals and radionuclides, and radon.

Criteria air contaminants have either federal or provincial ambient air quality criteria or both. Nitrogen oxides, sulphur dioxide, carbon monoxide, and particulates (TSP, PM_{10}, and $PM_{2.5}$) would be CACs directly emitted by the Project from stationary and mobile sources. Sulphuric acid emissions would be associated with the acid plant.

Dust commonly refers to large particulate matter, such as fugitive dust, that tends to settle out of suspension in the air by gravity within a short distance from the source. It would be associated with such activities as aggregate generation, road dust, materials hauling, and construction activities. It would be measured in terms of TSP deposition or dustfall.

Dioxins and furans represent a family of toxic compounds formed during the combustion process that share a similar chemical structure and are persistent in the environment. They would be associated with waste incineration.

Metals and radionuclides would be emitted as a portion of dust and combustion emissions. Dust emissions from waste rock, special waste, ore, and aggregate were assumed to contain metals. Dust emissions from waste rock, special waste, and ore were assumed to contain radionuclides. Radionuclides associated with dust from aggregate materials were considered to be negligible. The radionuclides included in the ERA were uranium-238 series radionuclides and were assumed to be in secular equilibrium.

Radon emissions from a number of sources were included in the air quality assessment: mine vent; ore storage pile; special waste rock pile; ore handling, grinding circuit / process plant, and slurry vessels; paste tailings preparation; settling pond; waste rock storage piles and material handling; and low-level radioactive waste incinerator. Potential radon emissions from the calciner and uranium concentrate handling stacks were considered to be negligible. Radon emissions were estimated based on U_3O_8 grade for waste rock (0.03%), special waste (0.05%) and ore (4%).

4.3.2 Atmospheric Sources

In this context, sources refer to total concentrations of constituents in air at specific human and ecological receptor locations. Constituent predictions for ambient air quality were obtained from the Air Dispersion Modelling Report (EIS Appendix 7A). Air quality modelling followed the Saskatchewan Air Quality Modelling Guideline (ENV 2012) using the atmospheric dispersion model AERMOD (EIS Appendix 7A). The emissions inputs were calculated to represent the maximum reasonably foreseeable emissions from the Project after applying mitigation actions and policies to reduce emissions.

Air quality modelling included predictions for CACs, dust, dioxins and furans, metals and radionuclides, and radon at the fence line and at specific human health and ecological receptor locations as described in Section 5.2.1, Exposure Locations, Duration, and Frequency, for the human health risk assessment, and in Section 6.2.1, Exposure Locations, for the ecological risk assessment. For the purposes of the ERA, the fence line was assumed to be the nearest location outside the property boundary where there would be public access (ENV 2012). The predicted air concentrations were based on a single "maximum year" scenario modelled for each of Construction and Operations.

Predicted total maximum concentrations in ambient air from the Air Dispersion Modelling Report (EIS Appendix 7A) were used in Section 4.3.3, Screening for Atmospheric Constituents of Potential Concern, for the relevant averaging period for Construction and Operations. For metals and radionuclides associated with dust emissions, total concentrations include only Project-related sources. Background concentrations of metals in dust were assumed to be negligible and were set to zero in the air quality model because there are no other industrial sources within 100 km of the LSA. Regional background concentrations for CACs are summarized in Table 4-4.

Conservative assumptions were used to create the emissions inventory as inputs to the air dispersion model (EIS Appendix 7A). Key areas of conservatism included the following (EIS Section 7.2.8, Prediction Confidence and Uncertainty):

- The emissions inventory was created for the highest intensity year of Construction and Operations. Emissions in other years would have lower emissions rates for CACs.
- When applicable, conservative assumptions and approaches were used to estimate the emissions from the Project. Examples include the following:
  - The power plant was assumed to be operating at 90% load hourly and 70% load daily continuously throughout the year. The actual operating loads are expected to be lower than these rates most of the time.
  - As underground sources do not occur at the mine vent, but emit via the mine vent, the assumption that emission rates at the source are equal to emission rates at the mine vent is conservative, particularly for heavier PM that would partially settle out along lateral development and ramps before being entrained in the high velocity vertical air shaft.
  - All mobile equipment was assumed to operate simultaneously, while in reality, it is not expected that all mobile equipment would be operating at same time.
  - For most of the emission sources, the emission inventory used emission factors (e.g., USEPA AP-42 emission factors) that were developed decades ago. With the new regulations and technologies, it is expected that the application of these emission factors is conservative. For example, the assessment used Tier 2 or Tier 3 emission standard mobile equipment; however, in practice, Tier 4 engines would be used to the extent that they are available.

In addition to the conservative assumptions listed above, emissions from blasting (i.e., NO_x, CO, and SO_2) were assumed to occur every hour over the year when modelling the air concentration for the 1-hour averaging period. However, much lower emission rates from the underground mine exhaust are expected for the non-blasting hours.

To account for the variability of meteorological parameters (e.g., local wind speed and direction), a five-year meteorological dataset was used in the modelling. The five-year meteorological dataset would represent most plausible meteorological conditions, and a wide range of combinations of wind, temperature, and atmospheric stability. Thus, the maximum predictions would represent the concentrations under the worst-case meteorological conditions.

Table 4-4: Background Concentrations of Air Quality Constituents Used in The Air Quality Model

Constituent (unit)	Averaging Period	Background Concentration
Nitrogen dioxide (µg/m^3)	1 hour	11.3
	24 hours	9.4
	Annual	3.8
Sulphur dioxide (µg/m^3)	1 hour	0
	24 hours	0
	Annual	0
Carbon monoxide (µg/m^3)	1 hour	572
	8 hours	572
PM_{10} (µg/m^3)	24 hours	23.1
$PM_{2.5}$ (µg/m^3)	24 hours	6.5
	Annual	3.1
TSP (µg/m^3)	24 hours	14.4
	Annual	6.2
Radon (Bq/m^3)	Average	2.94

Note: Background concentrations were obtained from EIS Appendix 7A, Air Dispersion Modelling Report.
Bq/m^3 = becquerels per cubic metre; TSP = total suspended particulates; PM_{10} = particulate matter with a diameter of 10 microns or less; $PM_{2.5}$ = particulate matter with a diameter of 2.5 microns or less.

4.3.3 Screening for Atmospheric Constituents of Potential Concern

Constituents of potential concern for air, as defined by Health Canada (Health Canada 2016a), are chemicals whose concentration(s) may become elevated in ambient air as a result of project-related activities, and which have the potential for adverse human or ecological health effects based on documented scientific evidence or suspected causal relationships. The purpose of this subsection is to identify those Project-related constituents in air that may be of concern for human and/or ecological health and require further assessment.

The screening of air quality constituents was based on maximum predicted concentrations of CACs, dioxins and furans, radon, and 28 metals and metalloids, and maximum dust deposition, at air quality model locations that correspond with receptor locations (Table 4-5), as described in Section 5.2.1, Exposure Locations, Duration, and Frequency, for the human health risk assessment, and Section 6.2.1, Exposure Locations, for the ecological risk assessment.

Table 4-5: Concordance between Air Quality Model and Receptor Locations

Air Quality Model Location	Human and Ecological Receptor Location	Air Quality Model Coordinates	
		X (m)	Y (m)
HHRA1	Hodge Lake Reference	593,768	6,407,146
HHRA2	Broach Lake	600,359	6,398,266
HHRA3	Camp[(a)]	603,778	6,393,226
HHRA4	Patterson Lake Human Health Receptors	598,658	6,387,580
HHRA5	Patterson Lake Ecological Receptors	602,320	6,392,289
HHRA6	Forrest Lake	605,446	6,388,744
HHRA7	Forrest Lake North	605,452	6,390,021
HHRA8	Beet Lake	608,931	6,389,997
HHRA9	Naomi Lake	614,179	6,390,462
HHRA10	Clearwater River	626,340	6,380,517
HHRA11	Lloyd Lake	616,793	6,361,563

(a) HHRA3 is located at the camp; other air quality model and human and ecological receptor locations are located outside of the Project footprint.

The modelled location HHRA3 is located at the camp within the Project footprint. This location was retained for the screening as a conservative measure to ensure potential COPCs in air are captured in the ERA, since it is the closest location to the source. This location would therefore be expected to experience higher air concentrations than locations farther away.

1. Human and ecological receptors at receptor locations were assumed to be in contact with air emissions for prolonged periods of time, at intervals that may be long-term (i.e., annual average) or repeated and short-term (i.e., 24 hours or less) over a lifetime. For this reason, long-term and short-term screening values at the receptor locations were used for the screening of constituents in air at receptor locations. Screening of constituents in air for the receptor locations followed the following protocol using maximum predicted concentrations for all receptor locations for the relevant time period:

2. If the model results from the Air Dispersion Modelling Report (EIS Appendix 7A) for a constituent were below all of its relevant air quality screening values, at all receptor locations, the constituent was assumed to be below levels associated with potential human health and ecological risks and was not considered further in the ERA for direct atmospheric exposures.

3. If the model result for an air quality constituent was greater than any one of its relevant air quality screening values at any receptor location, the constituent was determined to be a potential COPC in air and was evaluated further in Section 4.3.3.3, Discussion of Air Quality Constituents that Exceed a Screening Value.

4. Potential human health and ecological risks for the air quality constituents that were determined to be COPCs in Section 4.3.4, Air Quality Constituents for Further Evaluation

in the Environmental Risk Assessment, were characterized in Section 5.4 and Section 6.4, Risk Characterization, respectively.

The ERA also considered that humans (such as the subsistence harvester) and mobile ecological receptors (e.g., birds and mammals) would be present near the fence line occasionally and for short periods (i.e., less than 24 hours) of time. Maximum predicted concentrations from the Air Dispersion Modelling Report (EIS Appendix 7A) of Project-related constituents in air at the fence line were therefore screened using short-term screening values (i.e., 1 hour, 8 hours). This screening and its results are in Section 4.3.3.2, Screening of Air Quality Constituents. If the model results were below all relevant short-term air quality screening values, the constituent was assumed to be below levels associated with potential human health and ecological risks and was not considered further in the ERA.

4.3.3.1 Screening Value Selection

Ambient air quality criteria are available for different exposure averaging periods (e.g., 1 hour, 24 hour, annual). Maximum predicted concentrations from the Air Dispersion Modelling Report (EIS Appendix 7A) of constituents in air were screened against ambient air quality criteria for the same averaging period. Ambient air quality criteria for the relevant averaging periods were selected based on the following order for selection:

- Saskatchewan Ambient Air Quality Standards (SAAQS) are maximum concentrations in ambient air from all sources as stipulated in The Clean Air Regulations (Government of Saskatchewan 2015).

- Alberta Ambient Air Quality Objectives (Alberta 2021) (AAAQO) are based on an evaluation of scientific, social, technical, and economic factors.

- Ontario Ambient Air Quality Criteria (OAAQC) are concentrations of a contaminant in air that are protective against adverse effects on health and/or the environment (MECP 2020).

- 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).

Canadian Ambient Air Quality Standards (CAAQS) established under the national Air Quality Management System (CCME 2021b) were used for information purposes, but not selected as screening criteria. As indicated in the Air Quality assessment (EIS Section 7.2, Air Quality), the CAAQS achievement is determined by provinces and territories using ambient concentrations measured in the air zones for a three-year period, not by comparison of modelled predictions at or beyond a facility boundary.

Screening values for radionuclide concentrations in ambient air were not available. All relevant radionuclides were assessed in the ERA in terms of their contribution to the total radiological dose to human and ecological receptors.

A screening value for radon gas was not available from the sources identified. Health Canada's annual average corrective action trigger value of 200 becquerels per cubic metre (Bq/m^3) for indoor air was used for the screening (Health Canada 2009).

The selected ambient air quality screening values for different averaging periods, their source, and their rationale in terms of potential effects are summarized in Table 4-6. Where multiple sources recommended the same criterion value, each of the relevant sources is identified. The rationale provided in Table 4-6 for each of the selected screening values describes the sensitive effect that is the basis for the value cited by the relevant source.

Table 4-6: Screening Values for the Selection of Air Quality Contaminants of Potential Concern for the Environmental Risk Assessment

Constituent	Averaging Period	Selected Screening Value	Source	Rationale
CACs				
Nitrogen dioxide (NO_2)	1 hour	300	SAAQS/AAAQO	Respiratory effects
	24 hours	200	SAAQS/OAAQC	Human health
	Annual	45	SAAQS/AAAQO	Vegetation
Sulphur dioxide (SO_2)	1 hour	450	SAAQS/AAAQO	Pulmonary effects
	24 hours	125	SAAQS/AAAQO	Human health
	Annual	20	SAAQS/AAAQO	Ecosystem health
Carbon monoxide (CO)	1 hour	15,000	SAAQS/AAAQO	Oxygen carrying capacity of blood
	8 hours	6,000	SAAQS/AAAQO	Oxygen carrying capacity of blood
	Annual	n/v	n/a	n/a
Sulphuric acid (H_2SO_4)	1 hour	10	AAAQO	Not stated
	24 hours	5	OAAQC	Human health
	Annual	n/v	n/a	n/a
Total suspended particulates (TSP)	24 hours	100	SAAQS/AAAQO	Human health. Pulmonary effects
	Annual	60	SAAQS/OAAQC	Visibility
Particulate matter (PM_{10})	24 hours	50	SAAQS/OAAQC	Human health
	Annual	n/v	n/a	n/a
Particulate matter ($PM_{2.5}$)	24 hours	27	OAAQC/CAAQS	Human health
	Annual	8.8	OAAQC/CAAQS	Human health
Dust				
TSP deposition	Annual	4.6	OAAQC	Dustfall criterion. Aesthetics ($g/m^2/yr$)
	Monthly	5.3	AAAQO	Aesthetics ($g/m^2/30$ days)

Constituent	Averaging Period	Selected Screening Value	Source	Rationale
Dioxins and Furans				
Dioxins and furans	24 hour	0.1	OAAQC	Human health (pg TEQ/m^3)
	Annual	n/v	n/a	n/a
Radionuclides				
U-238 series radionuclides	24 hour	n/v	n/a	Addressed in terms of radiation dose in the ERA
	Annual	n/v	n/a	Addressed in terms of radiation dose in the ERA
Radon				
Radon	Annual	200	Government of Canada Radon Guideline (Health Canada 2009)	Addressed in terms of radiation dose in the ERA
Metals				
Silver (Ag)	24 hour	1	OAAQC	Human health
	Annual	n/v	n/a	n/a
Arsenic (As)	24 hour	0.3	OAAQC	Human health. Applies to arsenic and arsenic compounds
	Annual	0.01	AAAQO	Human health. Carcinogenic effects
Barium (Ba)	24 hour	10	OAAQC	Human health. Applies to total barium water-soluble fraction
	Annual	n/v	n/a	n/a
Beryllium (Be)	24 hour	0.01	OAAQC	Human health. Applies to beryllium and beryllium compounds
	Annual	n/v	n/a	n/a
Cadmium (Cd)	24 hour	0.025	OAAQC	Human health. Applies to cadmium and cadmium compounds. Converted from the annual AAQC to allow assessment of 24-hour air quality data
	Annual	0.005	OAAQC	Human health. Applies to cadmium and cadmium compounds

Constituent	Averaging Period	Selected Screening Value	Source	Rationale
Cobalt (Co)	24 hour	0.1	OAAQC	Human health
	Annual	n/v	n/a	n/a
Chromium (Cr)	24 hour	0.5	OAAQC	Human health. Applies to either chromium metallic, divalent, and trivalent, or to the percentage of chromium metallic, divalent, and trivalent relative to total chromium
	Annual	n/v	n/a	n/a
Copper (Cu)	24 hour	50	OAAQC	Human health
	Annual	n/v	n/a	n/a
Mercury (Hg)	24 hour	2	OAAQC	Human health
	Annual	n/v	n/a	n/a
Molybdenum (Mo)	24 hour	120	OAAQC	Particulate - visibility; molybdenum is more likely emitted as TSP, and therefore the AAQC for TSP is applied
	Annual	n/v	n/a	n/a
Nickel (Ni)	24 hour	0.2	OAAQC	In TSP. Human health. Applies to nickel and nickel compounds. Converted from the annual criterion to allow assessment of the 24-hour data (TSP). Intended to protect from development of chronic effects
	Annual	0.04	OAAQC	In TSP. Human health. Applies to nickel and nickel compounds
	24 hour	0.1	OAAQC	In PM_{10}. Human health. Applies to nickel and nickel compounds. Converted from the annual criterion to allow assessment of the 24-hour data (TSP). Intended to protect from development of chronic effects
	Annual	0.02	OAAQC	In PM_{10}. Human health. Applies to nickel and nickel compounds
Lead (Pb)	24 hour	0.5	OAAQC	Human health. Applies to lead and lead compounds. Converted from the 30-day AAQC to allow assessment of 24-hour air quality data

Constituent	Averaging Period	Selected Screening Value	Source	Rationale
	Monthly	0.2	OAAQC	Human health. Applies to lead and lead compounds. As arithmetic mean of a 30-day period
	Annual	n/v	n/a	n/a
Antimony (Sb)	24 hour	25	OAAQC	Human health
	Annual	n/v	n/a	n/a
Selenium (Se)	24 hour	10	OAAQC	Human health
	Annual	n/v	n/a	n/a
Tin (Sb)	24 hour	10	OAAQC	Human health
	Annual	n/v	n/a	n/a
Thorium (Th)	24 hour	n/v	n/a	n/a
	Annual	n/v	n/a	n/a
Uranium (U)	24 hour	0.3	OAAQC	In TSP. Human health. Applies to uranium and uranium compounds. Converted from the annual AAQC to allow assessment of 24-hour air quality data
	Annual	0.06	OAAQC	In TSP. Human health. Applies to uranium and uranium compounds
	24 hour	0.15	OAAQC	In PM_{10}. Human health. Applies to uranium and uranium compounds. Converted from the annual AAQC to allow assessment of 24-hour air quality data
	Annual	0.03	OAAQC	In PM_{10}. Human health. Applies to uranium and uranium compounds
Vanadium (V)	24 hour	2	OAAQC	Human health
	Annual	n/v	n/a	n/a
Zinc (Zn)	24 hour	120	OAAQC	Particulates
	Annual	n/v	n/a	n/a

Constituent	Averaging Period	Selected Screening Value	Source	Rationale
Cesium (Cs)	24 hour	n/v	n/a	n/a
	Annual	2	Texas Interim ESL	Human health
Bismuth (Bi)	24 hour	n/v	n/a	n/a
	Annual	5	Texas Interim ESL	Human health
Calcium (Ca)	24 hour	n/v	Texas ESL	Particulates
	Annual	n/v	Texas ESL	Particulates
Iron (Fe)	24 hour	4	OAAQC	Human health. Applies to metallic iron
	Annual	n/v	n/a	n/a
Magnesium (Mg)	24 hour	72	OAAQC	Human health
	Annual	n/v	n/a	n/a
Manganese (Mn)	24 hour	0.1	OAAQC	Human health. OAAQC (2020): 0.4 (TSP), 0.2 (PM_{10}) and 0.1 ($PM_{2.5}$). For manganese and manganese compounds in TSP
	Annual	0.2	AAAQO	Adopted from Texas (long-term ESL) and California (chronic reference exposure level for nervous system effects)
Sodium (Na)	24 hour	n/v	Texas ESL	Particulate
	Annual	n/v	Texas ESL	Particulate

Note: Units are µg/m³ unless otherwise specified.
Texas ESL = Texas Commission on Environmental Quality (TCEQ 2016); AAAQO = Alberta Ambient Air Quality Objectives (Alberta 2021); CAAQS = Canadian Ambient Air Quality Standards, air quality objectives under the *Canadian Environmental Protection Act, 1999* (CCME 2021b); OAAQC = Ontario Ambient Air Quality Criteria (MECP 2020); SAAQS = Saskatchewan Ambient Air Quality Standards (Government of Saskatchewan 2015); AAQC = ambient air quality criteria; CAC = criteria air contaminant; ESL = effects screening level; Bq/m³ = becquerels per cubic metre; TSP = total suspended particulates; ERA = environmental risk assessment; PM_{10} = particulate matter with a diameter of 10 microns or less; $PM_{2.5}$ = particulate matter with a diameter of 2.5 microns or less; n/a = not applicable; n/v = no value; pg TEQ/m³ = picogram toxic equivalency.

4.3.3.2 Screening of Air Quality Constituents

The screening of air quality constituents involved the following two types of screenings:

- Comparing the predicted maximum air concentrations from the air quality model at all human and ecological receptor locations for all (short and long-term) averaging periods against the corresponding air quality criteria (Table 4-7).

- Comparing the predicted maximum air concentrations from the air quality model at the fence line for short-term averaging periods against short-term air quality criteria (Table 4-8).

The screening of air quality constituents at the human and ecological receptor locations for short- and long-term averaging periods at receptor locations is provided in Table 4-7. Both human and ecological receptors were assumed to be present for extended periods of time at these locations and therefore susceptible to both short- and long-term exposures to airborne constituents. Constituents that had only a short-term or a long-term screening value were not considered further if the maximum predicted concentration was less than the screening value, as explained in Table 4-7.

The screening of air quality constituents at the fence line for short-term averaging periods only is provided in Table 4-8. Hypothetical visitors and mobile ecological receptors were assumed to be present for short periods of time at these locations and therefore susceptible to only short-term exposures to airborne constituents. The screening was performed using the maximum predicted concentrations for all fence line locations from the air quality model (EIS Appendix 7A) for the relevant averaging period. Note that these maximum fence line concentrations are in some cases higher than those presented in EIS Section 7.2, since the air quality assessment in the EIS followed Saskatchewan air quality dispersion modelling guidance which allows for discounting the maximum modelled concentrations.

Constituents that were predicted to exceed any of their screening values based on maximum predicted values for the relevant averaging period are further discussed in Section 4.3.3.3, to determine whether or not they should be retained as COPCs and further evaluated in terms of human health and/or ecological risk. Air quality constituents with maximum concentrations that exceeded either their short- or long-term screening value at receptor locations were nitrogen dioxide, particulate matter (TSP, PM_{10}, $PM_{2.5}$), and uranium. Dustfall exceeded its annual criterion during Construction. Air quality parameters with maximum short-term concentrations that exceed screening values at the fence line are nitrogen dioxide, particulate matter (TSP, PM_{10}, and $PM_{2.5}$), and uranium.

While no identified screening level is exceeded for radionuclides (including uranium-238 series) and radon gas, potential human health and ecological risks are discussed in Section 5.4 and Section 6.4, respectively.

Table 4-7: Air Quality Screening for Short-term and Long-term Exposures to Constituents in Air at Human and Ecological Receptor Locations

Constituent	Maximum Concentration at Receptor Locations		Screening Value	Averaging Period	Source	Is Concentration Greater than Selected Screening Value (Yes/No)	Is the Constituent Retained for Further Consideration as a COPC?
	Construction	Operations					
CACs							
Nitrogen dioxide (NO_2)	14.7	8.55	45	Annual	SAAQS/AAAQO	**Yes (1 hour)**	Yes. No exceedance of annual value but considered further because it does exceed screening value for 1 hour during Construction at HHRA3
	120	103	200	24 hours	SAAQS/OAAQC		
	374	174	300	1 hour	SAAQS/AAAQO		
Sulphur dioxide (SO_2)	0.0737	0.225	20	Annual	SAAQS/AAAQO	No	No
	1.19	6.31	125	24 hours	SAAQS/AAAQO		
	8.63	25.0	450	1 hour	SAAQS/AAAQO		
Carbon monoxide (CO)	771	994	6,000	8 hours	SAAQS/AAAQO	No	No. No annual value but not considered further because it does not exceed screening values for 8 hours or 1 hour
	1,170	1,232	15,000	1 hour	SAAQS/AAAQO		
Sulphuric acid (H_2SO_4)	n/c	0.816	5	24 hours	OAAQC	No	No. No annual value but not considered further because it does not exceed screening values for 24 hours or 1 hour
	n/c	3.19	10	1 hour	AAAQO		
TSP	15.3	10.2	60	Annual	SAAQS/OAAQC	**Yes (24 hour)**	Yes. No exceedance of annual value but considered further because it does exceed screening values for 24 hours during Construction and Operations at HHRA3
	296	**103**	100	24 hours	SAAQS/AAAQO		
PM_{10}	**164**	**70.8**	50	24 hours	SAAQS/OAAQC	**Yes (24 hour)**	Yes. No annual value but considered further because it does exceed screening values for 24 hours during Construction and Operations at HHRA3
$PM_{2.5}$	3.10	3.84	8.8	Annual	OAAQC/CAAQS	**Yes (24 hour)**	Yes. No exceedance of annual value but considered further because it does exceed screening values for 24 hours during Construction and Operations at HHRA3
	65.5	**28.0**	27	24 hours	OAAQC/CAAQS		
Dust							
TSP deposition	**87.9**	5.33	7	Annual	OAAQC Dustfall Criteria ($g/m^2/yr$)	**Yes (Annual)**	Yes. Considered further because it exceeds annual value during Construction at HHRA3
	1.61	1.08	5.3	Monthly	AAAQO ($g/m^2/30$ days)		
Dioxins and furans							
Dioxins and furans	0.000927	0.00186	0.1	24 hour	OAAQC (pg TEQ/m^3)	No	No. No annual value but not considered further because it does not exceed screening value for 24 hours
Radon							
Radon	n/c	44.5	200	Annual	Government of Canada Radon Guideline (Bq/m^3) (Health Canada (2009)	No	Yes. Assessed in terms of radiation dose in the ERA
Metals							
Silver (Ag)	n/c	3.00×10^{-05}	1	24 hour	OAAQC	No	No. No annual value but not considered further because it does not exceed screening value for 24 hours
Arsenic (As)	n/c	3.00×10^{-05}	0.01	Annual	AAAQO	No	No
	n/c	3.90×10^{-04}	0.3	24 hour	OAAQC	No	No
Barium (Ba)	n/c	3.70×10^{-02}	10	24 hour	OAAQC	No	No. No annual value but not considered further because it does not exceed screening value for 24 hours

Constituent	Maximum Concentration at Receptor Locations		Screening Value	Averaging Period	Source	Is Concentration Greater than Selected Screening Value (Yes/No)	Is the Constituent Retained for Further Consideration as a COPC?
	Construction	Operations					
Beryllium (Be)	n/c	6.00×10^{-05}	0.01	24 hour	OAAQC	No	No. No annual value but not considered further because it does not exceed screening value for 24 hours
Cadmium (Cd)	n/c	5.00×10^{-05}	0.005	Annual	OAAQC	No	No
	n/c	5.50×10^{-04}	0.025	24 hour	OAAQC	No	No
Cobalt (Co)	n/c	1.05×10^{-03}	0.1	24 hour	OAAQC	No	No. No annual value but not considered further because it does not exceed screening value for 24 hours
Chromium (Cr)	n/c	1.52×10^{-02}	0.5	24 hour	OAAQC	No	No. No annual value but not considered further because it does not exceed screening value for 24 hours
Copper (Cu)	n/c	4.96×10^{-03}	50	24 hour	OAAQC	No	No. No annual value but not considered further because it does not exceed screening value for 24 hours
Mercury (Hg)	n/c	8.00×10^{-04}	2	24 hour	OAAQC	No	No. No annual value but not considered further because it does not exceed screening value for 24 hours
Molybdenum (Mo)	n/c	3.84×10^{-03}	120	24 hour	OAAQC	No	No. No annual value but not considered further because it does not exceed screening value for 24 hours
Nickel (Ni) in TSP	n/c	1.70×10^{-04}	0.04	Annual	OAAQC	No	No
	n/c	2.99×10^{-03}	0.2	24 hour	OAAQC	No	No
Nickel (Ni) in PM_{10}	n/c	1.20×10^{-04}	0.02	Annual	OAAQC	No	No
	n/c	2.75×10^{-03}	0.1	24 hour	OAAQC	No	No
Lead (Pb)	n/c	7.40×10^{-04}	0.2	Monthly	OAAQC	No	No. No annual value but not considered further because it does not exceed screening values for 24 hours and monthly
	n/c	8.20×10^{-03}	0.5	24 hour	OAAQC	No	
Antimony (Sb)	n/c	5.00×10^{-05}	25	24 hour	OAAQC	No	No. No annual value but not considered further because it does not exceed screening values for 24 hours and monthly
Selenium (Se)	n/c	9.00×10^{-05}	10	24 hour	OAAQC	No	No. No annual value but not considered further because it does not exceed screening value for 24 hours
Tin (Sb)	n/c	1.30×10^{-04}	10	24 hour	OAAQC	No	No. No annual value but not considered further because it does not exceed screening value for 24 hours
Uranium (U) in TSP	n/c	9.38×10^{-03}	0.06	Annual	OAAQC	No	No
	n/c	2.68×10^{-01}	0.3	24 hour	OAAQC	No	No
Uranium (U) in PM_{10}	n/c	6.10×10^{-03}	0.03	Annual	OAAQC	No	Yes. Does not exceed annual value but considered further because it exceeds the 24 hours screening value during Operations at HHRA3
	n/c	**2.09×10^{-01}**	0.15	24 hour	OAAQC	**Yes (24 hour)**	
Vanadium (V)	n/c	7.82×10^{-03}	2	24 hour	OAAQC	No	No. No annual value but not considered further because it does not exceed screening value for 24 hours
Zinc (Zn)	n/c	2.85×10^{-03}	120	24 hour	OAAQC	No	No. No annual value but not considered further because it does not exceed screening value for 24 hours
Cesium (Cs)	n/c	<0.000001	2	Annual	Texas Interim ESL	No	No. No 24 hours value but not considered further because it does not exceed the annual screening value
Bismuth (Bi)	n/c	<0.000001	5	Annual	Texas Interim ESL	No	No. No 24 hours value but not considered further because it does not exceed the annual screening value

Constituent	Maximum Concentration at Receptor Locations		Screening Value	Averaging Period	Source	Is Concentration Greater than Selected Screening Value (Yes/No)	Is the Constituent Retained for Further Consideration as a COPC?
	Construction	Operations					
Iron (Fe)	n/c	$1.35 \times 10^{+00}$	4	24 hour	OAAQC	No	No. No annual value but not considered further because it does not exceed screening value for 24 hours
Magnesium (Mg)	n/c	$1.20 \times 10^{+00}$	72	24 hour	OAAQC	No	No. No annual value but not considered further because it does not exceed screening value for 24 hours
Manganese (Mn)	n/c	7.50×10^{-04}	0.2	Annual	AAAQO	No	No
	n/c	1.86×10^{-02}	0.1	24 hour	OAAQC	No	No

Notes: Air Concentrations are maximum predicted values from the Air Quality model for HHRA locations 1 through 11, inclusively, for the period indicated.
Maximum Concentration values are rounded to 3 significant figures.
For metals, where the model value was zero, the concentration was assumed to be <1.00×10^{-06} µg/m³. Units are µg/m³ unless otherwise specified.
Bold represents air quality parameters predicted to exceed screening values at receptor locations or are parameters that did not exceed the screening level but are discussed further in the ERA.
n/c = not calculated; n/v = no value; n/a = not applicable; ERA = environmental risk assessment; SAAQS = Saskatchewan Ambient Air Quality Standards (Government of Saskatchewan 2015); AAAQO = Alberta Ambient Air Quality Objectives (Alberta 2021); OAAQC = Ontario Ambient Air Quality Criteria (MECP 2020); CAAQS = Canadian Ambient Air Quality Standards (CCME 2021b); < = less than; Bq/m³ = becquerels per cubic metre; TSP = total suspended particulates; PM_{10} = particulate matter with a diameter of 10 microns or less; $PM_{2.5}$ = particulate matter with a diameter of 2.5 microns or less; ESL = effects screening level; pg TEQ/m³ = picogram toxic equivalency; CAC = criteria air contaminant.

Table 4-8: Air Quality Screening for Short-term Exposures to Constituents in Air for Hypothetical Human and Ecological Receptors at the Fence Line

Constituent	Maximum Concentration at Fence Line Locations		Screening Value	Averaging Period	Source	Is Concentration Greater than Selected Screening Value (Yes/No)	Is the Constituent Retained for further Consideration as a COPC?
	Construction	Operations					
CACs							
Nitrogen dioxide (NO_2)	95	73	200	24 hours	SAAQS/AAAQO	No	Yes. Did not exceed the 24-hour value but considered further because it exceeds its 1-hour screening value
	458	205	300	1 hour	SAAQS/AAAQO	**Yes (1 hour)**	
Sulphur dioxide (SO_2)	0.79	3.10	125	24 hours	SAAQS/AAAQO	No	No
	19.74	19.7	450	1 hour	SAAQS/AAAQO	No	No
Carbon monoxide (CO)	831	792	6,000	8 hours	SAAQS/AAAQO	No	No
	2,693	8,759	15,000	1 hour	SAAQS/AAAQO	No	No
Sulphuric acid (H_2SO_4)	n/c	0.391	5	24 hours	OAAQC	No	No
	n/c	2.02	10	1 hour	AAAQO	No	No
TSP	**234**	**173**	100	24 hours	SAAQS/AAAQO	**Yes (24 hour)**	Yes
PM_{10}	**204**	**86.6**	50	24 hours	SAAQS/OAAQC	**Yes (24 hour)**	Yes
$PM_{2.5}$	**51.5**	**35.1**	27	24 hours	OAAQC/CAAQS	**Yes (24 hour)**	Yes
Dioxins and furans							
Dioxins and furans	0.00119	0.00239	0.1	24 hour	OAAQC (pg TEQ/m^3)	No	No
Metals							
Silver (Ag)	n/c	1.10×10^{-04}	1	24 hour	OAAQC	No	No
Arsenic (As)	n/c	8.70×10^{-04}	0.3	24 hour	OAAQC	No	No
Barium (Ba)	n/c	5.47×10^{-02}	10	24 hour	OAAQC	No	No
Beryllium (Be)	n/c	1.00×10^{-04}	0.01	24 hour	OAAQC	No	No
Cadmium (Cd)	n/c	6.40×10^{-04}	0.025	24 hour	OAAQC	No	No
Cobalt (Co)	n/c	1.66×10^{-03}	0.1	24 hour	OAAQC	No	Non
Chromium (Cr)	n/c	2.84×10^{-02}	0.5	24 hour	OAAQC	No	No
Copper (Cu)	n/c	1.65×10^{-02}	50	24 hour	OAAQC	No	No
Mercury (Hg)	n/c	8.00×10^{-04}	2	24 hour	OAAQC	No	No
Molybdenum (Mo)	n/c	1.34×10^{-02}	120	24 hour	OAAQC	No	No
Nickel (Ni)	n/c	3.73×10^{-03}	0.2	24 hour	OAAQC in TSP	No	No
	n/c	3.11×10^{-03}	0.1	24 hour	OAAQC in PM_{10}	No	No
Lead (Pb)	n/c	2.77×10^{-02}	0.5	24 hour	OAAQC	No	No
Antimony (Sb)	n/c	1.70×10^{-04}	25	24 hour	OAAQC	No	No
Selenium (Se)	n/c	3.10×10^{-04}	10	24 hour	OAAQC	No	No
Tin (Sb)	n/c	2.10×10^{-04}	10	24 hour	OAAQC	No	No
Uranium (U)	n/c	**8.55×10^{-01}**	0.3	24 hour	OAAQC in TSP	**Yes (24 hour)**	Yes
	n/c	**6.74×10^{-01}**	0.15	24 hour	OAAQC in PM_{10}	**Yes (24 hour)**	Yes

Constituent	Maximum Concentration at Fence Line Locations		Screening Value	Averaging Period	Source	Is Concentration Greater than Selected Screening Value (Yes/No)	Is the Constituent Retained for further Consideration as a COPC?
	Construction	Operations					
Vanadium (V)	n/c	1.30×10^{-02}	2	24 hour	OAAQC	No	No
Zinc (Zn)	n/c	3.76×10^{-03}	120	24 hour	OAAQC	No	No
Iron (Fe)	n/c	$1.85 \times 10^{+00}$	4	24 hour	OAAQC	No	No
Magnesium (Mg)	n/c	$1.56 \times 10^{+00}$	72	24 hour	OAAQC	No	No
Manganese (Mn)	n/c	3.52×10^{-02}	0.1	24 hour	OAAQC	No	No

Notes: Units are µg/m^3 unless otherwise specified.
Air Concentrations are maximum predicted values from the Air Quality model for HHRA fence line locations, for the period indicated.
Maximum Concentration values are rounded to 3 significant figures.
For metals, where the model value was zero, the concentration was assumed to be <1.00 × 10-06 µg/m^3.
Bold represents air quality constituents with maximum concentrations predicted at fence line locations that exceed screening values during Construction or Operations.
< = less than; SAAQS = Saskatchewan Ambient Air Quality Standards; AAAQO = Alberta Ambient Air Quality Objectives; OAAQC = Ontario Ambient Air Quality Criteria; CAAQS = Canadian Ambient Air Quality Standards; n/c = not calculated; n/v = no value; n/a = not applicable; pg TEQ/m^3 = picogram toxic equivalency; PM_{10} = particulate matter with a diameter of 10 microns or less; $PM_{2.5}$ = particulate matter with a diameter of 2.5 microns or less; TSP = total suspended particulates; CAC = criteria air contaminant.

4.3.3.3 Discussion of Air Quality Constituents that Exceed a Screening Value

Air quality constituents that exceeded a screening value were nitrogen dioxide, particulate matter (TSP, PM_{10}, $PM_{2.5}$, and TSP deposition), and uranium (Table 4-9). These constituents were further evaluated to determine if they require further assessment in the ERA. Additionally, radionuclides were further evaluated because a relevant screening value was not available.

Table 4-9: Summary of Air Quality Constituents that Exceed a Screening Value

Constituent	Screening Criteria Exceeded		Predicted Exceedances		Number of Days Exceeding (Fence Line)	Frequency Exceeding (Fence Line)
	Short-Term	Long-Term	Maximum at Human/Ecological Locations	Maximum at Fence Line		
Nitrogen dioxide	1 h	None	Construction: exceedance of 1 hr screening value for nitrogen dioxide at the camp (HHRA3) Operations: No exceedance	Construction: exceedance of 1 hr screening value Operations: No exceedance	Construction: n/a[(a)] Operations: n/a	Construction: n/a[(a)] Operations: n/a
Particulate matter	24 h: TSP, PM_{10}, $PM_{2.5}$	Annual: TSP deposition	Construction: exceedances of 24 hr screening values for TSP, PM_{10}, $PM_{2.5}$ at the camp (HHRA3), and annual TSP deposition screening value at the camp (HHRA3) Operations: exceedance of 24 hr screening values for TSP, PM_{10}, $PM_{2.5}$ at the camp (HHRA3)	Construction: exceedance of 24 hr screening values for TSP, PM_{10}, $PM_{2.5}$ Operations: exceedance of 24 hr screening values for TSP, PM_{10}, $PM_{2.5}$	Construction: 10 (PM_{10}) 4 (TSP) Operations: 2 (PM_{10}) 2 (TSP)	Construction: 2.7% (PM_{10}) 1.1% (TSP) Operations: 0.5% (PM_{10}) 0.5% (TSP)
Uranium	24 h	none	Construction: not modelled for metals Operations: exceedance of 24 h screening value at the camp (HHRA3)	Construction: not modelled for metals Operations: exceedance of 24 h screening value for uranium in TSP and PM_{10}	Construction: n/a Operations: 4 (PM_{10}) 2 (TSP)	Construction: n/a Operations: 1.1% (PM_{10}) 0.5% (TSP)

(a) The number of days and frequency of exceeding were not available for 1-hour nitrogen dioxide since no exceedance was identified in the air quality model due to guidance from Saskatchewan that allows for removal of maximum concentrations output from AERMOD (EIS Section 7.2.2.8.3, Dispersion Modelling).
ERA = environmental risk assessment; TSP = total suspended particulates; $PM_{2.5}$ = particulate matter with a diameter of 2.5 microns or less; n/a = not applicable.

4.3.3.3.1 Nitrogen Dioxide

Screening values were available for 1-hour, 24-hour, and annual averaging periods for nitrogen dioxide. The maximum predicted 1-hour concentrations of nitrogen dioxide during Construction exceeded the screening value of 300 micrograms per cubic metre (µg/m^3) only at the camp (374 µg/m^3) and at the fence line (458 µg/m^3). Maximum predicted short-term (i.e., 1-hour) levels of nitrogen dioxide at all other modelled human and ecological receptor locations farther away from the Project footprint were below Health Canada's maximum acceptable level and for this reason are not expected to be associated with adverse health effects. No exceedances were predicted for 24-hour and annual exposures; therefore, no adverse health effects are anticipated due to long-term exposure.

Potential adverse human and ecological effects from nitrogen dioxide are associated with direct atmospheric exposure through inhalation. Adverse health effects that are attributed to short-term exposures to ambient nitrogen dioxide include asthma exacerbations and possibly increased risk of cardiopulmonary effects, and to a lesser extent cardiovascular and respiratory mortality (Health Canada 2016b). Individuals with certain pre-existing diseases such as asthma appear to be sensitive to exposure to ambient nitrogen dioxide. If individuals are present during periods when ambient nitrogen dioxide concentrations exceed the screening value, it is possible that they could experience minor irritation of the respiratory system. These effects would be reversible and would subside after exposure.

Additionally, since potential adverse effects are associated with the inhalation pathway, nitrogen dioxide was not retained as a COPC for assessment of potential risk to human and ecological receptors through the food chain.

Overall, exceedance of the 1-hour short-term screening value for nitrogen dioxide at the camp site would be limited to Construction, and any health effects would be reversible and subside after exposure; therefore, nitrogen dioxide was not considered for further quantitative assessment in the ERA.

As noted in Section 4.3.3.1, Screening Value Selection, the CAAQS were not selected as screening criteria as CAAQS achievement is determined by provinces and territories using ambient concentrations measured in the air zones for a three-year period, not by comparison of modelled predictions at or beyond a facility boundary. Therefore, using the CAAQS as a screening guideline would not be appropriate. However, for information purposes, a comparison of Project predicted nitrogen dioxide emissions were compared to the annual and 1-hour nitrogen dioxide CAAQS at the ecological and human health receptors (Table 4-10). In summary, during Construction, there are predicted exceedances for 1-hour NO_2 CAAQS at seven of the HHRA receptor locations and no predicted exceedances for annual NO_2 CAAQS. During Operations and for the RFD Case, there are predicted exceedances for 1-hour NO_2 CAAQS at the camp location (HHRA3) and the potential ecological receptor location near Patterson Lake (HHRA5) and no predicted exceedances for annual NO_2 CAAQS. During Construction, exceedances of the 1-hour NO_2 guideline are predicted to occur less than 1% of the time at all receptor locations other than at the Camp location, where exceedances are predicted to occur approximately 7% of the time. During Operations and the RFD

Case, there are no predicted exceedances at receptor locations other than at the Camp location (6% of the time) and at the ecological receptor location at Patterson Lake (0.1% of the time). As noted above, there are no exceedances of the annual NO_2 CAAQS of 23 $\mu g/m^3$ at any receptor location during any phase of the Project under the Application Case or the RFD Case (maximum values range from 8.55 $\mu g/m^3$ to 14.7 $\mu g/m^3$ at the Camp location). Realistically, these exceedances are anticipated to occur less frequently as the predictions include multiple levels of conservatism applied in the air quality model (Section 4.3.3.2). To facilitate comparison against the CAAQS, the predictions referenced in this paragraph represent the annual average predicted concentrations and the 3-year average of the annual 98th percentile of the daily maximum 1-hour predicted concentrations.

Table 4-10: Summary of Annual and 1-hour Nitrogen Dioxide Concentrations at Human and Ecological Risk Assessment Receptor Locations for Construction, Operations, and the Reasonably Foreseeable Development Case

Name	Description	Location		NO_2 Annual Concentration			NO_2 1-hour Concentration (3-year Average of the Annual 98th Percentile of the Daily Maximum 1-hour Concentrations)			Frequency of Exceedance of 1-hour limit (Based on Hours with Concentrations Exceeding 79 µg/m³)		
		X (m)	Y (m)	Construction [µg/m³]	Operations [µg/m³]	RFD - Operations [µg/m³]	Construction [µg/m³]	Operations [µg/m³]	RFD - Operations [µg/m³]	Construction [µg/m³]	Operations [µg/m³]	RFD - Operations [µg/m³]
HHRA1	Hodge Lake Reference	593,768	6,407,146	3.89	3.82	3.86	46.9	29.3	31.5	n/a	n/a	n/a
HHRA2	Broach Lake	600,359	6,398,266	4.10	3.91	3.98	**113.2**	48.8	50.2	0.2%	n/a	n/a
HHRA3	Camp	603,778	6,393,226	14.67	8.55	8.63	**244.1**	**148.0**	**148.0**	7%	6%	6%
HHRA4	Patterson Lake Human Health Receptors	598,658	6,387,580	3.95	3.82	4.07	71.7	28.2	76.0	n/a	n/a	n/a
HHRA5	Patterson Lake Ecological Receptors VC	602,320	6,392,289	4.49	4.01	4.10	**129.7**	**84.6**	**84.7**	0.5%	0.1%	0.1%
HHRA6	Forrest Lake	605,446	6,388,744	4.16	3.91	3.97	**121.6**	49.5	54.0	0.3%	n/a	n/a
HHRA7	Forrest Lake North	605,452	6,390,021	4.28	3.99	4.05	**127.9**	67.0	70.4	0.3%	n/a	n/a
HHRA8	Beet Lake	608,931	6,389,997	4.12	3.90	3.95	**114.5**	39.4	44.2	0.2%	n/a	n/a
HHRA9	Naomi Lake	614,179	6,390,462	3.94	3.84	3.87	**82.9**	31.4	33.5	0.1%	n/a	n/a
HHRA10	Clearwater River	626,340	6,380,517	3.87	3.80	3.82	39.6	22.6	24.2	n/a	n/a	n/a
HHRA11	Lloyd Lake	616,793	6,361,563	3.83	3.80	3.81	25.9	22.3	23.2	n/a	n/a	n/a

Notes: **Bolded and shaded** indicate exceedance of 1-hr NO_2 CAAQS of 79 µg/m³ or annual NO_2 CAAQS of 23 µg/m³.
RFD = Reasonably Foreseeable Development Case; CAAQS = Canadian Ambient Air Quality Standard; NO_2 = nitrogen dioxide; µg/m³ = micrograms per cubic metre; n/a = not applicable.

4.3.3.3.2 Particulate Matter

Particulate matter is defined as liquid or solid particles, or a mixture of both, less than 100 µm in diameter. Particulate matter includes TSP, particulate matter less that 10 µm (PM_{10}), and particulate matter less than 2.5 µm ($PM_{2.5}$). Particulate matter in the form of TSP, PM_{10}, $PM_{2.5}$, and TSP deposition were screened. Screening values were based on 24-hour and annual averaging periods for TSP, PM_{10}, $PM_{2.5}$, and on an annual averaging period for TSP deposition.

The discussion below demonstrates that the predicted exceedances of screening values for particulate matter in all of the forms assessed (i.e., TSP, PM_{10}, $PM_{2.5}$, and TSP deposition) would be short-term (i.e., 24-hour averaging period) and spatially limited to the camp and the fence line. Particulate concentrations and TSP deposition at locations outside of the Project footprint did not exceed screening values.

The predicted exceedances of screening values within the Project fence line suggest that the Project's environmental management programs would need to include measures to monitor and control particulate matter at the site during Construction and Operations.

Total Suspended Particulates and Dust Deposition

Maximum predicted concentrations of TSP exceeded its 24-hour screening value (100 µg/m^3) only at the camp site (296 µg/m^3 during Construction and 103 µg/m^3 during Operations), and at the fence line (234 µg/m^3 during Construction and 173 µg/m^3 during Operations). During Construction, the frequency of exceedance of the 24-hour TSP criterion at the fence line would be low, approximately 1.1% and during Operations, it would be 0.5%. On an annual basis, the maximum predicted concentrations for airborne TSP would not exceed screening values at any location outside of the Project footprint during any Project phase.

The 24-hour screening value for TSP is an ambient air quality standard cited by both Saskatchewan and Alberta. The 24-hour ambient air quality objective is based on potential adverse pulmonary effects (Alberta 2021). A higher 24-hour effects-based screening value of 120 µg/m^3 for TSP in ambient air is available from Ontario. The Ontario 24-hour and annual ambient air quality criteria (AAQC) are meant to be protective of chronic effects. Ontario identifies visibility as the sensitive endpoint for the TSP AAQC rather than human or ecological health. Elevated TSP concentrations are generally not considered to pose significant health risks because these particles are too large to be inhaled deep into the lungs; therefore, TSP was not considered further in the ERA.

Dust deposition (measured as dustfall) was also evaluated during this screening. Dustfall was not assessed for direct human health and ecological risks. Exceedance of the dustfall criterion is aesthetic and not health based. The maximum predicted TSP deposition rate exceeded the annual Ontario dustfall criterion of 7 g/m^2/yr only during Construction and only within the Project footprint and at the camp (87.9 g/m^2/yr), and did not extend to other human and ecological receptor locations at Patterson Lake, Beet Lake, and Lloyd Lake where country foods harvesting may occur. The maximum predicted monthly TSP deposition did not exceed its screening value of 5.3 g/m^2/30 days at any location during any Project phase. For these reasons, dustfall was not considered further in the ERA for direct human health and ecological risks. However, the potential for air quality constituents in dust to deposit to soil are considered in Section 4.3.3.4, Constituents in Soil.

Particulate Matter (PM_{10} and $PM_{2.5}$)

Maximum predicted concentrations of PM_{10} and $PM_{2.5}$ exceeded their 24-hour screening values (50 µg/m^3 and 27 µg/m^3, respectively) only within the Project footprint, at the camp (164 µg/m^3 and 65.5 µg/m^3 respectively during Construction, and 70.8 µg/m^3 and 28.0 µg/m^3 respectively during Operations), and at the fence line (204 µg/m^3 and 51.5 µg/m^3 respectively during Construction, and 86.6 µg/m^3 and 35.1 µg/m^3 respectively during Operations). During Construction, the frequency of exceedance of 24-hour PM_{10} at the fence line was low, approximately 2.7% and during Operations, it was 0.5%. The maximum predicted concentration for PM_{10} and $PM_{2.5}$ did not exceed their annual screening values at any modelled location during any Project phase.

Human health has been shown to be the most sensitive receptor for exposure to PM_{10} and $PM_{2.5}$ in ambient air (Health Canada 1998). Exposure to elevated concentrations of both PM_{10} and $PM_{2.5}$ are associated with various respiratory and cardiovascular effects in humans. The finer particles that can be inhaled deeply into the lungs are associated with greater risk because they are more chemically active and have more complex characteristics than larger particles (Health Canada 2016c). If individuals are present during short-term periods of elevated PM_{10} and/or $PM_{2.5}$, they may experience respiratory symptoms such as coughing or difficulty breathing, or asthma symptoms and chronic bronchitis. For most individuals, effects would be reversible and subside after exposure.

Overall, exceedances of the 24-hour short-term screening values for PM_{10} and $PM_{2.5}$ were predicted during Construction and Operation at the camp site and at the fence line. However, health effects would be infrequent, reversible and subside after exposure; therefore, PM_{10} and $PM_{2.5}$ were not considered for further quantitative assessment in the ERA.

4.3.3.3.3 Uranium

Maximum concentrations of uranium were estimated for Operations because sources would be associated with mining and waste management that would occur during Operations. Screening values for uranium were available for 24-hour and annual averaging periods that are associated with the TSP and PM_{10} fractions of airborne particulate matter. For both uranium in TSP and in PM_{10}, the Ontario 24-hour screening values were calculated from an effects-based annual average value to allow for assessment of the 24-hour air quality data (MECP 2020). The maximum predicted concentrations of uranium did not exceed annual screening values in TSP and PM_{10} (0.06 µg/m^3 and 0.3 µg/m^3, respectively) at any ERA location during Operations.

Uranium can be toxic to humans due to its chemical and radiological properties. The ambient air quality criteria for uranium (MOE 2011) is based on non-radiological effects of which kidney toxicity was the most sensitive endpoint associated with chronic exposure to uranium in air. Since the predicted maximum concentrations did not exceed the annual screening value, unacceptable levels of risk for human and ecological health are not expected from the occasional exceedances of the 24-hour value. Potential non-radiological risks from exposure to uranium in air were not assessed further.

Consideration of potential radiological effects for uranium, from uranium-238 series radionuclides in air, are discussed in Section 4.3.3.3.4, Radon and Uranium-238 Series Radionuclides.

4.3.3.3.4 Radon and Uranium-238 Series Radionuclides

Maximum concentrations for radon gas were estimated for the operational period because radon sources are associated with mining and waste management during Operations. A remedial action level of 200 Bq/m^3 for radon for indoor air in dwellings (Health Canada 2014) was used as a screening value for radon. The predicted maximum annual value for radon in ambient air did not exceed the annual screening value at any human or ecological receptor location.

No concentration-based screening values for uranium-238 series radionuclides in air were available. However, because radionuclides are considered of public interest, they were assessed further in the ERA. Potential risks from radiological effects were assessed through environmental exposure pathways in terms of total radiation dose, in Section 5.0, Human Health Risk Assessment, for human health risks, and in Section 6.0, Ecological Risk Assessment, for ecological risks.

4.3.3.4 Constituents in Soil

No specific COPCs were retained from the screening of atmospheric constituents; however, as a secondary check, mine-related metals of interest were identified for further assessment in soil (Table 4-11).

Based on soil type characterization in the Terrain and Soils section (EIS Section 12), the soil type is sand. This also aligns with observations of the Patterson Lake area by BNDN and BRDN, which was characterized as having a lot of sand and supporting jackpine (TSD II: BNDN), and mostly all pine and rock (TSD III: BRDN). A member of BNDN commented that “the north” has experienced many wildfires in recent years resulting in no topsoil and only sand, which made it challenging for trees to regenerate (TSD II: BNDN).

Predicted soil concentrations were estimated from atmospheric deposition and maximum air concentrations from the AERMOD atmospheric model at the camp site (Table 4-7), along with constituent-specific deposition rates, according to the equations defined in the IMPACT Model Report (Appendix A, Section 2.3.4, Terrestrial Pathways). The camp site is represented in the IMPACT model as the terrestrial location of Patterson Lake North Arm – West Basin, and would be considered the closest human health receptor location to the Project where harvesting of traditional foods would likely occur.

Predicted maximum concentrations of constituents in soil from atmospheric deposition were compared against soil quality guidelines. The selected soil quality guidelines were the federal CCME (CCME 1999b) soil quality guidelines for protection of human health and environmental health. Agricultural soil quality values were used for other land types, because these guidelines account for ingestion of plants by birds and mammals. As shown in Table 4-11, all predicted soil concentrations were below the CCME soil quality guidelines. As such, no additional COPCs were identified for further quantitative assessment in the ERA based on the soil pathway.

Table 4-11: Soil Quality Screening for the Rook I Project

Parameter	Maximum Predicted Air Concentrations(a)	Maximum Predicted Soil Concentration from Atmospheric Deposition(b)	Soil Screening Guideline(c)				Is Concentration Greater than Selected Screening Value? (Y/N)
			Agricultural	Residential/ Parkland	Commercial	Industrial	
Non-radionuclides	Annual average µg/m³	mg/kg dw	mg/kg dw	mg/kg dw	mg/kg dw	mg/kg dw	
Arsenic	3.00×10^{-05}	0.59	**12**	12	12	12	N
Cadmium	5.00×10^{-05}	0.11	**1.4**	10	22	22	N
Cobalt	2.00×10^{-05}	0.43	**40**	50	300	300	N
Copper	1.70×10^{-03}	0.62	**63**	63	91	91	N
Lead	2.50×10^{-03}	1.71	**70**	140	260	600	N
Molybdenum	1.20×10^{-03}	0.15	**5**	10	40	40	N
Nickel	1.70×10^{-04}	1.05	**45**	45	89	89	N
Selenium	1.00×10^{-05}	0.10	**1**	1	2.9	2.9	N
Uranium	9.38×10^{-03}	1.30	**23**	23	33	300	N
Zinc	5.00×10^{-05}	2.72	**250**	250	410	410	N

Notes: **Bold** indicates soil guideline value selected for this assessment.
(a) Maximum annual average concentrations in the Project footprint, and the camp site from AERMOD (EIS Appendix 7A, Air Dispersion Modelling Report).
(b) Maximum soil concentrations estimated from maximum annual air concentrations in Table 4-7 of the HHRA and constituent-specific deposition rates (Appendix A**)**.
(c) Canadian Environmental Quality Guidelines (CCME 1999b).
N = no; Y = yes; dw = dry weight; HHRA = human health risk assessment.

4.3.4 Air Quality Constituents for Further Evaluation in the Environmental Risk Assessment

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 for human and ecological receptors. No constituents at any human or ecological receptor location exceeded their annual screening value, indicating that unacceptable chronic effects from direct exposure to air would not be expected.

Short-term exceedances, based on maximum predicted concentrations for the 24-hour averaging period, may occur at the camp and at the fence line, for nitrogen dioxide, and particulate matter, including uranium in TSP and PM_{10}. The predicted exceedances were infrequent, short-term, and limited to near the site. Unacceptable levels of risk would not be expected from infrequent direct short-term exposures to these constituents in air.

Air quality constituents would be monitored as part of an overall Environmental Protection Program, which would include ambient air monitoring and adaptive management. Additionally, on-Site health and safety requirements and mitigation measures would be developed to control dust emissions. Monitoring would be used to verify the air quality predictions and evaluate the effectiveness of mitigation measures.

No concentration-based screening values were available for uranium-238 series radionuclides in air. However, because radionuclides are considered of public interest, they were assessed further in the ERA. The ERA included the assessment of human and ecological risk from exposure to radionuclides as part of the total radiological dose from atmospheric and aquatic pathways combined in Section 5.4 and Section 6.4, respectively. While radon concentrations were predicted to be below the screening value, this constituent was considered further in the HHRA in Section 5.4, due to public interest.

Other air quality constituents were included in the evaluation of potential human health and ecological risk in Section 5.4 and Section 6.4, respectively, via indirect exposures, such as soil contact and through the food chain (including country foods). These parameters were selected based on a cumulative exposure pathways approach that included COPCs identified for exposures through aquatic pathways (Section 4.2.5, Water Quality Constituents for Further Evaluation in the Environmental Risk Assessment) and engagement with Indigenous and other communities and regulators.

4.4 Final List of Constituents of Potential Concern for the Environmental Risk Assessment

Based on evaluation of aqueous and atmospheric sources, including a conservative screening of maximum predicted concentrations in surface water, sediment, air and soil, the final list of COPCs to be evaluated further in the HHRA and EcoRA are listed in Table 4-12.

As indicated in Section 4.2.3.2, Constituents in Surface Water, radon-222 was not considered a COPC in surface water for the ERA. Radon is expected to volatilize rapidly to air. Health Canada (2020) considers that the health risk from ingesting radon-contaminated drinking water is negligible. Additionally, chloride and sulphate were identified as COPCs in the aquatic environment, but not in the terrestrial environment. As well, while deposition of COPCs from air to soil was evaluated, no COPCs in soil were identified for further evaluation; therefore, for the EcoRA, toxicity via direct contact with COPCs in soil for terrestrial plants and soil invertebrates was not quantitatively assessed.

Table 4-12: Final List of Constituents of Potential Concern for the Project Environmental Risk Assessment

Major Ions	Physical Media Where Guideline Exceeded
Chloride	Water
Sulphate	Water
Metals and Metalloids	
Arsenic	Water
Cobalt	Water
Copper	Water
Molybdenum	Water
Uranium	Water
Radionuclides	
Uranium-238	Air, Water
Uranium-234	Air, Water
Thorium-230	Air, Water
Radium-226	Air, Water
Radon-222[a]	Air
Lead-210	Air, Water
Polonium-210	Air, Water

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

5.0 HUMAN HEALTH RISK ASSESSMENT

The components of an HHRA are Problem Formulation (Section 5.1), Exposure Assessment (Section 5.2), Toxicity Assessment (Section 5.3), and Risk Characterization (Section 5.4).

5.1 Problem Formulation

The intent of the problem formulation for an HHRA is to define the goals of the risk assessment, develop an understanding of site conditions, and develop working hypotheses as to how potential exposure of people to contaminants may result in potential risks to human health.

The assessment endpoint for the HHRA is the health of individual humans.

The problem formulation for this HHRA:

- identifies COPCs for human health risks;
- identifies and characterizes non-nuclear energy workers who may frequent the site, and the selected human health receptor groups that represent them in the ERA; and
- identifies the complete exposure pathways by which the COPCs may affect the human health receptors in a conceptual site model.

The conceptual site model for the HHRA summarizes the links between contaminant sources, exposure pathways, and receptors of concern.

5.1.1 Human Receptor Selection and Characterization

The human receptors for the HHRA were selected to be appropriate for 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, 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 (CSA 2022).

The selection of human health receptor groups was based on current understanding of how people use the Project LSA and RSA, information from IKTLU Studies, which was supplemented by information obtained during community information sessions (NexGen 2019) and JWG meetings, as well as the potential for exposure to Project-related media (i.e., air, soil, water, sediment) concentrations during one or more 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. A summary of the rationale for selection is provided in Table 5-1.

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 age class “infant” and falls within the Health Canada age class “toddler”. The selected human health receptor groups are shown on Figure 5-1 and included:

- 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.

Table 5-1: Rationale for Selection of Human Health Receptor Groups

Receptor	Rationale for Selection
Camp worker	The camp worker 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).

Receptor	Rationale for Selection
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 Forrest 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.

The purpose of this subsection is to provide a narrative description of the key assumptions used to characterize human receptors for the Project.

Human health exposure pathways considered for the Project for each of the human receptors, including assumptions for the Traditional Foods diet, are summarized in Section 5.1.3, Selection of Exposure Pathways. The human health conceptual model is provided in Section 5.1.4, Human Health Conceptual Site Model. The residency assumptions for each of the human health receptors (locations, durations, and frequencies) are described in Section 5.1.1.1 through Section 5.1.1.4 and summarized in the exposure assessment (Section 5.2.1, Exposure Locations, Duration, and Frequency).

5.1.1.1 Camp Worker

A camp worker at the Project (i.e., a non-nuclear energy worker such as a camp cook) would represent an adult male or female. This receptor group was assumed to work and reside at the Project site (camp) for 50% of the year and away from the Project site for the other 50% of the year. A camp worker was assessed for all Project phases except 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. Fresh water for drinking and bathing would be obtained 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 be permitted to hunt, fish, or gather berries/plants in the area and therefore would not ingest Traditional Foods from within the LSA.

Based on discussions with NexGen, a camp worker who also does subsistence harvesting was considered representative of the northern workforce. 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 (Section 5.1.3, Selection of Exposure Pathways). 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 would travel to the LSA for subsistence harvesting activities (i.e., Patterson Lake South Arm area) for a portion of the year (i.e., 3 months; 25%). This is consistent with Indigenous and Local Knowledge that suggests that 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, they may come in direct contact with surface water through swimming and sediments through wading, and they may obtain fresh water for drinking and bathing from Patterson Lake. The remainder of the time (i.e., 3 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.

5.1.1.2 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 local area of the Project but based on 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. Clearwater River Dene Nation members 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 would be exposed to Project-related COPCs through inhalation of air and dermal (skin) contact 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 would use local surface water for drinking, bathing, and swimming, and would come in contact with sediments during wading.

Subsistence harvesters would 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 would comprise about 50% of their Traditional Foods diet. The portion of locally or regionally sourced Traditional Foods in the subsistence harvester overall annual diet would be consistent with an Indigenous Group's high consumer of Traditional Foods. In the HHRA, about 50% of the Traditional Foods in the overall diet of the subsistence harvesters would be sourced from either Patterson Lake South Arm or Beet Lake in the LSA or from Lloyd Lake, and the other 50% from a reference location. The Patterson Lake location is a near-field location within the LSA. The Beet

Lake 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.

5.1.1.3 Seasonal Resident/Lodge Operator

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 (approximately 4 months) and away from the LSA and RSA for 70% of the year (approximately 8 months) during the Project phases. 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 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. Potable 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 Forrest Lake Outfitters or Clearwater River Provincial Park, who would be expected to frequent those locations less often.

While at Patterson Lake or Lloyd Lake, seasonal residents were assumed to ingest Traditional Foods fished, hunted, and gathered local to the Patterson Lake or Lloyd Lake areas to an extent consistent with an Indigenous Group's average consumer of Traditional Foods. 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 the practice of activities such as wading. For the remainder of the time, when not at Patterson Lake or Lloyd Lake, the seasonal residents would reside at an unexposed location with constituents in the environment at background levels.

5.1.1.4 Future Permanent Resident

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). To address these concerns, a future permanent resident was considered for the HHRA. The permanent resident group would represent potential risks to a hypothetical family (adult and one-year-old) that would reside at the decommissioned and reclaimed Project site in the far-future projection 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 mine site; therefore, this receptor is considered hypothetical, but is assessed as a conservative assumption. The future permanent residents were assumed to reside at the former Project for 100% of the year (i.e., in the Patterson Lake North Arm area).

Similar to the subsistence harvester, the future permanent resident would consume a large proportion of locally sourced Traditional Foods in their overall annual diet, consistent with an Indigenous Group's high consumer of Traditional Foods. 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 come from Patterson Lake. Contact with sediments in Patterson Lake during activities such as wading was also assumed. Since there would be no Project-associated air emissions in the far-future projection, atmospheric exposure pathways were considered to be incomplete for the permanent resident.

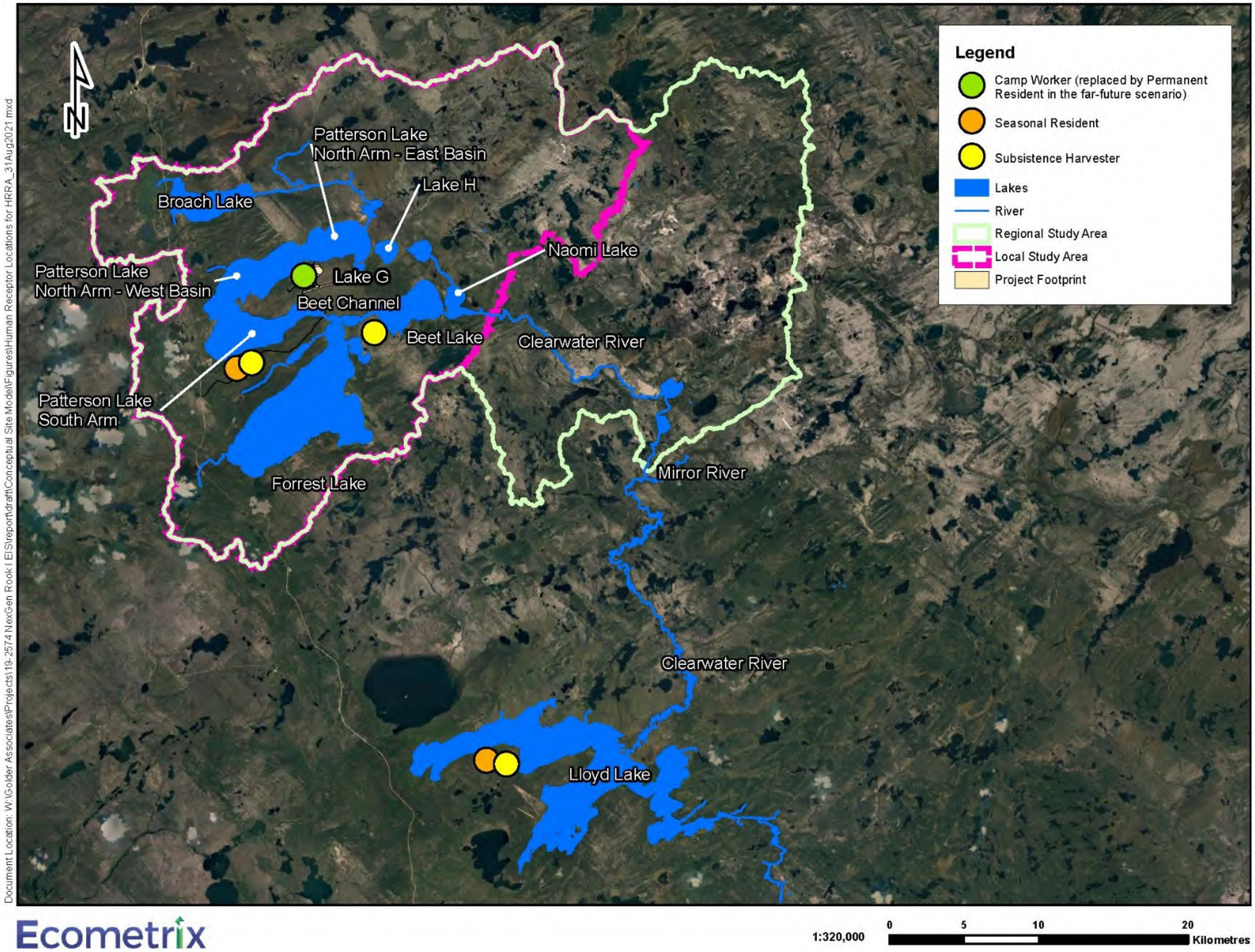


Figure 5-1: Human Receptor Locations

5.1.2 Constituents of Potential Concern Retained for Further Evaluation in the Human Health Risk Assessment

The selection of chemical stressors to be evaluated in the ERA followed a tiered approach to reduce the risk of overlooking Project-related COPCs to human health that would be emitted through water and air. The selection was detailed in Section 4.0, Model Integration and Evaluation of Sources.

The final list of COPCs for assessment in the ERA is presented in Section 4.4, Final List of Constituents of Potential Concern for the Environmental Risk Assessment. While chloride and sulphate were identified as COPCs for further assessment in the ERA, they were not considered further in the 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 (Table 4-2); and 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 in the HHRA.

5.1.3 Selection of Exposure Pathways

The HHRA considered potential releases of Project-related constituents to the atmosphere and to surface water. Therefore, the relevant primary media were air, water, soil, sediment, and food.

Complete exposure pathways consisted of a contaminant source, a release mechanism, a transport mechanism within the relevant environmental medium or media, a point of exposure, and an exposure route. No pathways have been removed due to controls, mitigation, or treatment.

5.1.3.1 Summary of Complete Exposure Pathways

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

- 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.

The potential exposure pathways were expected to be the same for all human receptors assessed, with the exception of inhalation in the far-future projection when there is no ongoing source of air COPCs. Exposure pathways for selected human receptors are summarized in Table 5-2.

Table 5-2: Human Health Exposure Pathways Considered for the Rook I Project

<table>
<tr><th rowspan="2">Human Receptor Group</th><th colspan="5">Environmental Exposure Pathway</th></tr>
<tr><th>Air</th><th>Soil</th><th>Water</th><th>Sediment</th><th>Traditional Foods[(a)]</th></tr>
<tr><td colspan="6">Non-radiological Exposures</td></tr>
<tr><td>Camp worker</td><td rowspan="3">Inhalation</td><td rowspan="4">Incidental ingestion

Dermal contact</td><td rowspan="4">Ingestion

Dermal contact</td><td rowspan="4">Incidental ingestion

Dermal contact</td><td rowspan="4">Ingestion</td></tr>
<tr><td>Subsistence harvester</td></tr>
<tr><td>Seasonal resident</td></tr>
<tr><td>Permanent resident</td><td>Incomplete[(b)]</td></tr>
<tr><td colspan="6">Radiological Exposures</td></tr>
<tr><td>Camp worker</td><td rowspan="3">Inhalation

External</td><td rowspan="4">Incidental ingestion

External</td><td rowspan="4">Ingestion

External</td><td rowspan="4">Incidental ingestion

External</td><td rowspan="4">Ingestion</td></tr>
<tr><td>Subsistence harvester</td></tr>
<tr><td>Seasonal resident</td></tr>
<tr><td>Permanent resident</td><td>Incomplete[(b)]</td></tr>
</table>

(a) Plants and animals that are ingested as a source of food and have been directly or indirectly exposed to Project-related COPCs.
(b) 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.

5.1.3.2 Dietary Assumptions

The purpose of this subsection is to provide the rationale used to derive the Traditional Foods diet for the Project HHRA and how the Traditional Foods diet fits into the overall total diet for human receptors. Traditional Foods are those animals and plants that are fished, hunted, or gathered from the land and consumed as food (Health Canada 2018). The remainder of the total food diet is assumed to be from store bought foods (store foods). Store foods include grain and other agricultural products of a typical diet that are not available locally.

Each of the human health receptors described in Section 5.1.1, Human Receptor Selection and Characterization, would consume locally sourced Traditional Foods from the LSA or RSA to an extent that is consistent with either an average or a high First Nations consumer of Traditional Foods. The basis for deriving appropriate average and high Traditional Foods diets, and how the engagement process informed the derivations are presented in the following sections (Section 5.1.3.2.1, Total Food Diet General Assumptions; Section 5.1.3.2.2, Traditional Foods Diet; Section 5.1.3.2.3, Store Foods).

5.1.3.2.1 Total Food Diet General Assumptions

The initial assumptions for ingestion rates and components of the total foods diet for the HHRA were taken from CSA N288.1-20 Adult (Table G.9b – Central) total diet. Human receptor groups in the HHRA (Section 5.1.1) were assumed to obtain a portion of their overall diet from Traditional Foods and the rest from store bought foods.

As discussed further in Section 5.1.3.2.2, human receptors were assumed to consume lower or higher proportions of Traditional Foods in their overall diets depending on their lifestyles. These are referred to as average Traditional Foods consumers and high Traditional Foods consumers, respectively. In both cases, the proportion of Traditional Foods in the overall diet of human health receptor groups in the HHRA was based on First Nations dietary studies. The camp worker, subsistence harvester and permanent resident receptor groups represent residents of northern Saskatchewan and were assumed to have an overall diet consistent with a First Nations high consumer of Traditional Foods. The seasonal resident receptor group represents residents of Saskatchewan and was assumed to ingest Traditional Foods consistent with an average First Nations consumer of Traditional Foods. The type of traditional diet attributed to each of the human health receptor groups is listed in Table 5-3.

Table 5-3: Traditional Food Diets for Each Human Receptor Group

Human Receptor Group	Type of Traditional Diet
Camp worker	**High consumer**
Subsistence harvester	**High consumer**
Seasonal resident/lodge operator	**Average consumer**
Permanent resident	**High consumer**

The methods used to develop the Traditional Foods diet for average and high Traditional Foods consumers is described in Section 5.1.3.2.2. The store foods diet is described in Section 5.1.3.2.3.

5.1.3.2.2 Traditional Foods Diet

The initial assumptions for ingestion 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 other communities primarily through JWG discussions in October 2019 and February 2020, and later in discussion with representatives from Saskatchewan Ministry of Environment, Saskatchewan Health Authority, and CNSC. As discussed in the next sections, 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 IMPACT environmental pathways model to support the Traditional Foods exposure assessment.

The starting point for the Traditional Foods diet was the FNFNES report for Saskatchewan. The FNFNES report considers First Nations diets by ecozone to reflect the types of food items available locally to consumers of Traditional Foods. The study also provides breakdowns for Traditional Food items for:

- adult male, adult female, and average adult male and female diets;
- diets for both average and high (95th percentile) consumers of Traditional Foods; and
- detailed and simplified diets for each ecozone.

Consistent with the CSA total food diet, the HHRA considers ingestion rates for adult males for both average and high Traditional Foods diets.

The Project is located near the boundary of the Boreal Shield and Boreal Plain ecozones, as shown in Figure 5-2; therefore, the food categories for Traditional Foods in the diets for each of the ecozones were initially considered, as well as a combined (averaged) diet for the two ecozones. Reliance on fish and game differed somewhat between First Nations in the Boreal Shield and Boreal Plain ecozones. The Boreal Shield diet relies on less game (38%) and more fish (50%), whereas the Boreal Plain diet relies on more game (59%) and less fish (26%). The averaged Boreal Shield / Boreal Plain diet results in a more even distribution of game (44%) and fish (43%) in the traditional diet. The three diets were presented to local First Nations communities for input.

When the communities were consulted through JWG meetings, they indicated that of the three diets presented (Figure 5-3), the averaged diet which shows approximately equal proportions for game and fish ingestion was the most representative. Therefore, further development of the Traditional Food diet considered these proportions for the four Traditional Foods categories (fish, game and game organs, birds, and berries and plants) for both average and high consumers of Traditional Foods. The community feedback indicated that locally harvested berries were more prevalent in the regional diet than what was presented, 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 concern. During JWG meetings, the MN-S (MN-S-JWG 2019a) indicated that they ate more blueberries than what was proposed since they pick and store them to eat all winter.

The increase in the Traditional Foods berry ingestion rate was balanced by a decrease in the ingestion rate for store bought foods. This resulted in an increase in the overall Traditional Foods ingestion rate when compared to FNFNES. This is reflected in the final ingestion rates developed for the ERA in Section 5.2.3.1, Annual Food Ingestion Rates for Human Receptors in the Human Health Risk Assessment.

The FNFNES report and erratum lists over 100 different Traditional Food items as being harvested across Saskatchewan. The daily intakes (average and 95th percentile) of Traditional Food items were summarized for the following food categories for each ecozone: fish; game (meat and organs); birds; and berries/plants.

Engagement through the JWG sessions confirmed general agreement with the four Traditional Foods categories (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 would contribute to the Traditional Foods diet to a lesser extent, but in almost equal proportions.

Using the detailed Traditional Food data provided in the FNFNES, the food categories were expanded for the HHRA to include:

- fish:
  - predator species; and
  - forage species.
- game and game organs:
  - large mammals;
  - large mammal organs; and
  - small mammals.
- birds:
  - aquatic birds; and
  - terrestrial birds.
- berries and plants:
  - berries; and
  - Labrador tea.

The annual Traditional Foods ingestion rates for the Boreal Shield Traditional Foods diet were selected as the basis for the HHRA Traditional Foods diet because they are higher than those estimated for Traditional Foods consumers in the Boreal Plain Ecozone. The ingestion rates for each of the Traditional Foods food categories were adjusted to maintain the distribution that the communities recognized as being more representative of their Traditional Foods diets. The ingestion rates for the various Traditional Food items within each Traditional Foods category were proportioned using the FNFNES dietary data for the Boreal Shield total diet. As a final step, the amount of Traditional Foods – berries ingested was increased from approximately 5% of the fruits and berry component of the total N288.1-20 diet to 10% by reducing the store food percentage. Figure 5-4 illustrates the proportional distribution of food items in the Traditional Foods diet for average and high Traditional Foods consumers selected for the HHRA.

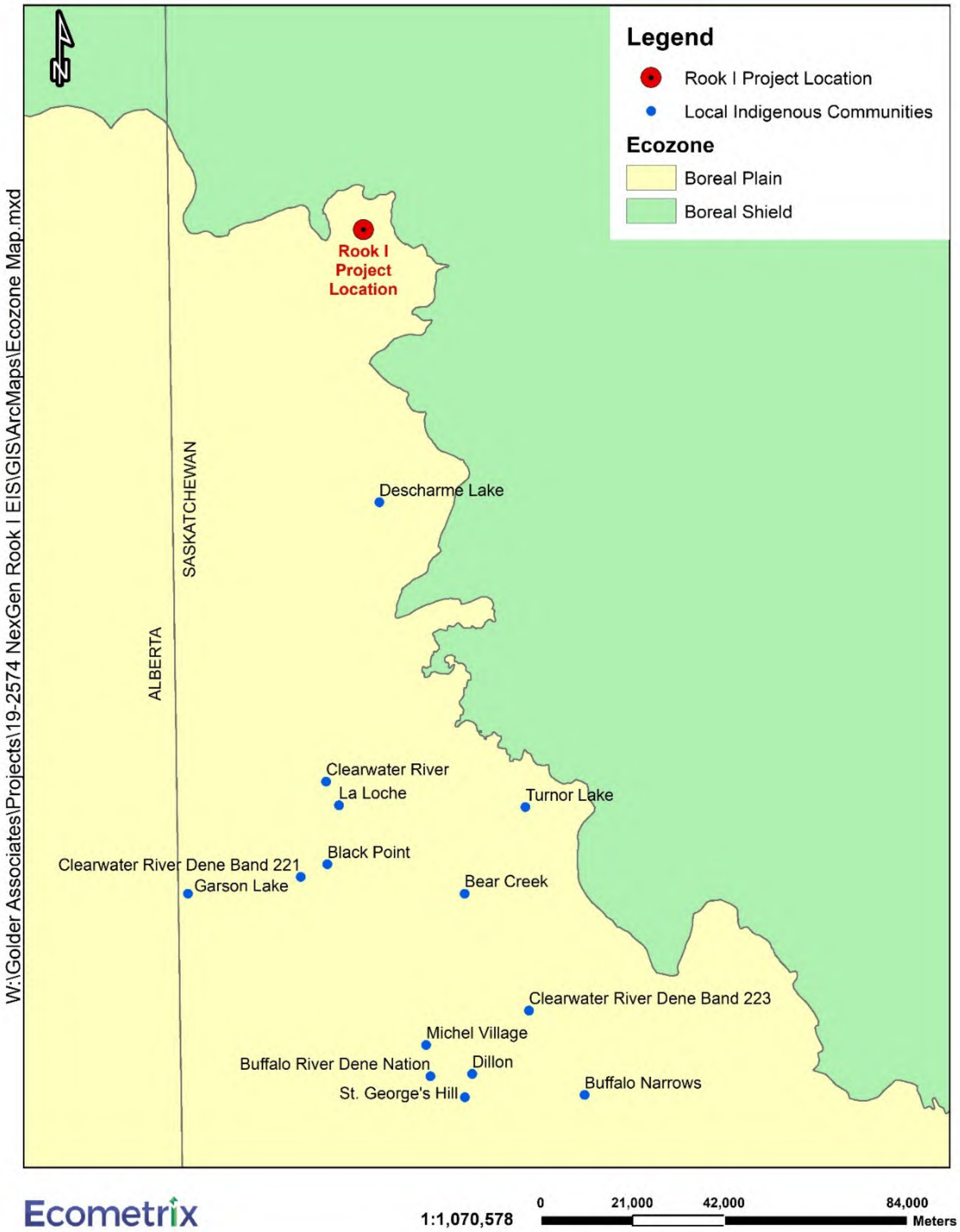
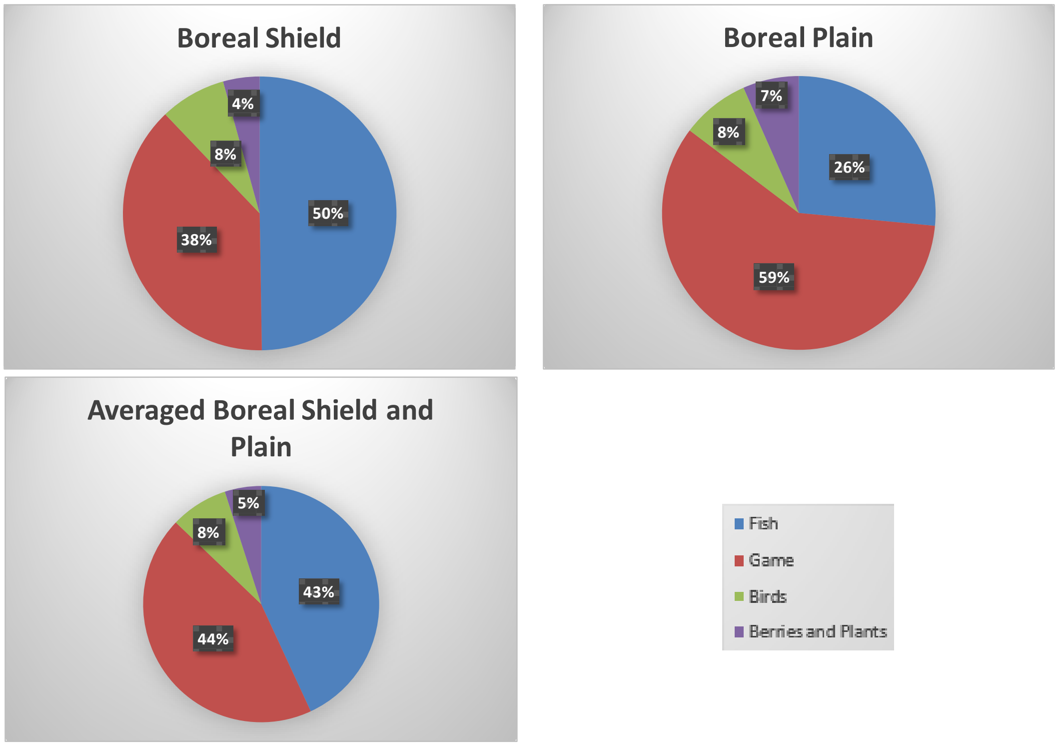
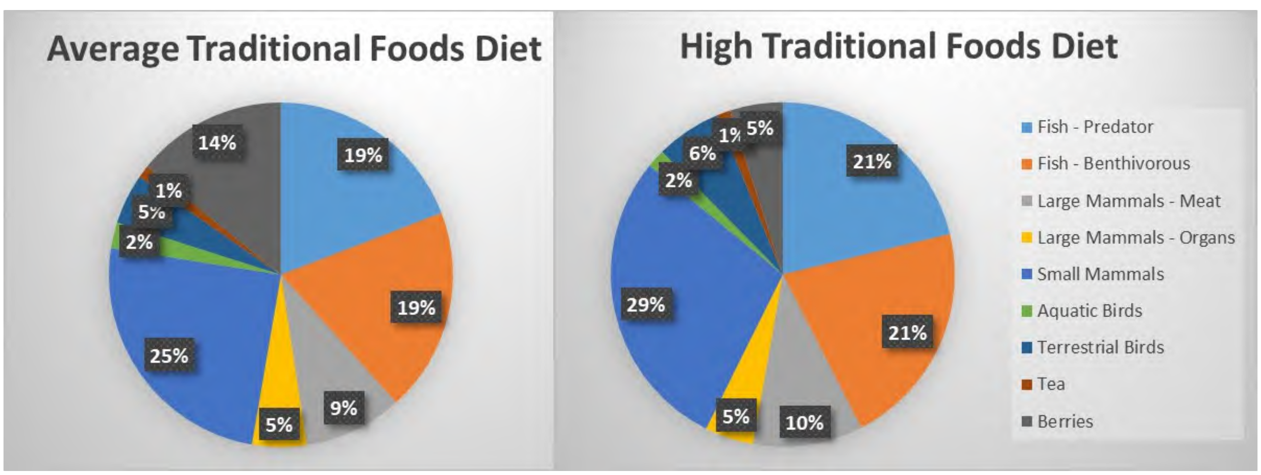


Figure 5-2: Location of Rook I Site with Respect to Saskatchewan Ecozones



Note: Data from Chan et al, 2018 and 2019 for average traditional diets

Figure 5-3: Proportions of Traditional Food Categories in the Boreal Shield, Boreal Plain, and Averaged Diets Reviewed during Engagement Activities with Local Communities



Note: Male average and high Traditional Foods Boreal Shield diets were initially derived using data from Chan et al. 2018, 2019. Proportions of fish species and berries in the Traditional Foods diets were adjusted based on engagement activities.

Figure 5-4: Proportional Distribution of Traditional Food Items in Average and High Traditional Diets Selected for the Human Health Risk Assessment

5.1.3.2.3 Store Foods

The proportion of the overall diet not accounted for by Traditional Foods was considered to be from store-bought foods. Store foods are not from the area of influence of the Project. Ingestion of COPCs in store foods would be considered part of the background dose for human health receptors.

The concentrations of constituents in the store-food diet of human receptors were based on data from Health Canada (2000, 2011a) for non-radiological constituents in foods for Canadian cities (Health Canada 2011a) and United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR 2000) for radiological constituents. The data for different food types were averaged to represent the HHRA food components based on the proportions of different types in the store foods of the Hatchet Lake Band (CanNorth 2000).

5.1.4 Human Health Conceptual Site Model

The human health conceptual model illustrates how receptors are exposed to COPCs. It represents the relationship between the source and receptors by identifying the source of contaminants, the 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.

The complete exposure pathways for the human receptors that are considered in the HHRA are illustrated in Figure 5-5, based on the selected human receptor groups (Section 5.1.1, Human Receptor Selection and Characterization) and the potential exposure pathways (Section 5.1.3, Selection of Exposure Pathways).

As outlined in Section 4.4 and Section 5.1.2, the list of COPCs relevant to the water exposure pathway include various metals and metalloids (i.e., arsenic, cobalt, copper, molybdenum, and uranium), and select radionuclides of the uranium-238 decay chain (i.e., uranium-238, uranium-234, thorium-230, radium-226, lead-210, and polonium-210). These waterborne COPCs are also expected to partition from surface water to sediment. Human and ecological receptors may be directly exposed to these COPCs via ingestion and/or dermal contact with surface water and sediment. Human receptors would be potentially further exposed through the ingestion of aquatic and terrestrial country foods that ingest or come into contact with contaminated surface water and sediment.

The list of COPCs relevant to the air exposure pathway include the same list of radionuclides as the water exposure pathway with the addition of radon-222. Human and terrestrial ecological receptors may come into direct contact with these radionuclides via the inhalation exposure pathway. Radionuclide particles may also deposit onto soil and plants, where they may be taken up into the vascular system of plants or be incidentally ingested or come into dermal contact by humans and terrestrial biota. Human receptors would again be potentially further exposed via the consumption of terrestrial country foods that come into contact with radionuclides via inhalation or through ingestion/dermal contact with contaminated soil or plants.

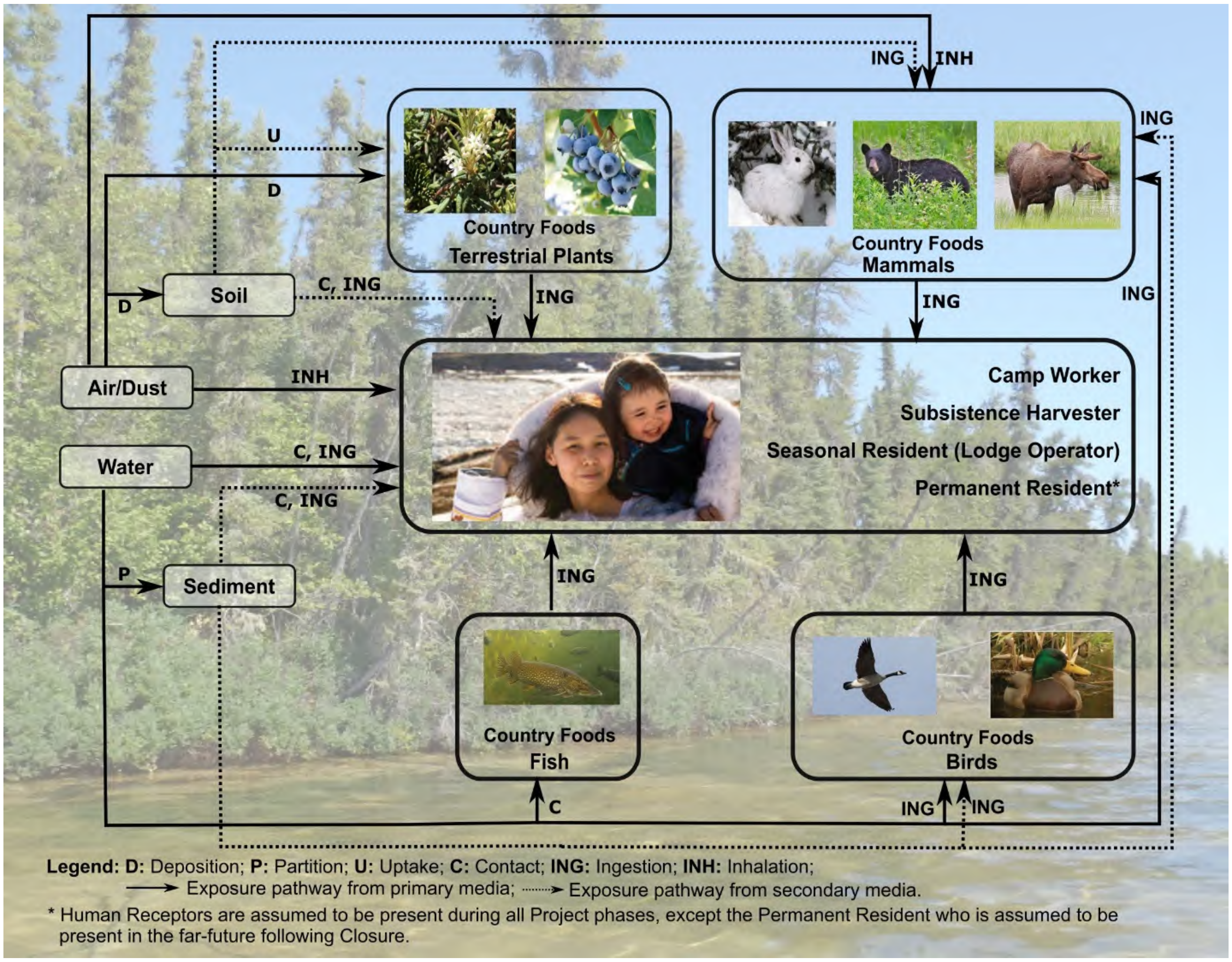


Figure 5-5: Human Health Conceptual Site Model

5.1.5 Uncertainty in Problem Formulation

The assumptions used to characterize human health receptors and develop the conceptual site model followed best industry practices and CSA guidance. Where possible, region-specific information was used to develop initial assumptions for human health receptor groups, locations and frequency, and duration of exposures. Communities 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 (such as the Traditional Foods diet) where regional information was scarce.

The selection of Project-related COPCs was based on comparing maximum predicted water, sediment, air, and soil concentrations at the human health receptor locations to relevant environmental guideline concentrations (i.e., screening values). Numerous conservative measures were integrated into the models used to predict COPC concentrations used in the screening process (EIS Appendix 7A, Air Dispersion Modelling Report; EIS Appendix 9A, Hydrological Modelling Summary Report; TSD XIV, Groundwater Flow and Solute Transport Modelling Report). The predicted concentrations were compared to screening values protective of both human health and biota. There is, therefore, a high level of confidence that the HHRA captures all Project-related COPCs that would be emitted by Project activities to water and air.

5.2 Exposure Assessment

The exposure assessment included identification of exposure locations and exposure factors for each human health receptor and presentation of exposure concentrations and doses (radiological and non-radiological). Uncertainties are discussed. This subsection presents the information used in the environmental pathways model, IMPACT, at a high level. The details of the model are included in Appendix A.

5.2.1 Exposure Locations, Duration, and Frequency

The selection of exposure locations for 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 and JWG meetings, as well as the potential for exposure to Project-related media concentrations during one or more Project phases. Exposure locations for each of the human health receptors are shown in Figure 5-1. The residency assumptions for each of the human health receptors are summarized in Table 5-4, which includes the exposure frequency (months per year) and fraction of time the receptor would spend at a given location. The exposure duration, which refers to the number of years of exposure, was either the duration of the Project phases (43 years) or the lifetime of the receptor.

The selected human health receptor exposure locations include:

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

With the exception of the future permanent resident, all of the human health receptors were assumed to spend part of their time away from the LSA and RSA at a location represented in the ERA by the reference location. The reference location, represented by Broach Lake, is intended to represent a location unaffected by the proposed Project, and is characterized by the compilation of baseline data in the RSA.

Table 5-4: Summary of Residency Assumptions for Human Health Receptor Groups

Human Health Receptor Group	Life Stage(s)	Receptor Location(s)	Residency[(a)]		Consumer of Traditional Foods
			Fraction of Time at Location	Exposure Frequency (mo/yr)	
All Project Phases: Construction, Operations, Closure					
Camp worker	Adult	Camp / Patterson Lake South Arm / reference location	0.5 / 0.25 / 0.25	6/3/3	Yes, high consumer while away from the camp
Subsistence harvester	Adult and one-year-old	Patterson Lake South Arm / reference location	0.5 / 0.5	6/6	Yes, high consumer year-round in study area and reference location
		Beet Lake / reference location	0.5 / 0.5	6/6	
		Lloyd Lake / reference location	0.5 / 0.5	6/6	
Seasonal resident	Adult and one-year-old	Patterson Lake South Arm / reference location	0.3 / 0.7	4/8	Yes, average consumer year-round in study area and reference location
		Lloyd Lake / reference location	0.3 / 0.7	4/8	
Far-future Projection					
Permanent resident	Adult and one-year-old	Patterson Lake North Arm – West Basin	1	12	Yes, high consumer year-round
Subsistence harvester	Adult and one-year-old	Patterson Lake South Arm / reference location	0.5 / 0.5	6/6	Yes, high consumer year-round in study area and reference location
		Beet Lake / reference location	0.5 / 0.5	6/6	
		Lloyd Lake / reference location	0.5 / 0.5	6/6	
Seasonal Resident	Adult and one-year-old	Patterson Lake South Arm / reference location	0.3 / 0.7	4/8	Yes, average consumer year-round in study area and reference location
		Lloyd Lake / reference Location	0.3 / 0.7	4/8	

(a) The exposure duration for subsistence harvesters, seasonal residents, and permanent residents is considered to be over a lifetime; the exposure duration for the camp worker is considered to be the duration of the Project (43 years).

5.2.2 Exposure and Dose Calculations

Exposure and dose calculations for human receptors were completed using IMPACT version 5.6.0. IMPACT is consistent with the COPC transport equations and radiological dose calculations outlined in CSA N288.1-20. Equations used for non-radiological dose calculations are consistent with CSA N288.6-22, which have generally been obtained from Health Canada guidance.

The inputs and assumptions used in the IMPACT model for the Rook I Project, including receptor characteristics, exposure pathways, and the derivation and identification of site-specific information used in the model, are provided in Appendix A. Relevant to the exposure and dose calculations for human receptors, the Model Report:

- describes the model structure for human health receptor assessment, specific assumptions made for the Project, and the generic equations used to calculate the transfer of constituents between environmental media and the receptors; and
- presents the input parameters for adult and one-year-old receptors, including those for dietary assumptions and intake rates, inhalation rates, and exposed skin area.

5.2.3 Exposure Factors

Exposure estimates rely on several COPC- and media-specific exposure factors for the dose calculations. These parameters include body characteristics and intake rates as well as exposure frequency (Section 5.2.1, Exposure Locations, Durations, and Frequency) and dose coefficients.

5.2.3.1 Annual Food Ingestion Rates for Human Receptors in the Human Health Risk Assessment

Adult Diet

As mentioned in Section 5.1.3.2, Dietary Assumptions, the initial assumptions for food ingestion rates and components of the total diet for the HHRA were taken from CSA N288.1-20 Adult (Table G.9b – Central) total diet. The CSA N288.1-20 dietary composition was based on the 2004 Canadian nutrition survey results (Statistics Canada 2004), processed for International Commission on Radiological Protection (ICRP) age groups and for two sexes in the adult age group. The dietary intakes for ICRP ages were adjusted to align with ICRP reference energy intakes for each age group (ICRP 2003).

The N288.1-20 human diet was selected over the Health Canada (2010a) human diet for the HHRA. Health Canada (2010a) references Richardson (Richardson 1997), which used survey results from the late 1970s. The Richardson diet was also a combined adult male/female diet. The CSA N288.1-20 total adult diet is a smaller overall diet (706 kg/yr) than the Richardson diet (808 kg/yr; by about 100 kg/yr) and is based on more recent data.

The total food diet is the sum of Traditional Foods and store foods. Its dietary components, expressed in kilograms per year of food consumed, are shown in Table 5-5 for non-consumers, average consumers, and high consumers of Traditional Foods.

The derivation of the Traditional Foods diet is described in Section 5.1.3.2. The overall ingestion rate for the Traditional Foods diet used in the HHRA is higher that that estimated by the FNFNES due to a higher ingestion rate for Traditional Foods – berries being considered in response to input from Indigenous and local communities. The concentrations of COPCs in Traditional Food items used in the exposure assessment are estimated using the IMPACT model, as described in Appendix A, Section 3.6, Transfer of Constituents to Aquatic Receptors, and Section 3.7, Transfer of Constituents to Terrestrial Receptors and Humans. The selection of representative ecological receptors used in the IMPACT model is discussed below.

The store food intakes in each food category were estimated from the total diet intakes provided in CSA N288.1-20, minus the Traditional Food intake. If the Traditional Foods intakes were higher than the total intake for the same CSA N288.1-20 food category, then the store food intake was set to zero and the values for other store food categories were reduced as needed to obtain total dietary intakes equal to those in CSA N288.1-20. The store food diet and concentrations of COPCs in store foods used in the exposure assessment are consistent with other recent HHRAs conducted for uranium mine and mill projects in Saskatchewan. Concentrations of COPCs in store foods are provided in Appendix A (Table 2-11).

One-Year-Old Diet

Annual food consumption rates for the one-year-old diet were calculated using adult-to-one-year-old ratios from CSA N288.1-20 for each of the selected food categories. Annual ingestion rates for individual food categories were combined into relevant food categories, and the adult-to-one-year-old ratios were determined for each of these food categories.

Representative Ecological Receptors Used in the IMPACT Model

The representative ecological receptor is the specific species modelled in the ERA that represents each Traditional Food category. Based on the descriptions of the different human receptor groups and their Traditional Food diets, representative ecological receptors were selected for the IMPACT model to represent each Traditional Food category. The representative ecological receptor selected to represent the Traditional Food category was informed and modified based on feedback received from JWG meetings and engagement with regulators. Specifically, these engagement activities informed assumptions for fish species, large mammals, and small mammals.

- Northern pike and lake whitefish were included as fish species in the exposure assessment and part of the Traditional Foods diet.
- Preference for eating moose over other large mammals such as caribou.

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[2] 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).
- 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:

[2] 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.

  - 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 identifed ducks as important species that are hunted (TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN).

The final selection of representative ecological receptors for the Traditional Foods diet is shown in Table 5-6. Additional discussions on how ecological receptors were selected, their characteristics and exposure assumptions are provided in the EcoRA in Section 6.0, Ecological Risk Assessment, and Appendix B, Ecological Receptor Profiles.

Table 5-5: Annual Ingestion Rates for Traditional Food Items of the Total Food Diet for Non-consumers, and Average and High Consumers of Traditional Foods

Food Category	Non-Traditional Foods Consumer Diet[(a)]	Average Traditional Foods Consumer[(b, c, d, e, f)]				High Traditional Foods Consumer[(b, c, d, e, f)]			
	Adult	Adult		One-Year-Old		Adult		One-Year-Old	
	Total Diet	Traditional Foods	Store Foods	Traditional Foods	Store Foods	Traditional Foods	Store Foods	Traditional Foods	Store Foods
	kg/yr	kg/yr		kg/yr		kg/yr		kg/yr	
Milk	126	0	126	0	243	0	32.6	0	226
Fish	8.25	26.8	0	5.94	0	84.8	0	18.76	0
Northern pike	n/a	13.4	0	2.97	0	42.4	0	9.38	0
Lake whitefish	n/a	13.4	0	2.97	0	42.4	0	9.38	0
Meat - large mammals	67.9	6.52	24.1	0.785	2.90	20.6	0	2.48	0
Meat - large mammal organs	2.04	3.59	0	0.897	0	9.16	0	2.29	0
Meat - small mammals	0.230	17.4	0	1.66	0	56.9	0	5.42	0
Meat - birds and eggs	58.1	n/a	53.1	n/a	9.48	n/a	42.3	n/a	7.55
Aquatic bird	n/a	1.71	0	0.304	0	3.46	0	0.618	0
Terrestrial bird	n/a	3.29	0	0.587	0	12.3	0	2.19	0

Food Category	Non-Traditional Foods Consumer Diet[a]	Average Traditional Foods Consumer[b, c, d, e, f]				High Traditional Foods Consumer[b, c, d, e, f]			
	Adult	Adult		One-Year-Old		Adult		One-Year-Old	
	Total Diet	Traditional Foods	Store Foods	Traditional Foods	Store Foods	Traditional Foods	Store Foods	Traditional Foods	Store Foods
Root vegetables	47.9	0	47.9	0	8.65	0	47.9	0	8.65
Other vegetables	297	0.844	296	0.225	82.3	2.45	294	0.681	81.9
Fruits and berries	99.4	9.94	89.5	5.46	49.2	9.94	89.5	5.46	49.2
Total diet – subtotal	n/a	**70.1**	**636**	**15.9**	**395**	**200**	**506**	**37.9**	**373**
Total diet	**706**	**706**		**411**		**706**		**411**	

Note: Values greater than 0 are rounded to 3-significant figures.
(a) Total Diet is derived from CSA N288.1-20 central dietary intakes Table G.9b.
(b) Traditional Foods annual consumption rates for adults are taken from *First Nations Food, Nutrition and Environment Study* (Chan et al. 2018) Boreal Shield diet for Saskatchewan First Nations Communities for either average or high Traditional Food consumers (male) for the Traditional Foods diet.
(c) Annual food consumption rates for one-year-old were calculated using 'Adult to 1-year-old' ratios (CSA N288.1-20 Adult (Central): 1-year old) derived for each food category. Annual consumption rates for individual food items were combined into relevant food category and the ratios for each food category were derived based on the total kg/yr for each category.
(d) The store food intakes in each food category were estimated from the non-Traditional Foods intakes provided in CSA N288.1-20, minus the Traditional Foods intakes. If the Traditional Foods intakes were higher than the total intake for the food category, the store food intake was set to zero, and then the value for other store food categories were reduced as needed to obtain total dietary intakes equal to those in CSA N288.1-20.
(e) The fractions of northern pike (predator species) and lake whitefish (forage species) were set at 50% each of the total fish diet based on input received from regulatory bodies to include both predator and forage species for a conservative assessment of exposure to constituents.
(f) The fraction of Traditional Foods "Fruits and Berries" was increased from approximately 5% (Chan et al. 2018) to 10% of the total "fruits and berries" based on input received from local Indigenous communities. The total food diet was adjusted by reducing the store foods and increasing Traditional Foods "Fruits and Berries" fractions, respectively.
n/a = value not available or not applicable.

Table 5-6: Representative Ecological Receptors used in the Traditional Foods Diet

Traditional Food Category	Representative Ecological Receptor	Traditional Food Items	Rationale[a]
Fish			
Fish	Northern pike	Walleye Northern pike	• Predator species and forage species represent two ecological trophic levels • Northern pike and lake whitefish are present in all lakes in the vicinity of the Project according to baseline studies • Important Traditional Food items for Boreal Shield and Boreal Plains ecozones • Both are known to be fished in the vicinity of the Project
	Lake whitefish	Lake whitefish	
Game Meat/Organs			
Large mammal	Moose meat	Moose meat	• Large herbivore with linkages to the aquatic environment • Generally present in the vicinity of the Project according to baseline studies • Important Traditional Food items for Boreal Shield and Boreal Plains ecozones
	Moose organs	Moose kidney Moose liver Caribou kidney	
Small mammal	Beaver	Beaver meat Rabbit meat	• Small herbivore with linkages to the aquatic environment • Generally present in the vicinity of the Project according to baseline studies • Important Traditional Food items for Boreal Shield ecozone
Birds			
Aquatic bird	Mallard	Mallard	• Omnivorous bird with linkages to the aquatic environment • Seasonally present in the vicinity of the Project according to baseline studies Important Traditional Food items for Boreal Shield and Boreal Plains ecozones
Terrestrial bird	Grouse	Grouse Goose	• Upland herbivore bird • Generally present in the vicinity of the Project according to baseline studies • Important Traditional Food items for Boreal Shield and Boreal Plains ecozones
Berries/Plants			
Berries	Blueberry	Blueberry	• Generally present in the vicinity of the Project according to baseline studies • Important Traditional Food items for Boreal Shield and Boreal Plains ecozones
Plants	Labrador tea	Mint Rat root	

(a) The selection of representative ecological receptors to represent Traditional Food items was informed by feedback received during engagement activities.

5.2.3.2 Bioavailability

In general, the IMPACT model was used to calculate exposure doses for arsenic. However, the general assumption in IMPACT is that a COPC is 100% bioavailable from all media types, including food.

In the initial outputs from the IMPACT model, the contribution of moose organs and moose meat to total exposure assuming 100% bioavailability was relatively high and a key driver for the risk estimates, particularly the subsistence harvester. 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 to incorporate arsenic bioaccessibility into the outputs for moose meat and moose organs using data collected as part of a study based out of British Columbia (Laird and Chan 2013). Laird and Chan (2013) collected samples of various types of traditional foods considered in the FNFNES including moose organs (kidney and liver) and moose meat. The mean percent in vitro bioaccessibility (a surrogate for bioavailability) ranged from 7% to 19% for moose organs, and was 59% for moose meat. These bioaccessibilities were incorporated into the exposure assessment by adjusting the model outputs from IMPACT by 0.19 for moose organs and 0.59 for moose meat.

ATSDR (2007) indicates that in seafood (i.e., fish), approximately 10% of arsenic is present in the inorganic form, while the remainder is in an organic form (arsenobetaine) that is generally not associated with toxicity. Therefore, the estimates of exposure generated by IMPACT overestimate arsenic exposure from the fish consumption pathway. As such, the model outputs from IMPACT were adjusted such that the exposure doses from fish were multiplied by a factor of 0.10.

These are reasonable estimates of bioaccessibility and are expected to reduce the uncertainty associated with the risk estimates for those food types. However, 100% bioaccessibility was 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.

5.2.3.3 Other Receptor Characteristics

Other receptor characteristics used in the exposure assessment were taken from CSA N288.1-20, and include:

1. air inhalation rates – Table 19 in CSA N288.1-20;
2. water ingestion rates – Table 21 in CSA N288.1-20;
3. soil and sediment ingestion rates – Table 20 in CSA N288.1-20; and
4. exposed surface area (whole body) – Table 22 in CSA N288.1-20.

Receptor characteristics used in the IMPACT model are provided in Appendix A, Section 2.4, Exposure of Human Receptors.

5.2.3.4 Dose Coefficients

Dose coefficients (DCFs) for all internal and external exposure routes for humans are used to estimate radiological exposure. The DCFs for ingestion and inhalation by human receptors were taken from CSA N288.1-20. The external DCFs used in this IMPACT model update were derived based on the methods described in N288.1-20. Dose coefficients used in the IMPACT model are provided in Appendix A, Section 3.7.6, Dose Coefficients for Terrestrial Animals, Birds, and Humans.

5.2.4 Exposure Point Concentration and Doses

Concentrations of COPCs in environmental media (water, sediment, air, soil, and Traditional Food items) at the receptor locations and reference location were derived using IMPACT. The concentrations of COPCs in store foods used in the exposure assessment are consistent with other recent HHRAs conducted for uranium mine and mill projects in Saskatchewan (Appendix A, Section 2.4.1, Exposure Assumptions for Human Receptors). The equations used are provided in Appendix A, Section 2.4.3, Radiological Dose and Section 2.4.4, Non-radiological Dose for radiological and non-radiological doses, respectively.

Assessment of radiation exposures to members of the public is commonly based on estimation of the incremental effects of the project or site. Assessments consider the radiation dose received from direct exposure to radiation as well as the dose received from ingestion of radionuclides. The radionuclide intake by human receptors from various pathways is converted into a dose that is presented in millisieverts per year (mSv/yr).

Assessment of non-radiological exposures to members of the public is commonly based on estimation of the total effects of the project or site. Assessments consider the dose received from ingestion of constituents of concern as well as dermal absorption due to contact with soil. This is presented as a dose in milligrams per kilogram per day (mg/kg/d) for each pathway.

Section 5.2.4, Exposure Point Concentration and Doses, presents the estimated non-radiological dose and radiological dose to human receptors due to releases from the Project during all phases of the Project, including the far-future projection once groundwater solutes have been released to Patterson Lake. The results are presented for both the Application Case as well as the reasonable upper bound sensitivity scenario (Section 5.2.4.1, Estimated Dose to Human Receptors – Application Case) and the RFD Case (Section 5.2.4.2, Estimated Dose to Human Receptors – Reasonably Foreseeable Development Case). The estimated non-radiological and radiological concentrations in environmental media and biota tissue concentrations relevant to human ingestion pathways are shown in Appendix C, Model Results in Support of the Environmental Risk Assessment.

5.2.4.1 Estimated Dose to Human Receptors – Application Case

This subsection presents the estimated doses to human receptors due to releases from the Project during all phases including the far-future projection once groundwater solutes have been released to Patterson Lake. The results are presented for both the Application Case as well as the Upper Bound sensitivity scenario. Doses are presented for non-carcinogens (cobalt, copper, molybdenum, uranium), carcinogens (arsenic), and radionuclides (uranium-238 decay series radionuclides). The doses represent the maximum dose over the Project lifespan for the COPCs of interest, which is a conservative representation as exposure varies over the different Project phases. As indicated in Section 5.1.2, Constituents of Potential Concern Retained for Further Evaluation in the Human Health Risk Assessment, chloride and sulphate were not considered COPCs for the HHRA since their predicted maximum concentrations at the edge of the mixing zone would not be considered to present a risk to human health.

5.2.4.1.1 Non-carcinogen Doses

The doses for cobalt, copper, molybdenum, and uranium to the camp worker, subsistence harvester, and seasonal resident, and future permanent resident are presented by exposure pathway for the Application Case and the reasonable upper bound sensitivity scenario during Operations and the far-future projection in Table 5-7.

Table 5-7: Estimated Non-carcinogen Doses to Human Receptors – Operations – Application Case and Upper Bound Scenario

		Dose by Pathway Project Lifespan (mg/kg/d)								Dose by Pathway Far Future (mg/kg/d)							
	COPC	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^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	1.15×10^{-05}	7.21×10^{-06}	1.97×10^{-04}	2.25×10^{-04}	n/a-	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	3.81×10^{-04}	1.15×10^{-04}	1.66×10^{-02}	1.71×10^{-02}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Molybdenum	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	3.39×10^{-08}	4.10×10^{-06}	2.30×10^{-03}	2.31×10^{-03}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Uranium	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	2.06×10^{-06}	1.15×10^{-05}	4.37×10^{-05}	5.88×10^{-05}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Application Case																
	Cobalt	8.63×10^{-06}	9.07×10^{-09}	1.02×10^{-08}	$0.00 \times 10^{+00}$	1.25×10^{-05}	7.29×10^{-06}	2.01×10^{-04}	2.29×10^{-04}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Copper	1.24×10^{-05}	1.28×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	3.99×10^{-04}	1.15×10^{-04}	1.66×10^{-02}	1.72×10^{-02}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Molybdenum	3.04×10^{-06}	3.03×10^{-09}	4.55×10^{-09}	$0.00 \times 10^{+00}$	5.00×10^{-08}	4.25×10^{-06}	2.31×10^{-03}	2.31×10^{-03}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Uranium	1.48×10^{-06}	1.66×10^{-08}	1.35×10^{-08}	$0.00 \times 10^{+00}$	2.83×10^{-06}	2.44×10^{-05}	5.21×10^{-05}	8.08×10^{-05}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Upper Bound Scenario																
	Cobalt	8.63×10^{-06}	9.07×10^{-09}	1.02×10^{-08}	$0.00 \times 10^{+00}$	1.25×10^{-05}	7.29×10^{-06}	2.01×10^{-04}	2.29×10^{-04}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Copper	1.24×10^{-05}	1.28×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	3.99×10^{-04}	1.15×10^{-04}	1.66×10^{-02}	1.72×10^{-02}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Molybdenum	3.04×10^{-06}	3.03×10^{-09}	4.55×10^{-09}	$0.00 \times 10^{+00}$	8.31×10^{-08}	4.25×10^{-06}	2.31×10^{-03}	2.32×10^{-03}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Uranium	1.48×10^{-06}	1.66×10^{-08}	1.35×10^{-08}	$0.00 \times 10^{+00}$	4.18×10^{-06}	2.44×10^{-05}	5.24×10^{-05}	8.25×10^{-05}	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Subsistence Harvester Adult (Patterson Lake South Arm)	Base Case																
	Cobalt	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	2.30×10^{-05}	1.44×10^{-05}	2.44×10^{-04}	2.90×10^{-04}	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	2.30×10^{-05}	1.44×10^{-05}	2.44×10^{-04}	2.90×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	7.61×10^{-04}	2.29×10^{-04}	1.75×10^{-02}	1.86×10^{-02}	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	7.61×10^{-04}	2.29×10^{-04}	1.75×10^{-02}	1.86×10^{-02}
	Molybdenum	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	6.77×10^{-08}	8.18×10^{-06}	1.95×10^{-03}	1.96×10^{-03}	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	6.77×10^{-08}	8.18×10^{-06}	1.95×10^{-03}	1.96×10^{-03}
	Uranium	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	4.11×10^{-06}	2.30×10^{-05}	4.92×10^{-05}	7.78×10^{-05}	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	4.11×10^{-06}	2.30×10^{-05}	4.92×10^{-05}	7.78×10^{-05}
	Application Case																
	Cobalt	9.32×10^{-06}	9.05×10^{-09}	1.09×10^{-08}	$0.00 \times 10^{+00}$	2.49×10^{-05}	1.46×10^{-05}	2.51×10^{-04}	3.00×10^{-04}	1.23×10^{-05}	9.05×10^{-09}	1.46×10^{-08}	$0.00 \times 10^{+00}$	3.30×10^{-05}	1.44×10^{-05}	2.73×10^{-04}	3.33×10^{-04}
	Copper	1.30×10^{-05}	1.26×10^{-08}	1.83×10^{-08}	$0.00 \times 10^{+00}$	7.97×10^{-04}	2.30×10^{-04}	1.77×10^{-02}	1.87×10^{-02}	1.82×10^{-05}	1.26×10^{-08}	2.57×10^{-08}	$0.00 \times 10^{+00}$	1.12×10^{-03}	2.29×10^{-04}	1.79×10^{-02}	1.92×10^{-02}
	Molybdenum	4.51×10^{-06}	2.99×10^{-09}	6.50×10^{-09}	$0.00 \times 10^{+00}$	9.99×10^{-08}	8.49×10^{-06}	1.96×10^{-03}	1.97×10^{-03}	2.18×10^{-05}	2.98×10^{-09}	3.26×10^{-08}	$0.00 \times 10^{+00}$	4.86×10^{-07}	8.18×10^{-06}	1.97×10^{-03}	2.01×10^{-03}
	Uranium	2.04×10^{-06}	6.74×10^{-09}	1.75×10^{-08}	$0.00 \times 10^{+00}$	5.65×10^{-06}	4.87×10^{-05}	6.59×10^{-05}	1.22×10^{-04}	3.31×10^{-06}	5.34×10^{-09}	3.02×10^{-08}	$0.00 \times 10^{+00}$	9.23×10^{-06}	2.38×10^{-05}	5.17×10^{-05}	8.81×10^{-05}
	Upper Bound Scenario																
	Cobalt	9.35×10^{-06}	9.05×10^{-09}	1.10×10^{-08}	$0.00 \times 10^{+00}$	2.50×10^{-05}	1.46×10^{-05}	2.51×10^{-04}	3.00×10^{-04}	1.44×10^{-05}	9.05×10^{-09}	1.70×10^{-08}	$0.00 \times 10^{+00}$	3.84×10^{-05}	1.44×10^{-05}	2.89×10^{-04}	3.56×10^{-04}
	Copper	1.30×10^{-05}	1.26×10^{-08}	1.83×10^{-08}	$0.00 \times 10^{+00}$	7.98×10^{-04}	2.30×10^{-04}	1.77×10^{-02}	1.87×10^{-02}	2.11×10^{-05}	1.26×10^{-08}	2.99×10^{-08}	$0.00 \times 10^{+00}$	1.29×10^{-03}	2.29×10^{-04}	1.80×10^{-02}	1.96×10^{-02}
	Molybdenum	7.51×10^{-06}	2.99×10^{-09}	1.06×10^{-08}	$0.00 \times 10^{+00}$	1.66×10^{-07}	8.49×10^{-06}	1.96×10^{-03}	1.98×10^{-03}	7.51×10^{-05}	2.98×10^{-09}	1.12×10^{-07}	$0.00 \times 10^{+00}$	1.68×10^{-06}	8.18×10^{-06}	2.04×10^{-03}	2.12×10^{-03}
	Uranium	3.01×10^{-06}	6.74×10^{-09}	2.48×10^{-08}	$0.00 \times 10^{+00}$	8.34×10^{-06}	4.87×10^{-05}	6.66×10^{-05}	1.27×10^{-04}	3.32×10^{-06}	5.34×10^{-09}	3.02×10^{-08}	$0.00 \times 10^{+00}$	9.24×10^{-06}	2.38×10^{-05}	5.17×10^{-05}	8.81×10^{-05}
Subsistence Harvester One-Year-Old (Patterson Lake South Arm)	Base Case																
	Cobalt	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	2.18×10^{-05}	2.84×10^{-05}	4.78×10^{-04}	5.39×10^{-04}	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	2.18×10^{-05}	2.84×10^{-05}	4.78×10^{-04}	5.39×10^{-04}
	Copper	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	7.21×10^{-04}	4.52×10^{-04}	4.13×10^{-02}	4.25×10^{-02}	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	7.21×10^{-04}	4.52×10^{-04}	4.13×10^{-02}	4.25×10^{-02}
	Molybdenum	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	6.42×10^{-08}	1.61×10^{-05}	6.06×10^{-03}	6.08×10^{-03}	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	6.42×10^{-08}	1.61×10^{-05}	6.06×10^{-03}	6.08×10^{-03}
	Uranium	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	3.90×10^{-06}	4.54×10^{-05}	1.02×10^{-04}	1.54×10^{-04}	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	3.90×10^{-06}	4.54×10^{-05}	1.02×10^{-04}	1.54×10^{-04}
	Application Case																
	Cobalt	1.04×10^{-05}	5.91×10^{-07}	7.14×10^{-07}	$0.00 \times 10^{+00}$	2.36×10^{-05}	2.86×10^{-05}	4.85×10^{-04}	5.49×10^{-04}	1.38×10^{-05}	5.91×10^{-07}	9.54×10^{-07}	$0.00 \times 10^{+00}$	3.13×10^{-05}	2.84×10^{-05}	5.08×10^{-04}	5.83×10^{-04}
	Copper	1.45×10^{-05}	8.23×10^{-07}	1.20×10^{-06}	$0.00 \times 10^{+00}$	7.55×10^{-04}	4.54×10^{-04}	4.15×10^{-02}	4.27×10^{-02}	2.03×10^{-05}	8.21×10^{-07}	1.68×10^{-06}	$0.00 \times 10^{+00}$	1.06×10^{-03}	4.52×10^{-04}	4.16×10^{-02}	4.32×10^{-02}

		Dose by Pathway Project Lifespan (mg/kg/d)								Dose by Pathway Far Future (mg/kg/d)							
	COPC	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
	Molybdenum	5.04×10^{-06}	1.95×10^{-07}	4.25×10^{-07}	$0.00 \times 10^{+00}$	9.47×10^{-08}	1.66×10^{-05}	6.07×10^{-03}	6.09×10^{-03}	2.43×10^{-05}	1.95×10^{-07}	2.13×10^{-06}	$0.00 \times 10^{+00}$	4.61×10^{-07}	1.61×10^{-05}	6.08×10^{-03}	6.13×10^{-03}
	Uranium	2.27×10^{-06}	4.41×10^{-07}	1.14×10^{-06}	$0.00 \times 10^{+00}$	5.36×10^{-06}	8.40×10^{-05}	1.14×10^{-04}	2.08×10^{-04}	3.70×10^{-06}	3.49×10^{-07}	1.98×10^{-06}	$0.00 \times 10^{+00}$	8.75×10^{-06}	4.68×10^{-05}	1.04×10^{-04}	1.66×10^{-04}
	Upper Bound Scenario																
	Cobalt	1.04×10^{-05}	5.91×10^{-07}	7.16×10^{-07}	$0.00 \times 10^{+00}$	2.37×10^{-05}	2.86×10^{-05}	4.85×10^{-04}	5.49×10^{-04}	1.60×10^{-05}	5.91×10^{-07}	1.11×10^{-06}	$0.00 \times 10^{+00}$	3.64×10^{-05}	2.84×10^{-05}	5.25×10^{-04}	6.07×10^{-04}
	Copper	1.45×10^{-05}	8.23×10^{-07}	1.20×10^{-06}	$0.00 \times 10^{+00}$	7.56×10^{-04}	4.54×10^{-04}	4.15×10^{-02}	4.27×10^{-02}	2.35×10^{-05}	8.21×10^{-07}	1.95×10^{-06}	$0.00 \times 10^{+00}$	1.23×10^{-03}	4.52×10^{-04}	4.18×10^{-02}	4.35×10^{-02}
	Molybdenum	8.39×10^{-06}	1.95×10^{-07}	6.94×10^{-07}	$0.00 \times 10^{+00}$	1.57×10^{-07}	1.66×10^{-05}	6.07×10^{-03}	6.10×10^{-03}	8.39×10^{-05}	1.95×10^{-07}	7.35×10^{-06}	$0.00 \times 10^{+00}$	1.59×10^{-06}	1.61×10^{-05}	6.14×10^{-03}	6.25×10^{-03}
	Uranium	3.37×10^{-06}	4.41×10^{-07}	1.62×10^{-06}	$0.00 \times 10^{+00}$	7.91×10^{-06}	8.40×10^{-05}	1.15×10^{-04}	2.12×10^{-04}	3.70×10^{-06}	3.49×10^{-07}	1.98×10^{-06}	$0.00 \times 10^{+00}$	8.76×10^{-06}	4.68×10^{-05}	1.04×10^{-04}	1.66×10^{-04}
Subsistence Harvester Adult (Beet Lake)	**Base Case**																
	Cobalt	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	2.30×10^{-05}	1.44×10^{-05}	2.44×10^{-04}	2.90×10^{-04}	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	2.30×10^{-05}	1.44×10^{-05}	2.44×10^{-04}	2.90×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	7.61×10^{-04}	2.29×10^{-04}	1.75×10^{-02}	1.86×10^{-02}	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	7.61×10^{-04}	2.29×10^{-04}	1.75×10^{-02}	1.86×10^{-02}
	Molybdenum	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	6.77×10^{-08}	8.18×10^{-06}	1.95×10^{-03}	1.96×10^{-03}	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	6.77×10^{-08}	8.18×10^{-06}	1.95×10^{-03}	1.96×10^{-03}
	Uranium	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	4.11×10^{-06}	2.30×10^{-05}	4.92×10^{-05}	7.78×10^{-05}	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	4.11×10^{-06}	2.30×10^{-05}	4.92×10^{-05}	7.78×10^{-05}
	Application Case																
	Cobalt	8.97×10^{-06}	9.05×10^{-09}	1.06×10^{-08}	$0.00 \times 10^{+00}$	2.40×10^{-05}	1.46×10^{-05}	2.47×10^{-04}	2.94×10^{-04}	1.06×10^{-05}	9.05×10^{-09}	1.25×10^{-08}	$0.00 \times 10^{+00}$	2.83×10^{-05}	1.44×10^{-05}	2.54×10^{-04}	3.08×10^{-04}
	Copper	1.27×10^{-05}	1.26×10^{-08}	1.79×10^{-08}	$0.00 \times 10^{+00}$	7.79×10^{-04}	2.30×10^{-04}	1.76×10^{-02}	1.86×10^{-02}	1.54×10^{-05}	1.26×10^{-08}	2.18×10^{-08}	$0.00 \times 10^{+00}$	9.46×10^{-04}	2.29×10^{-04}	1.77×10^{-02}	1.89×10^{-02}
	Molybdenum	3.79×10^{-06}	2.98×10^{-09}	5.55×10^{-09}	$0.00 \times 10^{+00}$	8.42×10^{-08}	8.34×10^{-06}	1.95×10^{-03}	1.97×10^{-03}	1.28×10^{-05}	2.98×10^{-09}	1.92×10^{-08}	$0.00 \times 10^{+00}$	2.86×10^{-07}	8.18×10^{-06}	1.96×10^{-03}	1.98×10^{-03}
	Uranium	1.68×10^{-06}	6.10×10^{-09}	1.49×10^{-08}	$0.00 \times 10^{+00}$	4.68×10^{-06}	3.82×10^{-05}	5.55×10^{-05}	1.00×10^{-04}	2.16×10^{-06}	5.27×10^{-09}	1.97×10^{-08}	$0.00 \times 10^{+00}$	6.01×10^{-06}	2.35×10^{-05}	5.01×10^{-05}	8.17×10^{-05}
	Upper Bound Scenario																
	Cobalt	8.98×10^{-06}	9.05×10^{-09}	1.06×10^{-08}	$0.00 \times 10^{+00}$	2.40×10^{-05}	1.46×10^{-05}	2.47×10^{-04}	2.94×10^{-04}	1.16×10^{-05}	9.05×10^{-09}	1.38×10^{-08}	$0.00 \times 10^{+00}$	3.11×10^{-05}	1.44×10^{-05}	2.60×10^{-04}	3.17×10^{-04}
	Copper	1.27×10^{-05}	1.26×10^{-08}	1.79×10^{-08}	$0.00 \times 10^{+00}$	7.80×10^{-04}	2.30×10^{-04}	1.76×10^{-02}	1.86×10^{-02}	1.69×10^{-05}	1.26×10^{-08}	2.40×10^{-08}	$0.00 \times 10^{+00}$	1.04×10^{-03}	2.29×10^{-04}	1.77×10^{-02}	1.90×10^{-02}
	Molybdenum	5.35×10^{-06}	2.98×10^{-09}	7.66×10^{-09}	$0.00 \times 10^{+00}$	1.18×10^{-07}	8.34×10^{-06}	1.96×10^{-03}	1.97×10^{-03}	4.06×10^{-05}	2.98×10^{-09}	6.07×10^{-08}	$0.00 \times 10^{+00}$	9.05×10^{-07}	8.18×10^{-06}	1.98×10^{-03}	2.03×10^{-03}
	Uranium	2.04×10^{-06}	6.10×10^{-09}	1.76×10^{-08}	$0.00 \times 10^{+00}$	5.67×10^{-06}	3.82×10^{-05}	5.57×10^{-05}	1.02×10^{-04}	2.16×10^{-06}	5.27×10^{-09}	1.97×10^{-08}	$0.00 \times 10^{+00}$	6.02×10^{-06}	2.35×10^{-05}	5.01×10^{-05}	8.17×10^{-05}
Subsistence Harvester One-Year-Old (Beet Lake)	**Base Case**																
	Cobalt	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	2.18×10^{-05}	2.84×10^{-05}	4.78×10^{-04}	5.39×10^{-04}	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	2.18×10^{-05}	2.84×10^{-05}	4.78×10^{-04}	5.39×10^{-04}
	Copper	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	7.21×10^{-04}	4.52×10^{-04}	4.13×10^{-02}	4.25×10^{-02}	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	7.21×10^{-04}	4.52×10^{-04}	4.13×10^{-02}	4.25×10^{-02}
	Molybdenum	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	6.42×10^{-08}	1.61×10^{-05}	6.06×10^{-03}	6.08×10^{-03}	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	6.42×10^{-08}	1.61×10^{-05}	6.06×10^{-03}	6.08×10^{-03}
	Uranium	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	3.90×10^{-06}	4.54×10^{-05}	1.02×10^{-04}	1.54×10^{-04}	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	3.90×10^{-06}	4.54×10^{-05}	1.02×10^{-04}	1.54×10^{-04}
	Application Case																
	Cobalt	1.00×10^{-05}	5.91×10^{-07}	6.89×10^{-07}	$0.00 \times 10^{+00}$	2.27×10^{-05}	2.86×10^{-05}	4.80×10^{-04}	5.43×10^{-04}	1.18×10^{-05}	5.91×10^{-07}	8.17×10^{-07}	$0.00 \times 10^{+00}$	2.68×10^{-05}	2.84×10^{-05}	4.89×10^{-04}	5.57×10^{-04}
	Copper	1.42×10^{-05}	8.23×10^{-07}	1.17×10^{-06}	$0.00 \times 10^{+00}$	7.39×10^{-04}	4.53×10^{-04}	4.14×10^{-02}	4.26×10^{-02}	1.72×10^{-05}	8.21×10^{-07}	1.43×10^{-06}	$0.00 \times 10^{+00}$	8.97×10^{-04}	4.52×10^{-04}	4.14×10^{-02}	4.28×10^{-02}
	Molybdenum	4.23×10^{-06}	1.95×10^{-07}	3.62×10^{-07}	$0.00 \times 10^{+00}$	7.98×10^{-08}	1.63×10^{-05}	6.06×10^{-03}	6.08×10^{-03}	1.43×10^{-05}	1.95×10^{-07}	1.25×10^{-06}	$0.00 \times 10^{+00}$	2.71×10^{-07}	1.61×10^{-05}	6.07×10^{-03}	6.10×10^{-03}
	Uranium	1.88×10^{-06}	3.98×10^{-07}	9.77×10^{-07}	$0.00 \times 10^{+00}$	4.43×10^{-06}	6.82×10^{-05}	1.07×10^{-04}	1.83×10^{-04}	2.41×10^{-06}	3.44×10^{-07}	1.29×10^{-06}	$0.00 \times 10^{+00}$	5.70×10^{-06}	4.63×10^{-05}	1.03×10^{-04}	1.59×10^{-04}
	Upper Bound Scenario																
	Cobalt	1.00×10^{-05}	5.91×10^{-07}	6.91×10^{-07}	$0.00 \times 10^{+00}$	2.28×10^{-05}	2.86×10^{-05}	4.81×10^{-04}	5.43×10^{-04}	1.30×10^{-05}	5.91×10^{-07}	8.99×10^{-07}	$0.00 \times 10^{+00}$	2.95×10^{-05}	2.84×10^{-05}	4.94×10^{-04}	5.66×10^{-04}
	Copper	1.42×10^{-05}	8.23×10^{-07}	1.17×10^{-06}	$0.00 \times 10^{+00}$	7.39×10^{-04}	4.53×10^{-04}	4.14×10^{-02}	4.26×10^{-02}	1.89×10^{-05}	8.21×10^{-07}	1.57×10^{-06}	$0.00 \times 10^{+00}$	9.85×10^{-04}	4.52×10^{-04}	4.15×10^{-02}	4.30×10^{-02}
	Molybdenum	5.97×10^{-06}	1.95×10^{-07}	5.01×10^{-07}	$0.00 \times 10^{+00}$	1.12×10^{-07}	1.63×10^{-05}	6.06×10^{-03}	6.09×10^{-03}	4.53×10^{-05}	1.95×10^{-07}	3.97×10^{-06}	$0.00 \times 10^{+00}$	8.58×10^{-07}	1.61×10^{-05}	6.09×10^{-03}	6.16×10^{-03}
	Uranium	2.28×10^{-06}	3.98×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	5.37×10^{-06}	6.82×10^{-05}	1.07×10^{-04}	1.84×10^{-04}	2.41×10^{-06}	3.44×10^{-07}	1.29×10^{-06}	$0.00 \times 10^{+00}$	5.70×10^{-06}	4.63×10^{-05}	1.03×10^{-04}	1.59×10^{-04}

		Dose by Pathway Project Lifespan (mg/kg/d)								Dose by Pathway Far Future (mg/kg/d)							
	COPC	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 Adult (Lloyd Lake)	**Base Case**																
	Cobalt	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	2.30×10^{-05}	1.44×10^{-05}	2.44×10^{-04}	2.90×10^{-04}	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	2.30×10^{-05}	1.44×10^{-05}	2.44×10^{-04}	2.90×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	7.61×10^{-04}	2.29×10^{-04}	1.75×10^{-02}	1.86×10^{-02}	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	7.61×10^{-04}	2.29×10^{-04}	1.75×10^{-02}	1.86×10^{-02}
	Molybdenum	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	6.77×10^{-08}	8.18×10^{-06}	1.95×10^{-03}	1.96×10^{-03}	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	6.77×10^{-08}	8.18×10^{-06}	1.95×10^{-03}	1.96×10^{-03}
	Uranium	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	4.11×10^{-06}	2.30×10^{-05}	4.92×10^{-05}	7.78×10^{-05}	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	4.11×10^{-06}	2.30×10^{-05}	4.92×10^{-05}	7.78×10^{-05}
	Application Case																
	Cobalt	8.62×10^{-06}	9.05×10^{-09}	1.02×10^{-08}	$0.00 \times 10^{+00}$	2.31×10^{-05}	1.46×10^{-05}	2.45×10^{-04}	2.91×10^{-04}	8.78×10^{-06}	9.05×10^{-09}	1.04×10^{-08}	$0.00 \times 10^{+00}$	2.35×10^{-05}	1.44×10^{-05}	2.45×10^{-04}	2.92×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	7.63×10^{-04}	2.30×10^{-04}	1.76×10^{-02}	1.86×10^{-02}	1.27×10^{-05}	1.26×10^{-08}	1.80×10^{-08}	$0.00 \times 10^{+00}$	7.80×10^{-04}	2.29×10^{-04}	1.76×10^{-02}	1.86×10^{-02}
	Molybdenum	3.11×10^{-06}	2.98×10^{-09}	4.65×10^{-09}	$0.00 \times 10^{+00}$	6.94×10^{-08}	8.34×10^{-06}	1.95×10^{-03}	1.97×10^{-03}	4.03×10^{-06}	2.98×10^{-09}	6.03×10^{-09}	$0.00 \times 10^{+00}$	8.99×10^{-08}	8.18×10^{-06}	1.95×10^{-03}	1.97×10^{-03}
	Uranium	1.49×10^{-06}	5.21×10^{-09}	1.36×10^{-08}	$0.00 \times 10^{+00}$	4.16×10^{-06}	2.36×10^{-05}	4.94×10^{-05}	7.87×10^{-05}	1.54×10^{-06}	5.18×10^{-09}	1.40×10^{-08}	$0.00 \times 10^{+00}$	4.28×10^{-06}	2.30×10^{-05}	4.92×10^{-05}	7.81×10^{-05}
	Upper Bound Scenario																
	Cobalt	8.62×10^{-06}	9.05×10^{-09}	1.02×10^{-08}	$0.00 \times 10^{+00}$	2.31×10^{-05}	1.46×10^{-05}	2.45×10^{-04}	2.91×10^{-04}	8.89×10^{-06}	9.05×10^{-09}	1.05×10^{-08}	$0.00 \times 10^{+00}$	2.38×10^{-05}	1.44×10^{-05}	2.46×10^{-04}	2.93×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	7.63×10^{-04}	2.30×10^{-04}	1.76×10^{-02}	1.86×10^{-02}	1.29×10^{-05}	1.26×10^{-08}	1.82×10^{-08}	$0.00 \times 10^{+00}$	7.89×10^{-04}	2.29×10^{-04}	1.76×10^{-02}	1.86×10^{-02}
	Molybdenum	3.27×10^{-06}	2.98×10^{-09}	4.86×10^{-09}	$0.00 \times 10^{+00}$	7.29×10^{-08}	8.34×10^{-06}	1.95×10^{-03}	1.97×10^{-03}	6.86×10^{-06}	2.98×10^{-09}	1.03×10^{-08}	$0.00 \times 10^{+00}$	1.53×10^{-07}	8.18×10^{-06}	1.96×10^{-03}	1.97×10^{-03}
	Uranium	1.53×10^{-06}	5.21×10^{-09}	1.38×10^{-08}	$0.00 \times 10^{+00}$	4.25×10^{-06}	2.36×10^{-05}	4.95×10^{-05}	7.89×10^{-05}	1.54×10^{-06}	5.18×10^{-09}	1.40×10^{-08}	$0.00 \times 10^{+00}$	4.28×10^{-06}	2.30×10^{-05}	4.92×10^{-05}	7.81×10^{-05}
Subsistence Harvester One-Year-Old (Lloyd Lake)	**Base Case**																
	Cobalt	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	2.18×10^{-05}	2.84×10^{-05}	4.78×10^{-04}	5.39×10^{-04}	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	2.18×10^{-05}	2.84×10^{-05}	4.78×10^{-04}	5.39×10^{-04}
	Copper	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	7.21×10^{-04}	4.52×10^{-04}	4.13×10^{-02}	4.25×10^{-02}	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	7.21×10^{-04}	4.52×10^{-04}	4.13×10^{-02}	4.25×10^{-02}
	Molybdenum	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	6.42×10^{-08}	1.61×10^{-05}	6.06×10^{-03}	6.08×10^{-03}	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	6.42×10^{-08}	1.61×10^{-05}	6.06×10^{-03}	6.08×10^{-03}
	Uranium	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	3.90×10^{-06}	4.54×10^{-05}	1.02×10^{-04}	1.54×10^{-04}	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	3.90×10^{-06}	4.54×10^{-05}	1.02×10^{-04}	1.54×10^{-04}
	Application Case																
	Cobalt	9.62×10^{-06}	5.91×10^{-07}	6.65×10^{-07}	$0.00 \times 10^{+00}$	2.19×10^{-05}	2.86×10^{-05}	4.79×10^{-04}	5.40×10^{-04}	9.80×10^{-06}	5.91×10^{-07}	6.78×10^{-07}	$0.00 \times 10^{+00}$	2.23×10^{-05}	2.84×10^{-05}	4.79×10^{-04}	5.41×10^{-04}
	Copper	1.39×10^{-05}	8.22×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	7.23×10^{-04}	4.53×10^{-04}	4.13×10^{-02}	4.25×10^{-02}	1.42×10^{-05}	8.21×10^{-07}	1.18×10^{-06}	$0.00 \times 10^{+00}$	7.39×10^{-04}	4.52×10^{-04}	4.13×10^{-02}	4.25×10^{-02}
	Molybdenum	3.48×10^{-06}	1.95×10^{-07}	3.04×10^{-07}	$0.00 \times 10^{+00}$	6.58×10^{-08}	1.63×10^{-05}	6.06×10^{-03}	6.08×10^{-03}	4.50×10^{-06}	1.95×10^{-07}	3.94×10^{-07}	$0.00 \times 10^{+00}$	8.52×10^{-08}	1.61×10^{-05}	6.06×10^{-03}	6.08×10^{-03}
	Uranium	1.67×10^{-06}	3.40×10^{-07}	8.88×10^{-07}	$0.00 \times 10^{+00}$	3.95×10^{-06}	4.63×10^{-05}	1.02×10^{-04}	1.55×10^{-04}	1.72×10^{-06}	3.38×10^{-07}	9.16×10^{-07}	$0.00 \times 10^{+00}$	4.06×10^{-06}	4.54×10^{-05}	1.02×10^{-04}	1.55×10^{-04}
	Upper Bound Scenario																
	Cobalt	9.62×10^{-06}	5.91×10^{-07}	6.65×10^{-07}	$0.00 \times 10^{+00}$	2.19×10^{-05}	2.86×10^{-05}	4.79×10^{-04}	5.40×10^{-04}	9.93×10^{-06}	5.91×10^{-07}	6.87×10^{-07}	$0.00 \times 10^{+00}$	2.26×10^{-05}	2.84×10^{-05}	4.80×10^{-04}	5.42×10^{-04}
	Copper	1.39×10^{-05}	8.22×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	7.23×10^{-04}	4.53×10^{-04}	4.13×10^{-02}	4.25×10^{-02}	1.44×10^{-05}	8.21×10^{-07}	1.19×10^{-06}	$0.00 \times 10^{+00}$	7.48×10^{-04}	4.52×10^{-04}	4.13×10^{-02}	4.26×10^{-02}
	Molybdenum	3.66×10^{-06}	1.95×10^{-07}	3.18×10^{-07}	$0.00 \times 10^{+00}$	6.91×10^{-08}	1.63×10^{-05}	6.06×10^{-03}	6.08×10^{-03}	7.66×10^{-06}	1.95×10^{-07}	6.71×10^{-07}	$0.00 \times 10^{+00}$	1.45×10^{-07}	1.61×10^{-05}	6.06×10^{-03}	6.09×10^{-03}
	Uranium	1.71×10^{-06}	3.40×10^{-07}	9.04×10^{-07}	$0.00 \times 10^{+00}$	4.03×10^{-06}	4.63×10^{-05}	1.02×10^{-04}	1.56×10^{-04}	1.72×10^{-06}	3.38×10^{-07}	9.16×10^{-07}	$0.00 \times 10^{+00}$	4.06×10^{-06}	4.54×10^{-05}	1.02×10^{-04}	1.55×10^{-04}
Seasonal Resident Adult (Patterson Lake South Arm)	**Base Case**																
	Cobalt	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	7.27×10^{-06}	1.13×10^{-05}	1.88×10^{-04}	2.15×10^{-04}	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	7.27×10^{-06}	1.13×10^{-05}	1.88×10^{-04}	2.15×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	2.41×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.69×10^{-02}	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	2.41×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.69×10^{-02}
	Molybdenum	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	2.14×10^{-08}	6.42×10^{-06}	2.41×10^{-03}	2.42×10^{-03}	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	2.14×10^{-08}	6.42×10^{-06}	2.41×10^{-03}	2.42×10^{-03}
	Uranium	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	1.30×10^{-06}	1.81×10^{-05}	4.08×10^{-05}	6.16×10^{-05}	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	1.30×10^{-06}	1.81×10^{-05}	4.08×10^{-05}	6.16×10^{-05}
	Application Case																
	Cobalt	9.02×10^{-06}	9.05×10^{-09}	1.06×10^{-08}	$0.00 \times 10^{+00}$	7.65×10^{-06}	1.13×10^{-05}	1.89×10^{-04}	2.17×10^{-04}	1.08×10^{-05}	9.04×10^{-09}	1.28×10^{-08}	$0.00 \times 10^{+00}$	9.19×10^{-06}	1.13×10^{-05}	1.95×10^{-04}	2.26×10^{-04}
	Copper	1.27×10^{-05}	1.26×10^{-08}	1.80×10^{-08}	$0.00 \times 10^{+00}$	2.48×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.69×10^{-02}	1.59×10^{-05}	1.26×10^{-08}	2.25×10^{-08}	$0.00 \times 10^{+00}$	3.08×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.70×10^{-02}
	Molybdenum	3.92×10^{-06}	2.98×10^{-09}	5.72×10^{-09}	$0.00 \times 10^{+00}$	2.76×10^{-08}	6.50×10^{-06}	2.41×10^{-03}	2.42×10^{-03}	1.43×10^{-05}	2.98×10^{-09}	2.14×10^{-08}	$0.00 \times 10^{+00}$	1.01×10^{-07}	6.42×10^{-06}	2.41×10^{-03}	2.43×10^{-03}

		Dose by Pathway Project Lifespan (mg/kg/d)								Dose by Pathway Far Future (mg/kg/d)							
	COPC	**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**
	Uranium	1.81×10^{-06}	6.11×10^{-09}	1.59×10^{-08}	$0.00 \times 10^{+00}$	1.59×10^{-06}	2.61×10^{-05}	4.39×10^{-05}	7.34×10^{-05}	2.58×10^{-06}	5.27×10^{-09}	2.35×10^{-08}	$0.00 \times 10^{+00}$	2.28×10^{-06}	1.84×10^{-05}	4.14×10^{-05}	6.47×10^{-05}
	Upper Bound Scenario																
	Cobalt	9.04×10^{-06}	9.05×10^{-09}	1.06×10^{-08}	$0.00 \times 10^{+00}$	7.66×10^{-06}	1.13×10^{-05}	1.89×10^{-04}	2.18×10^{-04}	1.20×10^{-05}	9.04×10^{-09}	1.42×10^{-08}	$0.00 \times 10^{+00}$	1.02×10^{-05}	1.13×10^{-05}	1.99×10^{-04}	2.32×10^{-04}
	Copper	1.28×10^{-05}	1.26×10^{-08}	1.80×10^{-08}	$0.00 \times 10^{+00}$	2.48×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.69×10^{-02}	1.76×10^{-05}	1.26×10^{-08}	2.49×10^{-08}	$0.00 \times 10^{+00}$	3.42×10^{-04}	1.80×10^{-04}	1.66×10^{-02}	1.71×10^{-02}
	Molybdenum	5.72×10^{-06}	2.98×10^{-09}	8.19×10^{-09}	$0.00 \times 10^{+00}$	4.01×10^{-08}	6.50×10^{-06}	2.41×10^{-03}	2.42×10^{-03}	4.63×10^{-05}	2.98×10^{-09}	6.93×10^{-08}	$0.00 \times 10^{+00}$	3.27×10^{-07}	6.42×10^{-06}	2.43×10^{-03}	2.48×10^{-03}
	Uranium	2.40×10^{-06}	6.11×10^{-09}	2.03×10^{-08}	$0.00 \times 10^{+00}$	2.11×10^{-06}	2.61×10^{-05}	4.41×10^{-05}	7.47×10^{-05}	2.58×10^{-06}	5.27×10^{-09}	2.35×10^{-08}	$0.00 \times 10^{+00}$	2.28×10^{-06}	1.84×10^{-05}	4.14×10^{-05}	6.47×10^{-05}
Seasonal Resident One-Year-Old (Patterson Lake South Arm)	**Base Case**																
	Cobalt	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	6.89×10^{-06}	2.47×10^{-05}	4.13×10^{-04}	4.55×10^{-04}	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	6.89×10^{-06}	2.47×10^{-05}	4.13×10^{-04}	4.56×10^{-04}
	Copper	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	2.29×10^{-04}	3.93×10^{-04}	3.97×10^{-02}	4.03×10^{-02}	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	2.29×10^{-04}	3.93×10^{-04}	3.97×10^{-02}	4.03×10^{-02}
	Molybdenum	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	2.03×10^{-08}	1.40×10^{-05}	6.38×10^{-03}	6.40×10^{-03}	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	2.03×10^{-08}	1.40×10^{-05}	6.38×10^{-03}	6.40×10^{-03}
	Uranium	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	1.23×10^{-06}	3.95×10^{-05}	9.62×10^{-05}	1.40×10^{-04}	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	1.23×10^{-06}	3.95×10^{-05}	9.62×10^{-05}	1.40×10^{-04}
	Application Case																
	Cobalt	1.01×10^{-05}	5.91×10^{-07}	6.94×10^{-07}	$0.00 \times 10^{+00}$	7.25×10^{-06}	2.48×10^{-05}	4.15×10^{-04}	4.59×10^{-04}	1.21×10^{-05}	5.91×10^{-07}	8.37×10^{-07}	$0.00 \times 10^{+00}$	8.71×10^{-06}	2.47×10^{-05}	4.21×10^{-04}	4.68×10^{-04}
	Copper	1.42×10^{-05}	8.23×10^{-07}	1.18×10^{-06}	$0.00 \times 10^{+00}$	2.35×10^{-04}	3.94×10^{-04}	3.97×10^{-02}	4.04×10^{-02}	1.77×10^{-05}	8.21×10^{-07}	1.47×10^{-06}	$0.00 \times 10^{+00}$	2.92×10^{-04}	3.93×10^{-04}	3.98×10^{-02}	4.05×10^{-02}
	Molybdenum	4.38×10^{-06}	1.95×10^{-07}	3.74×10^{-07}	$0.00 \times 10^{+00}$	2.61×10^{-08}	1.42×10^{-05}	6.38×10^{-03}	6.40×10^{-03}	1.60×10^{-05}	1.95×10^{-07}	1.40×10^{-06}	$0.00 \times 10^{+00}$	9.58×10^{-08}	1.40×10^{-05}	6.38×10^{-03}	6.41×10^{-03}
	Uranium	2.02×10^{-06}	4.00×10^{-07}	1.04×10^{-06}	$0.00 \times 10^{+00}$	1.51×10^{-06}	5.38×10^{-05}	9.85×10^{-05}	1.57×10^{-04}	2.88×10^{-06}	3.45×10^{-07}	1.54×10^{-06}	$0.00 \times 10^{+00}$	2.16×10^{-06}	4.02×10^{-05}	9.67×10^{-05}	1.44×10^{-04}
	Upper Bound Scenario																
	Cobalt	1.01×10^{-05}	5.91×10^{-07}	6.95×10^{-07}	$0.00 \times 10^{+00}$	7.26×10^{-06}	2.48×10^{-05}	4.15×10^{-04}	4.59×10^{-04}	1.34×10^{-05}	5.91×10^{-07}	9.30×10^{-07}	$0.00 \times 10^{+00}$	9.68×10^{-06}	2.47×10^{-05}	4.25×10^{-04}	4.74×10^{-04}
	Copper	1.42×10^{-05}	8.23×10^{-07}	1.18×10^{-06}	$0.00 \times 10^{+00}$	2.35×10^{-04}	3.94×10^{-04}	3.97×10^{-02}	4.04×10^{-02}	1.97×10^{-05}	8.21×10^{-07}	1.63×10^{-06}	$0.00 \times 10^{+00}$	3.25×10^{-04}	3.93×10^{-04}	3.98×10^{-02}	4.05×10^{-02}
	Molybdenum	6.39×10^{-06}	1.95×10^{-07}	5.35×10^{-07}	$0.00 \times 10^{+00}$	3.80×10^{-08}	1.42×10^{-05}	6.38×10^{-03}	6.40×10^{-03}	5.17×10^{-05}	1.95×10^{-07}	4.53×10^{-06}	$0.00 \times 10^{+00}$	3.10×10^{-07}	1.40×10^{-05}	6.40×10^{-03}	6.47×10^{-03}
	Uranium	2.68×10^{-06}	4.00×10^{-07}	1.33×10^{-06}	$0.00 \times 10^{+00}$	2.00×10^{-06}	5.38×10^{-05}	9.87×10^{-05}	1.59×10^{-04}	2.88×10^{-06}	3.45×10^{-07}	1.54×10^{-06}	$0.00 \times 10^{+00}$	2.16×10^{-06}	4.02×10^{-05}	9.67×10^{-05}	1.44×10^{-04}
Seasonal Resident Adult (Lloyd Lake)	**Base Case**																
	Cobalt	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	7.27×10^{-06}	1.13×10^{-05}	1.88×10^{-04}	2.15×10^{-04}	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	7.27×10^{-06}	1.13×10^{-05}	1.88×10^{-04}	2.15×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	2.41×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.69×10^{-02}	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	2.41×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.69×10^{-02}
	Molybdenum	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	2.14×10^{-08}	6.42×10^{-06}	2.41×10^{-03}	2.42×10^{-03}	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	2.14×10^{-08}	6.42×10^{-06}	2.41×10^{-03}	2.42×10^{-03}
	Uranium	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	1.30×10^{-06}	1.81×10^{-05}	4.08×10^{-05}	6.16×10^{-05}	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	1.30×10^{-06}	1.81×10^{-05}	4.08×10^{-05}	6.16×10^{-05}
	Application Case																
	Cobalt	8.60×10^{-06}	9.05×10^{-09}	1.02×10^{-08}	$0.00 \times 10^{+00}$	7.31×10^{-06}	1.13×10^{-05}	1.88×10^{-04}	2.15×10^{-04}	8.70×10^{-06}	9.04×10^{-09}	1.03×10^{-08}	$0.00 \times 10^{+00}$	7.45×10^{-06}	1.13×10^{-05}	1.88×10^{-04}	2.16×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	3.21×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.70×10^{-02}	1.26×10^{-05}	1.26×10^{-08}	1.78×10^{-08}	$0.00 \times 10^{+00}$	3.28×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.70×10^{-02}
	Molybdenum	3.08×10^{-06}	2.98×10^{-09}	4.60×10^{-09}	$0.00 \times 10^{+00}$	2.20×10^{-08}	6.46×10^{-06}	2.41×10^{-03}	2.42×10^{-03}	3.63×10^{-06}	2.98×10^{-09}	5.44×10^{-09}	$0.00 \times 10^{+00}$	2.85×10^{-08}	6.42×10^{-06}	2.41×10^{-03}	2.42×10^{-03}
	Uranium	1.49×10^{-06}	5.20×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	1.64×10^{-06}	1.82×10^{-05}	4.08×10^{-05}	6.22×10^{-05}	1.51×10^{-06}	5.18×10^{-09}	1.38×10^{-08}	$0.00 \times 10^{+00}$	1.68×10^{-06}	1.81×10^{-05}	4.08×10^{-05}	6.21×10^{-05}
	Upper Bound Scenario																
	Cobalt	8.60×10^{-06}	9.05×10^{-09}	1.02×10^{-08}	$0.00 \times 10^{+00}$	7.31×10^{-06}	1.13×10^{-05}	1.88×10^{-04}	2.15×10^{-04}	8.76×10^{-06}	9.04×10^{-09}	1.04×10^{-08}	$0.00 \times 10^{+00}$	7.54×10^{-06}	1.13×10^{-05}	1.88×10^{-04}	2.16×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	3.21×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.70×10^{-02}	1.27×10^{-05}	1.26×10^{-08}	1.80×10^{-08}	$0.00 \times 10^{+00}$	3.32×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.70×10^{-02}
	Molybdenum	3.18×10^{-06}	2.98×10^{-09}	4.73×10^{-09}	$0.00 \times 10^{+00}$	2.31×10^{-08}	6.46×10^{-06}	2.41×10^{-03}	2.42×10^{-03}	5.33×10^{-06}	2.98×10^{-09}	7.98×10^{-09}	$0.00 \times 10^{+00}$	4.85×10^{-08}	6.42×10^{-06}	2.41×10^{-03}	2.42×10^{-03}
	Uranium	1.51×10^{-06}	5.20×10^{-09}	1.37×10^{-08}	$0.00 \times 10^{+00}$	1.67×10^{-06}	1.82×10^{-05}	4.08×10^{-05}	6.23×10^{-05}	1.51×10^{-06}	5.18×10^{-09}	1.38×10^{-08}	$0.00 \times 10^{+00}$	1.68×10^{-06}	1.81×10^{-05}	4.08×10^{-05}	6.21×10^{-05}

		Dose by Pathway Project Lifespan (mg/kg/d)								Dose by Pathway Far Future (mg/kg/d)							
	COPC	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 One-Year-Old (Lloyd Lake)	**Base Case**																
	Cobalt	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	6.89×10^{-06}	2.47×10^{-05}	4.13×10^{-04}	4.56×10^{-04}	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	6.89×10^{-06}	2.47×10^{-05}	4.13×10^{-04}	4.56×10^{-04}
	Copper	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	2.29×10^{-04}	3.93×10^{-04}	3.97×10^{-02}	4.03×10^{-02}	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	2.29×10^{-04}	3.93×10^{-04}	3.97×10^{-02}	4.03×10^{-02}
	Molybdenum	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	2.03×10^{-08}	1.40×10^{-05}	6.38×10^{-03}	6.40×10^{-03}	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	2.03×10^{-08}	1.40×10^{-05}	6.38×10^{-03}	6.40×10^{-03}
	Uranium	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	1.23×10^{-06}	3.95×10^{-05}	9.62×10^{-05}	1.40×10^{-04}	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	1.23×10^{-06}	3.95×10^{-05}	9.62×10^{-05}	1.40×10^{-04}
	Application Case																
	Cobalt	9.60×10^{-06}	5.91×10^{-07}	6.64×10^{-07}	$0.00 \times 10^{+00}$	6.91×10^{-06}	2.48×10^{-05}	4.14×10^{-04}	4.56×10^{-04}	9.71×10^{-06}	5.91×10^{-07}	6.72×10^{-07}	$0.00 \times 10^{+00}$	6.99×10^{-06}	2.47×10^{-05}	4.14×10^{-04}	4.56×10^{-04}
	Copper	1.39×10^{-05}	8.22×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	2.29×10^{-04}	3.93×10^{-04}	3.97×10^{-02}	4.03×10^{-02}	1.40×10^{-05}	8.21×10^{-07}	1.16×10^{-06}	$0.00 \times 10^{+00}$	2.32×10^{-04}	3.93×10^{-04}	3.97×10^{-02}	4.03×10^{-02}
	Molybdenum	3.44×10^{-06}	1.95×10^{-07}	3.01×10^{-07}	$0.00 \times 10^{+00}$	2.06×10^{-08}	1.41×10^{-05}	6.38×10^{-03}	6.40×10^{-03}	4.06×10^{-06}	1.95×10^{-07}	3.55×10^{-07}	$0.00 \times 10^{+00}$	2.43×10^{-08}	1.40×10^{-05}	6.38×10^{-03}	6.40×10^{-03}
	Uranium	1.66×10^{-06}	3.39×10^{-07}	8.85×10^{-07}	$0.00 \times 10^{+00}$	1.24×10^{-06}	3.98×10^{-05}	9.63×10^{-05}	1.40×10^{-04}	1.69×10^{-06}	3.38×10^{-07}	9.02×10^{-07}	$0.00 \times 10^{+00}$	1.27×10^{-06}	3.95×10^{-05}	9.63×10^{-05}	1.40×10^{-04}
	Upper Bound Scenario																
	Cobalt	9.60×10^{-06}	5.91×10^{-07}	6.64×10^{-07}	$0.00 \times 10^{+00}$	6.91×10^{-06}	2.48×10^{-05}	4.14×10^{-04}	4.56×10^{-04}	9.79×10^{-06}	5.91×10^{-07}	6.77×10^{-07}	$0.00 \times 10^{+00}$	7.05×10^{-06}	2.47×10^{-05}	4.14×10^{-04}	4.57×10^{-04}
	Copper	1.39×10^{-05}	8.22×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	2.29×10^{-04}	3.93×10^{-04}	3.97×10^{-02}	4.03×10^{-02}	1.42×10^{-05}	8.21×10^{-07}	1.17×10^{-06}	$0.00 \times 10^{+00}$	2.34×10^{-04}	3.93×10^{-04}	3.97×10^{-02}	4.03×10^{-02}
	Molybdenum	3.55×10^{-06}	1.95×10^{-07}	3.09×10^{-07}	$0.00 \times 10^{+00}$	2.13×10^{-08}	1.41×10^{-05}	6.38×10^{-03}	6.40×10^{-03}	5.95×10^{-06}	1.95×10^{-07}	5.21×10^{-07}	$0.00 \times 10^{+00}$	3.57×10^{-08}	1.40×10^{-05}	6.38×10^{-03}	6.40×10^{-03}
	Uranium	1.68×10^{-06}	3.39×10^{-07}	8.94×10^{-07}	$0.00 \times 10^{+00}$	1.26×10^{-06}	3.98×10^{-05}	9.63×10^{-05}	1.40×10^{-04}	1.69×10^{-06}	3.38×10^{-07}	9.02×10^{-07}	$0.00 \times 10^{+00}$	1.27×10^{-06}	3.95×10^{-05}	9.63×10^{-05}	1.40×10^{-04}
Permanent Resident Adult (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^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	2.30×10^{-05}	1.44×10^{-05}	2.44×10^{-04}	2.90×10^{-04}
	Copper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	7.61×10^{-04}	2.29×10^{-04}	1.75×10^{-02}	1.86×10^{-02}
	Molybdenum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	6.77×10^{-08}	8.18×10^{-06}	1.95×10^{-03}	1.96×10^{-03}
	Uranium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	4.11×10^{-06}	2.30×10^{-05}	4.92×10^{-05}	7.78×10^{-05}
	Application Case																
	Cobalt	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.10×10^{-05}	9.07×10^{-09}	2.48×10^{-08}	$0.00 \times 10^{+00}$	5.62×10^{-05}	1.44×10^{-05}	3.08×10^{-04}	4.00×10^{-04}
	Copper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3.21×10^{-05}	1.26×10^{-08}	4.54×10^{-08}	$0.00 \times 10^{+00}$	1.97×10^{-03}	2.30×10^{-04}	1.83×10^{-02}	2.05×10^{-02}
	Molybdenum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	6.77×10^{-05}	2.98×10^{-09}	1.01×10^{-07}	$0.00 \times 10^{+00}$	1.51×10^{-06}	8.18×10^{-06}	2.00×10^{-03}	2.08×10^{-03}
	Uranium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.48×10^{-05}	7.48×10^{-09}	1.35×10^{-07}	$0.00 \times 10^{+00}$	4.11×10^{-05}	3.33×10^{-05}	6.76×10^{-05}	1.57×10^{-04}
	Upper Bound Scenario																
	Cobalt	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.76×10^{-05}	9.07×10^{-09}	3.26×10^{-08}	$0.00 \times 10^{+00}$	7.39×10^{-05}	1.44×10^{-05}	3.42×10^{-04}	4.58×10^{-04}
	Copper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	4.20×10^{-05}	1.26×10^{-08}	5.94×10^{-08}	$0.00 \times 10^{+00}$	2.58×10^{-03}	2.30×10^{-04}	1.87×10^{-02}	2.15×10^{-02}
	Molybdenum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.51×10^{-04}	2.98×10^{-09}	3.76×10^{-07}	$0.00 \times 10^{+00}$	5.61×10^{-06}	8.18×10^{-06}	2.15×10^{-03}	2.41×10^{-03}
	Uranium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.48×10^{-05}	7.48×10^{-09}	1.35×10^{-07}	$0.00 \times 10^{+00}$	4.12×10^{-05}	3.33×10^{-05}	6.76×10^{-05}	1.57×10^{-04}

		Dose by Pathway Project Lifespan (mg/kg/d)								Dose by Pathway Far Future (mg/kg/d)							
	COPC	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^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	2.18×10^{-05}	2.84×10^{-05}	4.78×10^{-04}	5.39×10^{-04}
	Copper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	7.21×10^{-04}	4.52×10^{-04}	4.13×10^{-02}	4.25×10^{-02}
	Molybdenum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	6.42×10^{-08}	1.61×10^{-05}	6.06×10^{-03}	6.08×10^{-03}
	Uranium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	3.90×10^{-06}	4.54×10^{-05}	1.02×10^{-04}	1.54×10^{-04}
	Application Case																
	Cobalt	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.34×10^{-05}	5.92×10^{-07}	1.62×10^{-06}	$0.00 \times 10^{+00}$	5.33×10^{-05}	2.85×10^{-05}	5.43×10^{-04}	6.50×10^{-04}
	Copper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3.58×10^{-05}	8.23×10^{-07}	2.97×10^{-06}	$0.00 \times 10^{+00}$	1.87×10^{-03}	4.53×10^{-04}	4.20×10^{-02}	4.44×10^{-02}
	Molybdenum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	7.56×10^{-05}	1.95×10^{-07}	6.62×10^{-06}	$0.00 \times 10^{+00}$	1.43×10^{-06}	1.61×10^{-05}	6.11×10^{-03}	6.21×10^{-03}
	Uranium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.65×10^{-05}	4.89×10^{-07}	8.80×10^{-06}	$0.00 \times 10^{+00}$	3.90×10^{-05}	6.56×10^{-05}	1.16×10^{-04}	2.46×10^{-04}
	Upper Bound Scenario																
	Cobalt	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3.08×10^{-05}	5.92×10^{-07}	2.13×10^{-06}	$0.00 \times 10^{+00}$	7.01×10^{-05}	2.85×10^{-05}	5.77×10^{-04}	7.09×10^{-04}
	Copper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	4.69×10^{-05}	8.23×10^{-07}	3.88×10^{-06}	$0.00 \times 10^{+00}$	2.44×10^{-03}	4.53×10^{-04}	4.24×10^{-02}	4.53×10^{-02}
	Molybdenum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.81×10^{-04}	1.95×10^{-07}	2.46×10^{-05}	$0.00 \times 10^{+00}$	5.32×10^{-06}	1.61×10^{-05}	6.26×10^{-03}	6.58×10^{-03}
	Uranium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.65×10^{-05}	4.89×10^{-07}	8.81×10^{-06}	$0.00 \times 10^{+00}$	3.90×10^{-05}	6.56×10^{-05}	1.16×10^{-04}	2.46×10^{-04}

COPC = constituent of potential concern; n/a = receptor not assessed in that phase.

5.2.4.1.2 Carcinogen Doses

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 (toddler, child, teen, adult) to permit estimation of the lifetime risk to a composite receptor for each of the subsistence harvester, seasonal resident, and permanent resident (Table 5-8). Therefore, a composite receptor was calculated assuming 4.5 years as a toddler, 7 years as a child, 8 years as a teen and 60 years as an adult. 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.

Table 5-8: Estimated Carcinogen Doses for Arsenic to Human Receptors – Operations – Application Case and Upper Bound Scenario

Lifetime Average Daily Dose (mg/kg/d)												
	Application Case – Operations						Upper Bound Scenario - Operations					
Age Group	Camp Worker	Subsistence Harvester - Patterson Lake South Arm	Subsistence Harvester - Beet Lake	Subsistence Harvester - Lloyd Lake	Seasonal Resident - Patterson Lake South Arm	Seasonal Resident - Lloyd Lake	Camp Worker	Subsistence Harvester - Patterson Lake South Arm	Subsistence Harvester - Beet Lake	Subsistence Harvester - Lloyd Lake	Seasonal Resident - Patterson Lake South Arm	Seasonal Resident - Lloyd Lake
1 year old	n/a	9.61×10^{-07}	5.55×10^{-08}	2.59×10^{-08}	2.13×10^{-07}	6.14×10^{-09}	n/a	9.84×10^{-07}	5.63×10^{-08}	2.60×10^{-08}	2.18×10^{-07}	6.15×10^{-09}
Child	n/a	2.05×10^{-06}	1.26×10^{-07}	5.76×10^{-08}	4.55×10^{-07}	1.27×10^{-08}	n/a	2.10×10^{-06}	1.28×10^{-07}	5.77×10^{-08}	4.66×10^{-07}	1.28×10^{-08}
Teen	n/a	1.60×10^{-06}	1.01×10^{-07}	4.78×10^{-08}	3.47×10^{-07}	9.93×10^{-09}	n/a	1.64×10^{-06}	1.02×10^{-07}	4.79×10^{-08}	3.55×10^{-07}	9.95×10^{-09}
Adult	4.27×10^{-05}	1.61×10^{-05}	1.02×10^{-06}	4.67×10^{-07}	3.43×10^{-06}	9.62×10^{-08}	4.36×10^{-05}	1.65×10^{-05}	1.03×10^{-06}	4.68×10^{-07}	3.52×10^{-06}	9.64×10^{-08}

Lifetime Average Daily Dose (mg/kg/d)												
	Application Case - Far-Future Projection						Upper Bound Scenario - Far-Future Projection					
Age Group	Permanent Resident	Subsistence Harvester - Patterson Lake South Arm	Subsistence Harvester - Beet Lake	Subsistence Harvester - Lloyd Lake	Seasonal Resident - Patterson Lake South Arm	Seasonal Resident - Lloyd Lake	Permanent Resident	Subsistence Harvester - Patterson Lake South Arm	Subsistence Harvester - Beet Lake	Subsistence Harvester - Lloyd Lake	Seasonal Resident - Patterson Lake South Arm	Seasonal Resident - Lloyd Lake
1 year old	1.25×10^{-07}	2.37×10^{-08}	8.31×10^{-10}	4.79×10^{-11}	5.24×10^{-09}	1.04×10^{-11}	1.93×10^{-07}	3.74×10^{-08}	1.28×10^{-09}	7.36×10^{-11}	8.28×10^{-09}	1.60×10^{-11}
Child	2.90×10^{-07}	5.05×10^{-08}	1.92×10^{-09}	1.11×10^{-10}	1.12×10^{-08}	2.40×10^{-11}	4.46×10^{-07}	7.97×10^{-08}	2.96×10^{-09}	1.70×10^{-10}	1.77×10^{-08}	3.70×10^{-11}
Teen	2.26×10^{-07}	3.94×10^{-08}	1.49×10^{-09}	8.62×10^{-11}	8.56×10^{-09}	1.85×10^{-11}	3.47×10^{-07}	6.22×10^{-08}	2.30×10^{-09}	1.32×10^{-10}	1.35×10^{-08}	2.84×10^{-11}
Adult	2.35×10^{-06}	3.97×10^{-07}	1.56×10^{-08}	8.98×10^{-10}	8.50×10^{-08}	1.89×10^{-10}	3.61×10^{-06}	6.28×10^{-07}	2.40×10^{-08}	1.38×10^{-09}	1.34×10^{-07}	2.91×10^{-10}

n/a = not applicable or not assessed.

5.2.4.1.3 Radiological Dose

The estimated radiation doses to human receptors during the Project phases and far-future projection resulting from the Application Case and reasonable upper bound sensitivity scenario are shown in Table 5-9 and Table 5-10. The doses shown represent the maximum annual dose over the assessment period. The tables present the dose breakdown by radionuclide and exposure pathway, as well as the total dose. The radiation dose is presented as an incremental dose (i.e., only considering Project effects).

The maximum estimated radiation 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 maximum estimated radiation dose to the subsistence harvester (one-year-old) was predicted to be 0.1 mSv/yr for the Application Case and 0.1 mSv/yr for the reasonable upper bound sensitivity scenario. The main contribution to total dose would be from polonium-210 from eating terrestrial animals in the Traditional Food diet, including moose (meat and organs), beaver, grouse, and mallard.

In the far-future projection, the maximum estimated dose was predicted to be 0.1 mSv/yr for the future permanent resident residing at the decommissioned and reclaimed Project site well beyond Closure, both for the Application Case and reasonable upper bound sensitivity scenario.

Table 5-9: Estimated Radiation Doses to Human Receptors – Operations – Application Case, Upper Bound Scenario

	Radionuclide	Incremental Dose by Pathway - Project Lifespan (mSv/yr)												
		Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by Radionuclide
Camp Worker (Patterson Lake North Arm - West Basin)		Application Case												
	Uranium-238	8.41×10^{-04}	2.31×10^{-12}	2.20×10^{-08}	1.67×10^{-13}	1.32×10^{-07}	1.47×10^{-03}	7.65×10^{-11}	8.15×10^{-10}	$0.00 \times 10^{+00}$	1.11×10^{-05}	4.68×10^{-05}	6.25×10^{-05}	2.43×10^{-03}
	Uranium-234	1.01×10^{-03}	5.64×10^{-12}	2.40×10^{-08}	2.92×10^{-14}	1.44×10^{-07}	7.40×10^{-06}	8.36×10^{-11}	2.97×10^{-12}	$0.00 \times 10^{+00}$	1.22×10^{-05}	5.10×10^{-05}	6.81×10^{-05}	1.15×10^{-03}
	Thorium-230	4.06×10^{-03}	1.37×10^{-11}	1.44×10^{-06}	9.77×10^{-13}	6.91×10^{-07}	1.06×10^{-05}	1.03×10^{-09}	2.54×10^{-11}	$0.00 \times 10^{+00}$	6.62×10^{-04}	5.09×10^{-04}	6.56×10^{-03}	1.18×10^{-02}
	Radium-226	1.01×10^{-03}	2.62×10^{-10}	6.77×10^{-07}	3.02×10^{-10}	9.34×10^{-07}	2.42×10^{-02}	1.61×10^{-09}	1.93×10^{-07}	$0.00 \times 10^{+00}$	9.97×10^{-05}	8.83×10^{-04}	7.43×10^{-04}	2.69×10^{-02}
	Lead-210	3.19×10^{-04}	4.12×10^{-11}	2.22×10^{-06}	1.95×10^{-12}	1.48×10^{-06}	3.44×10^{-04}	1.96×10^{-08}	1.11×10^{-09}	$0.00 \times 10^{+00}$	8.90×10^{-05}	1.90×10^{-03}	6.37×10^{-03}	9.03×10^{-03}
	Polonium-210	9.56×10^{-04}	3.59×10^{-13}	1.58×10^{-06}	4.74×10^{-15}	2.62×10^{-06}	7.77×10^{-08}	3.26×10^{-08}	4.48×10^{-12}	$0.00 \times 10^{+00}$	5.49×10^{-04}	3.04×10^{-03}	9.16×10^{-03}	1.37×10^{-02}
	Total by Pathway	8.20×10^{-03}	3.25×10^{-10}	5.96×10^{-06}	3.05×10^{-10}	6.01×10^{-06}	2.60×10^{-02}	5.50×10^{-08}	1.95×10^{-07}	$0.00 \times 10^{+00}$	1.42×10^{-03}	6.43×10^{-03}	2.30×10^{-02}	6.50×10^{-02}
		Upper Bound Scenario												
	Uranium-238	8.41×10^{-04}	2.31×10^{-12}	2.27×10^{-08}	1.72×10^{-13}	1.32×10^{-07}	1.47×10^{-03}	7.91×10^{-11}	8.43×10^{-10}	$0.00 \times 10^{+00}$	3.05×10^{-05}	4.68×10^{-05}	6.75×10^{-05}	2.45×10^{-03}
	Uranium-234	1.01×10^{-03}	5.64×10^{-12}	2.48×10^{-08}	3.02×10^{-14}	1.44×10^{-07}	7.40×10^{-06}	8.64×10^{-11}	3.07×10^{-12}	$0.00 \times 10^{+00}$	3.33×10^{-05}	5.10×10^{-05}	7.35×10^{-05}	1.18×10^{-03}
	Thorium-230	4.06×10^{-03}	1.37×10^{-11}	1.48×10^{-06}	1.01×10^{-12}	6.91×10^{-07}	1.06×10^{-05}	1.06×10^{-09}	2.61×10^{-11}	$0.00 \times 10^{+00}$	6.70×10^{-04}	5.09×10^{-04}	6.60×10^{-03}	1.19×10^{-02}
	Radium-226	1.01×10^{-03}	2.62×10^{-10}	7.12×10^{-07}	3.18×10^{-10}	9.34×10^{-07}	2.42×10^{-02}	1.72×10^{-09}	2.06×10^{-07}	$0.00 \times 10^{+00}$	1.04×10^{-04}	8.83×10^{-04}	7.45×10^{-04}	2.69×10^{-02}
	Lead-210	3.19×10^{-04}	4.12×10^{-11}	2.29×10^{-06}	2.02×10^{-12}	1.48×10^{-06}	3.44×10^{-04}	2.09×10^{-08}	1.18×10^{-09}	$0.00 \times 10^{+00}$	4.54×10^{-04}	1.90×10^{-03}	1.58×10^{-02}	1.89×10^{-02}
	Polonium-210	9.56×10^{-04}	3.59×10^{-13}	1.73×10^{-06}	5.20×10^{-15}	2.62×10^{-06}	7.77×10^{-08}	3.49×10^{-08}	4.79×10^{-12}	$0.00 \times 10^{+00}$	2.84×10^{-03}	3.04×10^{-03}	1.43×10^{-02}	2.12×10^{-02}
	Total by Pathway	8.20×10^{-03}	3.25×10^{-10}	6.27×10^{-06}	3.21×10^{-10}	6.01×10^{-06}	2.60×10^{-02}	5.88×10^{-08}	2.08×10^{-07}	$0.00 \times 10^{+00}$	4.13×10^{-03}	6.43×10^{-03}	3.77×10^{-02}	8.24×10^{-02}
Subsistence Harvester (Patterson Lake South Arm)		Application Case												
	Uranium-238	1.30×10^{-04}	3.57×10^{-13}	8.09×10^{-06}	6.14×10^{-11}	2.05×10^{-08}	2.27×10^{-04}	5.87×10^{-08}	6.26×10^{-07}	$0.00 \times 10^{+00}$	2.22×10^{-05}	9.36×10^{-05}	1.25×10^{-04}	6.07×10^{-04}
	Uranium-234	1.57×10^{-04}	8.74×10^{-13}	8.84×10^{-06}	1.07×10^{-11}	2.23×10^{-08}	1.15×10^{-06}	6.42×10^{-08}	2.28×10^{-09}	$0.00 \times 10^{+00}$	2.43×10^{-05}	1.02×10^{-04}	1.36×10^{-04}	4.30×10^{-04}
	Thorium-230	6.29×10^{-04}	2.12×10^{-12}	9.97×10^{-04}	6.76×10^{-10}	1.07×10^{-07}	1.64×10^{-06}	1.02×10^{-06}	2.53×10^{-08}	$0.00 \times 10^{+00}$	1.32×10^{-03}	1.02×10^{-03}	1.31×10^{-02}	1.71×10^{-02}
	Radium-226	1.57×10^{-04}	4.06×10^{-11}	7.70×10^{-05}	3.44×10^{-08}	1.45×10^{-07}	3.75×10^{-03}	3.40×10^{-07}	4.08×10^{-05}	$0.00 \times 10^{+00}$	1.99×10^{-04}	1.76×10^{-03}	1.49×10^{-03}	7.47×10^{-03}
	Lead-210	4.94×10^{-05}	6.39×10^{-12}	2.03×10^{-05}	1.78×10^{-11}	2.30×10^{-07}	5.34×10^{-05}	5.51×10^{-07}	3.12×10^{-08}	$0.00 \times 10^{+00}$	1.78×10^{-04}	3.80×10^{-03}	1.27×10^{-02}	1.68×10^{-02}
	Polonium-210	1.48×10^{-04}	5.57×10^{-14}	3.54×10^{-05}	1.06×10^{-13}	4.07×10^{-07}	1.20×10^{-08}	9.74×10^{-07}	1.34×10^{-10}	$0.00 \times 10^{+00}$	1.10×10^{-03}	6.07×10^{-03}	1.83×10^{-02}	2.57×10^{-02}
	Total by Pathway	1.27×10^{-03}	5.04×10^{-11}	1.15×10^{-03}	3.52×10^{-08}	9.31×10^{-07}	4.03×10^{-03}	3.01×10^{-06}	4.15×10^{-05}	$0.00 \times 10^{+00}$	2.84×10^{-03}	1.28×10^{-02}	4.59×10^{-02}	6.80×10^{-02}
		Upper Bound Scenario												
	Uranium-238	1.30×10^{-04}	3.57×10^{-13}	2.21×10^{-05}	1.68×10^{-10}	2.05×10^{-08}	2.27×10^{-04}	1.64×10^{-07}	1.74×10^{-06}	$0.00 \times 10^{+00}$	6.09×10^{-05}	9.36×10^{-05}	1.35×10^{-04}	6.71×10^{-04}
	Uranium-234	1.57×10^{-04}	8.74×10^{-13}	2.42×10^{-05}	2.94×10^{-11}	2.23×10^{-08}	1.15×10^{-06}	1.79×10^{-07}	6.35×10^{-09}	$0.00 \times 10^{+00}$	6.66×10^{-05}	1.02×10^{-04}	1.47×10^{-04}	4.98×10^{-04}
	Thorium-230	6.29×10^{-04}	2.12×10^{-12}	1.01×10^{-03}	6.85×10^{-10}	1.07×10^{-07}	1.64×10^{-06}	1.04×10^{-06}	2.56×10^{-08}	$0.00 \times 10^{+00}$	1.34×10^{-03}	1.02×10^{-03}	1.32×10^{-02}	1.72×10^{-02}
	Radium-226	1.57×10^{-04}	4.06×10^{-11}	8.05×10^{-05}	3.59×10^{-08}	1.45×10^{-07}	3.75×10^{-03}	3.56×10^{-07}	4.27×10^{-05}	$0.00 \times 10^{+00}$	2.08×10^{-04}	1.76×10^{-03}	1.49×10^{-03}	7.49×10^{-03}
	Lead-210	4.94×10^{-05}	6.39×10^{-12}	1.03×10^{-04}	9.12×10^{-11}	2.30×10^{-07}	5.34×10^{-05}	2.60×10^{-06}	1.47×10^{-07}	$0.00 \times 10^{+00}$	9.08×10^{-04}	3.80×10^{-03}	3.16×10^{-02}	3.65×10^{-02}
	Polonium-210	1.48×10^{-04}	5.57×10^{-14}	1.84×10^{-04}	5.53×10^{-13}	4.07×10^{-07}	1.20×10^{-08}	4.59×10^{-06}	6.30×10^{-10}	$0.00 \times 10^{+00}$	5.68×10^{-03}	6.07×10^{-03}	2.87×10^{-02}	4.08×10^{-02}
	Total by Pathway	1.27×10^{-03}	5.04×10^{-11}	1.42×10^{-03}	3.69×10^{-08}	9.31×10^{-07}	4.03×10^{-03}	8.92×10^{-06}	4.46×10^{-05}	$0.00 \times 10^{+00}$	8.26×10^{-03}	1.28×10^{-02}	7.52×10^{-02}	1.03×10^{-01}
Subsistence Harvester One-Year-Old (Patterson Lake South Arm)		Application Case												
	Uranium-238	1.30×10^{-04}	4.65×10^{-13}	5.62×10^{-06}	1.52×10^{-11}	8.34×10^{-07}	3.04×10^{-04}	2.39×10^{-06}	8.14×10^{-07}	$0.00 \times 10^{+00}$	1.31×10^{-05}	1.16×10^{-04}	5.64×10^{-05}	6.29×10^{-04}
	Uranium-234	1.52×10^{-04}	1.14×10^{-12}	6.11×10^{-06}	2.66×10^{-12}	9.03×10^{-07}	1.53×10^{-06}	2.60×10^{-06}	2.96×10^{-09}	$0.00 \times 10^{+00}$	1.43×10^{-05}	1.25×10^{-04}	6.12×10^{-05}	3.64×10^{-04}
	Thorium-230	4.84×10^{-04}	2.75×10^{-12}	5.07×10^{-04}	1.67×10^{-10}	3.19×10^{-06}	1.87×10^{-06}	3.04×10^{-05}	3.28×10^{-08}	$0.00 \times 10^{+00}$	5.71×10^{-04}	5.57×10^{-04}	6.32×10^{-03}	8.48×10^{-03}
	Radium-226	1.52×10^{-04}	5.27×10^{-11}	6.88×10^{-05}	8.51×10^{-09}	7.57×10^{-06}	5.02×10^{-03}	1.78×10^{-05}	5.32×10^{-05}	$0.00 \times 10^{+00}$	1.51×10^{-04}	2.00×10^{-03}	6.71×10^{-04}	8.14×10^{-03}
	Lead-210	5.11×10^{-05}	8.29×10^{-12}	2.75×10^{-05}	3.62×10^{-12}	1.83×10^{-05}	7.14×10^{-05}	4.38×10^{-05}	4.05×10^{-08}	$0.00 \times 10^{+00}$	2.05×10^{-04}	6.21×10^{-03}	1.57×10^{-02}	2.24×10^{-02}
	Polonium-210	1.52×10^{-04}	7.25×10^{-14}	6.76×10^{-05}	2.63×10^{-14}	4.55×10^{-05}	1.57×10^{-08}	1.09×10^{-04}	1.74×10^{-10}	$0.00 \times 10^{+00}$	1.78×10^{-03}	1.44×10^{-02}	1.80×10^{-02}	3.46×10^{-02}
	Total by Pathway	1.12×10^{-03}	6.55×10^{-11}	6.83×10^{-04}	8.70×10^{-09}	7.63×10^{-05}	5.39×10^{-03}	2.06×10^{-04}	5.41×10^{-05}	$0.00 \times 10^{+00}$	2.74×10^{-03}	2.34×10^{-02}	4.09×10^{-02}	7.45×10^{-02}
		Upper Bound Scenario												
	Uranium-238	1.30×10^{-04}	4.65×10^{-13}	1.54×10^{-05}	4.15×10^{-11}	8.34×10^{-07}	3.04×10^{-04}	6.65×10^{-06}	2.27×10^{-06}	$0.00 \times 10^{+00}$	3.59×10^{-05}	1.16×10^{-04}	6.11×10^{-05}	6.72×10^{-04}
	Uranium-234	1.52×10^{-04}	1.14×10^{-12}	1.67×10^{-05}	7.27×10^{-12}	9.03×10^{-07}	1.53×10^{-06}	7.23×10^{-06}	8.25×10^{-09}	$0.00 \times 10^{+00}$	3.91×10^{-05}	1.25×10^{-04}	6.62×10^{-05}	4.09×10^{-04}
	Thorium-230	4.84×10^{-04}	2.75×10^{-12}	5.14×10^{-04}	1.70×10^{-10}	3.19×10^{-06}	1.87×10^{-06}	3.08×10^{-05}	3.33×10^{-08}	$0.00 \times 10^{+00}$	5.79×10^{-04}	5.57×10^{-04}	6.37×10^{-03}	8.54×10^{-03}

	Radionuclide	Incremental Dose by Pathway - Project Lifespan (mSv/yr)												
		Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by Radionuclide
	Radium-226	1.52×10^{-04}	5.27×10^{-11}	7.19×10^{-05}	8.90×10^{-09}	7.57×10^{-06}	5.02×10^{-03}	1.86×10^{-05}	5.57×10^{-05}	$0.00 \times 10^{+00}$	1.58×10^{-04}	2.00×10^{-03}	6.72×10^{-04}	8.15×10^{-03}
	Lead-210	5.11×10^{-05}	8.29×10^{-12}	1.41×10^{-04}	1.85×10^{-11}	1.83×10^{-05}	7.14×10^{-05}	2.07×10^{-04}	1.91×10^{-07}	$0.00 \times 10^{+00}$	1.05×10^{-03}	6.21×10^{-03}	3.94×10^{-02}	4.71×10^{-02}
	Polonium-210	1.52×10^{-04}	7.25×10^{-14}	3.52×10^{-04}	1.37×10^{-13}	4.55×10^{-05}	1.57×10^{-08}	5.14×10^{-04}	8.19×10^{-10}	$0.00 \times 10^{+00}$	9.22×10^{-03}	1.44×10^{-02}	2.99×10^{-02}	5.45×10^{-02}
	Total by Pathway	1.12×10^{-03}	6.55×10^{-11}	1.11×10^{-03}	9.14×10^{-09}	7.63×10^{-05}	5.39×10^{-03}	7.84×10^{-04}	5.82×10^{-05}	$0.00 \times 10^{+00}$	1.11×10^{-02}	2.34×10^{-02}	7.64×10^{-02}	1.19×10^{-01}
Subsistence Harvester (Beet Lake)		Application Case												
	Uranium-238	7.59×10^{-05}	2.08×10^{-13}	2.98×10^{-06}	2.26×10^{-11}	1.19×10^{-08}	1.33×10^{-04}	2.15×10^{-08}	2.30×10^{-07}	$0.00 \times 10^{+00}$	8.18×10^{-06}	5.45×10^{-05}	4.94×10^{-05}	3.24×10^{-04}
	Uranium-234	9.16×10^{-05}	5.10×10^{-13}	3.25×10^{-06}	3.95×10^{-12}	1.30×10^{-08}	6.68×10^{-07}	2.35×10^{-08}	8.36×10^{-10}	$0.00 \times 10^{+00}$	8.94×10^{-06}	5.94×10^{-05}	5.38×10^{-05}	2.18×10^{-04}
	Thorium-230	3.67×10^{-04}	1.24×10^{-12}	5.24×10^{-04}	3.55×10^{-10}	6.24×10^{-08}	9.56×10^{-07}	5.37×10^{-07}	1.33×10^{-08}	$0.00 \times 10^{+00}$	6.94×10^{-04}	5.93×10^{-04}	2.56×10^{-03}	4.74×10^{-03}
	Radium-226	9.16×10^{-05}	2.36×10^{-11}	3.28×10^{-05}	1.46×10^{-08}	8.44×10^{-08}	2.18×10^{-03}	1.45×10^{-07}	1.73×10^{-05}	$0.00 \times 10^{+00}$	8.47×10^{-05}	1.03×10^{-03}	3.58×10^{-04}	3.80×10^{-03}
	Lead-210	2.88×10^{-05}	3.72×10^{-12}	2.67×10^{-06}	2.35×10^{-12}	1.34×10^{-07}	3.11×10^{-05}	7.27×10^{-08}	4.11×10^{-09}	$0.00 \times 10^{+00}$	2.35×10^{-05}	2.22×10^{-03}	1.00×10^{-03}	3.31×10^{-03}
	Polonium-210	8.64×10^{-05}	3.25×10^{-14}	4.67×10^{-06}	1.40×10^{-14}	2.37×10^{-07}	7.02×10^{-09}	1.28×10^{-07}	1.76×10^{-11}	$0.00 \times 10^{+00}$	1.45×10^{-04}	3.54×10^{-03}	5.68×10^{-03}	9.45×10^{-03}
	Total by Pathway	7.41×10^{-04}	2.94×10^{-11}	5.71×10^{-04}	1.50×10^{-08}	5.43×10^{-07}	2.35×10^{-03}	9.28×10^{-07}	1.76×10^{-05}	$0.00 \times 10^{+00}$	9.64×10^{-04}	7.49×10^{-03}	9.70×10^{-03}	2.18×10^{-02}
		Upper Bound Scenario												
	Uranium-238	7.59×10^{-05}	2.08×10^{-13}	8.14×10^{-06}	6.18×10^{-11}	1.19×10^{-08}	1.33×10^{-04}	6.00×10^{-08}	6.40×10^{-07}	$0.00 \times 10^{+00}$	2.24×10^{-05}	5.45×10^{-05}	5.23×10^{-05}	3.47×10^{-04}
	Uranium-234	9.16×10^{-05}	5.10×10^{-13}	8.90×10^{-06}	1.08×10^{-11}	1.30×10^{-08}	6.68×10^{-07}	6.56×10^{-08}	2.33×10^{-09}	$0.00 \times 10^{+00}$	2.45×10^{-05}	5.94×10^{-05}	5.70×10^{-05}	2.42×10^{-04}
	Thorium-230	3.67×10^{-04}	1.24×10^{-12}	5.31×10^{-04}	3.60×10^{-10}	6.24×10^{-08}	9.56×10^{-07}	5.45×10^{-07}	1.35×10^{-08}	$0.00 \times 10^{+00}$	7.04×10^{-04}	5.93×10^{-04}	2.59×10^{-03}	4.78×10^{-03}
	Radium-226	9.16×10^{-05}	2.36×10^{-11}	3.43×10^{-05}	1.53×10^{-08}	8.44×10^{-08}	2.18×10^{-03}	1.51×10^{-07}	1.81×10^{-05}	$0.00 \times 10^{+00}$	8.85×10^{-05}	1.03×10^{-03}	3.59×10^{-04}	3.80×10^{-03}
	Lead-210	2.88×10^{-05}	3.72×10^{-12}	1.34×10^{-05}	1.18×10^{-11}	1.34×10^{-07}	3.11×10^{-05}	3.54×10^{-07}	2.00×10^{-08}	$0.00 \times 10^{+00}$	1.18×10^{-04}	2.22×10^{-03}	1.15×10^{-03}	3.55×10^{-03}
	Polonium-210	8.64×10^{-05}	3.25×10^{-14}	2.38×10^{-05}	7.16×10^{-14}	2.37×10^{-07}	7.02×10^{-09}	6.27×10^{-07}	8.60×10^{-11}	$0.00 \times 10^{+00}$	7.37×10^{-04}	3.54×10^{-03}	6.66×10^{-03}	1.10×10^{-02}
	Total by Pathway	7.41×10^{-04}	2.94×10^{-11}	6.20×10^{-04}	1.57×10^{-08}	5.43×10^{-07}	2.35×10^{-03}	1.80×10^{-06}	1.88×10^{-05}	$0.00 \times 10^{+00}$	1.69×10^{-03}	7.49×10^{-03}	1.09×10^{-02}	2.38×10^{-02}
Subsistence Harvester One-Year-Old (Beet Lake)		Application Case												
	Uranium-238	7.57×10^{-05}	2.71×10^{-13}	2.07×10^{-06}	5.58×10^{-12}	4.86×10^{-07}	1.77×10^{-04}	8.76×10^{-07}	2.99×10^{-07}	$0.00 \times 10^{+00}$	4.83×10^{-06}	6.73×10^{-05}	2.19×10^{-05}	3.51×10^{-04}
	Uranium-234	8.86×10^{-05}	6.62×10^{-13}	2.25×10^{-06}	9.78×10^{-13}	5.26×10^{-07}	8.94×10^{-07}	9.53×10^{-07}	1.09×10^{-09}	$0.00 \times 10^{+00}$	5.25×10^{-06}	7.29×10^{-05}	2.37×10^{-05}	1.95×10^{-04}
	Thorium-230	2.82×10^{-04}	1.61×10^{-12}	2.67×10^{-04}	8.80×10^{-11}	1.86×10^{-06}	1.09×10^{-06}	1.60×10^{-05}	1.73×10^{-08}	$0.00 \times 10^{+00}$	3.00×10^{-04}	3.24×10^{-04}	1.23×10^{-03}	2.42×10^{-03}
	Radium-226	8.86×10^{-05}	3.07×10^{-11}	2.93×10^{-05}	3.63×10^{-09}	4.41×10^{-06}	2.92×10^{-03}	7.57×10^{-06}	2.26×10^{-05}	$0.00 \times 10^{+00}$	6.42×10^{-05}	1.17×10^{-03}	1.38×10^{-04}	4.44×10^{-03}
	Lead-210	2.98×10^{-05}	4.83×10^{-12}	3.63×10^{-06}	4.78×10^{-13}	1.07×10^{-05}	4.16×10^{-05}	5.78×10^{-06}	5.34×10^{-09}	$0.00 \times 10^{+00}$	2.71×10^{-05}	3.62×10^{-03}	1.13×10^{-03}	4.87×10^{-03}
	Polonium-210	8.86×10^{-05}	4.22×10^{-14}	8.93×10^{-06}	3.48×10^{-15}	2.65×10^{-05}	9.18×10^{-09}	1.44×10^{-05}	2.29×10^{-11}	$0.00 \times 10^{+00}$	2.35×10^{-04}	8.37×10^{-03}	5.76×10^{-03}	1.45×10^{-02}
	Total by Pathway	6.53×10^{-04}	3.81×10^{-11}	3.13×10^{-04}	3.72×10^{-09}	4.44×10^{-05}	3.14×10^{-03}	4.55×10^{-05}	2.29×10^{-05}	$0.00 \times 10^{+00}$	6.36×10^{-04}	1.36×10^{-02}	8.31×10^{-03}	2.68×10^{-02}
		Upper Bound Scenario												
	Uranium-238	7.57×10^{-05}	2.71×10^{-13}	5.66×10^{-06}	1.53×10^{-11}	4.86×10^{-07}	1.77×10^{-04}	2.44×10^{-06}	8.32×10^{-07}	$0.00 \times 10^{+00}$	1.32×10^{-05}	6.73×10^{-05}	2.32×10^{-05}	3.66×10^{-04}
	Uranium-234	8.86×10^{-05}	6.62×10^{-13}	6.15×10^{-06}	2.68×10^{-12}	5.26×10^{-07}	8.94×10^{-07}	2.65×10^{-06}	3.03×10^{-09}	$0.00 \times 10^{+00}$	1.44×10^{-05}	7.29×10^{-05}	2.51×10^{-05}	2.11×10^{-04}
	Thorium-230	2.82×10^{-04}	1.61×10^{-12}	2.70×10^{-04}	8.92×10^{-11}	1.86×10^{-06}	1.09×10^{-06}	1.62×10^{-05}	1.75×10^{-08}	$0.00 \times 10^{+00}$	3.04×10^{-04}	3.24×10^{-04}	1.24×10^{-03}	2.44×10^{-03}
	Radium-226	8.86×10^{-05}	3.07×10^{-11}	3.06×10^{-05}	3.79×10^{-09}	4.41×10^{-06}	2.92×10^{-03}	7.92×10^{-06}	2.37×10^{-05}	$0.00 \times 10^{+00}$	6.71×10^{-05}	1.17×10^{-03}	1.38×10^{-04}	4.45×10^{-03}
	Lead-210	2.98×10^{-05}	4.83×10^{-12}	1.83×10^{-05}	2.40×10^{-12}	1.07×10^{-05}	4.16×10^{-05}	2.82×10^{-05}	2.60×10^{-08}	$0.00 \times 10^{+00}$	1.36×10^{-04}	3.62×10^{-03}	1.30×10^{-03}	5.18×10^{-03}
	Polonium-210	8.86×10^{-05}	4.22×10^{-14}	4.55×10^{-05}	1.77×10^{-14}	2.65×10^{-05}	9.18×10^{-09}	7.01×10^{-05}	1.12×10^{-10}	$0.00 \times 10^{+00}$	1.20×10^{-03}	8.37×10^{-03}	7.01×10^{-03}	1.68×10^{-02}
	Total by Pathway	6.53×10^{-04}	3.81×10^{-11}	3.77×10^{-04}	3.90×10^{-09}	4.44×10^{-05}	3.14×10^{-03}	1.27×10^{-04}	2.46×10^{-05}	$0.00 \times 10^{+00}$	1.73×10^{-03}	1.36×10^{-02}	9.73×10^{-03}	2.94×10^{-02}
Subsistence Harvester (Lloyd Lake)		Application Case												
	Uranium-238	2.54×10^{-06}	6.97×10^{-15}	2.72×10^{-07}	2.06×10^{-12}	4.00×10^{-10}	4.43×10^{-06}	1.96×10^{-09}	2.09×10^{-08}	$0.00 \times 10^{+00}$	7.47×10^{-07}	1.82×10^{-06}	1.75×10^{-06}	1.16×10^{-05}
	Uranium-234	3.07×10^{-06}	1.70×10^{-14}	2.97×10^{-07}	3.61×10^{-13}	4.35×10^{-10}	2.23×10^{-08}	2.14×10^{-09}	7.59×10^{-11}	$0.00 \times 10^{+00}$	8.16×10^{-07}	1.99×10^{-06}	1.90×10^{-06}	8.09×10^{-06}
	Thorium-230	1.23×10^{-05}	4.13×10^{-14}	5.40×10^{-05}	3.66×10^{-11}	2.09×10^{-09}	3.20×10^{-08}	5.53×10^{-08}	1.37×10^{-09}	$0.00 \times 10^{+00}$	7.14×10^{-05}	1.98×10^{-05}	2.17×10^{-04}	3.75×10^{-04}
	Radium-226	3.07×10^{-06}	7.91×10^{-13}	3.17×10^{-06}	1.41×10^{-09}	2.82×10^{-09}	7.31×10^{-05}	1.39×10^{-08}	1.67×10^{-06}	$0.00 \times 10^{+00}$	8.19×10^{-06}	3.44×10^{-05}	1.31×10^{-05}	1.37×10^{-04}
	Lead-210	9.63×10^{-07}	1.25×10^{-13}	1.40×10^{-07}	1.24×10^{-13}	4.48×10^{-09}	1.04×10^{-06}	3.64×10^{-10}	2.07×10^{-11}	$0.00 \times 10^{+00}$	1.20×10^{-06}	7.41×10^{-05}	3.41×10^{-05}	1.12×10^{-04}
	Polonium-210	2.89×10^{-06}	1.09×10^{-15}	2.08×10^{-07}	6.26×10^{-16}	7.92×10^{-09}	2.35×10^{-10}	5.68×10^{-10}	7.82×10^{-14}	$0.00 \times 10^{+00}$	6.12×10^{-06}	1.18×10^{-04}	1.83×10^{-04}	3.11×10^{-04}
	Total by Pathway	2.48×10^{-05}	9.82×10^{-13}	5.81×10^{-05}	1.45×10^{-09}	1.82×10^{-08}	7.86×10^{-05}	7.42×10^{-08}	1.69×10^{-06}	$0.00 \times 10^{+00}$	8.85×10^{-05}	2.50×10^{-04}	4.51×10^{-04}	9.53×10^{-04}
		Upper Bound Scenario												
	Uranium-238	2.54×10^{-06}	6.97×10^{-15}	7.48×10^{-07}	5.68×10^{-12}	4.00×10^{-10}	4.43×10^{-06}	5.45×10^{-09}	5.81×10^{-08}	$0.00 \times 10^{+00}$	2.06×10^{-06}	1.82×10^{-06}	2.01×10^{-06}	1.37×10^{-05}

	Radionuclide	Incremental Dose by Pathway - Project Lifespan (mSv/yr)												
		Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by Radionuclide
	Uranium-234	3.07×10^{-06}	1.70×10^{-14}	8.18×10^{-07}	9.93×10^{-13}	4.35×10^{-10}	2.23×10^{-08}	5.96×10^{-09}	2.11×10^{-10}	$0.00 \times 10^{+00}$	2.25×10^{-06}	1.99×10^{-06}	2.19×10^{-06}	1.03×10^{-05}
	Thorium-230	1.23×10^{-05}	4.13×10^{-14}	5.48×10^{-05}	3.72×10^{-11}	2.09×10^{-09}	3.20×10^{-08}	5.60×10^{-08}	1.39×10^{-09}	$0.00 \times 10^{+00}$	7.25×10^{-05}	1.98×10^{-05}	2.20×10^{-04}	3.80×10^{-04}
	Radium-226	3.07×10^{-06}	7.91×10^{-13}	3.31×10^{-06}	1.48×10^{-09}	2.82×10^{-09}	7.31×10^{-05}	1.46×10^{-08}	1.74×10^{-06}	$0.00 \times 10^{+00}$	8.56×10^{-06}	3.44×10^{-05}	1.32×10^{-05}	1.37×10^{-04}
	Lead-210	9.63×10^{-07}	1.25×10^{-13}	6.89×10^{-07}	6.07×10^{-13}	4.48×10^{-09}	1.04×10^{-06}	1.48×10^{-08}	8.39×10^{-10}	$0.00 \times 10^{+00}$	6.02×10^{-06}	7.41×10^{-05}	4.14×10^{-05}	1.24×10^{-04}
	Polonium-210	2.89×10^{-06}	1.09×10^{-15}	1.18×10^{-06}	3.54×10^{-15}	7.92×10^{-09}	2.35×10^{-10}	2.62×10^{-08}	3.59×10^{-12}	$0.00 \times 10^{+00}$	3.62×10^{-05}	1.18×10^{-04}	2.33×10^{-04}	3.92×10^{-04}
	Total by Pathway	2.48×10^{-05}	9.82×10^{-13}	6.16×10^{-05}	1.52×10^{-09}	1.82×10^{-08}	7.86×10^{-05}	1.23×10^{-07}	1.80×10^{-06}	$0.00 \times 10^{+00}$	1.28×10^{-04}	2.50×10^{-04}	5.12×10^{-04}	1.06×10^{-03}
Subsistence Harvester One-Year-Old (Lloyd Lake)		Application Case												
	Uranium-238	2.53×10^{-06}	9.06×10^{-15}	1.89×10^{-07}	5.10×10^{-13}	1.63×10^{-08}	5.93×10^{-06}	7.95×10^{-08}	2.71×10^{-08}	$0.00 \times 10^{+00}$	4.41×10^{-07}	2.25×10^{-06}	7.75×10^{-07}	1.22×10^{-05}
	Uranium-234	2.96×10^{-06}	2.22×10^{-14}	2.05×10^{-07}	8.93×10^{-14}	1.76×10^{-08}	2.99×10^{-08}	8.65×10^{-08}	9.87×10^{-11}	$0.00 \times 10^{+00}$	4.79×10^{-07}	2.44×10^{-06}	8.40×10^{-07}	7.06×10^{-06}
	Thorium-230	9.43×10^{-06}	5.37×10^{-14}	2.75×10^{-05}	9.07×10^{-12}	6.22×10^{-08}	3.64×10^{-08}	1.65×10^{-06}	1.78×10^{-09}	$0.00 \times 10^{+00}$	3.09×10^{-05}	1.09×10^{-05}	1.05×10^{-04}	1.85×10^{-04}
	Radium-226	2.96×10^{-06}	1.03×10^{-12}	2.83×10^{-06}	3.50×10^{-10}	1.48×10^{-07}	9.78×10^{-05}	7.27×10^{-07}	2.17×10^{-06}	$0.00 \times 10^{+00}$	6.21×10^{-06}	3.90×10^{-05}	5.07×10^{-06}	1.57×10^{-04}
	Lead-210	9.97×10^{-07}	1.62×10^{-13}	1.91×10^{-07}	2.51×10^{-14}	3.57×10^{-07}	1.39×10^{-06}	2.89×10^{-08}	2.68×10^{-11}	$0.00 \times 10^{+00}$	1.38×10^{-06}	1.21×10^{-04}	3.83×10^{-05}	1.64×10^{-04}
	Polonium-210	2.96×10^{-06}	1.41×10^{-15}	3.98×10^{-07}	1.55×10^{-16}	8.86×10^{-07}	3.07×10^{-10}	6.24×10^{-08}	9.95×10^{-14}	$0.00 \times 10^{+00}$	9.94×10^{-06}	2.80×10^{-04}	1.84×10^{-04}	4.78×10^{-04}
	Total by Pathway	2.18×10^{-05}	1.28×10^{-12}	3.13×10^{-05}	3.60×10^{-10}	1.49×10^{-06}	1.05×10^{-04}	2.63×10^{-06}	2.20×10^{-06}	$0.00 \times 10^{+00}$	4.93×10^{-05}	4.55×10^{-04}	3.33×10^{-04}	1.00×10^{-03}
		Upper Bound Scenario												
	Uranium-238	2.53×10^{-06}	9.06×10^{-15}	5.20×10^{-07}	1.40×10^{-12}	1.63×10^{-08}	5.93×10^{-06}	2.22×10^{-07}	7.55×10^{-08}	$0.00 \times 10^{+00}$	1.21×10^{-06}	2.25×10^{-06}	8.95×10^{-07}	1.37×10^{-05}
	Uranium-234	2.96×10^{-06}	2.22×10^{-14}	5.65×10^{-07}	2.46×10^{-13}	1.76×10^{-08}	2.99×10^{-08}	2.41×10^{-07}	2.75×10^{-10}	$0.00 \times 10^{+00}$	1.32×10^{-06}	2.44×10^{-06}	9.70×10^{-07}	8.55×10^{-06}
	Thorium-230	9.43×10^{-06}	5.37×10^{-14}	2.79×10^{-05}	9.20×10^{-12}	6.22×10^{-08}	3.64×10^{-08}	1.67×10^{-06}	1.80×10^{-09}	$0.00 \times 10^{+00}$	3.13×10^{-05}	1.09×10^{-05}	1.06×10^{-04}	1.87×10^{-04}
	Radium-226	2.96×10^{-06}	1.03×10^{-12}	2.96×10^{-06}	3.66×10^{-10}	1.48×10^{-07}	9.78×10^{-05}	7.61×10^{-07}	2.28×10^{-06}	$0.00 \times 10^{+00}$	6.50×10^{-06}	3.90×10^{-05}	5.11×10^{-06}	1.57×10^{-04}
	Lead-210	9.97×10^{-07}	1.62×10^{-13}	9.37×10^{-07}	1.23×10^{-13}	3.57×10^{-07}	1.39×10^{-06}	1.18×10^{-06}	1.09×10^{-09}	$0.00 \times 10^{+00}$	6.95×10^{-06}	1.21×10^{-04}	4.70×10^{-05}	1.80×10^{-04}
	Polonium-210	2.96×10^{-06}	1.41×10^{-15}	2.25×10^{-06}	8.77×10^{-16}	8.86×10^{-07}	3.07×10^{-10}	2.93×10^{-06}	4.66×10^{-12}	$0.00 \times 10^{+00}$	5.87×10^{-05}	2.80×10^{-04}	2.48×10^{-04}	5.95×10^{-04}
	Total by Pathway	2.18×10^{-05}	1.28×10^{-12}	3.51×10^{-05}	3.77×10^{-10}	1.49×10^{-06}	1.05×10^{-04}	7.00×10^{-06}	2.35×10^{-06}	$0.00 \times 10^{+00}$	1.06×10^{-04}	4.55×10^{-04}	4.08×10^{-04}	1.14×10^{-03}
Seasonal Resident (Patterson Lake South Arm)		Application Case												
	Uranium-238	7.82×10^{-05}	2.14×10^{-13}	4.85×10^{-06}	3.68×10^{-11}	1.23×10^{-08}	1.36×10^{-04}	3.52×10^{-08}	3.76×10^{-07}	$0.00 \times 10^{+00}$	4.23×10^{-06}	4.44×10^{-05}	2.33×10^{-05}	2.92×10^{-04}
	Uranium-234	9.43×10^{-05}	5.25×10^{-13}	5.31×10^{-06}	6.44×10^{-12}	1.34×10^{-08}	6.88×10^{-07}	3.85×10^{-08}	1.37×10^{-09}	$0.00 \times 10^{+00}$	4.62×10^{-06}	4.84×10^{-05}	2.54×10^{-05}	1.79×10^{-04}
	Thorium-230	3.77×10^{-04}	1.27×10^{-12}	5.98×10^{-04}	4.06×10^{-10}	6.43×10^{-08}	9.84×10^{-07}	6.13×10^{-07}	1.52×10^{-08}	$0.00 \times 10^{+00}$	2.51×10^{-04}	2.14×10^{-04}	3.05×10^{-03}	4.50×10^{-03}
	Radium-226	9.43×10^{-05}	2.43×10^{-11}	4.62×10^{-05}	2.06×10^{-08}	8.68×10^{-08}	2.25×10^{-03}	2.04×10^{-07}	2.45×10^{-05}	$0.00 \times 10^{+00}$	3.79×10^{-05}	5.00×10^{-04}	2.87×10^{-04}	3.24×10^{-03}
	Lead-210	2.97×10^{-05}	3.83×10^{-12}	1.21×10^{-05}	1.07×10^{-11}	1.38×10^{-07}	3.20×10^{-05}	3.29×10^{-07}	1.86×10^{-08}	$0.00 \times 10^{+00}$	3.38×10^{-05}	9.79×10^{-04}	2.92×10^{-03}	4.01×10^{-03}
	Polonium-210	8.90×10^{-05}	3.34×10^{-14}	2.12×10^{-05}	6.38×10^{-14}	2.44×10^{-07}	7.23×10^{-09}	5.82×10^{-07}	7.98×10^{-11}	$0.00 \times 10^{+00}$	2.09×10^{-04}	1.65×10^{-03}	3.53×10^{-03}	5.50×10^{-03}
	Total by Pathway	7.63×10^{-04}	3.02×10^{-11}	6.88×10^{-04}	2.11×10^{-08}	5.59×10^{-07}	2.42×10^{-03}	1.80×10^{-06}	2.49×10^{-05}	$0.00 \times 10^{+00}$	5.40×10^{-04}	3.43×10^{-03}	9.84×10^{-03}	1.77×10^{-02}
		Upper Bound Scenario												
	Uranium-238	7.82×10^{-05}	2.14×10^{-13}	1.33×10^{-05}	1.01×10^{-10}	1.23×10^{-08}	1.36×10^{-04}	9.81×10^{-08}	1.05×10^{-06}	$0.00 \times 10^{+00}$	1.16×10^{-05}	4.44×10^{-05}	2.60×10^{-05}	3.11×10^{-04}
	Uranium-234	9.43×10^{-05}	5.25×10^{-13}	1.45×10^{-05}	1.76×10^{-11}	1.34×10^{-08}	6.88×10^{-07}	1.07×10^{-07}	3.81×10^{-09}	$0.00 \times 10^{+00}$	1.27×10^{-05}	4.84×10^{-05}	2.83×10^{-05}	1.99×10^{-04}
	Thorium-230	3.77×10^{-04}	1.27×10^{-12}	6.06×10^{-04}	4.11×10^{-10}	6.43×10^{-08}	9.84×10^{-07}	6.22×10^{-07}	1.54×10^{-08}	$0.00 \times 10^{+00}$	2.55×10^{-04}	2.14×10^{-04}	3.08×10^{-03}	4.53×10^{-03}
	Radium-226	9.43×10^{-05}	2.43×10^{-11}	4.83×10^{-05}	2.16×10^{-08}	8.68×10^{-08}	2.25×10^{-03}	2.14×10^{-07}	2.56×10^{-05}	$0.00 \times 10^{+00}$	3.96×10^{-05}	5.00×10^{-04}	2.87×10^{-04}	3.24×10^{-03}
	Lead-210	2.97×10^{-05}	3.83×10^{-12}	6.21×10^{-05}	5.47×10^{-11}	1.38×10^{-07}	3.20×10^{-05}	1.56×10^{-06}	8.80×10^{-08}	$0.00 \times 10^{+00}$	1.73×10^{-04}	9.79×10^{-04}	7.28×10^{-03}	8.55×10^{-03}
	Polonium-210	8.90×10^{-05}	3.34×10^{-14}	1.10×10^{-04}	3.32×10^{-13}	2.44×10^{-07}	7.23×10^{-09}	2.75×10^{-06}	3.78×10^{-10}	$0.00 \times 10^{+00}$	1.08×10^{-03}	1.65×10^{-03}	6.26×10^{-03}	9.19×10^{-03}
	Total by Pathway	7.63×10^{-04}	3.02×10^{-11}	8.55×10^{-04}	2.21×10^{-08}	5.59×10^{-07}	2.42×10^{-03}	5.35×10^{-06}	2.68×10^{-05}	$0.00 \times 10^{+00}$	1.57×10^{-03}	3.43×10^{-03}	1.70×10^{-02}	2.60×10^{-02}
Seasonal Resident One-Year-Old (Patterson Lake South Arm)		Application Case												
	Uranium-238	7.79×10^{-05}	2.79×10^{-13}	3.37×10^{-06}	9.11×10^{-12}	5.00×10^{-07}	1.83×10^{-04}	1.43×10^{-06}	4.88×10^{-07}	$0.00 \times 10^{+00}$	2.50×10^{-06}	6.06×10^{-05}	1.06×10^{-05}	3.40×10^{-04}
	Uranium-234	9.12×10^{-05}	6.82×10^{-13}	3.67×10^{-06}	1.60×10^{-12}	5.42×10^{-07}	9.21×10^{-07}	1.56×10^{-06}	1.78×10^{-09}	$0.00 \times 10^{+00}$	2.71×10^{-06}	6.56×10^{-05}	1.15×10^{-05}	1.78×10^{-04}
	Thorium-230	2.90×10^{-04}	1.65×10^{-12}	3.04×10^{-04}	1.00×10^{-10}	1.91×10^{-06}	1.12×10^{-06}	1.83×10^{-05}	1.97×10^{-08}	$0.00 \times 10^{+00}$	1.09×10^{-04}	1.18×10^{-04}	1.49×10^{-03}	2.33×10^{-03}
	Radium-226	9.12×10^{-05}	3.16×10^{-11}	4.13×10^{-05}	5.11×10^{-09}	4.54×10^{-06}	3.01×10^{-03}	1.07×10^{-05}	3.19×10^{-05}	$0.00 \times 10^{+00}$	2.87×10^{-05}	6.68×10^{-04}	1.35×10^{-04}	4.02×10^{-03}
	Lead-210	3.07×10^{-05}	4.97×10^{-12}	1.65×10^{-05}	2.17×10^{-12}	1.10×10^{-05}	4.28×10^{-05}	2.62×10^{-05}	2.42×10^{-08}	$0.00 \times 10^{+00}$	3.90×10^{-05}	1.83×10^{-03}	3.68×10^{-03}	5.68×10^{-03}
	Polonium-210	9.12×10^{-05}	4.35×10^{-14}	4.06×10^{-05}	1.58×10^{-14}	2.73×10^{-05}	9.45×10^{-09}	6.50×10^{-05}	1.04×10^{-10}	$0.00 \times 10^{+00}$	3.38×10^{-04}	4.54×10^{-03}	3.49×10^{-03}	8.59×10^{-03}
	Total by Pathway	6.72×10^{-04}	3.93×10^{-11}	4.10×10^{-04}	5.22×10^{-09}	4.58×10^{-05}	3.24×10^{-03}	1.23×10^{-04}	3.25×10^{-05}	$0.00 \times 10^{+00}$	5.20×10^{-04}	7.29×10^{-03}	8.82×10^{-03}	2.11×10^{-02}

	Radionuclide	Incremental Dose by Pathway - Project Lifespan (mSv/yr)												
		Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by Radionuclide
		Upper Bound Scenario												
	Uranium-238	7.79×10^{-05}	2.79×10^{-13}	9.23×10^{-06}	2.49×10^{-11}	5.00×10^{-07}	1.83×10^{-04}	3.99×10^{-06}	1.36×10^{-06}	$0.00 \times 10^{+00}$	6.83×10^{-06}	6.06×10^{-05}	1.19×10^{-05}	3.55×10^{-04}
	Uranium-234	9.12×10^{-05}	6.82×10^{-13}	1.00×10^{-05}	4.36×10^{-12}	5.42×10^{-07}	9.21×10^{-07}	4.34×10^{-06}	4.95×10^{-09}	$0.00 \times 10^{+00}$	7.43×10^{-06}	6.56×10^{-05}	1.29×10^{-05}	1.93×10^{-04}
	Thorium-230	2.90×10^{-04}	1.65×10^{-12}	3.08×10^{-04}	1.02×10^{-10}	1.91×10^{-06}	1.12×10^{-06}	1.85×10^{-05}	2.00×10^{-08}	$0.00 \times 10^{+00}$	1.10×10^{-04}	1.18×10^{-04}	1.50×10^{-03}	2.35×10^{-03}
	Radium-226	9.12×10^{-05}	3.16×10^{-11}	4.32×10^{-05}	5.34×10^{-09}	4.54×10^{-06}	3.01×10^{-03}	1.12×10^{-05}	3.34×10^{-05}	$0.00 \times 10^{+00}$	3.00×10^{-05}	6.68×10^{-04}	1.35×10^{-04}	4.03×10^{-03}
	Lead-210	3.07×10^{-05}	4.97×10^{-12}	8.44×10^{-05}	1.11×10^{-11}	1.10×10^{-05}	4.28×10^{-05}	1.24×10^{-04}	1.14×10^{-07}	$0.00 \times 10^{+00}$	1.99×10^{-04}	1.83×10^{-03}	9.22×10^{-03}	1.15×10^{-02}
	Polonium-210	9.12×10^{-05}	4.35×10^{-14}	2.11×10^{-04}	8.22×10^{-14}	2.73×10^{-05}	9.45×10^{-09}	3.08×10^{-04}	4.91×10^{-10}	$0.00 \times 10^{+00}$	1.75×10^{-03}	4.54×10^{-03}	6.64×10^{-03}	1.36×10^{-02}
	Total by Pathway	6.72×10^{-04}	3.93×10^{-11}	6.66×10^{-04}	5.48×10^{-09}	4.58×10^{-05}	3.24×10^{-03}	4.70×10^{-04}	3.49×10^{-05}	$0.00 \times 10^{+00}$	2.11×10^{-03}	7.29×10^{-03}	1.75×10^{-02}	3.20×10^{-02}
Seasonal Resident (Lloyd Lake)		Application Case												
	Uranium-238	1.52×10^{-06}	4.18×10^{-15}	1.63×10^{-07}	1.24×10^{-12}	2.40×10^{-10}	2.66×10^{-06}	1.17×10^{-09}	1.25×10^{-08}	$0.00 \times 10^{+00}$	1.59×10^{-06}	8.66×10^{-07}	3.15×10^{-07}	7.13×10^{-06}
	Uranium-234	1.84×10^{-06}	1.02×10^{-14}	1.78×10^{-07}	2.16×10^{-13}	2.61×10^{-10}	1.34×10^{-08}	1.28×10^{-09}	4.55×10^{-11}	$0.00 \times 10^{+00}$	1.73×10^{-06}	9.43×10^{-07}	3.43×10^{-07}	5.05×10^{-06}
	Thorium-230	7.36×10^{-06}	2.48×10^{-14}	3.24×10^{-05}	2.20×10^{-11}	1.25×10^{-09}	1.92×10^{-08}	3.32×10^{-08}	8.20×10^{-10}	$0.00 \times 10^{+00}$	2.28×10^{-05}	4.17×10^{-06}	5.07×10^{-05}	1.18×10^{-04}
	Radium-226	1.84×10^{-06}	4.75×10^{-13}	1.90×10^{-06}	8.49×10^{-10}	1.69×10^{-09}	4.38×10^{-05}	8.34×10^{-09}	1.00×10^{-06}	$0.00 \times 10^{+00}$	3.31×10^{-06}	9.75×10^{-06}	2.46×10^{-06}	6.41×10^{-05}
	Lead-210	5.78×10^{-07}	7.47×10^{-14}	8.31×10^{-08}	7.33×10^{-14}	2.69×10^{-09}	6.24×10^{-07}	1.49×10^{-10}	8.64×10^{-12}	$0.00 \times 10^{+00}$	7.56×10^{-04}	1.91×10^{-05}	7.49×10^{-06}	7.84×10^{-04}
	Polonium-210	1.73×10^{-06}	6.52×10^{-16}	1.24×10^{-07}	3.71×10^{-16}	4.76×10^{-09}	1.41×10^{-10}	2.26×10^{-10}	2.93×10^{-14}	$0.00 \times 10^{+00}$	5.12×10^{-04}	3.21×10^{-05}	2.97×10^{-05}	5.75×10^{-04}
	Total by Pathway	1.49×10^{-05}	5.89×10^{-13}	3.49×10^{-05}	8.72×10^{-10}	1.09×10^{-08}	4.71×10^{-05}	4.43×10^{-08}	1.01×10^{-06}	$0.00 \times 10^{+00}$	1.30×10^{-03}	6.69×10^{-05}	9.11×10^{-05}	1.55×10^{-03}
		Upper Bound Scenario												
	Uranium-238	1.52×10^{-06}	4.18×10^{-15}	4.49×10^{-07}	3.41×10^{-12}	2.40×10^{-10}	2.66×10^{-06}	3.27×10^{-09}	3.49×10^{-08}	$0.00 \times 10^{+00}$	2.11×10^{-06}	8.66×10^{-07}	3.91×10^{-07}	8.04×10^{-06}
	Uranium-234	1.84×10^{-06}	1.02×10^{-14}	4.91×10^{-07}	5.96×10^{-13}	2.61×10^{-10}	1.34×10^{-08}	3.57×10^{-09}	1.27×10^{-10}	$0.00 \times 10^{+00}$	2.30×10^{-06}	9.43×10^{-07}	4.26×10^{-07}	6.02×10^{-06}
	Thorium-230	7.36×10^{-06}	2.48×10^{-14}	3.29×10^{-05}	2.23×10^{-11}	1.25×10^{-09}	1.92×10^{-08}	3.36×10^{-08}	8.31×10^{-10}	$0.00 \times 10^{+00}$	2.32×10^{-05}	4.17×10^{-06}	5.14×10^{-05}	1.19×10^{-04}
	Radium-226	1.84×10^{-06}	4.75×10^{-13}	1.99×10^{-06}	8.87×10^{-10}	1.69×10^{-09}	4.38×10^{-05}	8.73×10^{-09}	1.05×10^{-06}	$0.00 \times 10^{+00}$	3.43×10^{-06}	9.75×10^{-06}	2.47×10^{-06}	6.44×10^{-05}
	Lead-210	5.78×10^{-07}	7.47×10^{-14}	4.12×10^{-07}	3.63×10^{-13}	2.69×10^{-09}	6.24×10^{-07}	7.40×10^{-09}	4.19×10^{-10}	$0.00 \times 10^{+00}$	7.58×10^{-04}	1.91×10^{-05}	9.17×10^{-06}	7.88×10^{-04}
	Polonium-210	1.73×10^{-06}	6.52×10^{-16}	7.06×10^{-07}	2.12×10^{-15}	4.76×10^{-09}	1.41×10^{-10}	1.30×10^{-08}	1.79×10^{-12}	$0.00 \times 10^{+00}$	5.21×10^{-04}	3.21×10^{-05}	4.48×10^{-05}	6.01×10^{-04}
	Total by Pathway	1.49×10^{-05}	5.89×10^{-13}	3.69×10^{-05}	9.14×10^{-10}	1.09×10^{-08}	4.71×10^{-05}	6.96×10^{-08}	1.08×10^{-06}	$0.00 \times 10^{+00}$	1.31×10^{-03}	6.69×10^{-05}	1.09×10^{-04}	1.59×10^{-03}
Seasonal Resident One-Year-Old (Lloyd Lake)		Application Case												
	Uranium-238	1.52×10^{-06}	5.44×10^{-15}	1.13×10^{-07}	3.06×10^{-13}	9.75×10^{-09}	3.56×10^{-06}	4.77×10^{-08}	1.63×10^{-08}	$0.00 \times 10^{+00}$	8.37×10^{-08}	1.18×10^{-06}	1.38×10^{-07}	6.67×10^{-06}
	Uranium-234	1.78×10^{-06}	1.33×10^{-14}	1.23×10^{-07}	5.36×10^{-14}	1.06×10^{-08}	1.79×10^{-08}	5.19×10^{-08}	5.92×10^{-11}	$0.00 \times 10^{+00}$	9.11×10^{-08}	1.28×10^{-06}	1.49×10^{-07}	3.50×10^{-06}
	Thorium-230	5.66×10^{-06}	3.22×10^{-14}	1.65×10^{-05}	5.44×10^{-12}	3.73×10^{-08}	2.18×10^{-08}	9.87×10^{-07}	1.07×10^{-09}	$0.00 \times 10^{+00}$	5.87×10^{-06}	2.31×10^{-06}	2.46×10^{-05}	5.60×10^{-05}
	Radium-226	1.78×10^{-06}	6.17×10^{-13}	1.70×10^{-06}	2.10×10^{-10}	8.85×10^{-08}	5.87×10^{-05}	4.36×10^{-07}	1.30×10^{-06}	$0.00 \times 10^{+00}$	1.18×10^{-06}	1.30×10^{-05}	9.76×10^{-07}	7.91×10^{-05}
	Lead-210	5.98×10^{-07}	9.70×10^{-14}	1.13×10^{-07}	1.49×10^{-14}	2.14×10^{-07}	8.35×10^{-07}	1.19×10^{-08}	1.09×10^{-11}	$0.00 \times 10^{+00}$	2.55×10^{-07}	3.57×10^{-05}	8.72×10^{-06}	4.65×10^{-05}
	Polonium-210	1.78×10^{-06}	8.48×10^{-16}	2.36×10^{-07}	9.19×10^{-17}	5.32×10^{-07}	1.84×10^{-10}	2.33×10^{-08}	3.73×10^{-14}	$0.00 \times 10^{+00}$	1.77×10^{-06}	8.86×10^{-05}	2.83×10^{-05}	1.21×10^{-04}
	Total by Pathway	1.31×10^{-05}	7.66×10^{-13}	1.88×10^{-05}	2.16×10^{-10}	8.92×10^{-07}	6.31×10^{-05}	1.56×10^{-06}	1.32×10^{-06}	$0.00 \times 10^{+00}$	9.25×10^{-06}	1.42×10^{-04}	6.30×10^{-05}	3.13×10^{-04}
		Upper Bound Scenario												
	Uranium-238	1.52×10^{-06}	5.44×10^{-15}	3.12×10^{-07}	8.42×10^{-13}	9.75×10^{-09}	3.56×10^{-06}	1.33×10^{-07}	4.53×10^{-08}	$0.00 \times 10^{+00}$	2.31×10^{-07}	1.18×10^{-06}	1.72×10^{-07}	7.16×10^{-06}
	Uranium-234	1.78×10^{-06}	1.33×10^{-14}	3.39×10^{-07}	1.48×10^{-13}	1.06×10^{-08}	1.79×10^{-08}	1.45×10^{-07}	1.65×10^{-10}	$0.00 \times 10^{+00}$	2.51×10^{-07}	1.28×10^{-06}	1.86×10^{-07}	4.01×10^{-06}
	Thorium-230	5.66×10^{-06}	3.22×10^{-14}	1.67×10^{-05}	5.52×10^{-12}	3.73×10^{-08}	2.18×10^{-08}	1.00×10^{-06}	1.08×10^{-09}	$0.00 \times 10^{+00}$	5.95×10^{-06}	2.31×10^{-06}	2.50×10^{-05}	5.67×10^{-05}
	Radium-226	1.78×10^{-06}	6.17×10^{-13}	1.78×10^{-06}	2.20×10^{-10}	8.85×10^{-08}	5.87×10^{-05}	4.56×10^{-07}	1.37×10^{-06}	$0.00 \times 10^{+00}$	1.23×10^{-06}	1.30×10^{-05}	9.83×10^{-07}	7.94×10^{-05}
	Lead-210	5.98×10^{-07}	9.70×10^{-14}	5.61×10^{-07}	7.37×10^{-14}	2.14×10^{-07}	8.35×10^{-07}	5.89×10^{-07}	5.44×10^{-10}	$0.00 \times 10^{+00}$	1.31×10^{-06}	3.57×10^{-05}	1.08×10^{-05}	5.06×10^{-05}
	Polonium-210	1.78×10^{-06}	8.48×10^{-16}	1.35×10^{-06}	5.25×10^{-16}	5.32×10^{-07}	1.84×10^{-10}	1.46×10^{-06}	2.32×10^{-12}	$0.00 \times 10^{+00}$	1.10×10^{-05}	8.86×10^{-05}	4.68×10^{-05}	1.52×10^{-04}
	Total by Pathway	1.31×10^{-05}	7.66×10^{-13}	2.11×10^{-05}	2.26×10^{-10}	8.92×10^{-07}	6.31×10^{-05}	3.78×10^{-06}	1.41×10^{-06}	$0.00 \times 10^{+00}$	2.00×10^{-05}	1.42×10^{-04}	8.39×10^{-05}	3.49×10^{-04}
Permanent Resident (Patterson Lake North Arm - West Basin)		Application Case												
	Uranium-238	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Uranium-234	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Thorium-230	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Radium-226	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Lead-210	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

	Radionuclide	Incremental Dose by Pathway - Project Lifespan (mSv/yr)												
		Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by Radionuclide
	Polonium-210	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Total by Pathway	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Upper Bound Scenario												
	Uranium-238	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Uranium-234	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Thorium-230	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Radium-226	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Lead-210	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Polonium-210	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Total by Pathway	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Permanent Resident One-Year-Old (Patterson Lake North Arm - West Basin)		Application Case												
	Uranium-238	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Uranium-234	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Thorium-230	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Radium-226	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Lead-210	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Polonium-210	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Total by Pathway	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Upper Bound Scenario												
	Uranium-238	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Uranium-234	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Thorium-230	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Radium-226	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Lead-210	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Polonium-210	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Total by Pathway	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

mSv/yr = millisieverts per year; n/a = not applicable or not assessed.

Table 5-10: Estimated Radiation Doses to Human Receptors – Far-Future – Application Case, Upper Bound Scenario

	Radionuclide	Incremental Dose by Pathway - Far-Future (mSv/yr)												
		Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by Radionuclide
Camp Worker (Patterson Lake North Arm - West Basin)		Application Case												
	Uranium-238	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Uranium-234	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Thorium-230	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Radium-226	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Lead-210	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Polonium-210	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Total by Pathway	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Upper Bound Scenario												
	Uranium-238	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Uranium-234	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Thorium-230	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Radium-226	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Lead-210	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Polonium-210	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Total by Pathway	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Subsistence Harvester (Patterson Lake South Arm)		Application Case												
	Uranium-238	$0.00\times10^{+00}$	$0.00\times10^{+00}$	2.64×10^{-05}	2.00×10^{-10}	2.16×10^{-09}	2.39×10^{-05}	2.41×10^{-07}	2.57×10^{-06}	$0.00\times10^{+00}$	7.35×10^{-05}	9.59×10^{-06}	3.47×10^{-05}	1.71×10^{-04}
	Uranium-234	$0.00\times10^{+00}$	$0.00\times10^{+00}$	2.88×10^{-05}	3.50×10^{-11}	2.35×10^{-09}	1.21×10^{-07}	2.63×10^{-07}	9.34×10^{-09}	$0.00\times10^{+00}$	8.03×10^{-05}	1.04×10^{-05}	3.79×10^{-05}	1.58×10^{-04}
	Thorium-230	$0.00\times10^{+00}$	$0.00\times10^{+00}$	1.54×10^{-05}	1.04×10^{-11}	5.98×10^{-08}	9.16×10^{-07}	1.68×10^{-08}	4.16×10^{-10}	$0.00\times10^{+00}$	2.06×10^{-05}	5.13×10^{-06}	1.90×10^{-04}	2.32×10^{-04}
	Radium-226	$0.00\times10^{+00}$	$0.00\times10^{+00}$	3.14×10^{-05}	1.40×10^{-08}	9.75×10^{-08}	2.53×10^{-03}	1.74×10^{-07}	2.08×10^{-05}	$0.00\times10^{+00}$	8.37×10^{-05}	1.61×10^{-04}	3.76×10^{-04}	3.20×10^{-03}
	Lead-210	$0.00\times10^{+00}$	$0.00\times10^{+00}$	2.02×10^{-06}	1.78×10^{-12}	1.56×10^{-10}	3.63×10^{-08}	6.81×10^{-08}	3.85×10^{-09}	$0.00\times10^{+00}$	1.80×10^{-05}	3.45×10^{-08}	4.02×10^{-04}	4.22×10^{-04}
	Polonium-210	$0.00\times10^{+00}$	$0.00\times10^{+00}$	3.55×10^{-06}	1.07×10^{-14}	2.78×10^{-10}	8.24×10^{-12}	1.20×10^{-07}	1.65×10^{-11}	$0.00\times10^{+00}$	1.13×10^{-04}	2.95×10^{-07}	3.22×10^{-04}	4.39×10^{-04}
	Total by Pathway	$0.00\times10^{+00}$	$0.00\times10^{+00}$	1.08×10^{-04}	1.42×10^{-08}	1.62×10^{-07}	2.55×10^{-03}	8.82×10^{-07}	2.34×10^{-05}	$0.00\times10^{+00}$	3.89×10^{-04}	1.86×10^{-04}	1.36×10^{-03}	4.62×10^{-03}
		Upper Bound Scenario												
	Uranium-238	$0.00\times10^{+00}$	$0.00\times10^{+00}$	2.64×10^{-05}	2.00×10^{-10}	2.16×10^{-09}	2.39×10^{-05}	2.41×10^{-07}	2.57×10^{-06}	$0.00\times10^{+00}$	7.35×10^{-05}	9.59×10^{-06}	3.47×10^{-05}	1.71×10^{-04}
	Uranium-234	$0.00\times10^{+00}$	$0.00\times10^{+00}$	2.89×10^{-05}	3.51×10^{-11}	2.35×10^{-09}	1.21×10^{-07}	2.63×10^{-07}	9.35×10^{-09}	$0.00\times10^{+00}$	8.04×10^{-05}	1.04×10^{-05}	3.79×10^{-05}	1.58×10^{-04}
	Thorium-230	$0.00\times10^{+00}$	$0.00\times10^{+00}$	1.54×10^{-05}	1.04×10^{-11}	5.98×10^{-08}	9.16×10^{-07}	1.68×10^{-08}	4.16×10^{-10}	$0.00\times10^{+00}$	2.06×10^{-05}	5.13×10^{-06}	1.90×10^{-04}	2.32×10^{-04}
	Radium-226	$0.00\times10^{+00}$	$0.00\times10^{+00}$	3.14×10^{-05}	1.40×10^{-08}	9.75×10^{-08}	2.53×10^{-03}	1.74×10^{-07}	2.09×10^{-05}	$0.00\times10^{+00}$	8.39×10^{-05}	1.61×10^{-04}	3.76×10^{-04}	3.20×10^{-03}
	Lead-210	$0.00\times10^{+00}$	$0.00\times10^{+00}$	2.03×10^{-06}	1.79×10^{-12}	1.56×10^{-10}	3.63×10^{-08}	6.84×10^{-08}	3.87×10^{-09}	$0.00\times10^{+00}$	1.81×10^{-05}	3.45×10^{-08}	4.03×10^{-04}	4.24×10^{-04}
	Polonium-210	$0.00\times10^{+00}$	$0.00\times10^{+00}$	3.57×10^{-06}	1.07×10^{-14}	2.78×10^{-10}	8.24×10^{-12}	1.21×10^{-07}	1.66×10^{-11}	$0.00\times10^{+00}$	1.13×10^{-04}	2.95×10^{-07}	3.24×10^{-04}	4.41×10^{-04}
	Total by Pathway	$0.00\times10^{+00}$	$0.00\times10^{+00}$	1.08×10^{-04}	1.43×10^{-08}	1.62×10^{-07}	2.55×10^{-03}	8.84×10^{-07}	2.34×10^{-05}	$0.00\times10^{+00}$	3.90×10^{-04}	1.86×10^{-04}	1.37×10^{-03}	4.62×10^{-03}
Subsistence Harvester One-Year-Old (Patterson Lake South Arm)		Application Case												
	Uranium-238	$0.00\times10^{+00}$	$0.00\times10^{+00}$	1.83×10^{-05}	4.95×10^{-11}	8.76×10^{-08}	3.20×10^{-05}	9.78×10^{-06}	3.34×10^{-06}	$0.00\times10^{+00}$	4.34×10^{-05}	1.18×10^{-05}	1.59×10^{-05}	1.35×10^{-04}
	Uranium-234	$0.00\times10^{+00}$	$0.00\times10^{+00}$	1.99×10^{-05}	8.67×10^{-12}	9.49×10^{-08}	1.61×10^{-07}	1.06×10^{-05}	1.21×10^{-08}	$0.00\times10^{+00}$	4.72×10^{-05}	1.27×10^{-05}	1.73×10^{-05}	1.08×10^{-04}
	Thorium-230	$0.00\times10^{+00}$	$0.00\times10^{+00}$	7.83×10^{-06}	2.58×10^{-12}	1.78×10^{-06}	1.04×10^{-06}	5.00×10^{-07}	5.40×10^{-10}	$0.00\times10^{+00}$	8.91×10^{-06}	4.61×10^{-06}	9.15×10^{-05}	1.16×10^{-04}
	Radium-226	$0.00\times10^{+00}$	$0.00\times10^{+00}$	2.80×10^{-05}	3.47×10^{-09}	5.10×10^{-06}	3.38×10^{-03}	9.08×10^{-06}	2.71×10^{-05}	$0.00\times10^{+00}$	6.35×10^{-05}	2.54×10^{-04}	1.70×10^{-04}	3.94×10^{-03}
	Lead-210	$0.00\times10^{+00}$	$0.00\times10^{+00}$	2.75×10^{-06}	3.62×10^{-13}	1.26×10^{-08}	4.89×10^{-08}	5.42×10^{-06}	5.01×10^{-09}	$0.00\times10^{+00}$	2.08×10^{-05}	8.29×10^{-08}	5.02×10^{-04}	5.32×10^{-04}
	Polonium-210	$0.00\times10^{+00}$	$0.00\times10^{+00}$	6.79×10^{-06}	2.64×10^{-15}	3.10×10^{-08}	1.08×10^{-11}	1.35×10^{-05}	2.15×10^{-11}	$0.00\times10^{+00}$	1.83×10^{-04}	9.95×10^{-07}	3.77×10^{-04}	5.81×10^{-04}
	Total by Pathway	$0.00\times10^{+00}$	$0.00\times10^{+00}$	8.37×10^{-05}	3.53×10^{-09}	7.11×10^{-06}	3.41×10^{-03}	4.89×10^{-05}	3.05×10^{-05}	$0.00\times10^{+00}$	3.67×10^{-04}	2.84×10^{-04}	1.17×10^{-03}	5.41×10^{-03}
		Upper Bound Scenario												
	Uranium-238	$0.00\times10^{+00}$	$0.00\times10^{+00}$	1.84×10^{-05}	4.95×10^{-11}	8.76×10^{-08}	3.20×10^{-05}	9.79×10^{-06}	3.34×10^{-06}	$0.00\times10^{+00}$	4.34×10^{-05}	1.18×10^{-05}	1.59×10^{-05}	1.35×10^{-04}
	Uranium-234	$0.00\times10^{+00}$	$0.00\times10^{+00}$	2.00×10^{-05}	8.68×10^{-12}	9.49×10^{-08}	1.61×10^{-07}	1.07×10^{-05}	1.22×10^{-08}	$0.00\times10^{+00}$	4.72×10^{-05}	1.27×10^{-05}	1.73×10^{-05}	1.08×10^{-04}
	Thorium-230	$0.00\times10^{+00}$	$0.00\times10^{+00}$	7.83×10^{-06}	2.58×10^{-12}	1.78×10^{-06}	1.04×10^{-06}	5.00×10^{-07}	5.40×10^{-10}	$0.00\times10^{+00}$	8.91×10^{-06}	4.61×10^{-06}	9.15×10^{-05}	1.16×10^{-04}
	Radium-226	$0.00\times10^{+00}$	$0.00\times10^{+00}$	2.81×10^{-05}	3.47×10^{-09}	5.10×10^{-06}	3.38×10^{-03}	9.10×10^{-06}	2.72×10^{-05}	$0.00\times10^{+00}$	6.37×10^{-05}	2.54×10^{-04}	1.70×10^{-04}	3.94×10^{-03}
	Lead-210	$0.00\times10^{+00}$	$0.00\times10^{+00}$	2.76×10^{-06}	3.63×10^{-13}	1.26×10^{-08}	4.89×10^{-08}	5.44×10^{-06}	5.03×10^{-09}	$0.00\times10^{+00}$	2.09×10^{-05}	8.29×10^{-08}	5.05×10^{-04}	5.34×10^{-04}
	Polonium-210	$0.00\times10^{+00}$	$0.00\times10^{+00}$	6.82×10^{-06}	2.66×10^{-15}	3.10×10^{-08}	1.08×10^{-11}	1.35×10^{-05}	2.16×10^{-11}	$0.00\times10^{+00}$	1.84×10^{-04}	9.95×10^{-07}	3.78×10^{-04}	5.84×10^{-04}
	Total by Pathway	$0.00\times10^{+00}$	$0.00\times10^{+00}$	8.38×10^{-05}	3.54×10^{-09}	7.11×10^{-06}	3.41×10^{-03}	4.90×10^{-05}	3.06×10^{-05}	$0.00\times10^{+00}$	3.68×10^{-04}	2.84×10^{-04}	1.18×10^{-03}	5.41×10^{-03}
Subsistence Harvester (Beet Lake)		Application Case												
	Uranium-238	$0.00\times10^{+00}$	$0.00\times10^{+00}$	9.81×10^{-06}	7.44×10^{-11}	1.26×10^{-09}	1.39×10^{-05}	8.94×10^{-08}	9.54×10^{-07}	$0.00\times10^{+00}$	2.73×10^{-05}	5.59×10^{-06}	1.18×10^{-05}	6.95×10^{-05}
	Uranium-234	$0.00\times10^{+00}$	$0.00\times10^{+00}$	1.07×10^{-05}	1.30×10^{-11}	1.37×10^{-09}	7.02×10^{-08}	9.78×10^{-08}	3.47×10^{-09}	$0.00\times10^{+00}$	2.99×10^{-05}	6.09×10^{-06}	1.29×10^{-05}	5.97×10^{-05}
	Thorium-230	$0.00\times10^{+00}$	$0.00\times10^{+00}$	8.19×10^{-06}	5.55×10^{-12}	3.49×10^{-08}	5.34×10^{-07}	8.93×10^{-09}	2.21×10^{-10}	$0.00\times10^{+00}$	1.10×10^{-05}	2.99×10^{-06}	4.72×10^{-05}	7.00×10^{-05}
	Radium-226	$0.00\times10^{+00}$	$0.00\times10^{+00}$	1.35×10^{-05}	6.02×10^{-09}	5.68×10^{-08}	1.47×10^{-03}	7.47×10^{-08}	8.95×10^{-06}	$0.00\times10^{+00}$	3.60×10^{-05}	9.37×10^{-05}	9.19×10^{-05}	1.72×10^{-03}
	Lead-210	$0.00\times10^{+00}$	$0.00\times10^{+00}$	2.79×10^{-07}	2.46×10^{-13}	9.19×10^{-11}	2.12×10^{-08}	9.37×10^{-09}	5.30×10^{-10}	$0.00\times10^{+00}$	2.48×10^{-06}	2.00×10^{-08}	4.16×10^{-06}	6.97×10^{-06}

	Radionuclide	Incremental Dose by Pathway - Far-Future (mSv/yr)												
		Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by Radionuclide
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.75×10^{-07}	1.42×10^{-15}	1.62×10^{-10}	4.80×10^{-12}	1.65×10^{-08}	2.27×10^{-12}	$0.00 \times 10^{+00}$	1.51×10^{-05}	1.72×10^{-07}	3.27×10^{-05}	4.85×10^{-05}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.30×10^{-05}	6.11×10^{-09}	9.46×10^{-08}	1.49×10^{-03}	2.97×10^{-07}	9.91×10^{-06}	$0.00 \times 10^{+00}$	1.22×10^{-04}	1.09×10^{-04}	2.01×10^{-04}	1.97×10^{-03}
		Upper Bound Scenario												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	9.82×10^{-06}	7.45×10^{-11}	1.26×10^{-09}	1.39×10^{-05}	8.95×10^{-08}	9.55×10^{-07}	$0.00 \times 10^{+00}$	2.73×10^{-05}	5.59×10^{-06}	1.18×10^{-05}	6.95×10^{-05}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.07×10^{-05}	1.30×10^{-11}	1.37×10^{-09}	7.02×10^{-08}	9.79×10^{-08}	3.48×10^{-09}	$0.00 \times 10^{+00}$	2.99×10^{-05}	6.09×10^{-06}	1.29×10^{-05}	5.98×10^{-05}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	8.19×10^{-06}	5.55×10^{-12}	3.49×10^{-08}	5.34×10^{-07}	8.93×10^{-09}	2.21×10^{-10}	$0.00 \times 10^{+00}$	1.10×10^{-05}	2.99×10^{-06}	4.72×10^{-05}	7.00×10^{-05}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.35×10^{-05}	6.03×10^{-09}	5.68×10^{-08}	1.47×10^{-03}	7.49×10^{-08}	8.97×10^{-06}	$0.00 \times 10^{+00}$	3.61×10^{-05}	9.37×10^{-05}	9.19×10^{-05}	1.72×10^{-03}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.80×10^{-07}	2.47×10^{-13}	9.19×10^{-11}	2.12×10^{-08}	9.41×10^{-09}	5.32×10^{-10}	$0.00 \times 10^{+00}$	2.49×10^{-06}	2.00×10^{-08}	4.18×10^{-06}	7.00×10^{-06}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.76×10^{-07}	1.43×10^{-15}	1.62×10^{-10}	4.80×10^{-12}	1.66×10^{-08}	2.28×10^{-12}	$0.00 \times 10^{+00}$	1.52×10^{-05}	1.72×10^{-07}	3.28×10^{-05}	4.87×10^{-05}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.30×10^{-05}	6.13×10^{-09}	9.46×10^{-08}	1.49×10^{-03}	2.97×10^{-07}	9.93×10^{-06}	$0.00 \times 10^{+00}$	1.22×10^{-04}	1.09×10^{-04}	2.01×10^{-04}	1.97×10^{-03}
Subsistence Harvester One-Year-Old (Beet Lake)		Application Case												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.81×10^{-06}	1.84×10^{-11}	5.11×10^{-08}	1.86×10^{-05}	3.64×10^{-06}	1.24×10^{-06}	$0.00 \times 10^{+00}$	1.61×10^{-05}	6.86×10^{-06}	5.35×10^{-06}	5.87×10^{-05}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	7.41×10^{-06}	3.22×10^{-12}	5.53×10^{-08}	9.40×10^{-08}	3.96×10^{-06}	4.51×10^{-09}	$0.00 \times 10^{+00}$	1.75×10^{-05}	7.43×10^{-06}	5.81×10^{-06}	4.23×10^{-05}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.17×10^{-06}	1.37×10^{-12}	1.04×10^{-06}	6.07×10^{-07}	2.66×10^{-07}	2.87×10^{-10}	$0.00 \times 10^{+00}$	4.74×10^{-06}	2.68×10^{-06}	2.27×10^{-05}	3.62×10^{-05}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.20×10^{-05}	1.49×10^{-09}	2.97×10^{-06}	1.97×10^{-03}	3.90×10^{-06}	1.17×10^{-05}	$0.00 \times 10^{+00}$	2.73×10^{-05}	1.48×10^{-04}	3.56×10^{-05}	2.21×10^{-03}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	3.79×10^{-07}	4.98×10^{-14}	7.33×10^{-09}	2.89×10^{-08}	7.46×10^{-07}	6.89×10^{-10}	$0.00 \times 10^{+00}$	2.86×10^{-06}	4.94×10^{-08}	4.94×10^{-06}	9.02×10^{-06}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	9.06×10^{-07}	3.53×10^{-16}	1.81×10^{-08}	6.28×10^{-12}	1.85×10^{-06}	2.95×10^{-12}	$0.00 \times 10^{+00}$	2.45×10^{-05}	5.79×10^{-07}	4.15×10^{-05}	6.94×10^{-05}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	3.17×10^{-05}	1.51×10^{-09}	4.14×10^{-06}	1.99×10^{-03}	1.44×10^{-05}	1.29×10^{-05}	$0.00 \times 10^{+00}$	9.31×10^{-05}	1.65×10^{-04}	1.16×10^{-04}	2.43×10^{-03}
		Upper Bound Scenario												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.82×10^{-06}	1.84×10^{-11}	5.11×10^{-08}	1.86×10^{-05}	3.64×10^{-06}	1.24×10^{-06}	$0.00 \times 10^{+00}$	1.61×10^{-05}	6.86×10^{-06}	5.35×10^{-06}	5.87×10^{-05}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	7.42×10^{-06}	3.23×10^{-12}	5.53×10^{-08}	9.40×10^{-08}	3.96×10^{-06}	4.52×10^{-09}	$0.00 \times 10^{+00}$	1.75×10^{-05}	7.43×10^{-06}	5.81×10^{-06}	4.23×10^{-05}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.17×10^{-06}	1.37×10^{-12}	1.04×10^{-06}	6.07×10^{-07}	2.66×10^{-07}	2.87×10^{-10}	$0.00 \times 10^{+00}$	4.74×10^{-06}	2.68×10^{-06}	2.27×10^{-05}	3.62×10^{-05}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.21×10^{-05}	1.49×10^{-09}	2.97×10^{-06}	1.97×10^{-03}	3.91×10^{-06}	1.17×10^{-05}	$0.00 \times 10^{+00}$	2.74×10^{-05}	1.48×10^{-04}	3.56×10^{-05}	2.21×10^{-03}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	3.81×10^{-07}	5.00×10^{-14}	7.33×10^{-09}	2.89×10^{-08}	7.49×10^{-07}	6.92×10^{-10}	$0.00 \times 10^{+00}$	2.88×10^{-06}	4.94×10^{-08}	4.95×10^{-06}	9.05×10^{-06}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	9.10×10^{-07}	3.55×10^{-16}	1.81×10^{-08}	6.28×10^{-12}	1.86×10^{-06}	2.96×10^{-12}	$0.00 \times 10^{+00}$	2.46×10^{-05}	5.79×10^{-07}	4.17×10^{-05}	6.97×10^{-05}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	3.18×10^{-05}	1.52×10^{-09}	4.14×10^{-06}	1.99×10^{-03}	1.44×10^{-05}	1.29×10^{-05}	$0.00 \times 10^{+00}$	9.33×10^{-05}	1.65×10^{-04}	1.16×10^{-04}	2.43×10^{-03}
Subsistence Harvester (Lloyd Lake)		Application Case												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	8.88×10^{-07}	6.74×10^{-12}	4.20×10^{-11}	4.66×10^{-07}	8.10×10^{-09}	8.64×10^{-08}	$0.00 \times 10^{+00}$	2.47×10^{-06}	1.87×10^{-07}	7.85×10^{-07}	4.89×10^{-06}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	9.71×10^{-07}	1.18×10^{-12}	4.58×10^{-11}	2.35×10^{-09}	8.85×10^{-09}	3.14×10^{-10}	$0.00 \times 10^{+00}$	2.70×10^{-06}	2.04×10^{-07}	8.57×10^{-07}	4.75×10^{-06}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	8.40×10^{-07}	5.69×10^{-13}	1.17×10^{-09}	1.79×10^{-08}	9.16×10^{-10}	2.26×10^{-11}	$0.00 \times 10^{+00}$	1.12×10^{-06}	1.00×10^{-07}	3.79×10^{-06}	5.87×10^{-06}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.29×10^{-06}	5.76×10^{-10}	1.90×10^{-09}	4.92×10^{-05}	7.15×10^{-09}	8.56×10^{-07}	$0.00 \times 10^{+00}$	3.45×10^{-06}	3.13×10^{-06}	3.55×10^{-06}	6.15×10^{-05}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.04×10^{-08}	1.81×10^{-14}	2.73×10^{-12}	6.98×10^{-10}	6.88×10^{-10}	3.89×10^{-11}	$0.00 \times 10^{+00}$	1.83×10^{-07}	4.66×10^{-10}	3.09×10^{-07}	5.14×10^{-07}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.91×10^{-12}	1.71×10^{-13}	1.14×10^{-09}	1.56×10^{-13}	$0.00 \times 10^{+00}$	5.96×10^{-08}	6.05×10^{-09}	2.18×10^{-06}	2.24×10^{-06}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.01×10^{-06}	5.84×10^{-10}	3.16×10^{-09}	4.97×10^{-05}	2.68×10^{-08}	9.43×10^{-07}	$0.00 \times 10^{+00}$	9.99×10^{-06}	3.63×10^{-06}	1.15×10^{-05}	7.98×10^{-05}
		Upper Bound Scenario												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	8.89×10^{-07}	6.75×10^{-12}	4.20×10^{-11}	4.66×10^{-07}	8.11×10^{-09}	8.65×10^{-08}	$0.00 \times 10^{+00}$	2.48×10^{-06}	1.87×10^{-07}	7.85×10^{-07}	4.90×10^{-06}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	9.72×10^{-07}	1.18×10^{-12}	4.58×10^{-11}	2.35×10^{-09}	8.86×10^{-09}	3.15×10^{-10}	$0.00 \times 10^{+00}$	2.71×10^{-06}	2.04×10^{-07}	8.57×10^{-07}	4.75×10^{-06}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	8.40×10^{-07}	5.69×10^{-13}	1.17×10^{-09}	1.79×10^{-08}	9.16×10^{-10}	2.26×10^{-11}	$0.00 \times 10^{+00}$	1.12×10^{-06}	1.00×10^{-07}	3.79×10^{-06}	5.87×10^{-06}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.29×10^{-06}	5.77×10^{-10}	1.90×10^{-09}	4.92×10^{-05}	7.16×10^{-09}	8.58×10^{-07}	$0.00 \times 10^{+00}$	3.45×10^{-06}	3.13×10^{-06}	3.55×10^{-06}	6.15×10^{-05}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.05×10^{-08}	1.82×10^{-14}	2.73×10^{-12}	6.98×10^{-10}	6.91×10^{-10}	3.91×10^{-11}	$0.00 \times 10^{+00}$	1.83×10^{-07}	4.66×10^{-10}	3.09×10^{-07}	5.15×10^{-07}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.91×10^{-12}	1.71×10^{-13}	1.14×10^{-09}	1.57×10^{-13}	$0.00 \times 10^{+00}$	5.96×10^{-08}	6.05×10^{-09}	2.18×10^{-06}	2.24×10^{-06}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.01×10^{-06}	5.86×10^{-10}	3.16×10^{-09}	4.97×10^{-05}	2.69×10^{-08}	9.45×10^{-07}	$0.00 \times 10^{+00}$	1.00×10^{-05}	3.63×10^{-06}	1.15×10^{-05}	7.98×10^{-05}
Subsistence Harvester One-Year-Old (Lloyd Lake)		Application Case												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.17×10^{-07}	1.67×10^{-12}	1.71×10^{-09}	6.24×10^{-07}	3.29×10^{-07}	1.12×10^{-07}	$0.00 \times 10^{+00}$	1.46×10^{-06}	2.29×10^{-07}	3.58×10^{-07}	3.73×10^{-06}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.71×10^{-07}	2.92×10^{-13}	1.85×10^{-09}	3.14×10^{-09}	3.58×10^{-07}	4.09×10^{-10}	$0.00 \times 10^{+00}$	1.59×10^{-06}	2.49×10^{-07}	3.89×10^{-07}	3.26×10^{-06}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.28×10^{-07}	1.41×10^{-13}	3.47×10^{-08}	2.03×10^{-08}	2.73×10^{-08}	2.94×10^{-11}	$0.00 \times 10^{+00}$	4.86×10^{-07}	8.98×10^{-08}	1.82×10^{-06}	2.91×10^{-06}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.15×10^{-06}	1.43×10^{-10}	9.94×10^{-08}	6.59×10^{-05}	3.74×10^{-07}	1.12×10^{-06}	$0.00 \times 10^{+00}$	2.61×10^{-06}	4.94×10^{-06}	1.39×10^{-06}	7.76×10^{-05}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.79×10^{-08}	3.66×10^{-15}	2.33×10^{-10}	9.31×10^{-10}	5.49×10^{-08}	5.07×10^{-11}	$0.00 \times 10^{+00}$	2.11×10^{-07}	1.86×10^{-09}	3.65×10^{-07}	6.62×10^{-07}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.82×10^{-10}	2.27×10^{-13}	1.29×10^{-07}	2.03×10^{-13}	$0.00 \times 10^{+00}$	9.69×10^{-08}	2.05×10^{-08}	2.80×10^{-06}	3.05×10^{-06}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.89×10^{-06}	1.45×10^{-10}	1.39×10^{-07}	6.65×10^{-05}	1.27×10^{-06}	1.23×10^{-06}	$0.00 \times 10^{+00}$	6.45×10^{-06}	5.53×10^{-06}	7.12×10^{-06}	9.12×10^{-05}
		Upper Bound Scenario												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.18×10^{-07}	1.67×10^{-12}	1.71×10^{-09}	6.24×10^{-07}	3.30×10^{-07}	1.12×10^{-07}	$0.00 \times 10^{+00}$	1.46×10^{-06}	2.29×10^{-07}	3.58×10^{-07}	3.73×10^{-06}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.72×10^{-07}	2.92×10^{-13}	1.85×10^{-09}	3.14×10^{-09}	3.59×10^{-07}	4.09×10^{-10}	$0.00 \times 10^{+00}$	1.59×10^{-06}	2.49×10^{-07}	3.89×10^{-07}	3.26×10^{-06}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.28×10^{-07}	1.41×10^{-13}	3.47×10^{-08}	2.03×10^{-08}	2.73×10^{-08}	2.94×10^{-11}	$0.00 \times 10^{+00}$	4.86×10^{-07}	8.98×10^{-08}	1.82×10^{-06}	2.91×10^{-06}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.16×10^{-06}	1.43×10^{-10}	9.94×10^{-08}	6.59×10^{-05}	3.75×10^{-07}	1.12×10^{-06}	$0.00 \times 10^{+00}$	2.62×10^{-06}	4.94×10^{-06}	1.39×10^{-06}	7.76×10^{-05}

	Radionuclide	Incremental Dose by Pathway - Far-Future (mSv/yr)												
		Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by Radionuclide
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.79×10^{-08}	3.69×10^{-15}	2.33×10^{-10}	9.31×10^{-10}	5.52×10^{-08}	5.07×10^{-11}	$0.00 \times 10^{+00}$	2.11×10^{-07}	1.86×10^{-09}	3.65×10^{-07}	6.63×10^{-07}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.82×10^{-10}	2.27×10^{-13}	1.29×10^{-07}	2.03×10^{-13}	$0.00 \times 10^{+00}$	1.04×10^{-07}	2.05×10^{-08}	2.80×10^{-06}	3.06×10^{-06}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.90×10^{-06}	1.45×10^{-10}	1.39×10^{-07}	6.65×10^{-05}	1.27×10^{-06}	1.23×10^{-06}	$0.00 \times 10^{+00}$	6.47×10^{-06}	5.53×10^{-06}	7.12×10^{-06}	9.12×10^{-05}
Seasonal Resident (Patterson Lake South Arm)		**Application Case**												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.58×10^{-05}	1.20×10^{-10}	1.29×10^{-09}	1.43×10^{-05}	1.44×10^{-07}	1.54×10^{-06}	$0.00 \times 10^{+00}$	1.40×10^{-05}	4.51×10^{-06}	8.43×10^{-06}	5.88×10^{-05}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.73×10^{-05}	2.10×10^{-11}	1.41×10^{-09}	7.23×10^{-08}	1.58×10^{-07}	5.60×10^{-09}	$0.00 \times 10^{+00}$	1.53×10^{-05}	4.92×10^{-06}	9.21×10^{-06}	4.69×10^{-05}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	9.24×10^{-06}	6.26×10^{-12}	3.59×10^{-08}	5.50×10^{-07}	1.01×10^{-08}	2.49×10^{-10}	$0.00 \times 10^{+00}$	3.92×10^{-06}	2.41×10^{-06}	4.42×10^{-05}	6.04×10^{-05}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.88×10^{-05}	8.40×10^{-09}	5.85×10^{-08}	1.52×10^{-03}	1.04×10^{-07}	1.25×10^{-05}	$0.00 \times 10^{+00}$	1.59×10^{-05}	7.57×10^{-05}	7.26×10^{-05}	1.71×10^{-03}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.21×10^{-06}	1.07×10^{-12}	9.46×10^{-11}	2.19×10^{-08}	4.08×10^{-08}	2.31×10^{-09}	$0.00 \times 10^{+00}$	3.43×10^{-06}	1.61×10^{-08}	9.27×10^{-05}	9.74×10^{-05}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.13×10^{-06}	6.40×10^{-15}	1.67×10^{-10}	4.95×10^{-12}	7.22×10^{-08}	9.91×10^{-12}	$0.00 \times 10^{+00}$	2.15×10^{-05}	1.39×10^{-07}	8.72×10^{-05}	1.11×10^{-04}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.45×10^{-05}	8.55×10^{-09}	9.74×10^{-08}	1.53×10^{-03}	5.29×10^{-07}	1.40×10^{-05}	$0.00 \times 10^{+00}$	7.40×10^{-05}	8.77×10^{-05}	3.14×10^{-04}	2.09×10^{-03}
		Upper Bound Scenario												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.58×10^{-05}	1.20×10^{-10}	1.29×10^{-09}	1.43×10^{-05}	1.44×10^{-07}	1.54×10^{-06}	$0.00 \times 10^{+00}$	1.40×10^{-05}	4.51×10^{-06}	8.43×10^{-06}	5.88×10^{-05}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.73×10^{-05}	2.10×10^{-11}	1.41×10^{-09}	7.23×10^{-08}	1.58×10^{-07}	5.61×10^{-09}	$0.00 \times 10^{+00}$	1.53×10^{-05}	4.92×10^{-06}	9.21×10^{-06}	4.70×10^{-05}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	9.24×10^{-06}	6.26×10^{-12}	3.59×10^{-08}	5.50×10^{-07}	1.01×10^{-08}	2.49×10^{-10}	$0.00 \times 10^{+00}$	3.92×10^{-06}	2.41×10^{-06}	4.42×10^{-05}	6.04×10^{-05}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.89×10^{-05}	8.42×10^{-09}	5.85×10^{-08}	1.52×10^{-03}	1.04×10^{-07}	1.25×10^{-05}	$0.00 \times 10^{+00}$	1.60×10^{-05}	7.57×10^{-05}	7.26×10^{-05}	1.71×10^{-03}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.22×10^{-06}	1.07×10^{-12}	9.46×10^{-11}	2.19×10^{-08}	4.10×10^{-08}	2.32×10^{-09}	$0.00 \times 10^{+00}$	3.44×10^{-06}	1.61×10^{-08}	9.31×10^{-05}	9.78×10^{-05}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.14×10^{-06}	6.43×10^{-15}	1.67×10^{-10}	4.95×10^{-12}	7.25×10^{-08}	9.95×10^{-12}	$0.00 \times 10^{+00}$	2.16×10^{-05}	1.39×10^{-07}	8.76×10^{-05}	1.11×10^{-04}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.46×10^{-05}	8.57×10^{-09}	9.74×10^{-08}	1.53×10^{-03}	5.31×10^{-07}	1.41×10^{-05}	$0.00 \times 10^{+00}$	7.42×10^{-05}	8.77×10^{-05}	3.15×10^{-04}	2.09×10^{-03}
Seasonal Resident One-Year-Old (Patterson Lake South Arm)		**Application Case**												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.10×10^{-05}	2.97×10^{-11}	5.26×10^{-08}	1.92×10^{-05}	5.87×10^{-06}	2.00×10^{-06}	$0.00 \times 10^{+00}$	8.24×10^{-06}	6.14×10^{-06}	3.84×10^{-06}	5.63×10^{-05}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.20×10^{-05}	5.20×10^{-12}	5.70×10^{-08}	9.68×10^{-08}	6.39×10^{-06}	7.29×10^{-09}	$0.00 \times 10^{+00}$	8.96×10^{-06}	6.65×10^{-06}	4.17×10^{-06}	3.83×10^{-05}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.70×10^{-06}	1.55×10^{-12}	1.07×10^{-06}	6.25×10^{-07}	3.00×10^{-07}	3.24×10^{-10}	$0.00 \times 10^{+00}$	1.69×10^{-06}	2.40×10^{-06}	2.16×10^{-05}	3.24×10^{-05}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.68×10^{-05}	2.08×10^{-09}	3.06×10^{-06}	2.03×10^{-03}	5.45×10^{-06}	1.63×10^{-05}	$0.00 \times 10^{+00}$	1.21×10^{-05}	1.32×10^{-04}	3.41×10^{-05}	2.25×10^{-03}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.65×10^{-06}	2.17×10^{-13}	7.45×10^{-09}	2.93×10^{-08}	3.25×10^{-06}	3.00×10^{-09}	$0.00 \times 10^{+00}$	3.95×10^{-06}	4.33×10^{-08}	1.18×10^{-04}	1.27×10^{-04}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.07×10^{-06}	1.59×10^{-15}	1.86×10^{-08}	6.48×10^{-12}	8.08×10^{-06}	1.29×10^{-11}	$0.00 \times 10^{+00}$	3.48×10^{-05}	5.20×10^{-07}	1.02×10^{-04}	1.49×10^{-04}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.02×10^{-05}	2.12×10^{-09}	4.26×10^{-06}	2.05×10^{-03}	2.93×10^{-05}	1.83×10^{-05}	$0.00 \times 10^{+00}$	6.98×10^{-05}	1.48×10^{-04}	2.83×10^{-04}	2.65×10^{-03}
		Upper Bound Scenario												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.10×10^{-05}	2.97×10^{-11}	5.26×10^{-08}	1.92×10^{-05}	5.88×10^{-06}	2.00×10^{-06}	$0.00 \times 10^{+00}$	8.25×10^{-06}	6.14×10^{-06}	3.84×10^{-06}	5.64×10^{-05}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.20×10^{-05}	5.21×10^{-12}	5.70×10^{-08}	9.68×10^{-08}	6.39×10^{-06}	7.29×10^{-09}	$0.00 \times 10^{+00}$	8.97×10^{-06}	6.65×10^{-06}	4.17×10^{-06}	3.83×10^{-05}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.70×10^{-06}	1.55×10^{-12}	1.07×10^{-06}	6.25×10^{-07}	3.00×10^{-07}	3.24×10^{-10}	$0.00 \times 10^{+00}$	1.69×10^{-06}	2.40×10^{-06}	2.16×10^{-05}	3.24×10^{-05}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.69×10^{-05}	2.08×10^{-09}	3.06×10^{-06}	2.03×10^{-03}	5.46×10^{-06}	1.63×10^{-05}	$0.00 \times 10^{+00}$	1.21×10^{-05}	1.32×10^{-04}	3.41×10^{-05}	2.25×10^{-03}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.66×10^{-06}	2.18×10^{-13}	7.45×10^{-09}	2.93×10^{-08}	3.26×10^{-06}	3.02×10^{-09}	$0.00 \times 10^{+00}$	3.97×10^{-06}	4.33×10^{-08}	1.18×10^{-04}	1.27×10^{-04}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.09×10^{-06}	1.59×10^{-15}	1.86×10^{-08}	6.48×10^{-12}	8.11×10^{-06}	1.29×10^{-11}	$0.00 \times 10^{+00}$	3.50×10^{-05}	5.20×10^{-07}	1.02×10^{-04}	1.50×10^{-04}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.03×10^{-05}	2.12×10^{-09}	4.26×10^{-06}	2.05×10^{-03}	2.94×10^{-05}	1.83×10^{-05}	$0.00 \times 10^{+00}$	7.00×10^{-05}	1.48×10^{-04}	2.84×10^{-04}	2.65×10^{-03}
Seasonal Resident (Lloyd Lake)		**Application Case**												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.33×10^{-07}	4.04×10^{-12}	2.52×10^{-11}	2.80×10^{-07}	4.86×10^{-09}	5.18×10^{-08}	$0.00 \times 10^{+00}$	2.27×10^{-06}	8.80×10^{-08}	2.08×10^{-07}	3.43×10^{-06}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.82×10^{-07}	7.07×10^{-13}	2.74×10^{-11}	1.41×10^{-09}	5.31×10^{-09}	1.89×10^{-10}	$0.00 \times 10^{+00}$	2.47×10^{-06}	9.58×10^{-08}	2.28×10^{-07}	3.39×10^{-06}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.04×10^{-07}	3.42×10^{-13}	6.99×10^{-10}	1.07×10^{-08}	5.50×10^{-10}	1.36×10^{-11}	$0.00 \times 10^{+00}$	4.47×10^{-07}	4.70×10^{-08}	8.83×10^{-07}	1.89×10^{-06}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	7.74×10^{-07}	3.46×10^{-10}	1.14×10^{-09}	2.95×10^{-05}	4.29×10^{-09}	5.14×10^{-07}	$0.00 \times 10^{+00}$	1.77×10^{-06}	1.47×10^{-06}	6.70×10^{-07}	3.47×10^{-05}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.22×10^{-08}	1.09×10^{-14}	9.09×10^{-13}	2.33×10^{-10}	4.15×10^{-10}	2.32×10^{-11}	$0.00 \times 10^{+00}$	7.56×10^{-04}	$0.00 \times 10^{+00}$	7.08×10^{-08}	7.56×10^{-04}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	3.18×10^{-12}	1.14×10^{-13}	6.84×10^{-10}	9.33×10^{-14}	$0.00 \times 10^{+00}$	5.10×10^{-04}	3.26×10^{-09}	6.56×10^{-07}	5.10×10^{-04}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.41×10^{-06}	3.51×10^{-10}	1.90×10^{-09}	2.98×10^{-05}	1.61×10^{-08}	5.66×10^{-07}	$0.00 \times 10^{+00}$	1.27×10^{-03}	1.71×10^{-06}	2.72×10^{-06}	1.31×10^{-03}
		Upper Bound Scenario												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.33×10^{-07}	4.05×10^{-12}	2.52×10^{-11}	2.80×10^{-07}	4.86×10^{-09}	5.19×10^{-08}	$0.00 \times 10^{+00}$	2.27×10^{-06}	8.80×10^{-08}	2.08×10^{-07}	3.43×10^{-06}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.83×10^{-07}	7.08×10^{-13}	2.74×10^{-11}	1.41×10^{-09}	5.32×10^{-09}	1.89×10^{-10}	$0.00 \times 10^{+00}$	2.47×10^{-06}	9.58×10^{-08}	2.28×10^{-07}	3.39×10^{-06}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.04×10^{-07}	3.42×10^{-13}	6.99×10^{-10}	1.07×10^{-08}	5.50×10^{-10}	1.36×10^{-11}	$0.00 \times 10^{+00}$	4.47×10^{-07}	4.70×10^{-08}	8.83×10^{-07}	1.89×10^{-06}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	7.76×10^{-07}	3.46×10^{-10}	1.14×10^{-09}	2.95×10^{-05}	4.30×10^{-09}	5.15×10^{-07}	$0.00 \times 10^{+00}$	1.77×10^{-06}	1.47×10^{-06}	6.70×10^{-07}	3.48×10^{-05}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.22×10^{-08}	1.09×10^{-14}	9.09×10^{-13}	2.33×10^{-10}	4.15×10^{-10}	2.34×10^{-11}	$0.00 \times 10^{+00}$	7.56×10^{-04}	$0.00 \times 10^{+00}$	7.08×10^{-08}	7.56×10^{-04}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	3.18×10^{-12}	1.14×10^{-13}	6.84×10^{-10}	9.41×10^{-14}	$0.00 \times 10^{+00}$	5.10×10^{-04}	3.26×10^{-09}	6.56×10^{-07}	5.10×10^{-04}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.41×10^{-06}	3.52×10^{-10}	1.90×10^{-09}	2.98×10^{-05}	1.61×10^{-08}	5.67×10^{-07}	$0.00 \times 10^{+00}$	1.27×10^{-03}	1.71×10^{-06}	2.72×10^{-06}	1.31×10^{-03}
Seasonal Resident One-Year-Old (Lloyd Lake)		**Application Case**												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	3.70×10^{-07}	9.99×10^{-13}	1.03×10^{-09}	3.74×10^{-07}	1.98×10^{-07}	6.74×10^{-08}	$0.00 \times 10^{+00}$	2.77×10^{-07}	1.20×10^{-07}	9.31×10^{-08}	1.50×10^{-06}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.03×10^{-07}	1.75×10^{-13}	1.11×10^{-09}	1.89×10^{-09}	2.15×10^{-07}	2.45×10^{-10}	$0.00 \times 10^{+00}$	3.02×10^{-07}	1.30×10^{-07}	1.01×10^{-07}	1.15×10^{-06}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.57×10^{-07}	8.46×10^{-14}	2.08×10^{-08}	1.22×10^{-08}	1.64×10^{-08}	1.77×10^{-11}	$0.00 \times 10^{+00}$	9.24×10^{-08}	4.68×10^{-08}	4.29×10^{-07}	8.74×10^{-07}

	Radionuclide	Incremental Dose by Pathway - Far-Future (mSv/yr)												
		Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by Radionuclide
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.92×10^{-07}	8.56×10^{-11}	5.96×10^{-08}	3.95×10^{-05}	2.24×10^{-07}	6.70×10^{-07}	$0.00 \times 10^{+00}$	4.97×10^{-07}	2.58×10^{-06}	2.70×10^{-07}	4.45×10^{-05}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.66×10^{-08}	2.22×10^{-15}	1.16×10^{-10}	4.66×10^{-10}	3.28×10^{-08}	3.05×10^{-11}	$0.00 \times 10^{+00}$	4.00×10^{-08}	9.31×10^{-10}	8.94×10^{-08}	1.80×10^{-07}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	3.49×10^{-10}	1.42×10^{-13}	7.73×10^{-08}	1.22×10^{-13}	$0.00 \times 10^{+00}$	2.24×10^{-08}	1.12×10^{-08}	8.05×10^{-07}	9.15×10^{-07}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.74×10^{-06}	8.68×10^{-11}	8.31×10^{-08}	3.99×10^{-05}	7.63×10^{-07}	7.38×10^{-07}	$0.00 \times 10^{+00}$	1.23×10^{-06}	2.89×10^{-06}	1.79×10^{-06}	4.91×10^{-05}
		Upper Bound Scenario												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	3.71×10^{-07}	1.00×10^{-12}	1.03×10^{-09}	3.74×10^{-07}	1.98×10^{-07}	6.74×10^{-08}	$0.00 \times 10^{+00}$	2.78×10^{-07}	1.20×10^{-07}	9.31×10^{-08}	1.50×10^{-06}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.03×10^{-07}	1.75×10^{-13}	1.11×10^{-09}	1.89×10^{-09}	2.15×10^{-07}	2.45×10^{-10}	$0.00 \times 10^{+00}$	3.02×10^{-07}	1.30×10^{-07}	1.01×10^{-07}	1.15×10^{-06}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.57×10^{-07}	8.46×10^{-14}	2.08×10^{-08}	1.22×10^{-08}	1.64×10^{-08}	1.77×10^{-11}	$0.00 \times 10^{+00}$	9.24×10^{-08}	4.68×10^{-08}	4.29×10^{-07}	8.74×10^{-07}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.94×10^{-07}	8.58×10^{-11}	5.96×10^{-08}	3.95×10^{-05}	2.25×10^{-07}	6.72×10^{-07}	$0.00 \times 10^{+00}$	4.98×10^{-07}	2.58×10^{-06}	2.70×10^{-07}	4.45×10^{-05}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.69×10^{-08}	2.22×10^{-15}	1.16×10^{-10}	4.66×10^{-10}	3.31×10^{-08}	3.05×10^{-11}	$0.00 \times 10^{+00}$	4.00×10^{-08}	9.31×10^{-10}	8.94×10^{-08}	1.81×10^{-07}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	3.49×10^{-10}	1.42×10^{-13}	7.73×10^{-08}	1.22×10^{-13}	$0.00 \times 10^{+00}$	2.24×10^{-08}	1.12×10^{-08}	8.34×10^{-07}	9.46×10^{-07}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.74×10^{-06}	8.71×10^{-11}	8.31×10^{-08}	3.99×10^{-05}	7.64×10^{-07}	7.40×10^{-07}	$0.00 \times 10^{+00}$	1.23×10^{-06}	2.89×10^{-06}	1.82×10^{-06}	4.92×10^{-05}
Permanent Resident (Patterson Lake North Arm - West Basin)		**Application Case**												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.91×10^{-04}	1.45×10^{-09}	2.64×10^{-08}	2.93×10^{-04}	1.74×10^{-06}	1.85×10^{-05}	$0.00 \times 10^{+00}$	5.31×10^{-04}	1.18×10^{-04}	2.38×10^{-04}	1.39×10^{-03}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.08×10^{-04}	2.53×10^{-10}	2.88×10^{-08}	1.48×10^{-06}	1.90×10^{-06}	6.75×10^{-08}	$0.00 \times 10^{+00}$	5.81×10^{-04}	1.28×10^{-04}	2.60×10^{-04}	1.18×10^{-03}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.00×10^{-05}	3.39×10^{-11}	7.33×10^{-07}	1.12×10^{-05}	5.48×10^{-08}	1.35×10^{-09}	$0.00 \times 10^{+00}$	6.70×10^{-05}	6.29×10^{-05}	5.31×10^{-04}	7.23×10^{-04}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.70×10^{-04}	7.61×10^{-08}	1.20×10^{-06}	3.10×10^{-02}	9.43×10^{-07}	1.13×10^{-04}	$0.00 \times 10^{+00}$	4.55×10^{-04}	1.97×10^{-03}	1.87×10^{-03}	3.55×10^{-02}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.15×10^{-05}	5.42×10^{-11}	1.93×10^{-09}	4.47×10^{-07}	2.07×10^{-06}	1.17×10^{-07}	$0.00 \times 10^{+00}$	5.48×10^{-04}	4.23×10^{-07}	9.16×10^{-04}	1.53×10^{-03}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.08×10^{-04}	3.24×10^{-13}	3.41×10^{-09}	1.01×10^{-10}	3.66×10^{-06}	5.02×10^{-10}	$0.00 \times 10^{+00}$	3.42×10^{-03}	3.61×10^{-06}	7.21×10^{-03}	1.07×10^{-02}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	7.89×10^{-04}	7.79×10^{-08}	1.99×10^{-06}	3.13×10^{-02}	1.04×10^{-05}	1.32×10^{-04}	$0.00 \times 10^{+00}$	5.61×10^{-03}	2.28×10^{-03}	1.10×10^{-02}	5.11×10^{-02}
		Upper Bound Scenario												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.91×10^{-04}	1.45×10^{-09}	2.64×10^{-08}	2.93×10^{-04}	1.74×10^{-06}	1.86×10^{-05}	$0.00 \times 10^{+00}$	5.32×10^{-04}	1.18×10^{-04}	2.38×10^{-04}	1.39×10^{-03}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.09×10^{-04}	2.53×10^{-10}	2.88×10^{-08}	1.48×10^{-06}	1.90×10^{-06}	6.76×10^{-08}	$0.00 \times 10^{+00}$	5.81×10^{-04}	1.28×10^{-04}	2.60×10^{-04}	1.18×10^{-03}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.00×10^{-05}	3.39×10^{-11}	7.33×10^{-07}	1.12×10^{-05}	5.48×10^{-08}	1.35×10^{-09}	$0.00 \times 10^{+00}$	6.70×10^{-05}	6.29×10^{-05}	5.31×10^{-04}	7.23×10^{-04}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.71×10^{-04}	7.63×10^{-08}	1.20×10^{-06}	3.10×10^{-02}	9.46×10^{-07}	1.13×10^{-04}	$0.00 \times 10^{+00}$	4.56×10^{-04}	1.97×10^{-03}	1.87×10^{-03}	3.56×10^{-02}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.18×10^{-05}	5.44×10^{-11}	1.93×10^{-09}	4.47×10^{-07}	2.08×10^{-06}	1.17×10^{-07}	$0.00 \times 10^{+00}$	5.50×10^{-04}	4.23×10^{-07}	9.20×10^{-04}	1.53×10^{-03}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.08×10^{-04}	3.25×10^{-13}	3.41×10^{-09}	1.01×10^{-10}	3.67×10^{-06}	5.04×10^{-10}	$0.00 \times 10^{+00}$	3.44×10^{-03}	3.61×10^{-06}	7.24×10^{-03}	1.08×10^{-02}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	7.90×10^{-04}	7.81×10^{-08}	1.99×10^{-06}	3.13×10^{-02}	1.04×10^{-05}	1.32×10^{-04}	$0.00 \times 10^{+00}$	5.63×10^{-03}	2.28×10^{-03}	1.11×10^{-02}	5.12×10^{-02}
Permanent Resident One-Year-Old (Patterson Lake North Arm - West Basin)		**Application Case**												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.33×10^{-04}	3.58×10^{-10}	1.07×10^{-06}	3.92×10^{-04}	7.07×10^{-05}	2.41×10^{-05}	$0.00 \times 10^{+00}$	3.13×10^{-04}	1.44×10^{-04}	1.08×10^{-04}	1.19×10^{-03}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.44×10^{-04}	6.27×10^{-11}	1.16×10^{-06}	1.98×10^{-06}	7.69×10^{-05}	8.78×10^{-08}	$0.00 \times 10^{+00}$	3.41×10^{-04}	1.56×10^{-04}	1.17×10^{-04}	8.38×10^{-04}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.54×10^{-05}	8.39×10^{-12}	2.18×10^{-05}	1.28×10^{-05}	1.63×10^{-06}	1.76×10^{-09}	$0.00 \times 10^{+00}$	2.89×10^{-05}	5.65×10^{-05}	2.54×10^{-04}	4.01×10^{-04}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.52×10^{-04}	1.88×10^{-08}	6.25×10^{-05}	4.14×10^{-02}	4.93×10^{-05}	1.47×10^{-04}	$0.00 \times 10^{+00}$	3.45×10^{-04}	3.11×10^{-03}	7.21×10^{-04}	4.60×10^{-02}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	8.36×10^{-05}	1.10×10^{-11}	1.53×10^{-07}	5.98×10^{-07}	1.65×10^{-04}	1.52×10^{-07}	$0.00 \times 10^{+00}$	6.32×10^{-04}	1.02×10^{-06}	1.09×10^{-03}	1.97×10^{-03}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.06×10^{-04}	8.02×10^{-14}	3.81×10^{-07}	1.32×10^{-10}	4.09×10^{-04}	6.52×10^{-10}	$0.00 \times 10^{+00}$	5.56×10^{-03}	1.22×10^{-05}	9.16×10^{-03}	1.53×10^{-02}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	7.44×10^{-04}	1.93×10^{-08}	8.72×10^{-05}	4.19×10^{-02}	7.72×10^{-04}	1.72×10^{-04}	$0.00 \times 10^{+00}$	7.22×10^{-03}	3.48×10^{-03}	1.14×10^{-02}	6.58×10^{-02}
		Upper Bound Scenario												
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.33×10^{-04}	3.58×10^{-10}	1.07×10^{-06}	3.92×10^{-04}	7.08×10^{-05}	2.41×10^{-05}	$0.00 \times 10^{+00}$	3.14×10^{-04}	1.44×10^{-04}	1.08×10^{-04}	1.19×10^{-03}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.44×10^{-04}	6.27×10^{-11}	1.16×10^{-06}	1.98×10^{-06}	7.70×10^{-05}	8.79×10^{-08}	$0.00 \times 10^{+00}$	3.41×10^{-04}	1.56×10^{-04}	1.17×10^{-04}	8.39×10^{-04}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.54×10^{-05}	8.39×10^{-12}	2.18×10^{-05}	1.28×10^{-05}	1.63×10^{-06}	1.76×10^{-09}	$0.00 \times 10^{+00}$	2.89×10^{-05}	5.65×10^{-05}	2.54×10^{-04}	4.01×10^{-04}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.52×10^{-04}	1.89×10^{-08}	6.25×10^{-05}	4.14×10^{-02}	4.93×10^{-05}	1.48×10^{-04}	$0.00 \times 10^{+00}$	3.46×10^{-04}	3.11×10^{-03}	7.21×10^{-04}	4.60×10^{-02}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	8.40×10^{-05}	1.10×10^{-11}	1.53×10^{-07}	5.98×10^{-07}	1.65×10^{-04}	1.53×10^{-07}	$0.00 \times 10^{+00}$	6.35×10^{-04}	1.02×10^{-06}	1.09×10^{-03}	1.98×10^{-03}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.07×10^{-04}	8.05×10^{-14}	3.81×10^{-07}	1.32×10^{-10}	4.11×10^{-04}	6.55×10^{-10}	$0.00 \times 10^{+00}$	5.58×10^{-03}	1.22×10^{-05}	9.20×10^{-03}	1.54×10^{-02}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	7.46×10^{-04}	1.93×10^{-08}	8.72×10^{-05}	4.19×10^{-02}	7.75×10^{-04}	1.72×10^{-04}	$0.00 \times 10^{+00}$	7.25×10^{-03}	3.48×10^{-03}	1.15×10^{-02}	6.58×10^{-02}

mSv/yr = millisieverts per year; n/a = not applicable or not assessed.

5.2.4.1.4 Radon Dose

The radon dose was calculated separately from the dose from other radionuclides and was estimated outside of IMPACT.

Project activities would result in the release of radon gas into the atmosphere. The atmospheric model for the Project used AERMOD to estimate radon concentrations at various locations based on radon source emissions (EIS Appendix 7A). The mine vent is the dominant source of radon emissions for the Project, representing approximately 98.6% of the total modelled radon emissions. The atmospheric model assumed that the maximum ore grade in year 1 of the Project (4.07%) occurs throughout the Project. The air quality dispersion model was developed as a reasonable upper bound due to the inherent conservatism associated with its configuration and therefore only the Application Case was run. For example, the air quality dispersion model makes the conservative assumption that emission sources from each piece of emitting equipment emit simultaneously and at their maximum possible emission rate. It is unlikely that all sources would emit at the same time; therefore, this assumption leads to higher than actual predicted deposition rates.

The camp worker would be exposed to radon through inhalation while at the camp site, located southwest of the mill terrace. The camp worker represents an adult who resides at the camp for 6 months of the year and away from the site for the remaining 6 months of the year. For exposure to radon, it has been conservatively assumed that the camp worker spends 100% of their time indoors when on site. The predicted radon concentration at the camp site, from AERMOD, is 44.5 Bq/m^3 (41.6 Bq/m^3 based on incremental radon, where background radon has been subtracted from the total).

The dose from radon in air considers ingrowth of radon decay progeny (polonium-218, lead-214, bismuth-214) during dispersion of radon gas from the source to receptor. Ingrowth was quantified in terms of the radon progeny equilibrium ratio, according to the methods outlined in Health Canada's federal guidance on contaminated site radiological risk assessment in Canada, Part VI (Health Canada 2010b). Radon dose is dependent on the radon equilibrium fraction as well as the exposure time for the receptor.

Consistent with recommendations in CSA N288.6-22 and Health Canada (2010b), the dose from radon in air was calculated according to the equation in Appendix A, Section 2.4.3, with input values shown in Table 5-11.

Indoor radon dose dominates over outdoor radon dose; and therefore, only indoor radon dose was quantified. However, the outdoor equilibrium fraction (F_{out}) was needed to estimate the indoor equilibrium fraction (F_{in}), which is needed to include short-lived progeny in the radon dose calculation.

Radon and radon progeny are expected to be in partial equilibrium at the mine exhaust vent. An initial time correction for estimating equilibrium fractions for radon and progeny from the mine ventilation was accounted for using guidance from USEPA (1985). A time correction factor of

11.79 minutes that corresponds to an equilibrium fraction of 0.2 was considered reasonable to account for the degree of equilibrium between radon and radon progeny in the mine exhaust vent (USEPA 1985). This initial time correction was added to the travel time.

Table 5-11: Summary of Input Parameters for Radon Dose Calculation

Parameter	Value	Source
C_{Rn} (background)	2.9 Bq/m^3	From baseline monitoring at site
C_{Rn} (camp site)	Max-year EA Case: 44.5 Bq/m^3	Atmospheric Model (EIS Section 7.2)
Distance from mine vent to camp	941 m	From AERMOD
Mean wind speed	212 m/min	From meteorological dataset
Initial time correction	11.79 min	USEPA 1985 – to account for partial equilibrium of radon and radon progeny in the mine vent
t (travel time to camp)	16.2 min	Calculated t = Initial time correction + (distance / wind speed)
Exposure time	4,380 h/yr	Assumption based on camp worker residency of 0.5 of the year
F_{out}	0.26	Calculated
F_{in}	0.44	Calculated

Bq/m^3 = becquerels per cubic metre; EA = Environmental Assessment; F_{out} = outdoor equilibrium fraction; F_{in} = indoor equilibrium fraction; C_{Rn} = concentration of radon in air; USEPA = United States Environmental Protection Agency.

The incremental radon dose to the camp worker during Operations from the Application Case is expected to be 0.51 mSv/yr.

5.2.4.2 Estimated Dose to Human Receptors – Reasonably Foreseeable Development Case

5.2.4.2.1 Non-carcinogen Doses

The doses for cobalt, copper, molybdenum, and uranium to the camp worker, subsistence harvester, and seasonal resident are presented by exposure pathway for the RFD Case in Table 5-12.

Table 5-12: Estimated Non-carcinogen Doses to Human Receptors – Reasonably Foreseeable Development Case

	COPC	Dose by Pathway RFD Case (mg/kg/d)							
		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^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	1.15×10^{-05}	7.21×10^{-06}	1.97×10^{-04}	2.25×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	3.81×10^{-04}	1.15×10^{-04}	1.66×10^{-02}	1.71×10^{-02}
	Molybdenum	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	3.39×10^{-08}	4.10×10^{-06}	2.30×10^{-03}	2.31×10^{-03}
	Uranium	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	2.06×10^{-06}	1.15×10^{-05}	4.37×10^{-05}	5.88×10^{-05}
	Project Lifespan								
	Cobalt	8.63×10^{-06}	9.06×10^{-09}	1.02×10^{-08}	$0.00 \times 10^{+00}$	1.33×10^{-05}	7.29×10^{-06}	2.01×10^{-04}	2.30×10^{-04}
	Copper	1.24×10^{-05}	1.28×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	4.18×10^{-04}	1.15×10^{-04}	1.66×10^{-02}	1.72×10^{-02}
	Molybdenum	3.04×10^{-06}	3.03×10^{-09}	4.55×10^{-09}	$0.00 \times 10^{+00}$	6.14×10^{-08}	4.17×10^{-06}	2.31×10^{-03}	2.31×10^{-03}
	Uranium	1.48×10^{-06}	1.68×10^{-08}	1.35×10^{-08}	$0.00 \times 10^{+00}$	6.36×10^{-06}	2.60×10^{-05}	5.29×10^{-05}	8.68×10^{-05}
	Far-Future								
	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 Adult (Patterson Lake South Arm)	**Base Case**								
	Cobalt	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	2.30×10^{-05}	1.44×10^{-05}	2.44×10^{-04}	2.90×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	7.61×10^{-04}	2.29×10^{-04}	1.75×10^{-02}	1.86×10^{-02}
	Molybdenum	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	6.77×10^{-08}	8.18×10^{-06}	1.95×10^{-03}	1.96×10^{-03}
	Uranium	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	4.11×10^{-06}	2.30×10^{-05}	4.92×10^{-05}	7.78×10^{-05}
	Project Lifespan								
	Cobalt	1.00×10^{-05}	9.05×10^{-09}	1.12×10^{-08}	$0.00 \times 10^{+00}$	2.65×10^{-05}	1.46×10^{-05}	2.51×10^{-04}	3.02×10^{-04}
	Copper	1.36×10^{-05}	1.26×10^{-08}	1.86×10^{-08}	$0.00 \times 10^{+00}$	8.34×10^{-04}	2.30×10^{-04}	1.77×10^{-02}	1.88×10^{-02}
	Molybdenum	5.72×10^{-06}	2.98×10^{-09}	7.11×10^{-09}	$0.00 \times 10^{+00}$	1.23×10^{-07}	8.34×10^{-06}	1.96×10^{-03}	1.97×10^{-03}

		Dose by Pathway RFD Case (mg/kg/d)							
	COPC	Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Uranium	4.68×10^{-06}	6.94×10^{-09}	2.23×10^{-08}	$0.00 \times 10^{+00}$	1.27×10^{-05}	5.20×10^{-05}	6.74×10^{-05}	1.37×10^{-04}
	Far-Future								
	Cobalt	1.23×10^{-05}	9.05×10^{-09}	1.46×10^{-08}	$0.00 \times 10^{+00}$	3.30×10^{-05}	1.44×10^{-05}	2.73×10^{-04}	3.33×10^{-04}
	Copper	1.82×10^{-05}	1.26×10^{-08}	2.57×10^{-08}	$0.00 \times 10^{+00}$	1.12×10^{-03}	2.30×10^{-04}	1.79×10^{-02}	1.92×10^{-02}
	Molybdenum	2.18×10^{-05}	2.98×10^{-09}	3.26×10^{-08}	$0.00 \times 10^{+00}$	4.86×10^{-07}	8.18×10^{-06}	1.97×10^{-03}	2.01×10^{-03}
	Uranium	3.31×10^{-06}	5.36×10^{-09}	3.02×10^{-08}	$0.00 \times 10^{+00}$	9.23×10^{-06}	2.39×10^{-05}	5.18×10^{-05}	8.83×10^{-05}
Subsistence Harvester One-Year-Old (Patterson Lake South Arm)	**Base Case**								
	Cobalt	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	2.18×10^{-05}	2.84×10^{-05}	4.78×10^{-04}	5.39×10^{-04}
	Copper	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	7.21×10^{-04}	4.52×10^{-04}	4.13×10^{-02}	4.25×10^{-02}
	Molybdenum	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	6.42×10^{-08}	1.61×10^{-05}	6.06×10^{-03}	6.08×10^{-03}
	Uranium	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	3.90×10^{-06}	4.54×10^{-05}	1.02×10^{-04}	1.54×10^{-04}
	Project Lifespan								
	Cobalt	1.12×10^{-05}	5.91×10^{-07}	7.34×10^{-07}	$0.00 \times 10^{+00}$	2.52×10^{-05}	2.86×10^{-05}	4.85×10^{-04}	5.51×10^{-04}
	Copper	1.52×10^{-05}	8.22×10^{-07}	1.22×10^{-06}	$0.00 \times 10^{+00}$	7.91×10^{-04}	4.53×10^{-04}	4.15×10^{-02}	4.27×10^{-02}
	Molybdenum	6.39×10^{-06}	1.95×10^{-07}	4.65×10^{-07}	$0.00 \times 10^{+00}$	1.16×10^{-07}	1.63×10^{-05}	6.07×10^{-03}	6.09×10^{-03}
	Uranium	5.23×10^{-06}	4.54×10^{-07}	1.46×10^{-06}	$0.00 \times 10^{+00}$	1.20×10^{-05}	8.90×10^{-05}	1.15×10^{-04}	2.24×10^{-04}
	Far-Future								
	Cobalt	1.38×10^{-05}	5.91×10^{-07}	9.54×10^{-07}	$0.00 \times 10^{+00}$	3.13×10^{-05}	2.84×10^{-05}	5.08×10^{-04}	5.83×10^{-04}
	Copper	2.03×10^{-05}	8.21×10^{-07}	1.68×10^{-06}	$0.00 \times 10^{+00}$	1.06×10^{-03}	4.52×10^{-04}	4.16×10^{-02}	4.32×10^{-02}
	Molybdenum	2.43×10^{-05}	1.95×10^{-07}	2.13×10^{-06}	$0.00 \times 10^{+00}$	4.61×10^{-07}	1.61×10^{-05}	6.08×10^{-03}	6.13×10^{-03}
	Uranium	3.70×10^{-06}	3.50×10^{-07}	1.98×10^{-06}	$0.00 \times 10^{+00}$	8.75×10^{-06}	4.70×10^{-05}	1.04×10^{-04}	1.66×10^{-04}
Subsistence Harvester Adult (Beet Lake)	**Base Case**								
	Cobalt	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	2.30×10^{-05}	1.44×10^{-05}	2.44×10^{-04}	2.90×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	7.61×10^{-04}	2.29×10^{-04}	1.75×10^{-02}	1.86×10^{-02}
	Molybdenum	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	6.77×10^{-08}	8.18×10^{-06}	1.95×10^{-03}	1.96×10^{-03}

	COPC	Dose by Pathway RFD Case (mg/kg/d) Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Uranium	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	4.11×10^{-06}	2.30×10^{-05}	4.92×10^{-05}	7.78×10^{-05}
	Project Lifespan								
	Cobalt	9.22×10^{-06}	9.05×10^{-09}	1.07×10^{-08}	$0.00 \times 10^{+00}$	2.45×10^{-05}	1.46×10^{-05}	2.47×10^{-04}	2.96×10^{-04}
	Copper	1.29×10^{-05}	1.26×10^{-08}	1.81×10^{-08}	$0.00 \times 10^{+00}$	7.93×10^{-04}	2.30×10^{-04}	1.76×10^{-02}	1.86×10^{-02}
	Molybdenum	4.23×10^{-06}	2.98×10^{-09}	5.88×10^{-09}	$0.00 \times 10^{+00}$	9.23×10^{-08}	8.34×10^{-06}	1.95×10^{-03}	1.97×10^{-03}
	Uranium	2.59×10^{-06}	6.16×10^{-09}	1.67×10^{-08}	$0.00 \times 10^{+00}$	7.09×10^{-06}	3.92×10^{-05}	5.60×10^{-05}	1.05×10^{-04}
	Far-Future								
	Cobalt	1.06×10^{-05}	9.05×10^{-09}	1.25×10^{-08}	$0.00 \times 10^{+00}$	2.83×10^{-05}	1.44×10^{-05}	2.54×10^{-04}	3.08×10^{-04}
	Copper	1.54×10^{-05}	1.26×10^{-08}	2.18×10^{-08}	$0.00 \times 10^{+00}$	9.46×10^{-04}	2.29×10^{-04}	1.77×10^{-02}	1.89×10^{-02}
	Molybdenum	1.28×10^{-05}	2.98×10^{-09}	1.92×10^{-08}	$0.00 \times 10^{+00}$	2.86×10^{-07}	8.18×10^{-06}	1.96×10^{-03}	1.98×10^{-03}
	Uranium	2.16×10^{-06}	5.28×10^{-09}	1.97×10^{-08}	$0.00 \times 10^{+00}$	6.01×10^{-06}	2.35×10^{-05}	5.01×10^{-05}	8.18×10^{-05}
Subsistence Harvester One-Year-Old (Beet Lake)	**Base Case**								
	Cobalt	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	2.18×10^{-05}	2.84×10^{-05}	4.78×10^{-04}	5.39×10^{-04}
	Copper	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	7.21×10^{-04}	4.52×10^{-04}	4.13×10^{-02}	4.25×10^{-02}
	Molybdenum	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	6.42×10^{-08}	1.61×10^{-05}	6.06×10^{-03}	6.08×10^{-03}
	Uranium	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	3.90×10^{-06}	4.54×10^{-05}	1.02×10^{-04}	1.54×10^{-04}
	Project Lifespan								
	Cobalt	1.03×10^{-05}	5.91×10^{-07}	7.01×10^{-07}	$0.00 \times 10^{+00}$	2.33×10^{-05}	2.86×10^{-05}	4.81×10^{-04}	5.45×10^{-04}
	Copper	1.44×10^{-05}	8.22×10^{-07}	1.18×10^{-06}	$0.00 \times 10^{+00}$	7.52×10^{-04}	4.53×10^{-04}	4.13×10^{-02}	4.26×10^{-02}
	Molybdenum	4.73×10^{-06}	1.95×10^{-07}	3.84×10^{-07}	$0.00 \times 10^{+00}$	8.75×10^{-08}	1.63×10^{-05}	6.06×10^{-03}	6.08×10^{-03}
	Uranium	2.89×10^{-06}	4.03×10^{-07}	1.09×10^{-06}	$0.00 \times 10^{+00}$	6.73×10^{-06}	6.98×10^{-05}	1.07×10^{-04}	1.88×10^{-04}
	Far-Future								
	Cobalt	1.18×10^{-05}	5.91×10^{-07}	8.17×10^{-07}	$0.00 \times 10^{+00}$	2.68×10^{-05}	2.84×10^{-05}	4.89×10^{-04}	5.57×10^{-04}
	Copper	1.72×10^{-05}	8.21×10^{-07}	1.43×10^{-06}	$0.00 \times 10^{+00}$	8.97×10^{-04}	4.52×10^{-04}	4.14×10^{-02}	4.28×10^{-02}
	Molybdenum	1.43×10^{-05}	1.95×10^{-07}	1.25×10^{-06}	$0.00 \times 10^{+00}$	2.71×10^{-07}	1.61×10^{-05}	6.07×10^{-03}	6.10×10^{-03}

		Dose by Pathway RFD Case (mg/kg/d)							
	COPC	**Water (Internal)**	**Soil (Internal)**	**Sediment (Internal)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial Animals**	**Total by COPC**
	Uranium	2.41×10^{-06}	3.45×10^{-07}	1.29×10^{-06}	$0.00 \times 10^{+00}$	5.70×10^{-06}	4.63×10^{-05}	1.03×10^{-04}	1.59×10^{-04}
Subsistence Harvester Adult (Lloyd Lake)	**Base Case**								
	Cobalt	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	2.30×10^{-05}	1.44×10^{-05}	2.44×10^{-04}	2.90×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	7.61×10^{-04}	2.29×10^{-04}	1.75×10^{-02}	1.86×10^{-02}
	Molybdenum	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	6.77×10^{-08}	8.18×10^{-06}	1.95×10^{-03}	1.96×10^{-03}
	Uranium	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	4.11×10^{-06}	2.30×10^{-05}	4.92×10^{-05}	7.78×10^{-05}
	Project Lifespan								
	Cobalt	8.64×10^{-06}	9.05×10^{-09}	1.02×10^{-08}	$0.00 \times 10^{+00}$	2.31×10^{-05}	1.46×10^{-05}	2.45×10^{-04}	2.91×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	7.64×10^{-04}	2.30×10^{-04}	1.76×10^{-02}	1.86×10^{-02}
	Molybdenum	3.16×10^{-06}	2.98×10^{-09}	4.68×10^{-09}	$0.00 \times 10^{+00}$	7.02×10^{-08}	8.34×10^{-06}	1.95×10^{-03}	1.97×10^{-03}
	Uranium	1.58×10^{-06}	5.19×10^{-09}	1.38×10^{-08}	$0.00 \times 10^{+00}$	4.39×10^{-06}	2.32×10^{-05}	4.93×10^{-05}	7.85×10^{-05}
	Far-Future								
	Cobalt	8.78×10^{-06}	9.05×10^{-09}	1.04×10^{-08}	$0.00 \times 10^{+00}$	2.35×10^{-05}	1.44×10^{-05}	2.45×10^{-04}	2.92×10^{-04}
	Copper	1.27×10^{-05}	1.26×10^{-08}	1.80×10^{-08}	$0.00 \times 10^{+00}$	7.80×10^{-04}	2.29×10^{-04}	1.76×10^{-02}	1.86×10^{-02}
	Molybdenum	4.03×10^{-06}	2.98×10^{-09}	6.03×10^{-09}	$0.00 \times 10^{+00}$	8.99×10^{-08}	8.18×10^{-06}	1.95×10^{-03}	1.97×10^{-03}
	Uranium	1.54×10^{-06}	5.18×10^{-09}	1.40×10^{-08}	$0.00 \times 10^{+00}$	4.28×10^{-06}	2.30×10^{-05}	4.92×10^{-05}	7.81×10^{-05}
Subsistence Harvester One-Year-Old (Lloyd Lake)	**Base Case**								
	Cobalt	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	2.18×10^{-05}	2.84×10^{-05}	4.78×10^{-04}	5.39×10^{-04}
	Copper	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	7.21×10^{-04}	4.52×10^{-04}	4.13×10^{-02}	4.25×10^{-02}
	Molybdenum	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	6.42×10^{-08}	1.61×10^{-05}	6.06×10^{-03}	6.08×10^{-03}
	Uranium	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	3.90×10^{-06}	4.54×10^{-05}	1.02×10^{-04}	1.54×10^{-04}
	Project Lifespan								
	Cobalt	9.65×10^{-06}	5.91×10^{-07}	6.66×10^{-07}	$0.00 \times 10^{+00}$	2.19×10^{-05}	2.86×10^{-05}	4.79×10^{-04}	5.40×10^{-04}
	Copper	1.39×10^{-05}	8.22×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	7.24×10^{-04}	4.53×10^{-04}	4.13×10^{-02}	4.25×10^{-02}
	Molybdenum	3.52×10^{-06}	1.95×10^{-07}	3.06×10^{-07}	$0.00 \times 10^{+00}$	6.65×10^{-08}	1.63×10^{-05}	6.06×10^{-03}	6.08×10^{-03}

		Dose by Pathway RFD Case (mg/kg/d)							
	COPC	Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Uranium	1.76×10^{-06}	3.39×10^{-07}	8.99×10^{-07}	$0.00 \times 10^{+00}$	4.16×10^{-06}	4.57×10^{-05}	1.02×10^{-04}	1.55×10^{-04}
	Far-Future								
	Cobalt	9.80×10^{-06}	5.91×10^{-07}	6.78×10^{-07}	$0.00 \times 10^{+00}$	2.23×10^{-05}	2.84×10^{-05}	4.79×10^{-04}	5.41×10^{-04}
	Copper	1.42×10^{-05}	8.21×10^{-07}	1.18×10^{-06}	$0.00 \times 10^{+00}$	7.39×10^{-04}	4.52×10^{-04}	4.13×10^{-02}	4.25×10^{-02}
	Molybdenum	4.50×10^{-06}	1.95×10^{-07}	3.94×10^{-07}	$0.00 \times 10^{+00}$	8.52×10^{-08}	1.61×10^{-05}	6.06×10^{-03}	6.08×10^{-03}
	Uranium	1.72×10^{-06}	3.38×10^{-07}	9.16×10^{-07}	$0.00 \times 10^{+00}$	4.06×10^{-06}	4.54×10^{-05}	1.02×10^{-04}	1.55×10^{-04}
Seasonal Resident Adult (Patterson Lake South Arm)	**Base Case**								
	Cobalt	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	7.27×10^{-06}	1.13×10^{-05}	1.88×10^{-04}	2.15×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	2.41×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.69×10^{-02}
	Molybdenum	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	2.14×10^{-08}	6.42×10^{-06}	2.41×10^{-03}	2.42×10^{-03}
	Uranium	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	1.30×10^{-06}	1.81×10^{-05}	4.08×10^{-05}	6.16×10^{-05}
	Project Lifespan								
	Cobalt	9.45×10^{-06}	9.05×10^{-09}	1.08×10^{-08}	$0.00 \times 10^{+00}$	7.96×10^{-06}	1.13×10^{-05}	1.89×10^{-04}	2.18×10^{-04}
	Copper	1.31×10^{-05}	1.26×10^{-08}	1.82×10^{-08}	$0.00 \times 10^{+00}$	2.55×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.69×10^{-02}
	Molybdenum	4.65×10^{-06}	2.98×10^{-09}	6.08×10^{-09}	$0.00 \times 10^{+00}$	3.19×10^{-08}	6.46×10^{-06}	2.41×10^{-03}	2.42×10^{-03}
	Uranium	3.40×10^{-06}	6.24×10^{-09}	1.88×10^{-08}	$0.00 \times 10^{+00}$	2.94×10^{-06}	2.71×10^{-05}	4.42×10^{-05}	7.77×10^{-05}
	Far-Future								
	Cobalt	1.08×10^{-05}	9.04×10^{-09}	1.28×10^{-08}	$0.00 \times 10^{+00}$	9.19×10^{-06}	1.13×10^{-05}	1.95×10^{-04}	2.26×10^{-04}
	Copper	1.59×10^{-05}	1.26×10^{-08}	2.25×10^{-08}	$0.00 \times 10^{+00}$	3.08×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.70×10^{-02}
	Molybdenum	1.43×10^{-05}	2.98×10^{-09}	2.14×10^{-08}	$0.00 \times 10^{+00}$	1.01×10^{-07}	6.42×10^{-06}	2.41×10^{-03}	2.43×10^{-03}
	Uranium	2.58×10^{-06}	5.29×10^{-09}	2.35×10^{-08}	$0.00 \times 10^{+00}$	2.28×10^{-06}	1.85×10^{-05}	4.14×10^{-05}	6.47×10^{-05}
Seasonal Resident One-Year-Old (Patterson Lake South Arm)	**Base Case**								
	Cobalt	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	6.89×10^{-06}	2.47×10^{-05}	4.13×10^{-04}	4.56×10^{-04}
	Copper	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	2.29×10^{-04}	3.93×10^{-04}	3.97×10^{-02}	4.03×10^{-02}
	Molybdenum	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	2.03×10^{-08}	1.40×10^{-05}	6.38×10^{-03}	6.40×10^{-03}

		Dose by Pathway RFD Case (mg/kg/d)							
	COPC	Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Uranium	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	1.23×10^{-06}	3.95×10^{-05}	9.62×10^{-05}	1.40×10^{-04}
	Project Lifespan								
	Cobalt	1.06×10^{-05}	5.91×10^{-07}	7.06×10^{-07}	$0.00 \times 10^{+00}$	7.54×10^{-06}	2.48×10^{-05}	4.15×10^{-04}	4.59×10^{-04}
	Copper	1.47×10^{-05}	8.22×10^{-07}	1.19×10^{-06}	$0.00 \times 10^{+00}$	2.42×10^{-04}	3.93×10^{-04}	3.97×10^{-02}	4.04×10^{-02}
	Molybdenum	5.19×10^{-06}	1.95×10^{-07}	3.98×10^{-07}	$0.00 \times 10^{+00}$	3.03×10^{-08}	1.41×10^{-05}	6.38×10^{-03}	6.40×10^{-03}
	Uranium	3.80×10^{-06}	4.07×10^{-07}	1.23×10^{-06}	$0.00 \times 10^{+00}$	2.78×10^{-06}	5.57×10^{-05}	9.87×10^{-05}	1.63×10^{-04}
	Far-Future								
	Cobalt	1.21×10^{-05}	5.91×10^{-07}	8.37×10^{-07}	$0.00 \times 10^{+00}$	8.71×10^{-06}	2.47×10^{-05}	4.21×10^{-04}	4.68×10^{-04}
	Copper	1.77×10^{-05}	8.21×10^{-07}	1.47×10^{-06}	$0.00 \times 10^{+00}$	2.92×10^{-04}	3.93×10^{-04}	3.98×10^{-02}	4.05×10^{-02}
	Molybdenum	1.60×10^{-05}	1.95×10^{-07}	1.40×10^{-06}	$0.00 \times 10^{+00}$	9.58×10^{-08}	1.40×10^{-05}	6.38×10^{-03}	6.41×10^{-03}
	Uranium	2.88×10^{-06}	3.45×10^{-07}	1.54×10^{-06}	$0.00 \times 10^{+00}$	2.16×10^{-06}	4.03×10^{-05}	9.67×10^{-05}	1.44×10^{-04}
Seasonal Resident Adult (Lloyd Lake)	**Base Case**								
	Cobalt	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	7.27×10^{-06}	1.13×10^{-05}	1.88×10^{-04}	2.15×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	2.41×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.69×10^{-02}
	Molybdenum	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	2.14×10^{-08}	6.42×10^{-06}	2.41×10^{-03}	2.42×10^{-03}
	Uranium	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	1.30×10^{-06}	1.81×10^{-05}	4.08×10^{-05}	6.16×10^{-05}
	Project Lifespan								
	Cobalt	8.62×10^{-06}	9.05×10^{-09}	1.02×10^{-08}	$0.00 \times 10^{+00}$	7.33×10^{-06}	1.13×10^{-05}	1.88×10^{-04}	2.15×10^{-04}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	3.21×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.70×10^{-02}
	Molybdenum	3.11×10^{-06}	2.98×10^{-09}	4.63×10^{-09}	$0.00 \times 10^{+00}$	2.23×10^{-08}	6.46×10^{-06}	2.41×10^{-03}	2.42×10^{-03}
	Uranium	1.54×10^{-06}	5.18×10^{-09}	1.36×10^{-08}	$0.00 \times 10^{+00}$	1.73×10^{-06}	1.81×10^{-05}	4.08×10^{-05}	6.22×10^{-05}
	Far-Future								
	Cobalt	8.70×10^{-06}	9.04×10^{-09}	1.03×10^{-08}	$0.00 \times 10^{+00}$	7.45×10^{-06}	1.13×10^{-05}	1.88×10^{-04}	2.16×10^{-04}
	Copper	1.26×10^{-05}	1.26×10^{-08}	1.78×10^{-08}	$0.00 \times 10^{+00}$	3.28×10^{-04}	1.80×10^{-04}	1.65×10^{-02}	1.70×10^{-02}
	Molybdenum	3.63×10^{-06}	2.98×10^{-09}	5.44×10^{-09}	$0.00 \times 10^{+00}$	2.85×10^{-08}	6.42×10^{-06}	2.41×10^{-03}	2.42×10^{-03}

		Dose by Pathway RFD Case (mg/kg/d)							
	COPC	**Water (Internal)**	**Soil (Internal)**	**Sediment (Internal)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial Animals**	**Total by COPC**
	Uranium	1.51×10^{-06}	5.18×10^{-09}	1.38×10^{-08}	$0.00 \times 10^{+00}$	1.68×10^{-06}	1.81×10^{-05}	4.08×10^{-05}	6.21×10^{-05}
Seasonal Resident One-Year-Old (Lloyd Lake)	**Base Case**								
	Cobalt	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	6.89×10^{-06}	2.47×10^{-05}	4.13×10^{-04}	4.56×10^{-04}
	Copper	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	2.29×10^{-04}	3.93×10^{-04}	3.97×10^{-02}	4.03×10^{-02}
	Molybdenum	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	2.03×10^{-08}	1.40×10^{-05}	6.38×10^{-03}	6.40×10^{-03}
	Uranium	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	1.23×10^{-06}	3.95×10^{-05}	9.62×10^{-05}	1.40×10^{-04}
	Project Lifespan								
	Cobalt	9.62×10^{-06}	5.91×10^{-07}	6.65×10^{-07}	$0.00 \times 10^{+00}$	6.92×10^{-06}	2.48×10^{-05}	4.14×10^{-04}	4.56×10^{-04}
	Copper	1.39×10^{-05}	8.22×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	2.29×10^{-04}	3.93×10^{-04}	3.97×10^{-02}	4.03×10^{-02}
	Molybdenum	3.47×10^{-06}	1.95×10^{-07}	3.02×10^{-07}	$0.00 \times 10^{+00}$	2.08×10^{-08}	1.41×10^{-05}	6.38×10^{-03}	6.40×10^{-03}
	Uranium	1.72×10^{-06}	3.39×10^{-07}	8.91×10^{-07}	$0.00 \times 10^{+00}$	1.28×10^{-06}	3.96×10^{-05}	9.63×10^{-05}	1.40×10^{-04}
	Far-Future								
	Cobalt	9.71×10^{-06}	5.91×10^{-07}	6.72×10^{-07}	$0.00 \times 10^{+00}$	6.99×10^{-06}	2.47×10^{-05}	4.14×10^{-04}	4.56×10^{-04}
	Copper	1.40×10^{-05}	8.21×10^{-07}	1.16×10^{-06}	$0.00 \times 10^{+00}$	2.32×10^{-04}	3.93×10^{-04}	3.97×10^{-02}	4.03×10^{-02}
	Molybdenum	4.06×10^{-06}	1.95×10^{-07}	3.55×10^{-07}	$0.00 \times 10^{+00}$	2.43×10^{-08}	1.40×10^{-05}	6.38×10^{-03}	6.40×10^{-03}
	Uranium	1.69×10^{-06}	3.38×10^{-07}	9.02×10^{-07}	$0.00 \times 10^{+00}$	1.27×10^{-06}	3.95×10^{-05}	9.63×10^{-05}	1.40×10^{-04}
Permanent Resident (Patterson Lake North Arm - West Basin)	**Base Case Adult**								
	Cobalt	8.58×10^{-06}	9.04×10^{-09}	1.01×10^{-08}	$0.00 \times 10^{+00}$	2.30×10^{-05}	1.44×10^{-05}	2.44×10^{-04}	1.24×10^{-05}
	Copper	1.24×10^{-05}	1.26×10^{-08}	1.76×10^{-08}	$0.00 \times 10^{+00}$	7.61×10^{-04}	2.29×10^{-04}	1.75×10^{-02}	1.48×10^{-06}
	Molybdenum	3.04×10^{-06}	2.98×10^{-09}	4.54×10^{-09}	$0.00 \times 10^{+00}$	6.77×10^{-08}	8.18×10^{-06}	1.95×10^{-03}	$0.00 \times 10^{+00}$
	Uranium	1.48×10^{-06}	5.17×10^{-09}	1.35×10^{-08}	$0.00 \times 10^{+00}$	4.11×10^{-06}	2.30×10^{-05}	4.92×10^{-05}	3.04×10^{-06}
	Base Case One-Year Old								
	Cobalt	9.58×10^{-06}	5.91×10^{-07}	6.62×10^{-07}	$0.00 \times 10^{+00}$	2.18×10^{-05}	2.84×10^{-05}	4.78×10^{-04}	1.38×10^{-05}
	Copper	1.38×10^{-05}	8.21×10^{-07}	1.15×10^{-06}	$0.00 \times 10^{+00}$	7.21×10^{-04}	4.52×10^{-04}	4.13×10^{-02}	1.65×10^{-06}
	Molybdenum	3.39×10^{-06}	1.95×10^{-07}	2.97×10^{-07}	$0.00 \times 10^{+00}$	6.42×10^{-08}	1.61×10^{-05}	6.06×10^{-03}	$0.00 \times 10^{+00}$

	Dose by Pathway RFD Case (mg/kg/d)								
	COPC	**Water (Internal)**	**Soil (Internal)**	**Sediment (Internal)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial Animals**	**Total by COPC**
	Uranium	1.65×10^{-06}	3.38×10^{-07}	8.79×10^{-07}	$0.00 \times 10^{+00}$	3.90×10^{-06}	4.54×10^{-05}	1.02×10^{-04}	3.39×10^{-06}
	Far-Future Adult								
	Cobalt	2.10×10^{-05}	9.05×10^{-09}	2.48×10^{-08}	$0.00 \times 10^{+00}$	5.62×10^{-05}	1.44×10^{-05}	3.08×10^{-04}	3.21×10^{-05}
	Copper	3.21×10^{-05}	1.26×10^{-08}	4.54×10^{-08}	$0.00 \times 10^{+00}$	1.97×10^{-03}	2.30×10^{-04}	1.83×10^{-02}	1.48×10^{-05}
	Molybdenum	6.77×10^{-05}	2.98×10^{-09}	1.01×10^{-07}	$0.00 \times 10^{+00}$	1.51×10^{-06}	8.18×10^{-06}	2.00×10^{-03}	$0.00 \times 10^{+00}$
	Uranium	1.48×10^{-05}	7.50×10^{-09}	1.35×10^{-07}	$0.00 \times 10^{+00}$	4.11×10^{-05}	3.34×10^{-05}	6.77×10^{-05}	6.77×10^{-05}
	Far Future One-Year Old								
	Cobalt	2.34×10^{-05}	5.92×10^{-07}	1.62×10^{-06}	$0.00 \times 10^{+00}$	5.33×10^{-05}	2.84×10^{-05}	5.43×10^{-04}	3.58×10^{-05}
	Copper	3.58×10^{-05}	8.23×10^{-07}	2.97×10^{-06}	$0.00 \times 10^{+00}$	1.87×10^{-03}	4.53×10^{-04}	4.20×10^{-02}	1.65×10^{-05}
	Molybdenum	7.56×10^{-05}	1.95×10^{-07}	6.62×10^{-06}	$0.00 \times 10^{+00}$	1.43×10^{-06}	1.61×10^{-05}	6.11×10^{-03}	$0.00 \times 10^{+00}$
	Uranium	1.65×10^{-05}	4.90×10^{-07}	8.80×10^{-06}	$0.00 \times 10^{+00}$	3.90×10^{-05}	6.58×10^{-05}	1.16×10^{-04}	7.56×10^{-05}

COPC = constituents of potential concern; n/a = not applicable or not assessed; RFD = reasonably foreseeable development.

5.2.4.2.2 Carcinogen Doses

Arsenic was evaluated in the HHRA as a non-threshold carcinogen; therefore, the exposure would be averaged over the receptor's lifetime to estimate a lifetime average daily dose (Health Canada 2021a). For this assessment, the lifetime average daily dose was estimated for various age groups (toddler, child, teen, 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 estimated lifetime average daily dose for the RFD case for Operations and the far-future projection is presented in Table 5-13.

Table 5-13: Estimated Carcinogen Doses for Arsenic to Human Receptors – Reasonably Foreseeable Development Case – Operations and Far-Future Projection

	Lifetime Average Daily Dose (mg/kg/d)												
	Reasonably Foreseeable Development Case – Operations						Reasonably Foreseeable Development – Far-Future Projection						
Age Group	Camp Worker	Subsistence Harvester - Patterson Lake South Arm	Subsistence Harvester - Beet Lake	Subsistence Harvester - Lloyd Lake	Seasonal Resident - Patterson Lake South Arm	Seasonal Resident - Lloyd Lake	Permanent Resident	Subsistence Harvester - Patterson Lake South Arm	Subsistence Harvester - Beet Lake	Subsistence Harvester - Lloyd Lake	Seasonal Resident - Patterson Lake South Arm	Seasonal Resident - Lloyd Lake
1 year old	n/a	2.80×10^{-06}	5.63×10^{-08}	2.60×10^{-08}	5.80×10^{-07}	6.15×10^{-09}	1.25×10^{-07}	2.37×10^{-08}	8.31×10^{-10}	4.79×10^{-11}	8.28×10^{-09}	1.60×10^{-11}
Child	n/a	6.55×10^{-06}	1.28×10^{-07}	5.77×10^{-08}	1.35×10^{-06}	1.28×10^{-08}	2.90×10^{-07}	5.05×10^{-08}	1.92×10^{-09}	1.11×10^{-10}	1.77×10^{-08}	3.70×10^{-11}
Teen	n/a	4.86×10^{-06}	1.02×10^{-07}	4.79×10^{-08}	9.96×10^{-07}	9.95×10^{-09}	2.26×10^{-07}	3.94×10^{-08}	1.50×10^{-09}	8.62×10^{-11}	1.35×10^{-08}	2.84×10^{-11}
Adult	8.70×10^{-05}	4.96×10^{-05}	1.03×10^{-06}	4.68×10^{-07}	1.01×10^{-05}	9.64×10^{-08}	2.35×10^{-06}	3.97×10^{-07}	1.56×10^{-08}	8.98×10^{-10}	1.34×10^{-07}	2.91×10^{-10}

n/a = not applicable or not assessed.

5.2.4.2.3 Radiological Dose

The estimated radiation doses to human receptors for the RFD Case are shown in Table 5-14. The doses shown represent the maximum annual dose over the assessment period with the addition of the Fission Patterson Lake South Property. The dose is presented by radionuclide and exposure pathway, as well as for total dose. The radiation dose is presented as an incremental dose (i.e., only considering Project effects and effects from the Fission Patterson Lake South Property).

The maximum estimated radiation dose for the RFD Case would be 0.2 mSv/yr for the subsistence harvester (one-year-old) who eats Traditional Foods gathered at Patterson Lake South Arm. The main contribution to total dose would be from polonium-210 from eating terrestrial animals in the Traditional Food diet, including moose (meat and organs), beaver, grouse, and mallard.

In the far-future projection, the maximum estimated dose for the RFD Case was predicted to be 0.1 mSv/yr for the future permanent resident residing at the decommissioned and reclaimed Project site well beyond Closure.

5.2.4.2.4 Radon Dose

The camp worker would be exposed to radon through inhalation while at the camp site, located southwest of the mill terrace. The camp worker represents an adult who resides at the camp for 6 months of the year and away from the site for the remaining 6 months of the year. For exposure to radon, it has been conservatively assumed that the camp worker spends 100% of their time indoors when on site.

For the RFD Case, the camp worker would also be exposed to radon from the Fission Patterson Lake South Property. The predicted radon concentration at the camp site, from AERMOD, is 49.3 Bq/m^3 (46.4 Bq/m^3 based on incremental radon where background radon has been subtracted from the total).

The method to estimate radon dose to the camp worker for the RFD Case follows the equations in Appendix A, Section 2.4.3 and assumptions presented in Section 5.2.4.1.4, Radon Dose. The incremental radon dose to the camp worker during Operations from the RFD Case would be 0.57 mSv/yr.

Table 5-14: Estimated Radiation Doses to Human Receptors – Reasonably Foreseeable Development Case

	Incremental Dose by Pathway RFD Case (mSv/yr)													
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by Radionuclide
Camp Worker (Patterson Lake North Arm - West Basin)	RFD Case													
	Uranium-238	8.63×10^{-04}	2.37×10^{-12}	2.20×10^{-08}	1.67×10^{-13}	1.36×10^{-07}	1.51×10^{-03}	7.65×10^{-11}	8.15×10^{-10}	$0.00 \times 10^{+00}$	6.22×10^{-05}	5.63×10^{-05}	7.24×10^{-05}	2.56×10^{-03}
	Uranium-234	1.04×10^{-03}	5.79×10^{-12}	2.40×10^{-08}	2.92×10^{-14}	1.48×10^{-07}	7.60×10^{-06}	8.36×10^{-11}	2.97×10^{-12}	$0.00 \times 10^{+00}$	6.80×10^{-05}	6.13×10^{-05}	7.88×10^{-05}	1.26×10^{-03}
	Thorium-230	4.17×10^{-03}	1.40×10^{-11}	1.44×10^{-06}	9.77×10^{-13}	7.10×10^{-07}	1.09×10^{-05}	1.03×10^{-09}	2.54×10^{-11}	$0.00 \times 10^{+00}$	1.13×10^{-03}	6.12×10^{-04}	6.63×10^{-03}	1.26×10^{-02}
	Radium-226	1.04×10^{-03}	2.69×10^{-10}	6.77×10^{-07}	3.02×10^{-10}	9.59×10^{-07}	2.48×10^{-02}	1.61×10^{-09}	1.93×10^{-07}	$0.00 \times 10^{+00}$	3.71×10^{-04}	1.06×10^{-03}	8.00×10^{-04}	2.81×10^{-02}
	Lead-210	3.27×10^{-04}	4.23×10^{-11}	2.22×10^{-06}	1.95×10^{-12}	1.52×10^{-06}	3.54×10^{-04}	1.96×10^{-08}	1.11×10^{-09}	$0.00 \times 10^{+00}$	1.59×10^{-03}	2.29×10^{-03}	6.51×10^{-03}	1.11×10^{-02}
	Polonium-210	9.82×10^{-04}	3.69×10^{-13}	1.58×10^{-06}	4.74×10^{-15}	2.69×10^{-06}	7.98×10^{-08}	3.26×10^{-08}	4.48×10^{-12}	$0.00 \times 10^{+00}$	9.46×10^{-03}	3.65×10^{-03}	1.62×10^{-02}	3.03×10^{-02}
	Total by Pathway	8.42×10^{-03}	3.34×10^{-10}	5.96×10^{-06}	3.05×10^{-10}	6.17×10^{-06}	2.67×10^{-02}	5.50×10^{-08}	1.95×10^{-07}	$0.00 \times 10^{+00}$	1.27×10^{-02}	7.73×10^{-03}	3.02×10^{-02}	8.58×10^{-02}
	Far-Future													
	Uranium-238	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Uranium-234	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Thorium-230	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Radium-226	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Lead-210	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Polonium-210	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Total by Pathway	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Subsistence Harvester (Patterson Lake South Arm)	RFD Case													
	Uranium-238	1.57×10^{-04}	4.30×10^{-13}	4.64×10^{-05}	3.52×10^{-10}	2.46×10^{-08}	2.73×10^{-04}	1.28×10^{-07}	1.36×10^{-06}	$0.00 \times 10^{+00}$	1.24×10^{-04}	1.12×10^{-04}	1.45×10^{-04}	8.59×10^{-04}
	Uranium-234	1.89×10^{-04}	1.05×10^{-12}	5.07×10^{-05}	6.16×10^{-11}	2.68×10^{-08}	1.38×10^{-06}	1.40×10^{-07}	4.96×10^{-09}	$0.00 \times 10^{+00}$	1.36×10^{-04}	1.22×10^{-04}	1.58×10^{-04}	6.57×10^{-04}
	Thorium-230	7.56×10^{-04}	2.55×10^{-12}	1.83×10^{-03}	1.24×10^{-09}	1.29×10^{-07}	1.97×10^{-06}	1.30×10^{-06}	3.20×10^{-08}	$0.00 \times 10^{+00}$	2.26×10^{-03}	1.22×10^{-03}	1.32×10^{-02}	1.93×10^{-02}
	Radium-226	1.89×10^{-04}	4.88×10^{-11}	3.07×10^{-04}	1.37×10^{-07}	1.74×10^{-07}	4.50×10^{-03}	5.92×10^{-07}	7.10×10^{-05}	$0.00 \times 10^{+00}$	7.41×10^{-04}	2.12×10^{-03}	1.60×10^{-03}	9.53×10^{-03}
	Lead-210	5.94×10^{-05}	7.68×10^{-12}	3.67×10^{-04}	3.24×10^{-10}	2.76×10^{-07}	6.41×10^{-05}	5.06×10^{-06}	2.86×10^{-07}	$0.00 \times 10^{+00}$	3.19×10^{-03}	4.57×10^{-03}	1.30×10^{-02}	2.12×10^{-02}
	Polonium-210	1.78×10^{-04}	6.70×10^{-14}	6.25×10^{-04}	1.88×10^{-12}	4.89×10^{-07}	1.45×10^{-08}	8.92×10^{-06}	1.22×10^{-09}	$0.00 \times 10^{+00}$	1.89×10^{-02}	7.29×10^{-03}	3.24×10^{-02}	5.94×10^{-02}
	Total by Pathway	1.53×10^{-03}	6.05×10^{-11}	3.23×10^{-03}	1.39×10^{-07}	1.12×10^{-06}	4.84×10^{-03}	1.61×10^{-05}	7.27×10^{-05}	$0.00 \times 10^{+00}$	2.54×10^{-02}	1.54×10^{-02}	6.05×10^{-02}	1.11×10^{-01}
	Far-Future													
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.64×10^{-05}	2.00×10^{-10}	2.59×10^{-09}	2.87×10^{-05}	2.41×10^{-07}	2.57×10^{-06}	$0.00 \times 10^{+00}$	7.35×10^{-05}	1.15×10^{-05}	3.64×10^{-05}	1.79×10^{-04}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.88×10^{-05}	3.50×10^{-11}	2.82×10^{-09}	1.45×10^{-07}	2.63×10^{-07}	9.34×10^{-09}	$0.00 \times 10^{+00}$	8.03×10^{-05}	1.26×10^{-05}	3.97×10^{-05}	1.62×10^{-04}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.54×10^{-05}	1.04×10^{-11}	7.19×10^{-08}	1.10×10^{-06}	1.68×10^{-08}	4.16×10^{-10}	$0.00 \times 10^{+00}$	2.06×10^{-05}	6.16×10^{-06}	1.94×10^{-04}	2.37×10^{-04}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	3.14×10^{-05}	1.40×10^{-08}	1.17×10^{-07}	3.03×10^{-03}	1.74×10^{-07}	2.08×10^{-05}	$0.00 \times 10^{+00}$	8.37×10^{-05}	1.93×10^{-04}	4.01×10^{-04}	3.77×10^{-03}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.02×10^{-06}	1.78×10^{-12}	1.90×10^{-10}	4.38×10^{-08}	6.81×10^{-08}	3.85×10^{-09}	$0.00 \times 10^{+00}$	1.80×10^{-05}	4.14×10^{-08}	4.02×10^{-04}	4.22×10^{-04}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	3.55×10^{-06}	1.07×10^{-14}	3.34×10^{-10}	9.90×10^{-12}	1.20×10^{-07}	1.65×10^{-11}	$0.00 \times 10^{+00}$	1.13×10^{-04}	3.54×10^{-07}	3.23×10^{-04}	4.40×10^{-04}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.08×10^{-04}	1.42×10^{-08}	1.95×10^{-07}	3.06×10^{-03}	8.82×10^{-07}	2.34×10^{-05}	$0.00 \times 10^{+00}$	3.89×10^{-04}	2.24×10^{-04}	1.40×10^{-03}	5.21×10^{-03}
Subsistence Harvester One-Year-Old (Patterson Lake South Arm)	RFD Case													
	Uranium-238	1.56×10^{-04}	5.59×10^{-13}	3.22×10^{-05}	8.70×10^{-11}	1.00×10^{-06}	3.66×10^{-04}	5.19×10^{-06}	1.77×10^{-06}	$0.00 \times 10^{+00}$	1.39×10^{-04}	6.53×10^{-05}	8.39×10^{-04}	1.39×10^{-04}
	Uranium-234	1.83×10^{-04}	1.37×10^{-12}	3.51×10^{-05}	1.52×10^{-11}	1.09×10^{-06}	1.84×10^{-06}	5.65×10^{-06}	6.45×10^{-09}	$0.00 \times 10^{+00}$	1.50×10^{-04}	7.07×10^{-05}	5.27×10^{-04}	1.50×10^{-04}
	Thorium-230	5.81×10^{-04}	3.31×10^{-12}	9.31×10^{-04}	3.07×10^{-10}	3.83×10^{-06}	2.24×10^{-06}	3.86×10^{-05}	4.17×10^{-08}	$0.00 \times 10^{+00}$	6.69×10^{-04}	6.39×10^{-03}	9.59×10^{-03}	6.69×10^{-04}
	Radium-226	1.83×10^{-04}	6.34×10^{-11}	2.74×10^{-04}	3.39×10^{-08}	9.10×10^{-06}	6.03×10^{-03}	3.10×10^{-05}	9.26×10^{-05}	$0.00 \times 10^{+00}$	2.40×10^{-03}	7.12×10^{-04}	1.03×10^{-02}	2.40×10^{-03}
	Lead-210	6.14×10^{-05}	9.96×10^{-12}	4.99×10^{-04}	6.57×10^{-11}	2.20×10^{-05}	8.58×10^{-05}	4.02×10^{-04}	3.72×10^{-07}	$0.00 \times 10^{+00}$	7.46×10^{-03}	1.60×10^{-02}	2.82×10^{-02}	7.46×10^{-03}
	Polonium-210	1.83×10^{-04}	8.71×10^{-14}	1.19×10^{-03}	4.65×10^{-13}	5.46×10^{-05}	1.89×10^{-08}	9.98×10^{-04}	1.59×10^{-09}	$0.00 \times 10^{+00}$	1.73×10^{-02}	3.65×10^{-02}	8.68×10^{-02}	1.73×10^{-02}
	Total by Pathway	1.35×10^{-03}	7.87×10^{-11}	2.97×10^{-03}	3.44×10^{-08}	9.16×10^{-05}	6.48×10^{-03}	1.48×10^{-03}	9.48×10^{-05}	$0.00 \times 10^{+00}$	2.81×10^{-02}	5.97×10^{-02}	1.36×10^{-01}	2.81×10^{-02}
	Far-Future													
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.83×10^{-05}	4.95×10^{-11}	1.05×10^{-07}	3.84×10^{-05}	9.78×10^{-06}	3.34×10^{-06}	$0.00 \times 10^{+00}$	1.41×10^{-05}	1.67×10^{-05}	1.44×10^{-04}	1.41×10^{-05}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.99×10^{-05}	8.67×10^{-12}	1.14×10^{-07}	1.94×10^{-07}	1.06×10^{-05}	1.21×10^{-08}	$0.00 \times 10^{+00}$	1.53×10^{-05}	1.81×10^{-05}	1.11×10^{-04}	1.53×10^{-05}

	Incremental Dose by Pathway RFD Case (mSv/yr)													
	Radionuclide	**Air (Internal)**	**Air (External)**	**Water (Internal)**	**Water (External)**	**Soil (Internal)**	**Soil (External)**	**Sediment (Internal)**	**Sediment (External)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial Animals**	**Total by Radionuclide**
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	7.83×10^{-06}	2.58×10^{-12}	2.14×10^{-06}	1.25×10^{-06}	5.00×10^{-07}	5.40×10^{-10}	$0.00 \times 10^{+00}$	5.53×10^{-06}	9.35×10^{-05}	1.20×10^{-04}	5.53×10^{-06}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.80×10^{-05}	3.47×10^{-09}	6.13×10^{-06}	4.06×10^{-03}	9.08×10^{-06}	2.71×10^{-05}	$0.00 \times 10^{+00}$	3.05×10^{-04}	1.79×10^{-04}	4.68×10^{-03}	3.05×10^{-04}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.75×10^{-06}	3.62×10^{-13}	1.50×10^{-08}	5.87×10^{-08}	5.42×10^{-06}	5.01×10^{-09}	$0.00 \times 10^{+00}$	1.01×10^{-07}	5.02×10^{-04}	5.32×10^{-04}	1.01×10^{-07}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.79×10^{-06}	2.64×10^{-15}	3.73×10^{-08}	1.29×10^{-11}	1.35×10^{-05}	2.15×10^{-11}	$0.00 \times 10^{+00}$	1.20×10^{-06}	3.77×10^{-04}	5.82×10^{-04}	1.20×10^{-06}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	8.37×10^{-05}	3.53×10^{-09}	8.54×10^{-06}	4.10×10^{-03}	4.89×10^{-05}	3.05×10^{-05}	$0.00 \times 10^{+00}$	3.41×10^{-04}	1.19×10^{-03}	6.17×10^{-03}	3.41×10^{-04}
	RFD Case													
Subsistence Harvester (Beet Lake)	Uranium-238	8.56×10^{-05}	2.35×10^{-13}	1.61×10^{-05}	1.22×10^{-10}	1.35×10^{-08}	1.49×10^{-04}	4.72×10^{-08}	5.03×10^{-07}	$0.00 \times 10^{+00}$	6.15×10^{-05}	5.72×10^{-05}	4.14×10^{-04}	6.15×10^{-05}
	Uranium-234	1.03×10^{-04}	5.75×10^{-13}	1.76×10^{-05}	2.14×10^{-11}	1.47×10^{-08}	7.53×10^{-07}	5.16×10^{-08}	1.83×10^{-09}	$0.00 \times 10^{+00}$	6.70×10^{-05}	6.23×10^{-05}	2.98×10^{-04}	6.70×10^{-05}
	Thorium-230	4.13×10^{-04}	1.39×10^{-12}	8.23×10^{-04}	5.58×10^{-10}	7.04×10^{-08}	1.08×10^{-06}	6.90×10^{-07}	1.70×10^{-08}	$0.00 \times 10^{+00}$	6.69×10^{-04}	3.87×10^{-03}	6.80×10^{-03}	6.69×10^{-04}
	Radium-226	1.03×10^{-04}	2.67×10^{-11}	1.18×10^{-04}	5.27×10^{-08}	9.51×10^{-08}	2.46×10^{-03}	2.57×10^{-07}	3.08×10^{-05}	$0.00 \times 10^{+00}$	1.16×10^{-03}	4.11×10^{-04}	4.57×10^{-03}	1.16×10^{-03}
	Lead-210	3.25×10^{-05}	4.20×10^{-12}	5.33×10^{-05}	4.70×10^{-11}	1.51×10^{-07}	3.51×10^{-05}	7.33×10^{-07}	4.14×10^{-08}	$0.00 \times 10^{+00}$	2.50×10^{-03}	1.75×10^{-03}	4.83×10^{-03}	2.50×10^{-03}
	Polonium-210	9.74×10^{-05}	3.66×10^{-14}	9.19×10^{-05}	2.76×10^{-13}	2.67×10^{-07}	7.91×10^{-09}	1.29×10^{-06}	1.77×10^{-10}	$0.00 \times 10^{+00}$	3.99×10^{-03}	7.70×10^{-03}	1.47×10^{-02}	3.99×10^{-03}
	Total by Pathway	8.35×10^{-04}	3.31×10^{-11}	1.12×10^{-03}	5.34×10^{-08}	6.12×10^{-07}	2.65×10^{-03}	3.07×10^{-06}	3.14×10^{-05}	$0.00 \times 10^{+00}$	8.44×10^{-03}	1.38×10^{-02}	3.16×10^{-02}	8.44×10^{-03}
	Far-Future													
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	9.81×10^{-06}	7.44×10^{-11}	1.42×10^{-09}	1.57×10^{-05}	8.94×10^{-08}	9.54×10^{-07}	$0.00 \times 10^{+00}$	6.30×10^{-06}	1.25×10^{-05}	7.26×10^{-05}	6.30×10^{-06}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.07×10^{-05}	1.30×10^{-11}	1.54×10^{-09}	7.92×10^{-08}	9.78×10^{-08}	3.47×10^{-09}	$0.00 \times 10^{+00}$	6.86×10^{-06}	1.36×10^{-05}	6.12×10^{-05}	6.86×10^{-06}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	8.19×10^{-06}	5.55×10^{-12}	3.93×10^{-08}	6.02×10^{-07}	8.93×10^{-09}	2.21×10^{-10}	$0.00 \times 10^{+00}$	3.37×10^{-06}	4.93×10^{-05}	7.25×10^{-05}	3.37×10^{-06}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.35×10^{-05}	6.02×10^{-09}	6.41×10^{-08}	1.66×10^{-03}	7.47×10^{-08}	8.95×10^{-06}	$0.00 \times 10^{+00}$	1.06×10^{-04}	1.03×10^{-04}	1.93×10^{-03}	1.06×10^{-04}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.79×10^{-07}	2.46×10^{-13}	1.03×10^{-10}	2.37×10^{-08}	9.37×10^{-09}	5.30×10^{-10}	$0.00 \times 10^{+00}$	2.26×10^{-08}	4.16×10^{-06}	6.98×10^{-06}	2.26×10^{-08}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.75×10^{-07}	1.42×10^{-15}	1.83×10^{-10}	5.41×10^{-12}	1.65×10^{-08}	2.27×10^{-12}	$0.00 \times 10^{+00}$	1.94×10^{-07}	3.28×10^{-05}	4.85×10^{-05}	1.94×10^{-07}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.30×10^{-05}	6.11×10^{-09}	1.07×10^{-07}	1.68×10^{-03}	2.97×10^{-07}	9.91×10^{-06}	$0.00 \times 10^{+00}$	1.22×10^{-04}	2.15×10^{-04}	2.19×10^{-03}	1.22×10^{-04}
	RFD Case													
Subsistence Harvester One-Year-Old (Beet Lake)	Uranium-238	8.53×10^{-05}	3.05×10^{-13}	1.12×10^{-05}	3.02×10^{-11}	5.48×10^{-07}	2.00×10^{-04}	1.92×10^{-06}	6.54×10^{-07}	$0.00 \times 10^{+00}$	2.55×10^{-05}	7.59×10^{-05}	2.54×10^{-05}	4.26×10^{-04}
	Uranium-234	9.99×10^{-05}	7.47×10^{-13}	1.22×10^{-05}	5.30×10^{-12}	5.94×10^{-07}	1.01×10^{-06}	2.09×10^{-06}	2.38×10^{-09}	$0.00 \times 10^{+00}$	2.77×10^{-05}	8.22×10^{-05}	2.75×10^{-05}	2.53×10^{-04}
	Thorium-230	3.18×10^{-04}	1.81×10^{-12}	4.19×10^{-04}	1.38×10^{-10}	2.10×10^{-06}	1.23×10^{-06}	2.05×10^{-05}	2.22×10^{-08}	$0.00 \times 10^{+00}$	4.41×10^{-04}	3.66×10^{-04}	1.86×10^{-03}	3.43×10^{-03}
	Radium-226	9.99×10^{-05}	3.46×10^{-11}	1.05×10^{-04}	1.30×10^{-08}	4.97×10^{-06}	3.30×10^{-03}	1.34×10^{-05}	4.02×10^{-05}	$0.00 \times 10^{+00}$	2.15×10^{-04}	1.31×10^{-03}	1.58×10^{-04}	5.25×10^{-03}
	Lead-210	3.36×10^{-05}	5.45×10^{-12}	7.25×10^{-05}	9.53×10^{-12}	1.20×10^{-05}	4.69×10^{-05}	5.83×10^{-05}	5.39×10^{-08}	$0.00 \times 10^{+00}$	5.33×10^{-04}	4.08×10^{-03}	2.01×10^{-03}	6.85×10^{-03}
	Polonium-210	9.99×10^{-05}	4.76×10^{-14}	1.76×10^{-04}	6.84×10^{-14}	2.99×10^{-05}	1.03×10^{-08}	1.45×10^{-04}	2.31×10^{-10}	$0.00 \times 10^{+00}$	4.51×10^{-03}	9.43×10^{-03}	8.38×10^{-03}	2.28×10^{-02}
	Total by Pathway	7.36×10^{-04}	4.30×10^{-11}	7.96×10^{-04}	1.32×10^{-08}	5.01×10^{-05}	3.54×10^{-03}	2.41×10^{-04}	4.09×10^{-05}	$0.00 \times 10^{+00}$	5.75×10^{-03}	1.54×10^{-02}	1.25×10^{-02}	3.90×10^{-02}
	Far-Future													
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.81×10^{-06}	1.84×10^{-11}	5.76×10^{-08}	2.10×10^{-05}	3.64×10^{-06}	1.24×10^{-06}	$0.00 \times 10^{+00}$	1.61×10^{-05}	7.73×10^{-06}	5.64×10^{-06}	6.23×10^{-05}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	7.41×10^{-06}	3.22×10^{-12}	6.24×10^{-08}	1.06×10^{-07}	3.96×10^{-06}	4.51×10^{-09}	$0.00 \times 10^{+00}$	1.75×10^{-05}	8.38×10^{-06}	6.12×10^{-06}	4.36×10^{-05}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.17×10^{-06}	1.37×10^{-12}	1.17×10^{-06}	6.85×10^{-07}	2.66×10^{-07}	2.87×10^{-10}	$0.00 \times 10^{+00}$	4.74×10^{-06}	3.03×10^{-06}	2.37×10^{-05}	3.77×10^{-05}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.20×10^{-05}	1.49×10^{-09}	3.35×10^{-06}	2.22×10^{-03}	3.90×10^{-06}	1.17×10^{-05}	$0.00 \times 10^{+00}$	2.73×10^{-05}	1.67×10^{-04}	3.97×10^{-05}	2.49×10^{-03}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	3.79×10^{-07}	4.98×10^{-14}	8.15×10^{-09}	3.21×10^{-08}	7.46×10^{-07}	6.89×10^{-10}	$0.00 \times 10^{+00}$	2.86×10^{-06}	5.49×10^{-08}	4.94×10^{-06}	9.02×10^{-06}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	9.06×10^{-07}	3.53×10^{-16}	2.04×10^{-08}	7.08×10^{-12}	1.85×10^{-06}	2.95×10^{-12}	$0.00 \times 10^{+00}$	2.45×10^{-05}	6.54×10^{-07}	4.16×10^{-05}	6.95×10^{-05}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	3.17×10^{-05}	1.51×10^{-09}	4.67×10^{-06}	2.24×10^{-03}	1.44×10^{-05}	1.29×10^{-05}	$0.00 \times 10^{+00}$	9.31×10^{-05}	1.87×10^{-04}	1.22×10^{-04}	2.71×10^{-03}
	RFD Case													
Subsistence Harvester (Lloyd Lake)	Uranium-238	4.08×10^{-06}	1.12×10^{-14}	1.50×10^{-06}	1.14×10^{-11}	6.42×10^{-10}	7.12×10^{-06}	4.32×10^{-09}	4.61×10^{-08}	$0.00 \times 10^{+00}$	4.01×10^{-06}	2.93×10^{-06}	2.88×10^{-06}	2.26×10^{-05}
	Uranium-234	4.92×10^{-06}	2.74×10^{-14}	1.64×10^{-06}	1.99×10^{-12}	6.99×10^{-10}	3.59×10^{-08}	4.72×10^{-09}	1.68×10^{-10}	$0.00 \times 10^{+00}$	4.38×10^{-06}	3.19×10^{-06}	3.13×10^{-06}	1.73×10^{-05}
	Thorium-230	1.97×10^{-05}	6.64×10^{-14}	8.37×10^{-05}	5.67×10^{-11}	3.35×10^{-09}	5.14×10^{-08}	7.12×10^{-08}	1.76×10^{-09}	$0.00 \times 10^{+00}$	1.04×10^{-04}	3.19×10^{-05}	3.56×10^{-04}	5.95×10^{-04}
	Radium-226	4.92×10^{-06}	1.27×10^{-12}	1.14×10^{-05}	5.09×10^{-09}	4.53×10^{-09}	1.17×10^{-04}	2.49×10^{-08}	2.98×10^{-06}	$0.00 \times 10^{+00}$	2.74×10^{-05}	5.52×10^{-05}	2.09×10^{-05}	2.40×10^{-04}
	Lead-210	1.55×10^{-06}	2.00×10^{-13}	2.90×10^{-06}	2.56×10^{-12}	7.20×10^{-09}	1.67×10^{-06}	3.78×10^{-08}	2.14×10^{-09}	$0.00 \times 10^{+00}$	2.52×10^{-05}	1.19×10^{-04}	8.81×10^{-05}	2.39×10^{-04}
	Polonium-210	4.64×10^{-06}	1.75×10^{-15}	4.96×10^{-06}	1.49×10^{-14}	1.27×10^{-08}	3.77×10^{-10}	6.67×10^{-08}	9.16×10^{-12}	$0.00 \times 10^{+00}$	1.50×10^{-04}	1.90×10^{-04}	3.77×10^{-04}	7.27×10^{-04}
	Total by Pathway	3.98×10^{-05}	1.58×10^{-12}	1.06×10^{-04}	5.16×10^{-09}	2.92×10^{-08}	1.26×10^{-04}	2.10×10^{-07}	3.03×10^{-06}	$0.00 \times 10^{+00}$	3.15×10^{-04}	4.02×10^{-04}	8.48×10^{-04}	1.84×10^{-03}

	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by Radionuclide
	Incremental Dose by Pathway RFD Case (mSv/yr)													
	Far-Future													
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	8.88×10^{-07}	6.74×10^{-12}	6.75×10^{-11}	7.49×10^{-07}	8.10×10^{-09}	8.64×10^{-08}	$0.00 \times 10^{+00}$	2.47×10^{-06}	3.00×10^{-07}	8.86×10^{-07}	5.39×10^{-06}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	9.71×10^{-07}	1.18×10^{-12}	7.35×10^{-11}	3.77×10^{-09}	8.85×10^{-09}	3.14×10^{-10}	$0.00 \times 10^{+00}$	2.70×10^{-06}	3.27×10^{-07}	9.68×10^{-07}	4.98×10^{-06}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	8.40×10^{-07}	5.69×10^{-13}	1.87×10^{-09}	2.87×10^{-08}	9.16×10^{-10}	2.26×10^{-11}	$0.00 \times 10^{+00}$	1.12×10^{-06}	1.61×10^{-07}	4.08×10^{-06}	6.24×10^{-06}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.29×10^{-06}	5.76×10^{-10}	3.05×10^{-09}	7.91×10^{-05}	7.15×10^{-09}	8.56×10^{-07}	$0.00 \times 10^{+00}$	3.45×10^{-06}	5.04×10^{-06}	5.26×10^{-06}	9.50×10^{-05}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.04×10^{-08}	1.81×10^{-14}	4.55×10^{-12}	9.31×10^{-10}	6.88×10^{-10}	3.89×10^{-11}	$0.00 \times 10^{+00}$	1.83×10^{-07}	1.16×10^{-09}	3.09×10^{-07}	5.15×10^{-07}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	8.19×10^{-12}	2.70×10^{-13}	1.14×10^{-09}	1.56×10^{-13}	$0.00 \times 10^{+00}$	5.96×10^{-08}	9.31×10^{-09}	2.18×10^{-06}	2.25×10^{-06}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.01×10^{-06}	5.84×10^{-10}	5.08×10^{-09}	7.99×10^{-05}	2.68×10^{-08}	9.43×10^{-07}	$0.00 \times 10^{+00}$	9.99×10^{-06}	5.84×10^{-06}	1.37×10^{-05}	1.14×10^{-04}
Subsistence Harvester One-Year-Old (Lloyd Lake)	**RFD Case**													
	Uranium-238	4.07×10^{-06}	1.46×10^{-14}	1.04×10^{-06}	2.81×10^{-12}	2.61×10^{-08}	9.53×10^{-06}	1.76×10^{-07}	5.99×10^{-08}	$0.00 \times 10^{+00}$	2.37×10^{-06}	3.62×10^{-06}	1.28×10^{-06}	2.22×10^{-05}
	Uranium-234	4.76×10^{-06}	3.56×10^{-14}	1.13×10^{-06}	4.93×10^{-13}	2.83×10^{-08}	4.81×10^{-08}	1.91×10^{-07}	2.18×10^{-10}	$0.00 \times 10^{+00}$	2.57×10^{-06}	3.92×10^{-06}	1.38×10^{-06}	1.40×10^{-05}
	Thorium-230	1.51×10^{-05}	8.63×10^{-14}	4.26×10^{-05}	1.40×10^{-11}	9.99×10^{-08}	5.84×10^{-08}	2.12×10^{-06}	2.29×10^{-09}	$0.00 \times 10^{+00}$	4.51×10^{-05}	1.74×10^{-05}	1.71×10^{-04}	2.94×10^{-04}
	Radium-226	4.76×10^{-06}	1.65×10^{-12}	1.02×10^{-05}	1.26×10^{-09}	2.37×10^{-07}	1.57×10^{-04}	1.30×10^{-06}	3.89×10^{-06}	$0.00 \times 10^{+00}$	2.08×10^{-05}	6.27×10^{-05}	8.11×10^{-06}	2.69×10^{-04}
	Lead-210	1.60×10^{-06}	2.60×10^{-13}	3.95×10^{-06}	5.19×10^{-13}	5.73×10^{-07}	2.24×10^{-06}	3.01×10^{-06}	2.78×10^{-09}	$0.00 \times 10^{+00}$	2.90×10^{-05}	1.94×10^{-04}	1.01×10^{-04}	3.36×10^{-04}
	Polonium-210	4.76×10^{-06}	2.27×10^{-15}	9.48×10^{-06}	3.69×10^{-15}	1.42×10^{-06}	4.93×10^{-10}	7.46×10^{-06}	1.19×10^{-11}	$0.00 \times 10^{+00}$	2.43×10^{-04}	4.50×10^{-04}	4.12×10^{-04}	1.13×10^{-03}
	Total by Pathway	3.51×10^{-05}	2.05×10^{-12}	6.84×10^{-05}	1.28×10^{-09}	2.39×10^{-06}	1.69×10^{-04}	1.43×10^{-05}	3.95×10^{-06}	$0.00 \times 10^{+00}$	3.43×10^{-04}	7.32×10^{-04}	6.96×10^{-04}	2.06×10^{-03}
	Far-Future													
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.17×10^{-07}	1.67×10^{-12}	2.75×10^{-09}	1.00×10^{-06}	3.29×10^{-07}	1.12×10^{-07}	$0.00 \times 10^{+00}$	1.46×10^{-06}	3.69×10^{-07}	4.03×10^{-07}	4.29×10^{-06}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.71×10^{-07}	2.92×10^{-13}	2.97×10^{-09}	5.05×10^{-09}	3.58×10^{-07}	4.09×10^{-10}	$0.00 \times 10^{+00}$	1.59×10^{-06}	3.99×10^{-07}	4.38×10^{-07}	3.46×10^{-06}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.28×10^{-07}	1.41×10^{-13}	5.58×10^{-08}	3.26×10^{-08}	2.73×10^{-08}	2.94×10^{-11}	$0.00 \times 10^{+00}$	4.86×10^{-07}	1.44×10^{-07}	1.96×10^{-06}	3.13×10^{-06}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.15×10^{-06}	1.43×10^{-10}	1.60×10^{-07}	1.06×10^{-04}	3.74×10^{-07}	1.12×10^{-06}	$0.00 \times 10^{+00}$	2.61×10^{-06}	7.94×10^{-06}	2.05×10^{-06}	1.21×10^{-04}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.79×10^{-08}	3.66×10^{-15}	3.49×10^{-10}	1.86×10^{-09}	5.49×10^{-08}	5.07×10^{-11}	$0.00 \times 10^{+00}$	2.11×10^{-07}	2.79×10^{-09}	3.65×10^{-07}	6.64×10^{-07}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	9.31×10^{-10}	3.41×10^{-13}	1.29×10^{-07}	2.03×10^{-13}	$0.00 \times 10^{+00}$	9.69×10^{-08}	3.17×10^{-08}	2.80×10^{-06}	3.06×10^{-06}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.90×10^{-06}	1.45×10^{-10}	2.23×10^{-07}	1.07×10^{-04}	1.27×10^{-06}	1.23×10^{-06}	$0.00 \times 10^{+00}$	6.45×10^{-06}	8.89×10^{-06}	8.02×10^{-06}	1.36×10^{-04}
Seasonal Resident (Patterson Lake South Arm)	**RFD Case**													
	Uranium-238	9.39×10^{-05}	2.58×10^{-13}	2.78×10^{-05}	2.11×10^{-10}	1.48×10^{-08}	1.64×10^{-04}	7.66×10^{-08}	8.17×10^{-07}	$0.00 \times 10^{+00}$	2.36×10^{-05}	5.34×10^{-05}	2.71×10^{-05}	3.91×10^{-04}
	Uranium-234	1.13×10^{-04}	6.30×10^{-13}	3.04×10^{-05}	3.69×10^{-11}	1.61×10^{-08}	8.27×10^{-07}	8.38×10^{-08}	2.97×10^{-09}	$0.00 \times 10^{+00}$	2.58×10^{-05}	5.81×10^{-05}	2.96×10^{-05}	2.58×10^{-04}
	Thorium-230	4.54×10^{-04}	1.53×10^{-12}	1.10×10^{-03}	7.44×10^{-10}	7.72×10^{-08}	1.18×10^{-06}	7.78×10^{-07}	1.92×10^{-08}	$0.00 \times 10^{+00}$	4.30×10^{-04}	2.57×10^{-04}	3.09×10^{-03}	5.33×10^{-03}
	Radium-226	1.13×10^{-04}	2.93×10^{-11}	1.84×10^{-04}	8.22×10^{-08}	1.04×10^{-07}	2.70×10^{-03}	3.55×10^{-07}	4.26×10^{-05}	$0.00 \times 10^{+00}$	1.41×10^{-04}	6.01×10^{-04}	3.08×10^{-04}	4.09×10^{-03}
	Lead-210	3.56×10^{-05}	4.61×10^{-12}	2.20×10^{-04}	1.94×10^{-10}	1.66×10^{-07}	3.85×10^{-05}	3.03×10^{-06}	1.72×10^{-07}	$0.00 \times 10^{+00}$	6.06×10^{-04}	1.18×10^{-03}	2.98×10^{-03}	5.06×10^{-03}
	Polonium-210	1.07×10^{-04}	4.02×10^{-14}	3.75×10^{-04}	1.13×10^{-12}	2.93×10^{-07}	8.69×10^{-09}	5.35×10^{-06}	7.34×10^{-10}	$0.00 \times 10^{+00}$	3.60×10^{-03}	1.98×10^{-03}	7.92×10^{-03}	1.40×10^{-02}
	Total by Pathway	9.17×10^{-04}	3.63×10^{-11}	1.94×10^{-03}	8.33×10^{-08}	6.71×10^{-07}	2.91×10^{-03}	9.68×10^{-06}	4.36×10^{-05}	$0.00 \times 10^{+00}$	4.82×10^{-03}	4.13×10^{-03}	1.44×10^{-02}	2.91×10^{-02}
	Far-Future													
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.58×10^{-05}	1.20×10^{-10}	1.55×10^{-09}	1.72×10^{-05}	1.44×10^{-07}	1.54×10^{-06}	$0.00 \times 10^{+00}$	1.40×10^{-05}	5.42×10^{-06}	8.71×10^{-06}	6.29×10^{-05}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.73×10^{-05}	2.10×10^{-11}	1.69×10^{-09}	8.69×10^{-08}	1.58×10^{-07}	5.60×10^{-09}	$0.00 \times 10^{+00}$	1.53×10^{-05}	5.91×10^{-06}	9.51×10^{-06}	4.82×10^{-05}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	9.24×10^{-06}	6.26×10^{-12}	4.31×10^{-08}	6.61×10^{-07}	1.01×10^{-08}	2.49×10^{-10}	$0.00 \times 10^{+00}$	3.92×10^{-06}	2.90×10^{-06}	4.52×10^{-05}	6.20×10^{-05}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.88×10^{-05}	8.40×10^{-09}	7.03×10^{-08}	1.82×10^{-03}	1.04×10^{-07}	1.25×10^{-05}	$0.00 \times 10^{+00}$	1.59×10^{-05}	9.09×10^{-05}	7.73×10^{-05}	2.04×10^{-03}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.21×10^{-06}	1.07×10^{-12}	1.13×10^{-10}	2.63×10^{-08}	4.08×10^{-08}	2.31×10^{-09}	$0.00 \times 10^{+00}$	3.43×10^{-06}	1.93×10^{-08}	9.27×10^{-05}	9.74×10^{-05}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.13×10^{-06}	6.40×10^{-15}	2.00×10^{-10}	5.95×10^{-12}	7.22×10^{-08}	9.91×10^{-12}	$0.00 \times 10^{+00}$	2.15×10^{-05}	1.67×10^{-07}	8.72×10^{-05}	1.11×10^{-04}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.45×10^{-05}	8.55×10^{-09}	1.17×10^{-07}	1.84×10^{-03}	5.29×10^{-07}	1.40×10^{-05}	$0.00 \times 10^{+00}$	7.40×10^{-05}	1.05×10^{-04}	3.21×10^{-04}	2.42×10^{-03}
Seasonal Resident One-Year-Old (Patterson Lake South Arm)	**RFD Case**													
	Uranium-238	9.37×10^{-05}	3.35×10^{-13}	1.93×10^{-05}	5.22×10^{-11}	1.48×10^{-08}	1.64×10^{-04}	7.66×10^{-08}	8.17×10^{-07}	$0.00 \times 10^{+00}$	2.36×10^{-05}	5.34×10^{-05}	2.71×10^{-05}	3.91×10^{-04}
	Uranium-234	1.10×10^{-04}	8.20×10^{-13}	2.10×10^{-05}	9.15×10^{-12}	1.61×10^{-08}	8.27×10^{-07}	8.38×10^{-08}	2.97×10^{-09}	$0.00 \times 10^{+00}$	2.58×10^{-05}	5.81×10^{-05}	2.96×10^{-05}	2.58×10^{-04}
	Thorium-230	3.49×10^{-04}	1.99×10^{-12}	5.59×10^{-04}	1.84×10^{-10}	7.72×10^{-08}	1.18×10^{-06}	7.78×10^{-07}	1.92×10^{-08}	$0.00 \times 10^{+00}$	4.30×10^{-04}	2.57×10^{-04}	3.09×10^{-03}	5.33×10^{-03}

	Incremental Dose by Pathway RFD Case (mSv/yr)													
	Radionuclide	**Air (Internal)**	**Air (External)**	**Water (Internal)**	**Water (External)**	**Soil (Internal)**	**Soil (External)**	**Sediment (Internal)**	**Sediment (External)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial Animals**	**Total by Radionuclide**
	Radium-226	1.10×10^{-04}	3.80×10^{-11}	1.64×10^{-04}	2.03×10^{-08}	1.04×10^{-07}	2.70×10^{-03}	3.55×10^{-07}	4.26×10^{-05}	$0.00 \times 10^{+00}$	1.41×10^{-04}	6.01×10^{-04}	3.08×10^{-04}	4.09×10^{-03}
	Lead-210	3.69×10^{-05}	5.98×10^{-12}	3.00×10^{-04}	3.94×10^{-11}	1.66×10^{-07}	3.85×10^{-05}	3.03×10^{-06}	1.72×10^{-07}	$0.00 \times 10^{+00}$	6.06×10^{-04}	1.18×10^{-03}	2.98×10^{-03}	5.06×10^{-03}
	Polonium-210	1.10×10^{-04}	5.23×10^{-14}	7.16×10^{-04}	2.79×10^{-13}	2.93×10^{-07}	8.69×10^{-09}	5.35×10^{-06}	7.34×10^{-10}	$0.00 \times 10^{+00}$	3.60×10^{-03}	1.98×10^{-03}	7.92×10^{-03}	1.40×10^{-02}
	Total by Pathway	8.08×10^{-04}	4.72×10^{-11}	1.78×10^{-03}	2.06×10^{-08}	6.71×10^{-07}	2.91×10^{-03}	9.68×10^{-06}	4.36×10^{-05}	$0.00 \times 10^{+00}$	4.82×10^{-03}	4.13×10^{-03}	1.44×10^{-02}	2.91×10^{-02}
	Far-Future													
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.10×10^{-05}	2.97×10^{-11}	1.55×10^{-09}	1.72×10^{-05}	1.44×10^{-07}	1.54×10^{-06}	$0.00 \times 10^{+00}$	8.24×10^{-06}	5.42×10^{-06}	8.71×10^{-06}	6.29×10^{-05}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.20×10^{-05}	5.20×10^{-12}	1.69×10^{-09}	8.69×10^{-08}	1.58×10^{-07}	5.60×10^{-09}	$0.00 \times 10^{+00}$	8.96×10^{-06}	5.91×10^{-06}	9.51×10^{-06}	4.82×10^{-05}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.70×10^{-06}	1.55×10^{-12}	4.31×10^{-08}	6.61×10^{-07}	1.01×10^{-08}	2.49×10^{-10}	$0.00 \times 10^{+00}$	1.69×10^{-06}	2.90×10^{-06}	4.52×10^{-05}	6.20×10^{-05}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.68×10^{-05}	2.08×10^{-09}	7.03×10^{-08}	1.82×10^{-03}	1.04×10^{-07}	1.25×10^{-05}	$0.00 \times 10^{+00}$	1.21×10^{-05}	9.09×10^{-05}	7.73×10^{-05}	2.04×10^{-03}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.65×10^{-06}	2.17×10^{-13}	1.13×10^{-10}	2.63×10^{-08}	4.08×10^{-08}	2.31×10^{-09}	$0.00 \times 10^{+00}$	3.95×10^{-06}	1.93×10^{-08}	9.27×10^{-05}	9.74×10^{-05}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.07×10^{-06}	1.59×10^{-15}	2.00×10^{-10}	5.95×10^{-12}	7.22×10^{-08}	9.91×10^{-12}	$0.00 \times 10^{+00}$	3.48×10^{-05}	1.67×10^{-07}	8.72×10^{-05}	1.11×10^{-04}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.02×10^{-05}	2.12×10^{-09}	1.17×10^{-07}	1.84×10^{-03}	5.29×10^{-07}	1.40×10^{-05}	$0.00 \times 10^{+00}$	6.98×10^{-05}	1.05×10^{-04}	3.21×10^{-04}	2.42×10^{-03}
Seasonal Resident (Lloyd Lake)	**RFD Case**													
	Uranium-238	2.45×10^{-06}	6.72×10^{-15}	9.00×10^{-07}	6.83×10^{-12}	3.85×10^{-10}	4.27×10^{-06}	2.59×10^{-09}	2.76×10^{-08}	$0.00 \times 10^{+00}$	2.90×10^{-06}	1.39×10^{-06}	5.27×10^{-07}	1.25×10^{-05}
	Uranium-234	2.95×10^{-06}	1.64×10^{-14}	9.83×10^{-07}	1.19×10^{-12}	4.20×10^{-10}	2.15×10^{-08}	2.83×10^{-09}	1.01×10^{-10}	$0.00 \times 10^{+00}$	3.17×10^{-06}	1.51×10^{-06}	5.74×10^{-07}	9.22×10^{-06}
	Thorium-230	1.18×10^{-05}	3.98×10^{-14}	5.02×10^{-05}	3.40×10^{-11}	2.01×10^{-09}	3.08×10^{-08}	4.27×10^{-08}	1.06×10^{-09}	$0.00 \times 10^{+00}$	3.41×10^{-05}	6.70×10^{-06}	8.29×10^{-05}	1.86×10^{-04}
	Radium-226	2.95×10^{-06}	7.62×10^{-13}	6.84×10^{-06}	3.05×10^{-09}	2.72×10^{-09}	7.04×10^{-05}	1.49×10^{-08}	1.79×10^{-06}	$0.00 \times 10^{+00}$	9.75×10^{-06}	1.57×10^{-05}	3.93×10^{-06}	1.11×10^{-04}
	Lead-210	9.29×10^{-07}	1.20×10^{-13}	1.74×10^{-06}	1.53×10^{-12}	4.32×10^{-09}	1.00×10^{-06}	2.20×10^{-08}	1.24×10^{-09}	$0.00 \times 10^{+00}$	7.65×10^{-04}	3.07×10^{-05}	1.97×10^{-05}	8.19×10^{-04}
	Polonium-210	2.79×10^{-06}	1.05×10^{-15}	2.97×10^{-06}	8.94×10^{-15}	7.64×10^{-09}	2.26×10^{-10}	3.88×10^{-08}	5.32×10^{-12}	$0.00 \times 10^{+00}$	5.59×10^{-04}	5.16×10^{-05}	8.13×10^{-05}	6.98×10^{-04}
	Total by Pathway	2.39×10^{-05}	9.47×10^{-13}	6.37×10^{-05}	3.10×10^{-09}	1.75×10^{-08}	7.57×10^{-05}	1.24×10^{-07}	1.82×10^{-06}	$0.00 \times 10^{+00}$	1.37×10^{-03}	1.08×10^{-04}	1.89×10^{-04}	1.84×10^{-03}
	Far-Future													
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.33×10^{-07}	4.04×10^{-12}	4.05×10^{-11}	4.49×10^{-07}	4.86×10^{-09}	5.18×10^{-08}	$0.00 \times 10^{+00}$	2.27×10^{-06}	1.41×10^{-07}	2.26×10^{-07}	3.67×10^{-06}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.82×10^{-07}	7.07×10^{-13}	4.41×10^{-11}	2.26×10^{-09}	5.31×10^{-09}	1.89×10^{-10}	$0.00 \times 10^{+00}$	2.47×10^{-06}	1.54×10^{-07}	2.46×10^{-07}	3.46×10^{-06}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.04×10^{-07}	3.42×10^{-13}	1.12×10^{-09}	1.72×10^{-08}	5.50×10^{-10}	1.36×10^{-11}	$0.00 \times 10^{+00}$	4.47×10^{-07}	7.56×10^{-08}	9.52×10^{-07}	2.00×10^{-06}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	7.74×10^{-07}	3.46×10^{-10}	1.83×10^{-09}	4.75×10^{-05}	4.29×10^{-09}	5.14×10^{-07}	$0.00 \times 10^{+00}$	1.77×10^{-06}	2.37×10^{-06}	9.88×10^{-07}	5.39×10^{-05}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.22×10^{-08}	1.09×10^{-14}	2.73×10^{-12}	6.98×10^{-10}	4.15×10^{-10}	2.32×10^{-11}	$0.00 \times 10^{+00}$	7.56×10^{-04}	2.33×10^{-10}	7.08×10^{-08}	7.56×10^{-04}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.00×10^{-12}	1.56×10^{-13}	6.84×10^{-10}	9.33×10^{-14}	$0.00 \times 10^{+00}$	5.10×10^{-04}	4.66×10^{-09}	6.56×10^{-07}	5.10×10^{-04}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.41×10^{-06}	3.51×10^{-10}	3.05×10^{-09}	4.79×10^{-05}	1.61×10^{-08}	5.66×10^{-07}	$0.00 \times 10^{+00}$	1.27×10^{-03}	2.75×10^{-06}	3.14×10^{-06}	1.33×10^{-03}
Seasonal Resident One-Year-Old (Lloyd Lake)	**RFD Case**													
	Uranium-238	2.44×10^{-06}	8.73×10^{-15}	6.25×10^{-07}	1.69×10^{-12}	1.57×10^{-08}	5.72×10^{-06}	1.05×10^{-07}	3.59×10^{-08}	$0.00 \times 10^{+00}$	4.50×10^{-07}	1.90×10^{-06}	2.31×10^{-07}	1.15×10^{-05}
	Uranium-234	2.86×10^{-06}	2.14×10^{-14}	6.80×10^{-07}	2.96×10^{-13}	1.70×10^{-08}	2.88×10^{-08}	1.15×10^{-07}	1.31×10^{-10}	$0.00 \times 10^{+00}$	4.89×10^{-07}	2.06×10^{-06}	2.50×10^{-07}	6.49×10^{-06}
	Thorium-230	9.09×10^{-06}	5.18×10^{-14}	2.55×10^{-05}	8.43×10^{-12}	5.99×10^{-08}	3.51×10^{-08}	1.27×10^{-06}	1.37×10^{-09}	$0.00 \times 10^{+00}$	8.57×10^{-06}	3.71×10^{-06}	4.03×10^{-05}	8.86×10^{-05}
	Radium-226	2.86×10^{-06}	9.91×10^{-13}	6.11×10^{-06}	7.56×10^{-10}	1.42×10^{-07}	9.42×10^{-05}	7.80×10^{-07}	2.33×10^{-06}	$0.00 \times 10^{+00}$	3.95×10^{-06}	2.09×10^{-05}	1.56×10^{-06}	1.33×10^{-04}
	Lead-210	9.61×10^{-07}	1.56×10^{-13}	2.37×10^{-06}	3.11×10^{-13}	3.44×10^{-07}	1.34×10^{-06}	1.75×10^{-06}	1.62×10^{-09}	$0.00 \times 10^{+00}$	5.52×10^{-06}	5.74×10^{-05}	2.34×10^{-05}	9.31×10^{-05}
	Polonium-210	2.86×10^{-06}	1.36×10^{-15}	5.68×10^{-06}	2.21×10^{-15}	8.54×10^{-07}	2.96×10^{-10}	4.34×10^{-06}	6.91×10^{-12}	$0.00 \times 10^{+00}$	4.62×10^{-05}	1.42×10^{-04}	8.88×10^{-05}	2.91×10^{-04}
	Total by Pathway	2.11×10^{-05}	1.23×10^{-12}	4.10×10^{-05}	7.67×10^{-10}	1.43×10^{-06}	1.01×10^{-04}	8.36×10^{-06}	2.37×10^{-06}	$0.00 \times 10^{+00}$	6.51×10^{-05}	2.28×10^{-04}	1.55×10^{-04}	6.24×10^{-04}
	Far-Future													
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	3.70×10^{-07}	9.99×10^{-13}	1.65×10^{-09}	6.01×10^{-07}	1.98×10^{-07}	6.74×10^{-08}	$0.00 \times 10^{+00}$	2.77×10^{-07}	1.92×10^{-07}	1.01×10^{-07}	1.81×10^{-06}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	4.03×10^{-07}	1.75×10^{-13}	1.78×10^{-09}	3.03×10^{-09}	2.15×10^{-07}	2.45×10^{-10}	$0.00 \times 10^{+00}$	3.02×10^{-07}	2.08×10^{-07}	1.09×10^{-07}	1.24×10^{-06}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.57×10^{-07}	8.46×10^{-14}	3.35×10^{-08}	1.96×10^{-08}	1.64×10^{-08}	1.77×10^{-11}	$0.00 \times 10^{+00}$	9.24×10^{-08}	7.52×10^{-08}	4.62×10^{-07}	9.56×10^{-07}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.92×10^{-07}	8.56×10^{-11}	9.58×10^{-08}	6.35×10^{-05}	2.24×10^{-07}	6.70×10^{-07}	$0.00 \times 10^{+00}$	4.97×10^{-07}	4.14×10^{-06}	3.95×10^{-07}	7.02×10^{-05}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.66×10^{-08}	2.22×10^{-15}	2.33×10^{-10}	9.31×10^{-10}	3.28×10^{-08}	3.05×10^{-11}	$0.00 \times 10^{+00}$	4.00×10^{-08}	1.40×10^{-09}	8.94×10^{-08}	1.82×10^{-07}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.82×10^{-10}	1.99×10^{-13}	7.73×10^{-08}	1.22×10^{-13}	$0.00 \times 10^{+00}$	2.24×10^{-08}	1.68×10^{-08}	8.34×10^{-07}	9.51×10^{-07}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.74×10^{-06}	8.68×10^{-11}	1.34×10^{-07}	6.41×10^{-05}	7.63×10^{-07}	7.38×10^{-07}	$0.00 \times 10^{+00}$	1.23×10^{-06}	4.64×10^{-06}	1.99×10^{-06}	7.54×10^{-05}

	Incremental Dose by Pathway RFD Case (mSv/yr)													
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by Radionuclide
Permanent Resident (Patterson Lake North Arm - West Basin)	Far-Future Adult													
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.91×10^{-04}	1.45×10^{-09}	2.69×10^{-08}	2.98×10^{-04}	1.74×10^{-06}	1.85×10^{-05}	$0.00 \times 10^{+00}$	5.31×10^{-04}	1.20×10^{-04}	2.40×10^{-04}	1.40×10^{-03}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.08×10^{-04}	2.53×10^{-10}	2.93×10^{-08}	1.50×10^{-06}	1.90×10^{-06}	6.75×10^{-08}	$0.00 \times 10^{+00}$	5.81×10^{-04}	1.30×10^{-04}	2.62×10^{-04}	1.18×10^{-03}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	5.00×10^{-05}	3.39×10^{-11}	7.47×10^{-07}	1.14×10^{-05}	5.48×10^{-08}	1.35×10^{-09}	$0.00 \times 10^{+00}$	6.70×10^{-05}	6.40×10^{-05}	5.37×10^{-04}	7.30×10^{-04}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.70×10^{-04}	7.61×10^{-08}	1.22×10^{-06}	3.15×10^{-02}	9.43×10^{-07}	1.13×10^{-04}	$0.00 \times 10^{+00}$	4.55×10^{-04}	2.01×10^{-03}	1.90×10^{-03}	3.62×10^{-02}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	6.15×10^{-05}	5.42×10^{-11}	1.96×10^{-09}	4.55×10^{-07}	2.07×10^{-06}	1.17×10^{-07}	$0.00 \times 10^{+00}$	5.48×10^{-04}	4.31×10^{-07}	9.16×10^{-04}	1.53×10^{-03}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.08×10^{-04}	3.24×10^{-13}	3.47×10^{-09}	1.03×10^{-10}	3.66×10^{-06}	5.02×10^{-10}	$0.00 \times 10^{+00}$	3.42×10^{-03}	3.68×10^{-06}	7.21×10^{-03}	1.07×10^{-02}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	7.89×10^{-04}	7.79×10^{-08}	2.03×10^{-06}	3.18×10^{-02}	1.04×10^{-05}	1.32×10^{-04}	$0.00 \times 10^{+00}$	5.61×10^{-03}	2.33×10^{-03}	1.11×10^{-02}	5.18×10^{-02}
	Far-Future One-Year-Old													
	Uranium-238	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.33×10^{-04}	3.58×10^{-10}	1.09×10^{-06}	3.99×10^{-04}	7.07×10^{-05}	2.41×10^{-05}	$0.00 \times 10^{+00}$	3.13×10^{-04}	1.47×10^{-04}	1.09×10^{-04}	1.20×10^{-03}
	Uranium-234	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.44×10^{-04}	6.27×10^{-11}	1.19×10^{-06}	2.01×10^{-06}	7.69×10^{-05}	8.78×10^{-08}	$0.00 \times 10^{+00}$	3.41×10^{-04}	1.59×10^{-04}	1.18×10^{-04}	8.42×10^{-04}
	Thorium-230	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.54×10^{-05}	8.39×10^{-12}	2.22×10^{-05}	1.30×10^{-05}	1.63×10^{-06}	1.76×10^{-09}	$0.00 \times 10^{+00}$	2.89×10^{-05}	5.75×10^{-05}	2.57×10^{-04}	4.06×10^{-04}
	Radium-226	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	1.52×10^{-04}	1.88×10^{-08}	6.37×10^{-05}	4.22×10^{-02}	4.93×10^{-05}	1.47×10^{-04}	$0.00 \times 10^{+00}$	3.45×10^{-04}	3.17×10^{-03}	7.33×10^{-04}	4.69×10^{-02}
	Lead-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	8.36×10^{-05}	1.10×10^{-11}	1.56×10^{-07}	6.09×10^{-07}	1.65×10^{-04}	1.52×10^{-07}	$0.00 \times 10^{+00}$	6.32×10^{-04}	1.03×10^{-06}	1.09×10^{-03}	1.97×10^{-03}
	Polonium-210	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	2.06×10^{-04}	8.02×10^{-14}	3.88×10^{-07}	1.34×10^{-10}	4.09×10^{-04}	6.52×10^{-10}	$0.00 \times 10^{+00}$	5.56×10^{-03}	1.24×10^{-05}	9.16×10^{-03}	1.53×10^{-02}
	Total by Pathway	$0.00 \times 10^{+00}$	$0.00 \times 10^{+00}$	7.44×10^{-04}	1.93×10^{-08}	8.87×10^{-05}	4.26×10^{-02}	7.72×10^{-04}	1.72×10^{-04}	$0.00 \times 10^{+00}$	7.22×10^{-03}	3.54×10^{-03}	1.15×10^{-02}	6.66×10^{-02}

mSv/yr = millisieverts per year; n/a = not applicable or not assessed; RFD = reasonably foreseeable development.

5.2.5 Uncertainty in Exposure Assessment

The exposure assessment followed CSA, Health Canada and USEPA guidance. Key uncertainties in the human health exposure assumptions and how they are addressed in the HHRA are summarized in Table 5-15.

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 are exposed to the maximum exposure concentrations at their location for each model scenario and Project phase. The duration of this exposure was assumed to be sufficient for each receptor to be in equilibrium with their environment. This results in conservatively high predicted uptakes of COPCs by ecological receptors and exposures to human health receptors.

The assumptions to address uncertainties in the exposure assessment were anticipated to produce conservative exposure estimates for human health receptors. Therefore, the risk that the exposure assessment underestimated potential exposure of human health receptors to COPCs from the Project is low.

Table 5-15: 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 • Sought 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 HH receptors in the LSA and RSA at locations known to be in the area of cabins, camps, outfitters • Included two receptors located at the Project site to cover all Project phases: 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 Rook I study area.	• 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 (FNFNES) as a starting point • Sought feedback from local Indigenous Groups and regulatory bodies. Based the total food intake for male and female HH 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 Plains 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 HH 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 preferred 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

COPC = constituent of potential concern; FNFNES = First Nations Food, Nutrition, and Environmental Study; HH = human health; LSA = local study area; RSA = regional study area.

5.3 Toxicity Assessment

The human health toxicity assessment considers potential adverse health effects from non-radiological and radiological exposures via two internal exposure pathways: ingestion and inhalation. In the case of chemical toxicity from exposure to radiological COPCs, the assessment also considers radiological dose from these exposures.

For assessment of non-radiological COPCs, a toxicity reference value (TRV) is used. A TRV is a toxicological index, associating specific health effects with a level of exposure to a chemical. TRVs may 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 used in the risk characterization to determine incremental lifetime cancer risks (ILCRs) for carcinogens and hazard quotients (HQs) for non-carcinogens.

For assessment of radiological COPCs, a radiation dose benchmark that combines external and internal radiological doses from all radiological COPCs is used.

5.3.1 Toxicity Reference Values

No COPCs in air were identified for further evaluation of potential risks for human health; therefore, toxicity via inhalation was not included in the toxicity assessment. Separate toxicity benchmarks for direct contact effects from dermal exposure are not available. Although some of the COPCs present in soil may cause direct contact dermatitis, information is not available to suggest that such effects can occur at environmental levels (CSA 2022). A summary of the TRVs used in the HHRA is shown in Table 5-16.

Chloride and sulphate are COPCs identified in Section 4.4, Final List of Constituents of Potential Concern for the Environmental Risk Assessment. 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. Sulphate in drinking water is associated with adverse physiological effects such as diarrhoea or dehydration at concentrations above 500 mg/L. The upper bound concentration of sulphate at the edge of the treated effluent mixing zone was 291 mg/L, as shown in Table 4-2, and 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 in the HHRA.

Arsenic, cobalt, copper, molybdenum, and uranium were retained for further evaluation in the HHRA because they were predicted to exceed water or sediment quality screening benchmarks (Section 4.2.5, Water Quality Constituents for Further Evaluation in the Environmental Risk Assessment).

The relevant non-cancer TRVs are expressed as a quantity of a chemical per unit body weight per unit time (mg/kg/d) for oral exposure and have generally been derived for sensitive individuals in the public based on sensitive endpoints. Additionally, these factors typically involve the incorporation of uncertainty factors by regulatory agencies to account for uncertainties inherent in the underlying studies or their applicability for protection of members of the public. Carcinogenic effects TRVs are generally referred to as slope factors or unit risks and are used to estimate upper-bound lifetime probabilities of an individual developing cancer as a result of exposure to a particular level of a potential carcinogen. The carcinogen slope factor or unit risk is, therefore, the lifetime cancer risk per unit of dose or concentration. The slope factor is expressed as risk per mg/kg/d, or $(mg/kg/d)^{-1}$, for oral exposure. Arsenic was the only Project-related COPC evaluated as a carcinogen.

In the selection of TRVs, preference was given to toxicological benchmarks derived by Health Canada, the USEPA Integrated Risk Information System database, the Agency for Toxic Substances and Disease Registry (ATSDR) and the WHO. The supporting documentation for each toxicity benchmark was reviewed and professional judgment was used to evaluate the appropriateness of the benchmark value.

The human health TRVs for arsenic, copper, molybdenum, and uranium were obtained from Health Canada's TRV Guidance (Health Canada 2021b; 2010c). Since Health Canada does not have a published TRV for cobalt, the cobalt TRV was obtained from the ATSDR (ATSDR 2004).

Table 5-16: Human Health Oral Exposure Toxicity Reference Values

COPC	Benchmark Value	Unit	Reference
Arsenic (cancer)	1.8	$(mg/kg/d)^{-1}$	Health Canada 2021b
Cobalt	0.01	mg/kg/d	ATSDR 2004
Copper	0.426	mg/kg/d	Health Canada 2021b
Molybdenum	0.023 (infant) 0.028 (adult)	mg/kg/d	Health Canada 2010c
Uranium	0.0006	mg/kg/d	Health Canada 2021b

COPC = constituent of potential concern.

5.3.1.1 Arsenic

Arsenic is classified as a Class I carcinogen to humans (Environment Canada and Health Canada 1993). Health Canada (2021b) recommends 1.8 $(mg/kg/d)^{-1}$ as the oral slope factor for arsenic. It was originally developed by Health Canada when the agency was deriving a Guideline for Canadian Drinking Water Quality (Health Canada 2006). The TRV is based on the risk of bladder, lung, and liver cancer in people exposed to arsenic in their drinking water (Morales et al. 2000; Chen et al. 1985; Wu et al. 1989).

5.3.1.2 Cobalt

Cobalt is a trace element that is essential to human health (Health Canada 2021b). Cobalt is not classified as a human carcinogen. Health Canada (Health Canada 2021b) does not provide a threshold oral TRV for cobalt. The listed TRV of 0.01 mg/kg/d is recommended by ATSDR (2004). The ATSDR TRV is an intermediate Minimal Risk Level, and is based on a study by Davis and Fields (Davis and Fields 1958), in which human males ingested a 2% cobalt chloride solution (in water or milk) for up to 22 days. The critical endpoint was hematological effects (increased levels of erythrocytes). The ATSDR took the lowest observed adverse effect level (LOAEL) of 1 mg/kg/d and applied a total uncertainty factor of 100 to arrive at their intermediate minimal risk level. The ATSDR did not derive a chronic minimal risk level for cobalt due to a lack of relevant animal and human studies.

5.3.1.3 Copper

Copper is a trace element that is essential for human health (Health Canada 2021b). Copper is not classified as a human carcinogen. Health Canada recommends 0.426 mg/kg/d as the threshold oral TRV for copper for all age groups. The TRV was originally developed by Health Canada when the agency was deriving a Guideline for Canadian Drinking Water Quality (Health Canada 2019a). The TRV is based on a critical health effect of gastrointestinal toxicity and liver function (hepatoxicity) in human infants exposed to copper in drinking water (Olivares et al. 1998). The TRV is based directly (no uncertainty factors applied) on the upper bound of the 95th confidence interval for a no observed adverse effect level (NOAEL) of 2 mg/L copper in drinking water (0.318 mg/kg/d).

5.3.1.4 Molybdenum

Molybdenum is considered to be an essential trace element for human health (Health Canada 2021b). However, Health Canada recommends that potential health risks to human receptors be characterized if molybdenum is identified as a COPC (Health Canada 2021b). The TRVs for essential trace elements are tolerable upper intake levels (ULs), which are considered to be the highest average daily nutrient intake levels that are likely to pose no risk of adverse health effects to almost all individuals in the general population. Health Canada (2010c) recommends age-specific ULs for molybdenum that are based on a NOAEL value derived for adults (IOM 2001) from sub-chronic developmental and reproductive effects on rats consuming molybdate in drinking water. An uncertainty factor of 30 was applied (10 for interspecies variability and 3 for intraspecies variability) to the NOAEL value of 0.9 mg/kg-d. The adult UL was weight adjusted to derive age-based TRVs. As with other essential trace elements, Health Canada (2010c) recommends that adjustments for relative bioavailability of molybdenum may be necessary when considering oral exposures from different pathways.

5.3.1.5 Uranium

Health Canada (2021b) recommends 6.0×10^{-4} mg/kg/d as the threshold oral TRV for uranium for non-radiological effects for all age groups. Uranium (non-radiological) is not classified as a human carcinogen. The TRV was originally developed by Health Canada when the agency was deriving a Guideline for Canadian Drinking Water Quality and it has since been re-affirmed (Health Canada 2019b). The TRV is based on the critical health effect of kidney toxicity in rats exposed to uranium in drinking water (Gilman et al. 1998). The TRV is based on a NOAEL of 0.06 mg/kg/d and a total uncertainty factor of 100.

5.3.2 Radiation Dose Limits and Targets

Radiological dose from radiological COPCs was retained for further evaluation because screening values were not available for individual radionuclides emitted to water and air.

Potential effects from radiation were compared to an effective dose limit (Table 5-17). The effective dose is defined as the sum of all tissue equivalent doses multiplied by the appropriate tissue weighting factors associated with each respective tissue (Health Canada 2010b). The limit is incremental and is exclusive of natural background, such as natural levels of radon, and medical exposures. The public dose limit for radiation protection is 1 mSv/yr, as described in the Radiation Protection Regulations under the *Nuclear Safety and Control Act*, and as recommended in CSA N288.6-22. A higher incremental dose than the effective dose limit is considered unacceptable.

Incremental dose from the Project can also be compared to a dose constraint. A dose constraint is a conservative value for the annual increment dose applied to a single operation that is considered protective without further demonstration in situations where multiple sources may contribute to incremental dose (Health Canada 2011b). Application of a dose constraint is meant to ensure that the combined doses from multiple sources do not exceed the public dose limit of 1 mSv/yr. A dose constraint of 0.3 mSv/yr is used in the ERA, as recommended by Health Canada (Health Canada 2011b). The dose constraint represents a dose, lower than the public dose limit that ensures that the combined dose from multiple sources does not result in exceedance of the public dose limit. Exceedance of the dose constraint does not indicate that adverse effects would occur, but instead indicates that the assumptions used in the calculation of exposure estimates for the operation should be examined in more detail.

Table 5-17: Radiation Dose Limits for Human Health

COPC	Benchmark Value	Unit	Reference
Effective dose limit: public and non-nuclear energy worker	1	mSv/yr	Radiation Protection Regulations. SOR/2000-203
Dose constraint	0.3	mSv/yr	Health Canada 2014; ICRP 2007; IAEA 2014

mSv/yr = millisieverts per year.

5.3.3 Uncertainty in the Toxicity Assessment

In general, TRV are usually based on limited toxicological data. For this reason, a margin of safety is built into TRV estimates, by use of uncertainty factors or conservative confidence levels, and actual risks are lower than those estimated. In this risk assessment, TRV recommended by Health Canada were used when available to reduce uncertainty that potential health risks for human receptors would be underestimated in the risk evaluation.

The two major areas of uncertainty introduced in this toxicity assessment are animal to human extrapolation for Health Canada's recommend TRV for uranium, and use of an intermediate-duration TRV from another regulatory agency than Health Canada for cobalt. In both cases, uncertainty factors were applied in the derivation of the TRVs. For uranium, the chronic TRV was based on a no observed adverse effects level for rats and a total uncertainty factor of 100. For cobalt, the intermediate (sub-chronic) TRV was based on a LOAEL for humans and a total uncertainty factor of 100. As a result, overestimation of the potential for adverse effects on humans is more likely than underestimation for similar exposure scenarios.

5.4 Risk Characterization

Risk assessment is the process of estimating the likelihood of undesirable effects on human health resulting from exposure to chemical contaminants. Three components must be present for risks to human health to exist:

- The COPC must be present at concentrations sufficient to cause a possible adverse effect.
- A receptor (theoretical human health receptor) must be present.
- There must be a complete exposure pathway by which the receptor can come into contact with the chemical.

5.4.1 Risk Estimation

The potential for adverse effects on human receptors 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 methods of non-radiological risk estimation used for the HHRA are:

- HQs for non-carcinogens; and
- ILCR for carcinogens.

Hazard quotients are calculated in IMPACT as the ratio of the exposure concentration or intake rate divided by the benchmark value, as shown below:

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

The HQs were compared to threshold values. Non-carcinogenic constituents are not expected to cause any adverse health effects below the toxicity reference or threshold value. The HQs can be compared to a benchmark value of one (1) if all exposure pathways (exposures from all pathways including background) are accounted for.

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) would be considered acceptable for the assessment. This approach is consistent with the approach taken by Health Canada in its guidance on human health preliminary quantitative risk assessment (Health Canada 2021a).

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)
$LADD_i$	=	dose received during lifestage i averaged over a lifetime (mg/kg/d)
SF	=	adult cancer slope factor (per mg/kg/d)
$ADAF_i$	=	age-dependent adjustment factors for lifestage i

Health Canada (2013) recommends that for carcinogens where the mode of action is unknown or the burden of proof for a threshold mode of action is not met, that the assessment should follow the non-threshold approach (i.e., a linear dose-response relationship). The Canadian drinking water guideline technical document for arsenic indicates that there is limited data on the mode of action for arsenic and that the use of a non-linear relationship may overestimate cancer risks of internal organs (Health Canada 2006). Therefore, for this assessment, a linear approach for arsenic was used, and the age-dependent adjustment factors for all life stages were set at 1.

Incremental lifetime cancer risks were compared to de minimis risk levels 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).

Total radiation doses due to radionuclides in the uranium-238 decay series were predicted. Incremental radiation doses were compared to the regulatory public dose limit and dose limit for a non-nuclear energy worker of 1 mSv/yr and a dose constraint of 0.3 mSv/yr, as described in Section 5.3.2, Radiation Dose Limits and Targets. Radon dose was calculated separately from the dose due to other radionuclides and was also compared to the dose limit of 1 mSv/yr.

5.4.1.1 Estimated Risk to Human Receptors – Application Case

This subsection presents the estimated risks to human receptors due to releases from the Project during all phases including the far-future projection once groundwater solutes have been released to Patterson Lake. Results are presented for the Application Case and the Upper Bound sensitivity scenario.

5.4.1.1.1 Non-carcinogen Risk

The estimated incremental HQs for all human receptors at all assessed locations during Operations and for the far-future projection are shown in Table 5-18. The HQs represent the maximum HQ over the Project phase for the COPCs of interest, which is a conservative representation as exposure varies over the different Project phases. HQs 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 predicted Project HQ was for uranium for the subsistence harvester (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), which 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.

For molybdenum, HQs for the base case (without the Project) slightly exceeded 0.2 for the terrestrial animal ingestion pathway for the reference subsistence harvester (one-year-old); however, considering the Project only, HQs remain below 0.2 for all receptors during Operations and for the far-future projection for both the Application Case and the reasonable upper bound sensitivity scenario. The terrestrial animal ingestion pathway for the one-year-old includes ingestion of moose meat and organs, as well as beaver. For molybdenum, the addition of the Project effects does not significantly change the existing base case HQ predictions indicating that the Project has a minimal contribution to existing risk from molybdenum in Traditional Foods.

No significant adverse effect would be likely on any human receptors as a result of releases from the Project during Operations for both the Application Case and reasonable upper bound sensitivity scenario. All estimated incremental Project HQs for all non-carcinogenic COPCs (i.e., cobalt, copper, molybdenum, and uranium) would remain below the acceptable risk level of 0.2 per pathway for the one-year-old and adult for all human receptors over the Project lifespan and in the far future.

Table 5-18: Estimated Non-carcinogen Risk to Human Receptors – Project Lifespan and Far-Future – Application Case and Upper Bound Scenario

	COPC	Project Lifespan HQs								Far Future HQs							
		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}

	COPC	Project Lifespan HQs								Far Future HQs							
		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}	6.48×10^{-03}
	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}	**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	4.34×10^{-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}	1.37×10^{-04}	$0.00 \times 10^{+00}$	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}

	COPC	Project Lifespan HQs								Far Future HQs							
		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^{-06}	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^{-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	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^{-06}	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}

Receptor	COPC	Project Lifespan HQs								Far Future HQs							
		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)	**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	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}	**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^{-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}

	COPC	Project Lifespan HQs								Far Future HQs							
		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}	$6.62 x 10^{-05}$	$0.00 \times 10^{+00}$	2.18×10^{-03}	2.84×10^{-03}	4.78×10^{-02}	$5.39 x 10^{-02}$
	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}	$2.69 x 10^{-06}$	$0.00 \times 10^{+00}$	1.69×10^{-03}	1.06×10^{-03}	9.70×10^{-02}	$9.98 x 10^{-02}$
	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}	$1.29 x 10^{-05}$	$0.00 \times 10^{+00}$	2.79×10^{-06}	7.01×10^{-04}	**2.64×10^{-01}**	$2.64 x 10^{-01}$
	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}	$1.47 x 10^{-03}$	$0.00 \times 10^{+00}$	6.49×10^{-03}	7.57×10^{-02}	1.70×10^{-01}	$2.57 x 10^{-01}$
	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}	$1.85 x 10^{-07}$	$9.59 x 10^{-05}$	$0.00 \times 10^{+00}$	3.15×10^{-03}	$8.90 x 10^{-06}$	$6.47 x 10^{-03}$	$1.11 x 10^{-02}$
	Copper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	5.16×10^{-05}	$3.95 x 10^{-09}$	$4.28 x 10^{-06}$	$0.00 \times 10^{+00}$	2.69×10^{-03}	$2.18 x 10^{-06}$	$1.67 x 10^{-03}$	$4.41 x 10^{-03}$
	Molybdenum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3.14×10^{-03}	$0.00 \times 10^{+00}$	$2.75 x 10^{-04}$	$0.00 \times 10^{+00}$	5.95×10^{-05}	$0.00 \times 10^{+00}$	2.20×10^{-03}	$5.67 x 10^{-03}$
	Uranium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.47×10^{-02}	$2.51 x 10^{-04}$	$1.32 x 10^{-02}$	$0.00 \times 10^{+00}$	5.85×10^{-02}	$3.37 x 10^{-02}$	$2.23 x 10^{-02}$	$1.53 x 10^{-01}$
	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}	$1.85 x 10^{-07}$	$1.47 x 10^{-04}$	$0.00 \times 10^{+00}$	4.83×10^{-03}	$8.90 x 10^{-06}$	$9.90 x 10^{-03}$	$1.70 x 10^{-02}$
	Copper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	7.75×10^{-05}	$3.95 x 10^{-09}$	$6.42 x 10^{-06}$	$0.00 \times 10^{+00}$	4.04×10^{-03}	$2.18 x 10^{-06}$	$2.50 x 10^{-03}$	$6.62 x 10^{-03}$
	Molybdenum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.21×10^{-02}	$0.00 \times 10^{+00}$	$1.06 x 10^{-03}$	$0.00 \times 10^{+00}$	2.28×10^{-04}	$0.00 \times 10^{+00}$	8.44×10^{-03}	$2.18 x 10^{-02}$
	Uranium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2.48×10^{-02}	$2.51 x 10^{-04}$	$1.32 x 10^{-02}$	$0.00 \times 10^{+00}$	5.85×10^{-02}	$3.37 x 10^{-02}$	$2.23 x 10^{-02}$	$1.53 x 10^{-01}$

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

5.4.1.1.2 Carcinogen Risk

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 (Table 5-19). 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 risks from arsenic for the subsistence harvester at Patterson Lake South Arm were predicted to be 4 in 100,000 in both the Application Case and reasonable upper bound sensitivity scenario. 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.

The main ingestion exposure pathway for arsenic for the adult camp worker, subsistence harvester and seasonal resident 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. The ILCRs for the Application Case and reasonable upper bound sensitivity scenario by food type are provided in Table 5-20 and Table 5-21 for the seasonal resident and subsistence harvester, respectively. The greatest contributor to the predicted ILCRs for the Application Case for both the seasonal resident and subsistence harvester at Patterson Lake South Arm during the Project lifespan is consumption of moose meat and organs.

Arsenic uptake by fish and their maximum arsenic concentrations in flesh were predicted as part of the environmental pathways assessment. For the Patterson Lake South Arm, the maximum predicted arsenic concentration in lake whitefish (0.043 mg/kg fw) was within the range of background variability observed in the baseline LSA and RSA (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 (0.01 mg/kg to 0.52 mg/kg fw; CanNorth 2018). The maximum predicted concentration of arsenic in northern pike (0.045 mg/kg fw) was also within the range of background variability measured in northern pike during baseline studies (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 (0.09 mg/kg to 0.15 mg/kg fw; CanNorth 2018), and the FNFNES sampling program for 2015 (maximum concentration of 0.1 mg/kg fw; Chan et al. 2018).

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 represent 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 for moose and moose organs in the Traditional Foods diet (Table 5-5) are considered 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 and the high consumer of Traditional Foods.

In the far-future projection, for the future permanent resident at the camp site, the arsenic ILCR was lower than for the camp worker during Operations and below the negligible cancer risk level (Table 5-19). The risk would be lower during the far-future projection because the main source of arsenic to the environment is during Operations when treated effluent is being released to Patterson Lake North Arm – West Basin.

Table 5-19: Estimated Incremental Lifetime Cancer Risk from Arsenic to Human Receptors – Application Case and Upper Bound Scenario

Receptor	Application Case Cancer Risk (per 100,000)		Upper Bound Scenario Cancer Risk (per 100,000)	
	Operations	Far-Future	Operations	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
Permanent resident - camp site (composite)	n/a	0.5	n/a	0.8

Bold indicates exceedance of the negligible cancer risk level of 1 in 100,000.
n/a = not applicable, receptor was not assessed.

Table 5-20: Estimated Carcinogen Risks for Arsenic to Seasonal Residents – Operations – Application Case and Upper Bound Scenario

Food Type	Application Case – Operations				Upper Bound Scenario – Operations			
	Seasonal Resident – Patterson Lake South Arm		Seasonal Resident – Lloyd Lake		Seasonal Resident – Patterson Lake South Arm		Seasonal Resident – Lloyd Lake	
	ILCR	% Contribution	ILCR	% Contribution	ILCR	% Contribution	ILCR	% Contribution
Labrador tea	5.04×10^{-08}	1%	5.04×10^{-08}	22%	5.04×10^{-08}	1%	5.04×10^{-08}	22%
Blueberry	2.08×10^{-08}	0.3%	2.08×10^{-08}	9%	2.08×10^{-08}	0.3%	2.08×10^{-08}	9%
Northern pike	2.21×10^{-07}	3%	2.10×10^{-09}	1%	2.27×10^{-07}	3%	2.15×10^{-09}	1%
Lake whitefish	2.03×10^{-07}	3%	1.92×10^{-09}	1%	2.08×10^{-07}	3%	1.96×10^{-09}	1%
Store-bought food	$0.00 \times 10^{+00}$	0%	$0.00 \times 10^{+00}$	0%	$0.00 \times 10^{+00}$	0%	$0.00 \times 10^{+00}$	0%
Moose	2.38×10^{-06}	30%	1.82×10^{-08}	8%	2.44×10^{-06}	30%	1.83×10^{-08}	8%
Moose organs	4.13×10^{-06}	53%	3.16×10^{-08}	14%	4.23×10^{-06}	53%	3.17×10^{-08}	14%
Beaver	4.97×10^{-07}	6%	8.59×10^{-08}	38%	5.08×10^{-07}	6%	8.60×10^{-08}	38%
Mallard	3.42×10^{-07}	4%	3.21×10^{-09}	1%	3.50×10^{-07}	4%	3.30×10^{-09}	1%
Spruce grouse	1.08×10^{-08}	0.1%	1.06×10^{-08}	5%	1.08×10^{-08}	0.1%	1.06×10^{-08}	5%
Total	7.86×10^{-06}	100%	2.25×10^{-07}	100%	8.05×10^{-06}	100%	2.25×10^{-07}	100%

Note: Total percentages may not sum to 100% due to rounding.
ILCR = incremental lifetime cancer risk.

Table 5-21: Estimated Carcinogen Risks for Arsenic to Subsistence Harvesters – Operations – Application Case and Upper Bound Scenario

Food Type	Application Case – Operations						Upper Bound Scenario - Operations					
	Subsistence Harvester – Patterson Lake South Arm		Subsistence Harvester – Beet Lake		Subsistence Harvester – Lloyd Lake		Subsistence Harvester – Patterson Lake South Arm		Subsistence Harvester – Beet Lake		Subsistence Harvester – Lloyd Lake	
	ILCR	% Contribution	ILCR	% Contribution	ILCR	% Contribution	ILCR	% Contribution	ILCR	% Contribution	ILCR	% Contribution
Labrador tea	2.44×10^{-07}	1%	2.44×10^{-07}	11%	2.44×10^{-07}	23%	2.44×10^{-07}	1%	2.44×10^{-07}	10%	2.44×10^{-07}	23%
Blueberry	3.46×10^{-08}	0.1%	3.46×10^{-08}	1%	3.46×10^{-08}	3%	3.46×10^{-08}	0.1%	3.46×10^{-08}	1%	3.46×10^{-08}	3%
Northern pike	1.16×10^{-06}	3%	1.89×10^{-07}	8%	1.10×10^{-08}	1%	1.19×10^{-06}	3%	1.94×10^{-07}	8%	1.13×10^{-08}	1%
Lake whitefish	1.07×10^{-06}	3%	1.74×10^{-07}	8%	1.01×10^{-08}	1%	1.09×10^{-06}	3%	1.78×10^{-07}	8%	1.03×10^{-08}	1%
Store-bought food	$0.00 \times 10^{+00}$	0%	$0.00 \times 10^{+00}$	0%	$0.00 \times 10^{+00}$	0%	$0.00 \times 10^{+00}$	0%	$0.00 \times 10^{+00}$	0%	$0.00 \times 10^{+00}$	0%
Moose	1.26×10^{-05}	34%	2.50×10^{-07}	11%	9.61×10^{-08}	9%	1.29×10^{-05}	34%	2.54×10^{-07}	11%	9.63×10^{-08}	9%
Moose Organs	1.76×10^{-05}	48%	3.50×10^{-07}	15%	1.34×10^{-07}	12%	1.80×10^{-05}	48%	3.56×10^{-07}	15%	1.35×10^{-07}	13%
Beaver	2.72×10^{-06}	7%	8.14×10^{-07}	35%	4.69×10^{-07}	44%	2.78×10^{-06}	7%	8.24×10^{-07}	35%	4.70×10^{-07}	44%
Mallard	1.16×10^{-06}	3%	1.88×10^{-07}	8%	1.09×10^{-08}	1%	1.19×10^{-06}	3%	1.93×10^{-07}	8%	1.12×10^{-08}	1%
Spruce grouse	6.74×10^{-08}	0.2%	6.63×10^{-08}	3%	6.61×10^{-08}	6%	6.74×10^{-08}	0.2%	6.63×10^{-08}	3%	6.61×10^{-08}	6%
Total	3.66×10^{-05}	100%	2.31×10^{-06}	100%	1.08×10^{-06}	100%	3.75×10^{-05}	100%	2.34×10^{-06}	100%	1.08×10^{-06}	100%

Note: Total percentages may not sum to 100% due to rounding.
ILCR = incremental lifetime cancer risk.

5.4.1.1.3 Radiological Risk

The incremental radiation dose to all human receptors during all Project phases and the far-future projection would be below the public regulatory dose limit of 1 mSv/yr for both the Application Case and the reasonable upper bound sensitivity scenario, as shown in Table 5-22. 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.

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 and for the reasonable upper bound sensitivity scenario, and well below the regulatory public dose limit.

In the far-future, a future permanent resident, residing at the decommissioned and reclaimed Project site well beyond Closure 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 were below the public dose limit, no discernable health effects would be 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 5-22: Summary of All Radiation Doses to Human Receptors – Application Case and Upper Bound 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, receptor was not assessed.

5.4.1.1.4 Radon Risk

The incremental radon dose to the camp worker was estimated to be 0.51 mSv/yr. The incremental radon dose was based on atmospheric modelling of the radon released during the maximum ore grade year (Year 1 of the Project). 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 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 scenario, both of which are below the dose limit for a non-nuclear energy worker of 1 mSv/yr (Table 5-23). The estimate of total dose including radon is conservative based on the following assumptions:

- The camp worker spends 100% of their time indoors when on site for exposure to radon (Section 5.2.4.1.4).
- Receptors are exposed to the maximum exposure concentrations at their location for each model scenario and Project phase (Section 5.2.5).
- For radionuclides in the U-238 decay chain (other than radon), the camp worker is also exposed to radionuclides through ingestion (water and food) pathways resulting in a conservative dose when also factoring in the dose from radon indoors.

Table 5-23: Total Radiation Dose to Camp Worker from all Radionuclides including Radon Progeny – Project Lifespan

Human Receptor	Location	Scenario	Maximum Total Incremental Dose – U-238 Decay Chain (mSv/yr)	Maximum Radon Dose (mSv/yr)	Maximum Total Dose (mSv/yr)	% of Dose Limit for Non-Nuclear Energy Worker
Camp Worker	Camp	Application Case	6.50×10^{-02}	5.10×10^{-01}	5.75×10^{-01}	58%
		Upper Bound	8.24×10^{-02}	5.10×10^{-01}	5.92×10^{-01}	59%

5.4.1.2 Estimated Risk to Human Receptors – Reasonably Foreseeable Development Case

5.4.1.2.1 Non-carcinogen Risk

With the addition of releases from the Fission Patterson Lake South Property, the estimated incremental HQs for all human receptors at all assessed locations were predicted to increase slightly under the RFD Case; however, they would remain below the acceptable risk level of 0.2 per pathway for the one-year-old and adult for all human receptors (Table 5-24). For assessment of non-carcinogens, the one-year-old is typically considered the most sensitive receptor (Health Canada 2010a). Table 5-24 shows the Project only risk, for the Project lifespan and for the far future, as well as the Base Case risk, all for the RFD Case. These results indicate that the Project only risks would be minimal.

Table 5-24: Estimated Non-carcinogen Risk to Human Receptors – Operations – 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}
Subsistence Harvester One-Year-Old	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}

	COPC	RFD Case Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
(Patterson Lake South Arm)	**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	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}
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}

	COPC	RFD Case Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	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}
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}	**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								

	COPC	RFD Case Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	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}
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}	**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	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}

	COPC	RFD Case Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	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}
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}	$\mathbf{2.77 \times 10^{-01}}$	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	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}

	COPC	RFD Case Hazard Quotients							
		Water (Internal)	Soil (Internal)	Sediment (Internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Copper	4.85 × 10^{-07}	6.98 x 10^{-11}	4.02 x 10^{-08}	0.00 × 10^{+00}	8.00 × 10^{-06}	3.34 x 10^{-08}	6.53 x 10^{-06}	1.51 x 10^{-05}
	Molybdenum	2.90 × 10^{-05}	0.00 × 10^{+00}	2.54 x 10^{-06}	0.00 × 10^{+00}	1.74 × 10^{-07}	0.00 × 10^{+00}	8.14 × 10^{-06}	3.99 x 10^{-05}
	Uranium	6.91 × 10^{-05}	8.03 x 10^{-08}	3.69 x 10^{-05}	0.00 × 10^{+00}	5.18 × 10^{-05}	9.37 x 10^{-06}	1.62 x 10^{-05}	1.83 x 10^{-04}
Permanent Resident (Patterson Lake North Arm - West Basin)	**Base Case**								
	Cobalt	8.58 × 10^{-04}	9.04 × 10^{-07}	1.01 x 10^{-06}	0.00 × 10^{+00}	2.30 × 10^{-03}	1.44 × 10^{-03}	2.44 × 10^{-02}	2.90 x 10^{-02}
	Copper	2.91 × 10^{-05}	2.95 × 10^{-08}	4.12 x 10^{-08}	0.00 × 10^{+00}	1.79 × 10^{-03}	5.38 × 10^{-04}	4.12 × 10^{-02}	4.35 x 10^{-02}
	Molybdenum	1.08 × 10^{-04}	1.06 × 10^{-07}	1.62 x 10^{-07}	0.00 × 10^{+00}	2.42 × 10^{-06}	2.92 × 10^{-04}	6.98 × 10^{-02}	7.02 x 10^{-02}
	Uranium	2.46 × 10^{-03}	8.62 × 10^{-06}	2.24 x 10^{-05}	0.00 × 10^{+00}	6.85 × 10^{-03}	3.84 × 10^{-02}	8.20 × 10^{-02}	1.30 x 10^{-01}
	Base Case One-Year-Old								
	Cobalt	9.58 × 10^{-04}	5.91 × 10^{-05}	6.62 x 10^{-05}	0.00 × 10^{+00}	2.18 × 10^{-03}	2.84 × 10^{-03}	4.78 × 10^{-02}	5.39 x 10^{-02}
	Copper	3.25 × 10^{-05}	1.93 × 10^{-06}	2.69 x 10^{-06}	0.00 × 10^{+00}	1.69 × 10^{-03}	1.06 × 10^{-03}	9.70 × 10^{-02}	9.98 x 10^{-02}
	Molybdenum	1.47 × 10^{-04}	8.46 × 10^{-06}	1.29 x 10^{-05}	0.00 × 10^{+00}	2.79 × 10^{-06}	7.01 × 10^{-04}	**2.64 × 10^{-01}**	2.64 x 10^{-01}
	Uranium	2.75 × 10^{-03}	5.64 × 10^{-04}	1.47 x 10^{-03}	0.00 × 10^{+00}	6.49 × 10^{-03}	7.57 × 10^{-02}	1.70 × 10^{-01}	2.57 x 10^{-01}
	Far-Future Adult - Incremental Project Risk								
	Cobalt	1.24 × 10^{-03}	1.42 x 10^{-09}	1.47 x 10^{-06}	0.00 × 10^{+00}	3.32 × 10^{-03}	2.26 x 10^{-06}	6.36 x 10^{-03}	1.09 x 10^{-02}
	Copper	4.62 × 10^{-05}	6.13 x 10^{-11}	6.54 x 10^{-08}	0.00 × 10^{+00}	2.84 × 10^{-03}	1.12 x 10^{-06}	1.81 x 10^{-03}	4.69 x 10^{-03}
	Molybdenum	2.31 × 10^{-03}	0.00 × 10^{+00}	3.46 x 10^{-06}	0.00 × 10^{+00}	5.15 × 10^{-05}	0.00 × 10^{+00}	1.80 × 10^{-03}	4.16 x 10^{-03}
	Uranium	2.21 × 10^{-02}	3.88 x 10^{-06}	2.02 x 10^{-04}	0.00 × 10^{+00}	6.17 × 10^{-02}	1.73 x 10^{-02}	3.09 x 10^{-02}	1.32 x 10^{-01}
	Far-Future One-Year-Old - Incremental Project Risk								
	Cobalt	1.39 × 10^{-03}	9.25 x 10^{-08}	9.59 x 10^{-05}	0.00 × 10^{+00}	3.15 × 10^{-03}	4.45 x 10^{-06}	6.46 x 10^{-03}	1.11 x 10^{-02}
	Copper	5.16 × 10^{-05}	4.00 x 10^{-09}	4.28 x 10^{-06}	0.00 × 10^{+00}	2.69 × 10^{-03}	2.20 x 10^{-06}	1.67 x 10^{-03}	4.41 x 10^{-03}
	Molybdenum	3.14 × 10^{-03}	0.00 × 10^{+00}	2.75 x 10^{-04}	0.00 × 10^{+00}	5.95 × 10^{-05}	0.00 × 10^{+00}	2.20 × 10^{-03}	5.67 x 10^{-03}
	Uranium	2.47 × 10^{-02}	2.54 x 10^{-04}	1.32 x 10^{-02}	0.00 × 10^{+00}	5.85 × 10^{-02}	3.41 x 10^{-02}	2.24 x 10^{-02}	1.53 x 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.

5.4.1.2.2 Carcinogen Risk

The arsenic ILCR is expected to exceed the cancer risk level of 1 in 100,000 for the adult camp worker, subsistence harvester, and seasonal resident harvesting Traditional Foods from Patterson Lake South Arm during Operations for the RFD Case (Table 5-25). The arsenic ILCR would be below the cancer risk level of 1 in 100,000 for all other human receptors during Operations.

The predicted cancer risk (ILCR) for the RFD Case was slightly higher than the Application Case mainly due to the additional 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.

The greatest contributor to the predicted ILCRs for the RFD Case during the Project lifespan for the seasonal resident and subsistence harvester at Patterson Lake South Arm is consumption of northern pike and beaver (Table 5-26).

In the far-future projection, the cancer risk for the future permanent resident at the camp site and subsistence harvester would be similar 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.

The interpretation of cancer risk is discussed in Section 5.4.1.1.2, Carcinogen Risk.

Table 5-25: Estimated Incremental Lifetime Cancer Risk from Arsenic to Human Receptors – Reasonably Foreseeable Development Case

Receptor	RFD Case Cancer 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 (composite)	n/a	0.5

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

Table 5-26: Estimated Carcinogen Risks for Arsenic to Subsistence Harvesters and Seasonal Resident – Operations – Reasonably Foreseeable Development

Food Type	Subsistence Harvester – Patterson Lake South Arm		Subsistence Harvester – Beet Lake		Subsistence Harvester – Lloyd Lake		Seasonal Resident – Patterson Lake South Arm		Seasonal Resident – Lloyd Lake	
	ILCR	% Contribution	ILCR	% Contribution	ILCR	% Contribution	ILCR	% Contribution	ILCR	% Contribution
Labrador tea	2.44×10^{-07}	0.2%	2.44×10^{-07}	10%	2.44×10^{-07}	23%	5.04×10^{-08}	0.2%	5.04×10^{-08}	22%
Blueberry	3.46×10^{-08}	0.03%	3.46×10^{-08}	1%	3.46×10^{-08}	3%	2.08×10^{-08}	0.1%	2.08×10^{-08}	9%
Northern pike	2.57×10^{-05}	22%	1.94×10^{-07}	8%	1.13×10^{-08}	1%	4.88×10^{-06}	21%	2.15×10^{-09}	1%
Lake whitefish	2.06×10^{-05}	18%	1.78×10^{-07}	8%	1.03×10^{-08}	1%	3.91×10^{-06}	17%	1.96×10^{-09}	1%
Store-bought food	$0.00 \times 10^{+00}$	0%	$0.00 \times 10^{+00}$	0%	$0.00 \times 10^{+00}$	0%	$0.00 \times 10^{+00}$	0%	$0.00 \times 10^{+00}$	0%
Moose	1.26×10^{-05}	11%	2.54×10^{-07}	11%	9.63×10^{-08}	9%	2.38×10^{-06}	10%	1.83×10^{-08}	8%
Moose Organs	1.76×10^{-05}	15%	3.56×10^{-07}	15%	1.35×10^{-07}	13%	4.13×10^{-06}	18%	3.17×10^{-08}	14%
Beaver	2.88×10^{-05}	25%	8.24×10^{-07}	35%	4.70×10^{-07}	44%	5.27×10^{-06}	23%	8.60×10^{-08}	38%
Mallard	9.04×10^{-06}	8%	1.93×10^{-07}	8%	1.12×10^{-08}	1%	2.67×10^{-06}	11%	3.30×10^{-09}	1%
Spruce grouse	9.56×10^{-08}	0.1%	6.63×10^{-08}	3%	6.61×10^{-08}	6%	1.53×10^{-08}	0.1%	1.06×10^{-08}	5%
Total	1.15×10^{-04}	100%	2.34×10^{-06}	100%	1.08×10^{-06}	100%	2.33×10^{-05}	100%	2.25×10^{-07}	100%

Note: Total percentages may not sum to 100% due to rounding.
ILCR = incremental lifetime cancer risk.

5.4.1.2.3 Radiological Risk

With the addition of releases from the Fission Patterson Lake South Property, the incremental radiation dose 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 dose to all human receptors would remain below the public regulatory dose limit of 1 mSv/yr, and below the dose constraint of 0.3 mSv/yr (Table 5-27, Table 5-28).

In the far-future projection, a future permanent resident, residing at the decommissioned and reclaimed Project site well beyond Closure could receive a dose up to 0.1 mSv/yr, well below both the regulatory public dose limit and the dose constraint.

Overall, since the radiation dose estimates were below the public dose limit, no discernable health effects would be anticipated due to exposure of these receptors to cumulative radioactive releases from both the Project and the Fission Patterson Lake South Property.

Table 5-27: 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}

n/a = not applicable, receptor was not assessed; mSv/yr = millisieverts per year; RFD = reasonably foreseeable development.

Table 5-28: Summary of Radiation Doses to Limiting Human Receptors

	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 Scenario	0.12	Subsistence Harvester one-year-old	Patterson Lake South Arm	Polonium-210 terrestrial animals	12%
RFD Case	0.14	Subsistence Harvester one-year-old	Patterson Lake South Arm	Polonium-210 terrestrial animals	14%
Far-Future					
Application Case	0.07	Permanent resident one-year-old	Patterson Lake North Arm – West Basin	Polonium-210 terrestrial animals	7%
Upper Bound Scenario	0.07	Permanent resident one-year-old	Patterson Lake North Arm – West Basin	Polonium-210 terrestrial animals	7%
RFD Case	0.07	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.

5.4.1.2.4 Radon Risk

For the RFD Case, the incremental radon dose to the camp worker was estimated to be 0.57 mSv/yr. The incremental radon dose was based on atmospheric modelling of radon released during the maximum ore grade year (Year 1 of the Project) 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 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 (Table 5-29). The estimate of total dose including radon is conservative based on the following assumptions:

- The camp worker spends 100% of their time indoors when on site for exposure to radon (Section 5.2.4.2.4).
- Receptors are exposed to the maximum exposure concentrations at their location for each model scenario and Project phase (Section 5.2.5).

- For radionuclides in the U-238 decay chain (other than radon), the camp worker is also exposed to radionuclides through ingestion (water and food) pathways resulting in a conservative dose when also factoring in the dose from radon indoors.

Table 5-29: Total Radiation Dose to Camp Worker from all Radionuclides including Radon Progeny – Project Lifespan (RFD Case)

Human Receptor	Location	Maximum Total Incremental Dose – U-238 Decay Chain (mSv/yr)	Maximum Radon Dose (mSv/yr)	Maximum Total Dose (mSv/yr)	% of Dose Limit for Non-Nuclear Energy Worker
Camp Worker	Camp	8.58×10^{-02}	5.70×10^{-01}	6.56×10^{-01}	65.6%

5.4.2 Uncertainty in the Risk Characterization

The problem formulation and toxicity and exposure information are combined in the risk characterization step to estimate the potential for human health effects. The uncertainties associated with each of the previous steps of the HHRA are discussed in Section 5.1.5, Uncertainty in Problem Formulation, Section 5.2.5, Uncertainty in Exposure Assessment, and Section 5.3.3, Uncertainty in the Toxicity Assessment. In each step of the HHRA, conservative assumptions were used to address uncertainties. The use of this approach is far more likely to overestimate potential risk than to underestimate risk.

6.0 ECOLOGICAL RISK ASSESSMENT

6.1 Problem Formulation

The intent of the problem formulation for an EcoRA is to define the goals of the risk assessment, develop an understanding of site conditions, and develop working hypotheses as to how potential exposure of ecological receptors to contaminants may result in potential ecological risks.

The problem formulation for this EcoRA:

- identifies COPCs for ecological health;
- identifies and characterizes the selected ecological receptors for the Project; and
- identifies the complete exposure pathways by which the COPCs may affect the receptors in a conceptual site model.

The conceptual site model for the EcoRA summarizes the links between contaminant sources, exposure pathways, and receptors of concern.

6.1.1 Selected Ecological Receptors

It is generally an impractical task to assess the effect of radiological and non-radiological emissions on all the species within a natural ecosystem (CSA 2022), and specifically within the ecosystem around the Project. Therefore, a representative group of organisms, referred to as ecological receptors, were chosen for the effects assessment and risk analysis. The ecological receptors selected for the ERA are a subset of valued components identified for the EA so that the results from the ERA could be integrated into the effects assessments for fish, vegetation, wildlife, human health, Indigenous land and resource use, and other land and resource uses.

The receptor selection process considered some of the same criteria as for VCs (EIS Section 6.3.1, Valued Components), such as: they are known to exist at the site and in the LSA, are representative of major taxonomic groups or exposure pathways, are listed federally and/or provincially, have a special importance or value to people including Indigenous communities, and/or meet other receptor selection criteria as further described in this subsection. In addition, the selection of ecological receptors considered the identification of potential exposure pathways to COPCs and availability of data from chemical analyses for radiological and non-radiological parameters for the species selected. As recognized in CSA N288.6-22, protection of the selected species should provide reasonable assurance that all species are protected.

6.1.1.1 Selection of Ecological Receptors

A preliminary list of ecological valued components for the Project was compiled from the species identified in EIS Section 6, Environmental Assessment Approach and Methods, as well as the following baseline reports:

- Annex V.1, Aquatic Environment Baseline Report;

- Annex VII.2, Vegetation Baseline Report 2 (Inventory, Rare Plants, and Wetlands);
- Annex VIII.2, Wildlife Baseline Report 2 (Amphibians, Birds, and Bats);
- Annex VIII.3, Wildlife Baseline Report 3 (Bird Migration and Bats);
- Annex VII.1, Vegetation Baseline Report 1 (Mapping); and
- Annex VIII.1 Wildlife Baseline Report 1 (Mammals, Waterfowl, and Raptors).

The list was reviewed again once data from the 2020 updated aquatic and terrestrial baseline studies were available (Annex VIII.2; Annex VIII.3; Annex VII.1; Annex VIII.1) to confirm that the compiled list was still appropriate. Additional information from avian migration and acoustic bat studies were also considered (Annex VIII.3). Species were included in the preliminary list if they were quantified and/or incidentally observed through respective survey methods. Species that were identified to be located within the LSA from searches of the Hunting, Angling and Biodiversity Information of Saskatchewan (HABISask) database, but were not observed in the baseline surveys, were excluded from further consideration.

A representative subset of organisms was selected from each major plant or animal group to be carried forward as ecological receptors. Several factors were considered in the selection process, following the criteria provided in Table 7.1 of CSA N288.6-22:

- Major plant or animal group:
    - Availability of scientific information for the receptor that can be used in risk analysis. For example, the Canadian toad was not included on the ecological receptor list on the basis of limited scientific information for amphibian risk assessment. However, the assessment of a fish receptor is considered to be protective of the most sensitive, tadpole life stage.
- Presence in the site, LSA, and/or RSA:
    - Abundance of the species in the study area relative to other species from the same organism group. For example, the most frequently observed songbird species for the area may be carried forward to represent other songbirds.
    - Availability of baseline data from chemical analyses for radiological and non-radiological parameters for the species. For example, the southern red-backed vole was selected on this basis.
- Socio-economic or ecological value and value to Indigenous communities:
    - Value or importance to Indigenous communities, based on information from the draft Traditional Land Use Desktop Study (InterGroup 2018a), the IKTLU Studies (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI:

YNLR) and feedback during subsequent community information sessions and JWG meetings.

- Value or importance to other land and resource uses in the area, based on the Other Land and Resource Use Memorandum (InterGroup 2018b). This report identified northern pike and lake whitefish as targets of commercial fishing in Patterson Lake, Lloyd Lake, and Lake La Loche.

- Classification as endangered, threatened, or species of special concern identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and listed under the federal *Species at Risk Act* (SARA) (e.g., woodland caribou).
- Exposed to and/or sensitive to stressors:
  - Representing a potential exposure pathway to COPCs through releases to the environment.

The major plant and animal groups were defined based on taxonomy and ecology so as to represent the different possible pathways of exposure to COPCs. The organisms selected to represent each major group were either individual species of vertebrate organisms, or generic types of plants or invertebrates such as aquatic macrophytes or zooplankton.

Species at Risk (SAR) often lack the information needed for risk assessment because they are difficult to study. It is acceptable practice in ERA to use a surrogate species approach to assess potential risk to SAR, where SAR are represented by other more common species that have similar diets and exposure pathways. For example, the rusty blackbird was selected to represent other aerial insectivores, which include the following SAR: common nighthawk, olive-sided flycatcher, and barn swallow.

While a surrogate species may be selected to represent a SAR, the species listed in the Government of Canada's SARA or its regulations, or in corresponding Saskatchewan statues and legislation were assessed at the individual level in the ERA, as effects on even a single individual would not be acceptable (CSA 2022).

The selection of ecological receptors was informed by IKTLU Studies, information obtained during community information sessions, and JWG meetings.

- Terrestrial vegetation (lichen, blueberry, Labrador tea):
  - The CRDN IKTLU identified the use of berries (blueberries, cranberries [bog, low bush], gooseberries, Saskatoon, cloudberry, strawberries), medicines (kinnikinnick, Labrador tea, mint, spruce gum, sweet flag [rat root], mushrooms), shrubs (dogwood [red willow], willows [spp.]), trees (birch, jack pine, poplar, spruce [spp.], tamarack) and other vegetal matter (barks, mosses, roots, punk [rotten wood]; TSD V.1: CRDN).

  - The MN-S identified the use of berries, such as blueberries, strawberries and raspberries, as important Traditional Foods since they are full of antioxidants and promote heart and brain health, and identified the Patterson Lake area as having a bounty for harvest (TSD IV: MN-S).
  - The Athabasca Denesųłiné IKTLU identified specific plants harvested including Ts'aili Teli (Frog Tail), Labrador Tea, and blueberries (TSD VI: YNLR).
- Fish (northern pike, lake whitefish):
  - The BNDN IKTLU identified fishing in Patterson Lake – whitefish, jackfish, suckers, ling cod (mariah; TSD II: BNDN).
  - The CRDN IKTLU identified use of jackfish, herring, lake trout, mariah, pickerel and suckers (spp.; TSD V.1: CRDN).
  - The MN-S IKTLU identified that fish is integral to the traditional diet, including whitefish, jackfish, pickerel, suckers, and catfish (TSD IV: MN-S).
  - The Athabasca Denesųłiné IKTLU identified lake trout, northern pike, and whitefish (TSD VI: YNLR).
- Woodland caribou:
  - The BNDN IKTLU identified caribou as a species of importance and identified as hunted but increasingly less available (TSD III: BNDN).
  - In a JWG meeting, the CRDN Band Manager said "We've already had caribou taken off our menu." (CRDN-JWG 2020).
- Moose:
  - The BNDN IKTLU identified moose as an important resource (TSD II: BNDN).
  - In a JWG meeting, MN-S identified moose as their main dietary animal (MN-S-JWG 2020).
  - The Athabasca Denesųłiné IKTLU identified caribou, moose, black bear, and white-tailed deer as big game harvested in the area (TSD VI: YNLR).
- Black bear:
  - In a JWG meeting, the BNDN identified bear as of importance (BNDN-JWG 2019b).
- Spruce grouse:
  - The BNDN IKTLU identified grouse as hunted (TSD II: BNDN).

  - The Athabasca Denesųłiné IKTLU identified wild chicken (spruce grouse, ruffed grouse), ptarmigan, ducks, geese, owls, ravens, crows, and seagulls, as being harvested in the area (TSD VI: YNLR).
  - In a JWG meeting, one of the action items was to consider adding ptarmigan and chicken (spruce grouse) to the list of VCs. Subsequently, grouse was added for assessment in the EcoRA (CRDN-JWG 2020).

- Mallard:
  - In a JWG meeting, MN-S said that they considered mallard to be a garbage eater and felt the goldeneye was more important (MN-S-JWG 2019b).
  - In a JWG meeting, the BRDN identified mallard as commonly eaten and does not eat goldeneye (BRDN-JWG 2019b).
  - The CRDN IKTLU has identified its right to hunt ducks and harvest duck eggs within its traditional territory (TSD V.1: CRDN).

Table 6-1 provides the rationale for the selected ecological receptors and Table 6-2 provides a summary of the selected ecological receptors. A short description of each of the selected ecological receptors including their habitats and feeding habits is provided in Appendix B, Ecological Receptor Profiles.

Table 6-1: Rationale for Selection of Ecological Receptors for the Rook I Project Ecological Risk Assessment

Organism Category	Representative Species	Selection Criteria				Other Species Represented[a]
		1	2	3	4	
		Major Plant or Animal Group	Presence in the Site, LSA, or RSA	Socioeconomic or Ecological Value and Value to Indigenous Communities	Exposed to and/or Sensitive to Stressor	
Terrestrial invertebrates	Earthworm (*Lumbricus terrestris*)	Soil-dwelling detritivore	Ubiquitous in the environment.	Food source for other ecological receptors.	Exposed to atmospheric release through soil.	Assessed as a group.
Terrestrial vegetation	Lichen	Lichen	Observed in the LSA and RSA. Samples collected for analysis of metals and radionuclides.	Primary winter food source for woodland caribou. Some lichen species are provincially rare.	Exposed to atmospheric release through soil and atmospheric deposition.	Represents all terrestrial and arboreal lichen species.
	Blueberry (*Vaccinium myrtilloides*)	Shrub	Observed in the study areas. Fruit, leaves, and stems collected and analyzed for metals and radionuclides.	Food source for other ecological receptors. Harvested by people for consumption.		Represents all terrestrial vegetation species, including jackpine, black spruce, and common ericaceous shrub species (e.g., bearberry, Labrador tea, blueberry, mountain cranberry, green alder).
	Labrador tea (*Rhododendron groenlandicum*)	Shrub	Present in study areas.	Food source for other ecological receptors. Medicinal plant harvested by Indigenous Peoples.		
Aquatic invertebrates	Zooplankton (general category)	Zooplankton	Present in lakes / potential discharge locations.	Food source for other ecological receptors.	Exposed to aquatic release through surface water.	Assessed as a group.
	Benthic invertebrates (i.e., Chironomidae)	Benthic invertebrates (infaunal)	Most abundant taxon found in areas surveyed.	Food source for other ecological receptors.	Exposed to aquatic release through sediment.	Assessed as a group.
	Benthic invertebrates (i.e., Ephemeroptera)	Benthic invertebrates (epifaunal)	Represents relatively large fraction of biomass in Patterson Lake and other areas.	Food source for other ecological receptors.	Exposed to aquatic release through surface water and sediment.	Assessed as a group.
Aquatic vegetation	Macrophyte (e.g., *Carex* sp.)	Aquatic macrophyte	Present in downstream surface waterbodies. Shoot, root, and sediment samples collected at Lloyd Lake, Broach Lake, Jed Creek, Patterson Creek, Beet Creek, and the Clearwater River Nearfield for analysis of metals and radionuclides.	Food source for other ecological receptors. Provides spawning substrate for some fish species (e.g., Northern Pike).	Exposed via surface water and sediment.	Assessed as a group.
	Phytoplankton	Phytoplankton	Present in lakes / potential discharge locations.	Food source for other ecological receptors.	Exposed through aquatic release to surface water.	Assessed as a group.

Organism Category	Representative Species	Selection Criteria				Other Species Represented[a]
		1	2	3	4	
		Major Plant or Animal Group	Presence in the Site, LSA, or RSA	Socioeconomic or Ecological Value and Value to Indigenous Communities	Exposed to and/or Sensitive to Stressor	
Fish	Northern pike (*Esox lucius*)	Pelagic predator fish	Present in Patterson Lake and surrounding surface waterbodies. Retained for chemical analysis and age determination.	Food source for other ecological receptors. Commercial fishing documented at Patterson Lake, Lloyd Lake, and Lac La Loche.	Exposed to aquatic release through surface water and consumption of prey (fish and/or aquatic invertebrates).	Burbot, lake trout, walleye.
	Lake Whitefish (*Coregonus clupeaformis*)	Benthopelagic fish	Present in Patterson Lake and surrounding surface waterbodies. Retained for chemical analysis and age determination.	Food source for other ecological receptors. Commercial fishing documented at Patterson Lake, Lloyd Lake, and Lac La Loche.	Exposed to aquatic release through water, sediment, and consumption of prey (planktonic crustaceans, benthic invertebrates, fish eggs).	Arctic grayling, lake herring (cisco), Johnny darter, lake chub, longnose sucker, ninespine stickleback, slimy sculpin, spottail shiner, trout perch, white sucker, yellow perch.
Terrestrial mammals	Woodland caribou (*Rangifer tarandus caribou*)	Terrestrial herbivore (large)	Present in study areas.	Threatened status under COSEWIC and SARA. Trapped for fur/meat and hunted by Indigenous Peoples.	Exposed to atmospheric release through consumption of food (terrestrial and arboreal lichens); exposed to aquatic release through drinking surface water.	None.
	Snowshoe hare (*Lepus americanus*)	Terrestrial herbivore (small)	Present in study areas.	Food source for other ecological receptors. Trapped for fur/meat and hunted by Indigenous Peoples.	Exposed to atmospheric release through food (plants) and soil.	None.
	Moose (*Alces americanus*)	Terrestrial herbivore (large)	Present in study areas.	Surrogate for other mammals such as white-tailed deer. Game animal for Indigenous Peoples.	Exposed to atmospheric release through food (leaves, upland plants, water plants) and soil; exposed to aquatic release through drinking surface water.	White-tailed deer.
	Little brown myotis (*Myotis lucifugus*)	Terrestrial insectivore	Present in study areas.	Threatened status under COSEWIC and SARA.	Exposed to atmospheric release through food (insects) and soil.	Northern myotis.
	Southern red-backed vole (*Myodes gapperi*)	Terrestrial omnivore (small)	Most abundant small mammal captured. Baseline tissue analysis collected (Aug 2018).	Food source for other ecological receptors selected.	Exposed to atmospheric release through food (plants, seeds, roots, insects, snails, berries) and soil.	Meadow jumping mouse, meadow vole, porcupine, deer mouse.
	Black bear (*Ursus americanus*)	Terrestrial omnivore (large)	Present in study areas.	Trapped for fur/meat and hunted by Indigenous Peoples.	Exposed to atmospheric release through food (berries, nuts, small mammals, fish, birds) and soil; exposed to aquatic release through drinking surface water.	None.

Organism Category	Representative Species	Selection Criteria				Other Species Represented[a]
		1	2	3	4	
		Major Plant or Animal Group	Presence in the Site, LSA, or RSA	Socioeconomic or Ecological Value and Value to Indigenous Communities	Exposed to and/or Sensitive to Stressor	
	Red fox (*Vulpes vulpes*)	Terrestrial carnivore	Present in study areas.	Trapped for fur/meat and hunted by Indigenous Peoples.	Exposed to atmospheric release through food (small mammals) and soil.	American marten, Canada lynx, least weasel, masked shrew, coyote, fisher, red squirrel.
Terrestrial mammals	Grey wolf (*Canis lupus*)	Terrestrial carnivore	Present in study areas.	Trapped for fur/meat.	Exposed to atmospheric release through food (small and large mammals) and soil.	None.
Riparian mammals	Muskrat (*Ondatra zibethicus*)	Riparian herbivore	Present in study areas.	Trapped for fur/meat and hunted by Indigenous Peoples.	Exposed to aquatic release through water, food (aquatic vegetation), and sediment.	None.
	North American beaver (*Castor canadensis*)	Riparian herbivore	Present in study areas.	Trapped for fur/meat and hunted by Indigenous Peoples.	Exposed to aquatic release through water, food (terrestrial and aquatic vegetation), and sediment.	None.
	American mink (*Neovison vison*)	Riparian carnivore	Present in study areas.	Trapped for fur/meat and hunted by Indigenous Peoples.	Exposed to aquatic release through water, food (small mammals, fish, amphibians, insects), and sediment, and atmospheric release through food and soil.	Common water shrew, short-tailed weasel (ermine), river otter.

Organism Category	Representative Species	Selection Criteria				Other Species Represented[(a)]
		1	2	3	4	
		Major Plant or Animal Group	Presence in the Site, LSA, or RSA	Socioeconomic or Ecological Value and Value to Indigenous Communities	Exposed to and/or Sensitive to Stressor	
Terrestrial birds	Canada goose (*Branta canadensis*)	Ground feeding herbivore	Commonly observed in study area.	Hunted by Indigenous Peoples.	Exposed to atmospheric release through food (grasses) and soil.	None
	Spruce grouse *(Falcipennis canadensis)*	Ground feeding herbivore	Observed in study areas.	Hunted by Indigenous Peoples.	Exposed to atmospheric release through food (seeds and berries) and soil.	Bay-breasted warbler, blackpoll warbler, blue-headed vireo, dedar waxwing, chipping sparrow, clay-coloured sparrow, dark-eyed junco, hermit thrush, horned lark, orange-crowned warbler, palm warbler, Philadelphia vireo, pine grosbeak, pine siskin, red crossbill, red-eyed vireo, wainson's thrush, Tennessee warbler, white-winged crossbill, willow ptarmigan, winter wren, yellow warbler, yellow-rumped warbler.
	Rusty blackbird (*Euphagus carolinus)*	Ground/aquatic feeding omnivore	Present in study areas.	Special concern status (COSEWIC and SARA). Surrogate for other birds and at-risk species.	Exposed to aquatic release through food (aquatic invertebrates), and atmospheric release through food (seeds and fruit).	LeConte's sparrow, American pipit, upland sandpiper, Wilson's warbler, common nighthawk, northern flicker, olive-sided flycatcher, western wood-pewee, American crow, common raven, alder flycatcher, yellow-bellied flycatcher, least flycatcher, mourning warbler, barn swallow, Lincoln's sparrow, song sparrow, black-and-white warbler, Nashville warbler, fox sparrow, Canada jay, ciff swallow, black-backed woodpecker, hairy woodpecker, Boreal chickadee, ruby-crowned kinglet, golden-crowned kinglet, ovenbird, magnolia warbler, American robin, white-throated sparrow, white-crowned sparrow, Wilson's snipe, swamp sparrow, northern waterthrush, tree swallow.

Organism Category	Representative Species	Selection Criteria				Other Species Represented[a]
		1	2	3	4	
		Major Plant or Animal Group	Presence in the Site, LSA, or RSA	Socioeconomic or Ecological Value and Value to Indigenous Communities	Exposed to and/or Sensitive to Stressor	
Riparian birds	Mallard (*Anas platyrhynchos*)	Riparian herbivore	Present in study areas.	Surrogate for other duck species (e.g., ring-necked duck). Hunted by Indigenous Peoples.	Exposed to aquatic release through water, food (aquatic plants and invertebrates), and sediment.	Green-winged teal, snow goose, sandhill crane, lesser scaup, redhead, ring-necked duck, bufflehead, common goldeneye, tundra swan, herring gull, ring-billed gull, solitary sandpiper.
	Common loon (*Gavia immer*)	Piscivore	Present in study areas.	Surrogate for other fish-eating birds (e.g., gull, bald eagle, osprey).	Exposed to aquatic release through water and aquatic food (fish).	Bald eagle, spotted sandpiper, Bonaparte's gull, California gull, belted kingfisher, common merganser, osprey, American white pelican, red-necked grebe, lesser yellowlegs, greater yellowlegs.

(a) Based on presence of species in the terrestrial and aquatic baseline studies. Species identified in this column are not an extensive list of all species identified; however, species were removed from list for either having an observation of 1, or no direct observations at all unless very strong evidence existed (e.g. lots of pellets, droppings, nests, eggs, seen on game cams).
COSEWIC = Committee on the Status of Endangered Wildlife in Canada; SARA = *Species at Risk Act*; LSA = local study area; RSA = regional study area.

Table 6-2: Selected Ecological Receptors for the Rook I Project Ecological Risk Assessment

Organism Category	Representative Species
Terrestrial invertebrates	Earthworm (*Lumbricus terrestris*)
Terrestrial vegetation	Lichen
	Blueberry (*Vaccinium myrtilloides*)
	Labrador tea (*Rhododendron groenlandicum*)
Aquatic invertebrates	Zooplankton (general category)
	Benthic invertebrates (i.e., Chironomidae)
	Benthic invertebrates (i.e., Ephemeroptera)
Aquatic vegetation	Macrophyte (e.g., *Carex* sp.)
	Phytoplankton
Fish	Northern pike (*Esox lucius*)
	Lake whitefish (*Coregonus clupeaformis*)
Terrestrial mammals	Woodland caribou (*Rangifer tarandus caribou*)
	Snowshoe hare (*Lepus americanus*)
	Moose (*Alces americanus*)
	Little brown myotis (*Myotis lucifugus*)
	Southern red-backed vole (*Myodes gapperi*)
	Black bear (*Ursus americanus*)
	Red fox (*Vulpes vulpes*)
	Grey wolf (*Canis lupus*)
Riparian mammals	Muskrat (*Ondatra zibethicus*)
	North American beaver (*Castor canadensis*)
	American mink (*Neovison vison*)
Terrestrial birds	Canada goose (*Branta canadensis*)
	Spruce grouse *(Falcipennis canadensis)*
	Rusty blackbird (*Euphagus carolinus)*
Riparian birds	Mallard (*Anas platyrhynchos*)
	Common loon (*Gavia immer*)

6.1.1.2 Consideration of Species at Risk

Table 6-3 lists federally listed species of conservation concern that may potentially interact with the Project as compiled partly based on terrestrial baseline studies (Annex VII.1; Annex VIII.1). The list was compiled through a combination of regional and provincial references, field data, and professional experience. The table includes species with endangered, threatened, or special concern status by COSEWIC or under SARA. The Saskatchewan Conservation Data Centre rankings are shown in the table and are intended to provide support in conservation planning and monitoring of SAR; however, protection of species on the Saskatchewan Conservation Data Centre is not regulated. There are no provincially threatened or endangered species listed in the Wild Species at Risk Regulations, Chapter W-13.11 Reg. 1 of the *Wildlife Act*.

The list of species at risk compiled by Omnia during baseline studies (Annex VIII.1) was refined by considering the presence of the species on the HABISask database in the study area, and detections of the species during the 2018 baseline surveys. No additional species were detected during subsequent surveys that were not previously identified in 2018 (Annex VIII.1; Annex VIII.3; Annex V.1).

Table 6-4 lists the surrogate species selected for identified species at risk. While not all SAR are selected as ecological receptors to be assessed, the selected ecological receptors include species with similar feeding habits, so that surrogate species from the ecological receptor list can be used to infer dose and risk for the SAR species that are present.

Woodland caribou, little brown myotis, and rusty blackbird were selected as ecological receptors; therefore, surrogate species were not needed to represent them.

Table 6-3: List of Identified Species with Conservation Status in the Vicinity of the Project

Species	COSEWIC Status	SARA Status	SKCDC Ranking	Listed in HABISask in Study Area	2018 to 2020 Field Survey Observations
Amphibians					
Northern leopard frog (*Lithobates pipiens*)	Special Concern	Special Concern	S3	Yes	Not observed in targeted acoustic surveys.
Birds					
Common nighthawk (*Chordeiles minor*)	Special Concern	Threatened	S4B, S4M	Yes	Common and widespread; identified at 44 locations.
Olive-sided flycatcher (*Contopus cooperi*)	Special Concern	Threatened	S4B, S4M	Yes	Suitable habitat common and widespread. Identified at 12 locations.
Rusty blackbird (*Euphagus carolinus*)	Special Concern	Special Concern	S3B, S3M	Yes	Suitable habitat common and widespread. Identified at three locations.
Barn swallow (*Hirundo rustica*)	Threatened	Threatened	S4B, S4M	Yes	Limited breeding habitat. Identified at ten locations.
Horned grebe (*Podiceps auritus*)	Special Concern	Special Concern	S5B, S5M	No	Not observed.
Peregrine falcon (*Falco peregrinus*)	Not at Risk	Special Concern	S1B	No	Not observed.
Yellow rail (*Coturnicops noveboracensis*)	Special Concern	Special Concern	S3B, S3M	No	Not observed in targeted surveys.
Whooping crane (*Grus americana*)	Endangered	Endangered	S1M	No	Not observed.
Hudsonian godwit (*Limosa haemastica*)	Threatened	No status	S4M	No	Not observed.
Buff-breasted sandpiper (*Calidris subruficollis*)	Special Concern	Special Concern	S4M	No	Not observed.
Eskimo curlew (*Numenius borealis*)	Endangered	Endangered	SXB, SXM	No	Not observed.
Red-necked phalarope (*Phalaropus lobatus*)	Special Concern	No status	S4B, S3M	No	Not observed.
Short-eared owl (*Asio flammeus*)	Special Concern	Special Concern	S3B, S2N, S3M	No	Not observed.
Bank Swallow (*Riparia riparia*)	Threatened	Threatened	S4B, S5M	No	Not observed.
Canada Warbler (*Cardellina canadensis*)	Threatened	Threatened	S4B, S3M	No	Not observed.
Harris' Sparrow (*Zonotrichia leucophrys*)	Special Concern	No status	S5M	No	Not observed.

Species	COSEWIC Status	SARA Status	SKCDC Ranking	Listed in HABISask in Study Area	2018 to 2020 Field Survey Observations
Mammals					
Little brown myotis (*Myotis lucifugus*)	Endangered	Endangered	S4	Yes	Detected with high certainty.
Northern myotis (*Myotis septentrionalis*)	Endangered	Endangered	S3	Yes	Likely present but in less abundance relative to the little brown myotis.
Woodland caribou (*Rangifer tarandus*)	Threatened	Threatened	S3	Yes	Moderate amount of suitable habitat. Incidentally observed at two locations.
Wolverine (*Gulo gulo*)	Special Concern	Special Concern	S2	No	Not observed.

SARA = *Species at Risk Act*; COSEWIC = Committee on the Status of Endangered Wildlife in Canada; SKCDC = Saskatchewan Conservation Data Centre; HABISask = Hunting, Angling and Biodiversity Information of Saskatchewan.

Several species in Table 6-3 were identified by Omnia (Annex VIII.1) to be potentially present in the Project study area but were not observed in the 2018 field surveys, including northern leopard frog, wolverine, and 12 species of birds. With exception of northern leopard frog, these species do not appear to have ranges overlapping with the Project study area (Annex V.1; Annex VII.2; Annex VIII.2; Annex VIII.3) and thus these species were not considered to be present on site; therefore, they were not considered as ecological receptors requiring surrogate receptors for the assessment.

Northern leopard frog was targeted in nocturnal amphibian surveys during the 2018 season at 16 survey sites, situated in areas with high habitat potential for breeding amphibians (Annex V.1; Annex VII.2; Annex VIII.2; Annex VIII.3). Northern leopard frogs were not detected or incidentally observed in the field, or identified through automated species-specific recognitions at recorded survey sites (Annex V.1; Annex VII.2; Annex VIII.2; Annex VIII.3). Because the potential incidence of these species appears to be low, they were not selected for assessment in the EcoRA. While amphibians were not specifically selected as receptors, they are sufficiently represented by the fish model. The sensitive life stages of frogs (i.e., egg and tadpole) are aquatic and similar to the sensitive life stages of a fish. For example, during the tadpole stage, tadpoles and fish have similar exposure pathways (e.g., absorption through skin and gills). In addition, exposure factor and toxicity data for amphibians are limited. Therefore, the fish assessment model is considered to be appropriate for frogs, including the northern leopard frog, during their sensitive life stages.

The rusty blackbird has a varied diet, but feeds mostly on aquatic invertebrates such as insect larvae, crustaceans, and snails. Its diet is supplemented by seeds and small fruit in the fall and winter. Breeding habitat for the rusty blackbird include forest wetlands, peat bogs, sedge meadows, marshes and swamps, beaver ponds, and pasture edges within the boreal forest (COSEWIC 2006). Suitable habitat for rusty blackbirds was noted to be common and widespread in baseline surveys (Annex V.1; Annex VII.2; Annex VIII.2; Annex VIII.3). Rusty blackbird was selected as an ecological receptor in the EcoRA; therefore, a surrogate to represent it is not needed.

Common nighthawk, olive-sided flycatcher, and barn swallow are aerial insectivores, consuming flying insects over both land and water. Breeding habitat for the common nighthawk is varied and may include open habitats such as sand dunes and beaches, recently burned or logged areas, open forests, peatbogs, marshes, lakeshores, river banks, or rocky outcrops (COSEWIC 2007). Most of the olive-sided flycatcher observations within the study area were near large waterbodies (i.e., Patterson Lake and Forrest Lake), or along creeks and bogs with sparse vegetation (Annex V.1; Annex VII.2; Annex VIII.2; Annex VIII.3). Barn swallows nest almost exclusively on man-made structures such as barns, out-buildings, houses, bridges, and road culverts (COSEWIC 2011). In the study area, barn swallows were observed near bridge crossings. The rusty blackbird was considered a suitable surrogate species for common nighthawk, olive-sided flycatcher, and barn swallow. The rusty blackbird's diet is primarily composed of aquatic invertebrates and is modelled in the EcoRA as eating benthic invertebrates, which are anticipated to be more directly exposed to COPCs than flying insects. Therefore, the selection of this surrogate is conservative.

Little brown myotis can be found roosting in trees and buildings; whereas northern myotis prefer to roost in the cavities of trees and under loose bark and are associated with the boreal forest. Both species prefer to forage over water features and along forest edges. In the vicinity of the site, the most bat detections were noted near the Patterson Creek Bridge and near the south side of the Rook I site at the edge of Patterson Lake south (Annex V.1; Annex VII.2; Annex VIII.2; Annex VIII.3). Little brown myotis was selected as an ecological receptor in the EcoRA, as it was noted to be in higher abundance relative to northern myotis in baseline surveys. Based on the similarities in diet between the two species of bat, the assessment of one is considered to be representative of the other.

Woodland caribou have a relatively large home range and seek mature jack pine and black spruce-dominated forest, black spruce bog, open muskeg habitats common to the Boreal Shield (McLoughlin 2016), and inaccessible rough terrain such as muskeg or islands on lakes for calving. The food source for the woodland caribou in the winter is terrestrial or arboreal lichens; terrestrial and aquatic vegetation are also food sources in the remainder of the year. Although the current suitability of the site for woodland caribou is relatively low due to an abundance of recently burned or harvested forest in the vicinity of the Project, the habitat potential over the timeframe of the Project is moderate to high (Annex VII.1; Annex VIII.1). Based on the importance of the species and its unique diet, the woodland caribou was selected as an ecological receptor in the EcoRA.

Omnia (Annex VII.1; Annex VIII.1) also identified 28 provincially sensitive and at-risk plant species within the baseline monitoring boundary for the Project during 2018 field surveys. None of the species are listed under COSEWIC or SARA or as SAR under the Saskatchewan *Wildlife Act*. Therefore, these species were not considered to require individual assessment as ecological receptors.

Table 6-4: Surrogate Species for Identified Species at Risk

Species at Risk	Surrogate Species
Common nighthawk (*Chordeiles minor*)	Rusty blackbird
Olive-sided flycatcher (*Contopus cooperi*)	Rusty blackbird
Barn swallow (*Hirundo rustica*)	Rusty blackbird
Northern myotis (*Myotis septentrionalis*)	Little brown myotis

6.1.2 Constituents of Potential Concern Retained for Further Evaluation in the Ecological Risk Assessment

The selection of COPCs retained for further evaluation in the EcoRA is presented in Section 4.0, Model Integration and Evaluation of Sources. Chloride and sulphate were identified as COPCs in the aquatic environment, but not in the terrestrial environment.

The selection of chemical stressors to evaluate in the EcoRA followed a tiered approach to reduce the risk of overlooking any COPCs relevant to ecological health. The selection of COPCs in water was based on predicted upper bound concentrations for treated effluent at end of pipe, in the receiving environment at the boundary of the mixing zone, and in runoff. Also, if predicted maximum concentrations of a COPC exceeded a benchmark value in sediments, it was retained for further evaluation in the ERA. The selection of COPCs in air was based on maximum-year air quality for Construction or Operations. This approach assumes maximum emissions from the various Project sources would be occurring at the same time, and under worst-case meteorological conditions. Also, if predicted maximum concentrations of a COPC exceeded a benchmark value in soil, it was retained for further evaluation in the EcoRA.

6.1.3 Assessment and Measurement Endpoints

Assessment endpoints for the EcoRA are explicit expressions of the environmental values that are to be protected (FCSAP 2012a). Assessment endpoints for the EcoRA should include the ecological receptor and the attribute of the ecological receptor that is to be protected (e.g., abundance, viability of the population) (FCSAP 2012a). The EcoRA assessment endpoints to be evaluated are presented in Table 6-5.

Measurement endpoints for the EcoRA are conceptually related to assessment endpoints and are defined as the specific measures that would be used to judge potential for effect on the attribute of an assessment endpoint (e.g., if we predict an effect on organism growth or reproduction, we can infer a potential for effect on abundance). Measurement endpoints for the EcoRA may include endpoints such as survival, growth, or reproduction. Measurement endpoints for the EcoRA are the foundation for the lines of evidence that are used to estimate risks to ecological receptors (FCSAP 2012a).

In this EcoRA, the assessment endpoints are at the population or community level; however, for species at risk, the assessment endpoint is at the individual level. While exposure and risk estimates always pertain to individuals, for most receptors, when effects on individuals are predicted from constituent levels in a certain location, further discussion of population or community effects (or lack thereof) is appropriate. For species at risk, it is considered that effects on even a single individual represent an effect on the population.

Table 6-5: Assessment Endpoints, Measurement Endpoints, and Lines of Evidence

Ecological Receptor	Level of Protection	Protection Goal	Assessment Endpoint	Lines of Evidence	
				Line of Evidence	Measurement Endpoints and their Interpretation
Bottom feeding fish (lake whitefish)	Population	Maintenance of bottom feeding fish populations in Patterson Lake, Beet Lake, and Naomi Lake as a source of food for piscivorous fish and wildlife.	Viability of bottom-feeding fish populations.	Water chemistry	COPC concentrations in water. Compare to toxicological reference values (low-effect threshold concentrations) for effect on survival, growth, or reproduction.
				Radiological dose	Compare estimated doses of COPCs to growth, survival, and reproduction benchmark values (low-effect threshold doses) relevant to the assessment endpoint.
Pelagic fish (northern pike)	Population	Maintenance of pelagic fish populations in Patterson Lake, Beet Lake, and Naomi Lake as a source of food for piscivorous fish and wildlife.	Viability of pelagic fish populations.	Water chemistry	COPC concentrations in water. Compare to toxicological reference values (low-effect threshold concentrations) for effect on survival, growth, or reproduction.
				Radiological dose	Compare estimated doses of COPCs to growth, survival, and reproduction benchmark values (low-effect threshold doses) relevant to the assessment endpoint.
Aquatic vegetation (macrophytes, phytoplankton)	Population	Maintenance of aquatic plant populations in Patterson Lake, Beet Lake, and Naomi Lake as a source of food and cover for wildlife.	Viability of aquatic plant populations.	Water chemistry	COPC concentrations in water. Compare to toxicological reference values (low-effect threshold concentrations) for aquatic plants for effect on survival, growth, or reproduction.
				Radiological dose	Compare estimated doses of COPCs to growth, survival, and reproduction benchmark values (low-effect threshold doses) relevant to the assessment endpoint.

Ecological Receptor	Level of Protection	Protection Goal	Assessment Endpoint	Lines of Evidence	
				Line of Evidence	Measurement Endpoints and their Interpretation
Zooplankton	Community	Maintenance of a diverse zooplankton community in Patterson Lake, Beet Lake, and Naomi Lake as a source of food for fish.	Density, richness, and diversity of zooplankton community.	Water chemistry	COPC concentrations in water. Compare to toxicological reference values (low-effect threshold concentrations) for zooplankton for effect on survival, growth, or reproduction.
				Radiological dose	Compare estimated doses of COPCs to growth, survival, and reproduction benchmark values (low-effect threshold doses) relevant to the assessment endpoint.
Benthic invertebrates	Community	Maintenance of a diverse aquatic and benthic invertebrate community in Patterson Lake, Beet Lake, and Naomi Lake as a source of food for fish and wildlife.	Richness, diversity, abundance of benthic invertebrates.	Water chemistry	Compare COPC concentrations to water quality guidelines.
				Sediment chemistry	Compare COPC concentrations to sediment quality guidelines.
				Radiological Dose	Compare estimated doses of COPCs to growth, survival, and reproduction benchmark values (low-effect threshold doses) relevant to the assessment endpoint.
Riparian birds (mallard, common loon)	Population	Maintenance of riparian bird populations along the shorelines of Patterson Lake, Beet Lake, and Naomi Lake as a source of food for predatory wildlife.	Viability of aquatic riparian bird populations.	Radiological and toxicological doses	Compare estimated doses of COPCs to growth, survival, and reproduction benchmark values (low-effect threshold doses) relevant to the assessment endpoint.
Riparian mammals (muskrat, beaver, American mink)	Population	Maintenance of riparian mammal population along the shorelines of Patterson Lake, Beet Lake, and Naomi Lake as a source of food for predatory wildlife.	Viability of aquatic riparian mammal populations.		
Terrestrial invertebrates (earthworm)	Population	Maintenance of terrestrial invertebrate population in the RSA as a source of food for wildlife.	Viability of terrestrial invertebrate populations.	Soil chemistry	COPC concentrations in soil. Compare COPC concentrations to soil quality guidelines.
				Radiological dose	Compare estimated doses to growth, survival, and reproduction benchmark values (low-effect threshold doses) relevant to the assessment endpoint.

Ecological Receptor	Level of Protection	Protection Goal	Assessment Endpoint	Lines of Evidence	
				Line of Evidence	Measurement Endpoints and their Interpretation
Terrestrial plants (lichen, blueberry, Labrador tea)	Population	Maintenance of terrestrial plant population in the RSA as a source of food for wildlife.	Viability of terrestrial plant populations.	Soil chemistry	COPC concentrations in soil. Compare COPC concentrations to soil quality guidelines.
				Radiological dose	Compare estimated doses to growth, survival, and reproduction benchmark values (low-effect threshold doses) relevant to the assessment endpoint.
Terrestrial birds (Canada goose, grouse, rusty blackbird[(a)])	Population	Maintenance of the terrestrial bird population in the RSA.	Viability of terrestrial bird populations.	Radiological and toxicological doses	Compare estimated doses of COPCs to growth, survival, and reproduction benchmark values (low-effect threshold doses) relevant to the assessment endpoint.
Terrestrial mammals (woodland caribou[(a)], snowshoe hare, moose, little brown myotis[(a)], southern red-backed vole, black bear, red fox, grey wolf)	Population	Maintenance of terrestrial mammal population in the RSA.	Viability of terrestrial mammal populations.		

(a) For species at risk, protection is at the individual level, recognizing that effects on even a few individuals represent an effect on the population.
COPC = constituent of potential concern; RSA = regional study area.

6.1.4 Selection of Exposure Pathways

Exposure pathways consider the various routes by which radionuclides and/or chemicals may enter the body of the receptor, or for radionuclides, may exert effects from outside the body. Exposures to environmental media may be direct (i.e., by contact) or indirect (i.e., via contaminant transport through the food chain).

For each type of ecological receptor, Table 6-6 summarizes, the relevant exposure pathways to various environmental media including air, surface water, soil, and sediment. Direct contact or uptake exposure pathways associated with groundwater are assumed to be incomplete, as it is assumed that groundwater is inaccessible to ecological receptors, or negligible relative to other pathways. Potential effects to surface water quality due to groundwater discharges were accounted for in the IMPACT model during Project phases where groundwater discharge is identified and hydrogeological model loadings of COPCs were input to the lake nodes in IMPACT.

Airborne COPCs partition to soil and plants. For most COPCs, ingestion pathways dominate over inhalation and air immersion. The latter pathways are considered minor pathways in the EcoRA, but inhalation was included in the IMPACT model and is thus included in Table 6-6.

For fish, aquatic plants, and aquatic invertebrates, contact with water and contaminant uptake from water via bioaccumulation represents the main exposure pathway. Direct contact or uptake from sediment are also considered for benthic invertebrates and bottom-feeding fish. Individual food chain transport pathways are not calculated by the IMPACT model for aquatic organisms because exposures for aquatic receptors are determined using bioaccumulation factors (BAFs) based on surface water concentrations; these BAFs represent all operable exposure pathways. The CSA N288.6-22 recommends the use of BAFs for the estimation of COPC concentrations in plant, invertebrate, and fish tissues based on concentrations in ambient media.

For soil invertebrates and terrestrial plants, the main exposure pathway is through contact with soil and contaminant uptake from soil via bioaccumulation. Earthworms and plant roots may have the potential to be exposed to groundwater when groundwater levels are high; however, both earthworms and plants would only be exposed to groundwater occasionally as they do not reside in the saturated zone. Therefore, direct contact with groundwater (for soil invertebrates) and uptake of groundwater (for terrestrial plants) are not quantified in IMPACT.

The dominant exposure pathways for birds and mammals are expected to include uptake of contaminants via the ingestion of water, direct contact with or incidental ingestion of soil and/or sediment, and ingestion of food/prey. Direct contact with water is also considered to be a complete exposure pathway for riparian mammals and birds.

Table 6-6: Complete Exposure Pathways for All Selected Ecological Receptors to be Assessed using the IMPACT Model

Category	Ecological Receptor	Exposure Pathways	Environmental Media
Terrestrial vegetation	Lichen	Direct contact	Air
	Blueberry	Direct contact	In soil
	Labrador tea	Direct contact	In soil
Terrestrial invertebrates	Earthworm	Direct contact	In soil
Zooplankton	Zooplankton	Direct contact	In water
Aquatic vegetation	Macrophytes	Direct contact	In water On sediment
	Phytoplankton	Direct contact	In water
Benthic invertebrates	Benthic invertebrates (infaunal)	Direct contact	In water In sediment
	Benthic invertebrates (epifaunal)	Direct contact	In water On sediment
Bottom-feeding fish	Lake whitefish	Direct contact	In water On sediment
Pelagic fish	Northern pike	Direct contact	In water
Terrestrial mammals	Woodland caribou	Direct contact	On soil
		Inhalation	Air
		Ingestion	Water Soil Sediment Browse Lichen Macrophytes
	Snowshoe hare	Direct contact	On soil
		Inhalation	Air
		Ingestion	Water Soil Browse Blueberry
	Moose	Direct contact	On soil
		Inhalation	Air
		Ingestion	Water Soil Sediment Browse Macrophytes
	Little brown myotis	Direct contact	On soil (minimal since aerial insectivore)
		Inhalation	Air
		Ingestion	Water Benthic invertebrates
	Southern red-backed vole	Direct contact	On soil
		Inhalation	Air

Category	Ecological Receptor	Exposure Pathways	Environmental Media
		Ingestion	Water Soil Blueberry Browse
Terrestrial mammals	Black bear	Direct contact	On soil
		Inhalation	Air
		Ingestion	Water Soil Blueberry Fish
	Red fox	Direct contact	On soil
		Inhalation	Air
		Ingestion	Water Soil Vole Earthworm Goose Blueberry
	Grey wolf	Direct contact	On soil
		Inhalation	Air
		Ingestion	Water Soil Moose Caribou Hare
Riparian Mammals	Muskrat	Direct contact	In water On sediment
		Inhalation	Air
		Ingestion	Water Sediment Macrophyte Benthic invertebrates
	Beaver	Direct contact	In water On soil On sediment
		Inhalation	Air
		Ingestion	Water Soil Sediment Browse Macrophytes
	American mink	Direct contact	In water On soil On sediment
		Inhalation	Air
		Ingestion	Water

Category	Ecological Receptor	Exposure Pathways	Environmental Media
			Soil Sediment Fish Benthic invertebrates Muskrat Mallard
Terrestrial birds	Canada goose	Direct contact	On soil
		Inhalation	Air
		Ingestion	Water Soil Browse
	Grouse	Direct contact	On soil
		Inhalation	Air
		Ingestion	Water Soil Browse Blueberry
	Rusty blackbird	Direct contact	On soil
		Inhalation	Air
		Ingestion	Water Soil Benthic invertebrates Blueberry
Riparian birds	Mallard	Direct contact	In water On sediment
		Inhalation	Air
		Ingestion	Water Sediment Macrophytes Benthic Invertebrates
	Common loon	Direct contact	In water
		Inhalation	Air
		Ingestion	Water Fish Benthic invertebrates

6.1.5 Ecological Conceptual Site Model

The ecological conceptual site model illustrates how receptors are exposed to COPCs. It identifies the source of contaminants, contaminant transport mechanisms, environmental media, and the exposure pathways to be considered in the assessment for each receptor. The conceptual model for the EcoRA is illustrated in Figure 6-1.

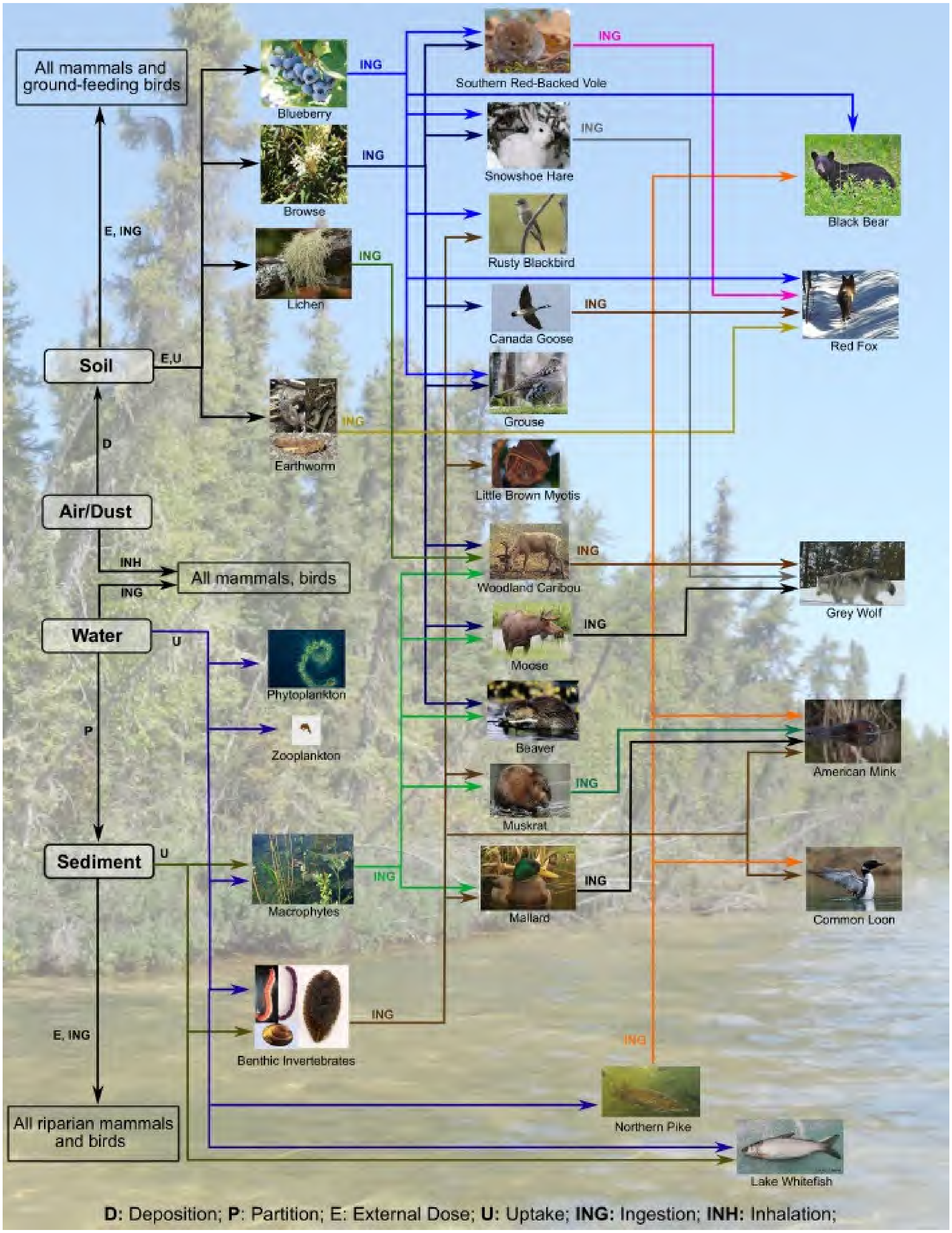


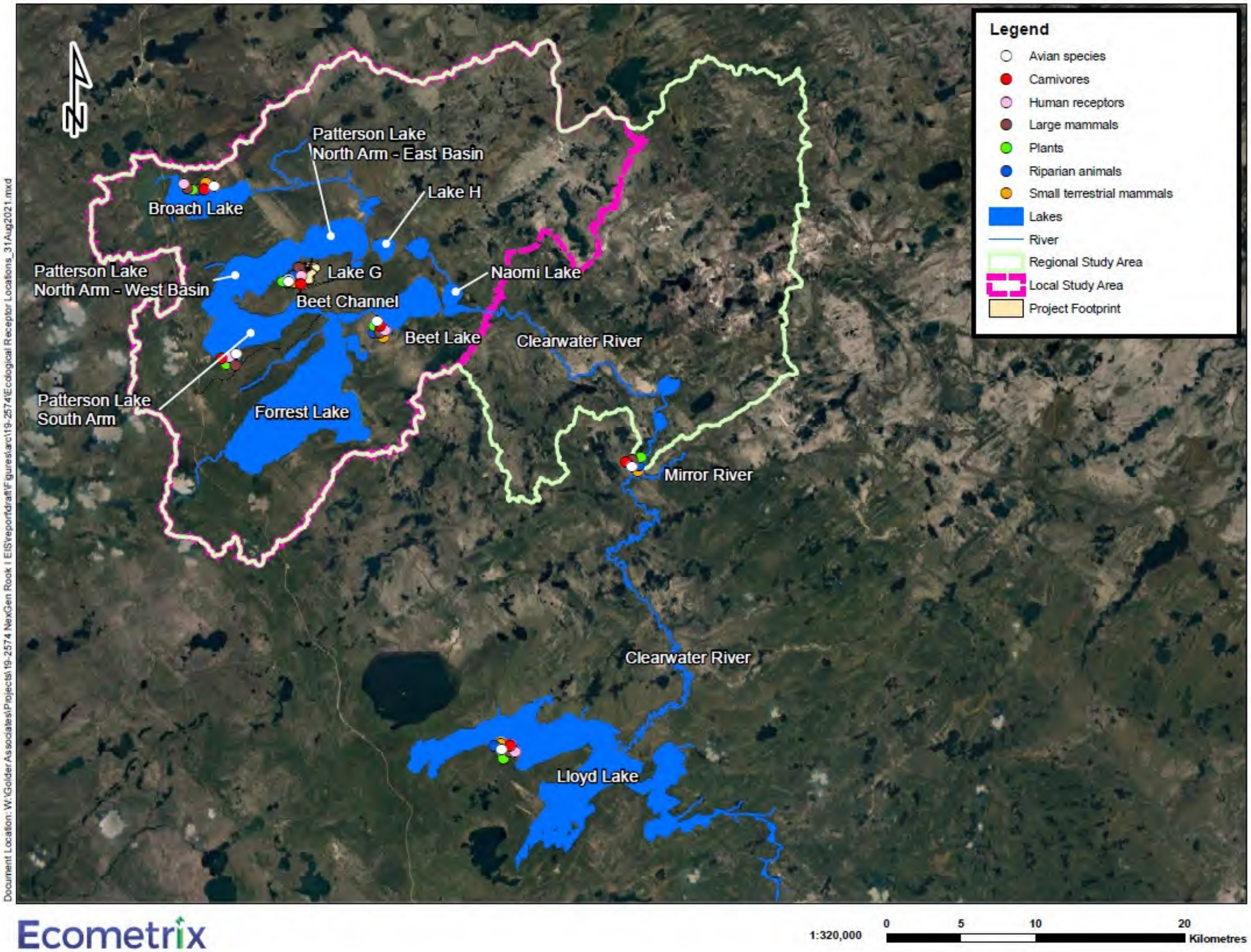
Figure 6-1: Ecological Health Conceptual Site Model

6.2 Exposure Assessment

The exposure assessment includes identification of exposure locations and exposure factors for each ecological receptor and presentation of exposure concentrations and doses (radiological and non-radiological). Uncertainties are discussed. This subsection presents the information used in the environmental pathways model, IMPACT, at a high level. The details of the model are provided in Appendix A.

6.2.1 Exposure Locations

The conceptual model assumes that all terrestrial and aquatic receptors are present at Patterson Lake (North Arm – West Basin and South Arm), Beet Lake, and Lloyd Lake (Figure 6-2). All terrestrial and aquatic receptors were also assumed to be at Broach Lake, which was chosen as a reference location. In addition, aquatic receptors were assessed at Clearwater River upstream of Mirror River, at the edge of the RSA, as shown in Figure 6-2. Separate exposure values were estimated for each receptor in the locations where they were assumed to be present.



Note: Aquatic receptors including zooplankton, aquatic plants, benthic invertebrates, and fish are located in the lakes and are not shown as separate polygons.

Figure 6-2: Locations of Ecological Receptors Assessed in the Ecological Risk Assessment

6.2.2 Exposure Averaging

Most ecological receptors were assessed assuming 100% residency at the exposure point location. This was the case for aquatic biota, immobile terrestrial biota such as plants and soil invertebrates, and mobile terrestrial mammals and birds that have small home ranges. This assumption was also applied to migratory ecological receptors, such as waterfowl and passerine birds, that spend part of the year away from the LSA and RSA, or ecological receptors that have a small home range while nesting or rearing young. For instance, mallards are not present in the LSA and RSA for over half the year due to migration, but have a small home range during the nesting and rearing season. Therefore, it was conservatively assumed that the mallard has a 100% residency factor on one lake where the young are hatched and reared. Similarly, moose have large annual home ranges but generally remain within small seasonal home ranges of 5 km^2 to 10 km^2 during the summer and winter. For modelling purposes, these animals were associated with one location.

Animals with larger home ranges (i.e., greater than 10 km^2), such as woodland caribou, black bear, and grey wolf, interact with a number of different waterbodies and land areas for feeding and water intake. For modelling purposes, these animals were associated with a central location but with residency factors applied to other adjacent locations depending on the size of their home range. In some cases, a portion of their time in the LSA or RSA may be attributed to time spent at unexposed (reference) locations. For example, due to its large home range of 1,300 km^2, a grey wolf located near Patterson Lake was assumed to spend 47.6% of its time at exposed locations and 52.4% of its time at unexposed locations. Further details are provided in Appendix A. Table 6-7 summarizes the residency assumptions for ecological receptors with large home ranges used for the ERA.

Table 6-7: Residency Factors for Terrestrial Ecological Receptors with Large Home Ranges

Terrestrial Ecological Receptor	Polygon	Area of Waterbody (ha)	Total Waterbody (ha)	Residency Factor
Woodland caribou at Patterson Lake	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm	59 1,256 1,595	2,910	0.02 0.43 0.55
Woodland caribou at Beet Lake	Reference Lake Beet Lake[(a)]	1,119 1,031[(a)]	2,150	0.52 0.48
Black bear at Patterson Lake	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm	59 1,256 1,595	2,910	0.02 0.43 0.55
Black bear at Beet Lake	Reference Lake Beet Lake[(a)]	1,119 1,031[(a)]	2,150	0.52 0.48

Terrestrial Ecological Receptor	Polygon	Area of Waterbody (ha)	Total Waterbody (ha)	Residency Factor
Grey wolf at Patterson Lake	Reference Lake[(b)]	5,564[(b)]	10,619	0.524
	Patterson Lake North Arm – West Basin[(c)]	2,184[(c)]		0.206
	Patterson Lake South Arm	1,595		0.150
	Beet Lake[(d)]	1,276[(d)]		0.120

(a) Woodland caribou and Black Bear at Beet Lake also use Forrest Lake – North Basin.

(b) Grey wolf at Reference Lake also uses Broach Lake; Lake C, Lake E, Lake G, Lake H, Unnamed Lake 1 (near Dennis Lake), and Unnamed Lake 2 (Near Naomi Lake); and Forrest Lake – South Basin.

(c) Grey wolf at Patterson Lake North Arm – West Basin also uses Patterson Lake North Arm – East Basin.

(d) Grey wolf at Beet Lake also uses Forrest Lake North Arm and Naomi Lake.

6.2.3 Exposure and Dose Calculations

Exposure and dose calculations for ecological receptors were completed using IMPACT version 5.6.0. IMPACT is consistent with the COPC transport equations outlined in CSA N288.1-20 and with the methods of biota dose calculation outlined in CSA N288.6-22 for both non-radiological and radiological COPCs. The equations are presented in Appendix A. Assessment of radiation exposures to ecological receptors is commonly based on estimation of the effects of the project or site. Assessments consider the radiation dose received from direct exposure to radiation as well as the dose received from ingestion of radionuclides. The radionuclide intake by ecological receptors from various pathways is converted into a dose that is presented in milligrays per day (mGy/d). The dose for each radionuclide is comprised of an internal dose component, and an external dose component, which is driven by water and sediment.

Assessment of non-radiological exposures to ecological receptors considers the dose received from ingestion of constituents of concern. This is presented as a dose in mg/kg/d for each pathway.

The inputs and assumptions used in the IMPACT model for the Project, including receptor characteristics, exposure pathways, and the derivation and identification of site-specific information used in the model are provided in Appendix A. Relevant to the exposure and dose calculations, the report:

- describes the model structure for ecological receptor assessment, specific assumptions made for the Project, and the generic equations used to calculate the transfer of constituents between environmental media and the receptors; and
- presents the development of input parameters and describes the approach used for calibration and validation based on regional monitoring data.

6.2.4 Exposure Factors

Exposure estimates rely on several COPC- and biota-specific exposure factors for the dose calculations. These parameters include body weights and intake rates as well as occupancy factors (OFs), DCFs, BAFs, and transfer factors (TFs).

6.2.4.1 Body Weights and Intake Rates for Ecological Receptors

Body weights and intake rates are required for the calculation of exposure to birds and mammals. Selected body weights and intake rates for bird and mammal ecological receptors are presented in Table 6-8. Body weights and intake rates were obtained, in order of preference, from CSA N288.1-20, the United States Environmental Protection Agency *Wildlife Exposure Factors Handbook* (USEPA 1993), the Federal Contaminated Sites Action Plan *Module 3: Standardization of Wildlife Receptor Characteristics* (FCSAP 2012b), and from Sample and Suter (1994), where the values were considered to be applicable. The CSA N288.6-22 recommends the use of CSA N288.1-20 and USEPA (1993) as primary literature sources for receptor characteristics, supplemented by other sources containing sufficient information to support applicability and credibility. For species not represented in the above sources, additional sources identified in Table 6-8 were consulted to identify representative body weights, and feed intake rates were calculated using allometric equations from USEPA (1993). Water intake and inhalation rates were determined using allometric equations from USEPA (1993) for birds and mammals. The incidental ingestion of soil and/or sediment was estimated from feed intake. As described by Beyer et al. (1994), incidental ingestion varied from 2% to 10.4% of dry weight food intake depending on the biota. No incidental soil or sediment ingestion was assumed for the little brown myotis, which is an aerial insectivore; nor was any sediment ingestion assumed for the Common loon, which feeds from the water column.

Table 6-8: Body Weights and Intake Rates for Bird and Mammal Ecological Receptors

Receptor	Body Weight		Total Feed Intake				Dietary Components	Feed Type Fraction		Feed Intake Rate		Moisture[h]	Intake of Soil[r]	Intake of Sediment[r]	Intake of Soil and Sediment[k]	Basis of the Soil and Sediment Intake Value	Total Soil/ Sediment Intake Rate[l]	Water Intake Rate[m]	Inhalation Rate	
	kg	Source	kg dw/d	Source	kg fw/d	Source		fw	dw	kg dw/d	kg fw/d	unitless	%	%	%		kg dw/d	L/d	m^3/d	Source
Woodland caribou	180	(e)	3.82	(m)	12.35	n/a	Browse	0.5	0.32	1.24	6.18	0.80	5.15	1.65	6.8	Bison	0.3	10.6	34.8	(m)
							Lichen	0.2	0.43	1.66	2.47	0.33								
							Macrophytes	0.3	0.24	0.927	3.71	0.75								
Snowshoe hare	1.8	(c)	0.110	(c)	0.564	n/a	Browse	0.9	0.92	0.102	0.508	0.80	3.7	0	3.7	Average of small mammals	0.004	0.168	0.9	(c,m)
							Berries (blueberry)	0.1	0.08	0.008	0.056	0.85								
Moose	400	(b)	8.0	(b)	38.1	n/a	Browse	0.8	0.76	6.10	30.5	0.80	1.5	0.5	2.0	Moose	0.2	21.8	65.9	(m)
							Macrophytes	0.2	0.24	1.90	7.62	0.75								
Little brown myotis	0.0075	(d)	0.001	n/a	0.0037	(d)	Benthic invertebrates	1	1	0.0009	0.0037	0.75	0	0	0	Assumed negligible (aerial)	0	0.00121	0.011	(m)
Southern red-backed vole	0.0329	(a, j)	0.00196	n/a	0.012	(a, j)	Berries (blueberry)	0.6	0.53	0.001	0.007	0.85	2.4	0	2.4	Meadow vole	0.000047	0.00458	0.048	(a)
							Browse	0.4	0.47	0.001	0.005	0.80								
Black bear	102.5	(o)	3.1	(b)	17.1	n/a	Berries (blueberry)	0.7	0.58	1.79	12.0	0.85	2.9	0	2.9	Average of large mammals	0.09	6.39	22.2	(m)
							Fish (northern pike)	0.3	0.42	1.28	5.13	0.75								
Red fox	4.54	(a)	0.105	n/a	0.429	(a)	Small mammals (vole)	0.4	0.490	0.052	0.172	0.70	2.8	0	2.8	Red fox	0.00295	0.386	1.83	(m)
							Terrestrial birds (goose)	0.2	0.245	0.026	0.086	0.70								
							Terrestrial invertebrates (earthworm)	0.25	0.173	0.018	0.107	0.83								
							Berries (blueberry)	0.15	0.092	0.010	0.064	0.85								
Grey wolf	45	(f)	1.57	(m)	5.23	n/a	Moose	0.45	0.45	0.707	2.356	0.70	2.8	0	2.8	Red fox	0.04	3.04	11.5	(m)
							Caribou	0.45	0.45	0.707	2.356	0.70								
							Small mammal (hare)	0.1	0.10	0.157	0.523	0.70								
Beaver	24	(p)	0.94	(m)	4.57	n/a	Macrophytes	0.1	0.12	0.114	0.457	0.75	1.8	0.24	2.0	Moose	0.019	1.729	6.9	(m)
							Browse	0.9	0.88	0.822	4.112	0.80								
Muskrat	1.17	(a)	0.088	n/a	0.352	(a)	Macrophytes	0.8	0.8	0.070	0.282	0.75	0	3.3	3.3	Mallard	0.003	0.114	0.59	(a)
							Benthic invertebrates	0.2	0.2	0.018	0.070	0.75								
American mink	1.02	(a)	0.045	n/a	0.161	(a)	Fish (northern pike)	0.3	0.270	0.012	0.048	0.75	2.6	0.41	3.05	Average of mallard and red fox	0.001	0.101	0.44	(a)
							Benthic invertebrates	0.15	0.135	0.006	0.024	0.75								
							Small mammals (muskrat)	0.45	0.486	0.022	0.072	0.70								
							Birds (mallard)	0.1	0.108	0.005	0.016	0.70								
Rusty blackbird	0.064	(g)	0.0177	n/a	0.077	(a,i)	Benthic invertebrates	0.8	0.87	0.015	0.062	0.75	10.4	0	10.4	American woodcock	0.002	0.00935	0.148	(m,n)
							Berries (blueberry)	0.2	0.13	0.002	0.015	0.85								
Canada goose	3.70	(c)	0.0229	n/a	0.115	(a)	Browse	1	1	0.023	0.115	0.80	8.2	0	8.2	Canada goose	0.0019	0.142	1.100	(c)
Grouse	0.6	(b)	0.042	(b)	0.227	n/a	Browse	0.7	0.76	0.032	0.159	0.80	8.2	0	8.2	Canada goose	0.0034	0.0419	0.276	(m)
							Berries (blueberry)	0.3	0.24	0.010	0.068	0.85								

Receptor	Body Weight		Total Feed Intake				Dietary Components	Feed Type Fraction		Feed Intake Rate		Moisture[h]	Intake of Soil[r]	Intake of Sediment[r]	Intake of Soil and Sediment[k]	Basis of the Soil and Sediment Intake Value	Total Soil/ Sediment Intake Rate[l]	Water Intake Rate[m]	Inhalation Rate	
	kg	Source	kg dw/d	Source	kg fw/d	Source		fw	dw	kg dw/d	kg fw/d	unitless	%	%	%		kg dw/d	L/d	m^3/d	Source
Mallard	1.13	(c)	0.06	(c)	0.240	n/a	Macrophytes	0.25	0.25	0.015	0.060	0.75	0	3.3	3.3	Mallard	0.002	0.0640	0.02	(c)
							Benthic invertebrates	0.75	0.75	0.045	0.180	0.75								
Common loon	5.3	(b)	0.159	(b)	0.636	n/a	Fish (northern pike)	0.9	0.9	0.143	0.572	0.75	0	0	0	Assumed negligible (sediment is washed off in water column)	0	0.180	1.477	(m)
							Benthic invertebrates	0.1	0.1	0.016	0.064	0.75								

(a) USEPA 1993; body weights, ingestion rates and inhalation rates of adults or all groups (adults and juveniles) are an average of the listed values. If only a range is given, the upper limit of the range is used. Values for the southern red-backed vole were based on the meadow vole.
(b) FCSAP 2012b.
(c) CSA N288.1-20.
(d) Sample and Suter 1994.
(e) COSEWIC Assessment and Update Status Report on the Woodland Caribou (COSEWIC 2002). Body weight calculated as a mean of the male and female upper range.
(f) Earthroots 2020.
(g) COSEWIC Assessment and Update Status Report on the Rusty Blackbird (COSEWIC 2006).
(h) Sources of moisture/dry weight fraction values obtained from CSA N288.1-20 for all receptors except for earthworm (Beresford et al. 2008a), and blueberries and lichen (EIS Appendix 7A, Air Dispersion Modelling Report). The blueberry value is based on the fruit only.
(i) The total feed intake for the American robin was used in the absence of a species-specific value.
(j) The body weight and total feed intake for the meadow vole was used in the absence of a species-specific value.
(k) Beyer et al. 1994.
(l) Intake of Soil & Sediment (kg dw/d) = Total Feed Intake (kg dw/d) x Intake of Soil & Sediment (%)/100.
(m) Calculated using allometric equations in (USEPA 1993).
(n) Inhalation rate was multiplied by a factor of 3 for passerine birds as per (USEPA 1993).
(o) Average of males and females from (Hinterland Who's Who 2007).
(p) Median of adult weight range of 16 to 32 kg from (Hinterland Who's Who 2017).
(q) For purposes of modelling the earthworm is counted to the terrestrial plants.
(r) The % intake of soil or sediment is calculated from the combined % intake of soil and sediment, weighted to the relative proportions of terrestrial vs. aquatic dietary components for each receptor, based on the following equations.
Intake of Soil (%) = Total Intake of Soil & Sediment (%) x Feed Type Fraction Terrestrial. Intake of Sediment (%) = Total Intake of Soil & Sediment (%) x Feed Type Fraction Aquatic.
fw = fresh weight; dw = dry weight; n/a = not applicable.

6.2.4.2 Occupancy Factors, Dose Coefficients, Bioaccumulation Factors, and Transfer Factors

Short descriptions of the role of the OFs, DCFs, BAFs, and TFs are provided in Table 6-9. Additional details and the numeric factors are presented in Appendix A, as indicated in Table 6-9.

Table 6-9: Exposure Factors Used in the Rook I Project IMPACT Model

Exposure Factor	Description	Appendix A
OFs	An OF is defined as the fraction of time the receptor species spends in or on various media. The OFs are based on the experience and judgment of the risk assessor and the known behaviour of the receptor. The OFs for air, soil/sediment, soil/sediment surface, and water were used in the model.	Section 2.3.3.2, Occupancy Factor
DCFs	The DCFs represent the dose-equivalent rate per unit concentration of a radionuclide in the environment (or tissue) for a particular mode of exposure. The model used DCFs for external and internal exposures to radionuclides. Aquatic DCFs were based on values published by the ICRP for aquatic plants and northern pike (ICRP 2008), and were calculated with the ERICA Tool (Brown et al. 2008) for benthic invertebrates, zooplankton, and whitefish DCFs. Terrestrial plant and invertebrate DCFs were based on values published by the ICRP (ICRP 2008). Terrestrial animal DCFs follow the approach of ICRP (ICRP 2008).	Section 3.6.3, Dose Coefficients for Aquatic Receptors Section 3.7.3, Dose Coefficients for Terrestrial Plants and Invertebrates Section 3.7.6, Dose Coefficients for Terrestrial Animals, Birds, and Humans
TFs and BAFs	The TFs are the ratio of concentration in an animal to the animal's daily intake of a COPC. BAFs are the ratio of concentration in an organism to the concentration in an environmental medium. The TFs and BAFs are generally COPC- and biota-specific. Aquatic BAFs were generally obtained from CSA N288.1-20 and IAEA (2010), and from publicly available regional data from other uranium mine sites in northern Saskatchewan. The soil-to-plant BAFs were derived from regional data from Northern Saskatchewan. Ingestion TFs for terrestrial receptors from forage to tissue for agricultural livestock were from CSA N288.1-20. An allometric equation (transfer proportional to a -3/4 power of body weight) (CSA N288.6-22) was applied to transfer factors available for beef and poultry from CSA N288.1-20, IAEA (2010), or NCRP (1996) to estimate the transfer factors for the mammal and bird receptors, respectively. Inhalation TFs for terrestrial receptors were calculated from the ingestion transfer factor by adjusting the ingestion transfer factor by a COPC-specific inhalation/ingestion ratio (II) from CSA N288.1-20.	Section 3.6.1, Aquatic Bioaccumulation Factors Section 3.7.1, Soil-to-Plant Transfer Section 3.7.4, Ingestion Transfer Factors for Terrestrial Receptors Section 3.7.5, Inhalation Transfer Factors for Terrestrial Receptors

IAEA = International Atomic Energy Agency; BAF = bioaccumulation factor; OF = occupancy factor; TF = transfer factor; DCF = dose coefficient factor; NCRP = National Council on Radiation Protection and Measurements; ICRP = International Commission on Radiological Protection; CSA = Canadian Standards Association; COPC = constituent of potential concern.

6.2.5 Exposure Point Concentrations and Doses

This subsection presents the estimated non-radiological and radiological doses to aquatic and terrestrial ecological receptors due to releases from the Project during all phases of the Project, including the far-future projection once groundwater solutes have been released to Patterson Lake. The results are presented for both the Application Case and Upper Bound sensitivity scenario (Section 6.2.5.1, Estimated Dose to Ecological Receptors – Application Case), and the RFD Case (Section 6.2.5.2, Estimated Dose to Ecological Receptors – Reasonable Foreseeable Development Case). The estimated non-radiological and radiological concentrations in environmental media and biota tissue concentrations are shown in Appendix C.

6.2.5.1 Estimated Dose to Ecological Receptors – Application Case

6.2.5.1.1 Non-radiological Dose

Non-radiological dose was only calculated for birds and mammals, as effects to aquatic animals (fish and invertebrates) and plants and soil invertebrates are assessed based on concentrations and not doses.

The estimated non-radiological dose to the selected birds and mammals during the Project phases and the far-future projection resulting from the Application Case and reasonable upper bound sensitivity scenario are shown by COPC in Table 6-10 and Table 6-11, respectively. The doses shown represent the maximum dose by COPC over the assessment period.

For arsenic and uranium, the estimated non-radiological dose was highest during Operations, whereas for cobalt and copper, the estimated non-radiological dose was highest during the far-future projection. That is due to the additional load of cobalt and copper from groundwater flows (infiltration and seepage), primarily from the waste rock storage area and secondarily from the UGTMF in the far-future projection. The groundwater modelling assumed that the waste rock storage area and UGTMF are inexhaustible and unmitigated loading sources, causing the predicted cobalt and copper concentrations to remain elevated indefinitely in the far-future projection.

Table 6-10: Estimated Non-radiological Doses to Ecological Receptors – Operations – Application Case and Upper Bound Scenario

	Biota	Location	Maximum Dose During Operations (mg/kg/d)									
			Application Case					Upper Bound Scenario				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
Terrestrial Animals	Beaver	Reference (Broach Lake)	3.48×10^{-03}	3.94×10^{-03}	3.15×10^{-02}	1.17×10^{-03}	3.20×10^{-03}	3.48×10^{-03}	3.94×10^{-03}	3.15×10^{-02}	1.17×10^{-03}	3.20×10^{-03}
		Patterson Lake North Arm – West Basin	6.52×10^{-03}	4.59×10^{-03}	3.32×10^{-02}	1.51×10^{-03}	2.49×10^{-02}	6.61×10^{-03}	4.61×10^{-03}	3.32×10^{-02}	1.88×10^{-03}	2.62×10^{-02}
		Patterson Lake South Arm	3.74×10^{-03}	4.29×10^{-03}	3.20×10^{-02}	1.29×10^{-03}	6.39×10^{-03}	3.75×10^{-03}	4.30×10^{-03}	3.20×10^{-02}	1.49×10^{-03}	6.73×10^{-03}
		Beet Lake	3.53×10^{-03}	4.13×10^{-03}	3.18×10^{-02}	1.23×10^{-03}	5.04×10^{-03}	3.53×10^{-03}	4.14×10^{-03}	3.18×10^{-02}	1.34×10^{-03}	5.16×10^{-03}
		Lloyd Lake	3.50×10^{-03}	3.97×10^{-03}	3.16×10^{-02}	1.19×10^{-03}	3.27×10^{-03}	3.50×10^{-03}	3.97×10^{-03}	3.16×10^{-02}	1.20×10^{-03}	3.28×10^{-03}
	Black Bear	Reference (Broach Lake)	2.81×10^{-03}	1.17×10^{-03}	2.86×10^{-02}	3.75×10^{-04}	1.02×10^{-03}	2.81×10^{-03}	1.17×10^{-03}	2.86×10^{-02}	3.75×10^{-04}	1.02×10^{-03}
		Patterson Lake North Arm – West Basin	5.07×10^{-03}	1.30×10^{-03}	3.15×10^{-02}	4.22×10^{-04}	3.90×10^{-03}	5.14×10^{-03}	1.30×10^{-03}	3.16×10^{-02}	4.60×10^{-04}	4.22×10^{-03}
		Beet Lake	3.12×10^{-03}	1.42×10^{-03}	2.94×10^{-02}	4.57×10^{-04}	1.41×10^{-03}	3.12×10^{-03}	1.42×10^{-03}	2.94×10^{-02}	4.64×10^{-04}	1.43×10^{-03}
		Lloyd Lake	2.83×10^{-03}	1.21×10^{-03}	2.88×10^{-02}	3.91×10^{-04}	1.04×10^{-03}	2.83×10^{-03}	1.21×10^{-03}	2.88×10^{-02}	3.92×10^{-04}	1.05×10^{-03}
	Grey Wolf	Reference (Broach Lake)	7.50×10^{-03}	6.01×10^{-04}	3.31×10^{-02}	2.88×10^{-04}	3.73×10^{-04}	7.50×10^{-03}	6.01×10^{-04}	3.31×10^{-02}	2.88×10^{-04}	3.73×10^{-04}
		Patterson Lake North Arm – West Basin	8.87×10^{-03}	6.13×10^{-04}	3.37×10^{-02}	3.17×10^{-04}	1.20×10^{-03}	8.90×10^{-03}	6.13×10^{-04}	3.37×10^{-02}	3.43×10^{-04}	1.22×10^{-03}
		Lloyd Lake	7.62×10^{-03}	6.06×10^{-04}	3.32×10^{-02}	2.95×10^{-04}	3.85×10^{-04}	7.62×10^{-03}	6.06×10^{-04}	3.32×10^{-02}	2.98×10^{-04}	3.85×10^{-04}
	American Mink	Reference (Broach Lake)	1.15×10^{-02}	4.61×10^{-03}	2.28×10^{-01}	1.15×10^{-03}	1.08×10^{-03}	1.15×10^{-02}	4.61×10^{-03}	2.28×10^{-01}	1.15×10^{-03}	1.08×10^{-03}
		Patterson Lake North Arm – West Basin	3.46×10^{-02}	5.83×10^{-03}	2.66×10^{-01}	2.80×10^{-03}	4.16×10^{-03}	3.52×10^{-02}	5.88×10^{-03}	2.67×10^{-01}	6.16×10^{-03}	7.50×10^{-03}
		Patterson Lake South Arm	1.34×10^{-02}	5.26×10^{-03}	2.47×10^{-01}	1.99×10^{-03}	1.75×10^{-03}	1.35×10^{-02}	5.29×10^{-03}	2.48×10^{-01}	3.77×10^{-03}	2.63×10^{-03}
		Beet Lake	1.18×10^{-02}	4.95×10^{-03}	2.38×10^{-01}	1.58×10^{-03}	1.37×10^{-03}	1.18×10^{-02}	4.97×10^{-03}	2.38×10^{-01}	2.50×10^{-03}	1.69×10^{-03}
		Lloyd Lake	1.15×10^{-02}	4.65×10^{-03}	2.29×10^{-01}	1.19×10^{-03}	1.10×10^{-03}	1.15×10^{-02}	4.65×10^{-03}	2.29×10^{-01}	1.28×10^{-03}	1.13×10^{-03}
	Moose	Reference (Broach Lake)	2.35×10^{-03}	2.83×10^{-03}	1.61×10^{-02}	5.80×10^{-04}	1.59×10^{-03}	2.35×10^{-03}	2.83×10^{-03}	1.61×10^{-02}	5.80×10^{-04}	1.59×10^{-03}
		Patterson Lake North Arm – West Basin	5.46×10^{-03}	3.46×10^{-03}	1.72×10^{-02}	8.27×10^{-04}	1.17×10^{-02}	5.54×10^{-03}	3.48×10^{-03}	1.73×10^{-02}	1.20×10^{-03}	1.30×10^{-02}
		Patterson Lake South Arm	5.43×10^{-03}	3.41×10^{-03}	1.72×10^{-02}	7.93×10^{-04}	1.14×10^{-02}	5.52×10^{-03}	3.44×10^{-03}	1.72×10^{-02}	1.12×10^{-03}	1.27×10^{-02}
		Beet Lake	2.40×10^{-03}	3.01×10^{-03}	1.64×10^{-02}	6.33×10^{-04}	2.45×10^{-03}	2.40×10^{-03}	3.01×10^{-03}	1.64×10^{-02}	7.33×10^{-04}	2.58×10^{-03}
		Lloyd Lake	2.36×10^{-03}	2.85×10^{-03}	1.62×10^{-02}	5.90×10^{-04}	1.63×10^{-03}	2.36×10^{-03}	2.85×10^{-03}	1.62×10^{-02}	6.01×10^{-04}	1.64×10^{-03}
	Muskrat	Reference (Broach Lake)	2.86×10^{-02}	1.60×10^{-02}	4.08×10^{-01}	3.65×10^{-03}	5.51×10^{-03}	2.86×10^{-02}	1.60×10^{-02}	4.08×10^{-01}	3.65×10^{-03}	5.51×10^{-03}
		Patterson Lake North Arm –West Basin	8.77×10^{-02}	2.08×10^{-02}	4.74×10^{-01}	9.77×10^{-03}	1.82×10^{-02}	8.92×10^{-02}	2.10×10^{-02}	4.76×10^{-01}	2.23×10^{-02}	4.11×10^{-02}
		Patterson Lake South Arm	3.35×10^{-02}	1.86×10^{-02}	4.42×10^{-01}	6.80×10^{-03}	8.88×10^{-03}	3.36×10^{-02}	1.87×10^{-02}	4.43×10^{-01}	1.34×10^{-02}	1.49×10^{-02}
		Beet Lake	2.94×10^{-02}	1.73×10^{-02}	4.25×10^{-01}	5.26×10^{-03}	6.74×10^{-03}	2.94×10^{-02}	1.74×10^{-02}	4.25×10^{-01}	8.67×10^{-03}	8.96×10^{-03}
		Lloyd Lake	2.86×10^{-02}	1.61×10^{-02}	4.09×10^{-01}	3.81×10^{-03}	5.62×10^{-03}	2.86×10^{-02}	1.61×10^{-02}	4.09×10^{-01}	4.16×10^{-03}	5.82×10^{-03}
	Red Fox	Reference (Broach Lake)	1.27×10^{-03}	4.90×10^{-04}	6.99×10^{-03}	3.17×10^{-04}	3.72×10^{-04}	1.27×10^{-03}	4.90×10^{-04}	6.99×10^{-03}	3.17×10^{-04}	3.72×10^{-04}
		Patterson Lake North Arm – West Basin	1.32×10^{-03}	5.12×10^{-04}	7.26×10^{-03}	3.79×10^{-04}	3.45×10^{-03}	1.32×10^{-03}	5.12×10^{-04}	7.26×10^{-03}	4.47×10^{-04}	3.49×10^{-03}
		Patterson Lake South Arm	1.28×10^{-03}	5.01×10^{-04}	7.04×10^{-03}	3.39×10^{-04}	8.14×10^{-04}	1.28×10^{-03}	5.02×10^{-04}	7.04×10^{-03}	3.74×10^{-04}	8.26×10^{-04}
		Beet Lake	1.28×10^{-03}	4.97×10^{-04}	7.02×10^{-03}	3.29×10^{-04}	6.31×10^{-04}	1.28×10^{-03}	4.97×10^{-04}	7.02×10^{-03}	3.47×10^{-04}	6.36×10^{-04}
		Lloyd Lake	1.28×10^{-03}	4.93×10^{-04}	7.00×10^{-03}	3.21×10^{-04}	3.82×10^{-04}	1.28×10^{-03}	4.93×10^{-04}	7.00×10^{-03}	3.22×10^{-04}	3.82×10^{-04}
	Snowshoe Hare	Reference (Broach Lake)	4.30×10^{-03}	3.98×10^{-03}	4.82×10^{-02}	2.01×10^{-03}	5.27×10^{-03}	4.30×10^{-03}	3.98×10^{-03}	4.82×10^{-02}	2.01×10^{-03}	5.27×10^{-03}
		Patterson Lake North Arm – West Basin	4.38×10^{-03}	4.05×10^{-03}	5.00×10^{-02}	2.31×10^{-03}	4.23×10^{-02}	4.38×10^{-03}	4.05×10^{-03}	5.00×10^{-02}	2.38×10^{-03}	4.23×10^{-02}
		Patterson Lake South Arm	4.32×10^{-03}	4.01×10^{-03}	4.86×10^{-02}	2.08×10^{-03}	1.06×10^{-02}	4.32×10^{-03}	4.02×10^{-03}	4.86×10^{-02}	2.11×10^{-03}	1.06×10^{-02}
		Beet Lake	4.31×10^{-03}	4.01×10^{-03}	4.84×10^{-02}	2.05×10^{-03}	8.39×10^{-03}	4.31×10^{-03}	4.01×10^{-03}	4.84×10^{-02}	2.07×10^{-03}	8.39×10^{-03}
		Lloyd Lake	4.31×10^{-03}	4.01×10^{-03}	4.83×10^{-02}	2.04×10^{-03}	5.39×10^{-03}	4.31×10^{-03}	4.01×10^{-03}	4.83×10^{-02}	2.04×10^{-03}	5.39×10^{-03}
	Southern Red-Backed Vole	Reference (Broach Lake)	3.10×10^{-03}	2.94×10^{-03}	3.66×10^{-02}	1.50×10^{-03}	3.95×10^{-03}	3.10×10^{-03}	2.94×10^{-03}	3.66×10^{-02}	1.50×10^{-03}	3.95×10^{-03}
		Patterson Lake North Arm – West Basin	3.18×10^{-03}	3.00×10^{-03}	3.79×10^{-02}	1.74×10^{-03}	3.05×10^{-02}	3.18×10^{-03}	3.00×10^{-03}	3.79×10^{-02}	1.85×10^{-03}	3.06×10^{-02}
		Patterson Lake South Arm	3.12×10^{-03}	2.97×10^{-03}	3.69×10^{-02}	1.56×10^{-03}	7.75×10^{-03}	3.12×10^{-03}	2.97×10^{-03}	3.69×10^{-02}	1.62×10^{-03}	7.76×10^{-03}
		Beet Lake	3.11×10^{-03}	2.96×10^{-03}	3.68×10^{-02}	1.53×10^{-03}	6.18×10^{-03}	3.11×10^{-03}	2.96×10^{-03}	3.68×10^{-02}	1.56×10^{-03}	6.19×10^{-03}
		Lloyd Lake	3.11×10^{-03}	2.96×10^{-03}	3.67×10^{-02}	1.52×10^{-03}	4.03×10^{-03}	3.11×10^{-03}	2.96×10^{-03}	3.67×10^{-02}	1.52×10^{-03}	4.03×10^{-03}
	Woodland Caribou	Reference (Broach Lake)	5.46×10^{-03}	3.94×10^{-03}	1.78×10^{-02}	1.24×10^{-03}	1.77×10^{-03}	5.46×10^{-03}	3.94×10^{-03}	1.78×10^{-02}	1.24×10^{-03}	1.77×10^{-03}
		Patterson Lake North Arm – West Basin	9.67×10^{-03}	4.70×10^{-03}	1.98×10^{-02}	2.44×10^{-03}	7.09×10^{-02}	9.77×10^{-03}	4.72×10^{-03}	1.98×10^{-02}	3.11×10^{-03}	7.28×10^{-02}
		Beet Lake	5.58×10^{-03}	4.11×10^{-03}	1.81×10^{-02}	1.36×10^{-03}	7.25×10^{-03}	5.58×10^{-03}	4.12×10^{-03}	1.81×10^{-02}	1.49×10^{-03}	7.41×10^{-03}

	Biota	Location	Maximum Dose During Operations (mg/kg/d)									
			Application Case					Upper Bound Scenario				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
		Lloyd Lake	5.60×10^{-03}	4.10×10^{-03}	1.80×10^{-02}	1.39×10^{-03}	2.21×10^{-03}	5.60×10^{-03}	4.10×10^{-03}	1.80×10^{-02}	1.41×10^{-03}	2.24×10^{-03}
	Grouse	Reference (Broach Lake)	6.44×10^{-03}	5.57×10^{-03}	5.26×10^{-02}	2.57×10^{-03}	6.34×10^{-03}	6.44×10^{-03}	5.57×10^{-03}	5.26×10^{-02}	2.57×10^{-03}	6.34×10^{-03}
		Patterson Lake North Arm – West Basin	6.51×10^{-03}	5.65×10^{-03}	5.45×10^{-02}	2.88×10^{-03}	4.81×10^{-02}	6.51×10^{-03}	5.65×10^{-03}	5.45×10^{-02}	2.94×10^{-03}	4.81×10^{-02}
		Patterson Lake South Arm	6.46×10^{-03}	5.61×10^{-03}	5.29×10^{-02}	2.64×10^{-03}	1.23×10^{-02}	6.46×10^{-03}	5.61×10^{-03}	5.29×10^{-02}	2.66×10^{-03}	1.23×10^{-02}
		Beet Lake	6.45×10^{-03}	5.61×10^{-03}	5.28×10^{-02}	2.61×10^{-03}	9.86×10^{-03}	6.45×10^{-03}	5.61×10^{-03}	5.28×10^{-02}	2.62×10^{-03}	9.86×10^{-03}
		Lloyd Lake	6.45×10^{-03}	5.61×10^{-03}	5.27×10^{-02}	2.60×10^{-03}	6.48×10^{-03}	6.45×10^{-03}	5.61×10^{-03}	5.27×10^{-02}	2.60×10^{-03}	6.48×10^{-03}
	Canada Goose	Reference (Broach Lake)	6.19×10^{-04}	5.56×10^{-04}	5.30×10^{-03}	2.58×10^{-04}	6.29×10^{-04}	6.19×10^{-04}	5.56×10^{-04}	5.30×10^{-03}	2.58×10^{-04}	6.29×10^{-04}
		Patterson Lake North Arm – West Basin	6.36×10^{-04}	5.69×10^{-04}	5.49×10^{-03}	3.02×10^{-04}	4.86×10^{-03}	6.37×10^{-04}	5.70×10^{-04}	5.49×10^{-03}	3.32×10^{-04}	4.88×10^{-03}
		Patterson Lake South Arm	6.22×10^{-04}	5.63×10^{-04}	5.34×10^{-03}	2.70×10^{-04}	1.24×10^{-03}	6.22×10^{-04}	5.63×10^{-04}	5.34×10^{-03}	2.86×10^{-04}	1.24×10^{-03}
		Beet Lake	6.21×10^{-04}	5.61×10^{-04}	5.32×10^{-03}	2.64×10^{-04}	9.86×10^{-04}	6.21×10^{-04}	5.61×10^{-04}	5.32×10^{-03}	2.72×10^{-04}	9.88×10^{-04}
		Lloyd Lake	6.21×10^{-04}	5.59×10^{-04}	5.31×10^{-03}	2.61×10^{-04}	6.42×10^{-04}	6.21×10^{-04}	5.59×10^{-04}	5.31×10^{-03}	2.62×10^{-04}	6.43×10^{-04}
	Little Brown Myotis	Reference (Broach Lake)	2.77×10^{-02}	5.73×10^{-02}	$3.22 \times 10^{+00}$	1.64×10^{-02}	4.77×10^{-03}	2.77×10^{-02}	5.73×10^{-02}	$3.22 \times 10^{+00}$	1.64×10^{-02}	4.77×10^{-03}
		Patterson Lake North Arm – West Basin	8.44×10^{-02}	7.41×10^{-02}	$3.74 \times 10^{+00}$	4.38×10^{-02}	1.57×10^{-02}	8.57×10^{-02}	7.48×10^{-02}	$3.76 \times 10^{+00}$	1.00×10^{-01}	3.52×10^{-02}
		Patterson Lake South Arm	3.23×10^{-02}	6.62×10^{-02}	$3.49 \times 10^{+00}$	3.05×10^{-02}	7.66×10^{-03}	3.25×10^{-02}	6.66×10^{-02}	$3.50 \times 10^{+00}$	6.03×10^{-02}	1.28×10^{-02}
		Beet Lake	2.84×10^{-02}	6.19×10^{-02}	$3.36 \times 10^{+00}$	2.36×10^{-02}	5.83×10^{-03}	2.84×10^{-02}	6.21×10^{-02}	$3.36 \times 10^{+00}$	3.89×10^{-02}	7.73×10^{-03}
		Lloyd Lake	2.77×10^{-02}	5.77×10^{-02}	$3.23 \times 10^{+00}$	1.71×10^{-02}	4.87×10^{-03}	2.77×10^{-02}	5.78×10^{-02}	$3.23 \times 10^{+00}$	1.87×10^{-02}	5.04×10^{-03}
	Common Loon	Reference (Broach Lake)	4.71×10^{-03}	2.18×10^{-03}	1.25×10^{-01}	4.10×10^{-04}	3.38×10^{-04}	4.71×10^{-03}	2.18×10^{-03}	1.25×10^{-01}	4.10×10^{-04}	3.38×10^{-04}
		Patterson Lake North Arm – West Basin	1.63×10^{-02}	2.84×10^{-03}	1.46×10^{-01}	1.10×10^{-03}	1.22×10^{-03}	1.66×10^{-02}	2.87×10^{-03}	1.46×10^{-01}	2.50×10^{-03}	2.85×10^{-03}
		Patterson Lake South Arm	5.67×10^{-03}	2.53×10^{-03}	1.35×10^{-01}	7.64×10^{-04}	5.72×10^{-04}	5.69×10^{-03}	2.54×10^{-03}	1.36×10^{-01}	1.51×10^{-03}	9.85×10^{-04}
		Beet Lake	4.87×10^{-03}	2.36×10^{-03}	1.30×10^{-01}	5.91×10^{-04}	4.24×10^{-04}	4.87×10^{-03}	2.37×10^{-03}	1.30×10^{-01}	9.74×10^{-04}	5.75×10^{-04}
		Lloyd Lake	4.72×10^{-03}	2.20×10^{-03}	1.25×10^{-01}	4.28×10^{-04}	3.46×10^{-04}	4.72×10^{-03}	2.20×10^{-03}	1.25×10^{-01}	4.68×10^{-04}	3.60×10^{-04}
	Mallard	Reference (Broach Lake)	2.78×10^{-02}	2.60×10^{-02}	$1.05 \times 10^{+00}$	6.52×10^{-03}	5.23×10^{-03}	2.78×10^{-02}	2.60×10^{-02}	$1.05 \times 10^{+00}$	6.52×10^{-03}	5.23×10^{-03}
		Patterson Lake North Arm – West Basin	8.52×10^{-02}	3.37×10^{-02}	$1.23 \times 10^{+00}$	1.75×10^{-02}	1.73×10^{-02}	8.66×10^{-02}	3.40×10^{-02}	$1.23 \times 10^{+00}$	3.98×10^{-02}	3.90×10^{-02}
		Patterson Lake South Arm	3.25×10^{-02}	3.01×10^{-02}	$1.14 \times 10^{+00}$	1.22×10^{-02}	8.42×10^{-03}	3.26×10^{-02}	3.03×10^{-02}	$1.14 \times 10^{+00}$	2.40×10^{-02}	1.42×10^{-02}
		Beet Lake	2.85×10^{-02}	2.81×10^{-02}	$1.10 \times 10^{+00}$	9.41×10^{-03}	6.40×10^{-03}	2.85×10^{-02}	2.82×10^{-02}	$1.10 \times 10^{+00}$	1.55×10^{-02}	8.50×10^{-03}
		Lloyd Lake	2.78×10^{-02}	2.62×10^{-02}	$1.06 \times 10^{+00}$	6.82×10^{-03}	5.33×10^{-03}	2.78×10^{-02}	2.62×10^{-02}	$1.06 \times 10^{+00}$	7.44×10^{-03}	5.52×10^{-03}
	Rusty Blackbird	Reference (Broach Lake)	7.16×10^{-02}	1.25×10^{-01}	$6.35 \times 10^{+00}$	3.66×10^{-02}	1.76×10^{-02}	7.16×10^{-02}	1.25×10^{-01}	$6.35 \times 10^{+00}$	3.66×10^{-02}	1.76×10^{-02}
		Patterson Lake North Arm – West Basin	1.83×10^{-01}	1.58×10^{-01}	$7.38 \times 10^{+00}$	9.06×10^{-02}	7.62×10^{-02}	1.86×10^{-01}	1.60×10^{-01}	$7.41 \times 10^{+00}$	2.01×10^{-01}	1.14×10^{-01}
		Patterson Lake South Arm	8.08×10^{-02}	1.43×10^{-01}	$6.88 \times 10^{+00}$	6.44×10^{-02}	2.85×10^{-02}	8.11×10^{-02}	1.44×10^{-01}	$6.89 \times 10^{+00}$	1.23×10^{-01}	3.87×10^{-02}
		Beet Lake	7.31×10^{-02}	1.34×10^{-01}	$6.62 \times 10^{+00}$	5.08×10^{-02}	2.28×10^{-02}	7.32×10^{-02}	1.35×10^{-01}	$6.63 \times 10^{+00}$	8.08×10^{-02}	2.65×10^{-02}
		Lloyd Lake	7.17×10^{-02}	1.26×10^{-01}	$6.38 \times 10^{+00}$	3.81×10^{-02}	1.79×10^{-02}	7.17×10^{-02}	1.26×10^{-01}	$6.38 \times 10^{+00}$	4.12×10^{-02}	1.82×10^{-02}

Table 6-11: Estimated Non-radiological Doses to Ecological Receptors – Far-Future Projection – Application Case and Upper Bound Scenario

	Biota	Location	Maximum Dose Far-Future (mg/kg/d)									
			Application Case					Upper Bound Scenario				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
Terrestrial Animals	Beaver	Reference (Broach Lake)	3.48×10^{-03}	3.94×10^{-03}	3.15×10^{-02}	1.17×10^{-03}	3.20×10^{-03}	3.48×10^{-03}	3.94×10^{-03}	3.15×10^{-02}	1.17×10^{-03}	3.20×10^{-03}
		Patterson Lake North Arm – West Basin	3.57×10^{-03}	6.75×10^{-03}	3.76×10^{-02}	3.39×10^{-03}	7.09×10^{-03}	3.61×10^{-03}	8.24×10^{-03}	4.06×10^{-02}	9.68×10^{-03}	7.09×10^{-03}
		Patterson Lake South Arm	3.49×10^{-03}	5.64×10^{-03}	3.50×10^{-02}	2.46×10^{-03}	4.10×10^{-03}	3.49×10^{-03}	6.55×10^{-03}	3.68×10^{-02}	6.11×10^{-03}	4.10×10^{-03}
		Beet Lake	3.49×10^{-03}	4.84×10^{-03}	3.34×10^{-02}	1.84×10^{-03}	3.57×10^{-03}	3.49×10^{-03}	5.32×10^{-03}	3.43×10^{-02}	3.75×10^{-03}	3.57×10^{-03}
		Lloyd Lake	3.48×10^{-03}	4.03×10^{-03}	3.17×10^{-02}	1.24×10^{-03}	3.23×10^{-03}	3.48×10^{-03}	4.08×10^{-03}	3.18×10^{-02}	1.44×10^{-03}	3.23×10^{-03}
	Black Bear	Reference (Broach Lake)	2.81×10^{-03}	1.17×10^{-03}	2.86×10^{-02}	3.75×10^{-04}	1.02×10^{-03}	2.81×10^{-03}	1.17×10^{-03}	2.86×10^{-02}	3.75×10^{-04}	1.02×10^{-03}
		Patterson Lake North Arm – West Basin	2.87×10^{-03}	1.63×10^{-03}	5.39×10^{-02}	6.09×10^{-04}	1.79×10^{-03}	2.90×10^{-03}	1.86×10^{-03}	6.66×10^{-02}	1.24×10^{-03}	1.79×10^{-03}
		Beet Lake	3.09×10^{-03}	1.49×10^{-03}	3.39×10^{-02}	4.95×10^{-04}	1.20×10^{-03}	3.09×10^{-03}	1.53×10^{-03}	3.63×10^{-02}	6.17×10^{-04}	1.20×10^{-03}
		Lloyd Lake	2.82×10^{-03}	1.22×10^{-03}	2.97×10^{-02}	3.97×10^{-04}	1.03×10^{-03}	2.82×10^{-03}	1.23×10^{-03}	3.02×10^{-02}	4.23×10^{-04}	1.03×10^{-03}
	Grey Wolf	Reference (Broach Lake)	7.50×10^{-03}	6.01×10^{-04}	3.31×10^{-02}	2.88×10^{-04}	3.73×10^{-04}	7.50×10^{-03}	6.01×10^{-04}	3.31×10^{-02}	2.88×10^{-04}	3.73×10^{-04}
		Patterson Lake North Arm – West Basin	7.53×10^{-03}	6.45×10^{-04}	3.43×10^{-02}	4.47×10^{-04}	4.53×10^{-04}	7.55×10^{-03}	6.67×10^{-04}	3.49×10^{-02}	9.00×10^{-04}	4.53×10^{-04}
		Lloyd Lake	7.50×10^{-03}	6.06×10^{-04}	3.32×10^{-02}	3.03×10^{-04}	3.75×10^{-04}	7.50×10^{-03}	6.09×10^{-04}	3.33×10^{-02}	3.46×10^{-04}	3.75×10^{-04}
	American Mink	Reference (Broach Lake)	1.15×10^{-02}	4.61×10^{-03}	2.28×10^{-01}	1.15×10^{-03}	1.08×10^{-03}	1.15×10^{-02}	4.61×10^{-03}	2.28×10^{-01}	1.15×10^{-03}	1.08×10^{-03}
		Patterson Lake North Arm – West Basin	1.22×10^{-02}	1.06×10^{-02}	5.90 x 10-01	2.20×10^{-02}	8.39×10^{-03}	1.25×10^{-02}	1.37×10^{-02}	7.72 x 10-01	8.14×10^{-02}	8.40×10^{-03}
		Patterson Lake South Arm	1.16×10^{-02}	8.23×10^{-03}	4.41 x 10-01	1.33×10^{-02}	3.09×10^{-03}	1.16×10^{-02}	1.02×10^{-02}	5.47 x 10-01	4.77×10^{-02}	3.09×10^{-03}
		Beet Lake	1.15×10^{-02}	6.53×10^{-03}	3.39 x 10-01	7.46×10^{-03}	1.83×10^{-03}	1.15×10^{-02}	7.55×10^{-03}	3.95 x 10-01	2.54×10^{-02}	1.83×10^{-03}
		Lloyd Lake	1.15×10^{-02}	4.81×10^{-03}	2.40 x 10-01	1.79×10^{-03}	1.15×10^{-03}	1.15×10^{-02}	4.91×10^{-03}	2.45 x 10-01	3.62×10^{-03}	1.15×10^{-03}
	Moose	Reference (Broach Lake)	2.35×10^{-03}	2.83×10^{-03}	1.61×10^{-02}	5.80×10^{-04}	1.59×10^{-03}	2.35×10^{-03}	2.83×10^{-03}	1.61×10^{-02}	5.80×10^{-04}	1.59×10^{-03}
		Patterson Lake North Arm – West Basin	2.44×10^{-03}	5.63×10^{-03}	2.22×10^{-02}	2.78×10^{-03}	4.82×10^{-03}	2.49×10^{-03}	7.11×10^{-03}	2.52×10^{-02}	9.02×10^{-03}	4.82×10^{-03}
		Patterson Lake South Arm	2.43×10^{-03}	5.55×10^{-03}	2.20×10^{-02}	2.53×10^{-03}	4.74×10^{-03}	2.48×10^{-03}	7.01×10^{-03}	2.50×10^{-02}	8.09×10^{-03}	4.74×10^{-03}
		Beet Lake	2.36×10^{-03}	3.73×10^{-03}	1.80×10^{-02}	1.24×10^{-03}	1.91×10^{-03}	2.36×10^{-03}	4.20×10^{-03}	1.89×10^{-02}	3.13×10^{-03}	1.91×10^{-03}
		Lloyd Lake	2.35×10^{-03}	2.92×10^{-03}	1.63×10^{-02}	6.48×10^{-04}	1.62×10^{-03}	2.35×10^{-03}	2.97×10^{-03}	1.64×10^{-02}	8.40×10^{-04}	1.62×10^{-03}
	Muskrat	Reference (Broach Lake)	2.86×10^{-02}	1.60×10^{-02}	4.08×10^{-01}	3.65×10^{-03}	5.51×10^{-03}	2.86×10^{-02}	1.60×10^{-02}	4.08×10^{-01}	3.65×10^{-03}	5.51×10^{-03}
		Patterson Lake North Arm - West Basin	3.03×10^{-02}	3.91×10^{-02}	$1.05 \times 10^{+00}$	8.14×10^{-02}	5.51×10^{-02}	3.12×10^{-02}	5.14×10^{-02}	$1.38 \times 10^{+00}$	3.02×10^{-01}	5.51×10^{-02}
		Patterson Lake South Arm	2.87×10^{-02}	3.00×10^{-02}	7.87×10^{-01}	4.88×10^{-02}	1.92×10^{-02}	2.88×10^{-02}	3.75×10^{-02}	9.78×10^{-01}	1.77×10^{-01}	1.92×10^{-02}
		Beet Lake	2.86×10^{-02}	2.34×10^{-02}	6.06×10^{-01}	2.71×10^{-02}	1.06×10^{-02}	2.86×10^{-02}	2.74×10^{-02}	7.06×10^{-01}	9.39×10^{-02}	1.06×10^{-02}
		Lloyd Lake	2.86×10^{-02}	1.67×10^{-02}	4.28×10^{-01}	6.04×10^{-03}	5.97×10^{-03}	2.86×10^{-02}	1.71×10^{-02}	4.38×10^{-01}	1.28×10^{-02}	5.97×10^{-03}
	Red Fox	Reference (Broach Lake)	1.27×10^{-03}	4.90×10^{-04}	6.99×10^{-03}	3.17×10^{-04}	3.72×10^{-04}	1.27×10^{-03}	4.90×10^{-04}	6.99×10^{-03}	3.17×10^{-04}	3.72×10^{-04}
		Patterson Lake North Arm - West Basin	1.27×10^{-03}	5.64×10^{-04}	7.12×10^{-03}	6.94×10^{-04}	6.12×10^{-04}	1.27×10^{-03}	6.03×10^{-04}	7.18×10^{-03}	1.76×10^{-03}	6.12×10^{-04}
		Patterson Lake South Arm	1.27×10^{-03}	5.35×10^{-04}	7.06×10^{-03}	5.36×10^{-04}	4.17×10^{-04}	1.27×10^{-03}	5.58×10^{-04}	7.09×10^{-03}	1.16×10^{-03}	4.17×10^{-04}
		Beet Lake	1.27×10^{-03}	5.14×10^{-04}	7.03×10^{-03}	4.31×10^{-04}	3.94×10^{-04}	1.27×10^{-03}	5.26×10^{-04}	7.04×10^{-03}	7.54×10^{-04}	3.94×10^{-04}
		Lloyd Lake	1.27×10^{-03}	4.93×10^{-04}	6.99×10^{-03}	3.29×10^{-04}	3.73×10^{-04}	1.27×10^{-03}	4.94×10^{-04}	6.99×10^{-03}	3.62×10^{-04}	3.73×10^{-04}
	Snowshoe Hare	Reference (Broach Lake)	4.30×10^{-03}	3.98×10^{-03}	4.82×10^{-02}	2.01×10^{-03}	5.27×10^{-03}	4.30×10^{-03}	3.98×10^{-03}	4.82×10^{-02}	2.01×10^{-03}	5.27×10^{-03}
		Patterson Lake North Arm - West Basin	4.30×10^{-03}	4.07×10^{-03}	4.85×10^{-02}	2.43×10^{-03}	7.70×10^{-03}	4.30×10^{-03}	4.11×10^{-03}	4.85×10^{-02}	3.61×10^{-03}	7.70×10^{-03}
		Patterson Lake South Arm	4.30×10^{-03}	4.03×10^{-03}	4.83×10^{-02}	2.25×10^{-03}	5.63×10^{-03}	4.30×10^{-03}	4.06×10^{-03}	4.84×10^{-02}	2.94×10^{-03}	5.63×10^{-03}
		Beet Lake	4.30×10^{-03}	4.01×10^{-03}	4.83×10^{-02}	2.14×10^{-03}	5.48×10^{-03}	4.30×10^{-03}	4.02×10^{-03}	4.83×10^{-02}	2.50×10^{-03}	5.48×10^{-03}
		Lloyd Lake	4.30×10^{-03}	3.99×10^{-03}	4.82×10^{-02}	2.03×10^{-03}	5.28×10^{-03}	4.30×10^{-03}	3.99×10^{-03}	4.83×10^{-02}	2.06×10^{-03}	5.28×10^{-03}
	Southern Red-Backed Vole	Reference (Broach Lake)	3.10×10^{-03}	2.94×10^{-03}	3.66×10^{-02}	1.50×10^{-03}	3.95×10^{-03}	3.10×10^{-03}	2.94×10^{-03}	3.66×10^{-02}	1.50×10^{-03}	3.95×10^{-03}
		Patterson Lake North Arm - West Basin	3.10×10^{-03}	3.06×10^{-03}	3.69×10^{-02}	2.12×10^{-03}	5.83×10^{-03}	3.10×10^{-03}	3.13×10^{-03}	3.70×10^{-02}	3.85×10^{-03}	5.83×10^{-03}
		Patterson Lake South Arm	3.10×10^{-03}	3.01×10^{-03}	3.67×10^{-02}	1.86×10^{-03}	4.23×10^{-03}	3.10×10^{-03}	3.05×10^{-03}	3.68×10^{-02}	2.87×10^{-03}	4.23×10^{-03}
		Beet Lake	3.10×10^{-03}	2.98×10^{-03}	3.67×10^{-02}	1.69×10^{-03}	4.11×10^{-03}	3.10×10^{-03}	3.00×10^{-03}	3.67×10^{-02}	2.21×10^{-03}	4.11×10^{-03}
		Lloyd Lake	3.10×10^{-03}	2.95×10^{-03}	3.66×10^{-02}	1.52×10^{-03}	3.95×10^{-03}	3.10×10^{-03}	2.95×10^{-03}	3.66×10^{-02}	1.58×10^{-03}	3.95×10^{-03}
	Woodland Caribou	Reference (Broach Lake)	5.46×10^{-03}	3.94×10^{-03}	1.78×10^{-02}	1.24×10^{-03}	1.77×10^{-03}	5.46×10^{-03}	3.94×10^{-03}	1.78×10^{-02}	1.24×10^{-03}	1.77×10^{-03}
		Patterson Lake North Arm - West Basin	5.57×10^{-03}	6.64×10^{-03}	2.34×10^{-02}	5.54×10^{-03}	6.08×10^{-03}	5.63×10^{-03}	8.08×10^{-03}	2.63×10^{-02}	1.77×10^{-02}	6.08×10^{-03}
		Beet Lake	5.46×10^{-03}	4.49×10^{-03}	1.89×10^{-02}	2.07×10^{-03}	2.13×10^{-03}	5.46×10^{-03}	4.78×10^{-03}	1.95×10^{-02}	4.43×10^{-03}	2.13×10^{-03}

	Biota	Location	Maximum Dose Far-Future (mg/kg/d)									
			Application Case					Upper Bound Scenario				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
		Lloyd Lake	5.46×10^{-03}	4.06×10^{-03}	1.80×10^{-02}	1.41×10^{-03}	1.83×10^{-03}	5.46×10^{-03}	4.12×10^{-03}	1.82×10^{-02}	1.92×10^{-03}	1.83×10^{-03}
	Grouse	Reference (Broach Lake)	6.44×10^{-03}	5.57×10^{-03}	5.26×10^{-02}	2.57×10^{-03}	6.34×10^{-03}	6.44×10^{-03}	5.57×10^{-03}	5.26×10^{-02}	2.57×10^{-03}	6.34×10^{-03}
		Patterson Lake North Arm - West Basin	6.44×10^{-03}	5.65×10^{-03}	5.28×10^{-02}	2.88×10^{-03}	9.23×10^{-03}	6.44×10^{-03}	5.68×10^{-03}	5.28×10^{-02}	3.75×10^{-03}	9.23×10^{-03}
		Patterson Lake South Arm	6.44×10^{-03}	5.62×10^{-03}	5.27×10^{-02}	2.75×10^{-03}	6.76×10^{-03}	6.44×10^{-03}	5.64×10^{-03}	5.27×10^{-02}	3.26×10^{-03}	6.76×10^{-03}
		Beet Lake	6.44×10^{-03}	5.60×10^{-03}	5.26×10^{-02}	2.67×10^{-03}	6.59×10^{-03}	6.44×10^{-03}	5.61×10^{-03}	5.26×10^{-02}	2.93×10^{-03}	6.59×10^{-03}
		Lloyd Lake	6.44×10^{-03}	5.59×10^{-03}	5.26×10^{-02}	2.58×10^{-03}	6.35×10^{-03}	6.44×10^{-03}	5.59×10^{-03}	5.26×10^{-02}	2.61×10^{-03}	6.35×10^{-03}
	Canada Goose	Reference (Broach Lake)	6.19×10^{-04}	5.56×10^{-04}	5.30×10^{-03}	2.58×10^{-04}	6.29×10^{-04}	6.19×10^{-04}	5.56×10^{-04}	5.30×10^{-03}	2.58×10^{-04}	6.29×10^{-04}
		Patterson Lake North Arm - West Basin	6.19×10^{-04}	5.90×10^{-04}	5.36×10^{-03}	4.27×10^{-04}	9.42×10^{-04}	6.20×10^{-04}	6.07×10^{-04}	5.39×10^{-03}	9.06×10^{-04}	9.42×10^{-04}
		Patterson Lake South Arm	6.19×10^{-04}	5.76×10^{-04}	5.33×10^{-03}	3.56×10^{-04}	6.78×10^{-04}	6.19×10^{-04}	5.87×10^{-04}	5.35×10^{-03}	6.34×10^{-04}	6.78×10^{-04}
		Beet Lake	6.19×10^{-04}	5.67×10^{-04}	5.32×10^{-03}	3.09×10^{-04}	6.56×10^{-04}	6.19×10^{-04}	5.72×10^{-04}	5.32×10^{-03}	4.54×10^{-04}	6.56×10^{-04}
		Lloyd Lake	6.19×10^{-04}	5.58×10^{-04}	5.30×10^{-03}	2.63×10^{-04}	6.30×10^{-04}	6.19×10^{-04}	5.58×10^{-04}	5.30×10^{-03}	2.78×10^{-04}	6.30×10^{-04}
	Little Brown Myotis	Reference (Broach Lake)	2.77×10^{-02}	5.73×10^{-02}	$3.22 \times 10^{+00}$	1.64×10^{-02}	4.77×10^{-03}	2.77×10^{-02}	5.73×10^{-02}	$3.22 \times 10^{+00}$	1.64×10^{-02}	4.77×10^{-03}
		Patterson Lake North Arm - West Basin	2.93×10^{-02}	1.40×10^{-01}	$8.33 \times 10^{+00}$	3.66×10^{-01}	4.78×10^{-02}	3.02×10^{-02}	1.84×10^{-01}	$1.09 \times 10^{+01}$	$1.36 \times 10^{+00}$	4.78×10^{-02}
		Patterson Lake South Arm	2.78×10^{-02}	1.08×10^{-01}	$6.22 \times 10^{+00}$	2.19×10^{-01}	1.67×10^{-02}	2.79×10^{-02}	1.34×10^{-01}	$7.73 \times 10^{+00}$	7.95×10^{-01}	1.67×10^{-02}
		Beet Lake	2.77×10^{-02}	8.39×10^{-02}	$4.79 \times 10^{+00}$	1.22×10^{-01}	9.19×10^{-03}	2.77×10^{-02}	9.81×10^{-02}	$5.58 \times 10^{+00}$	4.22×10^{-01}	9.20×10^{-03}
		Lloyd Lake	2.77×10^{-02}	6.00×10^{-02}	$3.38 \times 10^{+00}$	2.72×10^{-02}	5.17×10^{-03}	2.77×10^{-02}	6.14×10^{-02}	$3.46 \times 10^{+00}$	5.78×10^{-02}	5.17×10^{-03}
	Common Loon	Reference (Broach Lake)	4.71×10^{-03}	2.18×10^{-03}	1.25×10^{-01}	4.10×10^{-04}	3.38×10^{-04}	4.71×10^{-03}	2.18×10^{-03}	1.25×10^{-01}	4.10×10^{-04}	3.38×10^{-04}
		Patterson Lake North Arm – West Basin	5.00×10^{-03}	5.34×10^{-03}	3.22×10^{-01}	9.15×10^{-03}	3.38×10^{-03}	5.15×10^{-03}	7.01×10^{-03}	4.22×10^{-01}	3.40×10^{-02}	3.38×10^{-03}
		Patterson Lake South Arm	4.74×10^{-03}	4.09×10^{-03}	2.41×10^{-01}	5.48×10^{-03}	1.18×10^{-03}	4.75×10^{-03}	5.11×10^{-03}	2.99×10^{-01}	1.99×10^{-02}	1.18×10^{-03}
		Beet Lake	4.72×10^{-03}	3.19×10^{-03}	1.85×10^{-01}	3.05×10^{-03}	6.51×10^{-04}	4.72×10^{-03}	3.73×10^{-03}	2.16×10^{-01}	1.05×10^{-02}	6.51×10^{-04}
		Lloyd Lake	4.71×10^{-03}	2.28×10^{-03}	1.31×10^{-01}	6.79×10^{-04}	3.66×10^{-04}	4.71×10^{-03}	2.34×10^{-03}	1.34×10^{-01}	1.44×10^{-03}	3.66×10^{-04}
	Mallard	Reference (Broach Lake)	2.78×10^{-02}	2.60×10^{-02}	$1.05 \times 10^{+00}$	6.52×10^{-03}	5.23×10^{-03}	2.78×10^{-02}	2.60×10^{-02}	$1.05 \times 10^{+00}$	6.52×10^{-03}	5.23×10^{-03}
		Patterson Lake North Arm – West Basin	2.94×10^{-02}	6.35×10^{-02}	$2.73 \times 10^{+00}$	1.46×10^{-01}	5.23×10^{-02}	3.03×10^{-02}	8.35×10^{-02}	$3.57 \times 10^{+00}$	5.40×10^{-01}	5.23×10^{-02}
		Patterson Lake South Arm	2.79×10^{-02}	4.88×10^{-02}	$2.04 \times 10^{+00}$	8.72×10^{-02}	1.82×10^{-02}	2.80×10^{-02}	6.09×10^{-02}	$2.53 \times 10^{+00}$	3.16×10^{-01}	1.83×10^{-02}
		Beet Lake	2.78×10^{-02}	3.80×10^{-02}	$1.57 \times 10^{+00}$	4.85×10^{-02}	1.01×10^{-02}	2.78×10^{-02}	4.44×10^{-02}	$1.83 \times 10^{+00}$	1.68×10^{-01}	1.01×10^{-02}
		Lloyd Lake	2.78×10^{-02}	2.72×10^{-02}	$1.11 \times 10^{+00}$	1.08×10^{-02}	5.66×10^{-03}	2.78×10^{-02}	2.78×10^{-02}	$1.13 \times 10^{+00}$	2.30×10^{-02}	5.66×10^{-03}
	Rusty Blackbird	Reference (Broach Lake)	7.16×10^{-02}	1.25×10^{-01}	$6.35 \times 10^{+00}$	3.66×10^{-02}	1.76×10^{-02}	7.16×10^{-02}	1.25×10^{-01}	$6.35 \times 10^{+00}$	3.66×10^{-02}	1.76×10^{-02}
		Patterson Lake North Arm – West Basin	7.49×10^{-02}	2.88×10^{-01}	$1.64 \times 10^{+01}$	7.22×10^{-01}	1.05×10^{-01}	7.67×10^{-02}	3.75×10^{-01}	$2.14 \times 10^{+01}$	$2.67 \times 10^{+00}$	1.06×10^{-01}
		Patterson Lake South Arm	7.19×10^{-02}	2.24×10^{-01}	$1.22 \times 10^{+01}$	4.35×10^{-01}	4.14×10^{-02}	7.20×10^{-02}	2.77×10^{-01}	$1.52 \times 10^{+01}$	$1.56 \times 10^{+00}$	4.14×10^{-02}
		Beet Lake	7.17×10^{-02}	1.78×10^{-01}	$9.43 \times 10^{+00}$	2.44×10^{-01}	2.65×10^{-02}	7.17×10^{-02}	2.05×10^{-01}	$1.10 \times 10^{+01}$	8.32×10^{-01}	2.65×10^{-02}
		Lloyd Lake	7.16×10^{-02}	1.31×10^{-01}	$6.67 \times 10^{+00}$	5.77×10^{-02}	1.84×10^{-02}	7.16×10^{-02}	1.33×10^{-01}	$6.82 \times 10^{+00}$	1.18×10^{-01}	1.84×10^{-02}

6.2.5.1.2 Radiological Dose

The estimated radiation doses to aquatic and terrestrial ecological receptors during the Project phases and far-future projection resulting from the Application Case and Upper Bound sensitivity scenario are shown in Table 6-12. The doses shown represent the maximum total dose from all radionuclides over the assessment period. The dose breakdown by radionuclide is shown in Appendix C.

The maximum estimated radiation dose would occur during Operations for zooplankton in the Patterson Lake North Arm – West Basin. The estimated dose to zooplankton was 0.12 milligrays per day (mGy/d) in the Application Case and 0.26 mGy/d in the reasonable upper bound sensitivity scenario. The main contributor to total dose would be from polonium-210 in water.

For terrestrial receptors, the maximum estimated radiation dose for mammals and birds occurred during Operations for the rusty blackbird eating from the Patterson Lake North Arm – West Basin. The estimated dose to the rusty blackbird was 0.10 mGy/d in the Application Case and 0.19 mGy/d in the reasonable upper bound sensitivity scenario. The main contributor to total dose would be from polonium-210 in benthic invertebrates that are eaten by the rusty blackbird. The maximum dose for terrestrial plants is to lichen (0.68 mGy/d in the Application Case and the reasonable upper bound sensitivity scenario) due to atmospheric deposition from air to the plant.

The predicted radiation dose to all ecological receptors during the far-future projection was lower than during Operations. The maximum estimated dose to zooplankton was 0.07 mGy/d in both the Application Case and reasonable upper bound sensitivity scenario, in the far-future projection. The maximum estimated dose to lichen was 0.11 mGy/d in both the Application Case and reasonable upper bound sensitivity scenario in the far-future projection.

Table 6-12: Estimated Radiation Doses to Aquatic and Terrestrial Biota – All Cases

	Biota	Location	Maximum Total Dose (mGy/d)					
			Application Case		Upper Bound Scenario		RFD Case	
			Operations	Far-Future	Operations	Far-Future	Operations	Far-Future
Aquatic Animals	Benthic Invertebrate	Reference (Broach Lake)	1.19×10^{-04}	1.19×10^{-04}	1.19×10^{-04}	1.19×10^{-04}	1.19×10^{-04}	1.19×10^{-04}
		Patterson Lake North Arm – West Basin	1.82×10^{-04}	1.44×10^{-04}	2.36×10^{-04}	1.44×10^{-04}	1.82×10^{-04}	1.44×10^{-04}
		Patterson Lake South Arm	1.37×10^{-04}	1.28×10^{-04}	1.41×10^{-04}	1.28×10^{-04}	1.57×10^{-04}	1.28×10^{-04}
		Beet Lake	1.26×10^{-04}	1.22×10^{-04}	1.27×10^{-04}	1.22×10^{-04}	1.33×10^{-04}	1.22×10^{-04}
		Lloyd Lake	1.19×10^{-04}	1.19×10^{-04}	1.19×10^{-04}	1.19×10^{-04}	1.20×10^{-04}	1.19×10^{-04}
	Zooplankton	Reference (Broach Lake)	6.81×10^{-02}	6.81×10^{-02}	6.81×10^{-02}	6.81×10^{-02}	6.81×10^{-02}	6.81×10^{-02}
		Patterson Lake North Arm – West Basin	1.17×10^{-01}	7.38×10^{-02}	2.61×10^{-01}	7.38×10^{-02}	1.17×10^{-01}	7.38×10^{-02}
		Patterson Lake South Arm	7.93×10^{-02}	6.93×10^{-02}	8.74×10^{-02}	6.93×10^{-02}	1.21×10^{-01}	6.93×10^{-02}
		Beet Lake	7.31×10^{-02}	6.85×10^{-02}	7.43×10^{-02}	6.85×10^{-02}	8.16×10^{-02}	6.85×10^{-02}
		Lloyd Lake	6.86×10^{-02}	6.81×10^{-02}	6.87×10^{-02}	6.81×10^{-02}	6.92×10^{-02}	6.81×10^{-02}
	Northern Pike	Reference (Broach Lake)	8.33×10^{-04}	8.33×10^{-04}	8.33×10^{-04}	8.33×10^{-04}	8.33×10^{-04}	8.33×10^{-04}
		Patterson Lake North Arm – West Basin	1.54×10^{-03}	1.20×10^{-03}	3.05×10^{-03}	1.20×10^{-03}	1.54×10^{-03}	1.20×10^{-03}
		Patterson Lake South Arm	1.03×10^{-03}	9.36×10^{-04}	1.15×10^{-03}	9.36×10^{-04}	1.68×10^{-03}	9.36×10^{-04}
		Beet Lake	9.20×10^{-04}	8.72×10^{-04}	9.46×10^{-04}	8.72×10^{-04}	1.09×10^{-03}	8.72×10^{-04}
		Lloyd Lake	8.41×10^{-04}	8.36×10^{-04}	8.43×10^{-04}	8.36×10^{-04}	8.56×10^{-04}	8.36×10^{-04}
	Whitefish	Reference (Broach Lake)	2.58×10^{-04}	2.58×10^{-04}	2.58×10^{-04}	2.58×10^{-04}	2.58×10^{-04}	2.58×10^{-04}
		Patterson Lake North Arm – West Basin	5.57×10^{-04}	3.68×10^{-04}	6.99×10^{-04}	3.68×10^{-04}	5.57×10^{-04}	3.68×10^{-04}
		Patterson Lake South Arm	3.84×10^{-04}	2.93×10^{-04}	4.01×10^{-04}	2.93×10^{-04}	6.24×10^{-04}	2.93×10^{-04}
		Beet Lake	3.18×10^{-04}	2.72×10^{-04}	3.23×10^{-04}	2.72×10^{-04}	4.01×10^{-04}	2.72×10^{-04}
		Lloyd Lake	2.64×10^{-04}	2.59×10^{-04}	2.64×10^{-04}	2.59×10^{-04}	2.72×10^{-04}	2.59×10^{-04}
Aquatic Plants	Macrophytes	Reference (Broach Lake)	5.53×10^{-03}	5.53×10^{-03}	5.53×10^{-03}	5.53×10^{-03}	5.53×10^{-03}	5.53×10^{-03}
		Patterson Lake North Arm – West Basin	1.50×10^{-02}	7.25×10^{-03}	1.83×10^{-02}	7.25×10^{-03}	1.50×10^{-02}	7.25×10^{-03}
		Patterson Lake South Arm	1.02×10^{-02}	6.11×10^{-03}	1.05×10^{-02}	6.11×10^{-03}	1.65×10^{-02}	6.11×10^{-03}
		Beet Lake	7.88×10^{-03}	5.77×10^{-03}	7.97×10^{-03}	5.77×10^{-03}	1.01×10^{-02}	5.77×10^{-03}
		Lloyd Lake	5.77×10^{-03}	5.56×10^{-03}	5.78×10^{-03}	5.56×10^{-03}	5.98×10^{-03}	5.56×10^{-03}
	Phytoplankton	Reference (Broach Lake)	5.51×10^{-03}	5.51×10^{-03}	5.51×10^{-03}	5.51×10^{-03}	5.51×10^{-03}	5.51×10^{-03}
		Patterson Lake North Arm – West Basin	1.49×10^{-02}	7.22×10^{-03}	1.82×10^{-02}	7.22×10^{-03}	1.49×10^{-02}	7.22×10^{-03}
		Patterson Lake South Arm	1.01×10^{-02}	6.08×10^{-03}	1.05×10^{-02}	6.08×10^{-03}	1.65×10^{-02}	6.08×10^{-03}
		Beet Lake	7.84×10^{-03}	5.75×10^{-03}	7.94×10^{-03}	5.75×10^{-03}	1.00×10^{-02}	5.75×10^{-03}
		Lloyd Lake	5.75×10^{-03}	5.53×10^{-03}	5.75×10^{-03}	5.53×10^{-03}	5.95×10^{-03}	5.53×10^{-03}
Terrestrial Invertebrate	Terrestrial Invertebrate	Reference (Broach Lake)	5.91×10^{-03}	5.91×10^{-03}	5.91×10^{-03}	5.91×10^{-03}	5.91×10^{-03}	5.91×10^{-03}
		Patterson Lake North Arm – West Basin	$2.16 x 10^{-02}$	$8.49 x 10^{-03}$	$2.16 x 10^{-02}$	$8.49 x 10^{-03}$	$2.19 x 10^{-02}$	$8.54 x 10^{-03}$
		Patterson Lake South Arm	$8.47 x 10^{-03}$	$6.33 x 10^{-03}$	$8.47 x 10^{-03}$	$6.33 x 10^{-03}$	$8.99 x 10^{-03}$	$6.42 x 10^{-03}$
		Beet Lake	$7.40 x 10^{-03}$	$6.16 x 10^{-03}$	$7.40 x 10^{-03}$	$6.16 x 10^{-03}$	$7.59 x 10^{-03}$	$6.19 x 10^{-03}$
		Lloyd Lake	$5.96 x 10^{-03}$	$5.92 x 10^{-03}$	$5.96 x 10^{-03}$	$5.92 x 10^{-03}$	$5.99 x 10^{-03}$	$5.93 x 10^{-03}$

	Biota	Location	Maximum Total Dose (mGy/d)					
			Application Case		Upper Bound Scenario		RFD Case	
			Operations	Far-Future	Operations	Far-Future	Operations	Far-Future
Terrestrial Animals	Beaver	Reference (Broach Lake)	8.77×10^{-04}	8.77×10^{-04}	8.77×10^{-04}	8.77×10^{-04}	8.77×10^{-04}	8.77×10^{-04}
		Patterson Lake North Arm – West Basin	2.59×10^{-03}	1.17×10^{-03}	2.70×10^{-03}	1.17×10^{-03}	2.62×10^{-03}	1.17×10^{-03}
		Patterson Lake South Arm	1.16×10^{-03}	9.27×10^{-04}	1.17×10^{-03}	9.27×10^{-04}	1.27×10^{-03}	9.36×10^{-04}
		Beet Lake	1.04×10^{-03}	9.05×10^{-04}	1.04×10^{-03}	9.05×10^{-04}	1.07×10^{-03}	9.08×10^{-04}
		Lloyd Lake	8.83×10^{-04}	8.78×10^{-04}	8.83×10^{-04}	8.78×10^{-04}	8.87×10^{-04}	8.79×10^{-04}
	Black Bear	Reference (Broach Lake)	1.01×10^{-03}	1.01×10^{-03}	1.01×10^{-03}	1.01×10^{-03}	1.01×10^{-03}	1.01×10^{-03}
		Patterson Lake North Arm – West Basin	1.64×10^{-03}	1.21×10^{-03}	1.70×10^{-03}	1.21×10^{-03}	1.68×10^{-03}	1.22×10^{-03}
		Beet Lake	1.30×10^{-03}	1.26×10^{-03}	1.30×10^{-03}	1.26×10^{-03}	1.31×10^{-03}	1.26×10^{-03}
		Lloyd Lake	1.02×10^{-03}	1.02×10^{-03}	1.02×10^{-03}	1.02×10^{-03}	1.02×10^{-03}	1.02×10^{-03}
	Grey Wolf	Reference (Broach Lake)	1.09×10^{-03}	1.09×10^{-03}	1.09×10^{-03}	1.09×10^{-03}	1.09×10^{-03}	1.09×10^{-03}
		Patterson Lake North Arm – West Basin	1.28×10^{-03}	1.18×10^{-03}	1.29×10^{-03}	1.18×10^{-03}	1.29×10^{-03}	1.18×10^{-03}
		Lloyd Lake	1.10×10^{-03}	1.09×10^{-03}	1.10×10^{-03}	1.09×10^{-03}	1.10×10^{-03}	1.09×10^{-03}
	American Mink	Reference (Broach Lake)	9.40×10^{-04}	9.40×10^{-04}	9.40×10^{-04}	9.40×10^{-04}	9.40×10^{-04}	9.40×10^{-04}
		Patterson Lake North Arm – West Basin	1.32×10^{-03}	1.01×10^{-03}	2.51×10^{-03}	1.01×10^{-03}	1.32×10^{-03}	1.01×10^{-03}
		Patterson Lake South Arm	9.80×10^{-04}	9.51×10^{-04}	1.06×10^{-03}	9.51×10^{-04}	1.17×10^{-03}	9.51×10^{-04}
		Beet Lake	9.52×10^{-04}	9.44×10^{-04}	9.63×10^{-04}	9.44×10^{-04}	9.82×10^{-04}	9.44×10^{-04}
		Lloyd Lake	9.41×10^{-04}	9.40×10^{-04}	9.42×10^{-04}	9.40×10^{-04}	9.43×10^{-04}	9.40×10^{-04}
	Moose	Reference (Broach Lake)	1.25×10^{-03}	1.25×10^{-03}	1.25×10^{-03}	1.25×10^{-03}	1.25×10^{-03}	1.25×10^{-03}
		Patterson Lake North Arm – West Basin	3.09×10^{-03}	1.69×10^{-03}	3.33×10^{-03}	1.69×10^{-03}	3.12×10^{-03}	1.70×10^{-03}
		Patterson Lake South Arm	2.87×10^{-03}	1.55×10^{-03}	3.11×10^{-03}	1.55×10^{-03}	2.90×10^{-03}	1.56×10^{-03}
		Beet Lake	1.43×10^{-03}	1.30×10^{-03}	1.43×10^{-03}	1.30×10^{-03}	1.48×10^{-03}	1.30×10^{-03}
		Lloyd Lake	1.26×10^{-03}	1.26×10^{-03}	1.26×10^{-03}	1.26×10^{-03}	1.27×10^{-03}	1.26×10^{-03}
	Muskrat	Reference (Broach Lake)	2.00×10^{-03}	2.00×10^{-03}	2.00×10^{-03}	2.00×10^{-03}	2.00×10^{-03}	2.00×10^{-03}
		Patterson Lake North Arm – West Basin	2.84×10^{-03}	2.18×10^{-03}	5.33×10^{-03}	2.18×10^{-03}	2.84×10^{-03}	2.18×10^{-03}
		Patterson Lake South Arm	2.11×10^{-03}	2.04×10^{-03}	2.28×10^{-03}	2.04×10^{-03}	2.55×10^{-03}	2.04×10^{-03}
		Beet Lake	2.04×10^{-03}	2.01×10^{-03}	2.06×10^{-03}	2.01×10^{-03}	2.12×10^{-03}	2.01×10^{-03}
		Lloyd Lake	2.00×10^{-03}	2.00×10^{-03}	2.00×10^{-03}	2.00×10^{-03}	2.01×10^{-03}	2.00×10^{-03}
	Red Fox	Reference (Broach Lake)	7.28×10^{-04}	7.28×10^{-04}	7.28×10^{-04}	7.28×10^{-04}	7.28×10^{-04}	7.28×10^{-04}
		Patterson Lake North Arm – West Basin	1.34×10^{-03}	1.04×10^{-03}	1.34×10^{-03}	1.04×10^{-03}	1.36×10^{-03}	1.05×10^{-03}
		Patterson Lake South Arm	8.28×10^{-04}	7.79×10^{-04}	8.28×10^{-04}	7.79×10^{-04}	8.49×10^{-04}	7.89×10^{-04}
		Beet Lake	7.86×10^{-04}	7.57×10^{-04}	7.86×10^{-04}	7.57×10^{-04}	7.94×10^{-04}	7.61×10^{-04}
		Lloyd Lake	7.30×10^{-04}	7.29×10^{-04}	7.30×10^{-04}	7.29×10^{-04}	7.31×10^{-04}	7.29×10^{-04}
	Snowshoe Hare	Reference (Broach Lake)	1.44×10^{-03}	1.44×10^{-03}	1.44×10^{-03}	1.44×10^{-03}	1.44×10^{-03}	1.44×10^{-03}
		Patterson Lake North Arm – West Basin	3.41×10^{-03}	2.00×10^{-03}	3.41×10^{-03}	2.00×10^{-03}	3.45×10^{-03}	2.01×10^{-03}
		Patterson Lake South Arm	1.76×10^{-03}	1.53×10^{-03}	1.76×10^{-03}	1.53×10^{-03}	1.82×10^{-03}	1.55×10^{-03}
		Beet Lake	1.62×10^{-03}	1.49×10^{-03}	1.62×10^{-03}	1.49×10^{-03}	1.65×10^{-03}	1.50×10^{-03}
		Lloyd Lake	1.44×10^{-03}	1.44×10^{-03}	1.44×10^{-03}	1.44×10^{-03}	1.45×10^{-03}	1.44×10^{-03}
		Reference (Broach Lake)	9.64×10^{-04}	9.64×10^{-04}	9.64×10^{-04}	9.64×10^{-04}	9.64×10^{-04}	9.64×10^{-04}

	Biota	Location	Maximum Total Dose (mGy/d)					
			Application Case		Upper Bound Scenario		RFD Case	
			Operations	Far-Future	Operations	Far-Future	Operations	Far-Future
	Southern Red-Backed Vole	Patterson Lake North Arm – West Basin	1.91×10^{-03}	1.36×10^{-03}	1.91×10^{-03}	1.36×10^{-03}	1.93×10^{-03}	1.37×10^{-03}
		Patterson Lake South Arm	1.12×10^{-03}	1.03×10^{-03}	1.12×10^{-03}	1.03×10^{-03}	1.15×10^{-03}	1.04×10^{-03}
		Beet Lake	1.05×10^{-03}	1.00×10^{-03}	1.05×10^{-03}	1.00×10^{-03}	1.07×10^{-03}	1.01×10^{-03}
		Lloyd Lake	9.67×10^{-04}	9.65×10^{-04}	9.67×10^{-04}	9.65×10^{-04}	9.69×10^{-04}	9.66×10^{-04}
	Woodland Caribou	Reference (Broach Lake)	4.28×10^{-03}	4.28×10^{-03}	4.28×10^{-03}	4.28×10^{-03}	4.28×10^{-03}	4.28×10^{-03}
		Patterson Lake North Arm – West Basin	7.69×10^{-03}	4.47×10^{-03}	7.88×10^{-03}	4.47×10^{-03}	7.89×10^{-03}	4.48×10^{-03}
		Beet Lake	4.59×10^{-03}	4.31×10^{-03}	4.60×10^{-03}	4.31×10^{-03}	4.65×10^{-03}	4.32×10^{-03}
		Lloyd Lake	4.31×10^{-03}	4.29×10^{-03}	4.31×10^{-03}	4.29×10^{-03}	4.32×10^{-03}	4.29×10^{-03}
	Grouse	Reference (Broach Lake)	2.23×10^{-03}	2.23×10^{-03}	2.23×10^{-03}	2.23×10^{-03}	2.23×10^{-03}	2.23×10^{-03}
		Patterson Lake North Arm – West Basin	7.15×10^{-03}	2.75×10^{-03}	7.15×10^{-03}	2.75×10^{-03}	7.24×10^{-03}	2.76×10^{-03}
		Patterson Lake South Arm	3.03×10^{-03}	2.31×10^{-03}	3.03×10^{-03}	2.31×10^{-03}	3.19×10^{-03}	2.33×10^{-03}
		Beet Lake	2.69×10^{-03}	2.28×10^{-03}	2.69×10^{-03}	2.28×10^{-03}	2.75×10^{-03}	2.28×10^{-03}
		Lloyd Lake	2.24×10^{-03}	2.23×10^{-03}	2.24×10^{-03}	2.23×10^{-03}	2.25×10^{-03}	2.23×10^{-03}
	Canada goose	Reference (Broach Lake)	8.70×10^{-04}	8.70×10^{-04}	8.70×10^{-04}	8.70×10^{-04}	8.70×10^{-04}	8.70×10^{-04}
		Patterson Lake North Arm – West Basin	1.95×10^{-03}	1.19×10^{-03}	1.95×10^{-03}	1.19×10^{-03}	1.97×10^{-03}	1.19×10^{-03}
		Patterson Lake South Arm	1.05×10^{-03}	9.22×10^{-04}	1.05×10^{-03}	9.22×10^{-04}	1.08×10^{-03}	9.32×10^{-04}
		Beet Lake	9.73×10^{-04}	9.00×10^{-04}	9.73×10^{-04}	9.00×10^{-04}	9.86×10^{-04}	9.04×10^{-04}
		Lloyd Lake	8.73×10^{-04}	8.71×10^{-04}	8.73×10^{-04}	8.71×10^{-04}	8.75×10^{-04}	8.71×10^{-04}
	Little brown myotis	Reference (Broach Lake)	3.24×10^{-03}	3.23×10^{-03}	3.24×10^{-03}	3.23×10^{-03}	3.24×10^{-03}	3.23×10^{-03}
		Patterson Lake North Arm – West Basin	4.51×10^{-03}	3.43×10^{-03}	8.76×10^{-03}	3.43×10^{-03}	4.51×10^{-03}	3.43×10^{-03}
		Patterson Lake South Arm	3.37×10^{-03}	3.26×10^{-03}	3.66×10^{-03}	3.26×10^{-03}	4.02×10^{-03}	3.26×10^{-03}
		Beet Lake	3.27×10^{-03}	3.24×10^{-03}	3.31×10^{-03}	3.24×10^{-03}	3.38×10^{-03}	3.24×10^{-03}
		Lloyd Lake	3.24×10^{-03}	3.24×10^{-03}	3.24×10^{-03}	3.24×10^{-03}	3.24×10^{-03}	3.24×10^{-03}
	Common loon	Reference (Broach Lake)	2.98×10^{-03}	2.98×10^{-03}	2.98×10^{-03}	2.98×10^{-03}	2.98×10^{-03}	2.98×10^{-03}
		Patterson Lake North Arm – West Basin	4.14×10^{-03}	3.21×10^{-03}	8.45×10^{-03}	3.21×10^{-03}	4.14×10^{-03}	3.21×10^{-03}
		Patterson Lake South Arm	3.07×10^{-03}	3.02×10^{-03}	3.36×10^{-03}	3.02×10^{-03}	3.78×10^{-03}	3.02×10^{-03}
		Beet Lake	3.00×10^{-03}	2.99×10^{-03}	3.04×10^{-03}	2.99×10^{-03}	3.10×10^{-03}	2.99×10^{-03}
		Lloyd Lake	2.98×10^{-03}	2.98×10^{-03}	2.98×10^{-03}	2.98×10^{-03}	2.99×10^{-03}	2.98×10^{-03}
	Mallard	Reference (Broach Lake)	2.56×10^{-02}	2.56×10^{-02}	2.56×10^{-02}	2.56×10^{-02}	2.56×10^{-02}	2.56×10^{-02}
		Patterson Lake North Arm – West Basin	3.53×10^{-02}	2.77×10^{-02}	7.10×10^{-02}	2.77×10^{-02}	3.53×10^{-02}	2.77×10^{-02}
		Patterson Lake South Arm	2.63×10^{-02}	2.59×10^{-02}	2.88×10^{-02}	2.59×10^{-02}	3.16×10^{-02}	2.59×10^{-02}
		Beet Lake	2.57×10^{-02}	2.57×10^{-02}	2.61×10^{-02}	2.57×10^{-02}	2.65×10^{-02}	2.57×10^{-02}
		Lloyd Lake	2.56×10^{-02}	2.56×10^{-02}	2.56×10^{-02}	2.56×10^{-02}	2.56×10^{-02}	2.56×10^{-02}
	Rusty blackbird	Reference (Broach Lake)	7.07×10^{-02}	7.07×10^{-02}	7.07×10^{-02}	7.07×10^{-02}	7.07×10^{-02}	7.07×10^{-02}
		Patterson Lake North Arm – West Basin	9.85×10^{-02}	7.52×10^{-02}	1.94×10^{-01}	7.52×10^{-02}	9.85×10^{-02}	7.52×10^{-02}
		Patterson Lake South Arm	7.29×10^{-02}	7.12×10^{-02}	7.93×10^{-02}	7.12×10^{-02}	8.69×10^{-02}	7.12×10^{-02}
		Beet Lake	7.12×10^{-02}	7.09×10^{-02}	7.21×10^{-02}	7.09×10^{-02}	7.33×10^{-02}	7.09×10^{-02}
		Lloyd Lake	7.07×10^{-02}	7.07×10^{-02}	7.08×10^{-02}	7.07×10^{-02}	7.09×10^{-02}	7.07×10^{-02}

	Biota	Location	Maximum Total Dose (mGy/d)					
			Application Case		Upper Bound Scenario		RFD Case	
			Operations	Far-Future	Operations	Far-Future	Operations	Far-Future
Terrestrial Plants	Blueberries	Patterson Lake North Arm – West Basin	1.31×10^{-02}	6.80×10^{-03}	1.31×10^{-02}	6.80×10^{-03}	1.32×10^{-02}	6.83×10^{-03}
		Patterson Lake South Arm	6.20×10^{-03}	5.17×10^{-03}	6.20×10^{-03}	5.17×10^{-03}	6.47×10^{-03}	5.23×10^{-03}
	Browse	Patterson Lake North Arm – West Basin	3.18×10^{-02}	1.41×10^{-02}	3.18×10^{-02}	1.41×10^{-02}	3.22×10^{-02}	1.42×10^{-02}
		Patterson Lake South Arm	1.36×10^{-02}	1.08×10^{-02}	1.36×10^{-02}	1.08×10^{-02}	1.44×10^{-02}	1.09×10^{-02}
	Labrador tea	Patterson Lake North Arm – West Basin	1.30×10^{-01}	1.41×10^{-02}	1.30×10^{-01}	1.41×10^{-02}	1.32×10^{-01}	1.42×10^{-02}
		Patterson Lake South Arm	2.97×10^{-02}	1.08×10^{-02}	2.97×10^{-02}	1.08×10^{-02}	3.37×10^{-02}	1.09×10^{-02}
	Lichen	Patterson Lake North Arm – West Basin	6.79×10^{-01}	1.12×10^{-01}	6.79×10^{-01}	1.12×10^{-01}	6.90×10^{-01}	1.12×10^{-01}
		Patterson Lake South Arm	2.05×10^{-01}	1.12×10^{-01}	2.05×10^{-01}	1.12×10^{-01}	2.23×10^{-01}	1.12×10^{-01}

RFD = reasonably foreseeable development; mGy/d = milligrays per day.

6.2.5.2 Estimated Dose to Ecological Receptors – Reasonably Foreseeable Development Case

6.2.5.2.1 Non-radiological Dose

Non-radiological dose was only calculated for birds and mammals, as effects to aquatic animals (fish and invertebrates), plants, and soil invertebrates were assessed based on concentrations rather than doses.

The estimated non-radiological doses to the selected birds and mammals during the Project phases and the far-future projection resulting from the RFD Case are shown by COPC in Table 6-13. The doses shown represent the maximum dose by COPC over the assessment period.

The estimated non-radiological doses to the selected birds and mammals in the RFD Case include doses from the release of COPCs from the Fission Patterson Lake South Property. Overall, the estimated non-radiological doses from the RFD Case were similar to the results in the Application Case. Non-radiological doses for arsenic and uranium were higher in the RFD Case than in the Application Case for some terrestrial receptors. For example, during Operations for the RFD Case, the arsenic doses to the beaver, black bear, little brown myotis, common loon, mallard, American mink, muskrat, and rusty blackbird were noticeably higher in the RFD Case at Patterson Lake South Arm (Table 6-13) than in the Application Case (Table 6-10). Similarly, the uranium doses to the little brown myotis, common loon, mallard, American mink, and muskrat were noticeably higher in the RFD Case at Patterson Lake South Arm than in the Application Case. The increase in dose for arsenic and uranium to many of the riparian mammals and birds in the RFD Case is due to the expected release of effluent to Patterson Lake South Arm from the Fission Patterson Lake South Property.

The predicted dose to mammals and birds during the far-future projection in the RFD Case was similar to the that of the far-future projection in the Application Case; this is because the source term for the far-future projection is similar between the Application Case and the RFD Case.

Table 6-13: Estimated Non-radiological Doses to Ecological Receptors – Reasonably Foreseeable Development Case

	Biota	Location	Maximum Dose RFD Case (mg/kg/d)									
			Project Lifespan					Far-Future				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
Terrestrial Animals	Beaver	Reference (Broach Lake)	3.48×10^{-03}	3.94×10^{-03}	3.15×10^{-02}	1.17×10^{-03}	3.20×10^{-03}	3.48×10^{-03}	3.94×10^{-03}	3.15×10^{-02}	1.17×10^{-03}	3.20×10^{-03}
		Patterson Lake North Arm - West Basin	6.50×10^{-03}	4.57×10^{-03}	3.32×10^{-02}	1.51×10^{-03}	2.51×10^{-02}	3.57×10^{-03}	6.75×10^{-03}	3.76×10^{-02}	3.39×10^{-03}	7.10×10^{-03}
		Patterson Lake South Arm	6.64×10^{-03}	4.60×10^{-03}	3.23×10^{-02}	1.33×10^{-03}	7.28×10^{-03}	3.49×10^{-03}	5.64×10^{-03}	3.50×10^{-02}	2.46×10^{-03}	4.13×10^{-03}
		Beet Lake	4.03×10^{-03}	4.24×10^{-03}	3.19×10^{-02}	1.26×10^{-03}	5.34×10^{-03}	3.49×10^{-03}	4.84×10^{-03}	3.33×10^{-02}	1.84×10^{-03}	3.58×10^{-03}
		Lloyd Lake	3.53×10^{-03}	3.98×10^{-03}	3.16×10^{-02}	1.19×10^{-03}	3.24×10^{-03}	3.48×10^{-03}	4.03×10^{-03}	3.17×10^{-02}	1.24×10^{-03}	3.22×10^{-03}
	Black Bear	Reference (Broach Lake)	2.81×10^{-03}	1.17×10^{-03}	2.86×10^{-02}	3.75×10^{-04}	1.02×10^{-03}	2.81×10^{-03}	1.17×10^{-03}	2.86×10^{-02}	3.75×10^{-04}	1.02×10^{-03}
		Patterson Lake North Arm - West Basin	9.39×10^{-03}	1.31×10^{-03}	3.19×10^{-02}	4.23×10^{-04}	4.15×10^{-03}	2.87×10^{-03}	1.63×10^{-03}	5.39×10^{-02}	6.09×10^{-04}	1.80×10^{-03}
		Beet Lake	3.79×10^{-03}	1.43×10^{-03}	2.98×10^{-02}	4.59×10^{-04}	1.49×10^{-03}	3.09×10^{-03}	1.49×10^{-03}	3.39×10^{-02}	4.95×10^{-04}	1.21×10^{-03}
		Lloyd Lake	2.91×10^{-03}	1.21×10^{-03}	2.88×10^{-02}	3.91×10^{-04}	1.04×10^{-03}	2.82×10^{-03}	1.22×10^{-03}	2.97×10^{-02}	3.97×10^{-04}	1.03×10^{-03}
	Grey Wolf	Reference (Broach Lake)	7.50×10^{-03}	6.01×10^{-04}	3.31×10^{-02}	2.88×10^{-04}	3.73×10^{-04}	7.50×10^{-03}	6.01×10^{-04}	3.31×10^{-02}	2.88×10^{-04}	3.73×10^{-04}
		Patterson Lake North Arm - West Basin	9.02×10^{-03}	6.13×10^{-04}	3.37×10^{-02}	3.18×10^{-04}	1.22×10^{-03}	7.53×10^{-03}	6.45×10^{-04}	3.43×10^{-02}	4.47×10^{-04}	4.54×10^{-04}
		Lloyd Lake	7.66×10^{-03}	6.07×10^{-04}	3.32×10^{-02}	2.96×10^{-04}	3.78×10^{-04}	7.50×10^{-03}	6.06×10^{-04}	3.32×10^{-02}	3.03×10^{-04}	3.75×10^{-04}
	Mink	Reference (Broach Lake)	1.15×10^{-02}	4.61×10^{-03}	2.28×10^{-01}	1.15×10^{-03}	1.08×10^{-03}	1.15×10^{-02}	4.61×10^{-03}	2.28×10^{-01}	1.15×10^{-03}	1.08×10^{-03}
		Patterson Lake North Arm - West Basin	3.46×10^{-02}	5.83×10^{-03}	2.66×10^{-01}	2.80×10^{-03}	4.17×10^{-03}	1.22×10^{-02}	1.06×10^{-02}	5.90×10^{-01}	2.20×10^{-02}	8.39×10^{-03}
		Patterson Lake South Arm	3.14×10^{-02}	5.52×10^{-03}	2.56×10^{-01}	2.27×10^{-03}	2.56×10^{-03}	1.16×10^{-02}	8.23×10^{-03}	4.41×10^{-01}	1.33×10^{-02}	3.09×10^{-03}
		Beet Lake	1.49×10^{-02}	5.09×10^{-03}	2.43×10^{-01}	1.73×10^{-03}	1.64×10^{-03}	1.15×10^{-02}	6.53×10^{-03}	3.39×10^{-01}	7.46×10^{-03}	1.83×10^{-03}
		Lloyd Lake	1.17×10^{-02}	4.66×10^{-03}	2.30×10^{-01}	1.21×10^{-03}	1.13×10^{-03}	1.15×10^{-02}	4.81×10^{-03}	2.40×10^{-01}	1.79×10^{-03}	1.15×10^{-03}
	Moose	Reference (Broach Lake)	2.35×10^{-03}	2.83×10^{-03}	1.61×10^{-02}	5.80×10^{-04}	1.59×10^{-03}	2.35×10^{-03}	2.83×10^{-03}	1.61×10^{-02}	5.80×10^{-04}	1.59×10^{-03}
		Patterson Lake North Arm - West Basin	5.45×10^{-03}	3.45×10^{-03}	1.73×10^{-02}	8.29×10^{-04}	1.18×10^{-02}	2.44×10^{-03}	5.62×10^{-03}	2.22×10^{-02}	2.78×10^{-03}	4.83×10^{-03}
		Patterson Lake South Arm	5.42×10^{-03}	3.41×10^{-03}	1.72×10^{-02}	7.95×10^{-04}	1.15×10^{-02}	2.43×10^{-03}	5.55×10^{-03}	2.20×10^{-02}	2.53×10^{-03}	4.75×10^{-03}
		Beet Lake	2.90×10^{-03}	3.12×10^{-03}	1.65×10^{-02}	6.54×10^{-04}	2.68×10^{-03}	2.36×10^{-03}	3.73×10^{-03}	1.80×10^{-02}	1.24×10^{-03}	1.92×10^{-03}
		Lloyd Lake	2.39×10^{-03}	2.86×10^{-03}	1.62×10^{-02}	5.92×10^{-04}	1.62×10^{-03}	2.35×10^{-03}	2.92×10^{-03}	1.63×10^{-02}	6.48×10^{-04}	1.62×10^{-03}
	Muskrat	Reference (Broach Lake)	2.86×10^{-02}	1.60×10^{-02}	4.08×10^{-01}	3.65×10^{-03}	5.51×10^{-03}	2.86×10^{-02}	1.60×10^{-02}	4.08×10^{-01}	3.65×10^{-03}	5.51×10^{-03}
		Patterson Lake North Arm - West Basin	8.77×10^{-02}	2.08×10^{-02}	4.74×10^{-01}	9.77×10^{-03}	1.82×10^{-02}	3.03×10^{-02}	3.91×10^{-02}	$1.05 \times 10^{+00}$	8.14×10^{-02}	5.51×10^{-02}
		Patterson Lake South Arm	6.98×10^{-02}	2.01×10^{-02}	4.58×10^{-01}	7.84×10^{-03}	1.37×10^{-02}	2.87×10^{-02}	3.00×10^{-02}	7.87×10^{-01}	4.88×10^{-02}	1.92×10^{-02}
		Beet Lake	3.56×10^{-02}	1.80×10^{-02}	4.33×10^{-01}	5.82×10^{-03}	8.49×10^{-03}	2.86×10^{-02}	2.34×10^{-02}	6.06×10^{-01}	2.71×10^{-02}	1.06×10^{-02}
		Lloyd Lake	2.90×10^{-02}	1.62×10^{-02}	4.10×10^{-01}	3.87×10^{-03}	5.78×10^{-03}	2.86×10^{-02}	1.67×10^{-02}	4.28×10^{-01}	6.04×10^{-03}	5.97×10^{-03}
	Red Fox	Reference (Broach Lake)	1.27×10^{-03}	4.90×10^{-04}	6.99×10^{-03}	3.17×10^{-04}	3.72×10^{-04}	1.27×10^{-03}	4.90×10^{-04}	6.99×10^{-03}	3.17×10^{-04}	3.72×10^{-04}
		Patterson Lake North Arm - West Basin	1.31×10^{-03}	5.09×10^{-04}	7.26×10^{-03}	3.80×10^{-04}	3.48×10^{-03}	1.27×10^{-03}	5.64×10^{-04}	7.12×10^{-03}	6.94×10^{-04}	6.13×10^{-04}
		Patterson Lake South Arm	1.33×10^{-03}	5.10×10^{-04}	7.02×10^{-03}	3.51×10^{-04}	9.02×10^{-04}	1.27×10^{-03}	5.35×10^{-04}	7.06×10^{-03}	5.36×10^{-04}	4.20×10^{-04}
		Beet Lake	1.29×10^{-03}	5.00×10^{-04}	7.01×10^{-03}	3.34×10^{-04}	6.60×10^{-04}	1.27×10^{-03}	5.14×10^{-04}	7.02×10^{-03}	4.31×10^{-04}	3.94×10^{-04}
		Lloyd Lake	1.28×10^{-03}	4.93×10^{-04}	7.00×10^{-03}	3.21×10^{-04}	3.76×10^{-04}	1.27×10^{-03}	4.93×10^{-04}	6.99×10^{-03}	3.29×10^{-04}	3.73×10^{-04}
	Snowshoe Hare	Reference (Broach Lake)	4.30×10^{-03}	3.98×10^{-03}	4.82×10^{-02}	2.01×10^{-03}	5.27×10^{-03}	4.30×10^{-03}	3.98×10^{-03}	4.82×10^{-02}	2.01×10^{-03}	5.27×10^{-03}
		Patterson Lake North Arm - West Basin	4.34×10^{-03}	4.02×10^{-03}	5.00×10^{-02}	2.31×10^{-03}	4.26×10^{-02}	4.30×10^{-03}	4.06×10^{-03}	4.85×10^{-02}	2.43×10^{-03}	7.73×10^{-03}
		Patterson Lake South Arm	4.37×10^{-03}	4.02×10^{-03}	4.84×10^{-02}	2.07×10^{-03}	1.13×10^{-02}	4.30×10^{-03}	4.03×10^{-03}	4.83×10^{-02}	2.25×10^{-03}	5.67×10^{-03}
		Beet Lake	4.32×10^{-03}	4.01×10^{-03}	4.83×10^{-02}	2.05×10^{-03}	8.62×10^{-03}	4.30×10^{-03}	4.01×10^{-03}	4.83×10^{-02}	2.14×10^{-03}	5.49×10^{-03}
		Lloyd Lake	4.31×10^{-03}	4.01×10^{-03}	4.83×10^{-02}	2.04×10^{-03}	5.31×10^{-03}	4.30×10^{-03}	3.99×10^{-03}	4.82×10^{-02}	2.03×10^{-03}	5.28×10^{-03}
	Southern Red-Backed Vole	Reference (Broach Lake)	3.10×10^{-03}	2.94×10^{-03}	3.66×10^{-02}	1.50×10^{-03}	3.95×10^{-03}	3.10×10^{-03}	2.94×10^{-03}	3.66×10^{-02}	1.50×10^{-03}	3.95×10^{-03}
		Patterson Lake North Arm - West Basin	3.16×10^{-03}	2.98×10^{-03}	3.79×10^{-02}	1.74×10^{-03}	3.08×10^{-02}	3.10×10^{-03}	3.06×10^{-03}	3.69×10^{-02}	2.12×10^{-03}	5.84×10^{-03}
		Patterson Lake South Arm	3.19×10^{-03}	2.98×10^{-03}	3.67×10^{-02}	1.57×10^{-03}	8.29×10^{-03}	3.10×10^{-03}	3.01×10^{-03}	3.67×10^{-02}	1.86×10^{-03}	4.26×10^{-03}
		Beet Lake	3.13×10^{-03}	2.97×10^{-03}	3.67×10^{-02}	1.54×10^{-03}	6.36×10^{-03}	3.10×10^{-03}	2.98×10^{-03}	3.67×10^{-02}	1.69×10^{-03}	4.12×10^{-03}
		Lloyd Lake	3.11×10^{-03}	2.96×10^{-03}	3.67×10^{-02}	1.52×10^{-03}	3.98×10^{-03}	3.10×10^{-03}	2.95×10^{-03}	3.66×10^{-02}	1.52×10^{-03}	3.95×10^{-03}
	WoodLand Caribou	Reference (Broach Lake)	5.46×10^{-03}	3.94×10^{-03}	1.78×10^{-02}	1.24×10^{-03}	1.77×10^{-03}	5.46×10^{-03}	3.94×10^{-03}	1.78×10^{-02}	1.24×10^{-03}	1.77×10^{-03}
		Patterson Lake North Arm - West Basin	1.16×10^{-02}	4.71×10^{-03}	1.97×10^{-02}	2.42×10^{-03}	7.32×10^{-02}	5.57×10^{-03}	6.64×10^{-03}	2.34×10^{-02}	5.54×10^{-03}	6.08×10^{-03}
		Beet Lake	6.06×10^{-03}	4.18×10^{-03}	1.81×10^{-02}	1.39×10^{-03}	7.78×10^{-03}	5.46×10^{-03}	4.49×10^{-03}	1.89×10^{-02}	2.07×10^{-03}	2.13×10^{-03}
		Lloyd Lake	5.66×10^{-03}	4.11×10^{-03}	1.80×10^{-02}	1.39×10^{-03}	1.95×10^{-03}	5.46×10^{-03}	4.06×10^{-03}	1.80×10^{-02}	1.41×10^{-03}	1.83×10^{-03}
	Grouse	Reference (Broach Lake)	6.44×10^{-03}	5.57×10^{-03}	5.26×10^{-02}	2.57×10^{-03}	6.34×10^{-03}	6.44×10^{-03}	5.57×10^{-03}	5.26×10^{-02}	2.57×10^{-03}	6.34×10^{-03}
		Patterson Lake North Arm - West Basin	6.48×10^{-03}	5.62×10^{-03}	5.45×10^{-02}	2.89×10^{-03}	4.85×10^{-02}	6.44×10^{-03}	5.64×10^{-03}	5.28×10^{-02}	2.88×10^{-03}	9.26×10^{-03}
		Patterson Lake South Arm	6.49×10^{-03}	5.62×10^{-03}	5.27×10^{-02}	2.62×10^{-03}	1.31×10^{-02}	6.44×10^{-03}	5.62×10^{-03}	5.27×10^{-02}	2.75×10^{-03}	6.82×10^{-03}
		Beet Lake	6.46×10^{-03}	5.61×10^{-03}	5.27×10^{-02}	2.61×10^{-03}	1.01×10^{-02}	6.44×10^{-03}	5.60×10^{-03}	5.26×10^{-02}	2.67×10^{-03}	6.60×10^{-03}
		Lloyd Lake	6.45×10^{-03}	5.61×10^{-03}	5.27×10^{-02}	2.60×10^{-03}	6.39×10^{-03}	6.44×10^{-03}	5.59×10^{-03}	5.26×10^{-02}	2.58×10^{-03}	6.35×10^{-03}
	Canada Goose	Reference (Broach Lake)	6.19×10^{-04}	5.56×10^{-04}	5.30×10^{-03}	2.58×10^{-04}	6.29×10^{-04}	6.19×10^{-04}	5.56×10^{-04}	5.30×10^{-03}	2.58×10^{-04}	6.29×10^{-04}
		Patterson Lake North Arm - West Basin	6.33×10^{-04}	5.66×10^{-04}	5.50×10^{-03}	3.03×10^{-04}	4.91×10^{-03}	6.19×10^{-04}	5.89×10^{-04}	5.36×10^{-03}	4.27×10^{-04}	9.45×10^{-04}

	Biota	Location	Maximum Dose RFD Case (mg/kg/d)									
			Project Lifespan					Far-Future				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
		Patterson Lake South Arm	6.43×10^{-04}	5.66×10^{-04}	5.32×10^{-03}	2.74×10^{-04}	1.33×10^{-03}	6.19×10^{-04}	5.76×10^{-04}	5.33×10^{-03}	3.56×10^{-04}	6.83×10^{-04}
		Beet Lake	6.25×10^{-04}	5.62×10^{-04}	5.31×10^{-03}	2.67×10^{-04}	1.02×10^{-03}	6.19×10^{-04}	5.67×10^{-04}	5.32×10^{-03}	3.09×10^{-04}	6.58×10^{-04}
		Lloyd Lake	6.21×10^{-04}	5.59×10^{-04}	5.31×10^{-03}	2.61×10^{-04}	6.34×10^{-04}	6.19×10^{-04}	5.58×10^{-04}	5.30×10^{-03}	2.63×10^{-04}	6.29×10^{-04}
	Little Brown Myotis	Reference (Broach Lake)	2.77×10^{-02}	5.73×10^{-02}	$3.22 \times 10^{+00}$	1.64×10^{-02}	4.77×10^{-03}	2.77×10^{-02}	5.73×10^{-02}	$3.22 \times 10^{+00}$	1.64×10^{-02}	4.77×10^{-03}
		Patterson Lake North Arm - West Basin	8.44×10^{-02}	7.41×10^{-02}	$3.74 \times 10^{+00}$	4.38×10^{-02}	1.57×10^{-02}	2.93×10^{-02}	1.40×10^{-01}	$8.33 \times 10^{+00}$	3.66×10^{-01}	4.78×10^{-02}
		Patterson Lake South Arm	6.35×10^{-02}	6.97×10^{-02}	$3.61 \times 10^{+00}$	3.50×10^{-02}	1.11×10^{-02}	2.78×10^{-02}	1.08×10^{-01}	$6.22 \times 10^{+00}$	2.19×10^{-01}	1.67×10^{-02}
		Beet Lake	3.38×10^{-02}	6.39×10^{-02}	$3.42 \times 10^{+00}$	2.61×10^{-02}	7.10×10^{-03}	2.77×10^{-02}	8.39×10^{-02}	$4.79 \times 10^{+00}$	1.22×10^{-01}	9.19×10^{-03}
		Lloyd Lake	2.80×10^{-02}	5.79×10^{-02}	$3.24 \times 10^{+00}$	1.74×10^{-02}	4.99×10^{-03}	2.77×10^{-02}	6.00×10^{-02}	$3.38 \times 10^{+00}$	2.72×10^{-02}	5.17×10^{-03}
	Loon	Reference (Broach Lake)	4.71×10^{-03}	2.18×10^{-03}	1.25×10^{-01}	4.10×10^{-04}	3.38×10^{-04}	4.71×10^{-03}	2.18×10^{-03}	1.25×10^{-01}	4.10×10^{-04}	3.38×10^{-04}
		Patterson Lake North Arm - West Basin	1.63×10^{-02}	2.84×10^{-03}	1.46×10^{-01}	1.10×10^{-03}	1.22×10^{-03}	5.00×10^{-03}	5.34×10^{-03}	3.22×10^{-01}	9.15×10^{-03}	3.38×10^{-03}
		Patterson Lake South Arm	2.41×10^{-02}	2.66×10^{-03}	1.40×10^{-01}	8.78×10^{-04}	1.41×10^{-03}	4.74×10^{-03}	4.09×10^{-03}	2.41×10^{-01}	5.48×10^{-03}	1.18×10^{-03}
		Beet Lake	8.01×10^{-03}	2.43×10^{-03}	1.33×10^{-01}	6.53×10^{-04}	7.06×10^{-04}	4.72×10^{-03}	3.19×10^{-03}	1.85×10^{-01}	3.05×10^{-03}	6.51×10^{-04}
		Lloyd Lake	4.92×10^{-03}	2.21×10^{-03}	1.25×10^{-01}	4.35×10^{-04}	3.72×10^{-04}	4.71×10^{-03}	2.28×10^{-03}	1.31×10^{-01}	6.79×10^{-04}	3.66×10^{-04}
	Mallard	Reference (Broach Lake)	2.78×10^{-02}	2.60×10^{-02}	$1.05 \times 10^{+00}$	6.52×10^{-03}	5.23×10^{-03}	2.78×10^{-02}	2.60×10^{-02}	$1.05 \times 10^{+00}$	6.52×10^{-03}	5.23×10^{-03}
		Patterson Lake North Arm - West Basin	8.52×10^{-02}	3.37×10^{-02}	$1.23 \times 10^{+00}$	1.75×10^{-02}	1.73×10^{-02}	2.94×10^{-02}	6.35×10^{-02}	$2.73 \times 10^{+00}$	1.46×10^{-01}	5.23×10^{-02}
		Patterson Lake South Arm	6.74×10^{-02}	3.22×10^{-02}	$1.18 \times 10^{+00}$	1.40×10^{-02}	1.29×10^{-02}	2.79×10^{-02}	4.88×10^{-02}	$2.04 \times 10^{+00}$	8.72×10^{-02}	1.82×10^{-02}
		Beet Lake	3.45×10^{-02}	2.91×10^{-02}	$1.12 \times 10^{+00}$	1.04×10^{-02}	8.04×10^{-03}	2.78×10^{-02}	3.80×10^{-02}	$1.57 \times 10^{+00}$	4.85×10^{-02}	1.01×10^{-02}
		Lloyd Lake	2.82×10^{-02}	2.63×10^{-02}	$1.06 \times 10^{+00}$	6.92×10^{-03}	5.48×10^{-03}	2.78×10^{-02}	2.72×10^{-02}	$1.11 \times 10^{+00}$	1.08×10^{-02}	5.66×10^{-03}
	Rusty Blackbird	Reference (Broach Lake)	7.16×10^{-02}	1.25×10^{-01}	$6.35 \times 10^{+00}$	3.66×10^{-02}	1.76×10^{-02}	7.16×10^{-02}	1.25×10^{-01}	$6.35 \times 10^{+00}$	3.66×10^{-02}	1.76×10^{-02}
		Patterson Lake North Arm - West Basin	1.83×10^{-01}	1.58×10^{-01}	$7.38 \times 10^{+00}$	9.06×10^{-02}	7.66×10^{-02}	7.49×10^{-02}	2.88×10^{-01}	$1.64 \times 10^{+01}$	7.22×10^{-01}	1.06×10^{-01}
		Patterson Lake South Arm	1.42×10^{-01}	1.50×10^{-01}	$7.12 \times 10^{+00}$	7.30×10^{-02}	3.59×10^{-02}	7.19×10^{-02}	2.24×10^{-01}	$1.22 \times 10^{+01}$	4.35×10^{-01}	4.15×10^{-02}
		Beet Lake	8.36×10^{-02}	1.38×10^{-01}	$6.75 \times 10^{+00}$	5.56×10^{-02}	2.55×10^{-02}	7.17×10^{-02}	1.78×10^{-01}	$9.43 \times 10^{+00}$	2.44×10^{-01}	2.66×10^{-02}
		Lloyd Lake	7.24×10^{-02}	1.27×10^{-01}	$6.39 \times 10^{+00}$	3.86×10^{-02}	1.80×10^{-02}	7.16×10^{-02}	1.31×10^{-01}	$6.67 \times 10^{+00}$	5.77×10^{-02}	1.84×10^{-02}

RFD = reasonably foreseeable development.

6.2.5.2.2 Radiological Dose

The estimated radiation doses to aquatic and terrestrial ecological receptors during the Project phases and far-future projection resulting from the RFD Case are shown in Table 6-12. The doses shown represent the maximum total dose from all radionuclides over the assessment period. The dose breakdown by radionuclide is shown in Appendix C.

The estimated radiation dose to aquatic and terrestrial ecological receptors in the RFD Case includes a dose from the release of COPCs from the Fission Patterson Lake South Property. Thus, the radiation doses were slightly higher in the RFD Case at Patterson Lake South Arm than in the Application Case; however, the radiation dose would decrease to levels that are similar to the Application Case in the downstream environment.

In the RFD Case, the maximum estimated radiation dose of 0.12 mGy/d would occur during Operations for zooplankton in the Patterson Lake South Arm, and would decrease to 0.07 mGy/d in Lloyd Lake. The main contributor to total dose would be from polonium-210 in water. Similarly, the maximum estimated radiation doses for northern pike, lake whitefish, macrophytes, and phytoplankton were higher in the Patterson Lake South Arm in the RFD Case than in the Patterson Lake North Arm – West Basin.

For terrestrial receptors in the RFD Case, the maximum estimated radiation dose for birds and mammals still would occur during Operations for the rusty blackbird eating from the Patterson Lake North Arm – West Basin, which is 0.10 mGy/d in the Application Case and the RFD Case. The maximum dose for terrestrial plants in the RFD Case is to lichen (0.69 mGy/d) due to atmospheric deposition from air to the plant.

In the RFD Case, the predicted radiation dose to all ecological receptors during the far-future projection was lower than during Operations. The maximum estimated dose in the far-future projection to zooplankton was 0.07 mGy/d, to rusty blackbird was 0.08 mGy/d in the Patterson Lake North Arm – West Basin, and to lichen was 0.11 mGy/d in the Patterson Lake North Arm – West Basin.

6.2.6 Uncertainty in Exposure Assessment

For each model scenario and Project phase, it was conservatively assumed that ecological receptors are exposed to the maximum exposure concentrations at their location. The duration of exposure was assumed to be sufficient for each receptor to be in equilibrium with their environment. This resulted in conservatively high:

a. direct exposure estimates for aquatic biota exposed to COPCs in water, and terrestrial plants and soil invertebrates exposed to COPCs in soil;

b. predicted uptakes of COPCs by ecological receptors in the food chain; and

c. estimated doses of COPCs by ecological receptors through the food chain.

The assumptions to address uncertainties in the exposure assessment are anticipated to produce conservative exposure estimates for ecological receptors. The risk that the exposure assessment underestimates potential exposure of ecological receptors to COPCs from the Project is low. That said, the following provides more detail about assessment uncertainty and how it was addressed.

6.2.6.1 Uncertainties in Uptake and Exposure Factors

Wildlife exposure factors, such as intake rates and diets, are a potential source of uncertainty. Reputable sources were used for these factors, and the factors are considered to be representative of the organisms assessed. Feed, water, and inhalation intake rates were obtained or calculated based on the following primary sources: Federal Contaminated Sites Action Plan (FCSAP 2012b), USEPA (1993) and Sample and Suter (1994). These documents have undergone several stages of review and are considered appropriate literature values for use in this assessment; therefore, the uncertainty in these values is considered acceptable.

The BAFs were used to calculate uptake into tissues (fish, invertebrates, plants). Bioaccumulation factors from regional biota and water were used for a number of aquatic BAFs in this assessment. There is inherent uncertainty in using field data to calculate BAFs from metal concentrations in tissues of aquatic biota and surface water concentrations, because the actual exposure history of the organisms is unknown. Unless it is known that a metal concentration in surface water is at a steady state for an extended period of time, the use of tissue and water concentrations sampled at the same time from the same location may not reflect the average exposure of an organism. In addition, as a result of physiological control, intracellular storage and different excretion mechanisms, biota have an ability to actively regulate the body burden of many metals and maintain homeostatic control over a range of exposures (Hamilton and Mehrle 1986; Chapman et al. 1996; Wood and Port 2000). These homeostatic controls can produce a non-linear relationship between the steady-state tissue concentration and the environmental exposure (Newman and Unger 2002). As a result, the validity of assuming a linear relationship between water and tissue concentrations is an area of uncertainty. In most cases it is difficult to assess whether non-linear relationships may exist; therefore, linear relationships are assumed by default. However, these complicating issues do not diminish the importance of BAFs in assessing the environmental hazard associated with metals.

6.2.6.2 Uncertainties in Dose Coefficients

Dose coefficients were obtained from reputable sources for reference organisms, but have not been derived specifically for all the organisms assessed. Dose coefficients for surrogate organisms were often used. They were selected with attention to similar body size and exposure habits and are believed to adequately represent the organism assessed. Dose coefficients for each receptor were not adjusted for body size and dimensions, which represents a possible source of uncertainty. For the maximum exposed receptors, the dose is primarily delivered through an alpha decay as over 95% of the dose can be attributed to the decay of polonium-210. The geometry-scaling factor of alpha particles is 1 for all organisms and geometries; as such, geometry assumptions are expected to have very little effect on the total radiation dose.

6.3 Effects Assessment

The effects assessment characterized the nature of potential effects observed or expected as a result of the Project and the Project plus the Fission Patterson Lake property. The effects assessment considers potential health risks to ecological receptors from long-term (chronic) exposures to COPCs in the environment. The potential for adverse effects during sensitive life stages for ecological receptors, including effects on growth, reproduction, and survival, were considered.

The ecological toxicity assessment considered potential adverse ecological effects from non-radiological and radiological exposures. The selected TRVs represent concentrations or weight-normalized daily doses of COPCs, or radiological dose benchmarks, below which ecologically relevant effects on growth, reproduction, or survival are not expected to occur.

6.3.1 Toxicological Benchmarks

For assessment of non-radiological COPCs, a TRV was used. A TRV is a toxicological index associating specific effects with a level of exposure to a chemical. The TRVs for aquatic biota are based on concentrations in water, while TRVs for mammals and birds are weight-normalized daily oral doses.

Arsenic, chloride, cobalt, copper, molybdenum, sulphate, and uranium were identified in Section 4.0, Model Integration and Evaluation of Sources, for further evaluation in the EcoRA for aquatic biota, and arsenic, cobalt, copper, molybdenum, and uranium were identified for further evaluation in the EcoRA for terrestrial biota.

No COPCs in air were identified for further evaluation of potential risks for ecological health; therefore, TRVs for direct contact with air were not included in the toxicity assessment. Deposition of COPCs in dust to soil was evaluated; however, no COPCs in soil were identified for further evaluation; therefore, toxicity via direct contact with COPCs in soil for plants and soil invertebrates was not included in the toxicity assessment.

6.3.1.1 Toxicity Reference Values for Aquatic Biota

Water concentration-based TRVs for aquatic biota are considered chronic effects from long-term exposures. They are concentrations below which health risks to receptors are not anticipated. The TRVs derived for aquatic biota included six categories: forage fish (lake whitefish), predator fish (northern pike), zooplankton, benthic invertebrates, phytoplankton, and aquatic plants.

The selected TRVs were 20% ECs (i.e., EC_{20} values), which are concentrations at which only 20% of the test organisms respond. The EC_{20} value was preferred because 20% is near the level at which effects become statistically discernible or measurable in both laboratory and field studies (Suter 1996; Environment Canada and Health Canada 2003), and therefore can be reliably reproduced. However, chronic EC_{20} values are not always readily available; therefore, a protocol shown in Table 6-14 was established to derive chronic EC_{20} values from available data.

Table 6-14: Procedure for Adjusting Test Endpoints to Chronic 20% Effect Concentration

Test Endpoint[(a)]	Adjustment to Chronic EC_{20}
Chronic EC_{10}	Multiply by 2
Chronic EC_{25}	Multiply by 2/2.5
Chronic EC_{30}	Multiply by 2/3
Chronic EC_{50}	Multiply by 2/5
Chronic LC_{25}	Multiply by 0.5
Chronic LC_{50}	Divide by 4

(a) IC endpoints were treated as EC endpoints.
EC = effect concentration; LC = lethal concentration; IC = inhibition concentration.

Toxicity data for effect endpoints involving growth, reproduction, and survival were selected because they are considered to be relevant to the persistence of aquatic populations. Chronic toxicity data were preferred, and acute data were only considered when chronic data were not sufficient (a minimum of 2 values). If more than 20 chronic EC_{20} values were available in each taxonomic group, a 5th percentile of the EC_{20} values was used as a selected TRV. If there were less than 20 chronic EC_{20} values, the lowest EC_{20} was used as a selected TRV for the taxonomic category. Calculated values that fell below the CCME or provincial guideline were not considered appropriate as TRVs for aquatic biota and the CCME or provincial values were selected in their place. The selected TRVs for aquatic biota groups are summarized in Table 6-15. For aquatic TRVs that were based on the lowest chronic EC_{20} value, the reference is provided in Table 6-15.

In some cases, site-specific modifying factors (ambient conditions) may influence the toxicity of a chemical. For example. these modifying factors include water hardness for copper. In these cases, the TRV must be appropriate to the ambient condition.

The USEPA ECOTOXicology database (ECOTOX) was generally used for the selection of TRVs for aquatic organisms. There were sufficient data available from ECOTOX to derive TRVs for arsenic, copper, and molybdenum. There were limited data available in the USEPA ECOTOX database pertaining to the effects of cobalt, chloride, sulphate, and uranium exposure on aquatic biota. The TRVs for cobalt were selected from a recently published review of toxicological data by Stubblefield et al. (2020), in which a species sensitivity distribution approach was used. The TRVs for chloride were obtained from the CCME (2011a) and the TRVs for sulphate were obtained from the BC MOE (2013). The TRVs for uranium were derived from data available from toxicological reports.

Table 6-15: Selected Toxicity Reference Values for Aquatic Biota

COPC	Biotic Group	TRV	Unit	Rationale	Data Source
Arsenic	Forage fish	0.123	mg/L	Lowest estimated chronic EC_{20} (survival)	ECOTOX (Birge et al. 1979)
	Predator fish	0.630	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=50)	ECOTOX
	Zooplankton	0.340	mg/L	Lowest estimated chronic EC_{20} (intoxication)	ECOTOX (May-Passino and Novak 1984)
	Benthic invertebrates	0.122	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=27)	ECOTOX
	Phytoplankton	0.0192	mg/L	Lowest estimated chronic EC_{20} (growth)	ECOTOX (Vocke et al. 1980)
	Aquatic plants	0.252	mg/L	Lowest estimated chronic EC_{20} (population)	ECOTOX (Jenner and Janssen-Mommen 1993)
Chloride	Forage fish	693	mg/L	Chronic LOEC (survival)	CCME 2011a (Birge et al. 1985 in Elphick et al. 2011a)
	Predator fish	989	mg/L	Chronic EC_{25} (reproduction)	CCME 2011a (Beak 1999)
	Zooplankton	421	mg/L	Chronic EC_{25} (reproduction)	CCME 2011a (Elphick et al. 2011a)
	Benthic invertebrates	421	mg/L	Chronic EC_{25} (growth)	CCME 2011a (Bartlett 2009 unpublished)
	Phytoplankton	6,066	mg/L	Chronic MATC (growth)	CCME 2011a (Kessler 1974)
	Aquatic plants	3,150	mg/L	Chronic EC_{50} (population)	CCME 2011a (Buckley et al. 1996)
Cobalt	Forage fish	0.314	mg/L	Lowest chronic EC_{20} (biomass). Normalized to a hardness of 52 mg/L (lower end of the equation)	Stubblefield et al. 2020
	Predator fish	1.791	mg/L	Lowest chronic EC_{20} (survival) for Rainbow Trout. Normalized to a hardness of 52 mg/L (lower end of the equation)	Stubblefield et al. 2020
	Zooplankton	0.0111	mg/L	Lowest chronic EC_{20} (reproduction)	Stubblefield et al. 2020
	Benthic invertebrates	0.0122	mg/L	Lowest chronic EC_{20} (growth). Normalized to a hardness of 52 mg/L (lower end of the equation)	Stubblefield et al. 2020

COPC	Biotic Group	TRV	Unit	Rationale	Data Source
	Phytoplankton	0.046	mg/L	Lowest estimated EC_{20} (growth)	Stubblefield et al. 2020
	Aquatic plants	0.0096	mg/L	lowest estimated EC_{20} (growth). Normalized to a hardness of 52 mg/L (lower end of the equation)	Stubblefield et al. 2020
Copper[b,c,d]	Forage fish	0.002	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=237)	ECOTOX
	Predator fish	0.003	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=89)	ECOTOX
	Zooplankton	0.002	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=117)	ECOTOX; CCME
	Benthic invertebrates	0.002	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=264)	ECOTOX; CCME
	Phytoplankton[a]	0.0092	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=101)	ECOTOX
	Aquatic plants[a]	0.038	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=28)	ECOTOX
Molybdenum	Forage fish	31	mg/L	Saskatchewan Water Quality Guideline	WSA 2017
	Predator fish	80	mg/L	lowest estimated EC_{20} value	ECOTOX; Goettl et al. (1976); McConnell (1977)
	Zooplankton	31	mg/L	Saskatchewan Water Quality Guideline	WSA 2017
	Benthic invertebrates	31	mg/L	Saskatchewan Water Quality Guideline	WSA 2017
	Phytoplankton	31	mg/L	Saskatchewan Water Quality Guideline	WSA 2017
	Aquatic plants	31	mg/L	Saskatchewan Water Quality Guideline	WSA 2017
Sulphate	Forage fish	2,999	mg/L	Lowest chronic EC_{25} (biomass)	BC MOE 2013; PESC data
	Predator fish	502	mg/L	Lowest chronic LC_{25} (survival)	BC MOE 2013; PESC data
	Zooplankton	425	mg/L	Lowest chronic EC_{25} (reproduction)	BC MOE 2013; Elphick et al. 2011b
	Benthic invertebrates	730	mg/L	Lowest chronic LC_{25} (survival)	BC MOE 2013; PESC data
	Phytoplankton	2,660	mg/L	Lowest chronic EC_{25} (cell yield)	BC MOE 2013; Elphick et al. 2011b

COPC	Biotic Group	TRV	Unit	Rationale	Data Source
	Aquatic plants	2,310	mg/L	Lowest chronic EC_{10} (frond increase)	BC MOE 2013; PESC data
Uranium[(e)]	Forage fish	1.50	mg/L	Lowest estimated chronic EC_{20} (growth)	VST 2004; Liber et al. 2007
	Predator fish	0.550	mg/L	Lowest estimated chronic EC_{20} (growth)	VST 2004; Liber et al. 2007
	Zooplankton	0.060	mg/L	Lowest estimated chronic EC_{20} (growth)	VST 2004; Liber et al. 2007
	Benthic invertebrates	0.027	mg/L	Lowest estimated chronic EC_{20} (growth)	VST 2004; Liber et al. 2007
	Phytoplankton	0.440	mg/L	Geometric mean of 2 EC_{25} values	VST 2004; Liber et al. 2007
	Aquatic plants	5.50	mg/L	Geometric mean of 2 EC_{25} values	VST 2004; Liber et al. 2007

(a) Study specific hardness data were not available for the adjustment of TRVs.
(b) The TRV is hardness dependent and is presented as dissolved metal in soft water (hardness of 25 mg $CaCO_3$/L).
(c) Hardness dependent TRVs are presented for hardness of 25 mg $CaCO_3$/L and may be converted to reflect specific site hardness conditions using the equations presented.
(d) The TRVs presented in italics are CCME guidelines used as a default when estimated TRVs are below the recommended guideline.
(e) The TRVs are based on hardness of 60 mg/L, other than phytoplankton which is based on hardness of 120 mg/L.
EC_{XX} = effect concentration for XX% response; LOEC = lowest observed effect concentration; MATC = maximum acceptable toxicant concentration; $CaCO_3$ = calcium carbonate; TRV = toxicity reference value; PESC = Pacific Environmental Science Centre; CCME = Canadian Council of Ministers of the Environment.

6.3.1.1.1 Arsenic

The TRVs for arsenic were estimated chronic EC_{20} values that were selected based on EC_{50} and lethal concentration $(LC)_{50}$ values obtained from the USEPA ECOTOX database (Table 6-15). The results suggest that phytoplankton, benthic invertebrates, and forage fish are the most sensitive to arsenic exposure while predator fish are the least sensitive.

6.3.1.1.2 Chloride

Toxicity records were taken from data selected by CCME (2011a) to derive the Canadian Water Quality Guideline value for the protection of fresh water aquatic life. The studies met the minimum primary or secondary requirements for data quality. No EC_{20} concentrations were available from the CCME data. Low effects levels including EC_{25}, LOEC, and maximum acceptable toxicant concentration were selected preferentially, and the lowest for each aquatic group were selected (Table 6-15). The results suggest that benthic invertebrates are the most sensitive to chloride exposure while phytoplankton are the least sensitive.

6.3.1.1.3 Cobalt

The TRVs for cobalt are chronic EC_{20} values for aquatic animal groups and estimated chronic EC_{20} values for aquatic plant groups from Stubblefield et at. (2020). Stubblefield et at. (2020) conducted a series of acute and chronic toxicity tests with the primary objective to generate data needed to derive international water quality guidelines for cobalt based on USEPA and European Union requirements. Early life stage tests were conducted on three fish species, one zooplankton species, three aquatic invertebrate species, one alga, and one aquatic macrophyte. The study produced chronic EC_{20} values for the aquatic animal species and chronic EC_{10} values for aquatic plants. The TRVs for phytoplankton and aquatic plants were derived from EC_{10} values using a factor of 2 to adjust to an EC_{20} (Table 6-15). The results suggest that zooplankton, benthic invertebrates, and macrophytes are among the most sensitive to cobalt and fish are the least sensitive. The TRVs for fish, benthic invertebrates, and aquatic plants have been adjusted to the lowest hardness (i.e., 52 mg/L) based on the hardness slope from the Federal Environmental Quality Guideline (FEQG) (Environment Canada 2017).

6.3.1.1.4 Copper

The TRVs for copper for forage fish, predator fish, phytoplankton, and aquatic plants are estimated chronic EC_{20} values. They were estimated based on EC_{10}, EC_{25}, EC_{30}, EC_{50}, LC_{25}, LC_{50}, inhibition concentration (IC_{10}), IC_{25}, and IC_{50} values obtained from the USEPA ECOTOX database. In the case of zooplankton and benthic invertebrates, the derived TRVs were lower than the existing CCME guideline values; therefore, the CCME values were selected as the TRVs because the CCME guidelines are conservative and protective of all life forms of aquatic species in Canada. The selected TRVs are summarized in Table 6-15 for dissolved copper in soft water conditions (hardness of 25 milligrams of calcium carbonate per litre [mg $CaCO_3$/L]). The results suggest that zooplankton, benthic invertebrates, forage fish, and predator fish are the most sensitive to copper exposure while aquatic plants are the least sensitive.

According to the USEPA (2007a), the copper hardness-dependent criterion continuous concentration (CCC) can be calculated from the following:

$$CCC = e^{0.8545 \times ln(hardness) - 1.702} \times 0.96$$

A conversion factor of 0.96 was used to convert the total mean concentration of copper to a dissolved copper concentration. For studies on chronic toxicity of copper to aquatic biota that reported the hardness of the water, H1 (in mg/L $CaCO_3$), the CCC for the hardness used in the study was calculated. The CCC values for two hardness levels provide a ratio that can be used to adjust an EC_{20} at the test hardness (H1) to an EC_{20} at some standard hardness (H2), which is relevant to the site. This was used to determine the hardness adjusted TRV at 25 mg $CaCO_3$/L, H2, using the following relationship:

$$EC_{20}H2 = \frac{CCC_{H2}}{CCC_{H1}} \times EC_{20}H1$$

The EC_{20} values derived for copper, based on a hardness of 25 mg $CaCO_3$/L, were compared to the CCME water quality guidelines for the same hardness condition prior to selecting the appropriate TRVs (Table 6-15).

6.3.1.1.5 Sulphate

Toxicity records were taken from data selected by the British Columbia Ministry of Environment (BC MOE 2013) to derive British Columbia's Ambient Water Quality Guideline value for sulphate for the protection of fresh water aquatic life. The BC MOE used data from the Pacific Environmental Science Centre and Dr. Chris Kennedy (Simon Fraser University) and Elphick et al. (2011b). The tests selected by BC MOE were conducted over a range of hardness levels. The BC MOE determined that, though dose-response curves of many organisms were influenced by water hardness, a consistent relationship among the species could not be established. The selected TRVs are LC_{25} or EC_{25} values except for the aquatic plant TRV, which is an EC_{10} value (Table 6-15). The results suggest that aquatic animals are generally more sensitive to sulphate exposure than aquatic plants.

6.3.1.1.6 Molybdenum

For forage fish, zooplankton, benthic invertebrates, phytoplankton, and aquatic plants, the Saskatchewan Water Security Agency WQO for the protection of aquatic life (WSA 2017) was selected as the TRV for molybdenum. The WQO is based on current understanding of aquatic toxicity of molybdenum to fresh-water aquatic organisms as discussed in Section 4.2.3, Screening for Constituents of Potential Concern in Aquatic Environment. The TRV for predator fish is the lowest of three estimated chronic EC_{20} values, derived from LC_{50} values for rainbow trout (*Oncorhynchus mykiss*), obtained from the USEPA ECOTOX database. The selected TRV is from Goettl et al. (1976) and was republished in 1977 by McConnell, which provided detailed documentation as to the methods used to generate the data (cited in Tetra Tech 2008).

6.3.1.1.7 Uranium

Limited data were available in the USEPA ECOTOX database pertaining to the effects of uranium exposure on aquatic biota. Data were instead obtained from two reports that investigated the toxicity of uranium to aquatic biota in Northern Saskatchewan, VST (2004) and Liber et al. (2007). The TRVs for uranium are all estimated chronic EC_{20} values derived from EC_{25}, EC_{50} and LC_{25}, LC_{50}, IC_{25}, and IC_{50} values.

While uranium speciation and toxicity in fresh water are strongly determined by water characteristics such as hardness, pH, and temperature, the CCME (2011b) does not consider that there is sufficient information available to quantitatively evaluate the influence of these factors. Therefore, the CCME recommends a water quality guideline for uranium that is not hardness dependent. The TRVs in Table 6-15 are therefore considered appropriate for use across a range of hardness and may be conservative for hard water environments because they were derived from tests conducted under soft water conditions (water hardness of 60 mg $CaCO_3$/L from test studies other than phytoplankton which was based on a study using water hardness of 120 mg/L). The results suggest that zooplankton and benthic invertebrates are more sensitive to uranium exposure and phytoplankton and aquatic plants are less sensitive.

6.3.1.2 Toxicity Reference Values for Terrestrial Biota

Chronic dose-based TRVs for non-radiological COPCs were derived for birds and mammals based on endpoints (i.e., growth and reproduction) considered relevant for assessing the health of wildlife populations. The selected TRVs, shown in Table 6-16, are chronic daily intakes that are not expected to cause adverse effects to a particular ecological receptor. Where the TRV is based a single LOAEL, the specific reference is provided in Table 6-16. Lowest observed adverse effect levels were selected for each COPC. The LOAEL is the lowest exposure level at which the response of a test species in a toxicity study was statistically discernible.

The LOAELs were used in the ERA to identify a threshold of exposure below which adverse effects are not expected. Exceeding a LOAEL does not mean that effects would necessarily occur; rather, it means that effects may occur. Particularly in large populations, localized effects on a few individuals can be compensated such that there is no discernible effect on the population as a whole.

Toxicity data for bird and mammal species were preferentially selected from the USEPA ecological soil screening levels (Eco-SSL) database (USEPA 2005a). There were no data available in the USEPA Eco-SSL database pertaining to the effects of uranium exposure on birds and mammals, so TRVs were derived from data available in toxicological reports previously used in risk assessments for uranium mines in northern Saskatchewan.

Toxicity reference values were derived from the selected data for several test species of avian and mammalian wildlife. When possible, a test species was selected with a close taxonomic relationship to the ecological receptor in the risk assessment, such as within the same order, family, genus, or species. If there were several potential test species relevant to an ecological receptor, consideration was given to similar diet and body size. A sensitive test species of the same class was selected to represent an ecological receptor when no data were available for species with a closer taxonomic relationship.

Table 6-16: Selected Toxicity Reference Values for Terrestrial Biota

Ecological Receptor	Arsenic (mg/kg/d)	Cobalt (mg/kg/d)	Copper (mg/kg/d)	Molybdenum (mg/kg/d)	Uranium (mg/kg/d)
Mammals					
Black bear	3.1	13	12	2.6	5.6
Beaver	14	13	119	3.8	5.6
Woodland caribou	14	13	1.5	4.1	5.6
Red fox	3.1	13	12	2.6	5.6
Snowshoe hare	3.0	13	46	30	5.6
Little brown myotis	3.1	13	12	2.6	5.6
American mink	3.1	13	12	2.6	5.6
Moose	14	13	1.5	4.1	5.6
Muskrat	14	13	119	3.8	5.6
Southern red-backed vole	21	28	296	2.6	5.6
Grey wolf	3.1	13	12	2.6	5.6
Birds					
Grouse	3.6	14	35	39	16
Common loon	3.6	14	27	21	16
Mallard	5.1	14	75	21	16
Canada goose	3.6	14	27	21	16
Rusty blackbird	3.6	14	27	21	16

6.3.1.2.1 Arsenic

A summary of the TRVs selected for mammalian and avian species for arsenic is shown in Table 6-17.

Mammalian Toxicity Reference Values

Data for growth and reproduction for mammalian species were obtained from the Eco-SSL document for arsenic exposure (USEPA 2005b). The data were based on a total of 14 LOAEL values from studies with dogs, goats, guinea pigs, mice, pigs, rabbits, and rats. The geometric means of the LOAELs within species ranged from 0.84 mg/kg/d for a guinea pig to 20.7 mg/kg/d for a mouse. Each of the species mean values of LOAEL can be considered as a TRV for arsenic for other mammals. In the event that a species has no closely related test species, the second lowest LOAEL value of 3.0 mg/kg/d for rabbit and dog can be used as a conservative default for the arsenic TRV. Although this LOAEL is not the minimum of the species LOAELs, it was selected over the minimum LOAEL of 0.84 mg/kg/d for guinea pig because the latter value was essentially at the same level as the minimum NOAEL from the same dataset. Of the total 14 LOAEL values used to derive the species LOAELs only two are below 3.0 mg/kg/d. As such, the LOAEL of 3.0 mg/kg/d was selected as the default LOAEL as it is more representative of the LOAEL data overall.

Avian Toxicity Reference Values

Data for growth and reproduction for avian species were obtained from the Eco-SSL document for arsenic exposure (USEPA 2005b). The document was based on studies with chickens and ducks. After review of the data, two LOAEL values were retained for ducks and one was retained for chicken. The selected avian TRVs are 3.6 mg/kg/d for chickens based on a single LOAEL value, and 5.1 mg/kg/d for duck based on the geometric mean of two LOAEL values.

Table 6-17: Summary of Selected Toxicity Reference Values for Mammal and Bird Test Species – Arsenic

Test Species	TRV (mg/kg/d)	Rationale
Mammal		
Dog (*Canis familiaris*)	3.1	Geometric mean of two LOAELs for the species
Goat (*Capra hircus*)	14	Geometric mean of two LOAELs for the species
Guinea pig (*Cavia porcellus*)	0.84	Single LOAEL for the species (Hunder et al. 1999)
Mouse (*Mus musculus*)	21	Geometric mean of three LOAELs for the species
Pig (*Sus scrofa*)	9.4	Single LOAEL for the species (Morrison and Chavez 1983)
Rabbit (*Oryctolagus cuniculus*)	3.0	Single LOAEL for the species (Nemec et al. 1998)
Rat (*Rattus norvegicus*)	14	Geometric mean of four LOAELs for the species
Bird		
Mallard duck (*Anas platyrhynchos*)	5.1	Geometric mean of two LOAELs for the species
Chicken (*Gallus* sp.)	3.6	Single LOAEL for the species (Howell and Hill 1978)

LOAEL = lowest observed adverse effect level; TRV = toxicity reference value.

6.3.1.2.2 Cobalt

A summary of the TRVs selected for mammalian and avian species for cobalt is shown in Table 6-18.

Mammalian Toxicity Reference Values

Two mammal species were represented in the Eco-SSL database with growth or reproduction endpoints and with LOAEL values reported (USEPA 2005c). The species geometric mean values of LOAELs ranged from 13 mg/kg/d for rat to 28 mg/kg/d for mouse, from 6 and 7 LOAEL values respectively.

Avian Toxicity Reference Values

Data for growth and reproduction for avian species were obtained from the Eco-SSL database for cobalt exposure (USEPA 2005a). The document was based on studies with chickens and ducks. Eight LOAEL values were retained for chicken. The data for ducks were not retained because the LOAEL value was above the mortality endpoint. The selected avian TRV is 14 mg/kg/d for chickens based on the geometric mean of eight LOAEL values.

Table 6-18: Summary of Selected Toxicity Reference Values for Mammal and Bird Test Species – Cobalt

Test Species	TRV (mg/kg/d)	Rationale
Mammal		
Mouse (*Mus musculus*)	28	Geometric mean of six LOAELs for the species
Rat (*Rattus norvegicus*)	13	Geometric mean of seven LOAELs for the species
Bird		
Chicken (*Gallus* sp.)	14	Geometric mean of eight LOAELs for the species

LOAEL = lowest observed adverse effect level; TRV = toxicity reference value.

6.3.1.2.3 Copper

A summary of the TRVs selected for mammalian and avian species for copper is shown in Table 6-19.

Mammalian Toxicity Reference Values

The mammalian data for growth and reproduction were obtained from the data presented in the Eco-SSL document for copper exposure (USEPA 2007b). The data were based on studies with goats, minks, mice, pigs, rabbits, rats, and sheep. The TRVs for goat, rabbit, and sheep are each based on a single LOAEL value. The TRVs for mink, mouse, pig, and rat are geometric means of the LOAEL data for each test species. For rats, the geometric mean of the NOAEL values was larger than the geometric mean of the LOAEL values due to the larger dataset for the LOAEL values. For this species, the LOAEL was therefore derived only from the studies that had both LOAEL and NOAEL values. The geometric mean of the LOAELs ranged from 1.47 mg/kg/d for a goat to 296 mg/kg/d for a mouse. In the event that a species had no closely related test species, the LOAEL of 8.8 mg/kg/d for pig was used as the default mammalian TRV. It is not the lowest LOAEL; however, it can be used as the default mammalian TRV as it is the lowest species LOAEL above the lowest NOAEL from the same dataset.

Avian Toxicity Reference Values

The avian data for growth and reproduction were obtained from the data presented in the Eco-SSL document for copper exposure (USEPA 2007b). The data were based on studies with chickens, ducks, and turkeys. The geometric means of the LOAELs within species were selected to serve as the TRVs. The geometric means of the LOAELs for chickens, ducks, and turkeys were 34.9 mg/kg/d, 75.2 mg/kg/d, and 27 mg/kg/d respectively, based on 78, 3, and 9 LOAEL values, respectively. These values were used as TRVs for other similar species in the EcoRA.

Table 6-19: Summary of Selected Toxicity Reference Values for Mammal and Bird Test Species – Copper

Test Species	TRV (mg/kg/d)	Rationale
Mammal		
Goat (*Capra hircus*)	1.5	Single LOAEL for the species (Solaiman et al. 2001)
Mink (*Neovison vison*)	12	Geometric mean of two LOAELs for the species
Mouse (*Mus musculus*)	296	Geometric mean of five LOAELs for the species
Pig (*Sus scrofa*)	8.8	Geometric mean of four LOAELs for the species
Rabbit (*Oryctolagus cuniculus*)	46	Single LOAEL for the species (Grobner et al. 1986)
Rat (*Rattus norvegicus*)	119	Geometric mean of five LOAELs for the species
Sheep (*Ovis aires*)	3.0	Single LOAEL for the species (Ortolani et al. 2003)
Bird		
Chicken (*Gallus* sp.)	35	Geometric mean of 78 LOAELs for the species
Duck (*Anas platyrhynchos*)	75	Geometric mean of three LOAELs for the species
Turkey (*Meleagris gallopavo*)	27	Geometric mean of nine LOAELs for the species

LOAEL = lowest observed adverse effect level; TRV = toxicity reference value.

6.3.1.2.4 Molybdenum

A summary of the TRVs selected for mammalian and avian species for molybdenum is shown in Table 6-20.

Mammalian Toxicity Reference Values

The selected TRVs for mammals are from studies with reported LOAEL values for growth and reproduction endpoints. Relevant LOAEL values for molybdenum were obtained from literature for four mammal species: rabbit (*Oryctolagus cunculus*), mouse (*Mus musculus*), cow (*Bos taurus*), and rat (*Rattus norvegicus*). The TRVs for rabbit, mouse, and cow are based on one LOAEL value and the TRV for rat is the geometric mean of two LOAEL values. The TRVs range from 2.6 mg/kg/d for a mouse to 30 mg/kg/d for a rabbit. In the event that a species had no closely related test species, the LOAEL of 2.6 mg/kg/d for mouse was used as the default mammalian TRV.

Avian Toxicity Reference Values

The selected TRVs for birds are from studies with reported LOAEL values for growth and reproduction endpoints. Relevant LOAEL values for molybdenum were obtained from literature for two avian species: chicken (*Gallus* sp.) and turkey (*Meleagris gallopavo*). The TRV for chicken is the geometric mean of three LOAEL values and the TRV for turkey is based on one LOAEL value from Underwood (1971). The TRVs range from 21 mg/kg/d for a turkey to 39 mg/kg/d for a chicken. In the event that a species had no closely related test species, the LOAEL of 21 mg/kg/d for turkey was used as the default avian TRV.

Table 6-20: Summary of Selected Toxicity Reference Values for Mammal and Bird Test Species – Molybdenum

Test Species	TRV (mg/kg/d)	Rationale
Mammal		
Rabbit (*Oryctolagus cunculus*)	30	Single LOAEL for the species (Arrington and Davis 1953)
Mouse (*Mus musculus*)	2.6	Single LOAEL for the species (Schroeder and Mitchener 1971)
Cow (*Bos taurus*)	4.1	Single LOAEL for the species (Thomas and Moss 1951)
Rat (*Rattus norvegicus*)	3.8	Geometric mean of two LOAELs for the species
Bird		
Chicken (*Gallus domesticus*)	39	Geometric mean of three LOAELs for the species
Turkey (*Melagris gallopavo*)	21	Single LOAEL for the species (Underwood 1971)

LOAEL = lowest observed adverse effect level; TRV = toxicity reference value.

6.3.1.2.5 Uranium

A summary of the TRVs selected for mammalian and avian species for uranium is shown in Table 6-21.

Mammalian Toxicity Reference Values

There is no Eco-SSL document for uranium. Previous risk assessments have used TRVs for mammalian exposure to uranium derived from the data of Sample et al. (1996). The Sample et al. (1996) data for mammalian species were based on a study by Paternain et al. (1989) related to reproduction in mice. Sample et al. derived a LOAEL of 6.13 mg/kg/d from the study. The TRV quoted by Sample et al. (1996) contains a small unit conversion error. Instead of 6.13 mg/kg/d as reported, the value should be 5.6 mg/kg/d. The difference arises from Sample's use of uranyl acetate molecular weight rather that uranyl acetate dehydrate molecular weight in converting the molecular dose to uranium dose. The correct value (5.6 mg/kg/d) can be found in the ATSDR toxicity profile for uranium. It represents the oral dose (to parents) at which viability of F1 offspring was reduced. Since the LOAEL value from Paternain et al. (1989) is the only mammalian data available, this LOAEL value of 5.6 mg/kg/d was selected for evaluating uranium toxicity to mammalian species.

Avian Toxicity Reference Values

No data were available in the Eco-SSL database related to uranium exposure in avian species. Previous risk assessments used TRVs for avian exposure to uranium derived from the data of Sample et al. (1996). The Sample et al. data were based on a study by Haseltine and Sileo (1983) related to mortality, body weight, liver, and kidney effects in ducks; Sample et al. derived a NOAEL of 16 mg/kg/d, but no LOAEL from the study. There are no other avian data available for uranium. The study used powdered metallic uranium. Uranium in this form would likely be oxidized to ionic form in the gut since uranium is strongly reducing in aqueous systems (Durante and Pugliese 2002). Uranium in the environment similarly exists in an oxidized ionic form. Solubility differences among ionic forms in the gut can be bounded. The ICRP (1994) has determined that some oxidized species in the gut may be an order of magnitude less soluble than the most soluble species. Any reduced solubility in the gut would be offset by the fact that a NOAEL value is used in the absence of a LOAEL value. Since the NOAEL value from Haseltine and Sileo (1983) is the only avian data available, this NOAEL value of 16 mg/kg/d was selected as the TRV for evaluating uranium toxicity to avian species.

Table 6-21: Summary of Selected Toxicity Reference Values for Mammal and Bird Test Species – Uranium

Test Species	TRV (mg/kg/d)	Rationale
Mammal		
Mouse *(Mus musculus*)	5.6	Paternain et al. 1989, from Sample et al. 1996
Bird		
Black duck (*Anas rubripes*)	16	Haseltine and Sileo 1983, from Sample et al. 1996

TRV = toxicity reference value.

6.3.2 Radiation Benchmarks

Radiation dose benchmarks of 0.4 mGy/h (9.6 mGy/d) and 0.1 mGy/h (2.4 mGy/d; UNSCEAR [2008] were selected for the assessment of effects on aquatic biota and terrestrial biota, respectively, as recommended in CSA N288.6-22), and are summarized in Table 6-22. These are total dose benchmarks; therefore, the doses to biota due to each radionuclide of concern are summed to compare against these benchmarks. The aquatic biota considered by the United Nations Scientific Committee on Effects of Atomic Radiation are organisms such as fish and benthic invertebrates that reside in water. Birds and mammals with riparian habits are considered to be terrestrial biota. Dose calculations in this ERA follow the same convention.

Exceedance of either of these benchmarks is considered to indicate the potential for adverse effects to occur, and the need for more detailed assessment.

Table 6-22: Radiological Dose Benchmarks for Aquatic and Terrestrial Ecological Receptors

Ecological Receptor	Dose Rate Limit (mGy/d)
Aquatic Organism	
Aquatic plants (algae and macrophytes)	9.6
Benthic invertebrates	9.6
Fish	9.6
Terrestrial Organism	
Terrestrial animals	2.4
Terrestrial plants	2.4

mGy/d = milligrays per day.

6.3.3 Uncertainty in the Effects Assessment

Uncertainties associated with the estimation of ecotoxicological effect levels for COPCs are inherent in the ERA process. Many uncertainties are associated with the use of literature-based TRVs. These uncertainties may include: extrapolation of results from laboratory tests to the field, differences in sensitivity between the test organism and resident organisms, laboratory conditions that are not representative of field conditions, and the form of the COPC used in toxicity testing, which may not be representative of the form that would be found at the Project.

The use of TRVs from laboratory studies tends to be conservative because these studies are typically chemical-specific and use highly bioavailable forms of the COPC studied. In field situations, the chemical form of the same COPC may be less bioavailable, and toxicity-modifying factors may be present that were not acting in laboratory tests.

The EC_{20} values were used for aquatic biota to reduce uncertainty by representing a standard threshold level of low magnitude effects. Depending on the size of the available dataset, selection of the 5^{th} percentile or lowest EC_{20} value as the TRV for an aquatic biota group was intended to reduce the likelihood that risks would be underestimated.

There is inherent uncertainty associated with the use of LELs such as LOAEL values as TRVs for birds and mammals as these values are not precisely related to a particular magnitude of effect. However, LOAEL values have widespread use in the risk assessment community and the science is not currently available to change this approach to TRVs. Defaulting to the most conservative TRV for ecological receptors that are not closely related taxonomically to the test species was meant to reduce the likelihood that risks would be underestimated.

6.4 Risk Characterization

Risk assessment is the process of estimating the likelihood of undesirable effects on ecological health resulting from exposure to chemical or radiological contaminants. Three components must be present for risks to ecological health to exist:

- The COPC must be present at concentrations sufficient to cause a possible adverse effect.
- A receptor must be present.
- There must be a complete exposure pathway by which the receptor can come into contact with the COPC.

6.4.1 Risk Estimation

Risk characterization is the process in the EcoRA that integrated the results from the exposure and effects assessments to estimate the risk of adverse effects on ecological receptors. The risk characterization also evaluated the uncertainties associated with the overall conclusion of risk.

The hazard quotient (HQ) is a simple approach that provides a quantitative estimate of overall risk. The HQ is the ratio between the exposure estimate and a TRV:

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

If the HQ is less than or equal to 1, this suggests low risk to the ecological receptor because exposure estimates are below levels known to cause adverse effects. If the HQ is greater than 1, adverse effects may be possible, and further investigation of the assumptions of the exposure and effects assessments could be considered to reduce the conservatism inherent in the EcoRA. Risk assessment is often an iterative process of refining information, and the identified risk in the first iteration is often an artefact of conservative assumptions. If further evaluation under more realistic assumptions confirms the risk, this information can be used to inform mitigation to avoid, eliminate, or reduce the source of the risk.

6.4.1.1 Estimated Risk to Ecological Receptors – Application Case

This subsection presents the estimated risks to aquatic and terrestrial ecological receptors due to releases from the Project during all phases, including the far-future projection once groundwater solutes have been released to Patterson Lake. The results are presented for both the Application Case and the Upper Bound sensitivity scenario.

6.4.1.1.1 Non-radiological Risk

The estimated HQs for all aquatic and terrestrial ecological receptors at all assessed locations during Operations and the far-future projection are shown in Table 6-23 and Table 6-24. The HQs represent the maximum HQ over the Project phase for the COPCs of interest, which is a conservative representation of risk.

No significant adverse effect on either aquatic or terrestrial populations or communities as a result of releases from the Project would be likely during Operations, for both the Application Case and reasonable Upper Bound sensitivity scenario. All estimated HQs for all COPCs (i.e., chloride, sulphate, arsenic, cobalt, copper, molybdenum, and uranium) for all ecological receptors remain below the HQ benchmark of 1.

For assessment of risk to benthic invertebrates, risk was calculated based on toxicity benchmarks as water concentrations. However, considering that benthic invertebrates also reside in sediment, a comparison of predicted sediment concentrations against sediment toxicity benchmarks was warranted. This only applied to arsenic and molybdenum in sediment, as no other COPC exceeded sediment screening values (Table 4-3). Arsenic in sediment at Patterson Lake North Arm – West Basin was predicted to exceed the REF screening value from Burnett-Seidel and Liber (2013), but was below the NE2 value for the Application Case and reasonable upper bound sensitivity scenario. Arsenic was below the sediment screening values at all other downstream locations. Concentrations below the NE2 value for arsenic indicate that benthic invertebrate community metrics (abundance, richness, and evenness) downstream of discharges are not expected to differ significantly (i.e., by less than 20%) from those observed at natural background conditions.

Since there were no HQ exceedances for any of the aquatic or terrestrial receptors during Operations, individual species at risk would also be considered protected.

For the far-future projection, once groundwater solutes reach Patterson Lake North Arm – West Basin HQs would remain below the benchmark of 1 for all COPCs with the exception of copper for both the Application Case and reasonable upper bound sensitivity scenario. Exceedances of the HQ benchmark value of 1 for the far-future projection were limited spatially to Patterson Lake and were limited in magnitude to a maximum of 1.4 times the benchmark for the reasonable upper bound sensitivity scenario. Exceedances of the HQ benchmark were predicted for some groups of aquatic animals but not for aquatic plants:

1) The estimated HQ for copper exceeded 1 in Patterson Lake North Arm – West Basin for lake whitefish (1.1), aquatic invertebrates (1.1), and zooplankton (1.1) in the far-future projection for the Application Case. All other waterbodies in the downstream environment have HQs for copper below 1.

2) The estimated HQ for copper exceeded 1 in Patterson Lake North Arm – West Basin for lake whitefish (1.4), aquatic invertebrates (1.4), and zooplankton (1.4) in the far-future projection for the reasonable upper bound sensitivity scenario. In Patterson Lake South Arm the HQ is at 1 for lake whitefish, aquatic invertebrates, and zooplankton. All other waterbodies in the downstream environment had HQs for copper below 1.

3) The estimated HQs for all COPCs for all birds and mammals at all locations remained below 1 for both the Application Case and reasonable upper bound sensitivity scenario.

4) Molybdenum in sediment at Patterson Lake North Arm – West Basin was predicted to exceed its REF screening value from Burnett-Seidel and Liber (2013) but was below its NE2 value for the far-future projection reasonable upper bound sensitivity scenario. Molybdenum was below the sediment screening values at all other downstream locations. Concentrations below the NE2 value for molybdenum indicate that benthic invertebrate community metrics (abundance, richness, and evenness) downstream of discharges are not expected to differ significantly (i.e., by less than 20%) from those observed at natural background conditions.

An HQ that is slightly above a value of one is not indicative of impending risk to aquatic animal communities at Patterson Lake North Arm – West Basin. The fresh water copper TRVs used for lake whitefish, benthic invertebrates, and zooplankton were all 0.002 mg/L (Section 6.3.1, Toxicological Benchmarks). These TRV correspond to the CCME's default water quality guideline for copper.

The CCME water quality guideline value is a hardness-based equation, but the default water quality guideline of 0.002 mg/L applies to soft water conditions, below a hardness value of 82 mg $CaCO_3$/L. In the far-future projection, water hardness in Patterson Lake North Arm – West Basin is expected to be near baseline levels, at or below 25 mg $CaCO_3$/L; therefore, the default CCME water quality guideline is applicable. It is a conservative benchmark for copper below which adverse population level effects for most aquatic biota are not expected to occur. The most sensitive species include fresh water snails (*Lymnaea stagnalis* and *Pyrgulopsis robusta*), bivalves (*Villosa iris*), and water flea (*Daphnia magna*; ECCC 2021). The most sensitive endpoints for chronic exposure to copper include growth for benthic invertebrates, reproduction for zooplankton, and growth and reproduction for fish (ECCC 2021). The CCME water quality guideline is based on no or low effect levels for the most sensitive species; thus, the marginal TRV exceedances predicted by HQs just above 1 indicate a possible slight reduction in growth or reproduction for exposed individuals of sensitive species in Patterson Lake North Arm – West Basin. Additionally, since the HQ exceedance is localized to Patterson Lake North Arm – West Basin, population level effects are not expected.

For benthic invertebrates that are in contact with lake sediments, the far-future projection for copper in sediment in Patterson Lake North Arm – West Basin (6.51 mg/kg dw for Application Case and 8.52 mg/kg dw for Upper Bound) was well below the sediment quality LEL guideline for copper (22 mg/kg dw; Thompson et al. 2005), indicating that benthic invertebrates are unlikely to be adversely affected by copper at the predicted exposure level.

Additional evaluation of this copper risk was completed in the aquatic health assessment (EIS Appendix 11A, Aquatic Health Assessment of the Potential for Adverse Effects of Predicted Far-Future Copper Concentrations in Patterson Lake), with the objective of informing an adaptive management plan for assessing and reducing uncertainty related to waste rock storage area seepage and increasing mitigations if necessary.

Table 6-23: Non-radiological Risk to Ecological Receptors – Application Case and Upper Bound Scenario – Operations

	Biota	Location	Maximum HQ Operations													
			Application Case							Upper Bound Scenario						
			Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium	Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium
Aquatic Animals	Benthic Invertebrate	Reference (Broach Lake)	1.00×10^{-03}	1.45×10^{-03}	8.50×10^{-04}	4.75×10^{-02}	4.18×10^{-01}	6.61×10^{-06}	3.57×10^{-03}	1.00×10^{-03}	1.45×10^{-03}	8.50×10^{-04}	4.75×10^{-02}	4.18×10^{-01}	6.61×10^{-06}	3.57×10^{-03}
		Patterson Lake North Arm – West Basin	1.03×10^{-02}	2.93×10^{-01}	2.59×10^{-03}	6.15×10^{-02}	4.86×10^{-01}	1.77×10^{-05}	1.17×10^{-02}	2.38×10^{-01}	2.96×10^{-01}	2.64×10^{-03}	6.20×10^{-02}	4.88×10^{-01}	4.03×10^{-05}	2.63×10^{-02}
		Patterson Lake South Arm	7.52×10^{-03}	1.99×10^{-01}	9.94×10^{-04}	5.49×10^{-02}	4.53×10^{-01}	1.23×10^{-05}	5.73×10^{-03}	1.70×10^{-01}	2.01×10^{-01}	9.98×10^{-04}	5.52×10^{-02}	4.54×10^{-01}	2.43×10^{-05}	9.60×10^{-03}
		Beet Lake	4.69×10^{-03}	1.13×10^{-01}	8.74×10^{-04}	5.14×10^{-02}	4.36×10^{-01}	9.53×10^{-06}	4.36×10^{-03}	9.63×10^{-02}	1.14×10^{-01}	8.74×10^{-04}	5.15×10^{-02}	4.37×10^{-01}	1.57×10^{-05}	5.78×10^{-03}
		Lloyd Lake	1.39×10^{-03}	1.33×10^{-02}	8.51×10^{-04}	4.79×10^{-02}	4.20×10^{-01}	6.91×10^{-06}	3.64×10^{-03}	1.10×10^{-02}	1.34×10^{-02}	8.52×10^{-04}	4.79×10^{-02}	4.20×10^{-01}	7.54×10^{-06}	3.77×10^{-03}
	Zooplankton	Reference (Broach Lake)	1.00×10^{-03}	2.50×10^{-03}	3.64×10^{-04}	5.25×10^{-02}	4.21×10^{-01}	6.66×10^{-06}	1.67×10^{-03}	1.00×10^{-03}	2.50×10^{-03}	3.64×10^{-04}	5.25×10^{-02}	4.21×10^{-01}	6.66×10^{-06}	1.67×10^{-03}
		Patterson Lake North Arm – West Basin	1.03×10^{-02}	5.04×10^{-01}	1.28×10^{-03}	6.94×10^{-02}	4.97×10^{-01}	1.93×10^{-05}	6.39×10^{-03}	2.38×10^{-01}	5.09×10^{-01}	1.31×10^{-03}	7.01×10^{-02}	5.00×10^{-01}	4.48×10^{-05}	1.54×10^{-02}
		Patterson Lake South Arm	7.52×10^{-03}	3.42×10^{-01}	4.40×10^{-04}	6.17×10^{-02}	4.61×10^{-01}	1.31×10^{-05}	2.94×10^{-03}	1.70×10^{-01}	3.45×10^{-01}	4.42×10^{-04}	6.21×10^{-02}	4.62×10^{-01}	2.63×10^{-05}	5.16×10^{-03}
		Beet Lake	4.69×10^{-03}	1.94×10^{-01}	3.76×10^{-04}	5.73×10^{-02}	4.42×10^{-01}	9.97×10^{-06}	2.14×10^{-03}	9.63×10^{-02}	1.96×10^{-01}	3.77×10^{-04}	5.75×10^{-02}	4.42×10^{-01}	1.68×10^{-05}	2.95×10^{-03}
		Lloyd Lake	1.39×10^{-03}	2.29×10^{-02}	3.65×10^{-04}	5.30×10^{-02}	4.23×10^{-01}	7.00×10^{-06}	1.71×10^{-03}	1.10×10^{-02}	2.30×10^{-02}	3.65×10^{-04}	5.30×10^{-02}	4.24×10^{-01}	7.70×10^{-06}	1.79×10^{-03}
	Northern Pike	Reference (Broach Lake)	4.27×10^{-04}	2.11×10^{-03}	1.96×10^{-04}	3.26×10^{-04}	2.81×10^{-01}	2.58×10^{-06}	1.82×10^{-04}	4.27×10^{-04}	2.11×10^{-03}	1.96×10^{-04}	3.26×10^{-04}	2.81×10^{-01}	2.58×10^{-06}	1.82×10^{-04}
		Patterson Lake North Arm – West Basin	4.39×10^{-03}	4.27×10^{-01}	6.92×10^{-04}	4.30×10^{-04}	3.32×10^{-01}	7.48×10^{-06}	6.97×10^{-04}	1.01×10^{-01}	4.31×10^{-01}	7.09×10^{-04}	4.34×10^{-04}	3.33×10^{-01}	1.74×10^{-05}	1.68×10^{-03}
		Patterson Lake South Arm	3.20×10^{-03}	2.90×10^{-01}	2.37×10^{-04}	3.82×10^{-04}	3.08×10^{-01}	5.08×10^{-06}	3.21×10^{-04}	7.24×10^{-02}	2.92×10^{-01}	2.38×10^{-04}	3.85×10^{-04}	3.08×10^{-01}	1.02×10^{-05}	5.63×10^{-04}
		Beet Lake	2.00×10^{-03}	1.64×10^{-01}	2.03×10^{-04}	3.55×10^{-04}	2.95×10^{-01}	3.86×10^{-06}	2.33×10^{-04}	4.10×10^{-02}	1.66×10^{-01}	2.03×10^{-04}	3.56×10^{-04}	2.95×10^{-01}	6.51×10^{-06}	3.22×10^{-04}
		Lloyd Lake	5.92×10^{-04}	1.93×10^{-02}	1.97×10^{-04}	3.29×10^{-04}	2.82×10^{-01}	2.71×10^{-06}	1.87×10^{-04}	4.70×10^{-03}	1.95×10^{-02}	1.97×10^{-04}	3.29×10^{-04}	2.82×10^{-01}	2.98×10^{-06}	1.95×10^{-04}
	Whitefish	Reference (Broach Lake)	6.09×10^{-04}	3.54×10^{-04}	9.65×10^{-04}	1.85×10^{-03}	4.21×10^{-01}	6.64×10^{-06}	6.62×10^{-05}	6.09×10^{-04}	3.54×10^{-04}	9.65×10^{-04}	1.85×10^{-03}	4.21×10^{-01}	6.64×10^{-06}	6.62×10^{-05}
		Patterson Lake North Arm – West Basin	6.27×10^{-03}	7.14×10^{-02}	3.30×10^{-03}	2.44×10^{-03}	4.95×10^{-01}	1.89×10^{-05}	2.44×10^{-04}	1.45×10^{-01}	7.21×10^{-02}	3.38×10^{-03}	2.46×10^{-03}	4.97×10^{-01}	4.37×10^{-05}	5.81×10^{-04}
		Patterson Lake South Arm	4.57×10^{-03}	4.85×10^{-02}	1.16×10^{-03}	2.17×10^{-03}	4.59×10^{-01}	1.29×10^{-05}	1.14×10^{-04}	1.03×10^{-01}	4.89×10^{-02}	1.16×10^{-03}	2.18×10^{-03}	4.60×10^{-01}	2.58×10^{-05}	1.98×10^{-04}
		Beet Lake	2.85×10^{-03}	2.75×10^{-02}	9.97×10^{-04}	2.02×10^{-03}	4.40×10^{-01}	9.86×10^{-06}	8.38×10^{-05}	5.85×10^{-02}	2.78×10^{-02}	9.97×10^{-04}	2.02×10^{-03}	4.41×10^{-01}	1.65×10^{-05}	1.15×10^{-04}
		Lloyd Lake	8.45×10^{-04}	3.24×10^{-03}	9.67×10^{-04}	1.87×10^{-03}	4.23×10^{-01}	6.98×10^{-06}	6.78×10^{-05}	6.71×10^{-03}	3.27×10^{-03}	9.67×10^{-04}	1.87×10^{-03}	4.23×10^{-01}	7.66×10^{-06}	7.07×10^{-05}
Aquatic Plants	Macrophytes	Reference (Broach Lake)	1.34×10^{-04}	4.59×10^{-04}	4.91×10^{-04}	6.07×10^{-02}	2.22×10^{-02}	6.66×10^{-06}	1.82×10^{-05}	1.34×10^{-04}	4.59×10^{-04}	4.91×10^{-04}	6.07×10^{-02}	2.22×10^{-02}	6.66×10^{-06}	1.82×10^{-05}
		Patterson Lake North Arm – West Basin	1.38×10^{-03}	9.26×10^{-02}	1.73×10^{-03}	8.03×10^{-02}	2.62×10^{-02}	1.93×10^{-05}	6.97×10^{-05}	3.18×10^{-02}	9.34×10^{-02}	1.77×10^{-03}	8.11×10^{-02}	2.63×10^{-02}	4.48×10^{-05}	1.68×10^{-04}
		Patterson Lake South Arm	1.01×10^{-03}	6.28×10^{-02}	5.93×10^{-04}	7.13×10^{-02}	2.43×10^{-02}	1.31×10^{-05}	3.21×10^{-05}	2.27×10^{-02}	6.34×10^{-02}	5.96×10^{-04}	7.17×10^{-02}	2.43×10^{-02}	2.63×10^{-05}	5.63×10^{-05}
		Beet Lake	6.27×10^{-04}	3.56×10^{-02}	5.08×10^{-04}	6.62×10^{-02}	2.33×10^{-02}	9.97×10^{-06}	2.33×10^{-05}	1.29×10^{-02}	3.60×10^{-02}	5.08×10^{-04}	6.65×10^{-02}	2.33×10^{-02}	1.68×10^{-05}	3.22×10^{-05}
		Lloyd Lake	1.86×10^{-04}	4.20×10^{-03}	4.92×10^{-04}	6.13×10^{-02}	2.23×10^{-02}	7.00×10^{-06}	1.87×10^{-05}	1.48×10^{-03}	4.23×10^{-03}	4.92×10^{-04}	6.13×10^{-02}	2.23×10^{-02}	7.70×10^{-06}	1.95×10^{-05}
	Phytoplankton	Reference (Broach Lake)	6.96×10^{-05}	3.99×10^{-04}	6.44×10^{-03}	1.27×10^{-02}	9.16×10^{-02}	6.66×10^{-06}	2.28×10^{-04}	6.96×10^{-05}	3.99×10^{-04}	6.44×10^{-03}	1.27×10^{-02}	9.16×10^{-02}	6.66×10^{-06}	2.28×10^{-04}
		Patterson Lake North Arm – West Basin	7.16×10^{-04}	8.05×10^{-02}	2.27×10^{-02}	1.68×10^{-02}	1.08×10^{-01}	1.93×10^{-05}	8.72×10^{-04}	1.65×10^{-02}	8.13×10^{-02}	2.33×10^{-02}	1.69×10^{-02}	1.09×10^{-01}	4.48×10^{-05}	2.10×10^{-03}
		Patterson Lake South Arm	5.22×10^{-04}	5.47×10^{-02}	7.79×10^{-03}	1.49×10^{-02}	1.00×10^{-01}	1.31×10^{-05}	4.01×10^{-04}	1.18×10^{-02}	5.52×10^{-02}	7.83×10^{-03}	1.50×10^{-02}	1.01×10^{-01}	2.63×10^{-05}	7.03×10^{-04}
		Beet Lake	3.26×10^{-04}	3.10×10^{-02}	6.66×10^{-03}	1.38×10^{-02}	9.61×10^{-02}	9.97×10^{-06}	2.92×10^{-04}	6.68×10^{-03}	3.13×10^{-02}	6.67×10^{-03}	1.39×10^{-02}	9.62×10^{-02}	1.68×10^{-05}	4.03×10^{-04}
		Lloyd Lake	1.78×10^{-04}	1.34×10^{-02}	6.46×10^{-03}	1.28×10^{-02}	9.21×10^{-02}	7.00×10^{-06}	2.34×10^{-04}	7.66×10^{-04}	1.35×10^{-02}	6.51×10^{-03}	1.28×10^{-02}	9.21×10^{-02}	7.70×10^{-06}	2.44×10^{-04}
Terrestrial Animals	Beaver	Reference (Broach Lake)	n/a	n/a	2.45×10^{-04}	2.94×10^{-04}	2.65×10^{-04}	3.09×10^{-04}	5.71×10^{-04}	n/a	n/a	2.45×10^{-04}	2.94×10^{-04}	2.65×10^{-04}	3.09×10^{-04}	5.71×10^{-04}
		Patterson Lake North Arm – West Basin	n/a	n/a	4.59×10^{-04}	3.43×10^{-04}	2.79×10^{-04}	3.96×10^{-04}	4.45×10^{-03}	n/a	n/a	4.65×10^{-04}	3.45×10^{-04}	2.79×10^{-04}	4.94×10^{-04}	4.68×10^{-03}
		Patterson Lake South Arm	n/a	n/a	2.64×10^{-04}	3.20×10^{-04}	2.69×10^{-04}	3.40×10^{-04}	1.14×10^{-03}	n/a	n/a	2.64×10^{-04}	3.21×10^{-04}	2.69×10^{-04}	3.92×10^{-04}	1.20×10^{-03}
		Beet Lake	n/a	n/a	2.49×10^{-04}	3.08×10^{-04}	2.67×10^{-04}	3.25×10^{-04}	8.99×10^{-04}	n/a	n/a	2.49×10^{-04}	3.09×10^{-04}	2.67×10^{-04}	3.51×10^{-04}	9.22×10^{-04}
		Lloyd Lake	n/a	n/a	2.46×10^{-04}	2.97×10^{-04}	2.65×10^{-04}	3.14×10^{-04}	5.84×10^{-04}	n/a	n/a	2.46×10^{-04}	2.97×10^{-04}	2.65×10^{-04}	3.16×10^{-04}	5.86×10^{-04}
	Black Bear	Reference (Broach Lake)	n/a	n/a	9.22×10^{-04}	8.71×10^{-05}	2.49×10^{-03}	1.44×10^{-04}	1.82×10^{-04}	n/a	n/a	9.22×10^{-04}	8.71×10^{-05}	2.49×10^{-03}	1.44×10^{-04}	1.82×10^{-04}
		Patterson Lake North Arm – West Basin	n/a	n/a	1.66×10^{-03}	9.70×10^{-05}	2.74×10^{-03}	1.62×10^{-04}	6.96×10^{-04}	n/a	n/a	1.69×10^{-03}	9.73×10^{-05}	2.75×10^{-03}	1.77×10^{-04}	7.54×10^{-04}
		Beet Lake	n/a	n/a	1.02×10^{-03}	1.06×10^{-04}	2.56×10^{-03}	1.76×10^{-04}	2.51×10^{-04}	n/a	n/a	1.02×10^{-03}	1.06×10^{-04}	2.56×10^{-03}	1.78×10^{-04}	2.55×10^{-04}
		Lloyd Lake	n/a	n/a	9.27×10^{-04}	9.04×10^{-05}	2.50×10^{-03}	1.50×10^{-04}	1.86×10^{-04}	n/a	n/a	9.27×10^{-04}	9.04×10^{-05}	2.50×10^{-03}	1.51×10^{-04}	1.87×10^{-04}
	Grey Wolf	Reference (Broach Lake)	n/a	n/a	2.46×10^{-03}	4.49×10^{-05}	2.88×10^{-03}	1.11×10^{-04}	6.66×10^{-05}	n/a	n/a	2.46×10^{-03}	4.49×10^{-05}	2.88×10^{-03}	1.11×10^{-04}	6.66×10^{-05}
		Patterson Lake North Arm – West Basin	n/a	n/a	2.91×10^{-03}	4.58×10^{-05}	2.93×10^{-03}	1.22×10^{-04}	2.14×10^{-04}	n/a	n/a	2.92×10^{-03}	4.58×10^{-05}	2.93×10^{-03}	1.32×10^{-04}	2.18×10^{-04}
		Lloyd Lake	n/a	n/a	2.50×10^{-03}	4.53×10^{-05}	2.89×10^{-03}	1.14×10^{-04}	6.87×10^{-05}	n/a	n/a	2.50×10^{-03}	4.53×10^{-05}	2.89×10^{-03}	1.14×10^{-04}	6.88×10^{-05}
	American Mink	Reference (Broach Lake)	n/a	n/a	3.77×10^{-03}	3.45×10^{-04}	1.99×10^{-02}	4.40×10^{-04}	1.93×10^{-04}	n/a	n/a	3.77×10^{-03}	3.45×10^{-04}	1.99×10^{-02}	4.40×10^{-04}	1.93×10^{-04}
		Patterson Lake North Arm – West Basin	n/a	n/a	1.13×10^{-02}	4.36×10^{-04}	2.31×10^{-02}	1.08×10^{-03}	7.43×10^{-04}	n/a	n/a	1.15×10^{-02}	4.39×10^{-04}	2.32×10^{-02}	2.37×10^{-03}	1.34×10^{-03}

Biota	Location	Maximum HQ Operations													
		Application Case							Upper Bound Scenario						
		Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium	Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium
	Patterson Lake South Arm	n/a	n/a	4.39×10^{-03}	3.93×10^{-04}	2.15×10^{-02}	7.67×10^{-04}	3.12×10^{-04}	n/a	n/a	4.41×10^{-03}	3.95×10^{-04}	2.16×10^{-02}	1.45×10^{-03}	4.70×10^{-04}
	Beet Lake	n/a	n/a	3.87×10^{-03}	3.70×10^{-04}	2.07×10^{-02}	6.08×10^{-04}	2.44×10^{-04}	n/a	n/a	3.87×10^{-03}	3.71×10^{-04}	2.07×10^{-02}	9.60×10^{-04}	3.02×10^{-04}
	Lloyd Lake	n/a	n/a	3.78×10^{-03}	3.47×10^{-04}	2.00×10^{-02}	4.58×10^{-04}	1.97×10^{-04}	n/a	n/a	3.78×10^{-03}	3.47×10^{-04}	2.00×10^{-02}	4.94×10^{-04}	2.02×10^{-04}
Moose	Reference (Broach Lake)	n/a	n/a	1.63×10^{-04}	2.11×10^{-04}	1.07×10^{-02}	1.41×10^{-04}	2.84×10^{-04}	n/a	n/a	1.63×10^{-04}	2.11×10^{-04}	1.07×10^{-02}	1.41×10^{-04}	2.84×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	3.79×10^{-04}	2.58×10^{-04}	1.15×10^{-02}	2.02×10^{-04}	2.08×10^{-03}	n/a	n/a	3.85×10^{-04}	2.60×10^{-04}	1.15×10^{-02}	2.92×10^{-04}	2.32×10^{-03}
	Patterson Lake South Arm	n/a	n/a	3.77×10^{-04}	2.55×10^{-04}	1.15×10^{-02}	1.94×10^{-04}	2.03×10^{-03}	n/a	n/a	3.83×10^{-04}	2.57×10^{-04}	1.15×10^{-02}	2.73×10^{-04}	2.27×10^{-03}
	Beet Lake	n/a	n/a	1.67×10^{-04}	2.25×10^{-04}	1.09×10^{-02}	1.54×10^{-04}	4.37×10^{-04}	n/a	n/a	1.67×10^{-04}	2.25×10^{-04}	1.09×10^{-02}	1.79×10^{-04}	4.60×10^{-04}
	Lloyd Lake	n/a	n/a	1.64×10^{-04}	2.13×10^{-04}	1.08×10^{-02}	1.44×10^{-04}	2.91×10^{-04}	n/a	n/a	1.64×10^{-04}	2.13×10^{-04}	1.08×10^{-02}	1.46×10^{-04}	2.93×10^{-04}
Muskrat	Reference (Broach Lake)	n/a	n/a	2.01×10^{-03}	1.19×10^{-03}	3.42×10^{-03}	9.60×10^{-04}	9.83×10^{-04}	n/a	n/a	2.01×10^{-03}	1.19×10^{-03}	3.42×10^{-03}	9.60×10^{-04}	9.83×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	6.18×10^{-03}	1.56×10^{-03}	3.98×10^{-03}	2.57×10^{-03}	3.25×10^{-03}	n/a	n/a	6.28×10^{-03}	1.57×10^{-03}	4.00×10^{-03}	5.87×10^{-03}	7.34×10^{-03}
	Patterson Lake South Arm	n/a	n/a	2.36×10^{-03}	1.39×10^{-03}	3.71×10^{-03}	1.79×10^{-03}	1.59×10^{-03}	n/a	n/a	2.36×10^{-03}	1.40×10^{-03}	3.72×10^{-03}	3.53×10^{-03}	2.67×10^{-03}
	Beet Lake	n/a	n/a	2.07×10^{-03}	1.29×10^{-03}	3.57×10^{-03}	1.39×10^{-03}	1.20×10^{-03}	n/a	n/a	2.07×10^{-03}	1.30×10^{-03}	3.58×10^{-03}	2.28×10^{-03}	1.60×10^{-03}
	Lloyd Lake	n/a	n/a	2.02×10^{-03}	1.20×10^{-03}	3.44×10^{-03}	1.00×10^{-03}	1.00×10^{-03}	n/a	n/a	2.02×10^{-03}	1.20×10^{-03}	3.44×10^{-03}	1.10×10^{-03}	1.04×10^{-03}
Red Fox	Reference (Broach Lake)	n/a	n/a	4.18×10^{-04}	3.66×10^{-05}	6.08×10^{-04}	1.22×10^{-04}	6.64×10^{-05}	n/a	n/a	4.18×10^{-04}	3.66×10^{-05}	6.08×10^{-04}	1.22×10^{-04}	6.64×10^{-05}
	Patterson Lake North Arm – West Basin	n/a	n/a	4.32×10^{-04}	3.82×10^{-05}	6.31×10^{-04}	1.46×10^{-04}	6.16×10^{-04}	n/a	n/a	4.32×10^{-04}	3.83×10^{-05}	6.31×10^{-04}	1.72×10^{-04}	6.24×10^{-04}
	Patterson Lake South Arm	n/a	n/a	4.20×10^{-04}	3.74×10^{-05}	6.12×10^{-04}	1.30×10^{-04}	1.45×10^{-04}	n/a	n/a	4.20×10^{-04}	3.75×10^{-05}	6.12×10^{-04}	1.44×10^{-04}	1.47×10^{-04}
	Beet Lake	n/a	n/a	4.19×10^{-04}	3.71×10^{-05}	6.11×10^{-04}	1.26×10^{-04}	1.13×10^{-04}	n/a	n/a	4.19×10^{-04}	3.71×10^{-05}	6.11×10^{-04}	1.33×10^{-04}	1.13×10^{-04}
	Lloyd Lake	n/a	n/a	4.19×10^{-04}	3.68×10^{-05}	6.09×10^{-04}	1.23×10^{-04}	6.81×10^{-05}	n/a	n/a	4.19×10^{-04}	3.68×10^{-05}	6.09×10^{-04}	1.24×10^{-04}	6.82×10^{-05}
Snowshoe Hare	Reference (Broach Lake)	n/a	n/a	1.43×10^{-03}	2.97×10^{-04}	1.06×10^{-03}	6.71×10^{-05}	9.42×10^{-04}	n/a	n/a	1.43×10^{-03}	2.97×10^{-04}	1.06×10^{-03}	6.71×10^{-05}	9.42×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	1.46×10^{-03}	3.02×10^{-04}	1.09×10^{-03}	7.69×10^{-05}	7.54×10^{-03}	n/a	n/a	1.46×10^{-03}	3.03×10^{-04}	1.09×10^{-03}	7.94×10^{-05}	7.55×10^{-03}
	Patterson Lake South Arm	n/a	n/a	1.44×10^{-03}	3.00×10^{-04}	1.06×10^{-03}	6.92×10^{-05}	1.89×10^{-03}	n/a	n/a	1.44×10^{-03}	3.00×10^{-04}	1.06×10^{-03}	7.05×10^{-05}	1.89×10^{-03}
	Beet Lake	n/a	n/a	1.44×10^{-03}	2.99×10^{-04}	1.06×10^{-03}	6.82×10^{-05}	1.50×10^{-03}	n/a	n/a	1.44×10^{-03}	3.00×10^{-04}	1.06×10^{-03}	6.88×10^{-05}	1.50×10^{-03}
	Lloyd Lake	n/a	n/a	1.44×10^{-03}	2.99×10^{-04}	1.06×10^{-03}	6.79×10^{-05}	9.63×10^{-04}	n/a	n/a	1.44×10^{-03}	2.99×10^{-04}	1.06×10^{-03}	6.79×10^{-05}	9.61×10^{-04}
Southern Red-Backed Vole	Reference (Broach Lake)	n/a	n/a	1.50×10^{-04}	1.05×10^{-04}	1.24×10^{-04}	5.79×10^{-04}	7.05×10^{-04}	n/a	n/a	1.50×10^{-04}	1.05×10^{-04}	1.24×10^{-04}	5.79×10^{-04}	7.05×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	1.53×10^{-04}	1.07×10^{-04}	1.28×10^{-04}	6.68×10^{-04}	5.45×10^{-03}	n/a	n/a	1.54×10^{-04}	1.07×10^{-04}	1.28×10^{-04}	7.10×10^{-04}	5.46×10^{-03}
	Patterson Lake South Arm	n/a	n/a	1.51×10^{-04}	1.06×10^{-04}	1.24×10^{-04}	6.01×10^{-04}	1.38×10^{-03}	n/a	n/a	1.51×10^{-04}	1.06×10^{-04}	1.24×10^{-04}	6.23×10^{-04}	1.39×10^{-03}
	Beet Lake	n/a	n/a	1.50×10^{-04}	1.06×10^{-04}	1.24×10^{-04}	5.90×10^{-04}	1.10×10^{-03}	n/a	n/a	1.50×10^{-04}	1.06×10^{-04}	1.24×10^{-04}	6.01×10^{-04}	1.11×10^{-03}
	Lloyd Lake	n/a	n/a	1.50×10^{-04}	1.06×10^{-04}	1.24×10^{-04}	5.85×10^{-04}	7.20×10^{-04}	n/a	n/a	1.50×10^{-04}	1.06×10^{-04}	1.24×10^{-04}	5.86×10^{-04}	7.20×10^{-04}
Woodland Caribou	Reference (Broach Lake)	n/a	n/a	3.79×10^{-04}	2.94×10^{-04}	1.19×10^{-02}	3.02×10^{-04}	3.16×10^{-04}	n/a	n/a	3.79×10^{-04}	2.94×10^{-04}	1.19×10^{-02}	3.02×10^{-04}	3.16×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	6.71×10^{-04}	3.51×10^{-04}	1.32×10^{-02}	5.95×10^{-04}	1.27×10^{-02}	n/a	n/a	6.79×10^{-04}	3.52×10^{-04}	1.32×10^{-02}	7.58×10^{-04}	1.30×10^{-02}
	Beet Lake	n/a	n/a	3.87×10^{-04}	3.07×10^{-04}	1.20×10^{-02}	3.33×10^{-04}	1.30×10^{-03}	n/a	n/a	3.87×10^{-04}	3.07×10^{-04}	1.20×10^{-02}	3.62×10^{-04}	1.32×10^{-03}
	Lloyd Lake	n/a	n/a	3.89×10^{-04}	3.06×10^{-04}	1.20×10^{-02}	3.39×10^{-04}	3.95×10^{-04}	n/a	n/a	3.89×10^{-04}	3.06×10^{-04}	1.20×10^{-02}	3.45×10^{-04}	4.00×10^{-04}
Grouse	Reference (Broach Lake)	n/a	n/a	1.79×10^{-03}	3.95×10^{-04}	1.51×10^{-03}	6.67×10^{-05}	3.96×10^{-04}	n/a	n/a	1.79×10^{-03}	3.95×10^{-04}	1.51×10^{-03}	6.67×10^{-05}	3.96×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	1.81×10^{-03}	4.00×10^{-04}	1.56×10^{-03}	7.46×10^{-05}	3.00×10^{-03}	n/a	n/a	1.81×10^{-03}	4.00×10^{-04}	1.56×10^{-03}	7.61×10^{-05}	3.01×10^{-03}
	Patterson Lake South Arm	n/a	n/a	1.79×10^{-03}	3.97×10^{-04}	1.52×10^{-03}	6.83×10^{-05}	7.69×10^{-04}	n/a	n/a	1.79×10^{-03}	3.97×10^{-04}	1.52×10^{-03}	6.90×10^{-05}	7.70×10^{-04}
	Beet Lake	n/a	n/a	1.79×10^{-03}	3.97×10^{-04}	1.51×10^{-03}	6.75×10^{-05}	6.16×10^{-04}	n/a	n/a	1.79×10^{-03}	3.97×10^{-04}	1.51×10^{-03}	6.79×10^{-05}	6.16×10^{-04}
	Lloyd Lake	n/a	n/a	1.79×10^{-03}	3.97×10^{-04}	1.51×10^{-03}	6.73×10^{-05}	4.05×10^{-04}	n/a	n/a	1.79×10^{-03}	3.97×10^{-04}	1.51×10^{-03}	6.74×10^{-05}	4.05×10^{-04}
Canada Goose	Reference (Broach Lake)	n/a	n/a	1.72×10^{-04}	3.93×10^{-05}	1.96×10^{-04}	1.24×10^{-05}	3.93×10^{-05}	n/a	n/a	1.72×10^{-04}	3.93×10^{-05}	1.96×10^{-04}	1.24×10^{-05}	3.93×10^{-05}
	Patterson Lake North Arm – West Basin	n/a	n/a	1.77×10^{-04}	4.03×10^{-05}	2.03×10^{-04}	1.45×10^{-05}	3.04×10^{-04}	n/a	n/a	1.77×10^{-04}	4.03×10^{-05}	2.03×10^{-04}	1.60×10^{-05}	3.05×10^{-04}
	Patterson Lake South Arm	n/a	n/a	1.73×10^{-04}	3.98×10^{-05}	1.98×10^{-04}	1.30×10^{-05}	7.72×10^{-05}	n/a	n/a	1.73×10^{-04}	3.98×10^{-05}	1.97×10^{-04}	1.37×10^{-05}	7.75×10^{-05}
	Beet Lake	n/a	n/a	1.73×10^{-04}	3.97×10^{-05}	1.97×10^{-04}	1.27×10^{-05}	6.16×10^{-05}	n/a	n/a	1.73×10^{-04}	3.97×10^{-05}	1.97×10^{-04}	1.31×10^{-05}	6.17×10^{-05}
	Lloyd Lake	n/a	n/a	1.72×10^{-04}	3.96×10^{-05}	1.97×10^{-04}	1.25×10^{-05}	4.02×10^{-05}	n/a	n/a	1.72×10^{-04}	3.96×10^{-05}	1.97×10^{-04}	1.26×10^{-05}	4.02×10^{-05}
Little Brown Myotis	Reference (Broach Lake)	n/a	n/a	9.07×10^{-03}	4.28×10^{-03}	2.80×10^{-01}	6.31×10^{-03}	8.52×10^{-04}	n/a	n/a	9.07×10^{-03}	4.28×10^{-03}	2.80×10^{-01}	6.31×10^{-03}	8.52×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	2.77×10^{-02}	5.53×10^{-03}	3.26×10^{-01}	1.69×10^{-02}	2.80×10^{-03}	n/a	n/a	2.81×10^{-02}	5.59×10^{-03}	3.27×10^{-01}	3.84×10^{-02}	6.28×10^{-03}
	Patterson Lake South Arm	n/a	n/a	1.06×10^{-02}	4.95×10^{-03}	3.03×10^{-01}	1.17×10^{-02}	1.37×10^{-03}	n/a	n/a	1.06×10^{-02}	4.97×10^{-03}	3.04×10^{-01}	2.32×10^{-02}	2.29×10^{-03}
	Beet Lake	n/a	n/a	9.32×10^{-03}	4.62×10^{-03}	2.92×10^{-01}	9.10×10^{-03}	1.04×10^{-03}	n/a	n/a	9.32×10^{-03}	4.64×10^{-03}	2.92×10^{-01}	1.50×10^{-02}	1.38×10^{-03}

	Biota	Location	Maximum HQ Operations													
			Application Case							Upper Bound Scenario						
			Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium	Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium
		Lloyd Lake	n/a	n/a	9.08×10^{-03}	4.31×10^{-03}	2.81×10^{-01}	6.59×10^{-03}	8.70×10^{-04}	n/a	n/a	9.08×10^{-03}	4.31×10^{-03}	2.81×10^{-01}	7.20×10^{-03}	9.00×10^{-04}
	Common Loon	Reference (Broach Lake)	n/a	n/a	1.31×10^{-03}	1.54×10^{-04}	4.62×10^{-03}	1.97×10^{-05}	2.11×10^{-05}	n/a	n/a	1.31×10^{-03}	1.54×10^{-04}	4.62×10^{-03}	1.97×10^{-05}	2.11×10^{-05}
		Patterson Lake North Arm – West Basin	n/a	n/a	4.52×10^{-03}	2.01×10^{-04}	5.39×10^{-03}	5.27×10^{-05}	7.64×10^{-05}	n/a	n/a	4.62×10^{-03}	2.03×10^{-04}	5.42×10^{-03}	1.20×10^{-04}	1.78×10^{-04}
		Patterson Lake South Arm	n/a	n/a	1.58×10^{-03}	1.79×10^{-04}	5.01×10^{-03}	3.67×10^{-05}	3.57×10^{-05}	n/a	n/a	1.58×10^{-03}	1.80×10^{-04}	5.02×10^{-03}	7.24×10^{-05}	6.16×10^{-05}
		Beet Lake	n/a	n/a	1.35×10^{-03}	1.67×10^{-04}	4.82×10^{-03}	2.84×10^{-05}	2.65×10^{-05}	n/a	n/a	1.35×10^{-03}	1.68×10^{-04}	4.82×10^{-03}	4.68×10^{-05}	3.60×10^{-05}
		Lloyd Lake	n/a	n/a	1.31×10^{-03}	1.56×10^{-04}	4.64×10^{-03}	2.06×10^{-05}	2.16×10^{-05}	n/a	n/a	1.31×10^{-03}	1.56×10^{-04}	4.64×10^{-03}	2.25×10^{-05}	2.25×10^{-05}
	Mallard	Reference (Broach Lake)	n/a	n/a	5.44×10^{-03}	1.85×10^{-03}	1.40×10^{-02}	3.13×10^{-04}	3.27×10^{-04}	n/a	n/a	5.44×10^{-03}	1.85×10^{-03}	1.40×10^{-02}	3.13×10^{-04}	3.27×10^{-04}
		Patterson Lake North Arm – West Basin	n/a	n/a	1.67×10^{-02}	2.41×10^{-03}	1.63×10^{-02}	8.38×10^{-04}	1.08×10^{-03}	n/a	n/a	1.70×10^{-02}	2.43×10^{-03}	1.64×10^{-02}	1.91×10^{-03}	2.44×10^{-03}
		Patterson Lake South Arm	n/a	n/a	6.37×10^{-03}	2.15×10^{-03}	1.52×10^{-02}	5.84×10^{-04}	5.26×10^{-04}	n/a	n/a	6.40×10^{-03}	2.16×10^{-03}	1.52×10^{-02}	1.15×10^{-03}	8.85×10^{-04}
		Beet Lake	n/a	n/a	5.59×10^{-03}	2.01×10^{-03}	1.46×10^{-02}	4.52×10^{-04}	4.00×10^{-04}	n/a	n/a	5.60×10^{-03}	2.01×10^{-03}	1.46×10^{-02}	7.44×10^{-04}	5.31×10^{-04}
		Lloyd Lake	n/a	n/a	5.45×10^{-03}	1.87×10^{-03}	1.41×10^{-02}	3.27×10^{-04}	3.33×10^{-04}	n/a	n/a	5.45×10^{-03}	1.87×10^{-03}	1.41×10^{-02}	3.57×10^{-04}	3.45×10^{-04}
	Rusty Blackbird	Reference (Broach Lake)	n/a	n/a	1.99×10^{-02}	8.87×10^{-03}	2.35×10^{-01}	1.76×10^{-03}	1.10×10^{-03}	n/a	n/a	1.99×10^{-02}	8.87×10^{-03}	2.35×10^{-01}	1.76×10^{-03}	1.10×10^{-03}
		Patterson Lake North Arm – West Basin	n/a	n/a	5.08×10^{-02}	1.12×10^{-02}	2.73×10^{-01}	4.35×10^{-03}	4.76×10^{-03}	n/a	n/a	5.16×10^{-02}	1.13×10^{-02}	2.74×10^{-01}	9.63×10^{-03}	7.15×10^{-03}
		Patterson Lake South Arm	n/a	n/a	2.24×10^{-02}	1.01×10^{-02}	2.55×10^{-01}	3.09×10^{-03}	1.78×10^{-03}	n/a	n/a	2.25×10^{-02}	1.02×10^{-02}	2.55×10^{-01}	5.89×10^{-03}	2.24×10^{-03}
		Beet Lake	n/a	n/a	2.03×10^{-02}	9.52×10^{-03}	2.45×10^{-01}	2.44×10^{-03}	1.42×10^{-03}	n/a	n/a	2.03×10^{-02}	9.54×10^{-03}	2.46×10^{-01}	3.88×10^{-03}	1.66×10^{-03}
		Lloyd Lake	n/a	n/a	1.99×10^{-02}	8.93×10^{-03}	2.36×10^{-01}	1.83×10^{-03}	1.12×10^{-03}	n/a	n/a	1.99×10^{-02}	8.94×10^{-03}	2.36×10^{-01}	1.98×10^{-03}	1.14×10^{-03}

n/a = not applicable; HQ = hazard quotient.

Table 6-24: Non-radiological Risk to Ecological Receptors – Application Case and Upper Bound Scenario – Far-Future Projection

	Biota	Location	Maximum HQ Far-Future													
			Application Case							Upper Bound Scenario						
			Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium	Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium
Aquatic Animals	Benthic Invertebrate	Reference (Broach Lake)	1.00×10^{-03}	1.45×10^{-03}	8.50×10^{-04}	4.75×10^{-02}	4.18×10^{-01}	6.61×10^{-06}	3.57×10^{-03}	1.00×10^{-03}	1.45×10^{-03}	8.50×10^{-04}	4.75×10^{-02}	4.18×10^{-01}	6.61×10^{-06}	3.57×10^{-03}
		Patterson Lake North Arm – West Basin	1.99×10^{-03}	2.95×10^{-03}	9.01×10^{-04}	1.16×10^{-01}	**$1.08 \times 10^{+00}$**	1.47×10^{-04}	3.57×10^{-02}	2.48×10^{-03}	3.82×10^{-03}	9.29×10^{-04}	1.53×10^{-01}	**$1.42 \times 10^{+00}$**	5.47×10^{-04}	3.58×10^{-02}
		Patterson Lake South Arm	1.73×10^{-03}	2.55×10^{-03}	8.54×10^{-04}	8.92×10^{-02}	8.08×10^{-01}	8.83×10^{-05}	1.25×10^{-02}	2.08×10^{-03}	3.19×10^{-03}	8.57×10^{-04}	1.11×10^{-01}	**$1.00 \times 10^{+00}$**	3.20×10^{-04}	1.25×10^{-02}
		Beet Lake	1.41×10^{-03}	2.07×10^{-03}	8.51×10^{-04}	6.96×10^{-02}	6.22×10^{-01}	4.92×10^{-05}	6.88×10^{-03}	1.61×10^{-03}	2.43×10^{-03}	8.51×10^{-04}	8.13×10^{-02}	7.25×10^{-01}	1.70×10^{-04}	6.88×10^{-03}
		Lloyd Lake	1.04×10^{-03}	1.52×10^{-03}	8.50×10^{-04}	4.98×10^{-02}	4.39×10^{-01}	1.09×10^{-05}	3.87×10^{-03}	1.07×10^{-03}	1.56×10^{-03}	8.50×10^{-04}	5.10×10^{-02}	4.50×10^{-01}	2.33×10^{-05}	3.87×10^{-03}
	Zooplankton	Reference (Broach Lake)	1.00×10^{-03}	2.50×10^{-03}	3.64×10^{-04}	5.25×10^{-02}	4.21×10^{-01}	6.66×10^{-06}	1.67×10^{-03}	1.00×10^{-03}	2.50×10^{-03}	3.64×10^{-04}	5.25×10^{-02}	4.21×10^{-01}	6.66×10^{-06}	1.67×10^{-03}
		Patterson Lake North Arm – West Basin	1.99×10^{-03}	5.07×10^{-03}	3.86×10^{-04}	1.29×10^{-01}	**$1.09 \times 10^{+00}$**	1.49×10^{-04}	1.67×10^{-02}	2.48×10^{-03}	6.57×10^{-03}	3.98×10^{-04}	1.69×10^{-01}	**$1.43 \times 10^{+00}$**	5.51×10^{-04}	1.67×10^{-02}
		Patterson Lake South Arm	1.73×10^{-03}	4.38×10^{-03}	3.66×10^{-04}	9.87×10^{-02}	8.14×10^{-01}	8.90×10^{-05}	5.84×10^{-03}	2.08×10^{-03}	5.48×10^{-03}	3.67×10^{-04}	1.23×10^{-01}	**$1.01 \times 10^{+00}$**	3.23×10^{-04}	5.84×10^{-03}
		Beet Lake	1.41×10^{-03}	3.56×10^{-03}	3.64×10^{-04}	7.70×10^{-02}	6.27×10^{-01}	4.95×10^{-05}	3.22×10^{-03}	1.61×10^{-03}	4.18×10^{-03}	3.64×10^{-04}	8.99×10^{-02}	7.30×10^{-01}	1.71×10^{-04}	3.22×10^{-03}
		Lloyd Lake	1.04×10^{-03}	2.61×10^{-03}	3.64×10^{-04}	5.50×10^{-02}	4.42×10^{-01}	1.10×10^{-05}	1.81×10^{-03}	1.07×10^{-03}	2.67×10^{-03}	3.64×10^{-04}	5.64×10^{-02}	4.53×10^{-01}	2.34×10^{-05}	1.81×10^{-03}
	Northern Pike	Reference (Broach Lake)	4.27×10^{-04}	2.11×10^{-03}	1.96×10^{-04}	3.26×10^{-04}	2.81×10^{-01}	2.58×10^{-06}	1.82×10^{-04}	4.27×10^{-04}	2.11×10^{-03}	1.96×10^{-04}	3.26×10^{-04}	2.81×10^{-01}	2.58×10^{-06}	1.82×10^{-04}
		Patterson Lake North Arm – West Basin	8.49×10^{-04}	4.30×10^{-03}	2.08×10^{-04}	7.97×10^{-04}	7.27×10^{-01}	5.75×10^{-05}	1.83×10^{-03}	1.05×10^{-03}	5.56×10^{-03}	2.15×10^{-04}	1.05×10^{-03}	9.51×10^{-01}	2.14×10^{-04}	1.83×10^{-03}
		Patterson Lake South Arm	7.35×10^{-04}	3.71×10^{-03}	1.97×10^{-04}	6.12×10^{-04}	5.43×10^{-01}	3.45×10^{-05}	6.37×10^{-04}	8.86×10^{-04}	4.64×10^{-03}	1.98×10^{-04}	7.64×10^{-04}	6.74×10^{-01}	1.25×10^{-04}	6.37×10^{-04}
		Beet Lake	6.01×10^{-04}	3.01×10^{-03}	1.97×10^{-04}	4.77×10^{-04}	4.18×10^{-01}	1.92×10^{-05}	3.51×10^{-04}	6.85×10^{-04}	3.53×10^{-03}	1.97×10^{-04}	5.57×10^{-04}	4.87×10^{-01}	6.64×10^{-05}	3.52×10^{-04}
		Lloyd Lake	4.45×10^{-04}	2.21×10^{-03}	1.96×10^{-04}	3.41×10^{-04}	2.95×10^{-01}	4.27×10^{-06}	1.98×10^{-04}	4.54×10^{-04}	2.26×10^{-03}	1.96×10^{-04}	3.49×10^{-04}	3.02×10^{-01}	9.08×10^{-06}	1.98×10^{-04}
	Whitefish	Reference (Broach Lake)	6.09×10^{-04}	3.54×10^{-04}	9.65×10^{-04}	1.85×10^{-03}	4.21×10^{-01}	6.64×10^{-06}	6.62×10^{-05}	6.09×10^{-04}	3.54×10^{-04}	9.65×10^{-04}	1.85×10^{-03}	4.21×10^{-01}	6.64×10^{-06}	6.62×10^{-05}
		Patterson Lake North Arm – West Basin	1.21×10^{-03}	7.19×10^{-04}	1.02×10^{-03}	4.54×10^{-03}	**$1.09 \times 10^{+00}$**	1.48×10^{-04}	6.63×10^{-04}	1.50×10^{-03}	9.31×10^{-04}	1.05×10^{-03}	5.97×10^{-03}	**$1.42 \times 10^{+00}$**	5.50×10^{-04}	6.63×10^{-04}
		Patterson Lake South Arm	1.05×10^{-03}	6.21×10^{-04}	9.70×10^{-04}	3.48×10^{-03}	8.12×10^{-01}	8.88×10^{-05}	2.31×10^{-04}	1.26×10^{-03}	7.76×10^{-04}	9.73×10^{-04}	4.35×10^{-03}	**$1.01 \times 10^{+00}$**	3.22×10^{-04}	2.31×10^{-04}
		Beet Lake	8.57×10^{-04}	5.04×10^{-04}	9.66×10^{-04}	2.72×10^{-03}	6.25×10^{-01}	4.94×10^{-05}	1.28×10^{-04}	9.78×10^{-04}	5.92×10^{-04}	9.66×10^{-04}	3.17×10^{-03}	7.28×10^{-01}	1.71×10^{-04}	1.28×10^{-04}
		Lloyd Lake	6.35×10^{-04}	3.70×10^{-04}	9.65×10^{-04}	1.94×10^{-03}	4.42×10^{-01}	1.10×10^{-05}	7.18×10^{-05}	6.47×10^{-04}	3.79×10^{-04}	9.65×10^{-04}	1.99×10^{-03}	4.52×10^{-01}	2.34×10^{-05}	7.18×10^{-05}
Aquatic Plants	Macrophytes	Reference (Broach Lake)	1.34×10^{-04}	4.59×10^{-04}	4.91×10^{-04}	6.07×10^{-02}	2.22×10^{-02}	6.66×10^{-06}	1.82×10^{-05}	1.34×10^{-04}	4.59×10^{-04}	4.91×10^{-04}	6.07×10^{-02}	2.22×10^{-02}	6.66×10^{-06}	1.82×10^{-05}
		Patterson Lake North Arm – West Basin	2.66×10^{-04}	9.32×10^{-04}	5.21×10^{-04}	1.49×10^{-01}	5.74×10^{-02}	1.49×10^{-04}	1.83×10^{-04}	3.31×10^{-04}	1.21×10^{-03}	5.37×10^{-04}	1.95×10^{-01}	7.51×10^{-02}	5.51×10^{-04}	1.83×10^{-04}
		Patterson Lake South Arm	2.31×10^{-04}	8.05×10^{-04}	4.93×10^{-04}	1.14×10^{-01}	4.28×10^{-02}	8.90×10^{-05}	6.37×10^{-05}	2.78×10^{-04}	1.01×10^{-03}	4.95×10^{-04}	1.43×10^{-01}	5.32×10^{-02}	3.23×10^{-04}	6.37×10^{-05}
		Beet Lake	1.89×10^{-04}	6.54×10^{-04}	4.91×10^{-04}	8.90×10^{-02}	3.30×10^{-02}	4.95×10^{-05}	3.51×10^{-05}	2.15×10^{-04}	7.67×10^{-04}	4.92×10^{-04}	1.04×10^{-01}	3.84×10^{-02}	1.71×10^{-04}	3.52×10^{-05}
		Lloyd Lake	1.40×10^{-04}	4.79×10^{-04}	4.91×10^{-04}	6.36×10^{-02}	2.33×10^{-02}	1.10×10^{-05}	1.98×10^{-05}	1.42×10^{-04}	4.91×10^{-04}	4.91×10^{-04}	6.52×10^{-02}	2.38×10^{-02}	2.34×10^{-05}	1.98×10^{-05}
	Phytoplankton	Reference (Broach Lake)	6.96×10^{-05}	3.99×10^{-04}	6.44×10^{-03}	1.27×10^{-02}	9.16×10^{-02}	6.66×10^{-06}	2.28×10^{-04}	6.96×10^{-05}	3.99×10^{-04}	6.44×10^{-03}	1.27×10^{-02}	9.16×10^{-02}	6.66×10^{-06}	2.28×10^{-04}
		Patterson Lake North Arm – West Basin	1.38×10^{-04}	8.11×10^{-04}	6.83×10^{-03}	3.10×10^{-02}	2.37×10^{-01}	1.49×10^{-04}	2.28×10^{-03}	1.72×10^{-04}	1.05×10^{-03}	7.04×10^{-03}	4.08×10^{-02}	3.10×10^{-01}	5.51×10^{-04}	2.28×10^{-03}
		Patterson Lake South Arm	1.20×10^{-04}	7.00×10^{-04}	6.48×10^{-03}	2.38×10^{-02}	1.77×10^{-01}	8.90×10^{-05}	7.96×10^{-04}	1.44×10^{-04}	8.75×10^{-04}	6.49×10^{-03}	2.97×10^{-02}	2.20×10^{-01}	3.23×10^{-04}	7.97×10^{-04}
		Beet Lake	9.79×10^{-05}	5.69×10^{-04}	6.45×10^{-03}	1.86×10^{-02}	1.36×10^{-01}	4.95×10^{-05}	4.39×10^{-04}	1.12×10^{-04}	6.67×10^{-04}	6.45×10^{-03}	2.17×10^{-02}	1.59×10^{-01}	1.71×10^{-04}	4.39×10^{-04}
		Lloyd Lake	8.15×10^{-05}	4.70×10^{-04}	6.44×10^{-03}	1.33×10^{-02}	9.62×10^{-02}	1.10×10^{-05}	2.47×10^{-04}	8.73×10^{-05}	5.12×10^{-04}	6.44×10^{-03}	1.36×10^{-02}	9.84×10^{-02}	2.34×10^{-05}	2.47×10^{-04}
Terrestrial Animals	Beaver	Reference (Broach Lake)	n/a	n/a	2.45×10^{-04}	2.94×10^{-04}	2.65×10^{-04}	3.09×10^{-04}	5.71×10^{-04}	n/a	n/a	2.45×10^{-04}	2.94×10^{-04}	2.65×10^{-04}	3.09×10^{-04}	5.71×10^{-04}
		Patterson Lake North Arm – West Basin	n/a	n/a	2.51×10^{-04}	5.04×10^{-04}	3.16×10^{-04}	8.92×10^{-04}	1.27×10^{-03}	n/a	n/a	2.54×10^{-04}	6.15×10^{-04}	3.41×10^{-04}	2.55×10^{-03}	1.27×10^{-03}
		Patterson Lake South Arm	n/a	n/a	2.46×10^{-04}	4.21×10^{-04}	2.94×10^{-04}	6.47×10^{-04}	7.32×10^{-04}	n/a	n/a	2.46×10^{-04}	4.89×10^{-04}	3.09×10^{-04}	1.61×10^{-03}	7.32×10^{-04}
		Beet Lake	n/a	n/a	2.45×10^{-04}	3.62×10^{-04}	2.80×10^{-04}	4.85×10^{-04}	6.38×10^{-04}	n/a	n/a	2.45×10^{-04}	3.97×10^{-04}	2.88×10^{-04}	9.86×10^{-04}	6.38×10^{-04}
		Lloyd Lake	n/a	n/a	2.45×10^{-04}	3.01×10^{-04}	2.66×10^{-04}	3.27×10^{-04}	5.76×10^{-04}	n/a	n/a	2.45×10^{-04}	3.05×10^{-04}	2.67×10^{-04}	3.78×10^{-04}	5.76×10^{-04}
	Black Bear	Reference (Broach Lake)	n/a	n/a	9.22×10^{-04}	8.71×10^{-05}	2.49×10^{-03}	1.44×10^{-04}	1.82×10^{-04}	n/a	n/a	9.22×10^{-04}	8.71×10^{-05}	2.49×10^{-03}	1.44×10^{-04}	1.82×10^{-04}
		Patterson Lake North Arm – West Basin	n/a	n/a	9.42×10^{-04}	1.22×10^{-04}	4.69×10^{-03}	2.34×10^{-04}	3.20×10^{-04}	n/a	n/a	9.52×10^{-04}	1.39×10^{-04}	5.79×10^{-03}	4.77×10^{-04}	3.20×10^{-04}
		Beet Lake	n/a	n/a	1.01×10^{-03}	1.11×10^{-04}	2.94×10^{-03}	1.91×10^{-04}	2.15×10^{-04}	n/a	n/a	1.01×10^{-03}	1.15×10^{-04}	3.16×10^{-03}	2.37×10^{-04}	2.15×10^{-04}
		Lloyd Lake	n/a	n/a	9.25×10^{-04}	9.13×10^{-05}	2.58×10^{-03}	1.53×10^{-04}	1.85×10^{-04}	n/a	n/a	9.25×10^{-04}	9.21×10^{-05}	2.63×10^{-03}	1.63×10^{-04}	1.85×10^{-04}
	Grey Wolf	Reference (Broach Lake)	n/a	n/a	2.46×10^{-03}	4.49×10^{-05}	2.88×10^{-03}	1.11×10^{-04}	6.66×10^{-05}	n/a	n/a	2.46×10^{-03}	4.49×10^{-05}	2.88×10^{-03}	1.11×10^{-04}	6.66×10^{-05}
		Patterson Lake North Arm – West Basin	n/a	n/a	2.47×10^{-03}	4.81×10^{-05}	2.98×10^{-03}	1.72×10^{-04}	8.09×10^{-05}	n/a	n/a	2.48×10^{-03}	4.98×10^{-05}	3.03×10^{-03}	3.46×10^{-04}	8.09×10^{-05}
		Lloyd Lake	n/a	n/a	2.46×10^{-03}	4.53×10^{-05}	2.89×10^{-03}	1.17×10^{-04}	6.69×10^{-05}	n/a	n/a	2.46×10^{-03}	4.55×10^{-05}	2.89×10^{-03}	1.33×10^{-04}	6.69×10^{-05}

Biota	Location	Maximum HQ Far-Future													
		Application Case							Upper Bound Scenario						
		Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium	Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium
American Mink	Reference (Broach Lake)	n/a	n/a	3.77×10^{-03}	3.45×10^{-04}	1.99×10^{-02}	4.40×10^{-04}	1.93×10^{-04}	n/a	n/a	3.77×10^{-03}	3.45×10^{-04}	1.99×10^{-02}	4.40×10^{-04}	1.93×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	3.98×10^{-03}	7.90×10^{-04}	5.13×10^{-02}	8.48×10^{-03}	1.50×10^{-03}	n/a	n/a	4.10×10^{-03}	1.03×10^{-03}	6.71×10^{-02}	3.13×10^{-02}	1.50×10^{-03}
	Patterson Lake South Arm	n/a	n/a	3.79×10^{-03}	6.15×10^{-04}	3.83×10^{-02}	5.11×10^{-03}	5.52×10^{-04}	n/a	n/a	3.80×10^{-03}	7.58×10^{-04}	4.76×10^{-02}	1.84×10^{-02}	5.52×10^{-04}
	Beet Lake	n/a	n/a	3.77×10^{-03}	4.87×10^{-04}	2.95×10^{-02}	2.87×10^{-03}	3.27×10^{-04}	n/a	n/a	3.78×10^{-03}	5.64×10^{-04}	3.44×10^{-02}	9.77×10^{-03}	3.27×10^{-04}
	Lloyd Lake	n/a	n/a	3.77×10^{-03}	3.59×10^{-04}	2.08×10^{-02}	6.88×10^{-04}	2.05×10^{-04}	n/a	n/a	3.77×10^{-03}	3.67×10^{-04}	2.13×10^{-02}	1.39×10^{-03}	2.05×10^{-04}
Moose	Reference (Broach Lake)	n/a	n/a	1.63×10^{-04}	2.11×10^{-04}	1.07×10^{-02}	1.41×10^{-04}	2.84×10^{-04}	n/a	n/a	1.63×10^{-04}	2.11×10^{-04}	1.07×10^{-02}	1.41×10^{-04}	2.84×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	1.69×10^{-04}	4.20×10^{-04}	1.48×10^{-02}	6.77×10^{-04}	8.61×10^{-04}	n/a	n/a	1.73×10^{-04}	5.31×10^{-04}	1.68×10^{-02}	2.20×10^{-03}	8.62×10^{-04}
	Patterson Lake South Arm	n/a	n/a	1.69×10^{-04}	4.14×10^{-04}	1.47×10^{-02}	6.16×10^{-04}	8.46×10^{-04}	n/a	n/a	1.72×10^{-04}	5.24×10^{-04}	1.67×10^{-02}	1.97×10^{-03}	8.47×10^{-04}
	Beet Lake	n/a	n/a	1.64×10^{-04}	2.78×10^{-04}	1.20×10^{-02}	3.03×10^{-04}	3.41×10^{-04}	n/a	n/a	1.64×10^{-04}	3.14×10^{-04}	1.26×10^{-02}	7.63×10^{-04}	3.42×10^{-04}
	Lloyd Lake	n/a	n/a	1.63×10^{-04}	2.18×10^{-04}	1.09×10^{-02}	1.58×10^{-04}	2.89×10^{-04}	n/a	n/a	1.63×10^{-04}	2.22×10^{-04}	1.09×10^{-02}	2.05×10^{-04}	2.89×10^{-04}
Muskrat	Reference (Broach Lake)	n/a	n/a	2.01×10^{-03}	1.19×10^{-03}	3.42×10^{-03}	9.60×10^{-04}	9.83×10^{-04}	n/a	n/a	2.01×10^{-03}	1.19×10^{-03}	3.42×10^{-03}	9.60×10^{-04}	9.83×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	2.13×10^{-03}	2.92×10^{-03}	8.86×10^{-03}	2.14×10^{-02}	9.84×10^{-03}	n/a	n/a	2.20×10^{-03}	3.84×10^{-03}	1.16×10^{-02}	7.95×10^{-02}	9.85×10^{-03}
	Patterson Lake South Arm	n/a	n/a	2.02×10^{-03}	2.24×10^{-03}	6.61×10^{-03}	1.28×10^{-02}	3.43×10^{-03}	n/a	n/a	2.03×10^{-03}	2.80×10^{-03}	8.22×10^{-03}	4.65×10^{-02}	3.44×10^{-03}
	Beet Lake	n/a	n/a	2.01×10^{-03}	1.75×10^{-03}	5.09×10^{-03}	7.14×10^{-03}	1.89×10^{-03}	n/a	n/a	2.01×10^{-03}	2.04×10^{-03}	5.93×10^{-03}	2.47×10^{-02}	1.90×10^{-03}
	Lloyd Lake	n/a	n/a	2.01×10^{-03}	1.25×10^{-03}	3.59×10^{-03}	1.59×10^{-03}	1.07×10^{-03}	n/a	n/a	2.01×10^{-03}	1.28×10^{-03}	3.68×10^{-03}	3.38×10^{-03}	1.07×10^{-03}
Red Fox	Reference (Broach Lake)	n/a	n/a	4.18×10^{-04}	3.66×10^{-05}	6.08×10^{-04}	1.22×10^{-04}	6.64×10^{-05}	n/a	n/a	4.18×10^{-04}	3.66×10^{-05}	6.08×10^{-04}	1.22×10^{-04}	6.64×10^{-05}
	Patterson Lake North Arm – West Basin	n/a	n/a	4.18×10^{-04}	4.21×10^{-05}	6.19×10^{-04}	2.67×10^{-04}	1.09×10^{-04}	n/a	n/a	4.18×10^{-04}	4.50×10^{-05}	6.24×10^{-04}	6.78×10^{-04}	1.09×10^{-04}
	Patterson Lake South Arm	n/a	n/a	4.18×10^{-04}	3.99×10^{-05}	6.14×10^{-04}	2.06×10^{-04}	7.44×10^{-05}	n/a	n/a	4.18×10^{-04}	4.17×10^{-05}	6.17×10^{-04}	4.45×10^{-04}	7.44×10^{-05}
	Beet Lake	n/a	n/a	4.18×10^{-04}	3.84×10^{-05}	6.11×10^{-04}	1.66×10^{-04}	7.03×10^{-05}	n/a	n/a	4.18×10^{-04}	3.93×10^{-05}	6.12×10^{-04}	2.90×10^{-04}	7.03×10^{-05}
	Lloyd Lake	n/a	n/a	4.18×10^{-04}	3.68×10^{-05}	6.08×10^{-04}	1.27×10^{-04}	6.66×10^{-05}	n/a	n/a	4.18×10^{-04}	3.69×10^{-05}	6.08×10^{-04}	1.39×10^{-04}	6.66×10^{-05}
Snowshoe Hare	Reference (Broach Lake)	n/a	n/a	1.43×10^{-03}	2.97×10^{-04}	1.06×10^{-03}	6.71×10^{-05}	9.42×10^{-04}	n/a	n/a	1.43×10^{-03}	2.97×10^{-04}	1.06×10^{-03}	6.71×10^{-05}	9.42×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	1.43×10^{-03}	3.04×10^{-04}	1.06×10^{-03}	8.10×10^{-05}	1.38×10^{-03}	n/a	n/a	1.43×10^{-03}	3.07×10^{-04}	1.06×10^{-03}	1.20×10^{-04}	1.38×10^{-03}
	Patterson Lake South Arm	n/a	n/a	1.43×10^{-03}	3.01×10^{-04}	1.06×10^{-03}	7.52×10^{-05}	1.01×10^{-03}	n/a	n/a	1.43×10^{-03}	3.03×10^{-04}	1.06×10^{-03}	9.80×10^{-05}	1.01×10^{-03}
	Beet Lake	n/a	n/a	1.43×10^{-03}	2.99×10^{-04}	1.06×10^{-03}	7.13×10^{-05}	9.78×10^{-04}	n/a	n/a	1.43×10^{-03}	3.00×10^{-04}	1.06×10^{-03}	8.32×10^{-05}	9.78×10^{-04}
	Lloyd Lake	n/a	n/a	1.43×10^{-03}	2.98×10^{-04}	1.06×10^{-03}	6.76×10^{-05}	9.43×10^{-04}	n/a	n/a	1.43×10^{-03}	2.98×10^{-04}	1.06×10^{-03}	6.88×10^{-05}	9.43×10^{-04}
Southern Red-Backed Vole	Reference (Broach Lake)	n/a	n/a	1.50×10^{-04}	1.05×10^{-04}	1.24×10^{-04}	5.79×10^{-04}	7.05×10^{-04}	n/a	n/a	1.50×10^{-04}	1.05×10^{-04}	1.24×10^{-04}	5.79×10^{-04}	7.05×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	1.50×10^{-04}	1.10×10^{-04}	1.25×10^{-04}	8.14×10^{-04}	1.04×10^{-03}	n/a	n/a	1.50×10^{-04}	1.12×10^{-04}	1.25×10^{-04}	1.48×10^{-03}	1.04×10^{-03}
	Patterson Lake South Arm	n/a	n/a	1.50×10^{-04}	1.08×10^{-04}	1.24×10^{-04}	7.15×10^{-04}	7.56×10^{-04}	n/a	n/a	1.50×10^{-04}	1.09×10^{-04}	1.24×10^{-04}	1.10×10^{-03}	7.56×10^{-04}
	Beet Lake	n/a	n/a	1.50×10^{-04}	1.07×10^{-04}	1.24×10^{-04}	6.50×10^{-04}	7.33×10^{-04}	n/a	n/a	1.50×10^{-04}	1.07×10^{-04}	1.24×10^{-04}	8.52×10^{-04}	7.33×10^{-04}
	Lloyd Lake	n/a	n/a	1.50×10^{-04}	1.05×10^{-04}	1.24×10^{-04}	5.86×10^{-04}	7.06×10^{-04}	n/a	n/a	1.50×10^{-04}	1.05×10^{-04}	1.24×10^{-04}	6.06×10^{-04}	7.06×10^{-04}
Woodland Caribou	Reference (Broach Lake)	n/a	n/a	3.79×10^{-04}	2.94×10^{-04}	1.19×10^{-02}	3.02×10^{-04}	3.16×10^{-04}	n/a	n/a	3.79×10^{-04}	2.94×10^{-04}	1.19×10^{-02}	3.02×10^{-04}	3.16×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	3.87×10^{-04}	4.96×10^{-04}	1.56×10^{-02}	1.35×10^{-03}	1.09×10^{-03}	n/a	n/a	3.91×10^{-04}	6.04×10^{-04}	1.75×10^{-02}	4.33×10^{-03}	1.09×10^{-03}
	Beet Lake	n/a	n/a	3.79×10^{-04}	3.35×10^{-04}	1.26×10^{-02}	5.05×10^{-04}	3.80×10^{-04}	n/a	n/a	3.79×10^{-04}	3.57×10^{-04}	1.30×10^{-02}	1.08×10^{-03}	3.80×10^{-04}
	Lloyd Lake	n/a	n/a	3.79×10^{-04}	3.03×10^{-04}	1.20×10^{-02}	3.45×10^{-04}	3.28×10^{-04}	n/a	n/a	3.79×10^{-04}	3.08×10^{-04}	1.21×10^{-02}	4.67×10^{-04}	3.28×10^{-04}
Grouse	Reference (Broach Lake)	n/a	n/a	1.79×10^{-03}	3.95×10^{-04}	1.51×10^{-03}	6.67×10^{-05}	3.96×10^{-04}	n/a	n/a	1.79×10^{-03}	3.95×10^{-04}	1.51×10^{-03}	6.67×10^{-05}	3.96×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	1.79×10^{-03}	4.00×10^{-04}	1.51×10^{-03}	7.47×10^{-05}	5.77×10^{-04}	n/a	n/a	1.79×10^{-03}	4.02×10^{-04}	1.51×10^{-03}	9.73×10^{-05}	5.77×10^{-04}
	Patterson Lake South Arm	n/a	n/a	1.79×10^{-03}	3.98×10^{-04}	1.51×10^{-03}	7.13×10^{-05}	4.23×10^{-04}	n/a	n/a	1.79×10^{-03}	3.99×10^{-04}	1.51×10^{-03}	8.44×10^{-05}	4.23×10^{-04}
	Beet Lake	n/a	n/a	1.79×10^{-03}	3.96×10^{-04}	1.51×10^{-03}	6.91×10^{-05}	4.12×10^{-04}	n/a	n/a	1.79×10^{-03}	3.97×10^{-04}	1.51×10^{-03}	7.59×10^{-05}	4.12×10^{-04}
	Lloyd Lake	n/a	n/a	1.79×10^{-03}	3.95×10^{-04}	1.51×10^{-03}	6.69×10^{-05}	3.97×10^{-04}	n/a	n/a	1.79×10^{-03}	3.95×10^{-04}	1.51×10^{-03}	6.76×10^{-05}	3.97×10^{-04}
Canada Goose	Reference (Broach Lake)	n/a	n/a	1.72×10^{-04}	3.93×10^{-05}	1.96×10^{-04}	1.24×10^{-05}	3.93×10^{-05}	n/a	n/a	1.72×10^{-04}	3.93×10^{-05}	1.96×10^{-04}	1.24×10^{-05}	3.93×10^{-05}
	Patterson Lake North Arm – West Basin	n/a	n/a	1.72×10^{-04}	4.17×10^{-05}	1.99×10^{-04}	2.05×10^{-05}	5.89×10^{-05}	n/a	n/a	1.72×10^{-04}	4.30×10^{-05}	2.00×10^{-04}	4.35×10^{-05}	5.89×10^{-05}
	Patterson Lake South Arm	n/a	n/a	1.72×10^{-04}	4.08×10^{-05}	1.97×10^{-04}	1.71×10^{-05}	4.24×10^{-05}	n/a	n/a	1.72×10^{-04}	4.15×10^{-05}	1.98×10^{-04}	3.04×10^{-05}	4.24×10^{-05}
	Beet Lake	n/a	n/a	1.72×10^{-04}	4.01×10^{-05}	1.97×10^{-04}	1.48×10^{-05}	4.10×10^{-05}	n/a	n/a	1.72×10^{-04}	4.05×10^{-05}	1.97×10^{-04}	2.18×10^{-05}	4.10×10^{-05}

	Biota	Location	Maximum HQ Far-Future													
			Application Case							Upper Bound Scenario						
			Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium	Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium
		Lloyd Lake	n/a	n/a	1.72×10^{-04}	3.95×10^{-05}	1.96×10^{-04}	1.26×10^{-05}	3.94×10^{-05}	n/a	n/a	1.72×10^{-04}	3.95×10^{-05}	1.96×10^{-04}	1.33×10^{-05}	3.94×10^{-05}
	Little Brown Myotis	Reference (Broach Lake)	n/a	n/a	9.07×10^{-03}	4.28×10^{-03}	2.80×10^{-01}	6.31×10^{-03}	8.52×10^{-04}	n/a	n/a	9.07×10^{-03}	4.28×10^{-03}	2.80×10^{-01}	6.31×10^{-03}	8.52×10^{-04}
		Patterson Lake North Arm – West Basin	n/a	n/a	9.61×10^{-03}	1.05×10^{-02}	7.24×10^{-01}	1.41×10^{-01}	8.53×10^{-03}	n/a	n/a	9.91×10^{-03}	1.38×10^{-02}	9.48×10^{-01}	5.23×10^{-01}	8.54×10^{-03}
		Patterson Lake South Arm	n/a	n/a	9.11×10^{-03}	8.03×10^{-03}	5.41×10^{-01}	8.43×10^{-02}	2.98×10^{-03}	n/a	n/a	9.13×10^{-03}	1.00×10^{-02}	6.72×10^{-01}	3.06×10^{-01}	2.98×10^{-03}
		Beet Lake	n/a	n/a	9.07×10^{-03}	6.26×10^{-03}	4.16×10^{-01}	4.69×10^{-02}	1.64×10^{-03}	n/a	n/a	9.08×10^{-03}	7.32×10^{-03}	4.85×10^{-01}	1.62×10^{-01}	1.64×10^{-03}
		Lloyd Lake	n/a	n/a	9.07×10^{-03}	4.48×10^{-03}	2.94×10^{-01}	1.04×10^{-02}	9.24×10^{-04}	n/a	n/a	9.07×10^{-03}	4.59×10^{-03}	3.01×10^{-01}	2.22×10^{-02}	9.24×10^{-04}
	Common Loon	Reference (Broach Lake)	n/a	n/a	1.31×10^{-03}	1.54×10^{-04}	4.62×10^{-03}	1.97×10^{-05}	2.11×10^{-05}	n/a	n/a	1.31×10^{-03}	1.54×10^{-04}	4.62×10^{-03}	1.97×10^{-05}	2.11×10^{-05}
		Patterson Lake North Arm – West Basin	n/a	n/a	1.39×10^{-03}	3.78×10^{-04}	1.19×10^{-02}	4.39×10^{-04}	2.11×10^{-04}	n/a	n/a	1.43×10^{-03}	4.96×10^{-04}	1.56×10^{-02}	1.63×10^{-03}	2.11×10^{-04}
		Patterson Lake South Arm	n/a	n/a	1.32×10^{-03}	2.90×10^{-04}	8.92×10^{-03}	2.63×10^{-04}	7.37×10^{-05}	n/a	n/a	1.32×10^{-03}	3.62×10^{-04}	1.11×10^{-02}	9.54×10^{-04}	7.38×10^{-05}
		Beet Lake	n/a	n/a	1.31×10^{-03}	2.26×10^{-04}	6.86×10^{-03}	1.46×10^{-04}	4.07×10^{-05}	n/a	n/a	1.31×10^{-03}	2.64×10^{-04}	7.99×10^{-03}	5.06×10^{-04}	4.07×10^{-05}
		Lloyd Lake	n/a	n/a	1.31×10^{-03}	1.62×10^{-04}	4.85×10^{-03}	3.26×10^{-05}	2.29×10^{-05}	n/a	n/a	1.31×10^{-03}	1.65×10^{-04}	4.96×10^{-03}	6.93×10^{-05}	2.29×10^{-05}
	Mallard	Reference (Broach Lake)	n/a	n/a	5.44×10^{-03}	1.85×10^{-03}	1.40×10^{-02}	3.13×10^{-04}	3.27×10^{-04}	n/a	n/a	5.44×10^{-03}	1.85×10^{-03}	1.40×10^{-02}	3.13×10^{-04}	3.27×10^{-04}
		Patterson Lake North Arm – West Basin	n/a	n/a	5.77×10^{-03}	4.54×10^{-03}	3.63×10^{-02}	6.99×10^{-03}	3.27×10^{-03}	n/a	n/a	5.95×10^{-03}	5.97×10^{-03}	4.74×10^{-02}	2.59×10^{-02}	3.27×10^{-03}
		Patterson Lake South Arm	n/a	n/a	5.47×10^{-03}	3.48×10^{-03}	2.71×10^{-02}	4.19×10^{-03}	1.14×10^{-03}	n/a	n/a	5.48×10^{-03}	4.35×10^{-03}	3.36×10^{-02}	1.52×10^{-02}	1.14×10^{-03}
		Beet Lake	n/a	n/a	5.45×10^{-03}	2.72×10^{-03}	2.08×10^{-02}	2.33×10^{-03}	6.29×10^{-04}	n/a	n/a	5.45×10^{-03}	3.17×10^{-03}	2.43×10^{-02}	8.06×10^{-03}	6.29×10^{-04}
		Lloyd Lake	n/a	n/a	5.44×10^{-03}	1.94×10^{-03}	1.47×10^{-02}	5.19×10^{-04}	3.54×10^{-04}	n/a	n/a	5.44×10^{-03}	1.99×10^{-03}	1.51×10^{-02}	1.10×10^{-03}	3.54×10^{-04}
	Rusty Blackbird	Reference (Broach Lake)	n/a	n/a	1.99×10^{-02}	8.87×10^{-03}	2.35×10^{-01}	1.76×10^{-03}	1.10×10^{-03}	n/a	n/a	1.99×10^{-02}	8.87×10^{-03}	2.35×10^{-01}	1.76×10^{-03}	1.10×10^{-03}
		Patterson Lake North Arm – West Basin	n/a	n/a	2.08×10^{-02}	2.04×10^{-02}	6.07×10^{-01}	3.47×10^{-02}	6.59×10^{-03}	n/a	n/a	2.13×10^{-02}	2.65×10^{-02}	7.94×10^{-01}	1.28×10^{-01}	6.60×10^{-03}
		Patterson Lake South Arm	n/a	n/a	2.00×10^{-02}	1.59×10^{-02}	4.53×10^{-01}	2.09×10^{-02}	2.59×10^{-03}	n/a	n/a	2.00×10^{-02}	1.96×10^{-02}	5.63×10^{-01}	7.51×10^{-02}	2.59×10^{-03}
		Beet Lake	n/a	n/a	1.99×10^{-02}	1.26×10^{-02}	3.49×10^{-01}	1.17×10^{-02}	1.66×10^{-03}	n/a	n/a	1.99×10^{-02}	1.45×10^{-02}	4.07×10^{-01}	4.00×10^{-02}	1.66×10^{-03}
		Lloyd Lake	n/a	n/a	1.99×10^{-02}	9.25×10^{-03}	2.47×10^{-01}	2.77×10^{-03}	1.15×10^{-03}	n/a	n/a	1.99×10^{-02}	9.45×10^{-03}	2.53×10^{-01}	5.65×10^{-03}	1.15×10^{-03}

Note: **Bold** indicates the HQ is greater than 1.
n/a = not applicable; HQ = hazard quotient.

6.4.1.1.2 Radiological Risk

An HQ is not typically calculated for radiological risk; however, a comparison against the ecological dose benchmarks is discussed.

There were no predicted exceedances of the 9.6 mGy/d radiation dose benchmark for aquatic biota in all basins of Patterson Lake and all downstream waterbodies for the Application Case and reasonable upper bound sensitivity scenario during both the Project phases and far-future projection. Additionally, there were no predicted exceedances of the 2.4 mGy/d radiation dose benchmark for terrestrial and riparian biota at or near the Project site, LSA, or RSA for the Application Case and reasonable upper bound sensitivity scenario during both the Project phases and far-future projection.

6.4.1.2 Estimated Risk to Ecological Receptors – Reasonably Foreseeable Development Case

6.4.1.2.1 Non-radiological Risk

With the addition of the Fission Patterson Lake South Property, there were no predicted exceedances of the HQ of 1 for any of the ecological receptors in Operations (Table 6-25).

For assessment of risk to benthic invertebrates, risk was calculated based on toxicity benchmarks as water concentrations. However, considering that benthic invertebrates also reside in sediment, a comparison of predicted sediment concentrations against sediment toxicity benchmarks was warranted for arsenic based on the sediment screening conducted in Table 4-3. Arsenic concentrations in sediment at Patterson Lake North Arm – West Basin and at Patterson Lake South Arm were predicted to exceed the REF screening value from Burnett-Seidel and Liber (2013) but were below the NE2 value for the RFD Case at all waterbodies.

The results for the far-future projection in the RFD Case were the same as for the far-future projection in the Application Case, as discussed in Section 6.4.1.1.1, Non-radiological Risk.

6.4.1.2.2 Radiological Risk

A HQ is not typically calculated for radiological risk; however, a comparison against the ecological dose benchmarks is discussed.

With the addition of the Fission Patterson Lake South Property, there were no predicted exceedances of the 9.6 mGy/d radiation dose benchmark for aquatic biota, in all basins of Patterson Lake and all downstream waterbodies. Additionally, there were no exceedances of the 2.4 mGy/d radiation dose benchmark for terrestrial and riparian biota at or near the Project site, LSA, or RSA for the RFD Case.

Table 6-25: Non-radiological Risk to Ecological Receptors – Reasonably Foreseeable Development Case – Operations and Far-Future Projection

	Biota	Location	Maximum HQ RFD Case													
			Operations							Far-Future						
			Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium	Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium
Aquatic Animals	Benthic Invertebrate	Reference (Broach Lake)	1.00×10^{-03}	1.45×10^{-03}	8.50×10^{-04}	4.75×10^{-02}	4.18×10^{-01}	6.61×10^{-06}	3.57×10^{-03}	1.00×10^{-03}	1.45×10^{-03}	8.50×10^{-04}	4.75×10^{-02}	4.18×10^{-01}	6.61×10^{-06}	3.57×10^{-03}
		Patterson Lake North Arm – West Basin	1.03×10^{-02}	2.93×10^{-01}	2.59×10^{-03}	6.15×10^{-02}	4.86×10^{-01}	1.77×10^{-05}	1.17×10^{-02}	1.99×10^{-03}	2.95×10^{-03}	9.01×10^{-04}	1.16×10^{-01}	**$1.08 \times 10^{+00}$**	1.47×10^{-04}	3.57×10^{-02}
		Patterson Lake South Arm	1.01×10^{-02}	2.92×10^{-01}	1.95×10^{-03}	5.78×10^{-02}	4.69×10^{-01}	1.41×10^{-05}	8.26×10^{-03}	1.73×10^{-03}	2.55×10^{-03}	8.54×10^{-04}	8.92×10^{-02}	8.08×10^{-01}	8.83×10^{-05}	1.25×10^{-02}
		Beet Lake	5.63×10^{-03}	1.49×10^{-01}	1.04×10^{-03}	5.30×10^{-02}	4.45×10^{-01}	1.05×10^{-05}	5.30×10^{-03}	1.41×10^{-03}	2.07×10^{-03}	8.51×10^{-04}	6.96×10^{-02}	6.22×10^{-01}	4.92×10^{-05}	6.88×10^{-03}
		Lloyd Lake	1.49×10^{-03}	1.71×10^{-02}	8.61×10^{-04}	4.81×10^{-02}	4.21×10^{-01}	7.01×10^{-06}	3.73×10^{-03}	1.04×10^{-03}	1.52×10^{-03}	8.50×10^{-04}	4.98×10^{-02}	4.39×10^{-01}	1.09×10^{-05}	3.87×10^{-03}
	Zooplankton	Reference (Broach Lake)	1.00×10^{-03}	2.50×10^{-03}	3.64×10^{-04}	5.25×10^{-02}	4.21×10^{-01}	6.66×10^{-06}	1.67×10^{-03}	1.00×10^{-03}	2.50×10^{-03}	3.64×10^{-04}	5.25×10^{-02}	4.21×10^{-01}	6.66×10^{-06}	1.67×10^{-03}
		Patterson Lake North Arm – West Basin	1.03×10^{-02}	5.04×10^{-01}	1.28×10^{-03}	6.94×10^{-02}	4.97×10^{-01}	1.93×10^{-05}	6.39×10^{-03}	1.99×10^{-03}	5.07×10^{-03}	3.86×10^{-04}	1.29×10^{-01}	**$1.09 \times 10^{+00}$**	1.49×10^{-04}	1.67×10^{-02}
		Patterson Lake South Arm	1.01×10^{-02}	5.04×10^{-01}	2.04×10^{-03}	7.04×10^{-02}	5.04×10^{-01}	1.84×10^{-05}	8.94×10^{-03}	1.73×10^{-03}	4.38×10^{-03}	3.66×10^{-04}	9.87×10^{-02}	8.14×10^{-01}	8.90×10^{-05}	5.84×10^{-03}
		Beet Lake	5.63×10^{-03}	2.56×10^{-01}	6.50×10^{-04}	6.04×10^{-02}	4.57×10^{-01}	1.19×10^{-05}	4.20×10^{-03}	1.41×10^{-03}	3.56×10^{-03}	3.64×10^{-04}	7.70×10^{-02}	6.27×10^{-01}	4.95×10^{-05}	3.22×10^{-03}
		Lloyd Lake	1.49×10^{-03}	2.94×10^{-02}	3.81×10^{-04}	5.33×10^{-02}	4.25×10^{-01}	7.18×10^{-06}	1.91×10^{-03}	1.04×10^{-03}	2.61×10^{-03}	3.64×10^{-04}	5.50×10^{-02}	4.42×10^{-01}	1.10×10^{-05}	1.81×10^{-03}
	Northern Pike	Reference (Broach Lake)	4.27×10^{-04}	2.11×10^{-03}	1.96×10^{-04}	3.26×10^{-04}	2.81×10^{-01}	2.58×10^{-06}	1.82×10^{-04}	4.27×10^{-04}	2.11×10^{-03}	1.96×10^{-04}	3.26×10^{-04}	2.81×10^{-01}	2.58×10^{-06}	1.82×10^{-04}
		Patterson Lake North Arm – West Basin	4.39×10^{-03}	4.27×10^{-01}	6.92×10^{-04}	4.30×10^{-04}	3.32×10^{-01}	7.48×10^{-06}	6.97×10^{-04}	8.49×10^{-04}	4.30×10^{-03}	2.08×10^{-04}	7.97×10^{-04}	7.27×10^{-01}	5.75×10^{-05}	1.83×10^{-03}
		Patterson Lake South Arm	4.32×10^{-03}	4.27×10^{-01}	1.10×10^{-03}	4.36×10^{-04}	3.36×10^{-01}	7.15×10^{-06}	9.76×10^{-04}	7.35×10^{-04}	3.71×10^{-03}	1.97×10^{-04}	6.12×10^{-04}	5.43×10^{-01}	3.45×10^{-05}	6.37×10^{-04}
		Beet Lake	2.40×10^{-03}	2.17×10^{-01}	3.51×10^{-04}	3.75×10^{-04}	3.05×10^{-01}	4.62×10^{-06}	4.58×10^{-04}	6.01×10^{-04}	3.01×10^{-03}	1.97×10^{-04}	4.77×10^{-04}	4.18×10^{-01}	1.92×10^{-05}	3.51×10^{-04}
		Lloyd Lake	6.35×10^{-04}	2.49×10^{-02}	2.06×0^{-04}	3.30×10^{-04}	2.83×10^{-01}	2.78×10^{-06}	2.08×10^{-04}	4.45×10^{-04}	2.21×10^{-03}	1.96×10^{-04}	3.41×10^{-04}	2.95×10^{-01}	4.27×10^{-06}	1.98×10^{-04}
	Whitefish	Reference (Broach Lake)	6.09×10^{-04}	3.54×10^{-04}	9.65×10^{-04}	1.85×10^{-03}	4.21×10^{-01}	6.64×10^{-06}	6.62×10^{-05}	6.09×10^{-04}	3.54×10^{-04}	9.65×10^{-04}	1.85×10^{-03}	4.21×10^{-01}	6.64×10^{-06}	6.62×10^{-05}
		Patterson Lake North Arm – West Basin	6.27×10^{-03}	7.14×10^{-02}	3.30×10^{-03}	2.44×10^{-03}	4.95×10^{-01}	1.89×10^{-05}	2.44×10^{-04}	1.21×10^{-03}	7.19×10^{-04}	1.02×10^{-03}	4.54×10^{-03}	**$1.09 \times 10^{+00}$**	1.48×10^{-04}	6.63×10^{-04}
		Patterson Lake South Arm	6.15×10^{-03}	7.14×10^{-02}	4.71×10^{-03}	2.43×10^{-03}	4.95×10^{-01}	1.74×10^{-05}	3.05×10^{-04}	1.05×10^{-03}	6.21×10^{-04}	9.70×10^{-04}	3.48×10^{-03}	8.12×10^{-01}	8.88×10^{-05}	2.31×10^{-04}
		Beet Lake	3.42×10^{-03}	3.63×10^{-02}	1.60×10^{-03}	2.12×10^{-03}	4.54×10^{-01}	1.16×10^{-05}	1.50×10^{-04}	8.57×10^{-04}	5.04×10^{-04}	9.66×10^{-04}	2.72×10^{-03}	6.25×10^{-01}	4.94×10^{-05}	1.28×10^{-04}
		Lloyd Lake	9.07×10^{-04}	4.17×10^{-03}	1.00×10^{-03}	1.88×10^{-03}	4.24×10^{-01}	7.14×10^{-06}	7.40×10^{-05}	6.35×10^{-04}	3.70×10^{-04}	9.65×10^{-04}	1.94×10^{-03}	4.42×10^{-01}	1.10×10^{-05}	7.18×10^{-05}
Aquatic Plants	Macrophytes	Reference (Broach Lake)	1.34×10^{-04}	4.59×10^{-04}	4.91×10^{-04}	6.07×10^{-02}	2.22×10^{-02}	6.66×10^{-06}	1.82×10^{-05}	1.34×10^{-04}	4.59×10^{-04}	4.91×10^{-04}	6.07×10^{-02}	2.22×10^{-02}	6.66×10^{-06}	1.82×10^{-05}
		Patterson Lake North Arm – West Basin	1.38×10^{-03}	9.26×10^{-02}	1.73×10^{-03}	8.03×10^{-02}	2.62×10^{-02}	1.93×10^{-05}	6.97×10^{-05}	2.66×10^{-04}	9.32×10^{-04}	5.21×10^{-04}	1.49×10^{-01}	5.74×10^{-02}	1.49×10^{-04}	1.83×10^{-04}
		Patterson Lake South Arm	1.35×10^{-03}	9.26×10^{-02}	2.75×10^{-03}	8.14×10^{-02}	2.65×10^{-02}	1.84×10^{-05}	9.76×10^{-05}	2.31×10^{-04}	8.05×10^{-04}	4.93×10^{-04}	1.14×10^{-01}	4.28×10^{-02}	8.90×10^{-05}	6.37×10^{-05}
		Beet Lake	7.53×10^{-04}	4.71×10^{-02}	8.76×10^{-04}	6.99×10^{-02}	2.41×10^{-02}	1.19×10^{-05}	4.58×10^{-05}	1.89×10^{-04}	6.54×10^{-04}	4.91×10^{-04}	8.90×10^{-02}	3.30×10^{-02}	4.95×10^{-05}	3.51×10^{-05}
		Lloyd Lake	2.00×10^{-04}	5.40×10^{-03}	5.15×10^{-04}	6.17×10^{-02}	2.24×10^{-02}	7.18×10^{-06}	2.08×10^{-05}	1.40×10^{-04}	4.79×10^{-04}	4.91×10^{-04}	6.36×10^{-02}	2.33×10^{-02}	1.10×10^{-05}	1.98×10^{-05}
	Phytoplankton	Reference (Broach Lake)	6.96×10^{-05}	3.99×10^{-04}	6.44×10^{-03}	1.27×10^{-02}	9.16×10^{-02}	6.66×10^{-06}	2.28×10^{-04}	6.96×10^{-05}	3.99×10^{-04}	6.44×10^{-03}	1.27×10^{-02}	9.16×10^{-02}	6.66×10^{-06}	2.28×10^{-04}
		Patterson Lake North Arm – West Basin	7.16×10^{-04}	8.05×10^{-02}	2.27×10^{-02}	1.68×10^{-02}	1.08×10^{-01}	1.93×10^{-05}	8.72×10^{-04}	1.38×10^{-04}	8.11×10^{-04}	6.83×10^{-03}	3.10×10^{-02}	2.37×10^{-01}	1.49×10^{-04}	2.28×10^{-03}
		Patterson Lake South Arm	7.04×10^{-04}	8.06×10^{-02}	3.61×10^{-02}	1.70×10^{-02}	1.10×10^{-01}	1.84×10^{-05}	1.22×10^{-03}	1.20×10^{-04}	7.00×10^{-04}	6.48×10^{-03}	2.38×10^{-02}	1.77×10^{-01}	8.90×10^{-05}	7.96×10^{-04}
		Beet Lake	3.91×10^{-04}	4.10×10^{-02}	1.15×10^{-02}	1.46×10^{-02}	9.94×10^{-02}	1.19×10^{-05}	5.72×10^{-04}	9.79×10^{-05}	5.69×10^{-04}	6.45×10^{-03}	1.86×10^{-02}	1.36×10^{-01}	4.95×10^{-05}	4.39×10^{-04}
		Lloyd Lake	2.06×10^{-04}	1.76×10^{-02}	6.75×10^{-03}	1.29×10^{-02}	9.24×10^{-02}	7.18×10^{-06}	2.60×10^{-04}	8.15×10^{-05}	4.70×10^{-04}	6.44×10^{-03}	1.33×10^{-02}	9.62×10^{-02}	1.10×10^{-05}	2.47×10^{-04}
Terrestrial Animals	Beaver	Reference (Broach Lake)	n/a	n/a	2.45×10^{-04}	2.94×10^{-04}	2.65×10^{-04}	3.09×10^{-04}	5.71×10^{-04}	n/a	n/a	2.45×10^{-04}	2.94×10^{-04}	2.65×10^{-04}	3.09×10^{-04}	5.71×10^{-04}
		Patterson Lake North Arm – West Basin	n/a	n/a	4.58×10^{-04}	3.42×10^{-04}	2.79×10^{-04}	3.97×10^{-04}	4.49×10^{-03}	n/a	n/a	2.51×10^{-04}	5.04×10^{-04}	3.16×10^{-04}	8.92×10^{-04}	1.27×10^{-03}
		Patterson Lake South Arm	n/a	n/a	4.68×10^{-04}	3.43×10^{-04}	2.71×10^{-04}	3.50×10^{-04}	1.30×10^{-03}	n/a	n/a	2.46×10^{-04}	4.21×10^{-04}	2.94×10^{-04}	6.47×10^{-04}	7.37×10^{-04}
		Beet Lake	n/a	n/a	2.84×10^{-04}	3.17×10^{-04}	2.68×10^{-04}	3.31×10^{-04}	9.53×10^{-04}	n/a	n/a	2.45×10^{-04}	3.62×10^{-04}	2.80×10^{-04}	4.85×10^{-04}	6.39×10^{-04}
		Lloyd Lake	n/a	n/a	2.48×10^{-04}	2.97×10^{-04}	2.65×10^{-04}	3.14×10^{-04}	5.79×10^{-04}	n/a	n/a	2.45×10^{-04}	3.01×10^{-04}	2.66×10^{-04}	3.27×10^{-04}	5.76×10^{-04}
	Black Bear	Reference (Broach Lake)	n/a	n/a	9.22×10^{-04}	8.71×10^{-05}	2.49×10^{-03}	1.44×10^{-04}	1.82×10^{-04}	n/a	n/a	9.22×10^{-04}	8.71×10^{-05}	2.49×10^{-03}	1.44×10^{-04}	1.82×10^{-04}
		Patterson Lake North Arm – West Basin	n/a	n/a	3.08×10^{-03}	9.77×10^{-05}	2.77×10^{-03}	1.63×10^{-04}	7.41×10^{-04}	n/a	n/a	9.42×10^{-04}	1.22×10^{-04}	4.69×10^{-03}	2.34×10^{-04}	3.21×10^{-04}
		Beet Lake	n/a	n/a	1.24×10^{-03}	1.07×10^{-04}	2.59×10^{-03}	1.77×10^{-04}	2.65×10^{-04}	n/a	n/a	1.01×10^{-03}	1.11×10^{-04}	2.94×10^{-03}	1.91×10^{-04}	2.15×10^{-04}
		Lloyd Lake	n/a	n/a	9.55×10^{-04}	9.06×10^{-05}	2.51×10^{-03}	1.50×10^{-04}	1.86×10^{-04}	n/a	n/a	9.25×10^{-04}	9.13×10^{-05}	2.58×10^{-03}	1.53×10^{-04}	1.84×10^{-04}
	Grey Wolf	Reference (Broach Lake)	n/a	n/a	2.46×10^{-03}	4.49×10^{-05}	2.88×10^{-03}	1.11×10^{-04}	6.66×10^{-05}	n/a	n/a	2.46×10^{-03}	4.49×10^{-05}	2.88×10^{-03}	1.11×10^{-04}	6.66×10^{-05}
		Patterson Lake North Arm – West Basin	n/a	n/a	2.96×10^{-03}	4.58×10^{-05}	2.93×10^{-03}	1.22×10^{-04}	2.18×10^{-04}	n/a	n/a	2.47×10^{-03}	4.81×10^{-05}	2.98×10^{-03}	1.72×10^{-04}	8.10×10^{-05}
		Lloyd Lake	n/a	n/a	2.51×10^{-03}	4.53×10^{-05}	2.89×10^{-03}	1.14×10^{-04}	6.75×10^{-05}	n/a	n/a	2.46×10^{-03}	4.53×10^{-05}	2.89×10^{-03}	1.17×10^{-04}	6.69×10^{-05}

Biota	Location	Maximum HQ RFD Case													
		Operations							Far-Future						
		Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium	Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium
American Mink	Reference (Broach Lake)	n/a	n/a	3.77×10^{-03}	3.45×10^{-04}	1.99×10^{-02}	4.40×10^{-04}	1.93×10^{-04}	n/a	n/a	3.77×10^{-03}	3.45×10^{-04}	1.99×10^{-02}	4.40×10^{-04}	1.93×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	1.13×10^{-02}	4.36×10^{-04}	2.31×10^{-02}	1.08×10^{-03}	7.45×10^{-04}	n/a	n/a	3.98×10^{-03}	7.89×10^{-04}	5.13×10^{-02}	8.48×10^{-03}	1.50×10^{-03}
	Patterson Lake South Arm	n/a	n/a	1.03×10^{-02}	4.12×10^{-04}	2.23×10^{-02}	8.72×10^{-04}	4.56×10^{-04}	n/a	n/a	3.79×10^{-03}	6.15×10^{-04}	3.83×10^{-02}	5.11×10^{-03}	5.52×10^{-04}
	Beet Lake	n/a	n/a	4.87×10^{-03}	3.80×10^{-04}	2.11×10^{-02}	6.64×10^{-04}	2.94×10^{-04}	n/a	n/a	3.77×10^{-03}	4.87×10^{-04}	2.95×10^{-02}	2.87×10^{-03}	3.27×10^{-04}
	Lloyd Lake	n/a	n/a	3.84×10^{-03}	3.48×10^{-04}	2.00×10^{-02}	4.64×10^{-04}	2.01×10^{-04}	n/a	n/a	3.77×10^{-03}	3.59×10^{-04}	2.08×10^{-02}	6.88×10^{-04}	2.05×10^{-04}
Moose	Reference (Broach Lake)	n/a	n/a	1.63×10^{-04}	2.11×10^{-04}	1.07×10^{-02}	1.41×10^{-04}	2.84×10^{-04}	n/a	n/a	1.63×10^{-04}	2.11×10^{-04}	1.07×10^{-02}	1.41×10^{-04}	2.84×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	3.78×10^{-04}	2.58×10^{-04}	1.15×10^{-02}	2.02×10^{-04}	2.10×10^{-03}	n/a	n/a	1.69×10^{-04}	4.20×10^{-04}	1.48×10^{-02}	6.77×10^{-04}	8.62×10^{-04}
	Patterson Lake South Arm	n/a	n/a	3.77×10^{-04}	2.55×10^{-04}	1.15×10^{-02}	1.94×10^{-04}	2.05×10^{-03}	n/a	n/a	1.69×10^{-04}	4.14×10^{-04}	1.47×10^{-02}	6.16×10^{-04}	8.47×10^{-04}
	Beet Lake	n/a	n/a	2.02×10^{-04}	2.33×10^{-04}	1.10×10^{-02}	1.59×10^{-04}	4.79×10^{-04}	n/a	n/a	1.64×10^{-04}	2.78×10^{-04}	1.20×10^{-02}	3.03×10^{-04}	3.42×10^{-04}
	Lloyd Lake	n/a	n/a	1.66×10^{-04}	2.14×10^{-04}	1.08×10^{-02}	1.44×10^{-04}	2.90×10^{-04}	n/a	n/a	1.63×10^{-04}	2.18×10^{-04}	1.09×10^{-02}	1.58×10^{-04}	2.89×10^{-04}
Muskrat	Reference (Broach Lake)	n/a	n/a	2.01×10^{-03}	1.19×10^{-03}	3.42×10^{-03}	9.60×10^{-04}	9.83×10^{-04}	n/a	n/a	2.01×10^{-03}	1.19×10^{-03}	3.42×10^{-03}	9.60×10^{-04}	9.83×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	6.18×10^{-03}	1.56×10^{-03}	3.98×10^{-03}	2.57×10^{-03}	3.25×10^{-03}	n/a	n/a	2.13×10^{-03}	2.92×10^{-03}	8.86×10^{-03}	2.14×10^{-02}	9.84×10^{-03}
	Patterson Lake South Arm	n/a	n/a	4.91×10^{-03}	1.50×10^{-03}	3.85×10^{-03}	2.06×10^{-03}	2.44×10^{-03}	n/a	n/a	2.02×10^{-03}	2.24×10^{-03}	6.61×10^{-03}	1.28×10^{-02}	3.43×10^{-03}
	Beet Lake	n/a	n/a	2.51×10^{-03}	1.35×10^{-03}	3.64×10^{-03}	1.53×10^{-03}	1.52×10^{-03}	n/a	n/a	2.01×10^{-03}	1.75×10^{-03}	5.09×10^{-03}	7.14×10^{-03}	1.89×10^{-03}
	Lloyd Lake	n/a	n/a	2.04×10^{-03}	1.21×10^{-03}	3.45×10^{-03}	1.02×10^{-03}	1.03×10^{-03}	n/a	n/a	2.01×10^{-03}	1.25×10^{-03}	3.59×10^{-03}	1.59×10^{-03}	1.07×10^{-03}
Red Fox	Reference (Broach Lake)	n/a	n/a	4.18×10^{-04}	3.66×10^{-05}	6.08×10^{-04}	1.22×10^{-04}	6.64×10^{-05}	n/a	n/a	4.18×10^{-04}	3.66×10^{-05}	6.08×10^{-04}	1.22×10^{-04}	6.64×10^{-05}
	Patterson Lake North Arm – West Basin	n/a	n/a	4.29×10^{-04}	3.80×10^{-05}	6.32×10^{-04}	1.46×10^{-04}	6.21×10^{-04}	n/a	n/a	4.18×10^{-04}	4.21×10^{-05}	6.19×10^{-04}	2.67×10^{-04}	1.10×10^{-04}
	Patterson Lake South Arm	n/a	n/a	4.36×10^{-04}	3.81×10^{-05}	6.10×10^{-04}	1.35×10^{-04}	1.61×10^{-04}	n/a	n/a	4.18×10^{-04}	3.99×10^{-05}	6.14×10^{-04}	2.06×10^{-04}	7.49×10^{-05}
	Beet Lake	n/a	n/a	4.22×10^{-04}	3.74×10^{-05}	6.09×10^{-04}	1.28×10^{-04}	1.18×10^{-04}	n/a	n/a	4.18×10^{-04}	3.84×10^{-05}	6.11×10^{-04}	1.66×10^{-04}	7.04×10^{-05}
	Lloyd Lake	n/a	n/a	4.19×10^{-04}	3.68×10^{-05}	6.09×10^{-04}	1.24×10^{-04}	6.72×10^{-05}	n/a	n/a	4.18×10^{-04}	3.68×10^{-05}	6.08×10^{-04}	1.27×10^{-04}	6.66×10^{-05}
Snowshoe Hare	Reference (Broach Lake)	n/a	n/a	1.43×10^{-03}	2.97×10^{-04}	1.06×10^{-03}	6.71×10^{-05}	9.42×10^{-04}	n/a	n/a	1.43×10^{-03}	2.97×10^{-04}	1.06×10^{-03}	6.71×10^{-05}	9.42×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	1.45×10^{-03}	3.00×10^{-04}	1.09×10^{-03}	7.71×10^{-05}	7.61×10^{-03}	n/a	n/a	1.43×10^{-03}	3.04×10^{-04}	1.06×10^{-03}	8.10×10^{-05}	1.38×10^{-03}
	Patterson Lake South Arm	n/a	n/a	1.46×10^{-03}	3.01×10^{-04}	1.06×10^{-03}	6.90×10^{-05}	2.01×10^{-03}	n/a	n/a	1.43×10^{-03}	3.01×10^{-04}	1.06×10^{-03}	7.52×10^{-05}	1.01×10^{-03}
	Beet Lake	n/a	n/a	1.44×10^{-03}	3.00×10^{-04}	1.06×10^{-03}	6.84×10^{-05}	1.54×10^{-03}	n/a	n/a	1.43×10^{-03}	2.99×10^{-04}	1.06×10^{-03}	7.13×10^{-05}	9.81×10^{-04}
	Lloyd Lake	n/a	n/a	1.44×10^{-03}	2.99×10^{-04}	1.06×10^{-03}	6.79×10^{-05}	9.49×10^{-04}	n/a	n/a	1.43×10^{-03}	2.98×10^{-04}	1.06×10^{-03}	6.76×10^{-05}	9.42×10^{-04}
Southern Red-Backed Vole	Reference (Broach Lake)	n/a	n/a	1.50×10^{-04}	1.05×10^{-04}	1.24×10^{-04}	5.79×10^{-04}	7.05×10^{-04}	n/a	n/a	1.50×10^{-04}	1.05×10^{-04}	1.24×10^{-04}	5.79×10^{-04}	7.05×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	1.52×10^{-04}	1.07×10^{-04}	1.28×10^{-04}	6.69×10^{-04}	5.49×10^{-03}	n/a	n/a	1.50×10^{-04}	1.09×10^{-04}	1.25×10^{-04}	8.14×10^{-04}	1.04×10^{-03}
	Patterson Lake South Arm	n/a	n/a	1.54×10^{-04}	1.07×10^{-04}	1.24×10^{-04}	6.04×10^{-04}	1.48×10^{-03}	n/a	n/a	1.50×10^{-04}	1.08×10^{-04}	1.24×10^{-04}	7.15×10^{-04}	7.62×10^{-04}
	Beet Lake	n/a	n/a	1.51×10^{-04}	1.06×10^{-04}	1.24×10^{-04}	5.93×10^{-04}	1.14×10^{-03}	n/a	n/a	1.50×10^{-04}	1.07×10^{-04}	1.24×10^{-04}	6.50×10^{-04}	7.35×10^{-04}
	Lloyd Lake	n/a	n/a	1.50×10^{-04}	1.06×10^{-04}	1.24×10^{-04}	5.85×10^{-04}	7.10×10^{-04}	n/a	n/a	1.50×10^{-04}	1.05×10^{-04}	1.24×10^{-04}	5.86×10^{-04}	7.05×10^{-04}
Woodland Caribou	Reference (Broach Lake)	n/a	n/a	3.79×10^{-04}	2.94×10^{-04}	1.19×10^{-02}	3.02×10^{-04}	3.16×10^{-04}	n/a	n/a	3.79×10^{-04}	2.94×10^{-04}	1.19×10^{-02}	3.02×10^{-04}	3.16×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	8.03×10^{-04}	3.52×10^{-04}	1.31×10^{-02}	5.90×10^{-04}	1.31×10^{-02}	n/a	n/a	3.87×10^{-04}	4.96×10^{-04}	1.56×10^{-02}	1.35×10^{-03}	1.09×10^{-03}
	Beet Lake	n/a	n/a	4.21×10^{-04}	3.12×10^{-04}	1.20×10^{-02}	3.38×10^{-04}	1.39×10^{-03}	n/a	n/a	3.79×10^{-04}	3.35×10^{-04}	1.26×10^{-02}	5.05×10^{-04}	3.80×10^{-04}
	Lloyd Lake	n/a	n/a	3.93×10^{-04}	3.07×10^{-04}	1.20×10^{-02}	3.40×10^{-04}	3.49×10^{-04}	n/a	n/a	3.79×10^{-04}	3.03×10^{-04}	1.20×10^{-02}	3.45×10^{-04}	3.27×10^{-04}
Grouse	Reference (Broach Lake)	n/a	n/a	1.79×10^{-03}	3.95×10^{-04}	1.51×10^{-03}	6.67×10^{-05}	3.96×10^{-04}	n/a	n/a	1.79×10^{-03}	3.95×10^{-04}	1.51×10^{-03}	6.67×10^{-05}	3.96×10^{-04}
	Patterson Lake North Arm – West Basin	n/a	n/a	1.80×10^{-03}	3.98×10^{-04}	1.56×10^{-03}	7.48×10^{-05}	3.03×10^{-03}	n/a	n/a	1.79×10^{-03}	3.99×10^{-04}	1.51×10^{-03}	7.47×10^{-05}	5.79×10^{-04}
	Patterson Lake South Arm	n/a	n/a	1.80×10^{-03}	3.98×10^{-04}	1.51×10^{-03}	6.80×10^{-05}	8.19×10^{-04}	n/a	n/a	1.79×10^{-03}	3.98×10^{-04}	1.51×10^{-03}	7.13×10^{-05}	4.26×10^{-04}
	Beet Lake	n/a	n/a	1.79×10^{-03}	3.97×10^{-04}	1.51×10^{-03}	6.76×10^{-05}	6.32×10^{-04}	n/a	n/a	1.79×10^{-03}	3.96×10^{-04}	1.51×10^{-03}	6.91×10^{-05}	4.13×10^{-04}
	Lloyd Lake	n/a	n/a	1.79×10^{-03}	3.97×10^{-04}	1.51×10^{-03}	6.73×10^{-05}	3.99×10^{-04}	n/a	n/a	1.79×10^{-03}	3.95×10^{-04}	1.51×10^{-03}	6.69×10^{-05}	3.97×10^{-04}
Canada Goose	Reference (Broach Lake)	n/a	n/a	1.72×10^{-04}	3.93×10^{-05}	1.96×10^{-04}	1.24×10^{-05}	3.93×10^{-05}	n/a	n/a	1.72×10^{-04}	3.93×10^{-05}	1.96×10^{-04}	1.24×10^{-05}	3.93×10^{-05}
	Patterson Lake North Arm – West Basin	n/a	n/a	1.76×10^{-04}	4.01×10^{-05}	2.04×10^{-04}	1.45×10^{-05}	3.07×10^{-04}	n/a	n/a	1.72×10^{-04}	4.17×10^{-05}	1.99×10^{-04}	2.05×10^{-05}	5.90×10^{-05}
	Patterson Lake South Arm	n/a	n/a	1.79×10^{-04}	4.01×10^{-05}	1.97×10^{-04}	1.32×10^{-05}	8.30×10^{-05}	n/a	n/a	1.72×10^{-04}	4.08×10^{-05}	1.97×10^{-04}	1.71×10^{-05}	4.27×10^{-05}
	Beet Lake	n/a	n/a	1.74×10^{-04}	3.98×10^{-05}	1.97×10^{-04}	1.28×10^{-05}	6.35×10^{-05}	n/a	n/a	1.72×10^{-04}	4.01×10^{-05}	1.97×10^{-04}	1.48×10^{-05}	4.11×10^{-05}

	Biota	Location	Maximum HQ RFD Case													
			Operations							Far-Future						
			Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium	Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium
		Lloyd Lake	n/a	n/a	1.73×10^{-04}	3.96×10^{-05}	1.97×10^{-04}	1.25×10^{-05}	3.96×10^{-05}	n/a	n/a	1.72×10^{-04}	3.95×10^{-05}	1.96×10^{-04}	1.26×10^{-05}	3.93×10^{-05}
	Little Brown Myotis	Reference (Broach Lake)	n/a	n/a	9.07×10^{-03}	4.28×10^{-03}	2.80×10^{-01}	6.31×10^{-03}	8.52×10^{-04}	n/a	n/a	9.07×10^{-03}	4.28×10^{-03}	2.80×10^{-01}	6.31×10^{-03}	8.52×10^{-04}
		Patterson Lake North Arm – West Basin	n/a	n/a	2.77×10^{-02}	5.53×10^{-03}	3.26×10^{-01}	1.69×10^{-02}	2.80×10^{-03}	n/a	n/a	9.61×10^{-03}	1.05×10^{-02}	7.24×10^{-01}	1.41×10^{-01}	8.53×10^{-03}
		Patterson Lake South Arm	n/a	n/a	2.08×10^{-02}	5.21×10^{-03}	3.14×10^{-01}	1.35×10^{-02}	1.98×10^{-03}	n/a	n/a	9.11×10^{-03}	8.03×10^{-03}	5.41×10^{-01}	8.43×10^{-02}	2.98×10^{-03}
		Beet Lake	n/a	n/a	1.11×10^{-02}	4.77×10^{-03}	2.98×10^{-01}	1.00×10^{-02}	1.27×10^{-03}	n/a	n/a	9.07×10^{-03}	6.26×10^{-03}	4.16×10^{-01}	4.69×10^{-02}	1.64×10^{-03}
		Lloyd Lake	n/a	n/a	9.19×10^{-03}	4.33×10^{-03}	2.82×10^{-01}	6.69×10^{-03}	8.90×10^{-04}	n/a	n/a	9.07×10^{-03}	4.48×10^{-03}	2.94×10^{-01}	1.04×10^{-02}	9.24×10^{-04}
	Common Loon	Reference (Broach Lake)	n/a	n/a	1.31×10^{-03}	1.54×10^{-04}	4.62×10^{-03}	1.97×10^{-05}	2.11×10^{-05}	n/a	n/a	1.31×10^{-03}	1.54×10^{-04}	4.62×10^{-03}	1.97×10^{-05}	2.11×10^{-05}
		Patterson Lake North Arm – West Basin	n/a	n/a	4.52×10^{-03}	2.01×10^{-04}	5.39×10^{-03}	5.27×10^{-05}	7.64×10^{-05}	n/a	n/a	1.39×10^{-03}	3.78×10^{-04}	1.19×10^{-02}	4.39×10^{-04}	2.11×10^{-04}
		Patterson Lake South Arm	n/a	n/a	6.69×10^{-03}	1.88×10^{-04}	5.18×10^{-03}	4.22×10^{-05}	8.81×10^{-05}	n/a	n/a	1.32×10^{-03}	2.90×10^{-04}	8.92×10^{-03}	2.63×10^{-04}	7.37×10^{-05}
		Beet Lake	n/a	n/a	2.23×10^{-03}	1.72×10^{-04}	4.91×10^{-03}	3.13×10^{-05}	4.41×10^{-05}	n/a	n/a	1.31×10^{-03}	2.26×10^{-04}	6.86×10^{-03}	1.46×10^{-04}	4.07×10^{-05}
		Lloyd Lake	n/a	n/a	1.37×10^{-03}	1.56×10^{-04}	4.65×10^{-03}	2.09×10^{-05}	2.32×10^{-05}	n/a	n/a	1.31×10^{-03}	1.62×10^{-04}	4.85×10^{-03}	3.26×10^{-05}	2.29×10^{-05}
	Mallard	Reference (Broach Lake)	n/a	n/a	5.44×10^{-03}	1.85×10^{-03}	1.40×10^{-02}	3.13×10^{-04}	3.27×10^{-04}	n/a	n/a	5.44×10^{-03}	1.85×10^{-03}	1.40×10^{-02}	3.13×10^{-04}	3.27×10^{-04}
		Patterson Lake North Arm – West Basin	n/a	n/a	1.67×10^{-02}	2.41×10^{-03}	1.63×10^{-02}	8.38×10^{-04}	1.08×10^{-03}	n/a	n/a	5.77×10^{-03}	4.54×10^{-03}	3.63×10^{-02}	6.99×10^{-03}	3.27×10^{-03}
		Patterson Lake South Arm	n/a	n/a	1.32×10^{-02}	2.30×10^{-03}	1.57×10^{-02}	6.70×10^{-04}	8.07×10^{-04}	n/a	n/a	5.47×10^{-03}	3.48×10^{-03}	2.71×10^{-02}	4.19×10^{-03}	1.14×10^{-03}
		Beet Lake	n/a	n/a	6.77×10^{-03}	2.08×10^{-03}	1.49×10^{-02}	4.99×10^{-04}	5.02×10^{-04}	n/a	n/a	5.45×10^{-03}	2.72×10^{-03}	2.08×10^{-02}	2.33×10^{-03}	6.29×10^{-04}
		Lloyd Lake	n/a	n/a	5.52×10^{-03}	1.88×10^{-03}	1.41×10^{-02}	3.32×10^{-04}	3.43×10^{-04}	n/a	n/a	5.44×10^{-03}	1.94×10^{-03}	1.47×10^{-02}	5.19×10^{-04}	3.54×10^{-04}
	Rusty Blackbird	Reference (Broach Lake)	n/a	n/a	1.99×10^{-02}	8.87×10^{-03}	2.35×10^{-01}	1.76×10^{-03}	1.10×10^{-03}	n/a	n/a	1.99×10^{-02}	8.87×10^{-03}	2.35×10^{-01}	1.76×10^{-03}	1.10×10^{-03}
		Patterson Lake North Arm – West Basin	n/a	n/a	5.08×10^{-02}	1.12×10^{-02}	2.73×10^{-01}	4.35×10^{-03}	4.79×10^{-03}	n/a	n/a	2.08×10^{-02}	2.04×10^{-02}	6.07×10^{-01}	3.47×10^{-02}	6.59×10^{-03}
		Patterson Lake South Arm	n/a	n/a	3.94×10^{-02}	1.06×10^{-02}	2.64×10^{-01}	3.51×10^{-03}	2.24×10^{-03}	n/a	n/a	2.00×10^{-02}	1.59×10^{-02}	4.53×10^{-01}	2.09×10^{-02}	2.59×10^{-03}
		Beet Lake	n/a	n/a	2.32×10^{-02}	9.78×10^{-03}	2.50×10^{-01}	2.67×10^{-03}	1.59×10^{-03}	n/a	n/a	1.99×10^{-02}	1.26×10^{-02}	3.49×10^{-01}	1.17×10^{-02}	1.66×10^{-03}
		Lloyd Lake	n/a	n/a	2.01×10^{-02}	8.96×10^{-03}	2.37×10^{-01}	1.85×10^{-03}	1.13×10^{-03}	n/a	n/a	1.99×10^{-02}	9.25×10^{-03}	2.47×10^{-01}	2.77×10^{-03}	1.15×10^{-03}

Note: **Bold** indicates the HQ is greater than 1.
n/a = not applicable; HQ = hazard quotient; RFD = reasonably foreseeable development.

6.4.2 Uncertainty in the Risk Characterization

Since the risk characterization is dependent on the problem formulation and the exposure and effects assessments, any uncertainty identified in these assessments propagates uncertainty into the risk estimates. In general, the uncertainties are expected to cause an overestimation, not an underestimation of risk due to the conservative approaches employed in the ERA, including the use of:

- maximum predicted concentrations for COPCs in media for each exposure scenario;
- exposure of mobile ecological receptors to COPCs in the environment for chronic periods of time and during sensitive life stages; and
- effect levels based on low-effect threshold concentrations and doses.

The assumptions to address uncertainties in the ERA are anticipated to produce overly conservative estimates of risk, as discussed below.

For the calculation of risk to environmental receptors, there are uncertainties associated with the use of literature-based TRVs. These uncertainties may include: extrapolation of results from laboratory tests to the field, differences in sensitivity between the test organism and resident organisms, laboratory conditions that are not representative of field conditions, and the form of the COPC used in toxicity testing which may not be representative of the form found at the site.

The use of TRVs from laboratory studies tends to be conservative because these studies are typically chemical-specific and use highly bioavailable forms of the COPC. In field situations, the chemical form of the COPC may be less bioavailable, and toxicity-modifying factors may be present that were not acting in laboratory tests.

There is inherent uncertainty associated with the use of LELs such as LOAEL values as TRVs as these values are not precisely related to biologically relevant thresholds and do not provide information about the actual magnitude of effects in the reported studies. However, LOAEL values have widespread use in the risk assessment community and the science is not currently available to change this approach to TRVs.

Taken together, these approaches are anticipated to produce a risk characterization has not underestimated risk; the resulting HQs are either overestimates or realistic estimates of risk, both of which are considered acceptable.

7.0 QUALITY ASSURANCE AND SENSITIVITY ANALYSIS

7.1 Quality Assurance and Quality Control

Throughout the planning and preparation of the ERA, all staff worked under Ecometrix ISO 9001:2015 certified Quality Management System. All work was internally reviewed and verified. Reviews included verification of input data in the IMPACT files against the source documents and verification of selected results with independent calculation spreadsheets, as well as review of report content. Comments have been addressed as appropriate by report revisions. The review process has been documented through a paper trail of review comments and responses. Examples of the independent calculation spreadsheets are provided in Appendix C.

The software used for the ERA was IMPACT, the non-derived release limits Version 5.6.0, which aligns with the guidance for modelling radionuclides in the environment that is referred to in the Canadian Standards Association Group (CSA) standard N288.1-20 (CSA 2020), CSA N288.6-22 (CSA 2022), and supporting documentation. When utilizing IMPACT for this Project, all inputs to IMPACT were checked, along with an overall verification of IMPACT scenario files. Checks were performed on data and calculations to verify that transcription errors and formula errors, if any, were caught and addressed. Checks of the model structure, algorithms and functions have been made repeatedly throughout the model development history as it has been used in several related applications that underwent multiple layers of review.

The ERICA Tool, version 1.3.1, was used as a source of biota dose coefficients. Its parameters, including dose coefficients, have been subject to validation through numerous intercomparison exercises, as described by Brown et al., (2003, 2008, 2016) and have generally compared well with other sources. The intercomparisons of dose coefficients are described by Vives I Batlle et al. (2007, 2011). The external dose predictions for small mammals have been validated against dosimetric measurements (Beresford et al. 2008b). The code and database are updated from time to time, as described in its documented version history.

Quality assurance activities for other models used as inputs into the ERA are discussed in EIS Appendix 7A (Air Dispersion Modelling Report), TSD XIV (Groundwater Flow and Solute Transport Modelling Reporting) EIS Appendix 9A (Hydrological Modelling Summary Report) and EIS Appendix 10A (Surface Water Quality Modelling Report). As a quality control step, results from the other models were compared to IMPACT results wherever there were similar predictions in terms of nodes and parameters to confirm they were similar.

7.2 Sensitivity Analysis

A sensitivity analysis of key model parameters was undertaken to understand the degree to which the results or conclusions of the risk assessment would vary if these parameters differed from what was assumed.

7.2.1 Effects of Annual Weather Patterns

Dose and risk presented in Section 5.0 and Section 6.0 were calculated using average annual flows in all waterbodies. The effects of flow variation over each year were investigated separately in this sensitivity analysis. Average monthly flows at the model nodes are shown in Appendix A, Table 3-2). The change in flow is discussed using copper and polonium-210 as examples for a non-radiological and radiological COPC that either have the highest concentrations in waterbodies or have the highest contribution to dose of the most exposed human and ecological receptors. Average monthly and average annual outflows of all modelled waterbodies are provided in Table 7-1 below.

Figure 7-1 shows concentrations of copper and polonium-210 in water in Patterson Lake North Arm – West Basin during Operations. Concentrations were compared between a simulation using monthly flows and a simulation using annual average flows. The variation of water concentrations during Operations is mainly attributed to the changing patterns of liquid emissions as opposed to monthly flows. As treated effluent flow rates are reduced towards the end of Operations, the difference between the average and monthly flows becomes more noticeable (after year 30 of the total simulation time). Using monthly flows, the maximum deviation from the annual average for copper is -0.2% and +0.3%. For polonium-210 the maximum deviation from the concentrations calculated using annual average flows is -5.8% and +5.1%. The maximum deviation between annual average flows and monthly flows occurs while treated effluent is not discharged.

Similar deviations can be found when calculating dose and risk for humans. When considering monthly average flows, the total radiation dose to the subsistence harvester (one-year-old; i.e., the receptor with the highest exposure) increases by a maximum of 1% (Figure 7-2). This occurs after 42 years, when the total dose using constant flows is calculated to be 0.831 mSv/yr and the total dose using monthly flows is calculated to be 0.838 mSv/yr. Similar trends can be extrapolated for other human receptors and COPCs.

For ecological receptors, the increase in dose, when considering monthly flow patterns compared to annual averages, is a maximum of 0.5% for the total dose (i.e., sum of all pathways and radionuclides) during Operations. Risk (i.e., HQ) from copper from all pathways was estimated to be at a maximum of 0.2% greater when considering monthly flow patterns.

In summary, the doses and risks to human and ecological receptors have the potential to fluctuate around the average value presented in the report when monthly flow patterns are considered. In general, the maximum deviation of dose or risk between the monthly flows and annual average flows is under 1%. As the incremental dose to humans over the duration of a year is well below the public dose limit, this simplification of the calculation in the model does not affect conclusions for human receptors.

Table 7-1: Average Monthly Outflows and Average Annual Outflows of the Modelled Waterbodies

Lake Name	Average Monthly Flows (m^3/s)												Annual Average Flows (m^3/s)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Broach Lake	0.1	0.1	0.1	0.3	0.5	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.3
Clearwater River above Patterson Lake	0.2	0.2	0.3	0.8	1.2	0.9	0.7	0.6	0.6	0.6	0.5	0.3	0.6
Patterson Lake North Arm – East Basin	0.4	0.4	0.5	0.9	1.3	1.1	0.9	0.8	0.8	0.8	0.7	0.5	0.8
Patterson Lake North Arm – West Basin	0.7	0.7	0.7	1.0	1.4	1.3	1.2	1.1	1.0	1.0	0.9	0.7	1.0
Patterson Lake South Arm	1.1	1.0	1.1	1.2	1.7	1.7	1.6	1.5	1.5	1.4	1.2	1.1	1.4
Forrest Lake – North Basin	1.9	1.7	1.7	1.8	2.7	2.8	2.6	2.4	2.3	2.3	2.3	2.1	2.2
Beet Lake	2.0	1.8	1.8	2.1	3.3	3.0	2.7	2.6	2.5	2.5	2.4	2.2	2.4
Naomi Lake	2.4	2.2	2.1	2.6	4.6	4.0	3.5	3.3	3.2	3.2	3.0	2.7	3.1
Clearwater River above Mirror River confluence	3.5	3.5	3.5	6.0	10.0	8.0	6.6	6.0	6.0	6.0	5.4	4.0	5.7
Clearwater River above Lloyd Lake	11.7	11.6	11.7	20.0	33.1	26.5	22.1	20.0	19.9	20.0	17.8	13.2	19.0
Lloyd Lake	17.6	16.1	15.5	19.4	34.8	33.2	28.4	24.2	22.6	23.5	21.3	19.5	23.0

m^3/s = cubic metre per second.

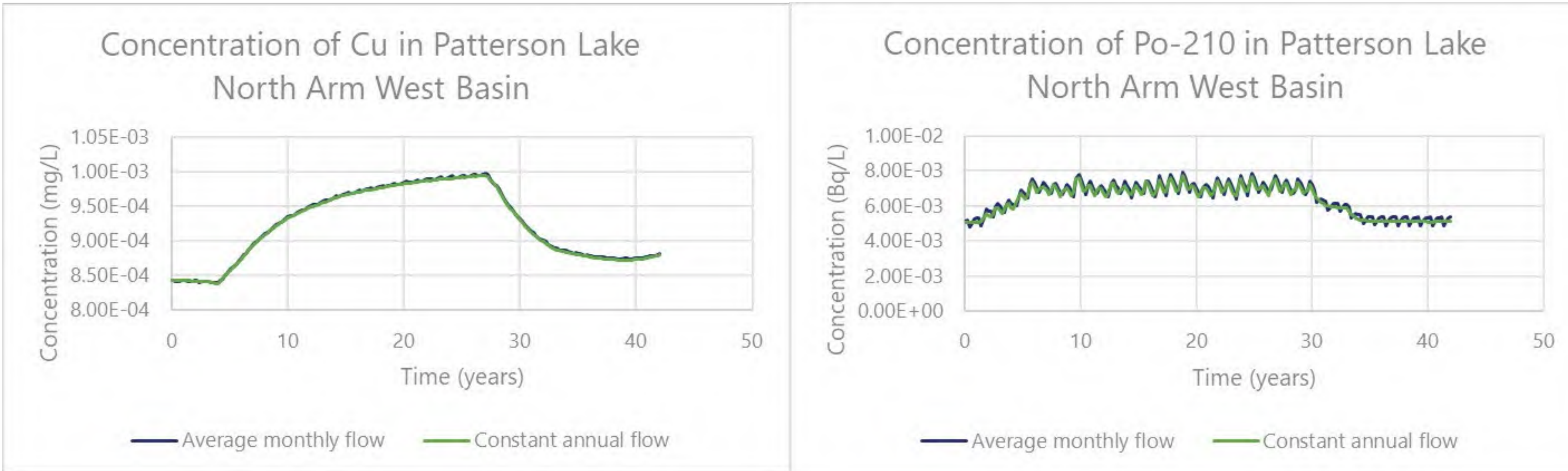


Figure 7-1: Concentrations of Copper and Polonium-210 in Patterson Lake North Arm – West Basin during Operations

Cu = copper; Po-210 = polonium-210; Bq/L = becquerels per litre.

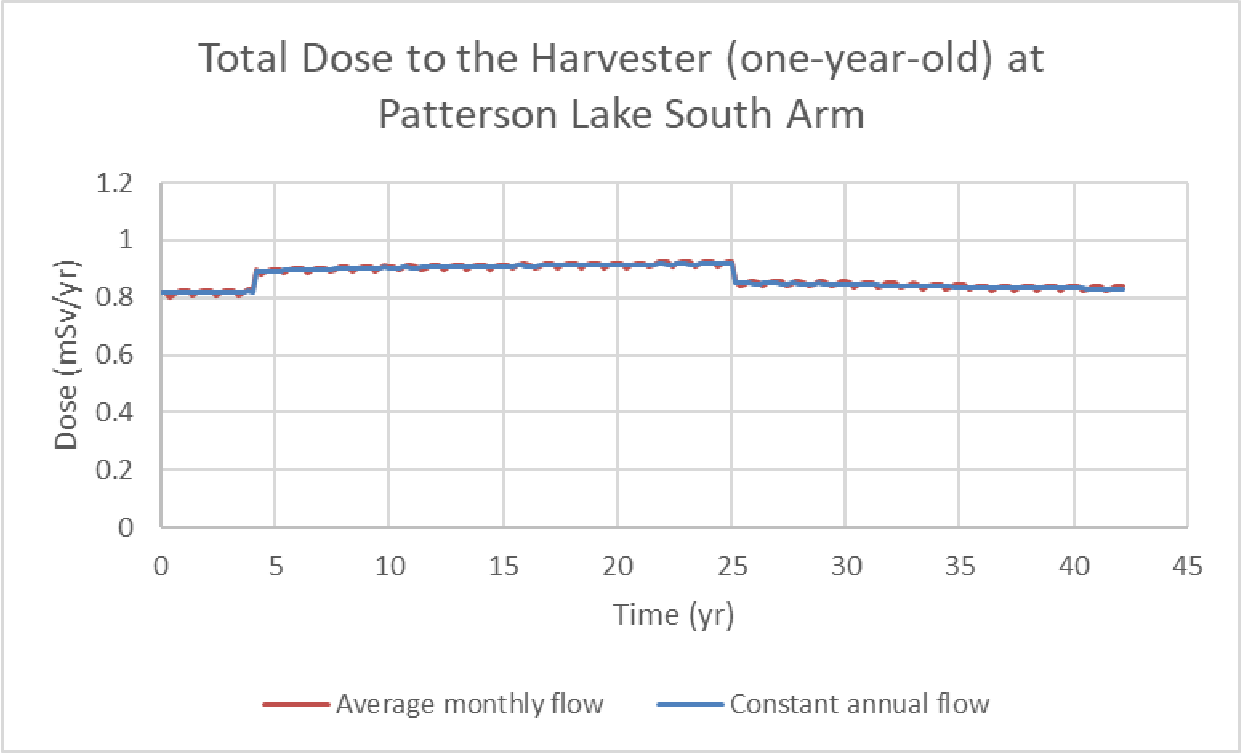


Figure 7-2: Total Dose to the Subsistence Harvester (One-Year-Old) at Patterson Lake South Arm during Operations

mSv/yr = millisieverts per year.

7.2.2 Deposition of Constituents of Potential Concern on Soil and Plants

IMPACT follows the CSA N288.1-20 model, which uses a number of input parameters that are specified in N288.1. The CSA N288.1-20 air dispersion model can be used in IMPACT to estimate average concentrations in air. In this assessment, modelled air concentrations were used from another model (AERMOD) and only the wet and dry deposition on plants and soil was calculated in IMPACT. This deposition was added to a soil baseline estimated from sampling results of soil and plants.

A number of assumptions (Table 7-2) based on default parameters from CSA N288.1-20 were made in modelling deposition of airborne contaminants in this assessment, which can be a source of uncertainty. Dry deposition velocity, washout ratio to soil and plants, and the fraction of time precipitation falls when the wind is from a certain sector are not site-specific, but the default values recommended by CSA N288.1-20 were used. For example, in the air model (EIS Appendix 7A), the dry deposition rates are location-specific. The dry deposition rates were calculated from the air concentrations for a given constituent and the deposition velocity, at a reference height. The wet deposition rates were calculated from the air concentrations for a given constituent and the washout ratio. The default dry deposition velocity of 0.0014 m/s was used for all metals (CSA 2020). Since concentrations decrease with distance from the emission sources, deposition rates also decrease with increasing distance from the emission sources, even with the assumption of a constant deposition velocity.

Table 7-2: Parameters Used in Modelling Deposition of Airborne Constituents of Potential Concern on Soil and Plants

Model Parameter	Unit	Value used in IMPACT (a)	Value used in AERMOD
Dry deposition velocity	m/s	0.0014	Greater than 0.002
Wet deposition washout ratio to soil	unitless	5.5E+6	Varied hourly with meteorological conditions
Wet deposition washout ratio to plants	unitless	6.3E+5	Same as washout ratio to soil
Precipitation rate	mm/yr	800	Varied hourly; annual precipitation was 573.6 mm/yr averaged over the five modelling years (2012 – 2016)
Fraction of time precipitation falls when the wind is from a certain sector	unitless	0.36	Not applicable; model uses hourly wind data and precipitation rate

(a) Values used in IMPACT model are the default parameters specified in CSA N288.1-20, assuming sandy soil. Values presented are for all elements other than noble gases, iodine, and N-13.
m/s = metres per second; mm/yr = millimetres per year.

7.2.3 Traditional Food Assumptions for Subsistence Harvesters

In the HHRA, the subsistence harvester was assumed to collect 50% of the Traditional Foods in the diet from locations potentially impacted by the Project, and the other 50% of the Traditional Foods in the diet from a reference location unaffected by the Project. This assumption was considered representative of how a subsistence harvester would collect Traditional Foods, by moving around and collecting from more than one location.

To evaluate the potential changes to the predicted cancer risk to the subsistence harvester, a sensitivity analysis was conducted assuming the subsistence harvester obtained 100% of the Traditional Foods in the overall diet from the area of the Project.

Additionally, as indicated in Section 5.2.3.2, Bioavailability, bioaccessibility factors (Table 7-3) for moose meat and organs were applied to the exposure doses, and exposure doses from fish were also adjusted to account for only the inorganic form of arsenic. In this sensitivity analysis these adjustments were removed as well.

Based on the assumption that the subsistence harvester would obtain Traditional Foods entirely from the area of the Project, the arsenic ILCR would exceed the negligible cancer risk level of 1 in 100,000 for the subsistence harvester harvesting Traditional Foods from Patterson Lake South Arm and would be at the negligible cancer risk level for the subsistence harvester at Beet Lake during Operations for all cases (Table 7-4). The arsenic ILCR would be below the negligible cancer risk level of 1 in 100,000 for the subsistence harvester at Lloyd Lake. During the far-future projection, the arsenic ILCR would generally be at or below the negligible cancer risk level at all locations.

This sensitivity scenario has been presented as a worst-case scenario, that would be considered unlikely, since a subsistence harvester is likely to obtain Traditional Foods from multiple locations.

Table 7-3: Comparison of Arsenic Bioavailability Assumptions and the Local Intake Fractions of Traditional Food for Adult Subsistence Harvester

Food Type	Arsenic Bioaccessibility Factors (unitless)			
	Assessed Scenario		Sensitivity Scenario	
Moose organs	0.19		1	
Moose meat	0.59		1	
Fish	0.1		1	
Food Type	**Local Intake Fractions of Traditional Food (%)**			
	Assessed Scenario		**Sensitivity Scenario**	
	Reference Location	**Exposure Location**	**Reference Location**	**Exposure Location**
Northern pike	25.00	25.00	0	50.00
Lake whitefish	25.00	25.00	0	50.00
Store foods	41.59	41.59	0	83.18
Moose	1.69	1.69	0	3.38
Moose organs	0.75	0.75	0	1.50
Beaver	4.68	4.68	0	9.36
Mallard	0.28	0.28	0	0.56
Grouse	1.01	1.01	0	2.02
Labrador tea	9.88	9.88	0	19.76
Fruits and berries	40.12	40.12	0	80.24

% = percent.

Table 7-4: Estimated Incremental Lifetime Cancer Risk from Arsenic to Subsistence Harvester – Sensitivity Scenario

Receptor	Application Case Cancer Risk (per 100,000)		Upper Bound Scenario Cancer Risk (per 100,000)		RFD Case Cancer Risk (per 100,000)	
	Operations	Far-Future	Operations	Far-Future	Operations	Far-Future
Subsistence harvester - Patterson Lake South Arm (composite)	**28**	0.7	**29**	1	**123**	0.7
Subsistence harvester - Beet Lake (composite)	1	0.03	1	0.04	1	0.03
Subsistence harvester - Lloyd Lake (composite)	0.4	0.002	0.4	0.003	0.4	0.002

Note: **Bold** indicates exceedance of the negligible cancer risk level of 1 in 100,000.

7.2.4 Climate Change

As a scenario within the RFD Case, potential effects from climate change, including how natural factors may be altered resulting from climate change, were considered. 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).

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 (EIS Section 10, Surface Water Quality and Sediment Quality). 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 EIS 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 ERA would also be negligible to minor, and no quantitative assessment was warranted.

8.0 CONCLUSIONS AND MONITORING

The selection of human and ecological receptors for inclusion in the ERA was informed by Indigenous Knowledge primarily through JWG meetings and IKTLU Studies, as well as other Local Knowledge, information from baseline studies, as well as professional judgement. The assumptions made for the Traditional Foods diet (i.e., amounts consumed and food types) was an iterative process that was informed by JWG meetings, IKTLU Studies, as well as discussions with representatives from Saskatchewan Ministry of Environment, Saskatchewan Health Authority and the CNSC.

The ERA focused on COPCs that exceeded screening values in air and water based on predicted atmospheric releases and aqueous releases (treated effluent, treated sewage, site runoff, and groundwater solute releases) from the Rook I Project. Based on the screening of atmospheric releases, no COPCs in air were advanced for further quantitative assessment in the ERA.

Based on the screening of aqueous releases, arsenic, cobalt, copper, molybdenum, uranium, sulphate, and chloride were advanced for further quantitative assessment in the ERA. Selenium, a constituent of interest for uranium mines and mills was assessed in terms of predicted fish tissue concentrations, since selenium toxicity in the aquatic environment is primarily from bioaccumulation of selenium in the aquatic food chain and not only from exposure to selenium in water. Predicted fish tissue concentrations in waterbodies immediately downstream of the source including Patterson Lake North Arm – West Basin were below the recommended USEPA fish tissue criterion; therefore, selenium was not considered further for quantitative assessment in the ERA.

Radionuclides, including the uranium-238 series and radon were included as COPCs because these constituents are of public interest.

8.1 Human Health Risk Assessment

The HHRA estimated dose and risk to the following receptors: camp worker, subsistence harvester, seasonal resident, and future permanent resident in the far-future projection. The Application Case, reasonable upper bound sensitivity scenario, and RFD Case were assessed for all phases of the Project and the far-future projection.

8.1.1 Non-radiological Human Health Risk Assessment

For assessment of non-carcinogens, risk was estimated based on an incremental HQ. Incremental HQs were compared to a benchmark HQ value of 0.2 because exposures to background sources were not included. This approach is consistent with Health Canada's guidance on human health preliminary quantitative risk assessment (Health Canada 2021a).

No significant adverse effect on any human receptors, as a result of releases from the Project, was likely during Operations for the Application Case, reasonable upper bound sensitivity scenario, and RFD Case. All estimated incremental HQs for all non-carcinogenic COPCs (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 (arsenic), the ILCR was estimated and compared against the 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. 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.

8.1.2 Radiological Human Health Risk Assessment

The incremental radiation dose to all human receptors during all Project phases and the far-future projection are below the regulatory public dose limit of 1 mSv/yr for the Application Case, the reasonable 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 reasonable 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 would be below the public dose limit, no discernable health effects are anticipated due to exposure of these receptors to radioactive releases from the Project.

8.2 Ecological Risk Assessment

The EcoRA estimated dose and risk to representative aquatic and terrestrial receptors. The Application Case, sensitive upper bound sensitivity scenario, and RFD Case were assessed for all phases of the Project and the far-future projection.

8.2.1 Non-radiological Ecological Risk Assessment

The potential for ecological effects was assessed by comparing exposure levels to toxicological benchmarks and characterized quantitatively in terms of HQs. An HQ greater than 1 indicates adverse effects may be possible for a given ecological receptor and further investigation would be warranted.

No significant adverse effect on either aquatic or terrestrial populations or communities, as a result of releases from the Project, would be likely during Operations, for the Application Case, reasonable upper bound sensitivity scenario, and RFD Case. All estimated HQs for all COPCs (chloride, sulphate, arsenic, cobalt, copper, molybdenum, and uranium) for all ecological receptors would remain below the HQ benchmark of 1.

For the far-future projection, once groundwater solutes reach Patterson Lake North Arm – West Basin, HQs would remain below the benchmark of 1 for all COPCs with the exception of copper for the Application Case, reasonable upper bound sensitivity scenario, and RFD Case. Exceedances of the HQ benchmark value of 1 for the far-future projection would be limited spatially to the Patterson Lake and are limited in magnitude to just above the benchmark of 1. Exceedances of the HQ benchmark were predicted for lake whitefish, aquatic invertebrates, and zooplankton.

The TRV for lake whitefish, benthic invertebrates and zooplankton corresponds to the CCME's default water quality guideline for copper. The CCME water quality guideline is a conservative benchmark for copper below which adverse effects for most aquatic biota are not expected to occur. The most sensitive species include fresh water snails (*Lymnaea stagnalis* and *Pyrgulopsis robusta*), bivalves (*Villosa iris*), and water flea (*Daphnia magna*; ECCC 2021). The most sensitive endpoints for chronic exposure to copper include growth for benthic invertebrates, reproduction for zooplankton, and growth and reproduction for fish (ECCC 2021). The CCME water quality guideline is based on no or low effect levels for the most sensitive species; thus, the marginal TRV exceedances predicted by HQs just above 1 indicate a possible slight reduction in growth or reproduction for exposed individuals of sensitive species in Patterson Lake North Arm – West Basin. However, since the HQ exceedance is localized to Patterson Lake North Arm – West Basin, population level effects are not expected.

As noted in Section 6.4.1, Risk Estimation, the evaluation of risk related to copper exposure is an iterative process. Additional evaluation of this risk was completed in the aquatic health assessment (EIS Appendix 11A), with the objective of informing an adaptive management plan for assessing and reducing uncertainty related to waste rock storage area seepage and increasing mitigations if necessary.

Species at risk were assessed using surrogate species. The rusty blackbird and little brown myotis were identified as surrogate species at risk. Since no HQs above 1 were identified for these ecological receptors, individual species at risk would also be considered protected.

8.2.2 Radiological Ecological Risk Assessment

Radiation dose benchmarks of 9.6 mGy/d and 2.4 mGy/d (UNSCEAR 2008) were selected for the assessment of effects on aquatic biota and terrestrial biota, respectively, as recommended in CSA N288.6-22.

There were no predicted exceedances of the 9.6 mGy/d radiation dose benchmark for aquatic biota and 2.4 mGy/d radiation dose benchmark for terrestrial and riparian biota for the Application Case, the reasonable upper bound sensitivity scenario, and the RFD Case, during both the Project phases and the far-future projection.

Since there are no predicted exceedances of the respective dose benchmarks for any of the aquatic or terrestrial receptors, individual species at risk would also be considered protected.

8.3 Monitoring and Follow-up

The HHRA and EcoRA were developed based on the best available information for the Rook I Project, including baseline monitoring data, assumptions on estimates of source terms, Traditional Food diet (consumption rates and food types), among others.

Monitoring would focus on collecting data to verify ERA model predictions as well as provide data to improve model predictions as the Project begins. Recommended monitoring would support NexGen's adaptive management framework with the goal 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 period may occur within the Project footprint at the camp and at the fence line for nitrogen dioxide and particulate matter, including uranium in TSP and PM_{10}. The predicted exceedances are infrequent, short-term, and limited to within the Project footprint and at the associated boundary. 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; Chan et al. 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 is implementing 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 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 limited 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 extend 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.

- **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.

- **Far-Future projection effects:** Localized effects to some individual ecological receptors were predicted due to copper released from groundwater into Patterson Lake North Arm – West Basin in the far-future projection. As it is difficult to verify effects predicted far into the future, adaptive management would be implemented throughout Operations to reduce the potential loads from surface and underground features into the groundwater in the far-future projection.

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Appendix A IMPACT Model Report

Ecometrix | Environmental INTELLIGENCE

ENVIRONMENTAL RISK ASSESSMENT FOR THE ROOK I PROJECT - APPENDIX A - IMPACT MODEL

MODELLING REPORT

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ABBREVIATIONS AND UNITS OF MEASURE

LIST OF ACRONYMS

Acronym	Definition
BAF	bioaccumulation factor
COPC	constituent of potential concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSA	Canadian Standards Association
DCF	dose coefficient
dw	dry weight
fw	fresh weight
HQ	hazard quotient
IMPACT	Integrated Model for the Probabilistic Assessment of Contaminant Transport
TF	transfer factor
USEPA	United States Environmental Protection Agency

LIST OF UNITS

Unit	Definition
%	percent
µGy/h	micrograys per hour
Bq/kg	becquerels per kilogram
Bq/L	becquerels per litre
Bq/m^2	becquerels per square metre
Bq/m^3	becquerels per cubic metre
cm/h	centimetres per hour
d	day
h	hour
ha	hectare
kg	kilogram
kg/L	kilograms per litre
kg/m^2/s	kilograms per square metre per second
kg/yr	kilograms per year
km	kilometre
km^2	square kilometre
L	litre
L/d	litres per day
L/kg	litres per kilogram

Unit	Definition
$L/m^2/s$	litres per square metre per second
L/m^3	litres per cubic metre
L/s	litres per second
m	metre
m/s	metres per second
m^2	square metre
m^3	cubic metre
m^3/d	cubic metres per day
m^3/kg	cubic metres per kilogram
m^3/yr	cubic metres per year
mg	milligram
mg/kg	milligrams per kilogram
mg/kg/d	milligrams per kilogram per day
mg/L	milligrams per litre
mg/m^3	milligrams per cubic metre
mg/s	milligrams per second
mSv/yr	millisieverts per year
s	second
Sv/Bq	sieverts per becquerel
Sv/yr	sieverts per year
yr	year

1.0 Introduction

1.1 Overview of the IMPACT Model

The environmental transport and pathways model, IMPACT (Integrated Model for the Probabilistic Assessment of Contaminant Transport), is used to evaluate the transport and effects of constituents of potential concern (COPCs) on the local environment and receptors, including humans and non-human biota. The model represents a convenient platform and powerful tool to complete systematic evaluations of the risks to ecological and human receptors associated with releases of constituents to water and air from proposed or existing anthropogenic (i.e., human) activities. The scope of this appendix is to provide further detail on the modelling approach followed to calculate dose and risk to ecological and human receptors, as reported in the main body of Technical Support Document (TSD) XXI, Environmental Risk Assessment.

IMPACT is a modelling tool, the current version of which was created, and is maintained and supported, by Ecometrix Incorporated (Ecometrix). The IMPACT model was originally developed by BEAK Consultants Ltd. in 1993 as part of a research initiative partially funded by the Atomic Energy Control Board (now the Canadian Nuclear Safety Commission, CNSC). Since the initial development, IMPACT has been continuously updated to improve the interface, to integrate various operating systems, and most importantly, to embody an up-to-date understanding of the fate, transport, and toxicity of metals, radionuclides, and other constituents released to the environment.

IMPACT updates have been funded by the CANDU Owners Group in order to ensure that it is continually aligned with the Canadian Standards Association (CSA) relevant standards. The CSA standard N288.1 presents analytical equations and parameters for radiological pathways analysis, developed with the participation of experts from the nuclear industry, government agencies and consultants, including the CNSC and Ecometrix. The CSA standard N288.6 provides guidance for environmental risk assessment at nuclear facilities, and references N288.1 for radiological risk assessment.

The IMPACT 5.6.1 is a dynamic version of the model and was tailored to align with the guidance in CSA standards N288.6-22 (CSA Group, 2022) and N288.1-20 (CSA Group, 2020). It contains differential equations for COPC transport, allowing for non-steady-state conditions, whereas N288.1 contains the corresponding steady-state equations.

The IMPACT model is a customizable tool that allows the user to assess the transport and fate of COPCs through a user-specified environment. The model is used to estimate concentrations of COPCs in a range of environmental media, based on releases and environmental features. The IMPACT model enables the quantification of potential doses and hazard quotients (HQs) for aquatic and terrestrial ecological receptors, as well as humans. The graphical user interface features make it possible to create or modify scenarios quickly and without the need to change the programming code. Thus, users can construct complex models to predict potential environmental effects in a wide variety of natural environments without the need for programming skills or the use of multiple, complex model interfaces.

The IMPACT model has been applied to ecological and human health risk assessments at several proposed and operating uranium mines and mills including Cigar Lake Mine (Cameco, 2004), Key Lake Mine (Ecometrix 2005, 2012, 2013a) and Millennium Mine (Ecometrix 2013b, c). This model has also been used extensively by other nuclear facilities for ecological and human health risk assessments, to support preparation of derived release limits and for annual public dose calculations. The extensive environmental database developed for northern Saskatchewan since the 1970s to present day has gone through numerous updates as a larger available database of environmental data became available over time. This has helped develop more statistically rigorous relationships for COPC transfer among various environmental compartments. Substantial effort was made during this assessment to review parameters in the model and compare to the existing baseline dataset for the Rook I Project, which is further discussed in Section 3.0, Development of Model Parameters.

1.2 Objective of this Document

The objective of this document is to present the structure and functioning of the IMPACT model as implemented for the Rook I Project (the Project). The Project is a proposed new uranium mining and milling operation located adjacent to Patterson Lake in the southwestern Athabasca Basin in northern Saskatchewan. The Project site and surrounding local and regional study areas are shown in Figure 1-1.

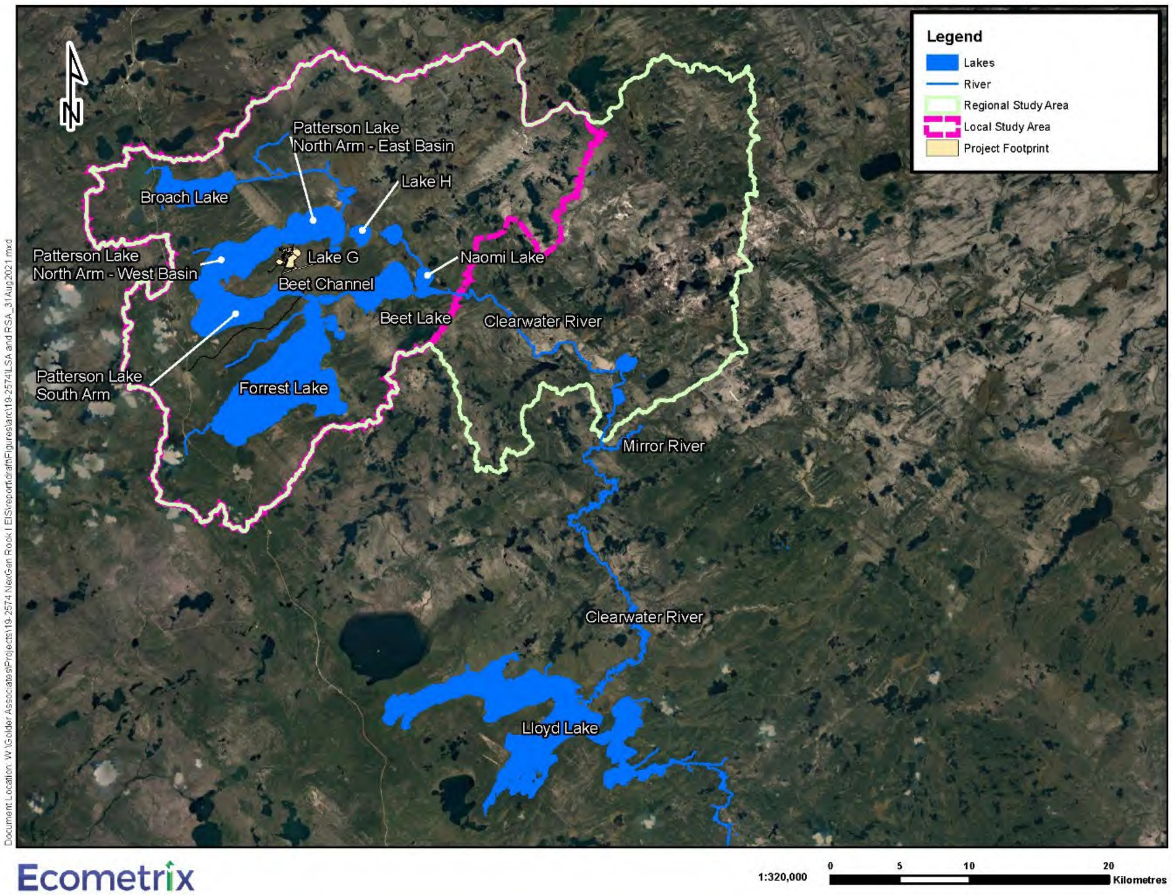


Figure 1-1: Rook I Project Site and Study Areas

This document discusses the inputs and assumptions used in the IMPACT model, including receptor characteristics, exposure pathways, and the derivation and identification of site-specific information.

1.3 Structure of this Document

The document contains the following sections and content:

Section 2.0: Describes the model structure for ecological and human receptor assessment, specific assumptions made for the Project, and the generic equations used to calculate the transfer of constituents between environmental media and the receptors.

Section 3.0: Presents the development of project-specific input parameters and describes the approach used for calibration and validation based on regional monitoring data.

2.0 The IMPACT Model

The IMPACT model simulates the transport of constituents from sources through various environmental media such as air, water, soil, and sediment, to receptors. The model estimates the resulting concentration of constituents in environmental media, potential uptake (i.e., absorption) by aquatic and terrestrial vegetation and animals, and potential intake (i.e., ingestion) by and dose to animals and humans.

Environmental pathways are the transport, transformation, and transfer mechanisms by which COPCs travel from sources to receptors. A pathway exists when there is a point at which COPC uptake or external exposure by an ecological or human receptor may occur, following COPC transport from the source through environmental media. If a complete transport pathway does not exist between the source of a COPC and an ecological or human receptor, then no exposure is expected to occur.

The links within a pathway represent different processes of COPC transfer, which depend on the receptors and environmental conditions. These processes can include intake, transfer, and accumulation of constituents.

IMPACT is consistent with the calculations outlined in CSA N288.1-20 and CSA N288.6-22. As such the default model parameters are consistent with these publications. All environmental parameters including bioaccumulation factors, transfer factors and other constants can be adjusted to site or regional data as these are available. In general, it is preferable to use regional values, and this approach was followed in this assessment. Values for water-sediment transfer as well as aquatic animals and plants were based on regional datasets, which have been developed using extensive environmental data collected over many years (Ecometrix 2005, 2012, 2013c). These values will be identified as regional data. For the remaining factors, literature values were selected. In this selection process, the CSA standards were preferred to other available literature.

This IMPACT model 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 Rook I baseline condition were compared to measured Rook I baseline data so that model predictions would not be underestimating as compared to measurements.

2.1 The IMPACT Model Structure

The basic spatial units of assessment in IMPACT are "polygons". IMPACT supports two types of polygons, aquatic and terrestrial, which represent aquatic and terrestrial environments respectively. Ecological and human receptors inhabit polygons. Polygons represent zones of surface water or land that have similar physical, chemical, biological, and/or hydrological characteristics. Individual polygons are given specific attributes, such as topography for land polygons and water depth and flow for water polygons, which can be based on site-specific information. Each polygon is given a specific spatial extent that is defined by a centroid point (with X and Y coordinates) and a surface area. Polygons can be connected by water or air pathways. A number of receptors may reside within each polygon and may have exposure connections to other polygons.

The transfer of constituents between environmental media, receptors, and polygons is conceptualized by links (i.e., arrows indicating direction of transfer). The links represent different transfer processes depending on the context. For example, a link between two waterbodies may represent flow of water, and a link between water and sediment may represent sedimentation. Each transfer process is represented by a differential equation.

Transfer of constituents is modelled iteratively with a constant user-selected timestep. IMPACT uses the Euler Method to numerically solve the set of ordinary differential equations at each timestep. The modelling timestep for this Project was selected to optimize computing time and produce a convergent solution in a dynamic system. The modelling timestep chosen was 0.02 years, which roughly equates to one week. Results were monitored at intervals of 0.02 years to 2 years, depending on the change rate for the scenario.

2.2 Water Polygons

Lakes and streams are defined within IMPACT as water polygons, which are distinct from land polygons. Water polygons can be inhabited by aquatic receptors and provide exposure pathways for terrestrial and human receptors.

The IMPACT model includes flow and mass balance in lakes and streams. Constituents enter the aquatic environment from a source and travel through various waterbodies. As constituents travel through a series of connected waterbodies such as lakes, concentrations in water can decrease as a result of mixing with natural inflows from the surrounding watershed and interactions with lake sediment. The sediment-water exchange of constituents is estimated using chemical-specific partitioning coefficients. The water and sediment pathways involve the exchange of constituents between surface water and sediment through the following processes:

- sorption and desorption between dissolved and particulate forms in water and sediment;
- settling of particulates from water to sediment;
- diffusive exchange between sediment porewater and the water column; and
- loss to deeper sediments through accumulation and burial.

The model estimates concentrations in the water and sediment using the advection dispersion equation (detailed below), which is essentially a mass conservation equation. The partial differential equations are solved iteratively. The model estimates changes in concentrations in water and sediment through each downstream waterbody, over time.

Aquatic receptors reside in water polygons. Terrestrial receptors (e.g., moose, humans) reside in land polygons and can be linked to aquatic receptors from water polygons.

The IMPACT model included the following distinct water polygons: Broach Lake, Patterson Lake North Arm – West Basin, Patterson Lake South Arm, Beet Lake, Lloyd Lake. Forrest Lake North Basin was considered as a flow-through channel, in the same way as the Clearwater River. This is discussed in more detail in Section 3.1.1, Lake Morphometry.

The Clearwater River has short sections in between these waterbodies, so Clearwater River chemical characteristics would be similar to the outflow of the upstream waterbody at any given location within the study area. The Clearwater River between Beet Lake and Lloyd Lake is modelled in sections to reflect increased flow rates at various points along the way.

2.2.1 Ecological Receptors Residing in Water Polygons

Aquatic plants and animals are assigned to water polygons. The aquatic ecological receptors that were considered in this iteration of the IMPACT model include aquatic macrophytes (i.e., plants), phytoplankton, zooplankton, benthic invertebrates, and fish.

Macrophytes

Aquatic macrophytes are primary producers that occupy the lowest level in the food chain and are exposed to constituents in surface water. Macrophytes can potentially uptake metals in their roots and shoots and are modelled accordingly. Macrophytes provide a pathway for the introduction of bioavailable constituents and their compounds into the food chain through direct consumption by terrestrial herbivores (e.g., moose [*Alces alces*] and woodland caribou [*Rangifer tarandus caribou*]).

Phytoplankton

Phytoplankton are primary producers that occupy the lowest level in the food chain and are assessed for exposure to constituents in surface water.

Zooplankton

Zooplankton are primary consumers that occupy the second lowest level in the food chain and are assessed for exposure to constituents in surface water.

Benthic Invertebrates

Benthic invertebrates are primary consumers. These organisms are important food sources for aquatic and semi-aquatic animals. In the IMPACT model, benthic invertebrates are assumed to be exposed to COPCs in the aquatic environment directly through contact with water and sediment.

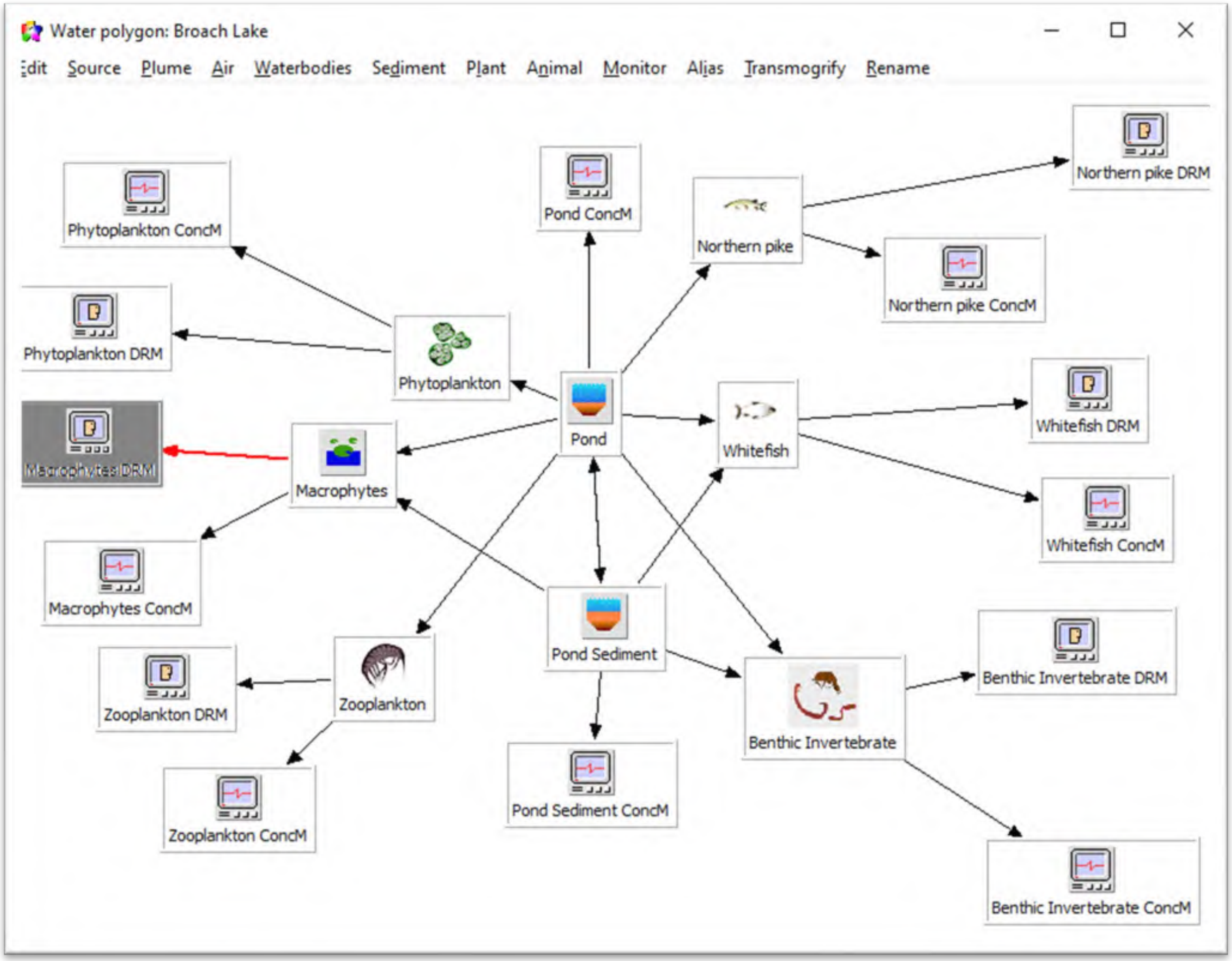
Fish

Fish were collected from waterbodies within the vicinity of the Project local and regional study areas to provide data on baseline COPC concentrations in muscle and bone tissues in large-bodied fish (Annex V.1, Aquatic Environment Baseline Report). Fish species observed and sampled include northern pike (*Esox lucius*) and lake whitefish (*Coregonus clupeaformis*). Northern pike was selected for IMPACT modelling purposes to represent a piscivorous (i.e., fish-eating) top carnivore. Lake whitefish was selected for IMPACT modelling to represent a bottom-feeding fish. Northern pike and lake whitefish represent different trophic levels. Although there may be other fish species that are not included explicitly in the model, northern pike and lake whitefish are assumed to be representative of other similar species. Since baseline data are available for these species, model predictions can be validated against measured data (Section 3.6.2, Model Validation).

Fish species were used as surrogates for amphibians (e.g., frogs) because the sensitive life stages of amphibians (i.e., egg and tadpole) are aquatic and similar to the sensitive life stages of fish. During the tadpole stage, tadpoles and fish have similar exposure pathways (i.e., gills for breathing, absorption through skin, and similar feeding habits). Toxicological data for amphibians are limited, but the available data for cadmium, cobalt, copper, lead, nickel, and zinc for sensitive life stages indicate that the selected toxicity reference values for fish are protective of amphibians. Therefore, the fish species in the model are expected to provide a reasonable surrogate for, and protection of, amphibians during the sensitive tadpole stage.

2.2.2 Aquatic Pathways

Aquatic pathways include the transfer of COPCs between water, sediment, aquatic animals, and aquatic plants. Environmental media (i.e., water and sediment) and aquatic ecological receptors (i.e., aquatic plants, phytoplankton, zooplankton, benthic invertebrates, and fish) are connected by arrows in the IMPACT model (Figure 2-1). The arrows represent equations listed below the figure. Model outputs include concentrations in environmental media and receptors, and dose and risk values for aquatic ecological receptors.



DRM = Dose-Risk Monitor; ConcM = Concentration Monitor.

Figure 2-1: Representation of Transfer between Aquatic Media in the IMPACT Model

The equations for concentrations in water and sediment are partial differential equations that are solved numerically within IMPACT. Each of these equations is characterized by a series of parameters that describe the physical and biochemical environment of each lake and stream represented by the model. These parameters can be divided into general categories to represent the following components and processes:

- physical environment;
- natural background conditions;
- project-related constituent loadings; and
- biochemical exchange processes.

There are four basic equations that describe the concentrations in the aquatic environment for water and sediment.

Water column concentration (C_{wc}):

$$\frac{dC_{wc}}{dt} = \frac{W_w + Q_{in} \cdot C_{in} + Q_{gw} \cdot C_{gw}}{V_w} + \lambda_{parent} \cdot C_{parent} - \frac{k_s}{z_w}\left[(1 - f_w) \cdot C_{wc} - C_{pw}\right] - C_{wc} \cdot \left[\lambda_T + \frac{g_w \cdot f_w}{z_w} + \frac{Q_{out} + (1 - f_w) \cdot Q_{gw \leftrightarrow out}}{V_w}\right]$$

Sediment layer concentration (C_s):

$$\frac{dC_s}{dt} = \frac{g_w \cdot f_w \cdot C_{wc}}{z_s} + \lambda_{parent} \cdot C_{parent} + \frac{k_s}{z_s}\left[(1 - f_w) \cdot C_{wc} - C_{pw}\right] + \frac{Q_{gw} \cdot C_{gw}}{V_s} - C_s \cdot \left[\lambda_T + \frac{g_b}{z_s} + \frac{(1 - f_s) \cdot Q_{gw \leftrightarrow out}}{\varepsilon_s \cdot V_s}\right]$$

The fraction of a constituent that is particulate in the water column (f_w) defined as:

$$f_w = \frac{K_d \cdot \frac{\rho_s}{\varepsilon_s}}{1 + K_d \cdot \frac{\rho_s}{\varepsilon_s}}$$

The sediment-water transport coefficient (k_s) defined as:

$$k_s = \frac{D^*}{z_i}$$

The burial rate of sediments (g_b) defined as:

$$g_b = \frac{g_w \cdot SS}{\rho_s}$$

Aquatic animal concentrations (C_{aa}) are calculated as:

$$C_{aa} = C_{wc} \cdot BAF_{aa} \cdot \alpha \cdot (1 - OF_s) + C_{pw} \cdot BAF_{aa} \cdot \alpha \cdot OF_s$$

Aquatic plant concentrations (C_{ap}) are calculated as:

$$C_{ap} = C_{wc} \cdot BAF_{ap}$$

where:

α	=	food web multiplier(s) (unitless)
BAF_{aa}	=	bioaccumulation factor for aquatic animals L/kg)
BAF_{ap}	=	bioaccumulation factor for aquatic plants L/kg)
C_{in}	=	concentration of constituent entering water column (mg/L, Bq/L)
C_{gw}	=	concentration of constituent in seepage (input) groundwater (mg/L, Bq/L)
C_{parent}	=	concentration of parent constituent (mg/L, Bq/L)
C_{pw}	=	concentration in the surficial sediment pore water (mg/L, Bq/L)
C_s	=	concentration of constituent in surficial sediments (mg/kg, Bq/kg)
C_{wc}	=	concentration of constituent in water column (mg/L, Bq/L)
D^*	=	sediment-water column diffusion coefficient (m^2/s)
ε_s	=	porosity of surficial sediment (unitless)
f_s	=	fraction of a constituent that is particulate in the sediment layer (unitless)
f_w	=	fraction of a constituent that is particulate in the water column (unitless)
g_b	=	burial rate of sediments (m/s)
g_w	=	settling rate of particulates in water column (m/s)
K_d	=	water-to-sediment partitioning coefficient (L/kg)
k_s	=	sediment-water transport coefficient (m/s)
λ_{parent}	=	first-order decay constant for parent constituent (1/s)
λ_T	=	total first-order decay constant for constituent (1/s), which is the sum of the universal decay constant and the media-specific decay constant
OF_S	=	sediment occupancy factor (unitless)
Q_{in}	=	inflow rate from upstream surface water (L/s)
Q_{gw}	=	inflow rate from groundwater (L/s)
Q_{out}	=	net outflow rate to downstream surface water (L/s)
$Q_{gw\leftrightarrow out}$	=	outflow rate to groundwater (L/s)
ρ_s	=	bulk density of surficial sediment (kg dw/L)
SS	=	suspended solids concentration (mg/L)
V_s	=	volume of surficial sediment layer (L)
V_w	=	volume of surface waterbody (L)
W_w	=	total effluent emission rate from all sub-sources (mg/s, Bq/s)
z_i	=	sediment-water column diffusion interface thickness (mm)
z_s	=	thickness of sediment layer (m)
z_w	=	mean lake depth (m)

Many parameters representing the physical environment were derived from baseline studies (Annex IV.2, Hydrometric Monitoring Characterization Report) including waterbody surface areas and volumes. Information from published literature and from experience with similar environments was used to quantify physical parameters that are conceptual or that were not observed directly (e.g., sediment interface thickness). A summary of these parameters used as inputs for the above transport equations is presented in Table 2-1.

It should be noted that the underlying assumption for water-sediment transport in IMPACT is that minimal suspended solids will be introduced through the effluent.

Table 2-1: Water-Sediment Transport Modelling Parameters

Model Parameter		Value	Unit
Mixing depth (thickness of sediment layer)	z_s	0.03	m
Dry bulk density	ρ_s	0.11	kg dw/L
Water content (porosity	ε_s	0.96	unitless
Diffusion coefficient	D*	3.16×10^{-10}	m^2/s
Interface thickness	z_i	0.01	m
Settling rate	g_w	2	mm/yr
Suspended solids	SS	2	mg/L

Note: Values calibrated based on regional data.
dw = dry weight.

The natural background conditions represent the quality of water and sediment within the watershed prior to mining. Where possible, field data were used to quantify natural background conditions (Section 3.2.1, Background Water Quality and Section, 3.3.1, Background Sediment Quality). Monitoring data indicated that concentrations of some constituents in water were below analytical detection limits. Concentrations in the sediments from lakes were generally measurable. Water-sediment partitioning coefficients were selected based on the available data (Section 3.3.2, Water to Sediment Partitioning Coefficients).

The source loads of constituents from natural and Project-related sources represent the boundary conditions of the model. Natural sources are represented by the chemical influx from natural groundwater discharge, overland runoff, and stream inflows from the surrounding landscape. These natural loadings were estimated from natural background water quality and inflow rates for site-specific conditions.

2.2.3 Radiological Dose to Aquatic Ecological Receptors

Radiological dose to an aquatic receptor is the radiation energy absorbed due to radiation emissions from radionuclides present in the environment (water or sediment) or in the tissues of the organism. Through comparison with dose benchmarks, the risk to the organism can be quantified. This model characterizes dose and risk resulting from both background and project exposure.

The total dose (D_{total}) to an aquatic ecological receptor from each constituent is:

$$D_{total} \quad = \quad D_{int} \; + \; D_{ext}$$

The dose of COPCs to an aquatic ecological receptor due to incorporated radioactivity (D_{int}) is:

$$D_{int} \quad = \quad C_t \cdot DCF_{int}$$

The external dose to the aquatic ecological receptor from radioactivity in water and sediment (D_{ext}) is:

$$D_{ext} \quad = \quad [C_w \cdot (OF_w + 0.5OF_{ws} + 0.5OF_{ss}) + C_s \cdot (OF_s + 0.5OF_{ss})] \cdot DCF_{ext}$$

where:

C_t	=	whole body tissue concentration from water (becquerels per kilogram fresh weight (Bq/kg fw))
C_w	=	water concentration (becquerels per litre (Bq/L))
C_s	=	sediment concentration (Bq/kg fw)
D_{int}	=	internal radiation dose (micrograys per hour (µGy/h))
D_{ext}	=	external radiation dose (µGy/h)
DCF_{int}	=	dose coefficient for radionuclide in tissue ([µGy/h])/[Bq/kg fw])
DCF_{ext}	=	external dose coefficient for water ([µGy/h]/[Bq/kg fw sediment] or [µGy/h]/[Bq/L water])
OF_s	=	fraction of time spent immersed in sediment (unitless). Assumption based on characteristics of the organism; see Table 2-5
OF_{ss}	=	fraction of time spent on the sediment surface (unitless). Assumption based on characteristics of the organism; see Table 2-5
OF_w	=	fraction of time spent immersed in the water column (unitless). Assumption based on characteristics of the organism; see Table 2-5
OF_{ws}	=	fraction of time spent on the water surface (unitless). Assumption based on characteristics of the organism; see Table 2-5

2.2.4 Non-radiological Risk to Aquatic Receptors

Risk to aquatic receptors from exposure to non-radionuclide COPCS is expressed as a Hazard Quotient (HQ). For aquatic receptors, it is characterized through comparison of the exposure concentration with a reference toxicity concentration. This model calculates the risk from both background and Project exposure. The HQ for aquatic ecological receptors due to exposure to COPCs in water is estimated as:

$$HQ = \frac{1}{RC_{wc}} \cdot [C_{wc} \cdot (1 - OF_s) + C_{pw} \cdot OF_s]$$

where:

C_{pw}	=	concentration in the surficial sediment pore water (mg/L)
C_{wc}	=	concentration of constituent in water column (mg/L)
OF_s	=	sediment occupancy factor (unitless). Assumption based on characteristics of the organism; see Table 2-5
RC_{wc}	=	reference toxic concentration – water column (mg/L)

2.3 Land Polygons

Terrestrial receptors are modelled as residing in land polygons. Land polygons provide exposure pathways for terrestrial and human receptors. Land polygons are populated by one or more terrestrial receptors that are expected to occupy the habitat represented by the prevailing vegetation community and physical characteristics of the surrounding environment.

IMPACT models both terrestrial and aquatic dietary components for terrestrial receptors. Terrestrial pathways include the transfer of constituents between air, soil, water, plants, and animals.

2.3.1 Terrestrial Ecological Receptors

Terrestrial receptors are divided into ecological receptors and human receptors. Ecological receptors typically are selected to include representative species of terrestrial plants, small and large mammals, invertebrates, birds, and riparian animals. Human receptors can be modelled to represent the habits of population groups and ages that are expected to reside in the area of interest (Section 2.4, Exposure of Human Receptors).

Terrestrial ecological receptors are assigned to a land polygon. The terrestrial ecological receptors that were selected include primary producers (plants) and consumers (invertebrates and animals). Primary consumers (herbivores) and secondary consumers (omnivores and carnivores) were selected from among mammals and birds that are known to be present in the vicinity of the Project and are known to be of value to Indigenous Groups and local communities. Documented rationale for receptor selection is provided in TSD XXI, Section 6.1.1, Selected Ecological Receptors.

The terrestrial ecological receptors considered in the IMPACT model include terrestrial plants, terrestrial invertebrates, terrestrial and riparian mammals, and birds, including waterfowl.

Terrestrial Vegetation

Terrestrial vegetation types are dietary components for terrestrial animals and humans. They are represented by browse (shrubs and grasses), lichen (*Cladonia* spp., *Cladina* spp.), blueberry (*Vaccinium mytilloides*), and Labrador tea (*Ledum groenlandicum)*. Plants are exposed to constituents in soil through contact with soil and contaminant uptake from soil via bioaccumulation. Lichen is exposed to constituents depositing from air. Berries and Labrador tea represent plants used in the Traditional Foods diet (i.e., diet made up of plants and animals fished, hunted, or gathered from the land).

Terrestrial Invertebrates

Terrestrial invertebrates are considered to be primary consumers. They are represented by earthworms, which live in soil and are therefore exposed to constituents in soil layers through direct contact. Earthworms acquire nutrition through organic matter in soil and decomposing remains of other animals. Terrestrial invertebrates are part of the diet for the red fox (*Vulpes vulpes*).

Terrestrial and Riparian Mammals

Mammalian herbivores are represented by woodland caribou, snowshoe hare (*Lepus americanus*), moose, southern red-backed vole (*Myodes gapperi*), and beaver (*Castor canadensis*). Herbivores convert vegetable matter to animal protein, and in turn are consumed by omnivores and carnivores. Snowshoe hare and southern red-backed vole are small mammals that consume berries and browse. These species are important prey for larger terrestrial predators such as red fox and grey wolf (*Canis lupus*). The southern red-backed vole is abundant in the vicinity of the Project (Annex VIII.1, Wildlife Baseline Report 1 [Mammals, Waterfowl, and Raptors]). Woodland caribou and moose are large ungulates with distinct home ranges and linkages to aquatic environments during the summer period. The primary food sources for Woodland caribou are lichen in the winter and terrestrial vegetation (browse) and aquatic vegetation (macrophytes) in the summer. Moose consume terrestrial and aquatic vegetation. Moose is part of the Traditional Foods diet and is assumed to be representative for other ungulate species such as white-tailed deer (*Odocoileus virginianus*).

Black bear (*Ursus americanus*) and red fox are terrestrial omnivores that are opportunistic and rely on readily available and easily accessed foods. Black bears consume berries and fish, and therefore have a dietary link to the aquatic environment. Red foxes consume a combination of terrestrial mammals and birds, terrestrial invertebrates, and berries.

Little brown myotis (the bat species *Myotis lucifugus*) represents terrestrial mammals that have a primarily insectivorous diet. In the IMPACT model, the diet of little brown myotis is composed of benthic invertebrates, representing the aquatic larval life stage of aerial insects. Although this diet originates from a water polygon, little brown myotis have negligible sediment intake exposures, because they are assumed to feed aerially.

Beaver and muskrat (*Ondatra zibethicus*) are riparian mammals that are exposed to constituents in both aquatic and terrestrial environments. Beavers are herbivores, with a major component of their diet composed of terrestrial vegetation and a minor component as aquatic vegetation. Beavers are also a component of the Traditional Foods diet. The muskrat's diet is fully aquatic, and muskrats are assumed to consume a combination of aquatic plants and benthic invertebrates.

Terrestrial predators representing the top level of the food chain include grey wolf and mink (*Neovison vison*). Grey wolf consumes terrestrial herbivores including moose, caribou, and hare. The mink's diet has linkages to both land and water polygons through the consumption of fish, benthic invertebrates, riparian mammals, and birds.

Terrestrial and Riparian Birds

Grouse (*Tetraoninae* sp.) and Canada goose (*Branta canadensis*) are terrestrial herbivores. Grouse is part of the Traditional Foods diet and is assumed to be representative for other birds with similar dietary characteristics, such as the ptarmigan.

Rusty blackbird (*Euphagus carolinus*) has a varied diet but feeds primarily on aquatic invertebrates. The rusty blackbird is a Species of Special Concern under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the *Species at Risk Act*, and suitable habitat for this species is common and widespread (Annex VIII.2, Wildlife Baseline Report 2 [Amphibians, Birds, and Bats]). Rusty blackbird can be considered representative for other insectivorous birds that have similar diets and exposure pathways.

Mallard (*Anas platyrhynchos*) and common loon (*Gavia immer*) are migratory water birds that are common to northern Saskatchewan. These riparian birds have a primarily aquatic diet; the mallard consumes macrophytes and benthic invertebrates, and the loon consumes fish and benthic invertebrates.

2.3.2 Home Ranges and Residency Factors

Home range is defined as the geographic area encompassed by an animal's activities, excluding migration, over a specific time (USEPA 1993). The home range size is used to determine the portion of time that an individual animal is expected to be exposed to COPCs through contact with environmental media. Small mammals such as muskrat and vole have small home ranges that are represented by small polygons with similar vegetation communities.

The residency factor represents the fraction of time an animal is expected to be exposed to a location and the proportion of the animal's intake (i.e., food, water) that is taken from each location. Animals are given a residency factor of one if they receive 100% of their exposures from one polygon location. The IMPACT model looked at four polygon locations where potential exposures to Project emissions could occur (Patterson Lake North Arm – West Basin, Patterson Lake South Arm, Beet Lake, Lloyd Lake) and one reference location that is unexposed to Project emissions (Reference Lake represented by Broach Lake). Each polygon location includes both water and land polygons, as animals will be exposed by both aquatic (drinking) as well as terrestrial pathways at each location.

Animals with large home ranges (i.e., greater than 10 km^2), such as the grey wolf, woodland caribou, and black bear, interact with a number of different exposed polygon locations for feeding and water intake. All other receptors have relatively small home ranges (i.e., less than 10 km^2) and were assumed to reside in the same polygon year-round. The estimated home ranges of selected mammalian receptors with potentially larger home ranges are presented in Table 2-2. The grey wolf has a home range of approximately 1,300 km^2, while the woodland caribou and black bear have home ranges of approximately 80 km^2 and therefore have the potential to be present at more than one polygon location to obtain their food. Home ranges are generally conservatively selected based on the expected home range during sensitive life stages.

Animals that are migratory are unlikely to have 100% residency at one polygon location for the entire year. However, because toxicity reference values that are used to establish potential risk are typically based on sensitive life stages such as reproduction, a 100% residency can be conservatively assumed for a specific life stage to capture the risk from exposure for the life stage of interest. For instance, mallards are not present in the vicinity of the Project for over half the year due to migration but have a small home range during the nesting and rearing of their young. Therefore, it is conservatively assumed that the mallard has a 100% residency factor at one polygon location where the young are hatched and reared.

Similarly, moose can move to different geographical locations between seasons, but generally remain within small seasonal home ranges of 5 km^2 to 10 km^2 during the summer and winter. For modelling purposes, these animals (with local home ranges or migratory patterns) are associated with one polygon location (100% residency).

Residency factors for receptors with large home ranges (i.e., caribou, bear, and grey wolf) were estimated based on the relative sizes of waterbodies (surface areas) that are located within an area consistent with the receptor's expected home range size. The objective is to determine the time spent at exposure locations and reference locations.

Table 2-2: Estimated Home Ranges of Selected Terrestrial Ecological Receptors

Ecological Receptor	Home Range (km^2)			Comments	Source
	Expected	Minimum	Maximum		
Woodland caribou	80	67	267	Female home ranges from GPS tracking data in the Saskatchewan Boreal Shield. The expected home range used for assessment is based on an average female range during the most sensitive life stage of the woodland caribou (i.e., calving/post-calving).	(McLoughlin et al. 2016)
Moose	10	5	10	Moose are essentially solitary and have one or several distinct home ranges to which they are strongly attached. Movements between seasonal home ranges may be extensive but home ranges are generally small. The same home ranges are generally returned to year after year.	(Franzmann 1981; Wilson and Ruff 1999)
Black bear	80	40	130	Female home ranges from GPS tracking data in the Saskatchewan Boreal Shield.	(McLoughlin et al. 2019)
Red fox	4	2.8	34	Red foxes tend to concentrate their activities near dens, preferred hunting areas with abundant food supplies, although young fox may travel great distances in search of new territory.	(Hinterland Who's Who 1993; Jones and Theberge 1981)
Grey wolf	1,300	100	2,451	Home ranges for wolves in Minnesota, Alaska, southern Yukon, and British Columbia.	(RIC 1998)
Mink	7.7	0.06	16.3	Expected value based on a study in southern Manitoba.	(Arnold and Fritzell 1987; FCSAP 2012)

The caribou or bear receptor at Patterson Lake (Table 2-3) was assumed to spend time at Patterson Lake North Arm – West Basin and Patterson Lake South Arm (i.e., exposed locations). The caribou or bear receptor at either Patterson Lake location is likely to overlap with the other due to the size of their expected home range of 80 km^2 and therefore exposures to these locations were assessed by one caribou or bear visiting both locations. It was also assumed that the caribou or bear spends a proportion of time at unexposed locations within its home range (i.e., lakes upstream of future water discharge points). One small lake northeast of Patterson Lake North Arm – West Basin (~0.59 km^2) was included as an unexposed location for the Patterson Lake caribou or bear receptor. As a result, the Patterson Lake caribou or bear receptor was assumed to spend 43% of its time at Patterson Lake North Arm – West Basin (12.56 km^2), 55% of its time at Patterson Lake South Arm (15.95 km^2), and 2% of its time at an unexposed location (0.59 km^2).

Similarly, a caribou or bear living near Beet Lake and within areas south of Beet Lake was considered. Within the 80 km^2 range, the Beet Lake caribou or bear receptor was assumed to spend 48% of its time at exposed locations and 52% of its time at unexposed locations. The exposed locations comprise Forrest Lake – North Basin (1.47 km^2), which is hydrologically connected to discharges via Patterson Lake and Beet Lake (8.84 km^2). Because food sources for the caribou or bear receptor have not been modelled at Forrest Lake, the Forrest Lake caribou or bear receptor was assumed to obtain their food from Beet Lake and the land adjacent to Beet Lake. Unexposed locations include a portion of Forrest Lake – South Basin (7.54 km^2) and other smaller, isolated lakes (0.78 km^2 and 2.87 km^2) within the 80 km^2 range that are located to the east of Forrest Lake and South of Beet Lake.

Due to its large home range of 1,300 km^2, the grey wolf located near Patterson Lake was also assumed to spend only a portion of its time at exposed locations. The exposed locations include Patterson Lake North Arm – West Basin and East Basin (21.84 km^2 combined), Patterson Lake South Arm (15.95 km^2), and Beet Lake, Forrest Lake – North Basin, and Naomi Lake (12.76 km^2 combined). For waterbody locations where food sources have not been modelled (i.e., Patterson Lake North Arm – East Basin), the grey wolf was assumed to obtain food from the nearest modelled polygon (i.e., Patterson Lake North Arm – West Basin). The unexposed locations include Broach Lake; Lake C, Lake E, Lake G, Lake H, Unnamed Lake 1 (near Dennis Lake), and Unnamed Lake 2 (Near Naomi Lake). These locations are included in the hydrology report (Annex IV.2). The sum of the surface areas of these waterbodies was used to determine the proportion of time the grey wolf near Patterson Lake spends at the reference (unexposed) locations, adding up to 55.64 km^2. Therefore, the grey wolf located near Patterson Lake was assumed to spend 47.6% of its time at exposed locations and 52.4% of its time at unexposed locations. Since the unexposed areas only include a fraction of the total surface area of unexposed waterbodies in the area, this approach likely overestimates the relative amount of time spent at exposed locations and therefore provides a conservative estimate of risk.

Due to the large size of Lloyd Lake relative to the terrestrial ecological receptors' home ranges, and its greater distance from the Project, the wolf, caribou, and bear at this location were assumed to have 100% residency at Lloyd Lake (i.e., residency factor of 1).

Table 2-3 presents the residency factors that were applied in the model for each terrestrial ecological receptor. The exposed lakes part of the LSA and RSA are shown on Figure 1-1.

Table 2-3: Residency Factors for Terrestrial Ecological Receptors

Terrestrial Ecological Receptor	Polygon	Surface Area of Waterbody (ha)	Total Waterbody (ha)	Residency Factor
Woodland caribou at Reference Lake	Reference Lake	-	-	1
Woodland caribou at Patterson Lake	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm	59 1,256 1,595	2,910	0.02 0.43 0.55
Woodland caribou at Beet Lake	Reference Lake Beet Lake[(a)]	1,119 1,031[(a)]	2,150	0.52 0.48
Woodland caribou at Lloyd Lake	Lloyd Lake	-	-	1
Snowshoe hare	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm Beet Lake Lloyd Lake	- - - - -	- - - - -	1 1 1 1 1
Moose	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm Beet Lake Lloyd Lake	- - - - -	- - - - -	1 1 1 1 1
Little brown myotis	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm Beet Lake Lloyd Lake	- - - - -	- - - - -	1 1 1 1 1
Southern red-backed vole	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm Beet Lake Lloyd Lake	- - - - -	- - - - -	1 1 1 1 1
Black bear at Reference Lake	Reference Lake	-	-	1
Black bear at Patterson Lake	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm	59 1,256 1,595	2,910	0.02 0.43 0.55
Black bear at Beet Lake	Reference Lake Beet Lake [(a)]	1,119 1,031[(a)]	2,150	0.52 0.48
Black bear at Lloyd Lake	Lloyd Lake	-	-	1
Red fox	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm Beet Lake Lloyd Lake	- - - - -	- - - - -	1 1 1 1 1

Terrestrial Ecological Receptor	Polygon	Surface Area of Waterbody (ha)	Total Waterbody (ha)	Residency Factor
Grey wolf at Reference Lake	Reference Lake	-	-	1
Grey wolf at Patterson Lake	Reference Lake [b] Patterson Lake North Arm – West Basin[c] Patterson Lake South Arm Beet Lake[d]	5,564[b] 2,184[c] 1,595 1,276[d]	10,619	0.524 0.206 0.150 0.120
Grey wolf at Lloyd Lake	Lloyd Lake	-	-	1
Beaver	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm Beet Lake Lloyd Lake	- - - - -	- - - - -	1 1 1 1 1
Muskrat	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm Beet Lake Lloyd Lake	- - - - -	- - - - -	1 1 1 1 1
Mink	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm Beet Lake Lloyd Lake	- - - - -	- - - - -	1 1 1 1 1
Rusty blackbird	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm Beet Lake Lloyd Lake	- - - - -	- - - - -	1 1 1 1 1
Canada goose	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm Beet Lake Lloyd Lake	- - - - -	- - - - -	1 1 1 1 1
Grouse	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm Beet Lake Lloyd Lake	- - - - -	- - - - -	1 1 1 1 1
Mallard	Reference Lake Patterson Lake North Arm – West Basin Patterson Lake South Arm Beet Lake Lloyd Lake	- - - - -	- - - - -	1 1 1 1 1

Terrestrial Ecological Receptor	Polygon	Surface Area of Waterbody (ha)	Total Waterbody (ha)	Residency Factor
Common loon	Reference Lake	-	-	1
	Patterson Lake North Arm – West Basin	-	-	1
	Patterson Lake South Arm	-	-	1
	Beet Lake	-	-	1
	Lloyd Lake	-	-	1

a) Includes Forrest Lake – North Basin.
b) Includes Broach Lake; Lake C, Lake E, Lake G, Lake H, Unnamed Lake 1 (near Dennis Lake), and Unnamed Lake 2 (near Naomi Lake); and Forrest Lake – South Basin.
c) Includes Patterson Lake North Arm – East Basin.
d) Includes Forrest Lake – North Basin and Naomi Lake.
- = Not required for the determination of residency factor; the receptor resides at a single location.

2.3.3 Exposure Assumptions for Terrestrial Ecological Receptors

2.3.3.1 Body Weight and Intake Rates

The body weight and intake rates are required for the calculation of exposure to birds and mammals (Table 2-4). Body weights and intake rates were obtained, in order of preference, from CSA N288.1-20, the US Environmental Protection Agency (USEPA) *Wildlife Exposure Factors Handbook* (USEPA 1993), the Federal Contaminated Sites Action Plan *Module 3: Standardization of Wildlife Receptor Characteristics* (FCSAP 2012), and from Oak Ridge National Laboratory (Sample and Suter 1994). For species not represented in the above sources, additional sources as identified in Table 2-4 were consulted to identify representative body weights, and feed intake rates were calculated using allometric equations from the USEPA (1993).

Water intake and inhalation rates were determined using allometric equations from the USEPA (1993) for birds and mammals. The incidental ingestion of soil and/or sediment was estimated from feed intake. Incidental ingestion varied from 2% to 10.4% of food intake as dry weight, depending on the biota (Beyer et al. 1994). However, no incidental soil or sediment ingestion was assumed for the little brown myotis, which is an aerial insectivore; nor was any sediment ingestion assumed for the common loon, which feeds from the water column.

Table 2-4: Bird and Mammal Body Weights and Intake Rates

Receptor	Body Weight		Total Feed Intake				Dietary Components	Feed Type Fraction		Feed Intake Rate		Moisture[h]	Intake of Soil[r]	Intake of Sediment[r]	Intake of Soil and Sediment[k]	Basis of the Soil and Sediment Intake Value	Total Soil/ Sediment Intake Rate[l]	Water Intake Rate[m]	Inhalation Rate	
	kg	Source	kg dw/d	Source	kg fw/d	Source		fw	dw	kg dw/d	kg fw/d	Unitless	%	%	%		kg dw/d	L/d	m³/d	Source
Woodland caribou	180	e	3.82	m	12.35	n/a	Browse	0.5	0.32	1.24	6.18	0.80	5.15	1.65	6.8	Bison	0.3	10.6	34.8	m
							Lichen	0.2	0.43	1.66	2.47	0.33								
							Macrophytes	0.3	0.24	0.927	3.71	0.75								
Snowshoe hare	1.8	c	0.110	c	0.564	n/a	Browse	0.9	0.92	0.102	0.508	0.80	3.7	0	3.7	Average of small mammals	0.004	0.168	0.9	c,m
							Berries (blueberry)	0.1	0.08	0.008	0.056	0.85								
Moose	400	b	8.0	b	38.1	n/a	Browse	0.8	0.76	6.10	30.5	0.80	1.5	0.5	2.0	Moose	0.2	21.8	65.9	m
							Macrophytes	0.2	0.24	1.90	7.62	0.75								
Little brown myotis	0.0075	d	0.001	n/a	0.0037	d	Benthic invertebrates	1	1	0.0009	0.0037	0.75	0	0	0	Assumed negligible (aerial)	0	0.00121	0.011	m
Southern red-backed vole	0.0329	a, j	0.00196	n/a	0.012	a, j	Berries (blueberry)	0.6	0.53	0.001	0.007	0.85	2.4	0	2.4	Meadow vole	0.000047	0.00458	0.048	a
							Browse	0.4	0.47	0.001	0.005	0.80								
Black bear	102.5	o	3.1	b	17.1	n/a	Berries (blueberry)	0.7	0.58	1.79	12.0	0.85	2.9	0	2.9	Average of large mammals	0.09	6.39	22.2	m
							Fish (northern pike)	0.3	0.42	1.28	5.13	0.75								
Red fox	4.54	a	0.105	n/a	0.429	a	Small mammals (vole)	0.4	0.490	0.052	0.172	0.70	2.8	0	2.8	Red fox	0.00295	0.386	1.83	m
							Terrestrial birds (goose)	0.2	0.245	0.026	0.086	0.70								
							Terrestrial invertebrates (earthworm)	0.25	0.173	0.018	0.107	0.83								
							Berries (blueberry)	0.15	0.092	0.010	0.064	0.85								
Grey wolf	45	f	1.57	m	5.23	n/a	Moose	0.45	0.45	0.707	2.356	0.70	2.8	0	2.8	Red fox	0.04	3.04	11.5	m
							Caribou	0.45	0.45	0.707	2.356	0.70								
							Small mammal (hare)	0.1	0.10	0.157	0.523	0.70								
Beaver	24	p	0.94	m	4.57	n/a	Macrophytes	0.1	0.12	0.114	0.457	0.75	1.8	0.24	2.0	Moose	0.019	1.729	6.9	m
							Browse	0.9	0.88	0.822	4.112	0.80								
Muskrat	1.17	a	0.088	n/a	0.352	a	Macrophytes	0.8	0.8	0.070	0.282	0.75	0	3.3	3.3	Mallard	0.003	0.114	0.59	a
							Benthic invertebrates	0.2	0.2	0.018	0.070	0.75								
Mink	1.02	a	0.045	n/a	0.161	a	Fish (northern pike)	0.3	0.270	0.012	0.048	0.75	2.6	0.41	3.05	Average of mallard and red fox	0.001	0.101	0.44	a
							Benthic invertebrates	0.15	0.135	0.006	0.024	0.75								
							Small mammals (muskrat)	0.45	0.486	0.022	0.072	0.70								
							Birds (mallard)	0.1	0.108	0.005	0.016	0.70								
Rusty blackbird	0.064	g	0.0177	n/a	0.077	a,i	Benthic invertebrates	0.8	0.87	0.015	0.062	0.75	10.4	0	10.4	American woodcock	0.002	0.00935	0.148	m,n
							Berries (blueberry)	0.2	0.13	0.002	0.015	0.85								
Canada goose	3.70	c	0.0229	n/a	0.115	a	Browse	1	1	0.023	0.115	0.80	8.2	0	8.2	Canada goose	0.0019	0.142	1.100	c
Grouse	0.6	b	0.042	b	0.227	n/a	Browse	0.7	0.76	0.032	0.159	0.80	8.2	0	8.2	Canada goose	0.0034	0.0419	0.276	m
							Berries (blueberry)	0.3	0.24	0.010	0.068	0.85								

Table 2-4: Bird and Mammal Body Weights and Intake Rates

Receptor	Body Weight		Total Feed Intake				Dietary Components	Feed Type Fraction		Feed Intake Rate		Moisture[h]	Intake of Soil[r]	Intake of Sediment[r]	Intake of Soil and Sediment[k]	Basis of the Soil and Sediment Intake Value	Total Soil/ Sediment Intake Rate[l]	Water Intake Rate[m]	Inhalation Rate	
	kg	Source	kg dw/d	Source	kg fw/d	Source		fw	dw	kg dw/d	kg fw/d	Unitless	%	%	%		kg dw/d	L/d	m³/d	Source
Mallard	1.13	c	0.06	c	0.240	n/a	Macrophytes	0.25	0.25	0.015	0.060	0.75	0	3.3	3.3	Mallard	0.002	0.0640	0.02	c
							Benthic invertebrates	0.75	0.75	0.045	0.180	0.75								
Common loon	5.3	b	0.159	b	0.636	n/a	Fish (northern pike)	0.9	0.9	0.143	0.572	0.75	0	0	0	Assumed negligible (sediment is washed off in water column)	0	0.180	1.477	m
							Benthic invertebrates	0.1	0.1	0.016	0.064	0.75								

a) (USEPA 1993) Body weights, ingestion rates and inhalation rates of adults or all groups (adults and juveniles) are an average of the listed values. If only a range is given, the upper limit of the range is used. Values for the southern red-backed vole were based on the meadow vole.
b) (FCSAP 2012).
c) CSA N288.1-20 (CSA Group 2020).
d) (Sample and Suter 1994).
e) COSEWIC Assessment and Update Status Report on the Woodland Caribou (COSEWIC 2002). Body weight calculated as a mean of the male and female upper range.
f) (Earthroots 2020).
g) COSEWIC Assessment and Update Status Report on the Rusty Blackbird (COSEWIC 2006).
h) Sources of moisture/dry weight fraction values obtained from CSA N288.1-20 (CSA Group 2020) for all receptors except for earthworm (Beresford et al. 2008); and blueberries and lichen (Annex VII.3, Vegetation Chemistry Characterization Report). The blueberry value is based on the fruit only.
i) The total feed intake for the American robin was used in the absence of a species-specific value.
j) The body weight and total feed intake for the meadow vole was used in the absence of a species-specific value.
k) (Beyer et al. 1994).
l) Intake of Soil & Sediment (kg dw/d) = Total Feed Intake (kg dw/d) x Intake of Soil & Sediment (%)/100.
m) Calculated using allometric equations in (USEPA 1993).
n) Inhalation rate was multiplied by a factor of 3 for passerine birds as per (USEPA 1993).
o) Average of males and females from Hinterland Who's Who (2007).
p) Median of adult weight range of 16 to 32 kg from Hinterland Who's Who (2017).
q) For purposes of modelling the earthworm is counted to the terrestrial plants.
r) The % intake of soil or sediment is calculated from the combined % intake of soil and sediment, weighted to the relative proportions of terrestrial vs. aquatic dietary components for each receptor, based on the following equations. Intake of Soil (%) = Total Intake of Soil & Sediment (%) x Feed Type Fraction Terrestrial. Intake of Sediment (%) = Total Intake of Soil & Sediment (%) x Feed Type Fraction Aquatic.
fw = fresh weight; dw = dry weight; n/a = not applicable.

2.3.3.2 Occupancy Factors

An occupancy factor is defined as the fraction of time the receptor species spends in or on various media. The occupancy factors are based on the experience and judgment of the risk assessor and the known behaviour of the receptor. The occupancy factors used in the IMPACT model are presented in Table 2-5.

Table 2-5: Receptor Occupancy Factors

Aquatic and Riparian Biota	OF_a	OF_S	OF_{SS}	OF_W	Terrestrial Biota	OF_a	OF_S	OF_{SS}
Macrophytes	-	-	0.1	0.9	Lichen	-	-	1
Phytoplankton	-	-	-	1	Blueberry	-	0.5	0.5
Zooplankton	-	-	-	1	Earthworm	-	1	-
Benthic invertebrates	-	1	-	-	Woodland caribou	1	-	1
Lake whitefish	-	-	0.5	0.5	Snowshoe hare	1	-	1
Northern pike	-	-	-	1	Moose	1	-	1
Muskrat	1	-	0.5	-	Little brown myotis	1	-	-
Beaver	1	-	0.5	-	Southern red-backed vole	1	-	1
American mink	1	-	0.5	-	Black bear	1	-	1
Mallard	1	-	0.5	-	Red fox	1	0.2	0.8
Common loon	1	-	0.5	-	Grey wolf	1	-	1
					Rusty blackbird	1	-	1
					Canada goose	1	-	1
					Grouse	1	-	1

OF_a = occupancy factor in air; OF_s = occupancy factor in soil/sediment; OF_{ss} = occupancy factor in soil/sediment surface; OF_w = occupancy factor in water; - = not applicable.

2.3.4 Terrestrial Pathways

Terrestrial pathways include the transfer of COPCs between air, soil, terrestrial plants, and terrestrial animals. The specific equations that consider the concentrations of COPCs in soil, terrestrial plants, and terrestrial animals along each of these pathways are listed below.

Concentration in soil (C_{soil}):

$$\frac{dC_{soil}}{dt} = \frac{C_{air} \cdot \left(V_g + W_r \cdot P_{pt}\right) \cdot D_f}{\rho_b \cdot z_{soil}} + \lambda_{parent} \cdot C_{parent} + \frac{C_{irr} \cdot Q_{irr}}{\rho_b \cdot z_{soil}} - C_{soil} \cdot \left[\lambda_T + \frac{L \cdot f_{soil}}{\rho_b \cdot z_{soil}} + \frac{v_i \cdot (1 - f_{soil})}{z_{soil} \cdot \varphi}\right]$$

where:

C_{soil}	=	concentration in soil (Bq/kg dw, mg/kg dw)
C_{air}	=	concentration in air (becquerels per cubic metre (Bq/m^3, mg/m^3)
C_{irr}	=	concentration of constituent in irrigation water (Bq/L, mg/L)
C_{parent}	=	concentration of parent constituent (Bq/kg, mg/kg)

D_f	=	deposition fraction for airborne constituents (unitless)
f_{soil}	=	fraction of constituent that is sorbed to solids in soil (unitless)
φ	=	volumetric water content (unitless)
λ_{parent}	=	first order decay constant for parent constituent (1/s)
λ_T	=	sum of the rate constants for all significant loss processes (1/s)
L	=	erosion loss rate in soil block (kg/m^2/s)
P_{pt}	=	precipitation rate (m/s)
Q_{irr}	=	irrigation rate (L/m^2/s)
ρ_b	=	bulk density of soil (kg/L)
v_i	=	infiltration rate (m/s)
V_g	=	atmospheric deposition velocity (m/s)
W_r	=	wet deposition washout ratio (unitless)
Z_{soil}	=	thickness of soil mixing layer (m)

Table 2-6: Modelling Parameters for the Soil Model

Model Parameter		Value	Unit
Mixing depth (thickness of soil layer)	Z_{soil}	0.2	m
Dry bulk density	ρ_b	1.5	kg dw/L
Water content (porosity)	φ	0.1	unitless
Infiltration rate	v_i	1.205E-8	m^3/m^2/s
Erosion rate	L	1.5E-8	kg dw/m^2/s
Precipitation rate	P_{pt}	800	mm/yr
Wet deposition washout ratio (metals)	W_r	5.5E+6	unitless
Dry Deposition velocity (metals)	V_g	0.0014	m/s

Note: All values for the soil model are the default parameters specified in CSA N288.1-20, assuming sandy soil.

Concentration in terrestrial plants (C_{tp}):

$$C_{tp} = C_{int} + C_{ext}$$

$$C_{int} = C_{soil} \cdot B_v + C_{air} \cdot T_f$$

$$\frac{dC_{ext}}{dt} = \frac{C_{air} \cdot (V_g + W_r \cdot P_{pt}) \cdot f_a}{Y} + \lambda_{parent} \cdot C_{parent} + \frac{C_{irr} \cdot Q_{irr} \cdot f_{irr}}{Y \cdot A} - C_{ext} \cdot [\lambda_T + \lambda_e]$$

Where:

A	=	Area of polygon (m^2)
B_v	=	bioaccumulation factor for soil-to-plant transfer (dw unitless)
C_{tp}	=	concentration in terrestrial plants (Bq/kg fw, mg/kg dw)
C_{int}	=	internal concentration in plant from soil uptake (Bq/kg fw, mg/kg dw)
C_{ext}	=	external concentration in plant from dust and irrigation (Bq/kg fw, mg/kg fw)
C_{soil}	=	concentration in soil (Bq/kg dw, mg/kg dw)
C_{air}	=	concentration in air (Bq/m^3, mg/m^3]
C_{irr}	=	concentration of constituent in irrigation water (Bq/L, mg/L)
C_{parent}	=	concentration of parent constituent (Bq/kg)

f_{irr}	=	irrigation fraction retained on irrigation (unitless)
λ_{Parent}	=	first order decay constant for parent constituent (1/s)
λ_T	=	sum of the rate constants for all significant loss processes (1/s)
λ_e	=	effective removal decay constant (1/s)
P_{pt}	=	precipitation rate (m/s)
Q_{irr}	=	irrigation rate (L/m^2/s)
T_f	=	air-to-plant transfer factor (m^3/kg)
V_g	=	atmospheric deposition velocity (m/s)
W_r	=	wet deposition washout ratio (unitless)
Y	=	vegetation yield (kg dw/m^2)

Concentration in terrestrial animals (C_{ta}):

$$C_{ta} = C_{air} \cdot I_a \cdot F_{inh} + F_{ing} \cdot \left[\begin{array}{l} I_w \cdot \sum(C_{wc} \cdot k_w) + I_s \cdot \sum(C_s \cdot k_{sed}) + I_{soil} \cdot \sum(C_{soil} \cdot k_{soil}) + \\ I_{tp} \cdot \sum(C_{tp} \cdot k_{tp}) + I_{ta} \cdot \sum(C_{ta} \cdot k_{ta}) + \\ I_{ap} \cdot \sum(C_{ap} \cdot k_{ap}) + I_{aa} \cdot \sum(C_{aa} \cdot k_{aa}) \end{array}\right]$$

Where:

C_{ta}	=	concentration in ingested terrestrial animals (Bq/kg fw, mg/kg fw)
C_{wc}	=	concentration in water column (Bq/L, mg/L)
C_s	=	concentration in surficial sediment (Bq/kg dw, mg/kg dw)
C_{soil}	=	concentration in soil (Bq/kg dw, mg/kg dw)
C_{tp}	=	concentration in ingested terrestrial plants (Bq/kg dw, mg/kg dw)
C_{ap}	=	concentration in ingested aquatic plants (Bq/kg fw, mg/kg fw)
C_{aa}	=	concentration in ingested aquatic animals (Bq/kg fw, mg/kg fw)
F_{inh}	=	inhalation transfer factor (d/kg fw)
F_{ing}	=	ingestion transfer factor (d/kg fw)
I_w	=	water ingestion rate (L/d)
I_a	=	inhalation rate (m^3/d)
I_s	=	sediment ingestion rate (kg dw/d)
I_{soil}	=	soil ingestion rate (kg dw/d)
I_{tp}	=	terrestrial plants ingestion rate (kg dw/d)
I_{ta}	=	terrestrial animals ingestion rate (kg fw/d)
I_{ap}	=	aquatic plants ingestion rate (kg fw/d)
I_{aa}	=	aquatic animals ingestion rate (kg fw/d)
k_w	=	fraction of water intake from contaminated sources (unitless)
k_{sed}	=	fraction of sediment intake from contaminated sources (unitless)
k_{soil}	=	fraction of soil intake from contaminated sources (unitless)
k_{ta}	=	fraction of terrestrial animal intake from contaminated sources (unitless)
k_{tp}	=	fraction of terrestrial plant intake from contaminated sources (unitless)

k_{aa}	=	fraction of aquatic animal intake from contaminated sources (unitless)
k_{ap}	=	fraction of aquatic plant intake from contaminated sources (unitless)

2.3.5 Radiological Dose to Terrestrial Ecological Receptors

Radiological dose to a terrestrial receptor is the radiation energy absorbed due to radiation emissions from radionuclides present in the environment (air or soil/sediment) or in the tissues of the organism. Through comparison with dose benchmarks, the risk to the organism can be quantified. This model characterizes dose and risk from both background and project exposure.

The total dose to terrestrial animals from each radionuclide is:

$$D_{total} = D_{int} + D_{ext}$$

The dose of COPCs to terrestrial animals due to internal radioactivity (D_{int}) is estimated using the equation shown below.

$$D_{int} = C_t \cdot DC_{int}$$

The external dose to terrestrial animals from radioactivity in sediment and soil (D_{ext}) is:

$$D_{ext} = D_{ext,s} + D_{ext,ss}$$

$$D_{ext,s} = C_{soil} \cdot DC_{ext,s} \cdot OF_s$$

$$D_{ext,ss} = C_{ss} \cdot DC_{ext,ss} \cdot OF_{ss}$$

The external dose from noble gases (naturally occurring gases with very low chemical reactivity [e.g., helium]) to terrestrial animals is calculated in IMPACT from outdoor air; however, there are no noble gases in the Rook I model applicable to ecological receptors, so the equation is not provided.

Where:

C_t	=	whole body tissue concentration (Bq/kg fw)
C_{soil}	=	soil concentration (Bq/kg dw)
C_{ss}	=	surface soil concentration (Bq/m^2)
D_{int}	=	internal radiation dose (µGy/h)
DC_{int}	=	dose coefficient for radionuclide in tissue ([µGy/h]/[Bq/kg fw])
$D_{ext,s}$	=	external radiation dose in soil (µGy/h)
$D_{ext,ss}$	=	external radiation dose on soil surface (µGy/h)
$DC_{ext,s}$	=	dose coefficient for radionuclide in soil ([µGy/h]/[Bq/kg dw])
$DC_{ext,ss}$	=	dose coefficient for radionuclide on soil surface([µGy/h]/[Bq/m^2])
OF_s	=	fraction of time spent immersed in soil (unitless)
OF_{ss}	=	fraction of time spent on the soil (unitless)

For animals with large home ranges (Section 2.3.2, Home Ranges and Residency Factors), the total dose is the combined exposure from several locations (Table 2-3), where the residency factors are used as weighting factors to calculate the total dose.

2.3.6 Non-radiological Risk to Terrestrial Ecological Receptors

The IMPACT model provides a means of evaluating the potential effects on environmental components by comparing the non-radiological exposures of receptors to recognized benchmarks, usually a concentration or dose-based toxicity reference values in the same units, for each COPC. This measure of potential risk is known as an HQ. This model calculates the risk from both background and project exposure.

The HQ for terrestrial animals due to ingestion of non-radiological constituents is estimated as:

$$HQ = \frac{1}{RD \cdot BM} \cdot \begin{bmatrix} I_w \cdot \sum(C_{wc} \cdot k_w) + I_s \cdot \sum(C_s \cdot k_{sed}) + \\ I_{soil} \cdot \sum(C_{soil} \cdot k_{soil}) + I_{tp} \cdot \sum(C_{tp} \cdot k_{tp}) + I_{ta} \cdot \sum(C_{ta} \cdot k_{ta}) + \\ I_{ap} \cdot \sum(C_{ap} \cdot k_{ap}) + I_{aa} \cdot \sum(C_{aa} \cdot k_{aa}) \end{bmatrix}$$

Where:

BM	=	body mass (kg)
C_{ap}	=	concentration in ingested aquatic plants (mq/kg fw)
C_{aa}	=	concentration in ingested aquatic animals (mq/kg fw)
C_s	=	concentration in surficial sediment (mg/kg dw)
C_{soil}	=	concentration in soil (mg/kg dw)
C_{ta}	=	concentration in ingested terrestrial animals (mg/kg fw)
C_{tp}	=	concentration in ingested terrestrial plants (mq/kg dw)
C_{wc}	=	concentration in water column (mg/L)
I_{aa}	=	aquatic animals ingestion rate (kg fw/d)
I_{ap}	=	aquatic plants ingestion rate (kg fw/d)
I_s	=	sediment ingestion rate (kg dw/d)
I_{soil}	=	soil ingestion rate (kg dw/d)
I_{tp}	=	terrestrial plants ingestion rate (kg dw/d)
I_{ta}	=	terrestrial animals ingestion rate (kg fw/d)
I_w	=	water ingestion rate (L/d)
k_{aa}	=	fraction of aquatic animal intake from contaminated sources (unitless)
k_{ap}	=	fraction of aquatic plant intake from contaminated sources (unitless)
k_{sed}	=	fraction of sediment intake from contaminated sources (unitless)
k_{soil}	=	fraction of soil intake from contaminated sources (unitless)
k_{ta}	=	fraction of terrestrial animal intake from contaminated sources (unitless)
k_{tp}	=	fraction of terrestrial plant intake from contaminated sources (unitless)
k_w	=	fraction of water intake from contaminated sources (unitless)
RD	=	reference toxic dose (mg/kg/d)

2.4 Exposure of Human Receptors

2.4.1 Exposure Assumptions for Human Receptors

The human receptor groups selected for the human health risk assessment are based on the current understanding of how people use the area in the vicinity of the Project and their potential for exposure to Project-related media concentrations during one or more Project phases (i.e., Construction, Operations, and Closure). The selected human receptor groups are a camp worker, subsistence harvester, seasonal resident, and permanent resident (as shown on Figure 2-2), with rationale for receptor selection provided in TSD XXI, Section 5.1.1, Human Receptor Selection and Characterization.

Adult and one-year-old receptors were used to assess potential risk to human health. The exposure factors for these two age groups are summarized in Table 2-7. The selection process and further characteristics of the human receptors are discussed in TSD XXI, Section 4.0, Model Integration and Evaluation of Sources.

Table 2-7: Summary of Receptor Characteristics for the Human Health Risk Assessment

Receptor Characteristic	Unit	Adult [a]	One-Year-Old [b]	Reference
Air inhalation (mean)	m^3/yr	5,950	1,830	CSA N288.1-20; Table 19
Water ingestion (mean)	L/yr	379.6	98.92	CSA N288.1-20; Table 21
Soil ingestion (mean) [c]	kg dw/d	4.00×10^{-06}	6.10×10^{-05}	CSA N288.1-20; Table 20
Sediment ingestion [c]	kg dw/d	4.00×10^{-06}	6.10×10^{-05}	CSA N288.1-20; Table 20
Exposed surface area - water (whole body)	m^2	2.19	0.72	CSA N288.1-20; Table 22
Total food ingestion [d]	kg fw/yr	706	410	CSA N288.1-20; Annex G

a) Adult applies to both male and female receptors.
b) The one-year-old is equivalent to the CSA N288.1-20 age class "infant".
c) Incidental ingestion rates for soil and sediment are assumed to be equal.
d) The higher total food ingestion for the adult male (from CSA N288.1) is used to represent both male and female human receptors, which is a conservative assumption for females.
dw = dry weight; fw = fresh weight.

The primary exposure routes for human health include ingestion (i.e., food, water, incidental amounts of soil and/or sediment), inhalation (i.e., vapours and/or particulates), dermal absorption (non-radiological), and external exposure to radiation (radiological). The potential exposure pathways are expected to be the same for all human receptors assessed.

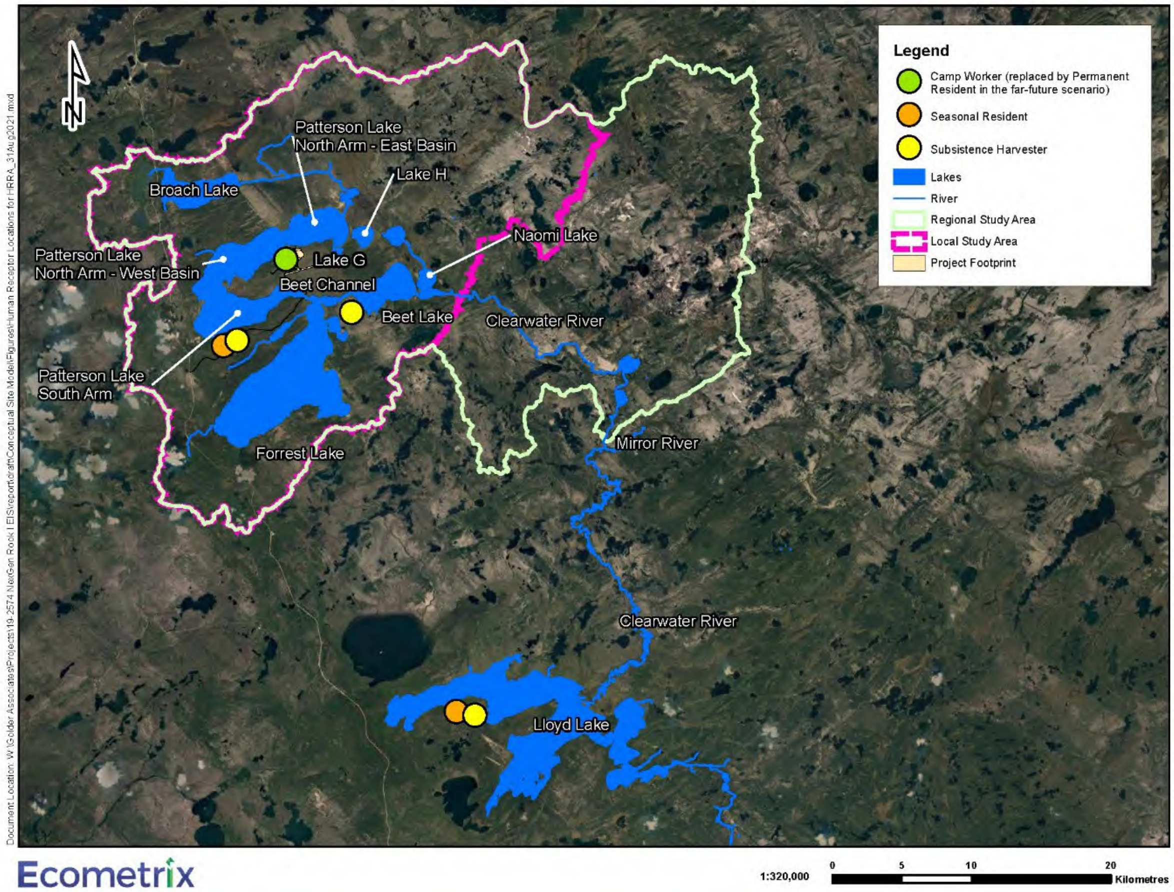


Figure 2-2: Human Receptor Locations for the Rook I Model

2.4.1.1 Dietary Assumptions

Each of the human health receptors described in Section 2.4.1, Exposure Assumptions for Human Receptors, consumes locally sourced Traditional Foods to an extent that is consistent with either an average or a high consumer. Where possible, the total of Traditional Foods derived was obtained from pertinent Traditional Foods surveys and engagement with Indigenous Groups and local communities. Traditional Foods are those animals and plants that are fished, hunted, or gathered from the land and consumed as food (Health Canada 2018). The remainder of the total food diet is assumed to be from store-bought foods (i.e., store foods). Store foods include grain and other agricultural products of a typical diet that are not available locally.

The camp worker is assumed to work and reside at the Rook I permanent camp for half of the year and does not consume any Traditional Foods while at the site. During the other times of the year, the camp worker is assumed to be a high Traditional Foods consumer. The subsistence harvester and the permanent camp resident are assumed to be high Traditional Foods consumers, and the seasonal resident or lodge operator is assumed to be an average Traditional Foods consumer.

Adult Diet

As stated in Table 2-7, the initial assumptions for ingestion rates and components of the total foods diet for the human health risk assessment were taken from CSA N288.1-20 Adult (Table G.9b – Central) total diet.

The human diet provided in CSA N288.1-20 was derived from the 2004 food basket survey results for an adult male. The CSA N288.1-20 human diet was selected over the Health Canada (2010a) human diet. Health Canada (2010a) references Richardson (1997), which used survey results from the late 1970s. The Richardson (1997) diet was also a combined adult male/female diet. The CSA N288.1-20 total adult diet is a smaller overall diet (706 kg/yr) than the Richardson diet (808 kg/yr) by about 100 kg/yr and is based on more recent data.

The total food diet is the sum of Traditional Foods and store foods. Its dietary components, expressed in kilograms per year (kg/yr) of food consumed, are shown in Table 2-8 for non-consumers, average consumers, and high consumers of Traditional Foods.

The store food intakes in each food category were estimated from the total diet intakes provided in CSA N288.1-20, minus the Traditional Foods intakes. If the Traditional Foods intakes were higher than the total intake for the same CSA N288.1-20 food category, the store food intake was set to zero, and then the values for other store food categories were reduced as needed to obtain total dietary intakes equal to those in CSA N288.1-20.

As a final step, the amount of Traditional Foods “berries” ingested was increased from approximately 5% of the fruit and berry component of the total CSA N288.1-20 diet to 10% by reducing the store food berry component value. This adjustment was made in response to comments from local Indigenous Groups during engagement who felt that they ingest more locally sourced berries than the diets that were presented to them suggest. After adjusting the Traditional Foods diet to account for a higher ingestion rate for berries, the overall Traditional Foods diet is greater than that estimated by the First Nations Food, Nutrition and Environment Study (Chan et al. 2018). This results in a precautionary approach to modelling and assessment.

One-Year-Old Diet

Annual food consumption rates for the "one-year-old" were calculated using “adult-to-one-year-old” ratios from CSA N288.1-20 for each of the selected food categories. Annual ingestion rates for individual food items were combined into relevant food categories and the adult-to-one-year-old ratios were determined for each of these food categories.

Surrogate Ecological Receptors Used in the IMPACT Model

The concentrations of COPCs in Traditional Foods used in the exposure assessment were estimated using the IMPACT model. Based on the descriptions of the different human receptor groups and their Traditional Foods diets, surrogate ecological receptors were selected for the IMPACT model to represent each Traditional Food category. The surrogate ecological receptor selected to represent a Traditional Food category was informed and modified based on feedback received from Joint Working Group meetings and engagement with regulators. Specifically, these engagement activities informed assumptions for fish species (e.g., inclusion of northern pike and lake whitefish in the exposure assessment), large mammals (e.g., preference for moose over other large mammals such as caribou, inclusion of moose organs as a specific Traditional Food category), and small mammals (e.g., beaver identified as of value and importance to the communities). The final selection of surrogate ecological receptors for the Traditional Foods diet is shown in Table 2-9.

The local intake fractions as implemented in IMPACT for the human diet are shown in Table 2-10, and are calculated as follows:

Local Intake Fraction (%) = (Traditional Annual Food Intake of a Food Type / Total Annual Food Intake in the Corresponding Food Category) * Residency Factor * 100%

Where:

Traditional Annual Food Intake of a Food Type = traditional annual ingestion rate of foods consumed within each relevant food category, as shown in Table 2-8 (kg/yr).

Total Annual Food Intake in the Corresponding Food Category = annual ingestion rate for traditional + store food in the food category, as shown in Table 2-8 (kg/yr).

Residency Factor = the exposure area or reference area residency factor as shown in Table 2-12 (unitless).

Table 2-8: Annual Food Intakes (kg/yr) for Food Items of the Human Receptors' Diets

Food Category	Non-Traditional Foods Consumer Diet [a]		Average Traditional Foods Consumer [b,c,d,e,f]				High Traditional Foods Consumer [b,c,d,e,f]			
	Adult	One-Year-Old	Adult		One-Year-Old		Adult		One-Year-Old	
	Total Diet	Total Diet	Traditional Foods	Store Foods	Traditional Foods	Store Foods	Traditional Foods	Store Foods	Traditional Foods	Store Foods
	kg/yr	kg/yr	kg/yr		kg/yr		kg/yr		kg/yr	
Milk	126	243	0	126	0	243	0	32.6	0	226
Fish	8.25	1.83	26.8	0	5.94	0	84.8	0	18.76	0
Northern pike	-	-	13.4	0	2.97	0	42.4	0	9.38	0
Lake whitefish	-	-	13.4	0	2.97	0	42.4	0	9.38	0
Meat - large mammals	67.9	8.18	6.52	24.1	0.785	2.90	20.6	0	2.48	0
Meat - large mammal organs	2.04	0.51	3.59	0	0.897	0	9.16	0	2.29	0
Meat - small mammals	0.230	0.02	17.4	0	1.66	0	56.9	0	5.42	0
Meat - birds and eggs	58.1	10.4	-	53.1	-	9.48	-	42.3	-	7.55
Aquatic bird	-	-	1.71	0	0.304	0	3.46	0	0.618	0
Terrestrial bird	-	-	3.29	0	0.587	0	12.3	0	2.19	0
Root vegetables	47.9	8.7	0	47.9	0	8.65	0	47.9	0	8.65
Other vegetables	297	82.5	0.844	296	0.225	82.3	2.45	294	0.681	81.9
Fruits and berries	99.4	54.6	9.94	89.5	5.46	49.2	9.94	89.5	5.46	49.2
Total diet - subtotal	-	-	70.1	636	15.9	395	200	506	37.9	373
Total diet[a]	**706**	**410**	**706**		**411**		**706**		**411**	

Values less than 0 are rounded to 3 significant figures.
a) Total diet is derived from CSA N288.1-20 central dietary intakes Table G.9b.
b) Traditional Foods annual consumption rates for adults are taken from the *First Nations Food, Nutrition and Environment Study* (Chan et al. 2018) Boreal Shield diet for Saskatchewan First Nations communities for either "average" or "high" Traditional Foods consumers (male) for the Traditional Foods diet.
c) Annual food consumption rates for "one-year-old" were calculated using "Adult to one-year-old" ratios (CSA N288.1 Adult (Central): one-year-old) derived for each food category. Annual consumption rates for individual food items were combined into relevant food categories and the ratios for each food categories were derived based on the total kg/yr for each group.
d) The store food intakes in each food category were estimated from the non-Traditional Foods intakes provided in CSA N288.1-20, minus the Traditional Foods intakes. If the Traditional Foods intakes were higher than the total intake for the food category, the store food intake was set to zero, and then the values for other store food categories were reduced as needed to obtain total dietary intakes equal to those in CSA N288.1-20.
e) The fractions of northern pike (predator species) and lake whitefish (forage species) were set at 50% each of the total fish diet based on input received from regulatory bodies to include both predator and forage species for a conservative assessment.
f) The fraction of Traditional Foods "fruits and berries" was increased from approximately 5% (Chan et al. 2018) to 10% of the total fruits and berries based on input received from local Indigenous communities. The total food diet was adjusted by reducing the store foods and increasing Traditional Foods fruits and Berries fractions, respectively.
- = value not available, or not applicable.

Table 2-9: Surrogate Ecological Receptors Used in the Traditional Foods Diet

Traditional Food Category	Representative Ecological Receptor	Traditional Food Items	Rationale[(a)]
Fish			
Fish	Northern pike	Walleye Northern pike	• Predator species and forage species represent two ecological trophic levels • Northern pike and lake whitefish are present in all lakes in the vicinity of the Project according to baseline studies • Important Traditional Food items for Boreal Shield and Boreal Plains ecozones • Both are known to be fished in the vicinity of the Project
	Lake whitefish	Lake whitefish	
Game Meat/Organs			
Large mammal	Moose meat	Moose meat	• Large herbivore with linkages to the aquatic environment • Generally present in the vicinity of the Project according to baseline studies • Important Traditional Food items for Boreal Shield and Boreal Plains ecozones
	Moose organs	Moose kidney Moose liver Caribou kidney	
Small mammal	Beaver	Beaver meat Rabbit meat	• Small herbivore with linkages to the aquatic environment • Generally present in the vicinity of the Project according to baseline studies • Important Traditional Food items for Boreal Shield ecozone
Birds			
Aquatic bird	Mallard	Mallard	• Omnivorous bird with linkages to the aquatic environment • Seasonally present in the vicinity of the Project according to baseline studies • Important Traditional Food items for Boreal Shield and Boreal Plains ecozones
Terrestrial bird	Grouse	Grouse Goose	• Upland herbivore bird • Generally present in the vicinity of the Project according to baseline studies • Important Traditional Food items for Boreal Shield and Boreal Plains ecozones
Berries/Plants			
Berries	Blueberry	Blueberry	• Generally present in the vicinity of the Project according to baseline studies • Important Traditional Food items for Boreal Shield and Boreal Plains ecozones
Plants	Labrador tea	Mint Rat root	• Generally present in the vicinity of the Project according to baseline studies • Important Traditional Food items for Boreal Shield and Boreal Plains ecozones

a) The selection of surrogate ecological receptors to represent Traditional Food items was informed by feedback during engagement activities.

Table 2-10: Local Intake Fractions for Human Diet

Food Category	Food Type	Camp Worker (Adult)		Seasonal Resident (One-Year-Old)		Seasonal Resident (Adult)		Subsistence Harvester (One-Year-Old)		Subsistence Harvester (Adult)		Permanent Resident (One-Year-Old)	Permanent Resident (Adult)
		Local Intake Reference %[(a)]	Local Intake Exposure %	Local Intake Reference %	Local Intake Exposure %	Local Intake Reference %	Local Intake Exposure %	Local Intake Reference %	Local Intake Exposure %	Local Intake Reference %	Local Intake Exposure %	Local Intake Exposure %	Local Intake Exposure %
Aquatic Animals	Northern pike	25.00	25.00	35.00	15.00	35.00	15.00	25.00	25.00	25.00	25.00	50.00	50.00
	Lake whitefish	25.00	25.00	35.00	15.00	35.00	15.00	25.00	25.00	25.00	25.00	50.00	50.00
Terrestrial Animals	Store foods	92.21	-	98.94	-	95.14	-	96.63	-	83.17	-	96.63	83.17
	Moose	0.78	0.78	0.14	0.06	0.68	0.29	0.32	0.32	1.69	1.69	0.64	3.38
	Moose organs	0.35	0.35	0.16	0.07	0.38	0.16	0.30	0.30	0.75	0.75	0.59	1.50
	Beaver	2.17	2.17	0.29	0.12	1.82	0.78	0.70	0.70	4.68	4.68	1.40	9.35
	Mallard	0.13	0.13	0.05	0.02	0.18	0.08	0.08	0.08	0.28	0.28	0.16	0.57
	Grouse	0.47	0.47	0.10	0.04	0.34	0.15	0.28	0.28	1.01	1.01	0.57	2.02
Terrestrial Plants	Labrador tea	9.88	9.88	2.88	1.24	5.48	2.35	5.54	5.54	9.88	9.88	11.08	19.75
	Fruits and berries	40.12	40.12	67.12	28.76	64.52	27.65	44.46	44.46	40.12	40.12	88.92	80.25

a) The % values were derived from the annual food intakes for components of the human receptors' diets as provided in Table 2-8 and the residency factors as provided in Table 2-12.
Local Intake Fraction (%) = (Traditional Annual Food Intake of a Food Type / Total Annual Food Intake in the Corresponding Food Category) * Residency Factor * 100%.
- = value not available, or not applicable.

The concentrations of COPCs in store foods (Table 2-11) used in the exposure assessment are consistent with other recent human health risk assessments conducted for uranium mine and mill projects in Saskatchewan. The proportions of different food items in store foods for the Hatchet Lake Band (CanNorth 2000) were used to derive weighted average concentrations of constituents in the store food diet of human receptors based on Health Canada data (2000 to 2011) for non-radiological constituents in foods for all Canadian cities (Health Canada 2011) and United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR 2000) for radiological constituents.

Table 2-11: Concentrations of Constituents of Potential Concern in Store Foods

Constituents of Potential Concern	Concentration [(a)]
Non-radionuclides [(b)]	**mg/kg fw**
Arsenic	0.0066
Cobalt	0.0055
Copper	0.57
Molybdenum	0.097
Uranium	0.0014
Radionuclides [(c)]	**Bq/kg fw**
Lead-210	0.039
Polonium-210	0.048
Radium-226	0.042
Thorium-230	0.0058
Uranium-234	0.0097
Uranium-238	0.0097

a) For the estimation of constituents of potential concern in store foods, proportions of food types in the store food diet were aligned with regional data from CanNorth (2000) for the Hatchet Lake First Nation.
b) Non-radionuclides in store foods were calculated from Health Canada data on trace elements in foods from the Total Diet Study (2000 to 2011) for all Canadian cities (Health Canada 2011).
c) Calculated from UNSCEAR (2000).
Bq = becquerel; fw = fresh weight.

2.4.2 Exposure Duration and Frequency

The residency assumptions for human receptors used for the human health risk assessment are summarized in Table 2-12. This includes the fraction of time the receptor spends at a given location as well as the exposure frequency (which refers to the frequency at which the activity causing the exposure occurs). The exposure duration (which refers to the length of time the receptor engages in the activity causing the exposure) was either the duration of the Project phases (43 years) for non-carcinogens, or the lifetime of the receptor for carcinogens.

Table 2-12: Summary of Residency Assumptions for Human Health Receptor Groups

Human Health Receptor Group	Life Stage(s)	Residence(s)	Residency[(a)]		Exposure Frequency (Months/Year)
			Residency Factor	Fraction of Time at Location	
All Project Phases: Construction, Operations, Closure					
Camp worker	Adult	Patterson Lake Camp/ Patterson Lake South Arm/ reference location	0.5 / 0.25 / 0.25	6 months/year 3 months/year 3 months/year	Yes, while away from the Camp
Subsistence harvester	Adult and one-year-old	Patterson Lake South Arm / reference location	0.5 / 0.5	6 months/year & 6 months/year	Yes, year-round
		Beet Lake/ reference location	0.5 / 0.5	6 months/year & 6 months/year	
		Lloyd Lake/ reference location	0.5 / 0.5	6 months/year & 6 months/year	
Seasonal resident	Adult and one-year-old	Patterson Lake South Arm / reference location	0.3 / 0.7	4 months/year & 8 months/year	Yes, while in the study area
		Lloyd Lake/ reference location	0.3 / 0.7	4 months/year & 8 months/year	
Far Future					
Permanent camp resident	Adult and one-year-old	Patterson Lake North Arm – West Basin	1	12 months/ year	Yes, year-round
Subsistence harvester	Adult and one-year-old	Patterson Lake South Arm / reference location	0.5 / 0.5	6 months/year & 6 months/year	Yes, year-round
		Beet Lake/ reference location	0.5 / 0.5	6 months/year & 6 months/year	
		Lloyd Lake/ reference location	0.5 / 0.5	6 months/year & 6 months/year	
Seasonal resident	Adult and one-year-old	Patterson Lake South Arm / reference location	0.3 / 0.7	4 months/year & 8 months/year	Yes, while in the study area
		Lloyd Lake/ reference location	0.3 / 0.7	4 months/year & 8 months/year	

a) The exposure duration for subsistence harvesters, seasonal residents and permanent residents is considered to be over a lifetime; the exposure duration for the camp worker is considered to be the duration of the Project phases (43 years).

2.4.3 Radiological Dose

The dose to human receptors from all radioactive isotopes except radon-222 is estimated using the equations listed below.

Radiological dose due to ingestion (D_f):

$$D_f = DCF_f \left[\cdot I_w \cdot \sum C_{wc} \cdot k_w \cdot rf \cdot + I_s \cdot \sum C_{soil} \cdot EF_{soil} + I_{sed} \cdot \sum C_s \cdot EF_s \cdot DF_s + I_{tp} \cdot \sum C_{tp} \cdot k_{tp} \cdot \rho_f + I_{ta} \cdot \sum C_{ta} \cdot k_{ta} \cdot \rho_f + I_{ap} \cdot \sum C_{ap} \cdot k_{ap} \cdot \rho_f + I_{aa} \cdot \sum C_{aa} \cdot k_{aa} \cdot \rho_f \right]$$

Radiological dose due to external exposure to water (D_w):

$$D_w = C_{wc} \cdot [k_w \cdot OF_w + k_w^S \cdot rf \cdot OF_w^S + k_w^B \cdot rf \cdot D_c \cdot OF_w^B] \cdot DCF_w$$

Radiological dose due to external exposure to soil (D_g):

$$D_g = C_{soil} \cdot f_o \cdot f_r \cdot \left[f_u + (1 - f_u) \cdot S_g \right] \cdot DCF_g \cdot \rho_b \cdot z_{soil}$$

Radiological dose due to external exposure to shoreline sediment (D_s):

$$D_s = C_s \cdot OF_s \cdot W \cdot DF_s \cdot DCF_s$$

Radiological dose due to inhalation in air (D_i):

$$D_i = I_a \cdot OF_i \cdot C_a \cdot DCF_{inh}$$

Radiological dose due to immersion in air (D_a):

$$D_a = f_o \cdot [f_u + (1 - f_u) \cdot S_b] \cdot C_a \cdot DCF_a$$

Total dose (D_{total}) to a human receptor from all pathways of exposure:

$$D_{total} = D_f + D_w + D_g + D_s + D_i + D_a$$

where:

C_{aa}	=	aquatic animal concentration (Bq/kg fw)
C_{ap}	=	aquatic plant concentration (Bq/kg fw)
C_s	=	sediment concentration (Bq/kg dw)
C_{soil}	=	surficial soil concentration (Bq/kg dw)
C_{tp}	=	terrestrial plant concentration (Bq/kg dw)
C_{ta}	=	terrestrial animal concentration (Bq/kg fw)
C_{wc}	=	water column concentration (Bq/L)
D_a	=	dose due to external exposure in air (mSv/yr)
D_c	=	bathtub correction factor (unitless)
D_f	=	dose due to ingestion (millisieverts per year (mSv/yr)
D_g	=	dose due to external exposure to soil/sediment (mSv/yr)
D_i	=	dose due to inhalation (mSv/yr)

D_w	=	dose due to external exposure in water (mSv/yr)
D_{total}	=	total dose (mSv/yr)
DCF_a	=	dose coefficient for external exposure in air ([Sv/yr]/[Bq/m^3])
DCF_f	=	dose coefficient for ingestion (sieverts per becquerel [Sv/Bq])
DCF_g	=	dose coefficient for external exposure to soil ([Sv/yr]/[Bq/m^2])
DCF_{inh}	=	dose coefficient for inhalation (Sv/Bq)
DCF_s	=	dose coefficient for external exposure to sediment ([Sv/yr]/[Bq/kg])
DCF_w	=	dose coefficient for external exposure in water ([Sv/yr]/[Bq/L])
DF_s	=	dilution factor for shoreline deposits (unitless)
EF_{soil}	=	number of days per year in which soil ingestion occurs (d/yr)
EF_s	=	number of days per year in which sediment ingestion occurs (d/yr)
f_o	=	fraction of total time spent by the individual at the particular location (unitless)
f_r	=	dose reduction factor for non-uniformity of ground surface (unitless)
f_u	=	time spent outdoors at a particular location as a fraction of total time spent at that location (unitless)
I_a	=	inhalation rate (m^3/yr)
I_{aa}	=	aquatic animals ingestion rate (kg fw/yr)
I_{ap}	=	aquatic plants ingestion rate (kg fw/yr)
I_s	=	sediment ingestion rate (kg dw/d)
I_{soil}	=	soil ingestion rate (kg dw/d)
I_{ta}	=	terrestrial animal ingestion rate (kg fw/yr)
I_{tp}	=	terrestrial plant ingestion rate (kg dw/yr)
I_w	=	water ingestion rate (L/yr)
k_a	=	fraction of air inhalation intake from contaminated source (unitless)
k_{aa}	=	fraction of aquatic animal intake from contaminated source (unitless)
k_{ap}	=	fraction of aquatic plant intake from contaminated source (unitless)
k_{ta}	=	fraction of terrestrial animal intake from contaminated source (unitless)
k_{tp}	=	fraction of terrestrial plant intake from contaminated source (unitless)
k_w	=	fraction of water intake from contaminated source (unitless)
k_w^B	=	fraction of bathing in contaminated water (unitless)
k_w^S	=	fraction of beach swimming in contaminated water (unitless)
OF_i	=	occupancy factor for inhalation (unitless)
OF_s	=	occupancy factor for sediment (unitless)
OF_W	=	occupancy factor for swimming in a surface water body (unitless)
OF_W^B	=	occupancy factor in bath water (unitless)
OF_W^S	=	occupancy factor in swimming water (unitless)
ρ_b	=	dry bulk density of the soil (kg dry soil per m^3)
ρ_f	=	adjustment factor for food processing (unitless)
rf	=	dose reduction factor for water treatment (unitless)
S_b	=	building shielding factor (unitless)
S_g	=	groundshine dose reduction factor for indoor shielding (unitless)
W	=	shore-width factor that describes the shoreline exposure geometry (unitless)
z_{soil}	=	soil mixing depth (m)

Dose from Radon

Consistent with recommendations in CSA N288.6-22 and Health Canada (2010b), the dose from radon in air is calculated according to the following equation:

$$Dose_{Rn} = \left[\frac{C_{Rn}}{3700\frac{Bq}{m^3}} \times F \times \frac{ET}{170h}\right] \times 4mSv$$

Radon typically dissipates quickly outdoors and is usually not a human health issue. However, dose from exposure to radon indoors should be quantified. The outdoor equilibrium fraction is needed to estimate the indoor equilibrium fraction. The equilibrium fraction for radon in outdoor air was estimated as a function of the travel time from the radon source using guidance from Health Canada and the USEPA according to the following equation (Health Canada 2010b; USEPA 1986):

$$F_{out} = 1.0 - 0.0479e^{-\frac{t}{4.39}} - 2.1963e^{-\frac{t}{38.6}} + 1.2442e^{-\frac{t}{28.4}}$$

The equilibrium fraction for radon in indoor air (F_{in}) was estimated as a function of the outdoor equilibrium fraction (F_{out}) using guidance from Health Canada (2010b) and the USEPA (1986) according to the following equation:

$$F_{in} = 0.35(1 + F_{out})$$

where:

C_{Rn}	=	concentration of radon in air (Bq/m^3)
$Dose_{Rn}$	=	incremental dose from radon (mSv/yr)
ET	=	exposure time (h/yr)
F	=	degree of equilibrium between radon and decay products (unitless)
F_{in}	=	indoor equilibrium fraction (unitless)
F_{out}	=	outdoors equilibrium fraction (unitless)
t	=	travel time from source to receptor (minutes) (distance from source to receptor divided by mean wind speed)

2.4.4 Non-radiological Dose

The human receptor exposure to non-radiological COPCs is estimated from the following equations:

Non-radiological intake due to inhalation (D_i):

$$D_i = \frac{C_{air} \cdot I_a \cdot k_a \cdot OF_i}{BM}$$

Non-radiological dose due to ingestion (D_f):

$$D_f = \frac{1}{BM \cdot C} \cdot \Big[I_w \cdot \sum (C_{wc} \cdot k_w \cdot rf) + I_s \cdot \sum (C_s \cdot EF_s \cdot DF_s \cdot RAF_{ing}) + I_{soil} \cdot \sum (C_{soil} \cdot EF_{soil} \cdot RAF_{ing}) + I_{tp} \cdot \sum (C_{tp} \cdot k_{tp} \cdot \rho_f) + I_{ta} \cdot \sum (C_{ta} \cdot k_{ta} \cdot \rho_f) + I_{ap} \cdot \sum (C_{ap} \cdot k_{ap} \cdot \rho_f) + I_{aa} \cdot \sum (C_{aa} \cdot k_{aa} \cdot \rho_f)\Big]$$

Non-radiological external exposure to water (dermal absorption) (D_w):

$$D_w = \frac{k_p \cdot SA_w}{BM} \cdot [C_w^S \cdot OF_w^S + C_w^B \cdot rf \cdot OF_w^B + C_w^P \cdot rf \cdot OF_w^P]$$

Non-radiological external exposure to soil and/or sediment (dermal absorption) ($D_{s,d}$):

$$D_{s,d} = \frac{[C_{soil} * (SA_{hands} * AF_{hands} + SA_{other} * AF_{other}) * RAF_{derm} * EF_{soil}]}{BM * C}$$

where:

AF_{hands}	=	soil adherence factor to hands (kg/m^2 d)
AF_{other}	=	soil adherence factor to skin other than hands (kg/m^2 d)
BM	=	body mass (kg)
C	=	conversion factor (365 days per year)
C_{aa}	=	aquatic animal concentration (mg/kg fw)
C_{air}	=	air concentration (mg/m^3)
C_{ap}	=	aquatic plant concentration (mg/kg fw)
C_s	=	sediment concentration (mg/kg dw)
C_{soil}	=	surficial soil concentration (mg/kg dw)
C_{tp}	=	terrestrial plant concentration (mg/kg dw)
C_{ta}	=	terrestrial animal concentration (mg/kg fw)
C_w^S	=	water concentration at the beach (mg/L)
C_w^B	=	water concentration in the bath (mg/L)
C_w^P	=	water concentration in the pool (mg/L)
C_{wc}	=	water column concentration (mg/L)
D_f	=	dose due to ingestion (mg/kg d)
D_i	=	dose due to inhalation (mg/kg d)
$D_{s,d}$	=	dose due to dermal contact with soil (mg/kg d)
EF_s	=	days per year exposed to sediment (d/yr)
EF_{soil}	=	days per year exposed to soil (d/yr)
I_a	=	inhalation rate (m^3/yr)
I_{aa}	=	aquatic animals ingestion rate (kg fw/yr)
I_{ap}	=	aquatic plants ingestion rate (kg fw/yr)
I_s	=	sediment ingestion rate (kg dw/d)

I_{soil}	=	soil ingestion rate (kg dw/d)
I_{ta}	=	terrestrial animal ingestion rate (kg fw/yr)
I_{tp}	=	terrestrial plant ingestion rate (kg dw/yr)
I_w	=	water ingestion rate (L/yr)
k_a	=	fraction of air inhalation intake from contaminated source (unitless)
k_{aa}	=	fraction of aquatic animal intake from contaminated source (unitless)
k_{ap}	=	fraction of aquatic plant intake from contaminated source (unitless)
k_p	=	chemical specific permeability coefficient (cm/h)
k_{ta}	=	fraction of terrestrial animal intake from contaminated source (unitless)
k_{tp}	=	fraction of terrestrial plant intake from contaminated source (unitless)
OF_i	=	occupancy factor for inhalation (unitless)
$OF_W{}^B$	=	occupancy factor in bath water (unitless)
$OF_W{}^P$	=	occupancy factor in pool water (unitless)
$OF_W{}^S$	=	occupancy factor at the beach (unitless)
ρ_f	=	adjustment factor for food processing (unitless)
RAF_{derm}	=	relative absorption factor for soil dermal contact (unitless)
RAF_{ing}	=	relative absorption factor for ingestion (unitless)
rf	=	dose reduction factor for water treatment (unitless)
SA_w	=	surface area of exposed skin (m^2)
SA_{hands}	=	surface area of hands (m^2)
SA_{other}	=	surface area of exposed skin other than hands (m^2)

Potential non-cancer effects are evaluated using HQ values estimated as described in Section 2.3.6, Non-radiological Risk to Terrestrial Ecological Receptors. Potential cancer risks from exposure to carcinogenic constituents are evaluated as incremental lifetime cancer risks.

3.0 Development of Model Parameters

3.1 Ambient Hydrology

A baseline sampling program is fundamental to the development and application of an ecological model for Environmental Assessment. In addition to data on environmental media, many other parameters are required to quantify the transport and fate of constituents in the environment. Many of those parameters are not typically measured and are therefore estimated in the modelling process.

3.1.1 Lake Morphometry

Waterbodies from Patterson Lake to the Lloyd Lake inlet were modelled to assess the effects of the Project on the downstream environment. Broach Lake, upstream of Patterson Lake, was modelled as a reference location. The lakes were modelled based on characteristics consistent with measured values as presented in Table 3-1. All values are based on the hydrological modelling inputs presented in Annex IV.2.

Table 3-1: Lake Morphometry for all Modelled Lakes in the IMPACT Model

Lake Modelled	Average Depth (m)	Area (km^2)
Broach Lake	25.9	9.3
Patterson Lake North Arm – East Basin	7.0	9.3
Patterson Lake North Arm – West Basin	18.7	12.6
Patterson Lake South Arm	14.8	16.0
Beet Lake	10.7	8.9
Naomi Lake	1.8	2.4
Lloyd Lake inlet	3.8	6.4

The stream model in IMPACT was used to model rivers and streams to connect Broach Lake and Patterson Lake North Arm East Basin, and Naomi Lake and Lloyd Lake. The three basins of Patterson Lake were modelled as separate waterbodies: North Arm – East Basin, North Arm – West Basin, and South Arm. Forrest Lake was split into Forrest Lake – North Basin and Forrest Lake – South Basin, with the direction of flow from the South Basin to the North Basin. For the Forrest Lake – North Basin, the stream model in IMPACT was used. As such, the Forrest Lake – North Basin acts as a flow-through channel, and no sediment interaction was modelled.

3.1.2 Surface Water Flows

Watersheds and yields were implemented consistently with the hydrological baseline model (Appendix 9A, Hydrological Modelling Summary Report). Average monthly flows from the Hydrological Modelling Summary Report are shown in Table 3-2 at the model nodes, and Figure 3-1 shows the flow direction through the modelled environment as implemented in IMPACT. The outflow in IMPACT is calculated as the sum of the upstream flow entering a body of water and the local inflow, defined as any inflow from the contributing watershed and tributaries. The local inflow was calculated based on watershed yield and area. Based on this, inputs for the local inflows were calculated for input into the IMPACT model (Table 3-3).

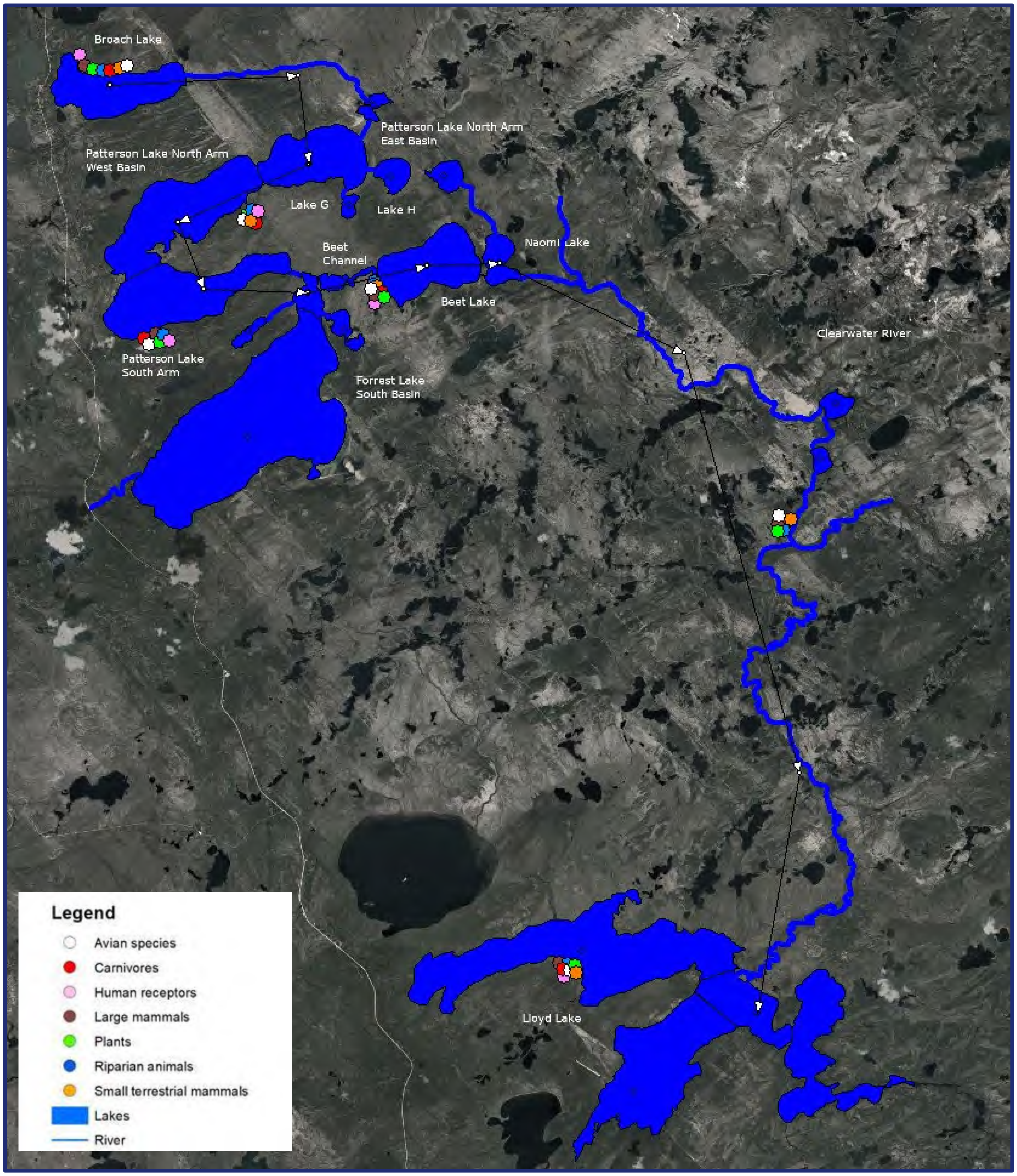


Figure 3-1: Waterbodies and Flow Direction as Implemented in the IMPACT Model

Table 3-2: Average Monthly Outflows at the Model Nodes

Node Name	Outflow (m^3/s)												Average (m^3/s)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Broach Lake	0.1	0.1	0.1	0.3	0.5	0.4	0.3	0.2	0.2	0.2	0.2	0.2	**0.3**
Clearwater River above Patterson Lake	0.2	0.2	0.3	0.8	1.2	0.9	0.7	0.6	0.6	0.6	0.5	0.3	**0.6**
Clearwater River below Patterson Lake	1.1	1.0	1.1	1.2	1.7	1.7	1.6	1.5	1.5	1.4	1.2	1.1	**1.4**
Clearwater River below Forrest Lake	1.9	1.7	1.7	1.8	2.7	2.8	2.6	2.4	2.3	2.3	2.3	2.1	**2.2**
Clearwater River below Beet Lake	2.0	1.8	1.8	2.1	3.3	3.0	2.7	2.6	2.5	2.5	2.4	2.2	**2.4**
Clearwater River below Naomi Lake	2.4	2.2	2.1	2.6	4.6	4.0	3.5	3.3	3.2	3.2	3.0	2.7	**3.1**
Clearwater River above Mirror River Confluence	3.5	3.5	3.5	6.0	10.0	8.0	6.6	6.0	6.0	6.0	5.4	4.0	**5.7**
Clearwater River below Mirror River Confluence	10.8	10.7	10.8	18.5	30.6	24.5	20.4	18.5	18.4	18.4	16.4	12.2	**17.5**
Clearwater River above Lloyd Lake	11.7	11.6	11.7	20.0	33.1	26.5	22.1	20.0	19.9	20.0	17.8	13.2	**19.0**
Clearwater River at Outlet of Lloyd Lake	17.6	16.1	15.5	19.4	34.8	33.2	28.4	24.2	22.6	23.5	21.3	19.5	**23.0**

Table 3-3: Mean Monthly Local Inflows for All Waterbodies Modelled in IMPACT

Lake Name	Mean Monthly Local Inflow (m^3/s)												Average m^3/s
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Broach Lake	0.13	0.12	0.13	0.29	0.54	0.43	0.31	0.24	0.23	0.23	0.21	0.17	**0.25**
Clearwater River above Patterson Lake	0.07	0.12	0.16	0.53	0.61	0.43	0.35	0.32	0.32	0.33	0.26	0.09	**0.30**
Patterson Lake North Arm – East Basin	0.23	0.21	0.20	0.11	0.13	0.23	0.25	0.25	0.23	0.22	0.20	0.23	**0.21**
Patterson Lake North Arm – West Basin	0.25	0.22	0.22	0.12	0.15	0.25	0.27	0.27	0.25	0.24	0.22	0.25	**0.23**
Patterson Lake South Arm	0.40	0.36	0.35	0.19	0.24	0.39	0.44	0.43	0.41	0.39	0.35	0.40	**0.36**
Forrest Lake – North Basin	0.80	0.71	0.60	0.61	1.00	1.07	1.00	0.90	0.88	0.93	1.05	0.94	**0.87**
Beet Lake	0.10	0.09	0.12	0.23	0.63	0.20	0.11	0.13	0.17	0.16	0.06	0.08	**0.17**
Naomi Lake	0.46	0.40	0.35	0.51	1.28	1.03	0.78	0.69	0.68	0.69	0.65	0.53	**0.67**
Clearwater River above Mirror River confluence	1.07	1.25	1.38	3.45	5.38	3.95	3.10	2.78	2.81	2.82	2.35	1.26	**2.63**
Clearwater River above Lloyd Lake	8.18	8.08	8.17	14.00	23.15	18.56	15.42	14.00	13.93	13.95	12.44	9.22	**13.26**
Lloyd Lake	5.22	5.22	1.61	1.61	4.14	4.14	5.27	5.27	3.11	3.11	4.90	4.90	**4.04**

3.2 Water Quality

3.2.1 Background Water Quality

To characterize regional background water quality, a database of baseline water quality data was compiled from baseline studies performed between 2018 and 2020 (Annex V.1). The waterbodies included in the calculation of a regional baseline were Patterson Lake (i.e., North Arm – East Basin, North Arm – West Basin, and South Arm), all measurement stations along the Clearwater River, Lake H, Lake G, Forrest Lake, Beet Lake, Naomi Lake, Mirror River, and Lloyd Lake. The geometric mean was selected as the baseline concentration for constituents that had measured data over the detection limit. In the case of constituents for which measured values in water were under the detection limit but sediment concentration measurements were over the detection limit, the baseline water concentration was calculated from the geometric mean of the sediment measurements using the partitioning coefficients (K_d; Section 3.3.2).

Lead-210 and its daughter polonium-210 were considered to be in transient equilibrium. Activity concentrations of a parent and daughter nuclide in transient equilibrium are governed by the following relationship:

$$Q_B = \frac{\lambda_B}{\lambda_B - \lambda_A} \cdot Q_A$$

where:

Q_A	=	activity of the parent
Q_B	=	activity of the daughter
λ_A	=	half life of the parent
λ_B	=	half life of the daughter

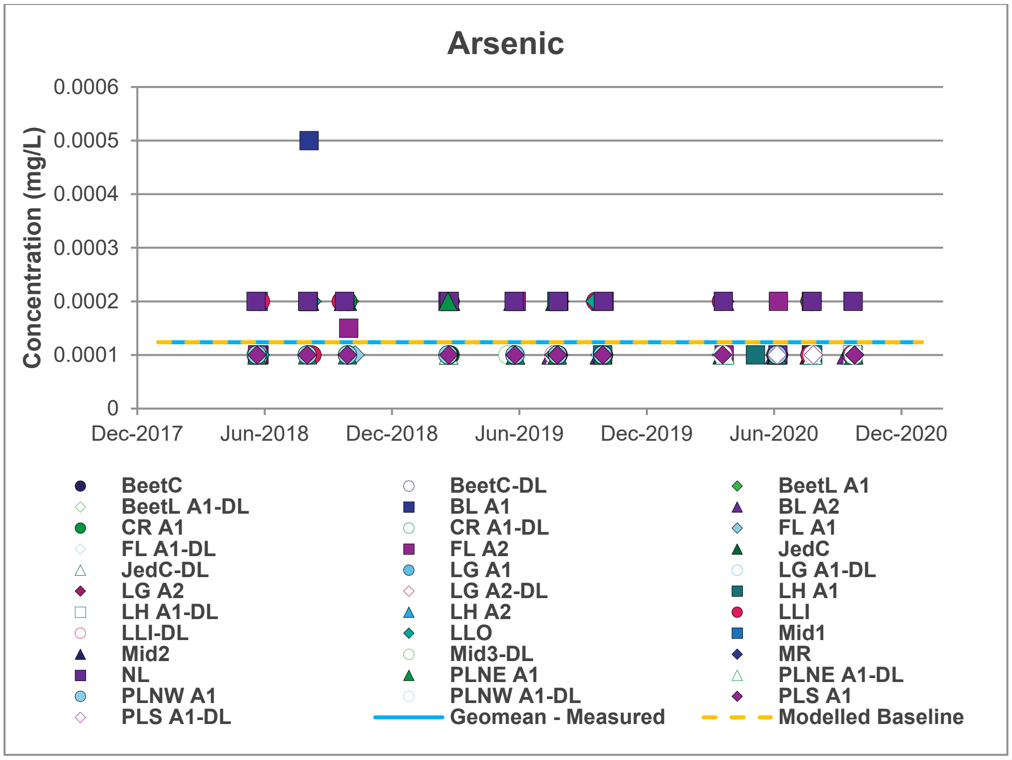
Polonium-210 and lead-210 were balanced to remain in transient equilibrium. Sediment concentration of Po-210 was calculated from measured values of water concentration using the K_d. The transient equilibrium assumption was used to calculate sediment concentrations of lead-210 from Po-210 sediment concentrations and, using the distribution coefficient (K_d), lead-210 sediment concentrations were used to model water concentrations of lead-210.

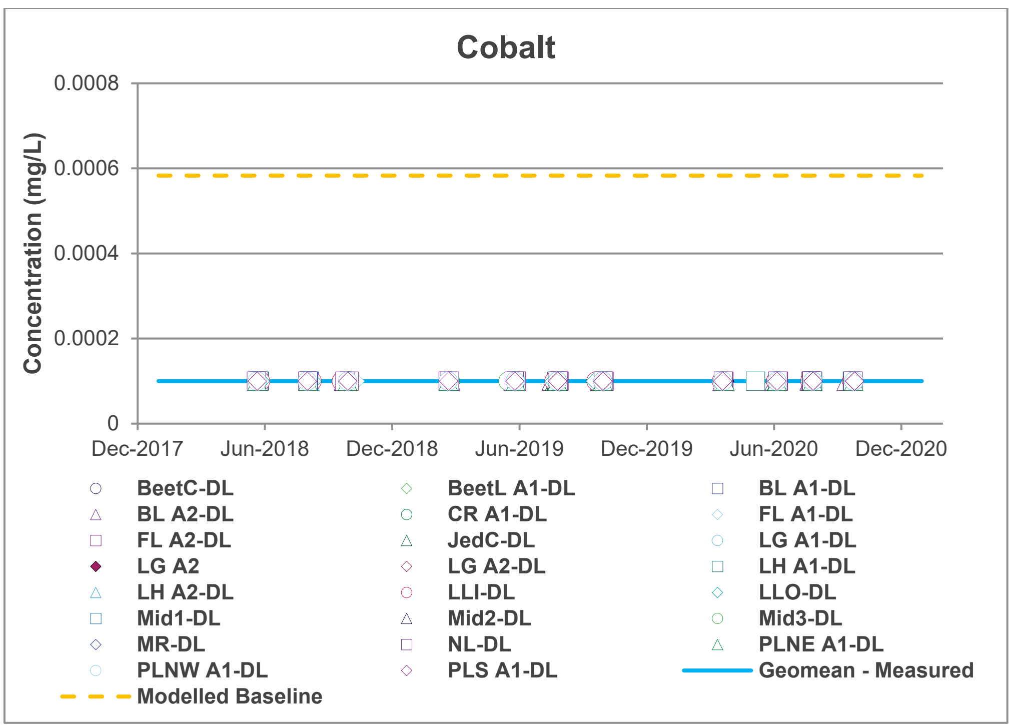
The inflow concentrations for each waterbody were assigned slightly higher values than the background concentrations since sedimentation processes remove metals and radionuclides from the inflow. Inflow concentrations were calculated from the background concentration, the residence time within each respective waterbody, the sedimentation rate, and the COPC-specific partitioning coefficient. The slightly higher inflow values were used in the model to predict stable concentrations in water and sediment within the range of observed values of background conditions and are presented in Table 3-4.

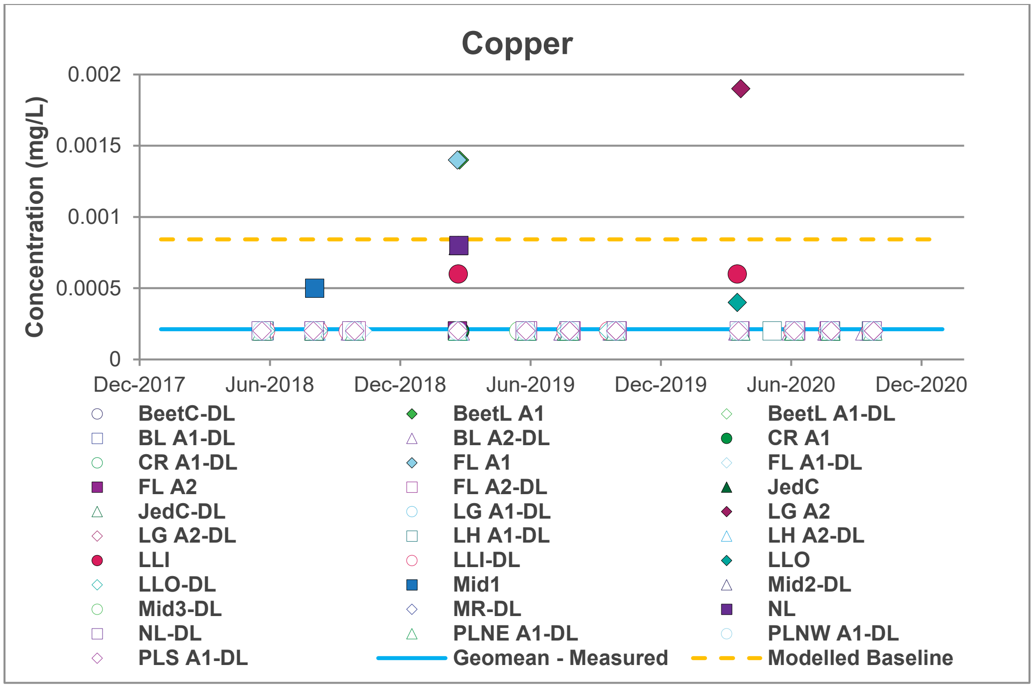
Table 3-4: Calibrated Local Inflow Concentrations for Each Water Polygon Modelled in IMPACT

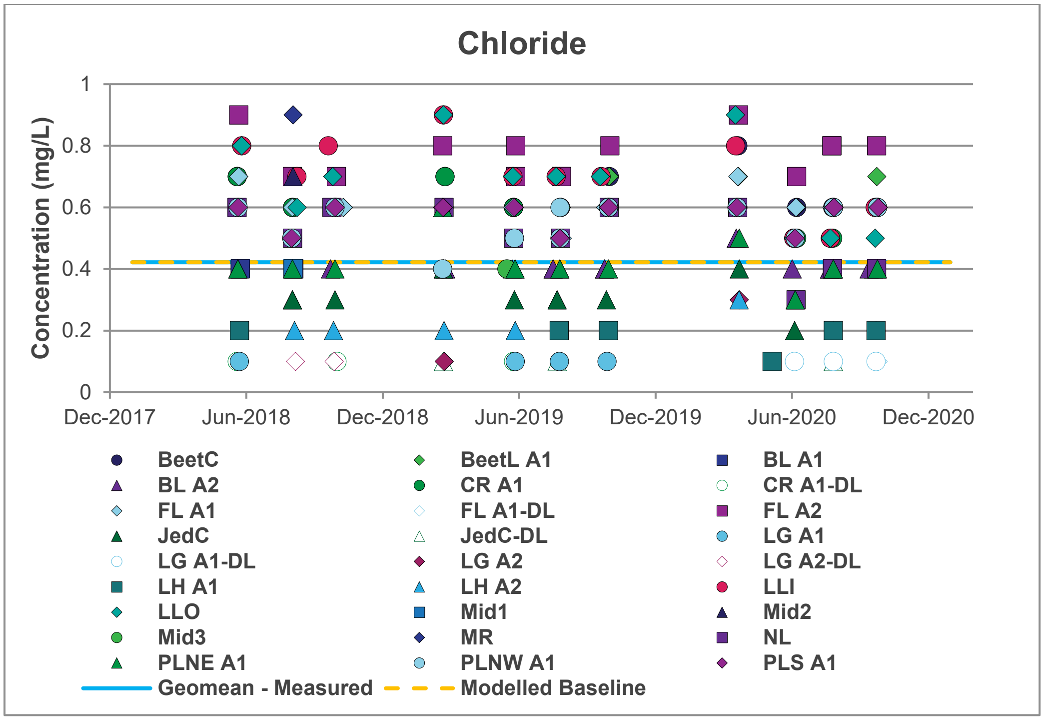
COPC	Water Baseline	Clearwater River upstream of Patterson Lake	Broach Lake	Patterson Lake North Arm East Basin	Patterson Lake North Arm West Basin	Patterson Lake South Arm	Forrest Lake North	Beet Lake	Naomi Lake	Clearwater river upstream of Mirror River Confluence	Clearwater river downstream of Mirror River Confluence	Lloyd Lake Inlet
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Arsenic	1.24×10^{-04}	1.24×10^{-04}	3.19×10^{-03}	3.85×10^{-03}	4.75×10^{-03}	3.79×10^{-03}	1.24×10^{-04}	4.37×10^{-03}	4.23×10^{-04}	1.24×10^{-04}	1.24×10^{-04}	2.55×10^{-04}
Chloride	4.22×10^{-01}	4.22×10^{-01}	4.22×10^{-01}	4.22×10^{-01}	4.22×10^{-01}	4.22×10^{-01}	4.22×10^{-01}	4.22×10^{-01}	4.22×10^{-01}	4.22×10^{-01}	4.22×10^{-01}	4.22×10^{-01}
Cobalt	5.83×10^{-04}	5.83×10^{-04}	9.58×10^{-04}	1.04×10^{-03}	1.15×10^{-03}	1.03×10^{-03}	5.83×10^{-04}	1.10×10^{-03}	6.20×10^{-04}	5.83×10^{-04}	5.83×10^{-04}	5.99×10^{-04}
Copper	8.43×10^{-04}	8.43×10^{-04}	1.49×10^{-03}	1.63×10^{-03}	1.82×10^{-03}	1.62×10^{-03}	8.43×10^{-04}	1.74×10^{-03}	9.06×10^{-04}	8.43×10^{-04}	8.43×10^{-04}	8.71×10^{-04}
Molybdenum	2.06×10^{-04}	2.06×10^{-04}	3.75×10^{-04}	4.11×10^{-04}	4.60×10^{-04}	4.07×10^{-04}	2.06×10^{-04}	4.39×10^{-04}	2.23×10^{-04}	2.06×10^{-04}	2.06×10^{-04}	2.14×10^{-04}
Sulphate	1.72×10^{-05}	1.03×10^{-02}	$1.06 \times 10^{+00}$	$1.06 \times 10^{+00}$	$1.06 \times 10^{+00}$	$1.06 \times 10^{+00}$	1.03×10^{-02}	$1.06 \times 10^{+00}$	$1.06 \times 10^{+00}$	1.03×10^{-02}	1.03×10^{-02}	$1.06 \times 10^{+00}$
Phosphorus	1.03×10^{-02}	$1.06 \times 10^{+00}$	1.05×10^{-02}	1.06×10^{-02}	1.06×10^{-02}	1.06×10^{-02}	$1.06 \times 10^{+00}$	1.06×10^{-02}	1.03×10^{-02}	$1.06 \times 10^{+00}$	$1.06 \times 10^{+00}$	1.03×10^{-02}
Uranium	1.00×10^{-04}	1.00×10^{-04}	6.16×10^{-04}	7.26×10^{-04}	8.78×10^{-04}	7.16×10^{-04}	1.00×10^{-04}	8.14×10^{-04}	1.51×10^{-04}	1.00×10^{-04}	1.00×10^{-04}	1.22×10^{-04}
	Bq/L	Bq/L	Bq/L	Bq/L	Bq/L	Bq/L	Bq/L	Bq/L	Bq/L	Bq/L	Bq/L	Bq/L
Lead-210	1.03×10^{-02}	5.07×10^{-03}	1.67×10^{-01}	1.98×10^{-01}	2.48×10^{-01}	1.96×10^{-01}	5.07×10^{-03}	2.26×10^{-01}	2.05×10^{-02}	5.07×10^{-03}	5.07×10^{-03}	1.18×10^{-02}
Polonium-210	1.03×10^{-02}	5.16×10^{-03}	1.70×10^{-01}	2.01×10^{-01}	2.52×10^{-01}	2.00×10^{-01}	5.15×10^{-03}	2.30×10^{-01}	2.08×10^{-02}	5.20×10^{-03}	5.16×10^{-03}	1.20×10^{-02}
Radium-226	1.03×10^{-02}	5.54×10^{-03}	2.26×10^{-02}	2.63×10^{-02}	3.13×10^{-02}	2.59×10^{-02}	5.54×10^{-03}	2.92×10^{-02}	7.21×10^{-03}	5.54×10^{-03}	5.54×10^{-03}	6.27×10^{-03}
Thorium-230	9.09×10^{-03}	9.09×10^{-03}	1.45×10^{-02}	1.56×10^{-02}	1.72×10^{-02}	1.55×10^{-02}	9.09×10^{-03}	1.65×10^{-02}	9.61×10^{-03}	9.09×10^{-03}	9.09×10^{-03}	9.32×10^{-03}
Uranium-234	3.56×10^{-04}	3.56×10^{-04}	2.18×10^{-03}	2.58×10^{-03}	3.12×10^{-03}	2.54×10^{-03}	3.56×10^{-04}	2.89×10^{-03}	5.34×10^{-04}	3.56×10^{-04}	3.56×10^{-04}	4.34×10^{-04}
Uranium-238	3.56×10^{-04}	3.56×10^{-04}	2.18×10^{-03}	2.58×10^{-03}	3.12×10^{-03}	2.54×10^{-03}	3.56×10^{-04}	2.89×10^{-03}	5.34×10^{-04}	3.56×10^{-04}	3.56×10^{-04}	4.34×10^{-04}

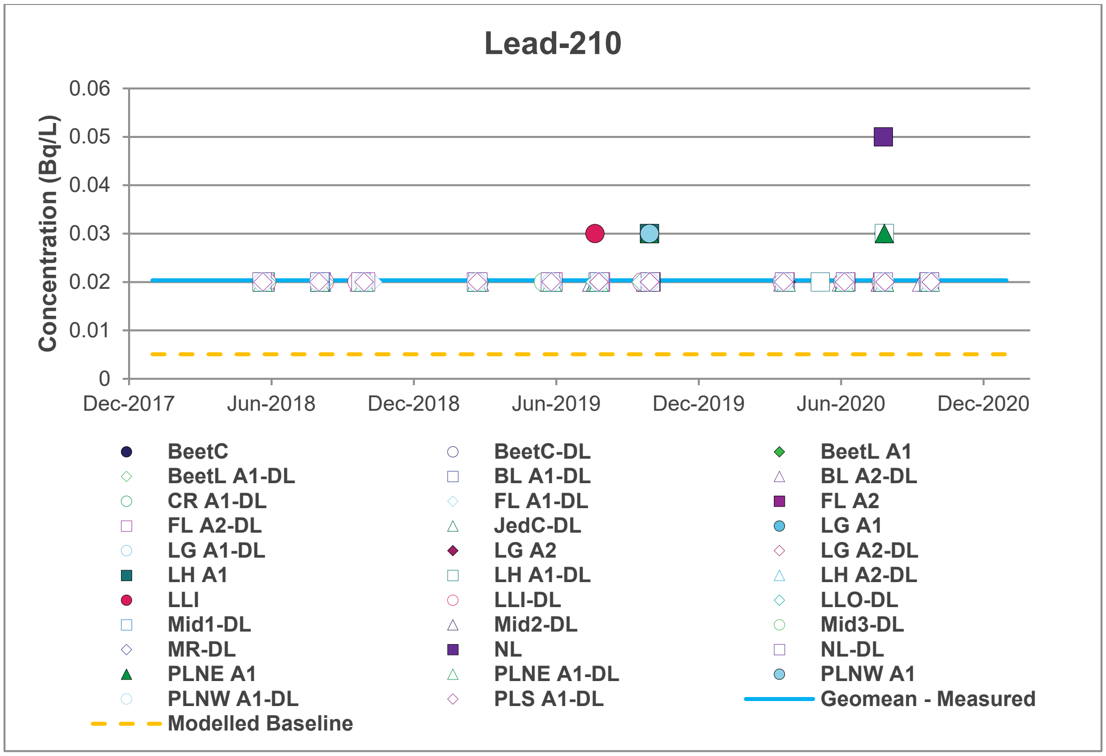
Modelled average baseline concentrations are presented in Table 3-5 and a comparison to measured values is shown in Figure 3-2 and Figure 3-3. Parameters include arsenic, chloride, phosphorus, copper, cobalt, sulphate, and uranium, as well as the considered radionuclides (i.e., lead-210, polonium-210, uranium-234, uranium-238, radium-226, thorium-230). The purpose of these plots is to show trends over time for selected COPCs and the generally good agreement between measured and predicted values that resulted from the calibration. Water concentrations for cobalt and copper are likely overestimates, since the modelled concentration is over the detection limit, with most or all measured values being under the detection limit for copper and cobalt, respectively. This overestimation is a result of the method for derivation of water concentrations based on measured sediment values (Section 3.3, Sediment Quality). Unlike chloride and sulphate, metals and radionuclides are expected to interact with sediment. In the case of radionuclides, ingrowth and decay are other factors that may influence activities in the receiving environment.

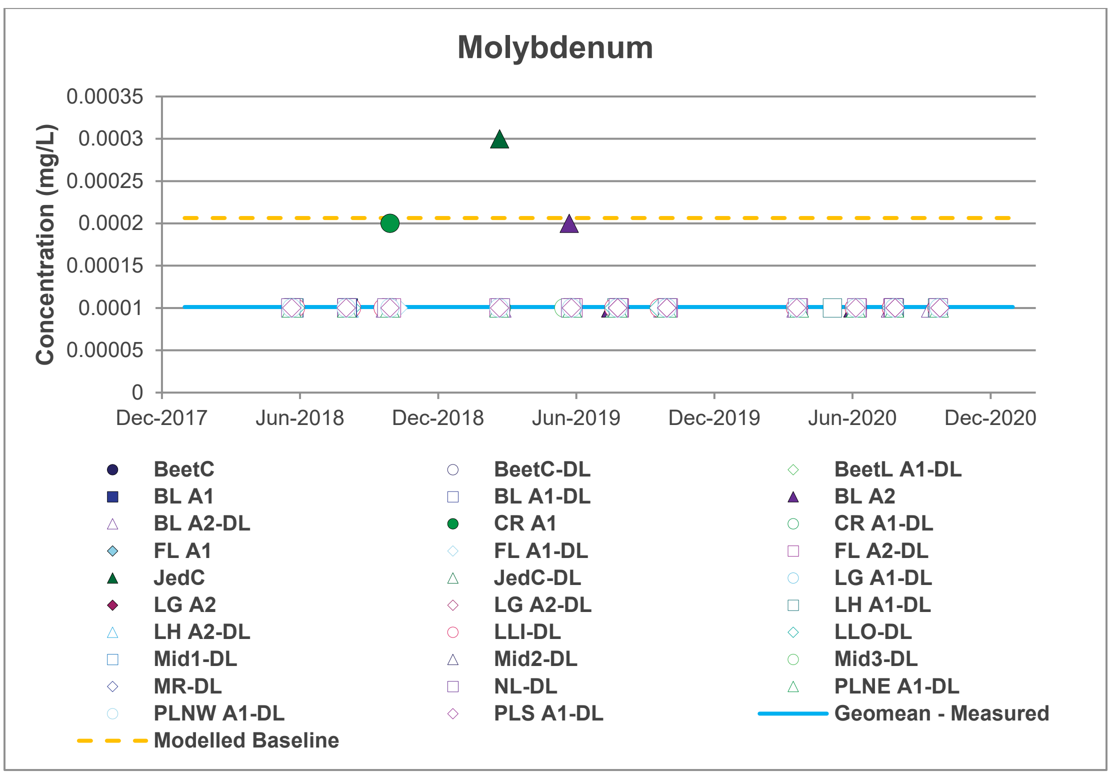

Arsenic
Concentration (mg/L)
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetC
BeetC-DL
BeetL A1
BeetL A1-DL
BL A1
BL A2
CR A1
CR A1-DL
FL A1
FL A1-DL
FL A2
JedC
JedC-DL
LG A1
LG A1-DL
LG A2
LG A2-DL
LH A1
LH A1-DL
LH A2
LLI
LLI-DL
LLO
Mid1
Mid2
Mid3-DL
MR
NL
PLNE A1
PLNE A1-DL
PLNW A1
PLNW A1-DL
PLS A1
PLS A1-DL
Geomean - Measured
Modelled Baseline

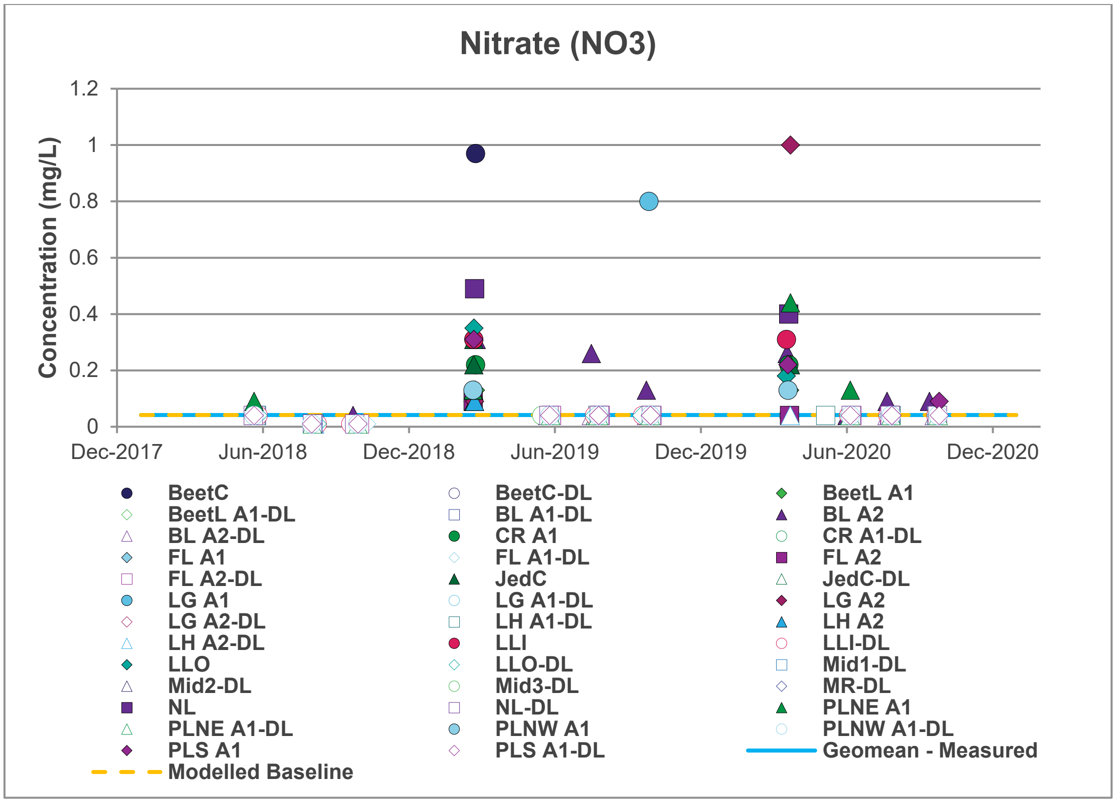

Cobalt
Concentration (mg/L)
0.0008
0.0006
0.0004
0.0002
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetC-DL
BeetL A1-DL
BL A1-DL
BL A2-DL
CR A1-DL
FL A1-DL
FL A2-DL
JedC-DL
LG A1-DL
LG A2
LG A2-DL
LH A1-DL
LH A2-DL
LLI-DL
LLO-DL
Mid1-DL
Mid2-DL
Mid3-DL
MR-DL
NL-DL
PLNE A1-DL
PLNW A1-DL
PLS A1-DL
Geomean - Measured
Modelled Baseline

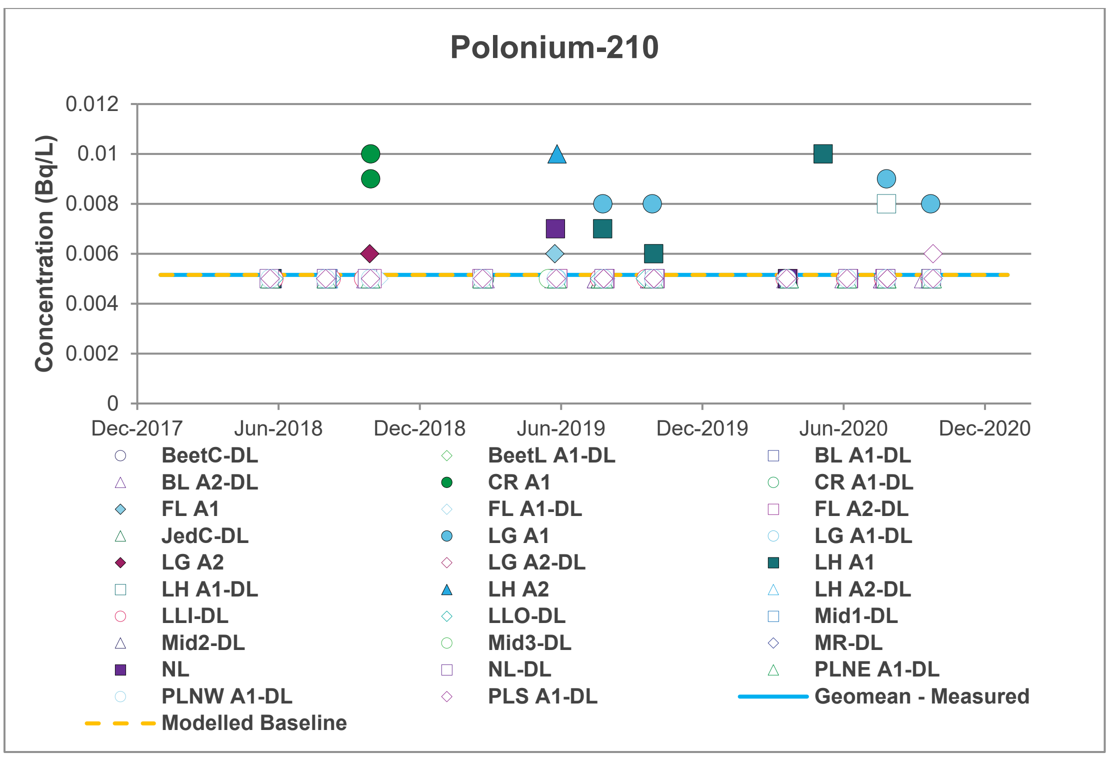

Copper
Concentration (mg/L)
0.002
0.0015
0.001
0.0005
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetC-DL
BeetL A1
BeetL A1-DL
BL A1-DL
BL A2-DL
CR A1
CR A1-DL
FL A1
FL A1-DL
FL A2
FL A2-DL
JedC
JedC-DL
LG A1-DL
LG A2
LG A2-DL
LH A1-DL
LH A2-DL
LLI
LLI-DL
LLO
LLO-DL
Mid1
Mid2-DL
Mid3-DL
MR-DL
NL
NL-DL
PLNE A1-DL
PLNW A1-DL
PLS A1-DL
Geomean - Measured
Modelled Baseline

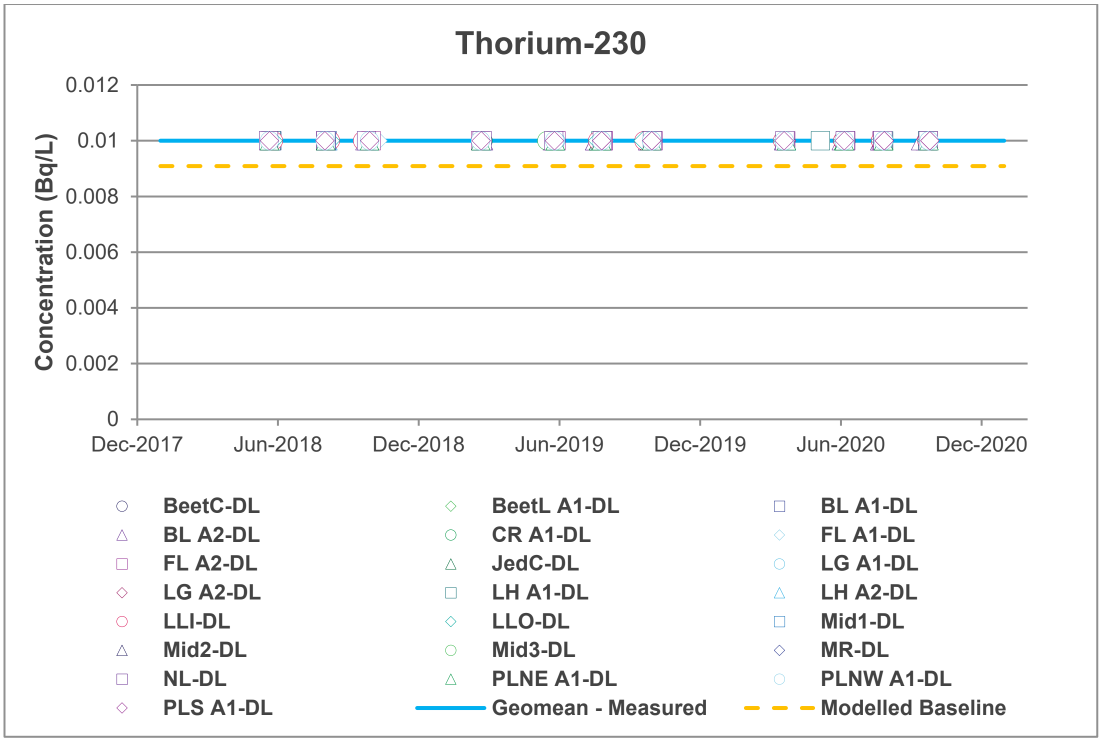

Chloride
Concentration (mg/L)
1
0.8
0.6
0.4
0.2
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetC
BeetL A1
BL A1
BL A2
CR A1
CR A1-DL
FL A1
FL A1-DL
FL A2
JedC
JedC-DL
LG A1
LG A1-DL
LG A2
LG A2-DL
LH A1
LH A2
LLI
LLO
Mid1
Mid2
Mid3
MR
NL
PLNE A1
PLNW A1
PLS A1
Geomean - Measured
Modelled Baseline

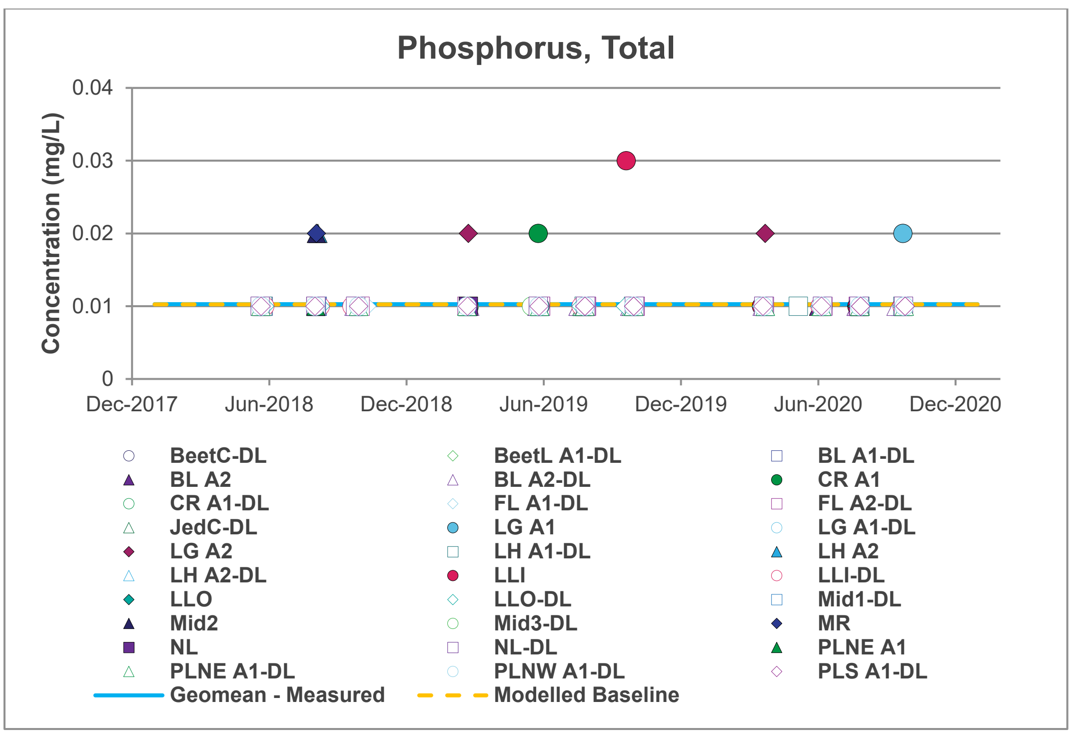

Lead-210
Concentration (Bq/L)
0.06
0.05
0.04
0.03
0.02
0.01
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetC
BeetC-DL
BeetL A1
BeetL A1-DL
BL A1-DL
BL A2-DL
CR A1-DL
FL A1-DL
FL A2
FL A2-DL
JedC-DL
LG A1
LG A1-DL
LG A2
LG A2-DL
LH A1
LH A1-DL
LH A2-DL
LLI
LLI-DL
LLO-DL
Mid1-DL
Mid2-DL
Mid3-DL
MR-DL
NL
NL-DL
PLNE A1
PLNE A1-DL
PLNW A1
PLNW A1-DL
PLS A1-DL
Geomean - Measured
Modelled Baseline

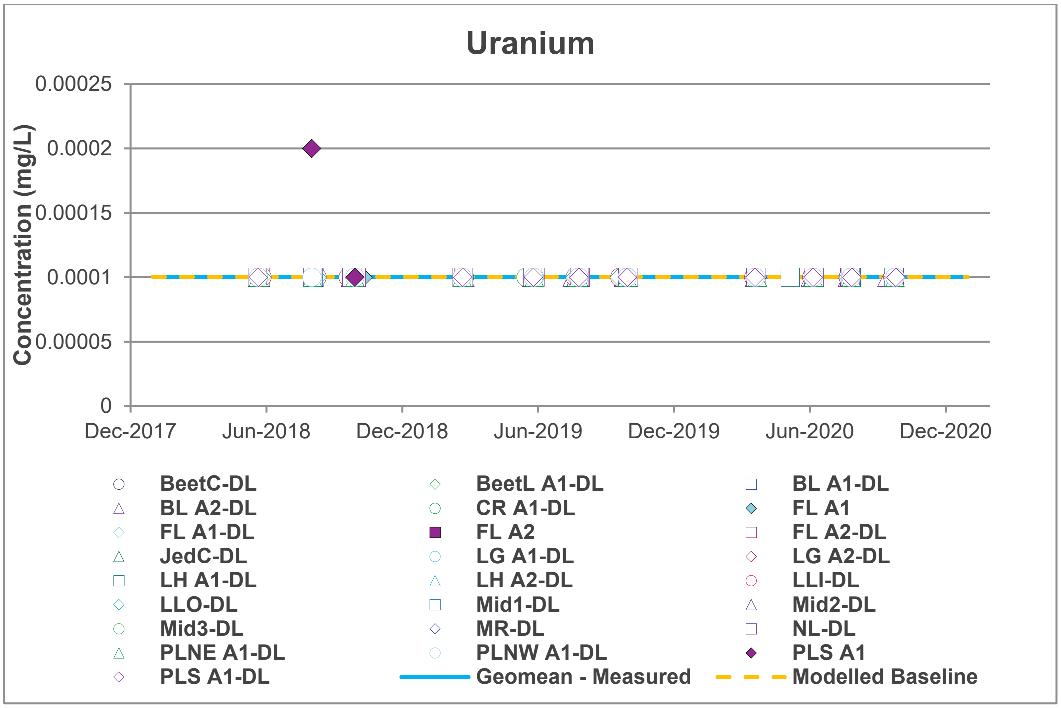

Molybdenum
Concentration (mg/L)
0.00035
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetC
BeetC-DL
BeetL A1-DL
BL A1
BL A1-DL
BL A2
BL A2-DL
CR A1
CR A1-DL
FL A1
FL A1-DL
FL A2-DL
JedC
JedC-DL
LG A1-DL
LG A2
LG A2-DL
LH A1-DL
LH A2-DL
LLI-DL
LLO-DL
Mid1-DL
Mid2-DL
Mid3-DL
MR-DL
NL-DL
PLNE A1-DL
PLNW A1-DL
PLS A1-DL
Geomean - Measured
Modelled Baseline

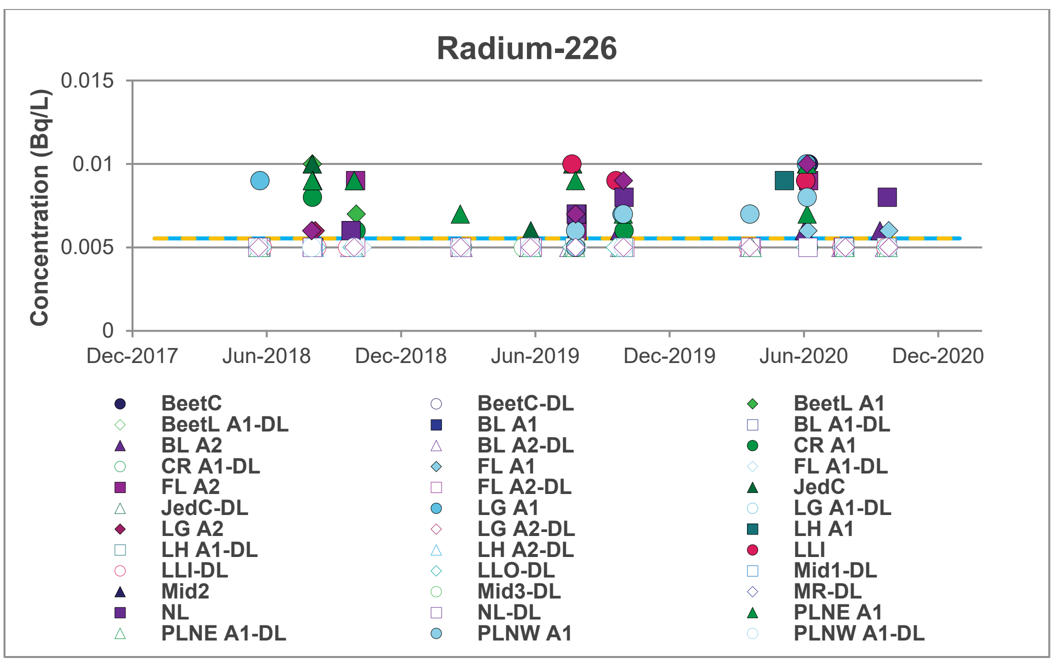

Nitrate (NO3)
Concentration (mg/L)
1.2
1
0.8
0.6
0.4
0.2
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetC
BeetC-DL
BeetL A1
BeetL A1-DL
BL A1-DL
BL A2
BL A2-DL
CR A1
CR A1-DL
FL A1
FL A1-DL
FL A2
FL A2-DL
JedC
JedC-DL
LG A1
LG A1-DL
LG A2
LG A2-DL
LH A1-DL
LH A2
LH A2-DL
LLI
LLI-DL
LLO
LLO-DL
Mid1-DL
Mid2-DL
Mid3-DL
MR-DL
NL
NL-DL
PLNE A1
PLNE A1-DL
PLNW A1
PLNW A1-DL
PLS A1
PLS A1-DL
Geomean - Measured
Modelled Baseline

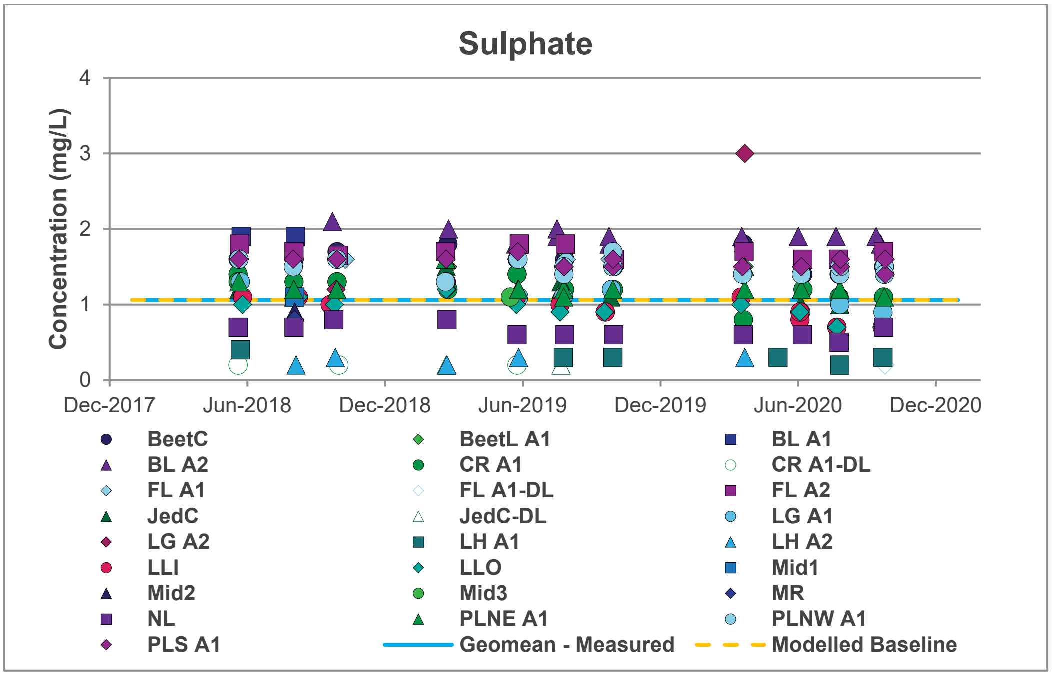

Polonium-210
Concentration (Bq/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetC-DL
BeetL A1-DL
BL A1-DL
BL A2-DL
CR A1
CR A1-DL
FL A1
FL A1-DL
FL A2-DL
JedC-DL
LG A1
LG A1-DL
LG A2
LG A2-DL
LH A1
LH A1-DL
LH A2
LH A2-DL
LLI-DL
LLO-DL
Mid1-DL
Mid2-DL
Mid3-DL
MR-DL
NL
NL-DL
PLNE A1-DL
PLNW A1-DL
PLS A1-DL
Geomean - Measured
Modelled Baseline


Thorium-230
Concentration (Bq/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetC-DL
BeetL A1-DL
BL A1-DL
BL A2-DL
CR A1-DL
FL A1-DL
FL A2-DL
JedC-DL
LG A1-DL
LG A2-DL
LH A1-DL
LH A2-DL
LLI-DL
LLO-DL
Mid1-DL
Mid2-DL
Mid3-DL
MR-DL
NL-DL
PLNE A1-DL
PLNW A1-DL
PLS A1-DL
Geomean - Measured
Modelled Baseline


Phosphorus, Total
Concentration (mg/L)
0.04
0.03
0.02
0.01
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetC-DL
BeetL A1-DL
BL A1-DL
BL A2
BL A2-DL
CR A1
CR A1-DL
FL A1-DL
FL A2-DL
JedC-DL
LG A1
LG A1-DL
LG A2
LH A1-DL
LH A2
LH A2-DL
LLI
LLI-DL
LLO
LLO-DL
Mid1-DL
Mid2
Mid3-DL
MR
NL
NL-DL
PLNE A1
PLNE A1-DL
PLNW A1-DL
PLS A1-DL
Geomean - Measured
Modelled Baseline


Uranium
Concentration (mg/L)
0.00025
0.0002
0.00015
0.0001
0.00005
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetC-DL
BeetL A1-DL
BL A1-DL
BL A2-DL
CR A1-DL
FL A1
FL A1-DL
FL A2
FL A2-DL
JedC-DL
LG A1-DL
LG A2-DL
LH A1-DL
LH A2-DL
LLI-DL
LLO-DL
Mid1-DL
Mid2-DL
Mid3-DL
MR-DL
NL-DL
PLNE A1-DL
PLNW A1-DL
PLS A1
PLS A1-DL
Geomean - Measured
Modelled Baseline


Radium-226
Concentration (Bq/L)
0.015
0.01
0.005
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetC
BeetC-DL
BeetL A1
BeetL A1-DL
BL A1
BL A1-DL
BL A2
BL A2-DL
CR A1
CR A1-DL
FL A1
FL A1-DL
FL A2
FL A2-DL
JedC
JedC-DL
LG A1
LG A1-DL
LG A2
LG A2-DL
LH A1
LH A1-DL
LH A2-DL
LLI
LLI-DL
LLO-DL
Mid1-DL
Mid2
Mid3-DL
MR-DL
NL
NL-DL
PLNE A1
PLNE A1-DL
PLNW A1
PLNW A1-DL



Note: Blank outline symbol (no-fill) indicates that the measurement was under the detection limit. Sampling stations summarized in Appendix A.
WQO = Water Quality Objective.

Figure 3-2: Modelled and Measured Baseline Concentrations in Water

3.3 Sediment Quality

3.3.1 Background Sediment Quality

To characterize regional background sediment quality, baseline water quality data were used from baseline studies performed between 2018 and 2020 (Annex V.1). The waterbodies included in the calculation of a regional sediment baseline were Patterson Lake (i.e., North Arm – East Basin and West Basin, South Arm), all measurement stations along the Clearwater River, Lake H, Lake G, Forrest Lake, Beet Lake, Naomi Lake, Mirror River, and Lloyd Lake.

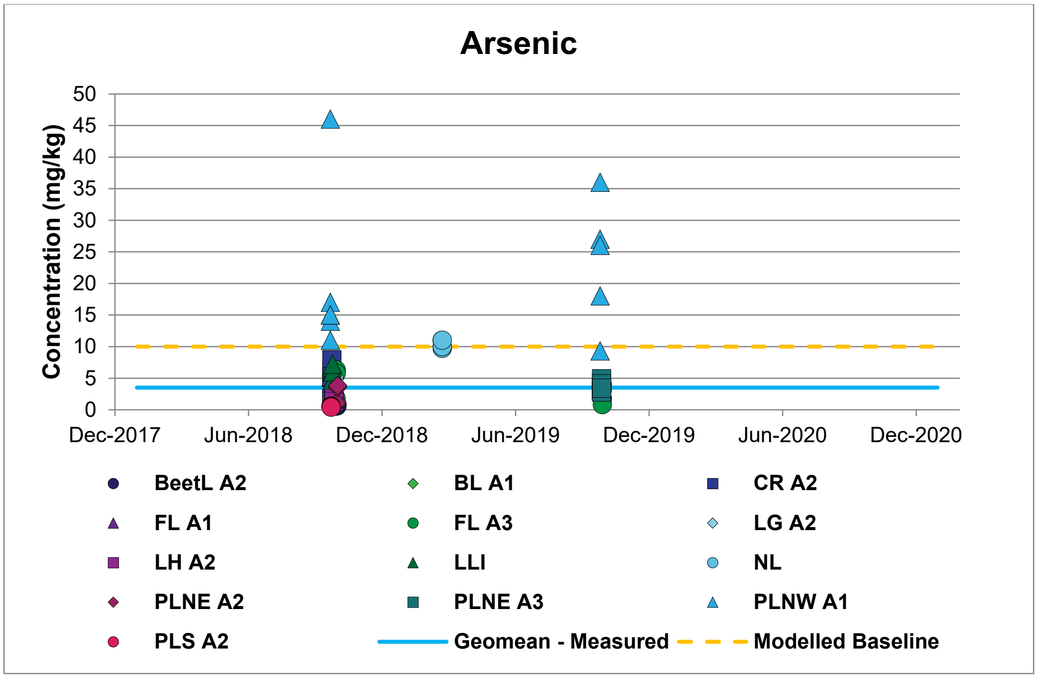
Concentrations in sediment were modelled based on concentrations in water (Section 3.3.2). If water concentration measurements for a constituent were under the detection limit, the baseline concentration in sediment was set to the geometric mean of the measured sediment concentrations. This was the case for copper, cobalt, and thorium-230. The lead-210 sediment concentration was based on its transient equilibrium with polonium-210.

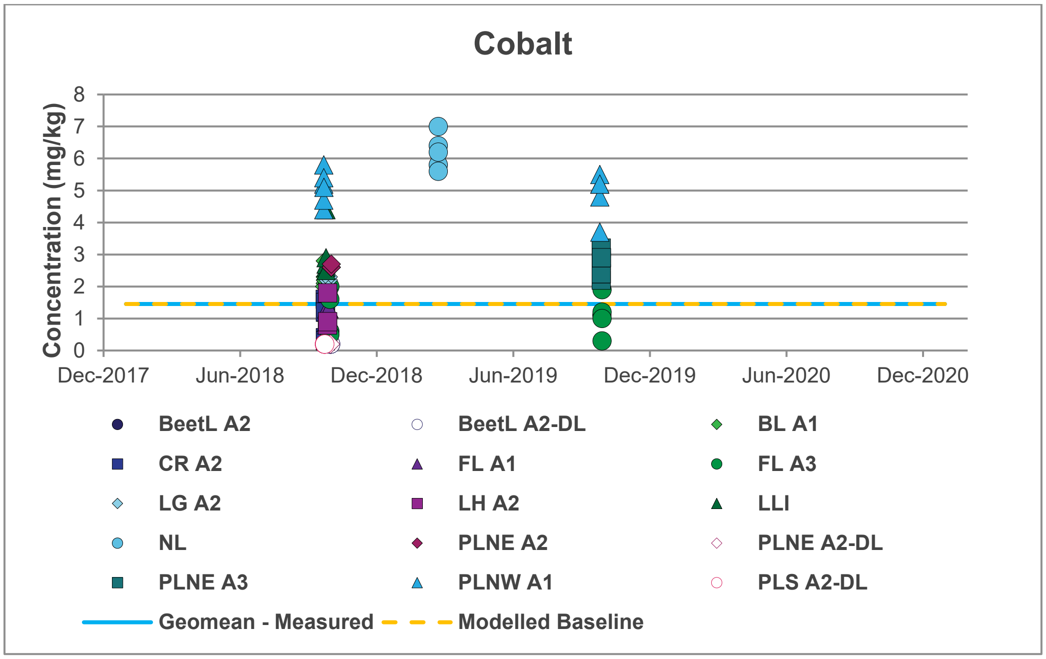
Average baseline concentrations are presented in Table 3-5, and a comparison to measured values is shown in Figure 3-2 and Figure 3-3. Parameters include arsenic, copper, cobalt, uranium, and the considered radionuclides (i.e., lead-210, polonium-210, uranium-234, uranium-238, radium-226, thorium-230). These plots indicate generally good agreement between measured and predicted values that resulted from the calibration. Metals and radionuclides are expected to interact with water and, in the case of radionuclides, ingrowth and decay are other factors that may influence activities in the receiving environment.

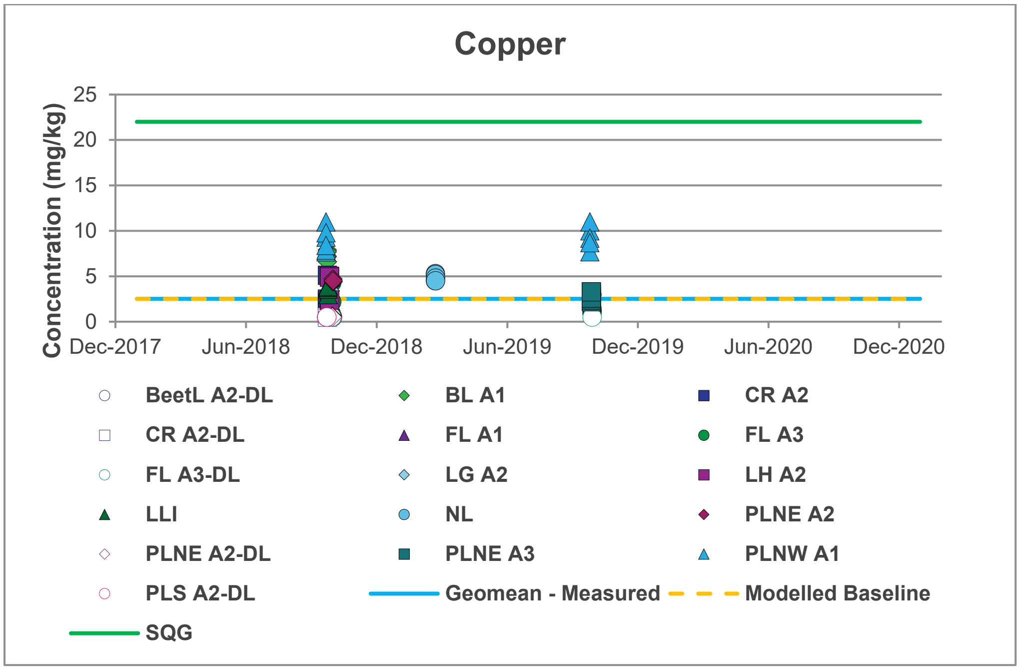
Table 3-5: Baseline Water and Sediment Concentrations Used in the IMPACT Model

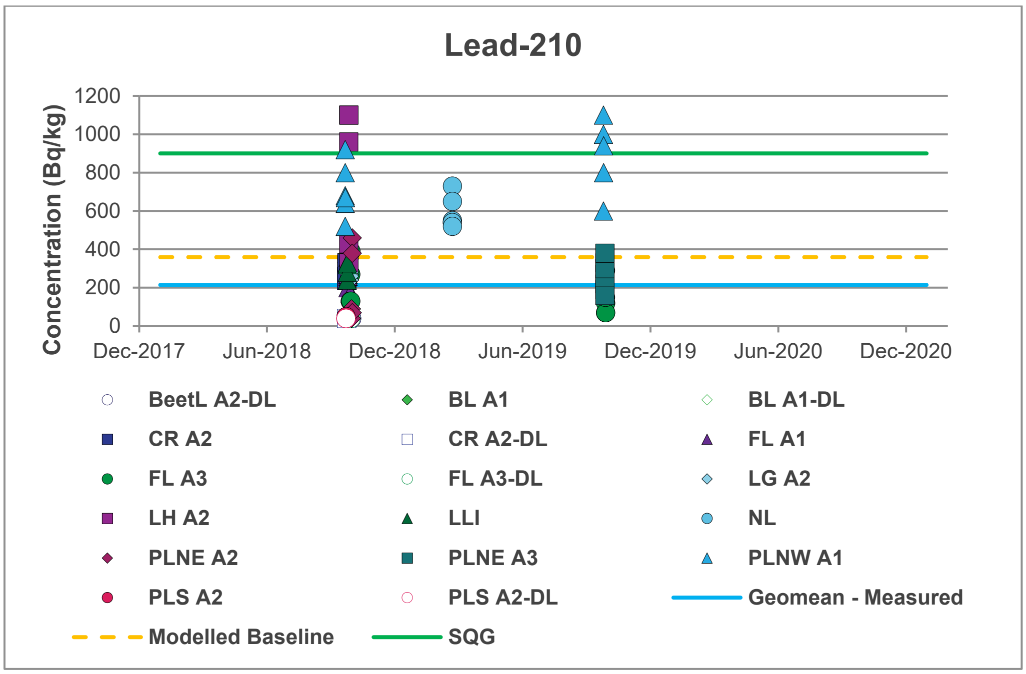
COPC	Water Baseline Concentration	Sediment Baseline Concentration
	mg/L	mg/kg dw
Arsenic	**1.24×10^{-04}**	$1.00 \times 10^{+01}$
Chloride	**4.22×10^{-01}**	-
Cobalt	5.83×10^{-04}	**$1.45 \times 10^{+00}$**
Copper	8.43×10^{-04}	**$2.52 \times 10^{+00}$**
Molybdenum	2.06×10^{-04}	**6.51×10^{-01}**
Sulphate	**1.72×10^{-05}**	-
Phosphorus	**1.03×10^{-02}**	$1.01 \times 10^{+00}$
Uranium	**1.00×10^{-04}**	$1.93 \times 10^{+00}$
	Bq/L	**Bq/kg dw**
Lead-210(1)	1.03×10^{-02}	$1.01 \times 10^{+00}$
Polonium-210	**1.03×10^{-02}**	$1.01 \times 10^{+00}$
Radium-226	**1.03×10^{-02}**	$1.01 \times 10^{+00}$
Thorium-230	**9.09×10^{-03}**	$2.09 \times 10^{+01}$
Uranium-234(2)	3.56×10^{-04}	$6.84 \times 10^{+00}$
Uranium-238(2)	3.56×10^{-04}	$6.84 \times 10^{+00}$

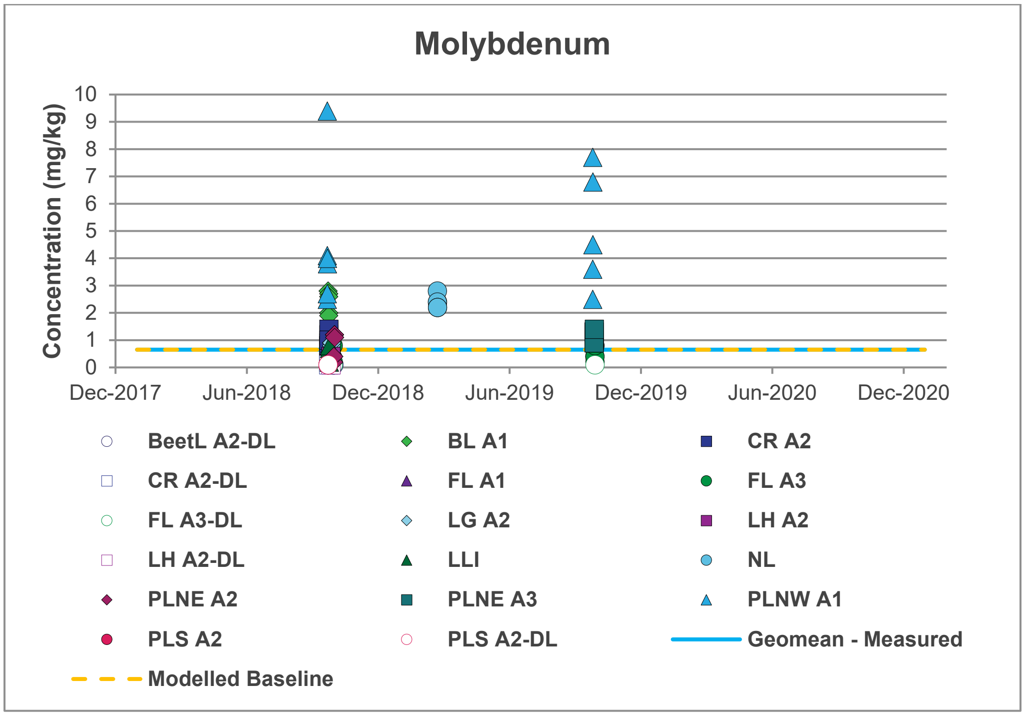
Dash (-) represents no value calculated as COPC does not partition to sediment.
Bold = measured values. Values that are not bolded indicate modelled values.
(1) Calculated to be in transient equilibrium with polonium-210.
(2) Calculated based on the specific activity of uranium.
COPC = constituent of potential concern; dw = dry weight.

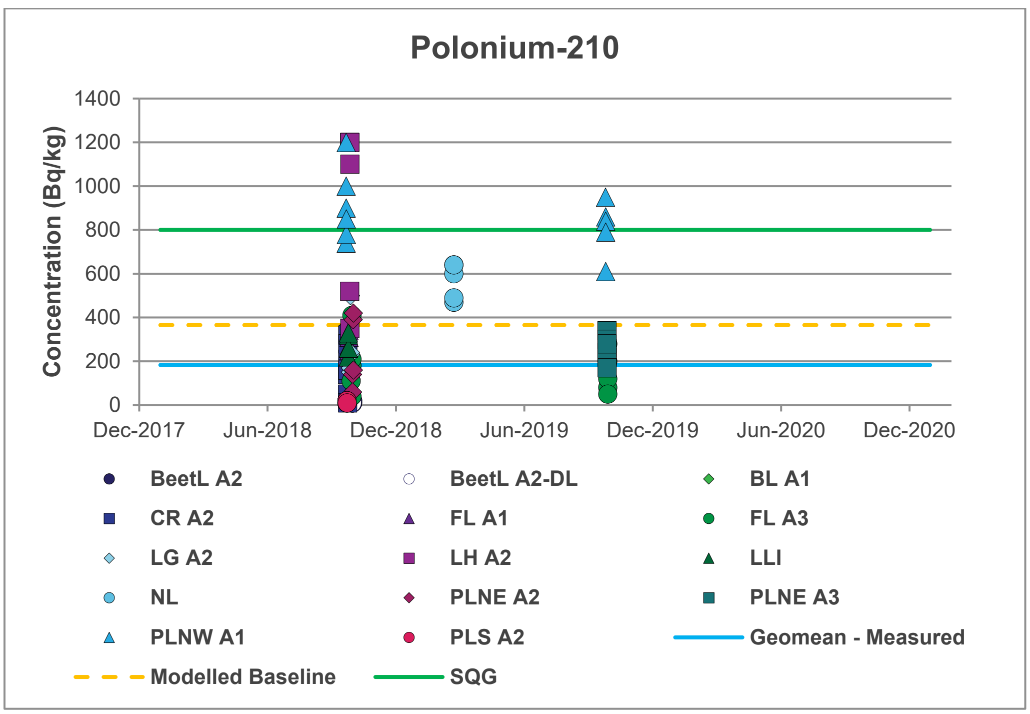

Arsenic
Concentration (mg/kg)
50
45
40
35
30
25
20
15
10
5
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetL A2
BL A1
CR A2
FL A1
FL A3
LG A2
LH A2
LLI
NL
PLNE A2
PLNE A3
PLNW A1
PLS A2
Geomean - Measured
Modelled Baseline

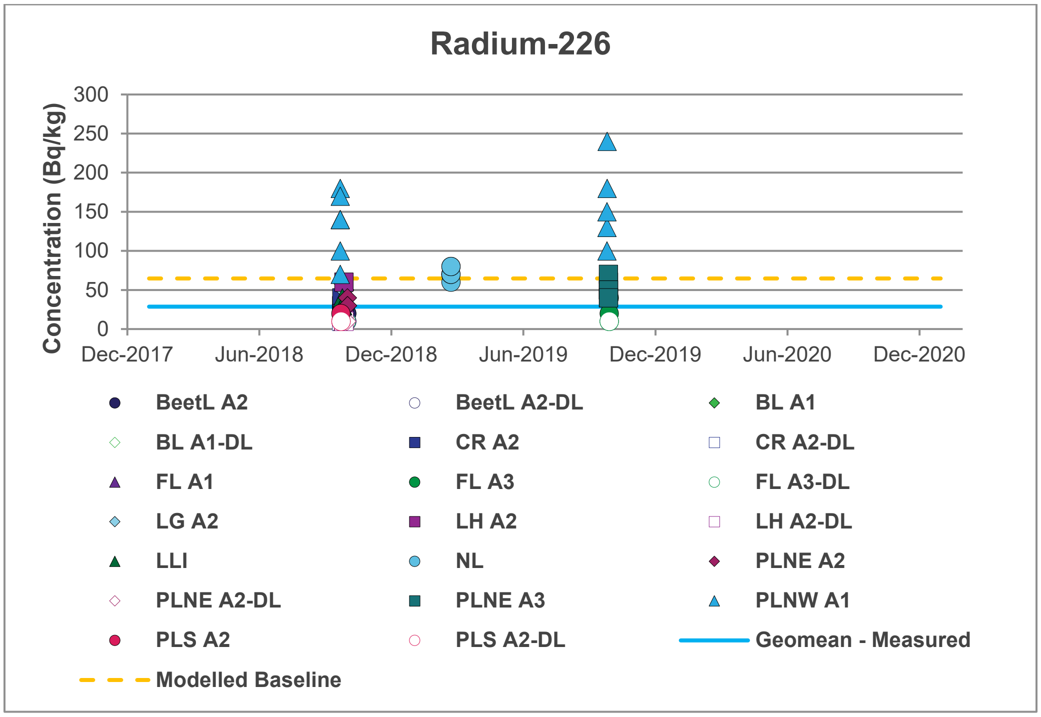

Cobalt
Concentration (mg/kg)
8
7
6
5
4
3
2
1
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetL A2
BeetL A2-DL
BL A1
CR A2
FL A1
FL A3
LG A2
LH A2
LLI
NL
PLNE A2
PLNE A2-DL
PLNE A3
PLNW A1
PLS A2-DL
Geomean - Measured
Modelled Baseline

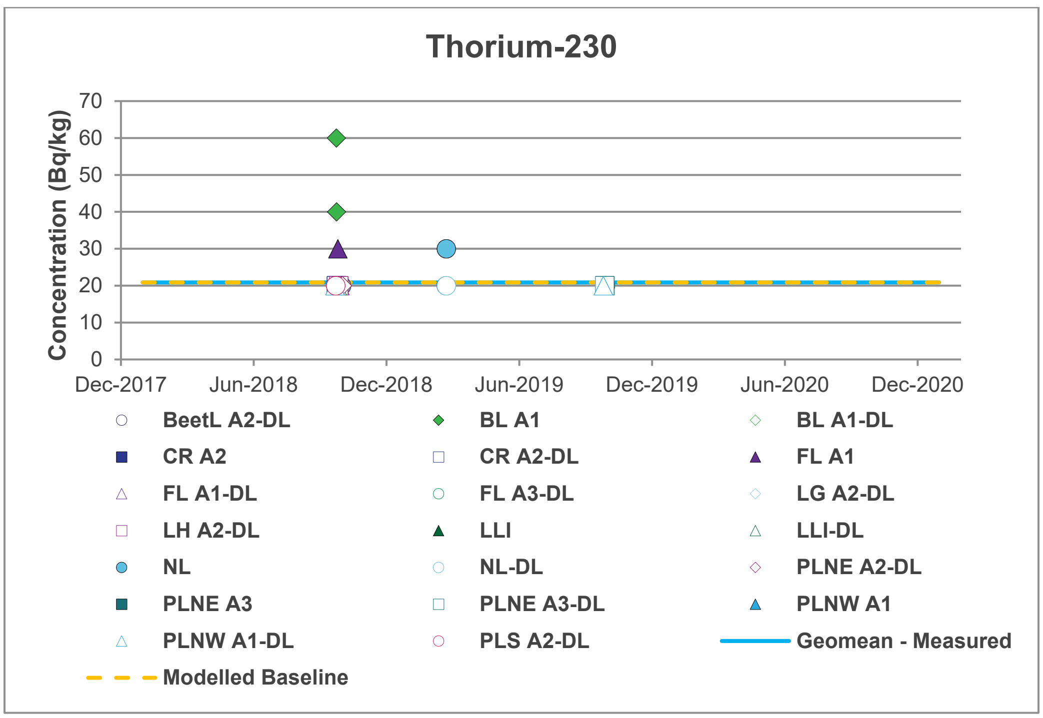

Copper
Concentration (mg/kg)
25
20
15
10
5
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetL A2-DL
BL A1
CR A2
CR A2-DL
FL A1
FL A3
FL A3-DL
LG A2
LH A2
LLI
NL
PLNE A2
PLNE A2-DL
PLNE A3
PLNW A1
PLS A2-DL
Geomean - Measured
Modelled Baseline
SQG

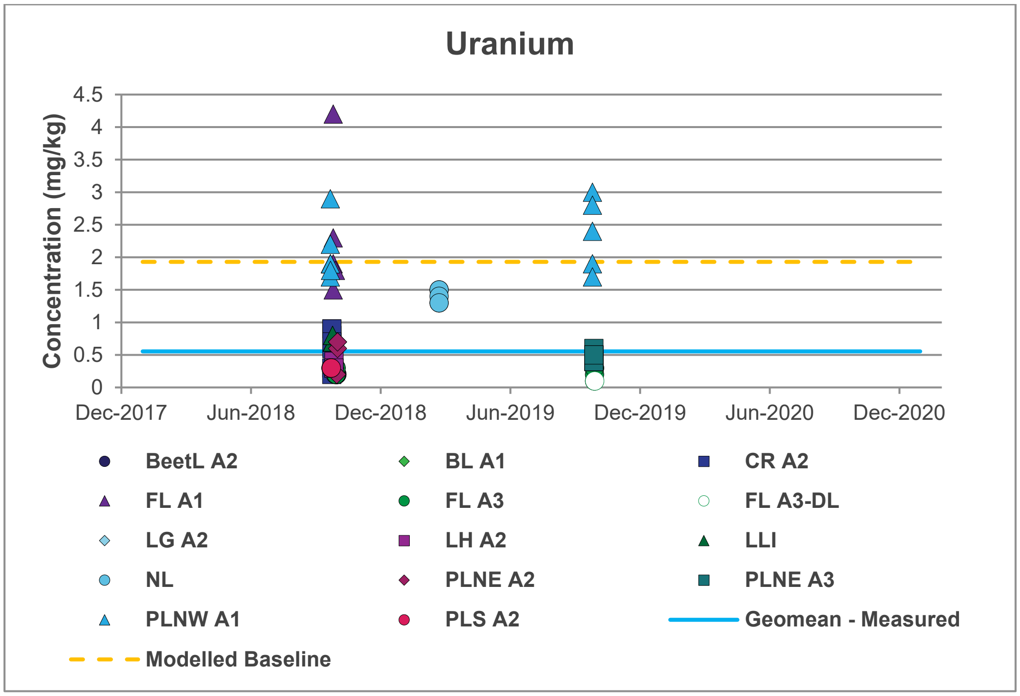

Lead-210
Concentration (Bq/kg)
1200
1000
800
600
400
200
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetL A2-DL
BL A1
BL A1-DL
CR A2
CR A2-DL
FL A1
FL A3
FL A3-DL
LG A2
LH A2
LLI
NL
PLNE A2
PLNE A3
PLNW A1
PLS A2
PLS A2-DL
Geomean - Measured
Modelled Baseline
SQG


Molybdenum
Concentration (mg/kg)
10
9
8
7
6
5
4
3
2
1
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetL A2-DL
BL A1
CR A2
CR A2-DL
FL A1
FL A3
FL A3-DL
LG A2
LH A2
LH A2-DL
LLI
NL
PLNE A2
PLNE A3
PLNW A1
PLS A2
PLS A2-DL
Geomean - Measured
Modelled Baseline


Polonium-210
Concentration (Bq/kg)
1400
1200
1000
800
600
400
200
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetL A2
BeetL A2-DL
BL A1
CR A2
FL A1
FL A3
LG A2
LH A2
LLI
NL
PLNE A2
PLNE A3
PLNW A1
PLS A2
Geomean - Measured
Modelled Baseline
SQG


Radium-226
Concentration (Bq/kg)
300
250
200
150
100
50
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetL A2
BeetL A2-DL
BL A1
BL A1-DL
CR A2
CR A2-DL
FL A1
FL A3
FL A3-DL
LG A2
LH A2
LH A2-DL
LLI
NL
PLNE A2
PLNE A2-DL
PLNE A3
PLNW A1
PLS A2
PLS A2-DL
Geomean - Measured
Modelled Baseline


Thorium-230
Concentration (Bq/kg)
70
60
50
40
30
20
10
0
Dec-2017
Jun-2018
Dec-2018
Jun-2019
Dec-2019
Jun-2020
Dec-2020
BeetL A2-DL
BL A1
BL A1-DL
CR A2
CR A2-DL
FL A1
FL A1-DL
FL A3-DL
LG A2-DL
LH A2-DL
LLI
LLI-DL
NL
NL-DL
PLNE A2-DL
PLNE A3
PLNE A3-DL
PLNW A1
PLNW A1-DL
PLS A2-DL
Geomean - Measured
Modelled Baseline



Blank outline symbol (no-fill) indicates that the measurement was under the detection limit. Sampling stations summarized in Appendix A.
SQO = Sediment Quality Objective.

Figure 3-3: Modelled and Measured Baseline Concentrations in Sediment

3.3.2 Water to Sediment Partitioning Coefficients

The water-to-sediment partitioning coefficients (K_d) are regional parameters governing the exchange between sediment and water in lakes. The K_d values are used to estimate the fraction of a constituent that is associated with the particulate fraction in the shallow sediment layer (f_s). The fraction of COPC in the solid phase is estimated using the following equation:

$$f_s = \frac{K_d \cdot \frac{\rho_s}{\varepsilon_s}}{1 + K_d \cdot \frac{\rho_s}{\varepsilon_s}}$$

where:

ε_s	=	porosity of surficial sediment (unitless)
K_d	=	distribution coefficient between water and sediment (L/kg)
ρ_s	=	bulk density of surficial sediment (kg/L)

The K_d values used in this model are presented in Table 3-6. They consist of regional published values that have been calibrated on similar sites in northern Saskatchewan.

Table 3-6: Distribution Coefficients Used in the IMPACT Model

COPC	Distribution Coefficient
	L/kg dw
Arsenic	$9.64 \times 10^{+04}$
Cobalt	$2.50 \times 10^{+03}$
Copper	$3.00 \times 10^{+03}$
Molybdenum	$3.17 \times 10^{+03}$
Uranium	$2.00 \times 10^{+04}$
Lead-210	$1.20 \times 10^{+05}$
Polonium-210	$1.20 \times 10^{+05}$
Radium-226	$1.20 \times 10^{+04}$
Thorium-230	$2.30 \times 10^{+03}$
Uranium-234	$2.00 \times 10^{+04}$
Uranium-238	$2.00 \times 10^{+04}$

COPC = constituent of potential concern; dw = dry weight.

3.4 Air Quality

Risk through air exposure pathways is considered during Operations. For the baseline, it is assumed that none of the considered COPC is present in air. Consequently, any risk increase through the air pathway is due to the operation of the mine. An exception is radon-222, which is discussed in detail in Section 2.4.3, Radiological Dose. A constant background concentration of 2.9 Bq/m^3 for radon-222 was used for the evaluation of incremental radon concentrations and incremental dose due to radon.

Modelled air quality during Operations was provided at the locations of interest for human and ecological receptors from the atmospheric environment model (Appendix 7A, Air Dispersion Modelling Report).

3.5 Soil Quality

3.5.1 Background Soil Quality

Regional background soil chemistry was derived from baseline data collected in 2019 (Annex VI, Terrain and Soils Baseline Report). The geometric mean of 18 soil samples at 6 locations was used to characterize background concentrations of metals and radionuclides in soil. Table 3-7 presents the selected background soil concentrations used in the IMPACT model. Sandy soil was selected for the IMPACT model based on baseline studies identifying the soils of the region are dominantly brunisolic soils that have been developed on sandy glacial till deposits (Annex VI).

Table 3-7: Soil Baseline Concentrations

COPC	Unit	Soil Baseline Concentration
Arsenic	mg/kg dw	5.89×10^{-01}
Cobalt	mg/kg dw	4.32×10^{-01}
Copper	mg/kg dw	6.01×10^{-01}
Molybdenum	mg/kg dw	1.42×10^{-01}
Uranium	mg/kg dw	2.47×10^{-01}
Lead-210	Bq/kg dw	$4.00 \times 10^{+01}$
Polonium-210	Bq/kg dw	$1.12 \times 10^{+01}$
Radium-226	Bq/kg dw	$1.79 \times 10^{+01}$
Thorium-230	Bq/kg dw	$2.00 \times 10^{+01}$
Uranium-234[(a)]	Bq/kg dw	$3.06 \times 10^{+00}$
Uranium-238[(a)]	Bq/kg dw	$3.06 \times 10^{+00}$

a) Uranium-234 and Uranium-238 concentration calculated using a specific activity of 12.356 Bq/mg.
COPC = constituent of potential concern; Bq = becquerel; dw = dry weight.

3.5.2 Soil Quality during Operations

Soil quality during Operations was estimated based on the calculated air quality at each location of interest for human and ecological receptors. IMPACT calculates COPC concentrations in terms of concentration per kg of dry soil, following the soil model equations in CSA N288.1-20 (Section 2.3.4, Terrestrial Pathways).

For wet deposition, the fraction of the time that precipitation falls when the wind blows from a specific sector was set conservatively to 0.36 for all wind directions (CSA Group 2020).

Concentrations calculated from deposition of air on soil during Operations were added to baseline concentrations to represent the total exposure concentrations in soil.

3.6 Transfer of Constituents to Aquatic Receptors

A fundamental premise of pathways analysis is that chemical uptake by receptors is related to the receptors' level of exposure. A linear relationship is usually assumed and is represented by a bioaccumulation factor (BAF). For aquatic receptors, the BAF is the concentration in the organism (e.g., Cfish) divided by the concentration in water (Cwater). The BAF may be estimated from organism and water data by fitting a regression line that generally is assumed to pass through the origin, such as "Cfish = Slope · Cwater". The slope of the regression line is the BAF. It represents the equilibrium ratio of Cfish / Cwater.

The IMPACT model uses the BAF model as a simplification of the more complex multi-media uptake process. While several media (e.g., water and food) may contribute to COPC uptake into the animal tissue, at steady state, all media concentrations will have a fixed ratio to the tissue concentration. Thus, the BAF based on water and tissue measurements will reflect all the multi-media contributions to uptake. If animals and their prey are in equilibrium with the COPC in the environment, their concentrations can be estimated using an overall BAF between the water and the organism (Thomann and Mueller 1987). If animals have not reached equilibrium because they have not spent enough time in the exposure situation, because they are migratory or the project effects are transient, the BAF provides a conservative estimate of tissue concentrations.

As a result of physiological control, intracellular storage, and different excretion mechanisms, biota have an ability to actively regulate the body burden of many metals, including selenium, and maintain homeostatic control over a range of exposures (Chapman et al. 1996; Hamilton and Mehrle 1986; Wood and Port 2000). These homeostatic controls can produce non-linear relationships between the steady-state tissue concentrations and the environmental exposure concentrations (Newman and Unger 2002). However, these complicating issues do not diminish the importance, or negate the practical application, of BAFs in the assessment of environmental risks associated with COPCs.

Because of non-linearity and other factors, BAF values cited in the literature vary over a considerable range. Bioaccumulation factor values based on site-specific data are preferred. The values of BAFs based on background concentrations tend to be higher than those based on higher exposure concentrations in affected environments. In this model BAFs representative of regional conditions have been used. The predictions are compared to measured baseline values in Section 3.6.2.

3.6.1 Aquatic Bioaccumulation Factors

Bioaccumulation factors relate the COPCs in the environmental media to the concentration in the receptor. Water-based BAFs were used to calculate COPC concentrations in aquatic and terrestrial plant, invertebrate, and fish tissues. These factors were generally obtained from CSA N288.1-20 and the International Atomic Energy Agency (IAEA 2010), and from publicly available regional data from other uranium mine sites in northern Saskatchewan. Table 3-8 shows all aquatic BAFs used in the model.

The water-based BAF values for aquatic organisms were based on measured ratios of COPC concentration in tissue vs. water, under multi-media equilibrium conditions.

$$\text{BAF (L/kg wet weight)} = \frac{\text{Concentration in Tissue (mg/kg wet weight)}}{\text{Concentration in Water (mg/L)}}$$

While expressed relative to water, BAFs represent all pathways of COPC uptake into the organism, because all pathways were operating under the environmental conditions of BAF measurement. These pathways include food ingestion, dermal absorption, and uptake across the gills.

Table 3-8: Aquatic Bioaccumulation Factors (L/kg fw)

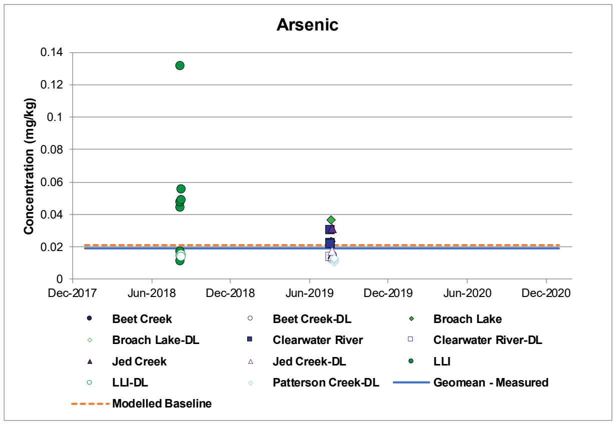
COPC	Zooplankton(1)	Benthic Invertebrates(1)	Macrophytes(2)	Northern Pike	Whitefish
Arsenic	$5.40 \times 10^{+02}$	$5.40 \times 10^{+02}$	$1.72 \times 10^{+02}$	$3.00 \times 10^{+02}$	$3.00 \times 10^{+02}$
Cobalt	$2.00 \times 10^{+02}$	$2.00 \times 10^{+02}$	$7.90 \times 10^{+02}$	$1.20 \times 10^{+01}$	$1.20 \times 10^{+01}$
Copper	$7.80 \times 10^{+03}$	$7.80 \times 10^{+03}$	$2.17 \times 10^{+02}$	$5.00 \times 10^{+02}$	$5.00 \times 10^{+01}$
Molybdenum	$1.62 \times 10^{+02}$	$1.62 \times 10^{+02}$	$6.80 \times 10^{+00}$	1.00×10^{-01}	1.00×10^{-01}
Uranium	$1.00 \times 10^{+02}$	$1.00 \times 10^{+02}$	$5.04 \times 10^{+01}$	$2.00 \times 10^{+01}$	$5.00 \times 10^{+00}$
Lead-210	$2.30 \times 10^{+03}$	$2.30 \times 10^{+03}$	$1.90 \times 10^{+03}$	$6.00 \times 10^{+01}$	$2.20 \times 10^{+01}$
Polonium-210	$1.58 \times 10^{+04}$	$1.58 \times 10^{+04}$	$2.93 \times 10^{+02}$	$1.50 \times 10^{+02}$	$1.50 \times 10^{+02}$
Radium-226	$2.50 \times 10^{+02}$	$2.50 \times 10^{+02}$	$1.63 \times 10^{+02}$	$1.20 \times 10^{+01}$	$1.20 \times 10^{+01}$
Thorium-230	$5.00 \times 10^{+02}$	$5.00 \times 10^{+02}$	$2.32 \times 10^{+02}$	$6.00 \times 10^{+00}$	$6.00 \times 10^{+00}$
Uranium-234	$1.00 \times 10^{+02}$	$1.00 \times 10^{+02}$	$5.04 \times 10^{+01}$	$2.00 \times 10^{+01}$	$5.00 \times 10^{+00}$
Uranium-238	$1.00 \times 10^{+02}$	$1.00 \times 10^{+02}$	$5.04 \times 10^{+01}$	$2.00 \times 10^{+01}$	$5.00 \times 10^{+00}$

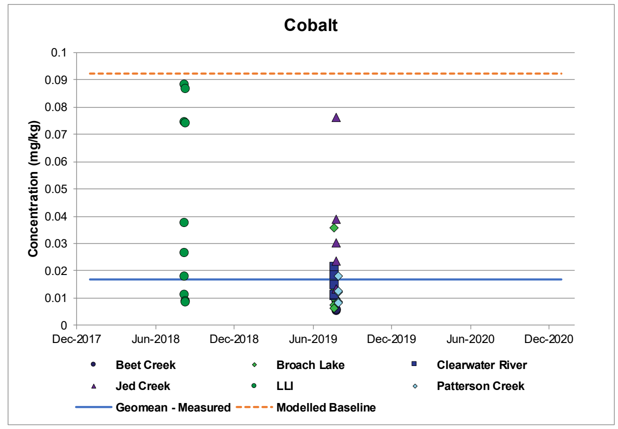
Regional data was used for aquatic BAFs, except for:
(1) Th-230, Ra-226, U and Co BAFs for Benthic Invertebrates are from Thompson (1972).
(2) Pb BAF for Macrophytes is from IAEA TRS 472 (IAEA 2010).
COPC = constituent of potential concern; fw = fresh weight.

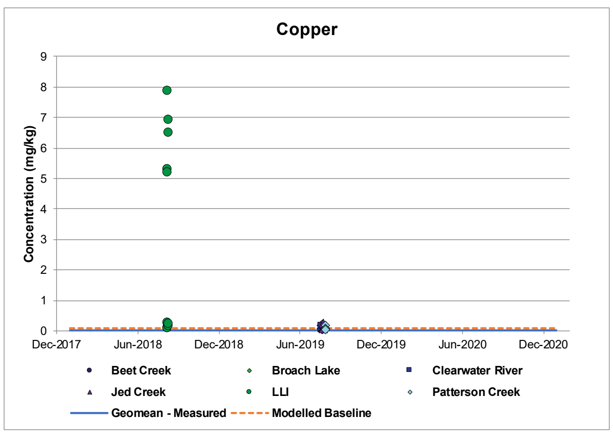
3.6.2 Model Validation

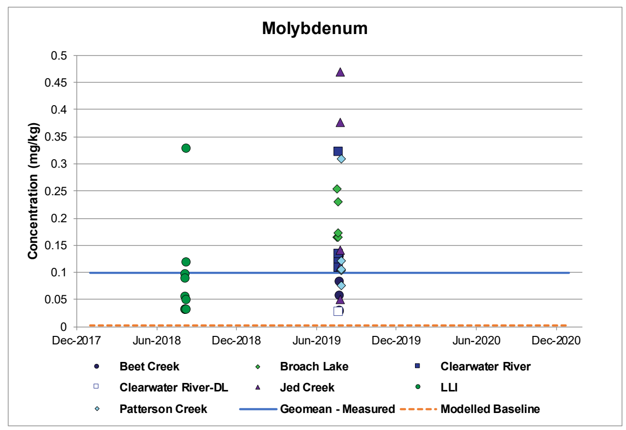
Figure 3-4 presents the predicted and observed concentrations of COPCs in aquatic macrophytes from baseline sampling in 2019 (Annex V.1). The predicted concentrations fall within the spread of measurements for macrophytes, except for thorium-230, where the model overpredicts macrophyte measurements that are under the detection limit. This comparison suggests that the parameters used in the model are suitable for describing the transport processes in the environment for aquatic plants. In the instance of thorium-230, the model produces conservative results. Refinement of the BAFs for aquatic plants can be completed as new data are available during future phases of the Project.

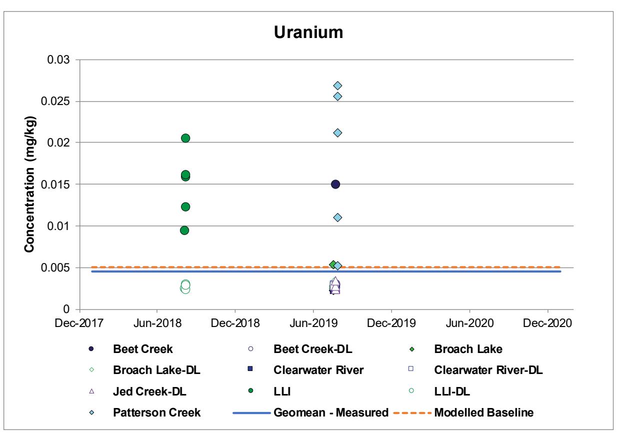
Figure 3-5 and Figure 3-6 present the predicted and observed concentrations of COPCs in northern pike and lake whitefish from baseline sampling in 2018 and 2019 (Annex V.1). Measured concentrations of radionuclides are mostly under the detection limit, which agrees with the modelled concentrations. In the case of northern pike, the data suggest that the model may be overpredicting concentrations in arsenic, cobalt, and copper. For lake whitefish, the model may be underpredicting copper; however, only data from one sampling event were available, and the BAFs used are consistent with regionally calibrated models representing exposure conditions. The predicted concentrations of the remaining COPCs are in good agreement with the measured values. The generally good agreement of modelled results with measured data validates the use of selected transfer factors and modelled processes. However, refinement of the BAFs for aquatic animals can be completed as new data become available during future phases of the Project.



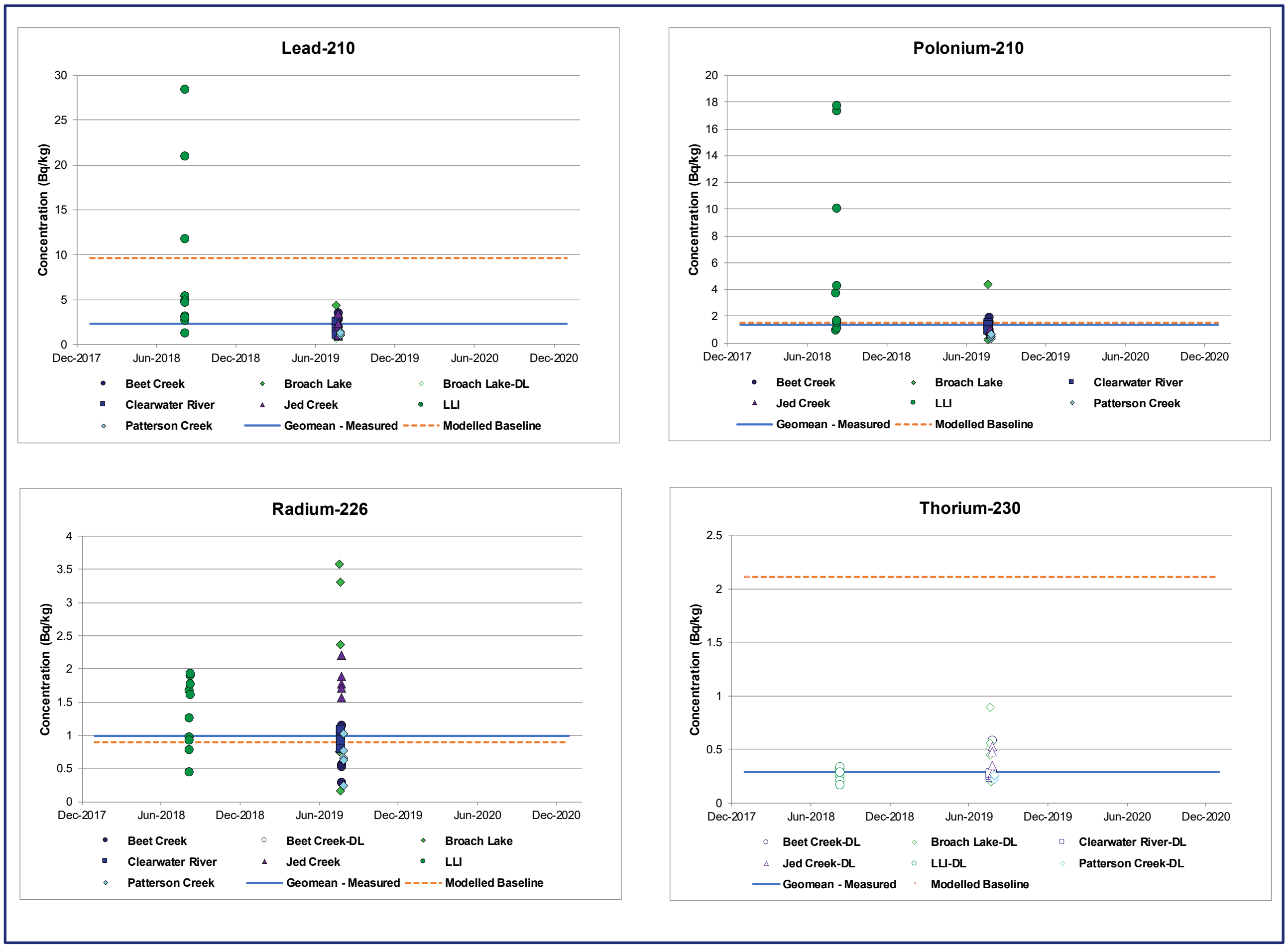






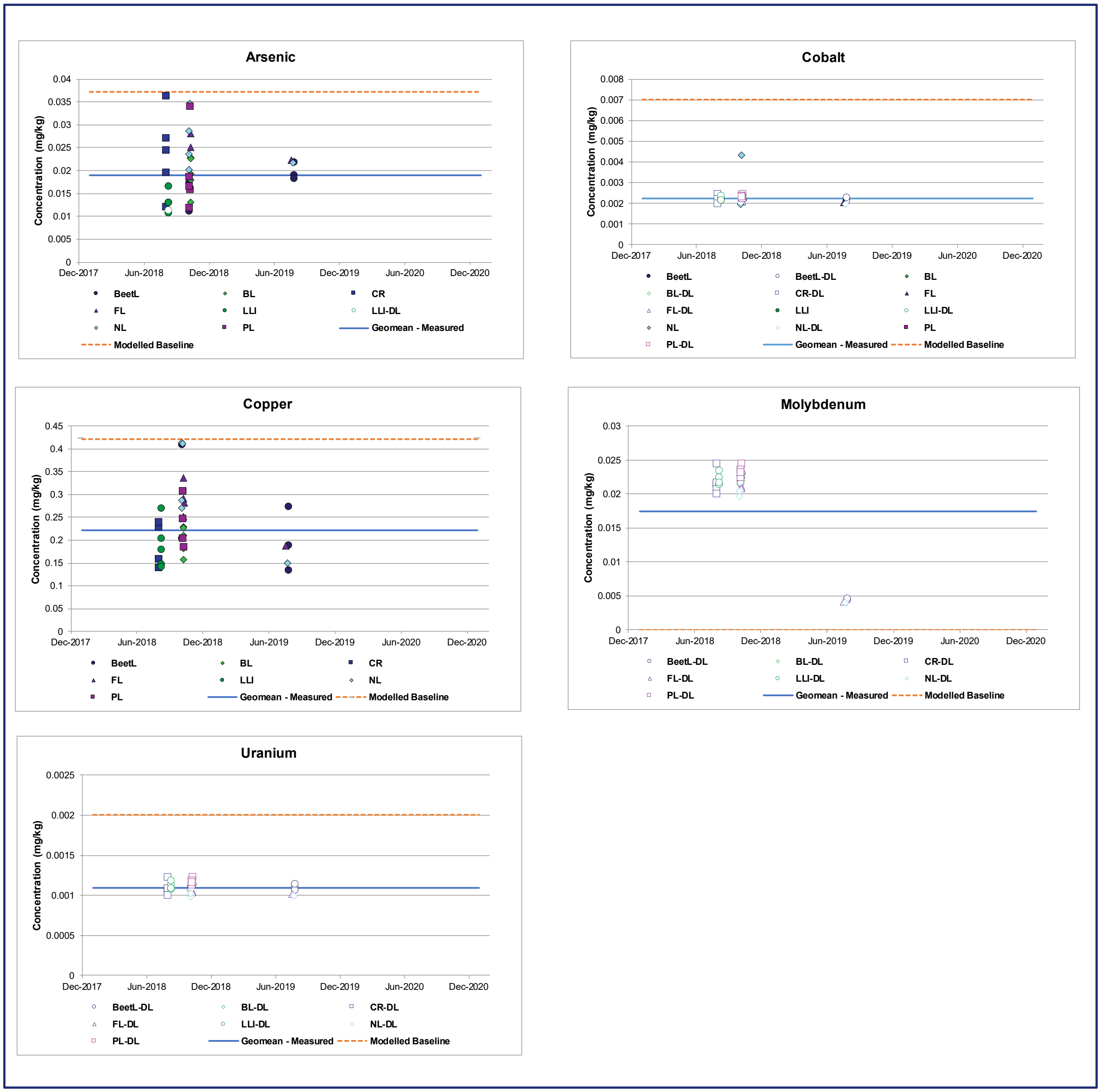


Blank outline symbol (no-fill) indicates that the measurement was under the detection limit.



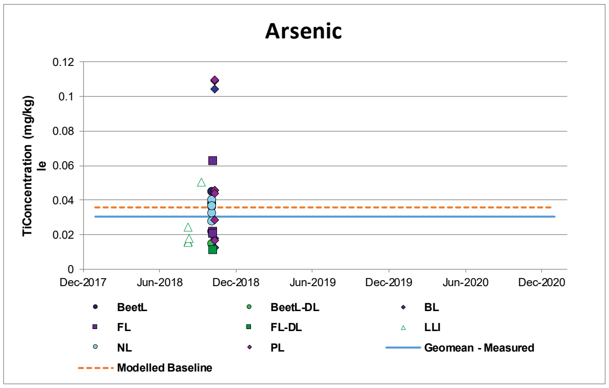
Blank outline symbol (no-fill) indicates that the measurement was under the detection limit.

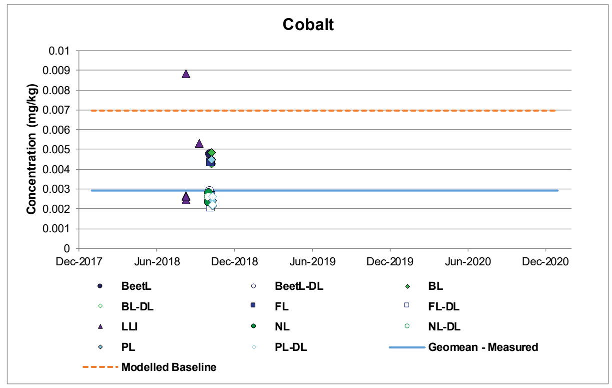
Figure 3-4: Modelled and Measured Baseline Concentrations (fresh weight) of Radionuclides in Macrophytes

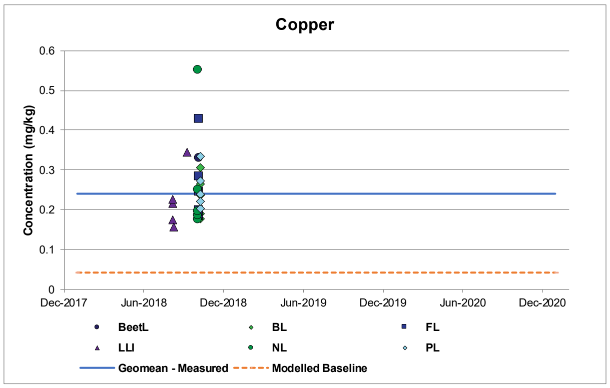


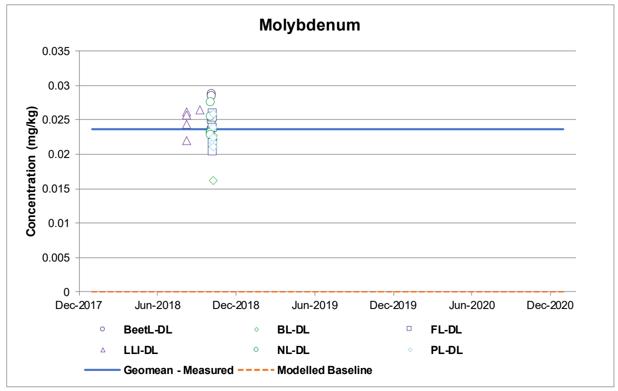
Blank outline symbol (no-fill) indicates that the measurement was under the detection limit.

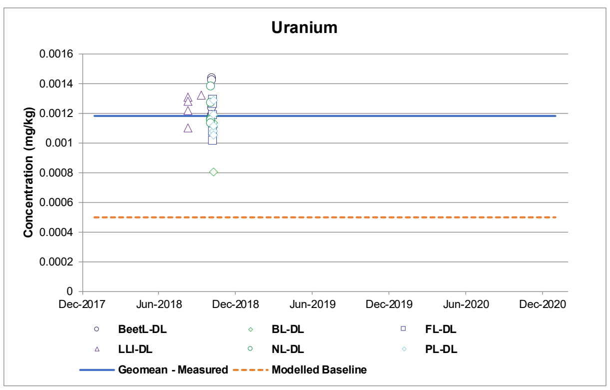
Figure 3-5: Modelled and Measured Baseline Concentrations (fresh weight) of Radionuclides in Northern Pike



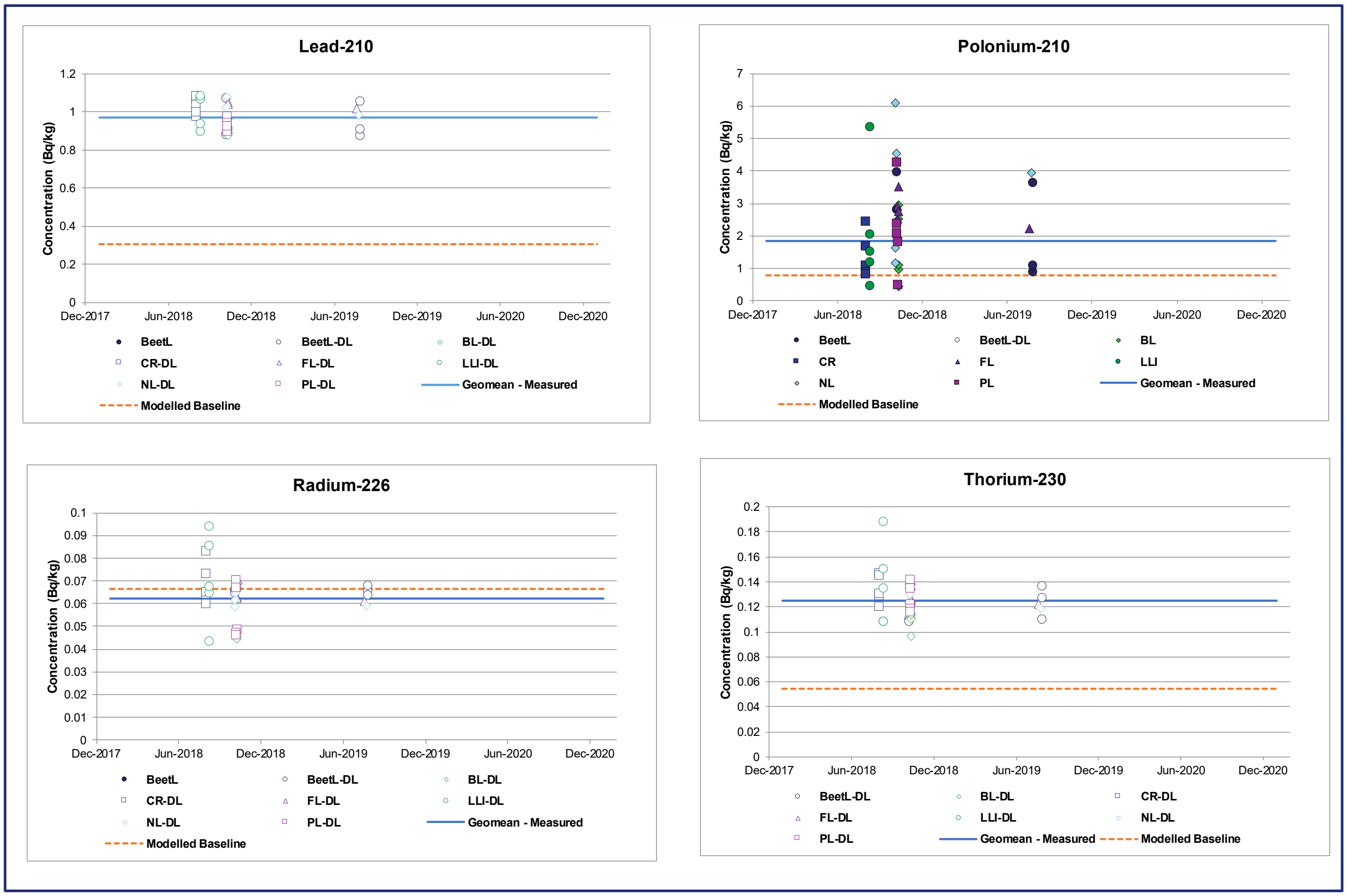








Blank outline symbol (no-fill) indicates that the measurement was under the detection limit.



Blank outline symbol (no-fill) indicates that the measurement was under the detection limit.

Figure 3-6: Modelled and Measured Baseline Concentrations (fresh weight) of Radionuclides in Lake Whitefish

3.6.3 Dose Coefficients for Aquatic Receptors

Dose coefficients (DCFs) for all external and internal exposure routes considered are presented in Table 3-9 and Table 3-10, respectively. Dose coefficients for internal and external exposure pathways are based on values published by the International Commission on Radiological Protection (ICRP) for aquatic plants and northern pike (ICRP 2008). For benthic invertebrates, zooplankton, and whitefish, DCFs were calculated with the ERICA Tool (Brown et al. 2008).

The DCF values from the ICRP (2008) and the ERICA Tool 1.3.1 (Brown et al. 2008) do not incorporate radiation quality factors for relative biological effectiveness for low beta and alpha components. The relative biological effectiveness is a radioecological weighting factor that represents the ratio of doses from different types of radiation needed to produce the same biological effect. Therefore, the "low beta" components of the DCFs were multiplied by 2, and the alpha components were multiplied by 10 (as per CSA N288.6-22), to represent their greater relative effectiveness.

Table 3-9: External Dose Coefficients for Aquatic Receptors

DCF External (µGy/h)/(Bq/kg[fw sediment] or Bq/L[water])					
COPC	Macrophytes[(a)]	Northern Pike[(b)]	Whitefish[(c)]	Zooplankton[(d)]	Benthic Invertebrates[(e)]
Lead-210	3.38×10^{-05}	4.00×10^{-06}	3.80×10^{-06}	1.50×10^{-04}	1.10×10^{-04}
Polonium-210	4.58×10^{-09}	4.17×10^{-09}	4.30×10^{-09}	4.90×10^{-09}	4.90×10^{-09}
Radium-226	1.13×10^{-03}	9.17×10^{-04}	9.10×10^{-04}	1.40×10^{-03}	1.30×10^{-03}
Thorium-230	4.58×10^{-07}	2.50×10^{-07}	2.40×10^{-07}	1.00×10^{-06}	9.00×10^{-07}
Uranium-234	4.17×10^{-07}	1.63×10^{-07}	1.50×10^{-07}	1.00×10^{-06}	9.40×10^{-07}
Uranium-238	3.17×10^{-07}	1.00×10^{-07}	9.50×10^{-08}	7.80×10^{-07}	7.20×10^{-07}

a) Dose coefficients are based on seaweed (ICRP 2008).
b) Dose coefficients are based on trout (ICRP 2008).
c) Dose coefficients are the value for benthic fish from the ERICA Database (Brown et al. 2008).
d) Dose coefficients are from the ERICA Database (Brown et al. 2008).
e) Dose coefficients are the value for insect larvae from the ERICA Database (Brown et al. 2008).
µGy = microgray; Bq = becquerel; fw = fresh weight; COPC = constituent of potential concern; DCF = dose coefficient.

Table 3-10: Internal Dose Coefficients for Aquatic Receptors

COPC	DCF Internal (µGy/h)/(Bq/kg fw)				
	Macrophytes[(a)]	Northern Pike[(b)]	Whitefish[(c)]	Zooplankton[(d)]	Benthic Invertebrate[(e)]
Lead-210	2.17×10^{-04}	2.46×10^{-04}	2.50×10^{-04}	1.00×10^{-04}	1.40×10^{-04}
Polonium-210	3.04×10^{-02}	3.04×10^{-02}	3.10×10^{-03}	3.10×10^{-02}	3.10×10^{-03}
Radium-226	1.38×10^{-01}	1.39×10^{-01}	1.43×10^{-01}	1.37×10^{-01}	1.37×10^{-01}
Thorium-230	2.71×10^{-02}	2.71×10^{-02}	2.70×10^{-02}	2.70×10^{-02}	2.70×10^{-02}
Uranium-234	2.75×10^{-02}	2.75×10^{-02}	2.80×10^{-02}	2.80×10^{-02}	2.80×10^{-02}
Uranium-238	2.42×10^{-02}	2.42×10^{-02}	2.40×10^{-02}	2.40×10^{-02}	2.40×10^{-02}

a) Dose coefficients are based on seaweed (ICRP 2008).
b) Dose coefficients are based on trout (ICRP 2008).
c) Dose coefficients are the value for benthic fish from the ERICA Database (Brown et al. 2008).
d) Dose coefficients are from the ERICA Database (Brown et al. 2008).
e) Dose coefficients are the value for insect larvae from the ERICA Database (Brown et al. 2008).
µGy = microgray; Bq = becquerel; fw = fresh weight; COPC = constituent of potential concern; DCF = dose coefficient.

3.7 Transfer of Constituents to Terrestrial Receptors and Humans

The COPCs may be transferred from environmental media to terrestrial receptors through food, water, and air. Ingestion and inhalation transfer factors (TFs) are defined as the ratio between the COPC concentrations in the receptor and the COPC intake rates. The TF may be determined for specific organs or other body tissues (e.g., food to liver; food to eggs). Soil to terrestrial plant transfers may include deposition from air to plant, as well as soil-to-plant bioaccumulation, and are defined as the ratio between the concentration of a COPC in the plant and that in the soil, both in dry weight.

3.7.1 Soil-to-Plant Transfer

A plant may take up COPCs by dry and wet deposition of COPCs from air and raindrop splash onto the plant, as well as from uptake of COPCs from soil to the plant via the root system. In the case of most COPCs, transfer from deposition on soil and then uptake from soil into the plant is considered to be the dominant pathway. The terrestrial plants include browse, blueberries, lichen, and Labrador tea. The soil-to-plant pathway is not considered applicable to lichen; therefore, the soil-to-plant BAFs are zero for lichen. Lichens are considered to take up COPCs via wet and dry deposition directly from air only (IAEA, 2010).

Uptake of COPCs by browse, blueberries, and Labrador tea is represented by soil-to-plant BAF values derived from regional data from northern Saskatchewan, as shown in Table 3-11. Uptake of COPCs by terrestrial invertebrates from soil is represented by the soil-to-invertebrate BAFs, as shown in Table 3-10.

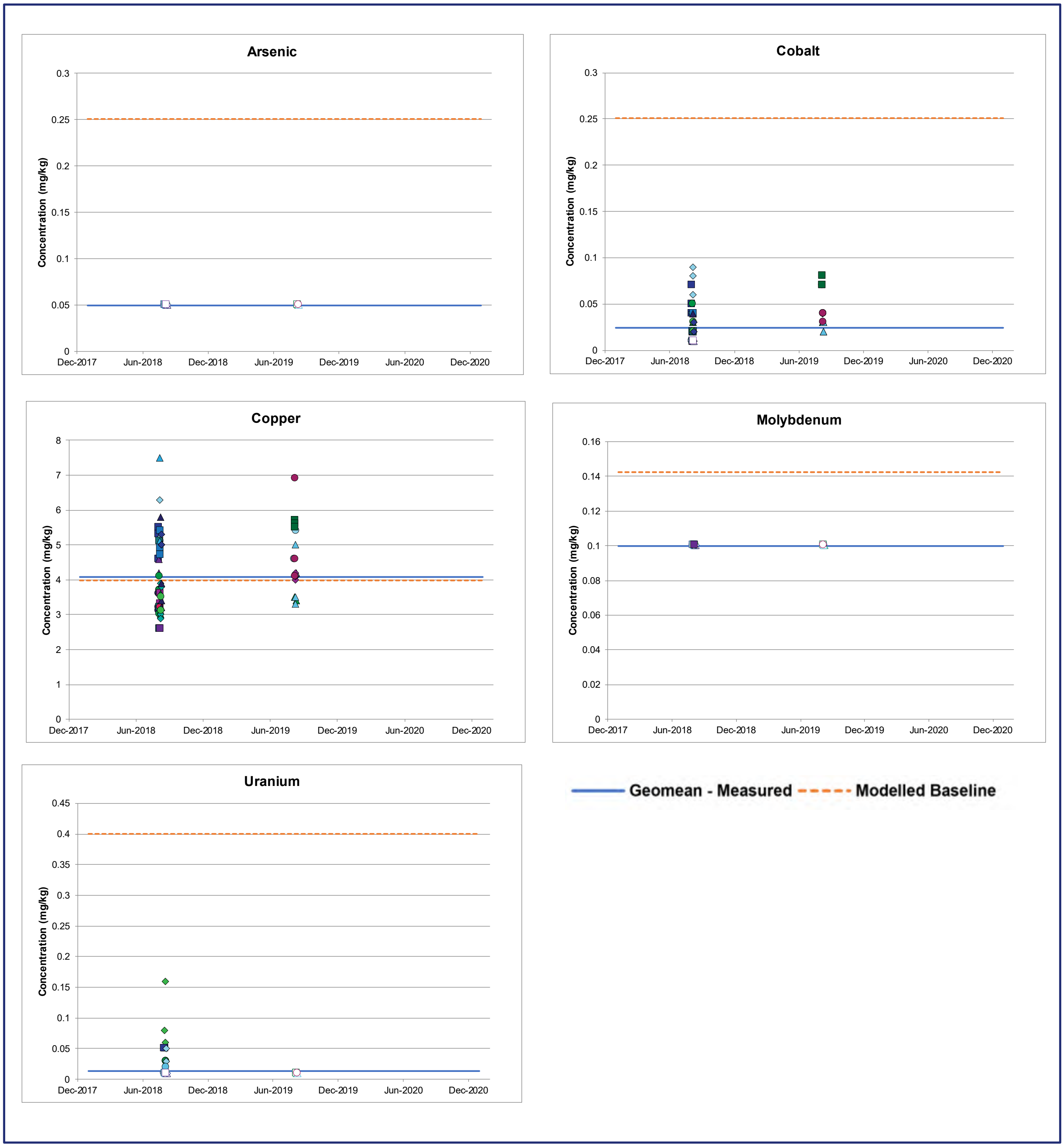
Table 3-11: Bioaccumulation Factors for Terrestrial Plants and Invertebrates

Bioaccumulation Factor kg(dw soil)/kg(dw plant)		
COPC	**Terrestrial Plants[(a)]**	**Terrestrial Invertebrates[(b)]**
Arsenic	4.26×10^{-01}	2.24×10^{-01}
Cobalt	5.80×10^{-01}	3.58×10^{-02}
Copper	$6.64 \times 10^{+00}$	5.15×10^{-01}
Molybdenum	$1.00 \times 10^{+00}$	$1.54 \times 10^{+00}$
Uranium	$1.62 \times 10^{+00}$	5.20×10^{-02}
Lead-210	8.00×10^{-02}	1.68×10^{-01}
Polonium-210	3.86×10^{-01}	1.64×10^{-02}
Radium-226	6.00×10^{-01}	5.29×10^{-01}
Thorium-230	3.12×10^{-02}	5.20×10^{-02}
Uranium-234	$1.62 \times 10^{+00}$	5.20×10^{-02}
Uranium-238	$1.62 \times 10^{+00}$	5.20×10^{-02}

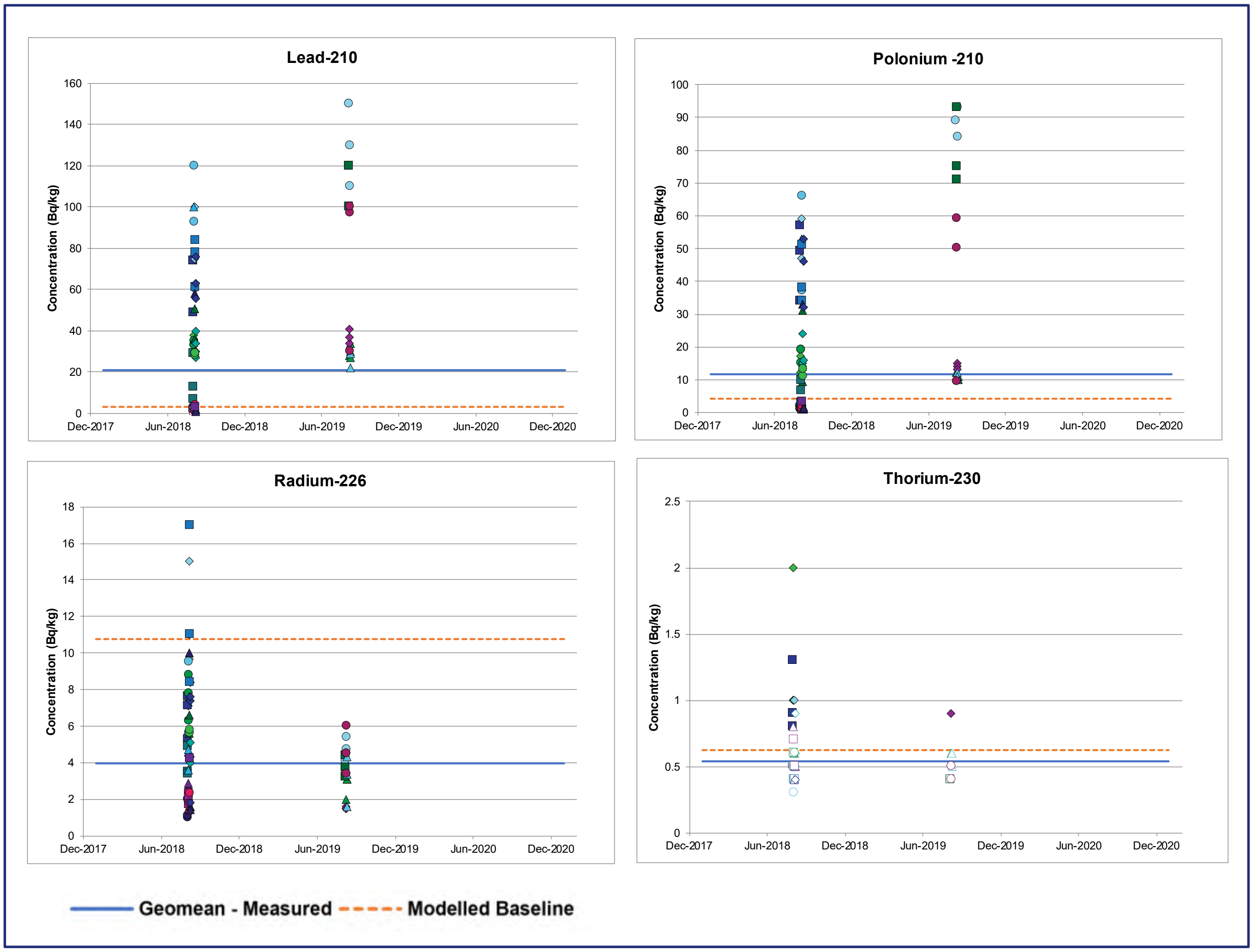
a) BAFs for terrestrial plants are compiled from regional data.
b) BAFs for terrestrial invertebrates from Sample et al (1998).
dw = dry weight; COPC = constituent of potential concern.

3.7.2 Model Validation

Figure 3-7 presents the predicted and observed concentrations of COPCs in blueberries from baseline sampling in 2019 (Annex VII.3). Modelled concentrations generally fall within the range of measured values from the two sampling events. Based on available data, the model is overpredicting arsenic (which is non-detect in blueberry samples), cobalt, and uranium. This comparison suggests a good agreement of available data with the modelling approach. For constituents for which the model predictions fall outside of the observed range, concentrations are conservatively overestimated. Refinement of the BAFs for aquatic plants can be completed as new data are available.



Blank outline symbol (no-fill) indicates that the measurement was under the detection limit.



Blank outline symbol (no-fill) indicates that the measurement was under the detection limit.

Figure 3-7: Modelled and Measured Concentrations (dry weight) of Radionuclides in Blueberries

3.7.3 Dose Coefficients for Terrestrial Plants and Invertebrates

Dose coefficients for all external and internal exposure routes to terrestrial plants and invertebrates are presented in Table 3-12 and Table 3-13, respectively. Dose coefficients for internal and external exposure pathways are based on values published by the ICRP (ICRP 2008).

Table 3-12: External Dose Coefficients for Terrestrial Plants and Invertebrates

COPC	DCF External Soil Surface (µGy/h)/(Bq/m²)			DCF External Soil (µGy/h)/(Bq/kg[dw soil])
	Blueberries[(a)]	Browse[(b)]	Labrador Tea[(b)]	Terrestrial Invertebrates[(c)]
Lead-210	7.50×10^{-09}	1.13×10^{-06}	1.13×10^{-06}	5.83×10^{-07}
Polonium-210	1.96×10^{-11}	6.67×10^{-11}	6.67×10^{-11}	4.58×10^{-09}
Radium-226	3.88×10^{-06}	1.33×10^{-05}	1.33×10^{-05}	9.17×10^{-04}
Thorium-230	2.67×10^{-09}	3.04×10^{-07}	3.04×10^{-07}	2.08×10^{-07}
Uranium-234	3.38×10^{-09}	3.67×10^{-07}	3.67×10^{-07}	1.75×10^{-07}
Uranium-238	2.63×10^{-09}	3.04×10^{-07}	3.04×10^{-07}	1.25×10^{-07}

a) Dose coefficients are based on pine tree (ICRP 2008).
b) Dose coefficients are based on grass (ICRP 2008).
c) Dose coefficients from ICRP (2008).
µGy = microgray; Bq = becquerel; dw = dry weight; COPC = constituent of potential concern; DCF = dose coefficient.

Table 3-13: Internal Dose Coefficients for Terrestrial Plants and Invertebrates

COPC	DCF Internal (µGy/h)/(Bq/kg(fw plant))			
	Blueberries[(a)]	Browse[(b)]	Labrador Tea[(b)]	Terrestrial Invertebrate[(c)]
Lead-210	2.50×10^{-04}	2.25×10^{-04}	2.25×10^{-04}	2.25×10^{-04}
Polonium-210	3.04×10^{-02}	3.04×10^{-02}	3.04×10^{-02}	3.04×10^{-02}
Radium-226	1.41×10^{-01}	1.38×10^{-01}	1.38×10^{-01}	1.38×10^{-01}
Thorium-230	2.71×10^{-02}	2.71×10^{-02}	2.71×10^{-02}	2.71×10^{-02}
Uranium-234	2.75×10^{-02}	2.75×10^{-02}	2.75×10^{-02}	2.75×10^{-02}
Uranium-238	2.42×10^{-02}	2.42×10^{-02}	2.42×10^{-02}	2.42×10^{-02}

a) Dose coefficients are based on pine tree (ICRP 2008).
b) Dose coefficients are based on grass (ICRP 2008).
c) Dose coefficients from ICRP (2008).
µGy = microgray; Bq = becquerel; fw = fresh weight; COPC = constituent of potential concern; DCF = dose coefficient.

3.7.4 Ingestion Transfer Factors for Terrestrial Receptors

Ingestion transfer factors are COPC- and biota-specific. Ingestion TFs from forage to tissue for agricultural livestock are available in CSA N288.1-20. An allometric equation (i.e., transfer proportional to a -3/4 power of body weight) (CSA N288.6-22) was applied to TFs available for beef and poultry from CSA N288.1-20, the IAEA (2010), or the National Council on Radiation Protection and Measurements (NCRP 1996) to estimate the TFs for the mammal and bird receptors, respectively. The derived ingestion TFs are presented in Table 3-14 and Table 3-15.

3.7.5 Inhalation Transfer Factors for Terrestrial Receptors

Inhalation TFs were calculated from the ingestion TF, by adjusting the ingestion TF by a COPC-specific inhalation/ingestion ratio (II) from CSA N288.1-20. The derived inhalation TFs are presented in Table 3-16.

Table 3-14: Ingestion Transfer Factors for Mammals (d/kg fw)

COPC	Beef Transfer Factor	Beef Transfer Factor Reference	Woodland Caribou	Snowshoe Hare	Moose	Little Brown Myotis	Southern Red-Backed Vole	Black Bear	Red Fox	Grey Wolf	Beaver	Muskrat	Mink	Beef Organs Transfer Factor	Beef Organs Transfer Factor Reference	Moose Organs (d)
Non-radionuclides																
Arsenic	2.00×10^{-02}	(a)	4.93×10^{-02}	$1.56 \times 10^{+00}$	2.71×10^{-02}	$9.51 \times 10^{+01}$	$3.14 \times 10^{+01}$	7.53×10^{-02}	7.80×10^{-01}	1.40×10^{-01}	2.24×10^{-01}	$2.15 \times 10^{+00}$	$2.39 \times 10^{+00}$	1.70×10^{-01}	(a)	2.30×10^{-01}
Cobalt	4.30×10^{-04}	(a)	1.06×10^{-03}	3.35×10^{-02}	5.83×10^{-04}	$2.05 \times 10^{+00}$	6.75×10^{-01}	1.62×10^{-03}	1.68×10^{-02}	3.00×10^{-03}	4.81×10^{-03}	4.62×10^{-02}	5.14×10^{-02}	1.00×10^{-01}	(a)	1.36×10^{-01}
Copper	1.00×10^{-02}	(b)	2.47×10^{-02}	7.80×10^{-01}	1.36×10^{-02}	$4.76 \times 10^{+01}$	$1.57 \times 10^{+01}$	3.76×10^{-02}	3.90×10^{-01}	6.98×10^{-02}	1.12×10^{-01}	$1.07 \times 10^{+00}$	$1.19 \times 10^{+00}$	4.00×10^{-01}	(a,d)	5.42×10^{-01}
Molybdenum	1.00×10^{-03}	(a)	1.23×10^{-02}	3.90×10^{-01}	6.78×10^{-03}	$2.38 \times 10^{+01}$	$7.85 \times 10^{+00}$	1.88×10^{-02}	1.95×10^{-01}	3.49×10^{-02}	5.59×10^{-02}	5.37×10^{-01}	5.97×10^{-01}	5.00×10^{-03}	(a)	6.78×10^{-03}
Uranium	3.90×10^{-04}	(a)	9.62×10^{-04}	3.04×10^{-02}	5.29×10^{-04}	$1.86 \times 10^{+00}$	6.13×10^{-01}	1.47×10^{-03}	1.52×10^{-02}	2.72×10^{-03}	4.36×10^{-03}	4.19×10^{-02}	4.66×10^{-02}	6.90×10^{-04}	(a)	9.35×10^{-04}
Radionuclides																
Lead-210	7.00×10^{-04}	(b)	1.73×10^{-03}	5.46×10^{-02}	9.49×10^{-04}	$3.33 \times 10^{+00}$	$1.10 \times 10^{+00}$	2.63×10^{-03}	2.73×10^{-02}	4.88×10^{-03}	7.83×10^{-03}	7.52×10^{-02}	8.36×10^{-02}	2.20×10^{-02}	(a,d)	2.98×10^{-02}
Polonium-210	5.00×10^{-03}	(c)	1.23×10^{-02}	3.90×10^{-01}	6.78×10^{-03}	$2.38 \times 10^{+01}$	$7.85 \times 10^{+00}$	1.88×10^{-02}	1.95×10^{-01}	3.49×10^{-02}	5.59×10^{-02}	5.37×10^{-01}	5.97×10^{-01}	5.00×10^{-05}	(a,d)	6.78×10^{-05}
Radium-226	1.70×10^{-03}	(a)	4.19×10^{-03}	1.33×10^{-01}	2.30×10^{-03}	$8.09 \times 10^{+00}$	$2.67 \times 10^{+00}$	6.40×10^{-03}	6.63×10^{-02}	1.19×10^{-02}	1.90×10^{-02}	1.83×10^{-01}	2.03×10^{-01}	9.50×10^{-04}	(a)	1.29×10^{-03}
Thorium-230	2.30×10^{-04}	(a)	5.67×10^{-04}	1.79×10^{-02}	3.12×10^{-04}	$1.09 \times 10^{+00}$	3.61×10^{-01}	8.66×10^{-04}	8.97×10^{-03}	1.60×10^{-03}	2.57×10^{-03}	2.47×10^{-02}	2.75×10^{-02}	6.30×10^{-02}	(a)	8.54×10^{-02}

Transfer factors in this table were calculated using the following allometric equation: TF (d/kg fw) = $aBW^{-0.75}$, where BW = body weight, TF = transfer factor, d/kg fw = days per kilogram fresh weight, "a" is a constant calculated using published transfer factor and body weight values for beef or beef organs as per CSA N288.1 (CSA Group 2020), and applied to calculate species-specific transfer factors.
a) CSA N288.1-20 (CSA Group 2020).
b) Handbook of Parameter Values for the Prediction of Radionuclide Transfer in Terrestrial and Freshwater Environments (IAEA 2010).
c) NCRP No. 123 (NCRP 1996).
d) For elements that are not listed in Table G.3 (CSA Group 2020), a surrogate element was used as follows (surrogate in parentheses): copper (silver), lead (tin), polonium (tellurium).
COPC = constituent of potential concern; TF = transfer factor; BW = body weight.

Table 3-15: Ingestion Transfer Factors for Birds (d/kg fw)

COPC	Poultry Transfer Factor	Poultry Transfer Factor Reference	Rusty Blackbird	Canada Goose	Grouse	Mallard	Loon
Non-radionuclides							
Arsenic	$1.20 \times 10^{+00}$	(a)	$1.59 \times 10^{+01}$	7.56×10^{-01}	$2.96 \times 10^{+00}$	$1.84 \times 10^{+00}$	5.78×10^{-01}
Cobalt	9.70×10^{-01}	(a)	$1.28 \times 10^{+01}$	6.11×10^{-01}	$2.39 \times 10^{+00}$	$1.49 \times 10^{+00}$	4.67×10^{-01}
Copper	6.20×10^{-01}	(c)	$8.19 \times 10^{+00}$	3.91×10^{-01}	$1.53 \times 10^{+00}$	9.51×10^{-01}	2.99×10^{-01}
Molybdenum	1.80×10^{-01}	(a)	$2.38 \times 10^{+00}$	1.13×10^{-01}	4.44×10^{-01}	2.76×10^{-01}	8.67×10^{-02}
Uranium	7.50×10^{-01}	(a)	$9.91 \times 10^{+00}$	4.73×10^{-01}	$1.85 \times 10^{+00}$	$1.15 \times 10^{+00}$	3.61×10^{-01}
Radionuclides							
Lead-210	5.00×10^{-02}	(c)	6.61×10^{-01}	3.15×10^{-02}	1.23×10^{-01}	7.67×10^{-02}	2.41×10^{-02}
Polonium-210	$2.40 \times 10^{+00}$	(b)	$3.17 \times 10^{+01}$	$1.51 \times 10^{+00}$	$5.92 \times 10^{+00}$	$3.68 \times 10^{+00}$	$1.16 \times 10^{+00}$
Radium-226	3.00×10^{-02}	(a)	3.97×10^{-01}	1.89×10^{-02}	7.40×10^{-02}	4.60×10^{-02}	1.44×10^{-02}
Thorium-230	1.00×10^{-02}	(a)	1.32×10^{-01}	6.30×10^{-03}	2.47×10^{-02}	1.53×10^{-02}	4.81×10^{-03}

Transfer factors in this table were calculated using the following allometric equation: TF (d/kg FW) = $aBW^{-0.75}$, where "a" is a constant calculated using published TF and BW values for poultry, and applied to calculate species-specific TFs.
a) CSA N288.1-20 (CSA Group 2020).
b) Handbook of Parameter Values for the Prediction of Radionuclide Transfer in Terrestrial and Freshwater Environments (IAEA 2010)
c) Transfer factor was calculated based on the beef TF published in NCRP No. 123 (NCRP 1996), adjusted to poultry using a ratio of 62, as per the CANDU Owners Group DRL Guidance (Hart 2013).
COPC = constituent of potential concern; TF = transfer factor; FW = fresh weight; BW = body weight; DRL = derived release limit.

Table 3-16: Inhalation Transfer Factors for Mammals and Birds (d/kg fw)

COPC	Inhalation/ Ingestion Ratio (II) (a,b)	Woodland Caribou	Snowshoe Hare	Moose	Little Brown Myotis	Southern Red-Backed Vole	Black Bear	Red Fox	Grey Wolf	Beaver	Muskrat	Mink	Moose Organs	Rusty Blackbird	Canada Goose	Grouse	Mallard	Loon
Non-radionuclides																		
Arsenic	0.75	3.70×10^{-02}	$1.17 \times 10^{+00}$	2.03×10^{-02}	$7.14 \times 10^{+01}$	$2.36 \times 10^{+01}$	5.64×10^{-02}	5.85×10^{-01}	1.05×10^{-01}	1.68×10^{-01}	$1.61 \times 10^{+00}$	$1.79 \times 10^{+00}$	1.73×10^{-01}	$1.19 \times 10^{+01}$	5.67×10^{-01}	$2.22 \times 10^{+00}$	$1.38 \times 10^{+00}$	4.33×10^{-01}
Cobalt	1.71	1.81×10^{-03}	5.74×10^{-02}	9.97×10^{-04}	$3.50 \times 10^{+00}$	$1.15 \times 10^{+00}$	2.77×10^{-03}	2.87×10^{-02}	5.13×10^{-03}	8.22×10^{-03}	7.90×10^{-02}	8.79×10^{-02}	2.32×10^{-01}	$2.19 \times 10^{+01}$	$1.05 \times 10^{+00}$	$4.09 \times 10^{+00}$	$2.55 \times 10^{+00}$	7.99×10^{-01}
Copper	2.91	7.18×10^{-02}	$2.27 \times 10^{+00}$	3.94×10^{-02}	$1.38 \times 10^{+02}$	$4.57 \times 10^{+01}$	1.10×10^{-01}	$1.14 \times 10^{+00}$	2.03×10^{-01}	3.25×10^{-01}	$3.13 \times 10^{+00}$	$3.48 \times 10^{+00}$	$1.58 \times 10^{+00}$	$2.38 \times 10^{+01}$	$1.14 \times 10^{+00}$	$4.45 \times 10^{+00}$	$2.77 \times 10^{+00}$	8.69×10^{-01}
Molybdenum	0.63	1.55×10^{-03}	4.91×10^{-02}	8.54×10^{-04}	$3.00 \times 10^{+00}$	9.90×10^{-01}	2.37×10^{-03}	2.46×10^{-02}	4.40×10^{-03}	7.04×10^{-03}	6.77×10^{-02}	7.53×10^{-02}	8.54×10^{-02}	$1.50 \times 10^{+00}$	7.15×10^{-02}	2.80×10^{-01}	1.74×10^{-01}	5.46×10^{-02}
Uranium	6.51	6.26×10^{-03}	1.98×10^{-01}	3.44×10^{-03}	$1.21 \times 10^{+01}$	$3.99 \times 10^{+00}$	9.55×10^{-03}	9.90×10^{-02}	1.77×10^{-02}	2.84×10^{-02}	2.73×10^{-01}	3.03×10^{-01}	6.09×10^{-03}	$6.45 \times 10^{+01}$	$3.08 \times 10^{+00}$	$1.20 \times 10^{+01}$	$7.49 \times 10^{+00}$	$2.35 \times 10^{+00}$
Radionuclides																		
Lead-210	24.2	4.18×10^{-02}	$1.32 \times 10^{+00}$	2.30×10^{-02}	$8.06 \times 10^{+01}$	$2.66 \times 10^{+01}$	6.38×10^{-02}	6.61×10^{-01}	1.18×10^{-01}	1.89×10^{-01}	$1.82 \times 10^{+00}$	$2.02 \times 10^{+00}$	7.22×10^{-01}	$1.60 \times 10^{+01}$	7.63×10^{-01}	$2.99 \times 10^{+00}$	$1.86 \times 10^{+00}$	5.83×10^{-01}
Polonium-210	0.91	1.12×10^{-02}	3.55×10^{-01}	6.17×10^{-03}	$2.16 \times 10^{+01}$	$7.15 \times 10^{+00}$	1.71×10^{-02}	1.77×10^{-01}	3.17×10^{-02}	5.09×10^{-02}	4.89×10^{-01}	5.44×10^{-01}	6.17×10^{-05}	$2.89 \times 10^{+01}$	$1.38 \times 10^{+00}$	$5.39 \times 10^{+00}$	$3.35 \times 10^{+00}$	$1.05 \times 10^{+00}$
Radium-226	1.11	4.66×10^{-03}	1.47×10^{-01}	2.56×10^{-03}	$8.98 \times 10^{+00}$	$2.96 \times 10^{+00}$	7.10×10^{-03}	7.36×10^{-02}	1.32×10^{-02}	2.11×10^{-02}	2.03×10^{-01}	2.25×10^{-01}	1.43×10^{-03}	4.40×10^{-01}	2.10×10^{-02}	8.21×10^{-02}	5.11×10^{-02}	1.60×10^{-02}
Thorium-230	101	5.73×10^{-02}	$1.81 \times 10^{+00}$	3.15×10^{-02}	$1.11 \times 10^{+02}$	$3.65 \times 10^{+01}$	8.74×10^{-02}	9.06×10^{-01}	1.62×10^{-01}	2.60×10^{-01}	$2.50 \times 10^{+00}$	$2.78 \times 10^{+00}$	$8.62 \times 10^{+00}$	$1.33 \times 10^{+01}$	6.37×10^{-01}	$2.49 \times 10^{+00}$	$1.55 \times 10^{+00}$	4.86×10^{-01}

a) Table G.8 (CSA Group 2020).
b) For elements that are not listed in Table G.8, a surrogate element was used as follows (surrogate in parentheses): copper (silver), lead (tin), polonium (tellurium).
COPC = constituent of potential concern.

3.7.6 Dose Coefficients for Terrestrial Animals, Birds, and Humans

Dose coefficients for all internal and external exposure routes to terrestrial animals and birds are presented in Table 3-17 and Table 3-18, respectively. The DCFs for terrestrial animals and birds follow the approach of the ICRP (2008). Progeny with half lives shorter than 10 days are included in each DCF.

Table 3-17: Internal Dose coefficients for Terrestrial Animals and Birds

DCF internal (µGy/h)/(Bq/kg(fw animal))								
COPC	Beaver[(a)]	Black Bear[(b)]	Canada Goose[(c)]	Grey Wolf[(a)]	Grouse[(c)]	Little Brown Myotis[(a)]	Loon[(c)]	Mallard[(c)]
Lead-210	2.4×10^{-04}	2.5×10^{-04}	2.5×10^{-04}	2.4×10^{-04}	2.5×10^{-04}	2.4×10^{-04}	2.5×10^{-04}	2.5×10^{-04}
Polonium-210	3.0×10^{-02}	3.0×10^{-02}	3.0×10^{-02}	3.0×10^{-02}	3.0×10^{-02}	3.0×10^{-02}	3.0×10^{-02}	3.0×10^{-02}
Radium-226	1.4×10^{-01}	1.4×10^{-01}	1.4×10^{-01}	1.4×10^{-01}	1.4×10^{-01}	1.4×10^{-01}	1.4×10^{-01}	1.4×10^{-01}
Thorium-230	2.7×10^{-02}	2.7×10^{-02}	2.7×10^{-02}	2.7×10^{-02}	2.7×10^{-02}	2.7×10^{-02}	2.7×10^{-02}	2.7×10^{-02}
Uranium-234	2.8×10^{-02}	2.8×10^{-02}	2.8×10^{-02}	2.8×10^{-02}	2.8×10^{-02}	2.8×10^{-02}	2.8×10^{-02}	2.8×10^{-02}
Uranium-238	2.4×10^{-02}	2.4×10^{-02}	2.4×10^{-02}	2.4×10^{-02}	2.4×10^{-02}	2.4×10^{-02}	2.4×10^{-02}	2.4×10^{-02}
COPC	Mink[(a)]	Moose[(b)]	Muskrat[(a)]	Red Fox[(a)]	Rusty Black-bird[(c)]	Snowshoe Hare[(a)]	Southern Red-Backed Vole[(a)]	Woodland Caribou[(b)]
Lead-210	2.4×10^{-04}	2.5×10^{-04}	2.4×10^{-04}	2.4×10^{-04}	2.5×10^{-04}	2.4×10^{-04}	2.4×10^{-04}	2.5×10^{-04}
Polonium-210	3.0×10^{-02}	3.0×10^{-02}	3.0×10^{-02}	3.0×10^{-02}	3.0×10^{-02}	3.0×10^{-02}	3.0×10^{-02}	3.0×10^{-02}
Radium-226	1.4×10^{-01}	1.4×10^{-01}	1.4×10^{-01}	1.4×10^{-01}	1.4×10^{-01}	1.4×10^{-01}	1.4×10^{-01}	1.4×10^{-01}
Thorium-230	2.7×10^{-02}	2.7×10^{-02}	2.7×10^{-02}	2.7×10^{-02}	2.7×10^{-02}	2.7×10^{-02}	2.7×10^{-02}	2.7×10^{-02}
Uranium-234	2.8×10^{-02}	2.8×10^{-02}	2.8×10^{-02}	2.8×10^{-02}	2.8×10^{-02}	2.8×10^{-02}	2.8×10^{-02}	2.8×10^{-02}
Uranium-238	2.4×10^{-02}	2.4×10^{-02}	2.4×10^{-02}	2.4×10^{-02}	2.4×10^{-02}	2.4×10^{-02}	2.4×10^{-02}	2.4×10^{-02}

a) Dose coefficients are based on rat (ICRP 2008).
b) Dose coefficients are based on deer (ICRP 2008).
c) Dose coefficients are based on duck (ICRP 2008).
COPC = constituent of potential concern; DCF = dose coefficient.

Table 3-18: External Dose Coefficients for Terrestrial Animals and Birds

DCF external (µGy/h)/(Bq/m²)								
COPC	**Beaver[(a)]**	**Black Bear[(b)]**	**Canada Goose[(c)]**	**Grey Wolf[(a)]**	**Grouse[(c)]**	**Little Brown Myotis[(a)]**	**Loon[(c)]**	**Mallard[(c)]**
Lead-210	6.3×10^{-09}	2.3×10^{-09}	5.8×10^{-09}	6.3×10^{-09}	5.8×10^{-09}	6.3×10^{-09}	5.8×10^{-09}	5.8×10^{-09}
Polonium-210	2.8×10^{-11}	1.4×10^{-11}	2.6×10^{-11}	2.8×10^{-11}	2.6×10^{-11}	2.8×10^{-11}	2.6×10^{-11}	2.6×10^{-11}
Radium-226	5.4×10^{-06}	2.8×10^{-06}	5.0×10^{-06}	5.4×10^{-06}	5.0×10^{-06}	5.4×10^{-06}	5.0×10^{-06}	5.0×10^{-06}
Thorium-230	1.3×10^{-09}	5.4×10^{-10}	1.3×10^{-09}	1.3×10^{-09}	1.3×10^{-09}	1.3×10^{-09}	1.3×10^{-09}	1.3×10^{-09}
Uranium-234	7.5×10^{-10}	2.8×10^{-10}	7.1×10^{-10}	7.5×10^{-10}	7.1×10^{-10}	7.5×10^{-10}	7.1×10^{-10}	7.1×10^{-10}
Uranium-238	4.1×10^{-10}	1.5×10^{-10}	3.9×10^{-10}	4.1×10^{-10}	3.9×10^{-10}	4.1×10^{-10}	3.9×10^{-10}	3.9×10^{-10}
COPC	**Mink[(a)]**	**Moose[(b)]**	**Muskrat[(a)]**	**Red Fox[(a)]**	**Rusty Black-bird[(c)]**	**Snowshoe Hare[(a)]**	**Southern Red-Backed Vole[(a)]**	**Woodland Caribou[(b)]**
Lead-210	6.3×10^{-09}	2.3×10^{-09}	6.3×10^{-09}	6.3×10^{-09}	5.8×10^{-09}	6.3×10^{-09}	6.3×10^{-09}	2.3×10^{-09}
Polonium-210	2.8×10^{-11}	1.4×10^{-11}	2.8×10^{-11}	2.8×10^{-11}	2.6×10^{-11}	2.8×10^{-11}	2.8×10^{-11}	1.4×10^{-11}
Radium-226	5.4×10^{-06}	2.8×10^{-06}	5.4×10^{-06}	5.4×10^{-06}	5.0×10^{-06}	5.4×10^{-06}	5.4×10^{-06}	2.8×10^{-06}
Thorium-230	1.3×10^{-09}	5.4×10^{-10}	1.3×10^{-09}	1.3×10^{-09}	1.3×10^{-09}	1.3×10^{-09}	1.3×10^{-09}	5.4×10^{-10}
Uranium-234	7.5×10^{-10}	2.8×10^{-10}	7.5×10^{-10}	7.5×10^{-10}	7.1×10^{-10}	7.5×10^{-10}	7.5×10^{-10}	2.8×10^{-10}
Uranium-238	4.1×10^{-10}	1.5×10^{-10}	4.1×10^{-10}	4.1×10^{-10}	3.9×10^{-10}	4.1×10^{-10}	4.1×10^{-10}	1.5×10^{-10}

a) Dose coefficients are based on rat (ICRP 2008).
b) Dose coefficients are based on deer (ICRP 2008).
c) Dose coefficients are based on duck (ICRP 2008).
COPC = constituent of potential concern; DCF = dose coefficient.

Dose coefficients for all internal and external exposure routes for humans are presented in Table 3-19. The DCFs for ingestion and inhalation by human receptors were taken from CSA N288.1-20 and are progeny inclusive.

The external DCFs used in this IMPACT model update were derived based on the methodology described in CSA N288.1-20. Uranium-238 progeny associated with each of the radionuclides, as required, were included in the external DCFs as follows:

- uranium-238 with its progeny thorium-234 and protactinium-234m;
- uranium-234 was modelled explicitly and no progeny were included in the external DCF;
- thorium-230 was modelled explicitly and no progeny were included in the external DCF;
- radium-226 with its progeny radon-222 (except for air immersion), polonium-218, lead-214, bismuth-214, and polonium-214;
- lead-210 with its progeny bismuth-210; and

- radon-222 (air immersion only) with its progeny polonium-218, lead-214, and bismuth-214.

The achievement of transient or secular equilibrium by ingrowth of progeny takes time. Therefore, the available time for ingrowth in each exposure medium must be considered in deciding whether it is reasonable to assume equilibrium. The timeframes for ingrowth of the progeny assumed for each of the external pathways were two hours for air immersion, one day for water immersion, and 40 years for exposure to soils and sediment. Details for the calculation of the external DCFs are described in CSA N288.1-20.

Table 3-19: Human Dose Coefficients for Internal and External Exposure

COPC	Ingestion DCF	Inhalation DCF	External Soil DCF	External Water Immersion DCF	External Sediment DCF	External Air Immersion DCF
	(Sv/Bq)	(Sv/Bq)	(Sv/yr)/ (Bq/m^2)	(Sv/yr)/ (Bq/L)	(Sv/yr)/ (Bq/kg)	(Sv/yr)/ (Bq/m^3)
Adult						
Lead-210	6.9×10^{-07}	1.1×10^{-06}	1.2×10^{-09}	4.5×10^{-09}	1.8×10^{-09}	1.4×10^{-09}
Polonium-210	1.2×10^{-06}	3.3×10^{-06}	2.6×10^{-13}	2.7×10^{-11}	7.4×10^{-12}	1.2×10^{-11}
Radium-226	2.8×10^{-07}	3.5×10^{-06}	5.3×10^{-08}	9.2×10^{-07}	1.5×10^{-06}	9.0×10^{-09}
Thorium-230	2.1×10^{-07}	1.4×10^{-05}	2.4×10^{-11}	1.1×10^{-09}	2.3×10^{-10}	4.7×10^{-10}
Uranium-234	4.9×10^{-08}	3.5×10^{-06}	1.9×10^{-11}	4.4×10^{-10}	7.8×10^{-11}	1.9×10^{-10}
Uranium-238	4.5×10^{-08}	2.9×10^{-06}	3.7×10^{-09}	2.5×10^{-09}	2.2×10^{-08}	7.9×10^{-11}
1-year old						
Lead-210	3.6×10^{-06}	3.7×10^{-06}	1.5×10^{-09}	4.8×10^{-09}	2.3×10^{-09}	1.8×10^{-09}
Polonium-210	8.8×10^{-06}	1.1×10^{-05}	3.3×10^{-13}	3.5×10^{-11}	9.6×10^{-12}	1.6×10^{-11}
Radium-226	9.6×10^{-07}	1.1×10^{-05}	6.9×10^{-08}	1.2×10^{-06}	2.0×10^{-06}	1.2×10^{-08}
Thorium-230	4.1×10^{-07}	3.5×10^{-05}	2.6×10^{-11}	1.4×10^{-09}	3.0×10^{-10}	6.1×10^{-10}
Uranium-234	1.3×10^{-07}	1.1×10^{-05}	2.4×10^{-11}	5.7×10^{-10}	1.0×10^{-10}	2.5×10^{-10}
Uranium-238	1.2×10^{-07}	9.4×10^{-06}	4.8×10^{-09}	3.3×10^{-09}	2.8×10^{-08}	1.0×10^{-10}

COPC = constituent of potential concern; DCF = dose coefficient; Sv/yr = sieverts per year; Bq = becquerel.

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Appendix A Water and Sediment Sampling Stations

Label ID	Name
BeetC	Beet Creek
BeetL	Beet Lake
CR	Clearwater River
FL	Forrest Lake
JedC	Jed Creek
LG	Lake G
LH	Lake H
LLI	Lloyd Lake Inlet
LLO	Lloyd Lake Outlet
Mid	Mid-field
MR	Mirror River
PLNW	Patterson Lake North Arm West Basin
PLNE	Patterson Lake North Arm East Basin
PLS	Patterson Lake South Arm

The location of sampling stations is described in detail in Annex V.1, which describes the baseline studies performed between 2018 and 2020.

Appendix B Ecological Receptor Profiles

APPENDIX B – ECOLOGICAL RECEPTOR PROFILES

One of the key considerations, which defines the scope of a risk assessment is the selection of ecological receptors. In selecting ecological receptors, it is important to identify plants and animals that are likely to be most exposed to the effects of the Project. As it is not possible to evaluate all ecological species at a site, representative species were selected based on the selection process provided in Table 7.1 of CSA N288.6 (2022).

This appendix describes the aquatic and terrestrial ecological receptors (groups or species) selected for the assessment. The general characteristics of each receptor including any status under COSEWIC, SARA or provincial ranking, its distribution and presence in the Regional Study Area (RSA), its home range and diet, as well as how it is incorporated into the ecological and/or human health models and the protection level that it is afforded in the risk assessment.

1.0 Aquatic and Riparian Biota

1.1 Aquatic Vegetation

1.1.1 Macrophytes

Macrophytes are aquatic plants growing in or near water and can be either emergent, submergent or floating. Emergent macrophytes are rooted in shallow water whereas submergent macrophytes are typically rooted in sediment and the entire plant is submerged. Macrophytes are primary producers that provide food, cover, and shelter for wildlife, such as spawning and nursery habitats for fish and nesting habitats for waterfowl, improve water quality and clarity, and help to stabilize shorelines and bottom sediments.

Dense amounts of submergent macrophytes including various pondweeds were found in the Clearwater River upstream of Mirror River, while downstream of Mirror River, emergent macrophytes were limited to areas close to the shoreline. Submergent macrophytes were also sampled at Lloyd Lake as part of baseline studies. A general lack of emergent macrophytes were noted in Patterson Lake, and for this reason the lake has been characterized as only marginally suitable for northern pike spawning (CanNorth 2021a).

In the ecological model, macrophytes are exposed to aquatic release through surface water, and they provide food for woodland caribou, moose, muskrat, and mallard. Because of their importance as a potential link between contaminants in sediments and surface water to other aquatic and terrestrial receptors, macrophytes were conservatively assumed to be present in every surface water body within the RSA.

In the ERA, macrophytes are assessed as a group at a community level.

1.1.2 Phytoplankton

Phytoplankton are small primary producers that use sunlight to produce oxygen and nutrients for other organisms. Phytoplankton are an important food sources for organisms in an aquatic environment.

Phytoplankton are present in all surface water bodies in the RSA. The phytoplankton communities in Patterson Lake North, Forrest Lake, Beet Lake, and Naomi Lake, Broach Lake, and Hodge Lake were sampled in fall 2018 (CanNorth 2021a). The phytoplankton communities were dominated by blue-green algae (Cyanophycota) primarily of the families Synechococcaceae and Chroococcaeae. Diatoms (Bacillariophyta) were also an important component of the phytoplankton communities of Beet and Naomi lakes.

In the model, phytoplankton are exposed to aquatic release through surface water. Phytoplankton communities represent a potential link between contaminants in surface water and other aquatic and terrestrial receptors.

In the ERA, phytoplankton are assessed as a group at a community level.

1.2 Aquatic Invertebrates

1.2.1 Epifaunal and Infaunal Benthic Invertebrates

Benthic invertebrates or "benthos" live on or within the sediments of surface water bodies. Benthic invertebrates play an integral role in the fresh water ecosystem through nutrient cycling and they function as an important food source for wildlife such as the diving (e.g. Bufflehead) and dabbling (e.g. Mallard) ducks, and fish (e.g. White Sucker). Benthic invertebrates represent a relatively large fraction of biomass in Patterson Lake and other lakes in the RSA (CanNorth 2021a).

Epifaunal benthic invertebrates live in water bodies on or attached to submerged substrates such as the bottom sediment or hard surfaces and feed at the substrate surface. Epifaunal benthic invertebrates primarily include amphipods, bivalves, shrimps, crabs, snails, and some aquatic insects. Amphipoda (*Gammarus* and *Hyalella*, also called scuds and fresh water shrimp) are an important group of epifaunal invertebrates in the RSA depending on the area (CanNorth 2021a). Ephemeroptera (mayfly nymphs) form a representative group of epifaunal benthic invertebrates generally found throughout the RSA that represent a relatively large fraction of the biomass of aquatic invertebrates (CanNorth 2021a).

Infaunal benthic invertebrates live and burrow in the sediments and feed within sediments. Infaunal benthic invertebrates primarily include bivalves, worms, and some aquatic insects. Chiromomids (non-biting midge larvae) was the most abundant group of infaunal benthic invertebrates found in the RSA, followed by Oligochaeta (aquatic earthworms and sludge worms), and Mollusca (other than Unionidae [river mussels]), depending on the area (CanNorth 2021a).

In the model, benthic invertebrates are exposed to aquatic release through surface water and sediment. Benthic invertebrates provide water to fish and sediment to fish pathway links and a link between aquatic and terrestrial ecosystems. Many benthic invertebrate species feed on decaying organic matter and thereby form an important link between the decomposer and primary consumer levels.

In the ERA, benthic invertebrates are assessed as a group at a community level.

1.2.2 Zooplankton

Zooplankton are small aquatic animals that are intermediaries in the aquatic food chain. Zooplankton are primary or secondary consumers that are also prey of other larger zooplankton predators or fish. Exposed to aquatic release through surface water.

Zooplankton are present in all surface water bodies in the RSA. The zooplankton communities in Patterson Lake North, Forrest Lake, Beet Lake, and Naomi Lake, Broach Lake, and Hodge Lake were sampled in fall 2018 (CanNorth 2021a). Zooplankton communities consisted of mainly crustaceans (Cyclopoida) and rotifers (Ploima). Other crustaceans (Cladocera) were also abundant in some areas.

In the model, zooplankton are exposed to aquatic release through surface water. Zooplankton communities represent a potential link between contaminants in surface water and phytoplankton, and other aquatic and terrestrial receptors.

In the ERA, zooplankton are assessed as a group at a community level.

1.3 Fish

1.3.1 Lake Whitefish

Lake whitefish (*Coregonus culpeaformis*) is a benthic cool water fish species of the family Salmonidae, that is found in fresh water lakes throughout much of Canada. It is a species of ecological and economic value. Regionally, the Other Land and Resource Use Memorandum (InterGroup 2018b) identified lake whitefish as a target of commercial fishing in Patterson Lake, Lloyd Lake, and Lake La Loche. Lake whitefish are also an important component of the traditional foods diet for First Nations in Saskatchewan (Chan et al. 2018, 2019).

Fish community surveys that targeted lake whitefish were conducted in 2018 at Broach, Hodge, G, H, and Patterson lakes, Lloyd Lake Inlet and the midfield area of the Clearwater River, and in 2019 at Broach Lake, Jed Creek, Patterson Lake, Patterson Creek, Forrest Lake, Beet Channel, Beet Lake, Beet Creek, Naomi Lake, Naomi Creek, Clearwater Creek, and Clearwater Nearfield. Lake whitefish were found to be present in many of these waterbodies, and were found to spawn in Patterson, Forrest and Beet lakes and Patterson Creek (CanNorth 2021a). Lake whitefish tissue samples were retained for chemical analysis. It is assumed that the lake whitefish spends 100% of its time in the Project area waterbody where it is assessed.

Lake whitefish ingest plankton during their larval and post larval stages then switch to benthic invertebrates, including snails, bivalves and insect larvae, and fish eggs. In the model, lake whitefish are exposed to aquatic release through surface water and sediments. In the human health model, they are a component of the Traditional Foods diet.

In the ERA, lake whitefish are assessed as a representative benthopelagic fish species at a population level.

1.3.2 Northern Pike

Northern pike (*Esox lucius*) is a pelagic top predator fish, of the family Esicidae, that is widely distributed in fresh water environments across Canada. It is of ecological and economic importance. Regionally, the Other Land and Resource Use Memorandum (InterGroup 2018b) identified northern pike as a target of commercial fishing in Patterson Lake, Lloyd Lake, and Lake La Loche. Northern pike is also an important component of the traditional foods diet for First Nations in Saskatchewan (Chan et al. 2018, 2019).

Fish community surveys that targeted northern pike were conducted in 2018 at Broach, Hodge, G, H, and Patterson lakes, Lloyd Lake Inlet and the midfield area of the Clearwater River, and in 2019 at Broach Lake, Jed Creek, Patterson Lake, Patterson Creek, Forrest Lake, Beet Channel, Beet Lake, Beet Creek, Naomi Lake, Naomi Creek, Clearwater Creek, and Clearwater Nearfield. Northern Pike were found to be present in all the waterbodies. Northern pike were found to spawn in Patterson, Forrest, Naomi lakes, Patterson, Jed, Beet, Naomi, Clearwater creeks, and Clearwater River (CanNorth 2021a). Northern pike tissue samples were retained for chemical analysis. It is assumed that the northern pike spends 100% of its time in the Project area waterbody where it is assessed.

Northern pike are exposed to aquatic release through surface water and consumption of prey (aquatic vertebrates and/or aquatic invertebrates). In the model, northern pike are exposed to aquatic release through surface water. Northern pike represent a potential link between contaminants in surface water, other aquatic and terrestrial receptors, and human receptor groups. In the ecological model, northern pike are consumed by bear, mink, and loon. In the human health model, they are a component of the human Traditional Foods diet and are used as a surrogate for other common predatory fish, such as walleye, which are also items in the human Traditional Foods diet.

In the ERA, northern pike are assessed as a representative pelagic predator fish species at a population level.

1.4 Riparian Mammals

1.4.1 Beaver

North American beaver (*Castor canadensis*) is a large rodent of the family Castoridae, measuring approximately 1.3 m including its large tail, and weighing about 20 kg. They are found throughout much of North America from southwest Alaska to northeast Mexico except for western California (EC & CWF 2017). Beavers are present in the RSA and are trapped for fur and meat and harvested by Indigenous people (Omnia 2020a). Beavers are an important component of the traditional foods diet for First Nations living in the Boreal Shield ecoregion of Saskatchewan (Chan et al. 2018, 2019).

Beavers live in wetland areas engineering their habitat through the construction of dams and channels to create suitable habitat with water deep enough not to freeze to the bottom in winter. Beavers mate in winter and produce 3 or 4 kits by May or June after a 100-day gestation period. For the ecological model, it is assumed that the beaver spends 100% of its time at the location where it is assessed.

Beavers consume a woody diet (aspen, poplar, willow, birch) during the winter from submerged caches prepared during the open water season. If the area is relatively free of predators, beavers may travel 125 m away in search of suitable winter food. During the other seasons beaver switch to an herbaceous diet of grasses, herbs, twigs, fruits, and aquatic plants. For the ecological model it is assumed that the beaver's diet consists of browse (90%) and macrophytes (10%).

In the model, beavers are exposed to aquatic release through water, food (terrestrial and aquatic vegetation) and sediment. In the ecological model, beavers are prey for larger predators such as wolves. In the human health model, beavers are a component of the First Nation's traditional foods diet and are used as a surrogate for other small mammals, such as hare.

In the ERA, beavers are assessed as a representative riparian herbivore species at a population level.

1.4.2 Muskrat

The muskrat (*Ondatra zibethicus*) is a large rodent (Muridae), measuring approximately 50 cm from tip of the nose to tail, and weighing on average 1 kg. Muskrats exist all over North America, from the Arctic Ocean in the north to the Gulf of Mexico in the south, from the Pacific Ocean in the west to the Atlantic Ocean in the east. Their mean home range size in the summer is between 0.048 to 0.17 hectares (USEPA 1993). Muskrats are present in the RSA and are trapped for fur and meat and harvested by Indigenous people (Omnia 2020a).

Muskrats prefer fresh water marshes, marshy areas of lakes, and slow-moving streams. The preferred water depth in these areas is 1 m to 2 m, deep enough not to freeze fully during the winter but shallow enough to allow aquatic vegetation to grow. Muskrats nest in compact mounds of partially dried and decayed plant material such as cattails and bulrushes. In winter, muskrats generally occupy lodges that they build through burrowing underneath their mounds, and spends most of its time eating and sleeping. They are capable of extended dives, allowing them to dig channels and burrows underwater, cut submerged stems and roots with their teeth, and travel long distances beneath the ice (EC & CWF 1986). Breeding generally occurs in March, April, or May. Birth of the litter usually occurs within 1 month of mating and usually contains 5 to 10 young. Breeding can occur multiple times throughout the season (EC & CWF 1986). For the ecological model, it is assumed that the muskrat spends 100% of its time at the location where it is assessed.

Muskrats mainly feed on aquatic plants such as cattails, bulrushes, horsetails, or pondweeds; although they prefer cattails. When aquatic plants are unavailable, muskrats are also known to feed on fish, frogs, and clams. In the model, muskrats are exposed to aquatic release through water, food, and sediment. For the ecological model it is assumed that the muskrat's diet consists of aquatic plants (80%) and benthic invertebrates (20%).

In the ERA, muskrats are assessed as a representative riparian herbivore species at a population level.

1.4.3 American Mink

American mink (*Neovison vison*) is a semi-aquatic, carnivorous mammal belonging to the weasel family (Mustelidae), measuring approximately 30 to 40 cm not including the tail and weighing on average 1 kg. Minks are widely distributed throughout North America, except in the far north, arid areas in southwestern United States, and Mexico. Minks are present in the RSA and are trapped for fur and harvested by Indigenous people (Omnia 2020a).

Preferred habitats for minks generally consist of aquatic habitats such as rivers, lakes, streams, marshes, and swamps, with wooded cover. Mink typically use bank burrows of other animals such as muskrats, cavities in tree roots, rock or brush piles, log jams, and beaver lodges for denning instead of constructing their own (USEPA 1993). Minks have been known to travel up to 200 m away from a water body and males have the largest home ranges of up to 10 km^2 (USEPA 1993). For the ecological model, it is assumed that the mink spends 100% of its time at the location where it is assessed.

Minks are nocturnal opportunistic hunters, consuming a variety of prey around shorelines or emergent vegetation, preferring small mammals such as voles, muskrats, and shrews. Other secondary prey items include aquatic birds, fish, amphibians, and crustaceans (USEPA 1993). For the ecological model it is assumed that the muskrat's diet consists of small mammals, represented by muskrat (45%); fish, represented by northern pike (30%); benthic invertebrates (15%) and aquatic birds; represented by mallard (10%).

In the ERA, minks are assessed as a representative riparian carnivore species at a population level.

1.5 Riparian Birds

1.5.1 Mallard

The mallard (*Anas platyrhynchos*) is an omnivorous migratory duck (Anatidae) that has a summer breeding range in Canada (USEPA 1993; FCSAP 2012). Male mallards average 1.1 kg in weight and females about 1.2 kg in weight (FCSAP 2012). Mallards are common to northern Saskatchewan and are known to breed in the RSA (Omnia 2020a).

Mallards are an important component of the traditional foods diet for First Nations living in the Boreal Shield and Boreal Plains ecozones of Saskatchewan (Chan et al. 2018, 2019).

The general habitat of the mallard is wetlands. The mean home range of a mallard in spring is between 111 and 620 hectares (USEPA 1993). Mallard typically nest on the ground in thick vegetation away from a waterbody. Mating pairs may produce more than one clutch per season, with the first clutch generally being finished by in late Spring, in the northern United States (USEPA 1993). Females remain with their brood until fledging (USEPA 1993). Although mallards are not present in the vicinity of the Project for over half the year due to migration, they have a small home range while nesting and rearing of their young. For the ecological model, it is conservatively assumed that the mallard spends 100% of its time at the location where it is assessed.

The mallard forages by dabbling and filtering though sediment (USEPA 1993). The bulk of the mallard`s diet is plant material, mostly aquatic plants and seeds, with the remaining portions of the diet consisting of aquatic invertebrates, especially during the breeding season (FCSAP 2012). For the ecological model it is assumed that the mallard's diet while in the RSA consists of benthic invertebrates (75%) and aquatic plants (25%).

In the model, mallards are exposed to aquatic release through water, food, and sediment. In the ecological model, mallards are prey for mink. In the human health model, mallards are a component of the First Nation's traditional foods diet and are used as a surrogate for other water birds with a similar diet.

In the ERA, mallards are assessed as a representative riparian avian species at a population level.

1.5.2 Common Loon

The loon (*Gavia immer*) is a piscivorous migratory waterfowl of the family Gaviidae, that breeds in Canada during the summer (FCSAP 2012). Male loons average 5.3 kg in weight and females about 4.7 kg in weight (FCSAP 2012). Loons are common to northern Saskatchewan and are known to breed in the RSA (Omnia 2020a).

Loons commonly inhabit open water areas of lakes and rivers during the summer (FCSAP 2012). Loons do not walk well on land so they spend their time on water. They prefer to nest offshore, on islands, islets, or floating mounds of vegetation in shallow water. Loon pairs may reuse the same nesting site year after year. They have one brood per year with 1 or 2 chicks being produced. Eggs hatch after an incubation period of 26-29 days (Cornell Lab (no date)). For the ecological model, it is conservatively assumed that the loon spends 100% of its time at the location where it is assessed.

Loons surface dive to the water column to catch fish. Loons are opportunistic feeders but appear to prefer perch to salmon (FCSAP 2012). Aquatic invertebrates and crayfish are significant secondary components of their diet especially if the water is not clear. For the ecological model, loons are assumed to eat 90% fish (northern pike) and 10% aquatic invertebrates.

In the model, loons are exposed to aquatic release through water and food.

In the ERA, loons are assessed as a representative avian piscivorous species at a population level.

2.0 Terrestrial Biota

2.1 Terrestrial Invertebrates

Terrestrial invertebrates are considered to be primary consumers. They are represented by earthworms, which live in soil and are therefore exposed to constituents in soil layers through direct contact. Earthworms live in soil and depending on the species they either move vertically or horizontally indifferent soil layers. Earthworms acquire their nutrition through the organic matter in soil as well as the decomposing remains of other animals. They can devour one third of their own body weight per day.

For the ecological model, terrestrial invertebrates represented by the earthworm are assumed to spend 100% of their time at the location where they are assessed.

In the model, terrestrial invertebrates are exposed to atmospheric release through deposition to soil. Terrestrial invertebrate communities represent a potential link between contaminants in air and other terrestrial receptors. In the ecological model, terrestrial invertebrates are part of the diet for the red fox (*Vulpes vulpes*).

In the ERA, terrestrial invertebrates are assessed as a group at a community level.

2.2 Terrestrial Vegetation

Terrestrial vegetation types are dietary components for terrestrial animals and humans. They are represented by browse (various shrubs and grasses), lichen (various species), blueberries (*Vaccinium myrtilloides*), and Labrador tea (*Rhododendron groenlandicum)*.

Individual plant species are included as food for other ecological receptors and for human receptors in the ecological and human health models. Three individual species are assessed in the model as representative species for lichen, fruits, and berries (blueberry), and leafy plants and browse (Labrador tea).

Plants are immobile and therefore are assumed to spend 100% of their time at the location where they are assessed.

In the ERA terrestrial vegetation is assessed as a group at a community level.

2.2.1 Lichen

Lichens are not plants, but rather they are composite organisms and symbiotic partnerships between fungus and algae. Some species are arboreal and grow on branches of higher plants, while others are terrestrial and grow on rocks and soil. The fungus provides structure and protection to the algae, while the algae which has chlorophyll, photosynthesizes and provides nutrition to the fungus. Lichens are found around the world in many different habitats.

Lichens are present in the RSA, especially in regenerating and recently burned jackpine stands that are common in the SSA (CanNorth 2021c). The forest floors of these communities have a greater proportion of lichens than mosses compared to the areas of mature jackpine stands that are also present in the RSA. Due to recurrent burn cycles in the area the dominant lichens are terrestrial species. Reindeer lichen is a dominant groundcover in regenerating coniferous forests in the area (Omnia 2020b).

In the model, lichen is exposed to atmospheric release depositing from air. In the ecological model lichens are food for woodland caribou.

2.2.2 Blueberry

Blueberry is a low spreading deciduous shrub that is common to Canada and northern United States. It often grows in the form of small thickets in open areas of coniferous forests in loose acidic soil, and in burn areas. Blueberries produce clusters of small sweet fruits. Blueberries are generally present in the RSA (CanNorth 2021c). Blueberries are an important Traditional Foods component for First Nations living in the Boreal Shield and Boreal Plains ecozones of Saskatchewan (Chan et al. 2018, 2019).

In the model, plants like blueberry are exposed to atmospheric release through deposition to soil and uptake from soil. In the ecological model blueberries are part of the diet for a number of mammals and birds including: snowshoe hare; Southern red-backed vole; black bear; red fox; rusty blackbird; and grouse. In the human health model blueberries are a component of the Traditional Foods diet, and is used as a surrogate for other fruits and berries in the human Traditional Foods diet, such as rosehips, cranberries, mooseberry, and squashberry (Chan et al. 2018, 2019).

2.2.3 Labrador Tea

Labrador tea is a common name for three closely related plant species in the genus Rhododendron, including *Rhododendron groenlandicum*, which is present in the RSA (CanNorth 2021c). Labrador tea is an important Traditional Foods component for First Nations living in the Boreal Shield and Boreal Plains ecozones of Saskatchewan (Chan et al. 2018, 2019), and is infused as a tea.

In the model, plants like Labrador tea are exposed to atmospheric release through deposition to soil. In the human health model Labrador tea is a component of the Traditional Foods diet, and is used as a surrogate for other plants in the human Traditional Foods diet, such as mint and rat root (Chan et al. 2018, 2019).

2.3 Terrestrial Mammals

2.3.1 Woodland Caribou

Woodland caribou (*Rangifer tarandus caribou*) is a medium sized member of the deer family (Cervidae), weighing between 100 and 250 kg (COSEWIC 2002). A body weight of 180 kg, representing the upper range mean for adult male and female woodland caribou (COSEWIC 2002) was selected for the ecological model. The boreal population of woodland caribou is designated as Threatened by COSEWIC and SARA and is provincially-ranked S3, meaning that the species is vulnerable/rare to uncommon in Saskatchewan (CanNorth 2021b). Woodland caribou were observed on two occasions in the RSA during baseline studies (CanNorth 2021b).

Woodland caribou have a relatively large home range that varies from 67 km^2 to 267 km^2 (McLoughlin 2016). Caribou seek mature jack pine- and black spruce-dominated forest, black spruce bog, and open muskeg habitats common to the Boreal Shield during most of the year, and inaccessible rough terrain such as muskeg or islands on lakes for calving (McLoughlin 2016). For the ecological model, a home rage of 80 km^2 was considered appropriate based on the average female range during the most sensitive life stage of the caribou (calving and post calving). For the ecological model, the caribou is assumed to interact with more than one exposure location in the RSA for feeding and water intake, due to the large home range.

The food source for the woodland caribou in the winter is terrestrial or arboreal lichens; terrestrial and aquatic vegetation are also food sources in the remainder of the year. Although the current suitability of the site for woodland caribou is relatively low due to an abundance of recently burned or harvested forest in the vicinity of the RSA, the habitat potential over the timeframe of the Project is moderate to high (Omnia 2020a). For the ecological model a diet comprised of 50% browse, 20% lichen and 30% macrophytes is assumed for the woodland caribou.

In the model, caribou are exposed to aquatic and atmospheric release through water and food. In the ecological model, caribou are part of the diet for the grey wolf. Caribou are represented by moose in the human traditional foods diet.

In the ERA, woodland caribou are assessed as a species of concern at an individual level and as a representative mammalian herbivore species at a population level.

2.3.2 Snowshoe Hare

The snowshoe hare (*Lepus americanus*) is a North American hare of the family Leporidae. Adult snowshoe hares typically weigh between 0.9 kg to 1.9 kg (FCSAP 2012) and females are often slightly larger than males (EC & CWF 2005). For the ecological model a bodyweight of 1.8 kg was selected for snowshoe hare. Snowshoe hares are one of the most common woodland mammals of every province and territory of Canada, and are present in the RSA (Omnia 2020a).

Snowshoe hares prefer forested areas with a heavy understory such as conifer-dominated habitats and deciduous riparian forests. The size of their home range can reach up to 10 ha (EC & CWF 2005), but their foraging range is relatively small (1.6 ha) especially for females during the spring and summer reproductive season (FCSAP 2012). In the ecological model snowshoe hare are assumed to reside 100% of the time at the location where they are assessed.

During the summer, the snowshoe hare's diet consists of grasses, sedges, and forbs while during the winter they eat stems and branches of woody plants (FCSAP 2012). They are also known to consume fruits and berries and some animal protein. In the ecological model, snowshoe hares are assumed to eat 90% browse and 10% berries represented by blueberries.

In the model, snowshoe hares are exposed to aquatic and atmospheric release through water and food. In the ecological model, snowshoe hare is part of the diet for the grey wolf. Snowshoe hare is represented by beaver in the human traditional foods diet in the human health model.

In the ERA, snowshoe hare is assessed as a representative upland mammalian herbivore species at a population level.

2.3.3 Moose

Moose (*Alces alces*) is a large ungulate of the family Cervidae, with an average weight for males and females of 453 kg and 350 kg, respectively (FCSAP 2012). For the ecological model a body weight of 400 kg was selected. Moose are found in Canadian forests from the Alaska boundary to the eastern tip of Newfoundland and Labrador (EC & CWF 1997). Moose meat and organs are important components of the traditional foods diet for First Nations living in the Boreal Shield and Boreal Plains ecozones of Saskatchewan (Chan et al. 2018, 2019).

Moose are essentially solitary animals that have one or several distinct seasonal home ranges to which they are strongly attached. Movements between seasonal home ranges may be extensive but home ranges are generally small and moose usually return to the same home ranges year after year (Franzmann 1981; Wilson and Ruff 1999). A seasonal home range of 10 km^2 was selected for the ecological model.

Breeding season, or rut, begins in mid-September. Cows usually bear one or two calves in the Spring, and the calves stay with the cow until she calves again the following spring. The number of calves born to a cow reflects the availability of nutrition during the rut. During the winter months, moose live almost solely on twigs and shrubs such as balsam fir, poplar, red osier dogwood, birch, willow, and red and striped maples (EC & CWF 1997). In summer the moose's diet includes leaves, some upland plants, and water plants in great quantity where available (EC & CWF 1997). The diet used in the ecological model reflects a spring/summer diet at the end of gestation and when calves are nursing. It assumes 80% browse and 20% macrophytes.

In the model, moose are exposed to aquatic and atmospheric releases through water and food. In the ecological model moose are part of the grey wolf diet. The moose is part of the Traditional

Foods diet in the human health model, and is used as a surrogate for other ungulate species such as white-tailed deer (*Odocoileus virginianus*) and woodland caribou.

In the ERA, moose are assessed as a representative ungulate species at a population level.

2.3.4 Little Brown Myotis

Little brown myotis (*Myotis lucifugus*) is a mouse-eared microbat of the family Vespertilionidae, with a body weight between 0.007 kg and 0.009 kg (EC & CWF 2013). Its range extends from Alaska, across most of North America and into central Mexico. It was, until recently, the most common bat species in Canada but its population is adversely affected by a disease called White Nose Syndrome. The little brown myotis is designated as an Endangered species under COSEWIC and SARA and is provincially-ranked S4. Two bat species, little brown myotis and northern myotis (*Myotis septentrionalis*), have breeding ranges overlapping the RSA (CanNorth 2021b). The northern myotis is also designated as an Endangered species under COSEWIC and SARA and is provincially-ranked S3 (CanNorth 2021b).

Little brown myotis does not migrate, but its summer roosting range can be up to 1000 km from its winter roosting range, also known as hibernacula, where it hibernates without eating. Bats mate in late summer, between August and early October, prior to moving to their hibernacula. Pregnant female bats leave the hibernacula in mid-April and move to their summer maternity or nursery roosts. While pregnant, females forage over a large area but stay closer to their maternity roost once the pups are born. The ecological model assumes a small home range such as during the sensitive reproductive period, and little brown myotis are assumed to spend 100% of their time at the location where they are assessed.

Little brown myotis are nocturnal opportunistic feeders. While at their summer roosts, their diet consists of a great variety of small, flying insects, typically moths, flies, mosquitoes, mayflies, beetles, and midges. In the ecological model, the diet of little brown myotis is composed exclusively of aerial insects with an aquatic larval life stage, represented by benthic invertebrates.

In the model, little brown myotis are exposed to aquatic release through water and food.

In the ERA, little brown myotis are assessed as a species of special concern on an individual level and as a representative insectivorous mammal or other mammals with a similar diet on a population level.

2.3.5 Southern Red-Backed Vole

Southern red-backed vole (*Myodes gapperi*), is a woodland vole of the family Cricetidae, found in Canada and the northern United States, that weighs up to 0.042 kg. Red-backed voles are present in the RSA and were among the most abundant small mammals trapped during baseline studies (Omnia 2020a). Similar small mammals trapped during baseline studies included meadow voles (*Microtus pennsylvanicus*), deer mice (*Peromyscus maniculatus*), masked shrew (*Sorex cinerus*), and water shrew (*Sorex palustris*) (Omnia 2020a). Red-backed vole tissue samples were retained for chemical analysis. For the model, the body weight and total feed intake for the meadow vole were used because it is a similar species that is well characterized and commonly used in risk assessments (FCSAP 2012).

Baseline studies indicate that red-backed voles are present in all ecosites and vegetation cover types in the RSA. Coarse woody debris and shrub cover are two major components of red-backed vole habitat (Omnia 2020a). They often reside in burrows created by other small mammals, and use runways they created through the vegetation understory or snow. They remain active year-round and generally feed during the night. Females may have two to four litters a year. In the ecological model, voles are assumed to reside 100% of the time at the location where they are assessed.

Southern red-backed voles are omnivorous. They generally feed on green plants, underground fungi, seeds, nuts, roots, and berries, but also eat small terrestrial invertebrates such as insects and snails. They are known to store food for later use. In the ecological model, voles are assumed to eat 60% berries (blueberries) and 40% browse.

In the model, voles are exposed to aquatic and atmospheric releases through water and food. In the ecological model voles are part of the diet for red fox.

In the ERA, voles are assessed as a representative mammalian herbivore at a population level.

2.3.6 Black Bear

Black bear (*Ursus americanus*) is a large terrestrial omnivore. The body weight of black bears varies seasonally and is at its greatest in the fall before winter hibernation. The summer (June/July) weights for males and females are approximately 90 kg and 46 kg, respectively, resulting in an average weight of 68 kg (FCSAP 2012). Although its natural range is across North America, black bears have been extirpated from much of their territory in the continental United States. Currently, black bears are commonly found across most of Canada and Alaska (EC & CWF 2007). Black bears are widespread within the RSA (CanNorth 2021b; Omnia 2020a).

Black bears are found in a variety of habitats but appear to prefer heavily wooded areas and dense bushland. Black bears mate in June or early July, and the cubs, generally one or two, are born the following January or February while the mother is still in her winter den (EC & CWF 2007). The availability of food in the foraging range leading up to denning is important to reproductive success because the bear's fetuses do not "implant" into the uterus until late fall when she enters her winter den (EC & CWF 2007). Home ranges from for female black bears in the Saskatchewan Boreal Shield range from 40 km^2 to 130 km^2, as determined from GPS tracking data (McLoughlin et al. 2019). In the ecological model an average female home range of 80 km^2 is used. For the ecological model, the black bear is assumed to interact with more than one exposure location in the RSA for feeding and water intake, due to the large home range.

Black bears are omnivores and eat seasonally available food. Most of their diet is composed of plant material, including many berries (blueberries, buffalo berries, strawberries, elderberries, Saskatoon berries), fruits (black cherries, and apples) and nuts (acorns, hazelnuts, and beechnuts)

(EC & CWF 2007; FCSAP 2012). Black bears also consume animals, especially invertebrates (ants, bee larvae), fish, small mammals and birds, and carrion (EC & CWF 2007; FCSAP 2012). In the ecological model, black bears are assumed to eat 70% berries (blueberries) and 30% fish (northern pike).

In the model, black bears are exposed to aquatic and atmospheric releases through water and food.

In the ERA, black bears are assessed as a representative terrestrial mammalian omnivorous species at a population level.

2.3.7 Red Fox

The red fox (*Vulpes vulpes*) is a small mammal that ranges in length between 90 cm and 112 cm, and weighs approximately 4.54 kg (USEPA 1993). They are the most widely distributed carnivore in the world (USEPA 1993). Red foxes are found throughout Canada in all provinces and territories. Red foxes are common to northern Saskatchewan and are known to be present in the RSA (Omnia 2020a).

Red foxes occupy many habitats, but in the RSA the highest densities were associated with anthropogenically modified habitats (Omnia 2020a). They generally occupy a home range between 4 to 8 km^2 and reside in a main underground den and one or more other burrows within their home range. Foxes tend to concentrate their activities near to their dens (USEPA 1993). Foxes breed between late December to mid-March, and pups are born from March through May, with litter sizes ranging from 1 to 10 pups. Pup-rearing is the primary focus of the red fox during spring and early summer. The red fox is assumed to spend 100% of its time at the location where it is assessed.

Red foxes are primarily carnivorous but also eat insects and plant material (fruits, berries, seeds and nuts) (USEPA 1993). Their diet varies with the seasons, eating mainly small mammals in fall and winter, nesting waterfowl in the spring, and insects and berries in the summer (EC & CWF 2019). For the ecological model it is assumed that the red fox's diet consists of 70% small mammals (48% hares and 32% voles) and 30% terrestrial plants represented by browse.

In the model, foxes are exposed to aquatic and atmospheric releases through water and food.

In the ERA, foxes are assessed as a representative mammalian carnivore species at a population level.

2.3.8 Grey Wolf

The grey wolf (*Canis lupus*) is a terrestrial carnivore representing the top level of the food chain. Grey wolves generally weigh between 27 kg and 45 kg, but can be larger (Earthroots 2020). The grey wolf's historical range was across North America, Europe and Asia but they have been extirpated from much of this range. Currently, they are still common in lightly settled portions of Canada from Labrador to British Columbia and in the Yukon Territory and the Northwest

Territories (EC & CWF 1993). The northern grey wolf (Canis lupus occidentalis) has been observed in the RSA during baseline studies (CanNorth 2021b). Wolves have been trapped and harvested for fur in the northern Saskatchewan, including in the Fur Conservation Area (N-19) of La Loche (Omnia 2020b).

Wolves are territorial. The size of their territory varies depending on the availability of prey (EC & CWF 1993). They live and hunt in packs generally composed on a male, female and their offspring. They generally breed once a year in the wild and pups are born in a den that is commonly dug into the soil or in old stumps or rock crevasses (EC & CWF 1993). Home ranges for grey wolves in Minnesota, Alaska, southern Yukon, and British Columbia range from 100 km^2 to 2,451 km^2 (RIC 1998). An expected home range of 1,300 km^2 was selected for the ecological model. For the ecological model, the grey wolf is assumed to interact with more than one exposure location in the RSA for feeding and water intake, due to the large home range.

The wolf's diet consumes terrestrial herbivores including large prey such as moose, caribou, and small prey such as hare (Earthroots 2020). Small prey generally makes up only a small portion of the overall diet (EC & CWF 1993). For the ecological model a diet comprised of 45% moose, 45% caribou and 10% small mammals (snowshoe hare).

In the model, grey wolves are exposed to aquatic and atmospheric releases through water and food.

In the ERA, grey wolves are assessed as a representative avian piscivorous species at a population level.

2.4 Terrestrial Birds

2.4.1 Canada Goose

Canada goose (*Branta canadensis*) is a large terrestrial herbivore of the family Anatidae. Canada geese breed in open forested areas near lake shores and coastal marshes from the arctic tundra through temperate climates (USEPA 1993). Canada goose was the most commonly detected bird species in the RSA during baseline studies (CanNorth 2021b) and are known to breed in the RSA (Omnia 2020a). Geese, including Canada geese and brant geese (*Branta bernicla*), are part of the Traditional Foods diet for the Boreal Plaines and Boreal Shield ecozones of Saskatchewan (Chan et al. 2018, 2019). The USEPA (1993) considers brant geese to be similar to Canada geese.

Body weights for Canada geese vary seasonally and are at their maximum in spring prior to migrating to their northern breeding grounds. Their body weights decline during reproduction and rearing of young (USEPA 1993). For the ecological model, a body weight of 3.7 kg is used for the Canada goose.

The foraging areas for Canada geese vary seasonally. After hatching, goose families tend to move away from their nesting site to other areas, generally on land in riparian areas and near water, with adequate cover and forage to rear their broods (USEPA 1993). Canada geese are almost exclusively vegetarian. They are primarily grazers but consume some grit to aid digestion (USEPA

1993). In the ecological model, Canada geese are assumed to eat 100% browse, and they are assumed to spend 100% of their time at the location where they are assessed.

In the model, Canada geese are exposed to aquatic and atmospheric releases through water and food.

In the ERA, Canada geese are assessed as a representative avian herbivore species at a population level. Although geese are part of the human traditional foods diet, grouse is used as a surrogate for geese in the human health model.

2.4.2 Spruce Grouse

Grouse are avian ground foraging herbivores. Spruce grouse (*Dendragapus canadensis*) have been observed in the RSA during baseline wildlife studies (CanNorth 2021b). Adult spruce grouse average 0.6 kg in weight (FCSAP 2012). Grouse are an important component of the traditional foods diet for First Nations living in the Boreal Shield and Boreal Plains ecozones of Saskatchewan (Chan et al. 2018, 2019).

Grouse are sedentary resident species with a foraging range of 3 to 24 hectares (FCSAP, 2012). Spruce grouse inhabit evergreen forests, especially spruce, jack pine, and lodgepole pine, and appear to prefer young, regenerating tracts that have a dense understory (Cornell Lab n.d.). In the ecological model, grouse are assumed to spend 100% of their time at the location where they are assessed.

Spruce grouse eat pine needles as the main component of their diet, with berries as a secondary food and insects and fungus comprise a small portion of their overall diet (FCSAP 2012). In the ecological model, grouse are assumed to eat 70% browse and 30% berries (blueberry).

In the model, grouse are exposed to aquatic and atmospheric releases through water and food. In the human health model, grouse is part of the human traditional foods diet, and is a surrogate for other terrestrial birds, such as geese and ptarmigan, that have similar diets.

In the ERA, grouse are assessed as a representative avian herbivore species at a population level.

2.4.3 Rusty Blackbird

The Rusty Blackbird (*Euphagus carolinus*) is a medium sized migratory passerine weighing about 64 g. Wintering areas occur primarily within the southeastern United States (EC 2015). It is designated as a Species of Special Concern under COSEWIC and SARA.

The rusty blackbird breeds throughout the boreal forest. Their preferred habitat includes forest wetlands, peat bogs, sedge meadows, marshes, swamps, beaver ponds, and pasture edges (COSEWIC 2006). Suitable summer habitat for the rusty blackbird was found to be common and widespread within the RSA, and rusty blackbirds were observed in the RSA during baseline studies (CanNorth 2021b).

The breeding season for the rusty blackbird begins in April or May, and ends between August to October. Females typically build nests placed in thickets of small conifers or deciduous shrubs, or in dead trees close to water. Females lay a clutch between 3 to 6 eggs and the nesting period lasts between 11 and 13 days (COSEWIC 2016). For the ecological risk assessment, it is assumed that the rusty blackbird spends 100% of its time at the location where it is assessed.

The main dietary components of the Rusty Blackbird include invertebrates associated with aquatic environments, supplanting its diet with seeds and small fruits in the fall and winter (COSEWIC 2006). For the ecological model, it is assumed that the Rusty Blackbird's diet consists of 80% aquatic invertebrates and 20% berries.

In the model, rusty blackbirds are exposed to aquatic and atmospheric releases through water and food.

In the ERA, rusty blackbird is assessed as a species of special concern on an individual level and is considered a suitable surrogate species for other species at risk with similar characteristics and diets that have been observed in the RSA during baseline studies, including common nighthawk, olive-sided flycatcher, and barn swallow (CanNorth 2021b). The rusty blackbird is assessed as a representative insectivorous avian species for other birds with a similar diet on a population level.

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Appendix C Model Results in Support of the Environmental Risk Assessment

Table C.1: Maximum Concentrations of Non-radiological COPCs for the Application Case and Upper Bound Scenario - Project Lifespan

	Location	Maximum Concentration during Operations													
		Application Case							Upper Bound Scenario						
		Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium	Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium
Water (mg/L)	Reference (Broach Lake)	4.22E-01	1.06E+00	1.24E-04	5.83E-04	8.43E-04	2.06E-04	1.00E-04	4.22E-01	1.06E+00	1.24E-04	5.83E-04	8.43E-04	2.06E-04	1.00E-04
	Clearwater River downstream of Broach Lake	4.22E-01	1.06E+00	1.24E-04	5.83E-04	8.43E-04	2.06E-04	1.00E-04	4.22E-01	1.06E+00	1.24E-04	5.83E-04	8.43E-04	2.06E-04	1.00E-04
	Patterson Lake North Arm - East Basin	4.32E-01	1.07E+00	1.25E-04	5.88E-04	8.44E-04	2.07E-04	1.00E-04	4.33E-01	1.07E+00	1.25E-04	5.89E-04	8.44E-04	2.07E-04	1.01E-04
	Patterson Lake North Arm - West Basin	4.35E+00	2.14E+02	4.36E-04	7.71E-04	9.95E-04	5.98E-04	3.84E-04	1.00E+02	2.16E+02	4.46E-04	7.78E-04	9.99E-04	1.39E-03	9.25E-04
	Patterson Lake South Arm	3.17E+00	1.45E+02	1.50E-04	6.85E-04	9.23E-04	4.07E-04	1.76E-04	7.16E+01	1.47E+02	1.50E-04	6.89E-04	9.25E-04	8.15E-04	3.09E-04
	Forrest Lake North Basin	2.10E+00	9.01E+01	1.39E-04	6.45E-04	8.92E-04	3.30E-04	1.47E-04	4.40E+01	9.08E+01	1.40E-04	6.48E-04	8.93E-04	5.82E-04	2.28E-04
	Beet Lake	1.97E+00	8.25E+01	1.28E-04	6.36E-04	8.84E-04	3.09E-04	1.28E-04	4.05E+01	8.33E+01	1.28E-04	6.38E-04	8.85E-04	5.20E-04	1.77E-04
	Naomi Lake	1.64E+00	6.49E+01	1.26E-04	6.24E-04	8.74E-04	2.85E-04	1.20E-04	3.18E+01	6.56E+01	1.26E-04	6.25E-04	8.75E-04	4.48E-04	1.55E-04
	Clearwater River upstream Mirror River Confluence	1.08E+00	3.57E+01	1.25E-04	6.05E-04	8.60E-04	2.49E-04	1.11E-04	1.74E+01	3.60E+01	1.25E-04	6.06E-04	8.60E-04	3.37E-04	1.30E-04
	Clearwater River downstream Mirror River Confluence	6.20E-01	1.16E+01	1.24E-04	5.90E-04	8.48E-04	2.19E-04	1.04E-04	5.55E+00	1.17E+01	1.24E-04	5.90E-04	8.48E-04	2.46E-04	1.09E-04
	Lloyd Lake Inlet	5.86E-01	9.71E+00	1.24E-04	5.89E-04	8.47E-04	2.17E-04	1.03E-04	4.65E+00	9.80E+00	1.24E-04	5.89E-04	8.47E-04	2.39E-04	1.07E-04
Sediment (mg/kg dw)	Reference (Broach Lake)	-	-	1.00E+01	1.45E+00	2.52E+00	6.51E-01	1.93E+00	-	-	1.00E+01	1.45E+00	2.52E+00	6.51E-01	1.93E+00
	Patterson Lake North Arm - West Basin - East Basin	-	-	1.00E+01	1.46E+00	2.52E+00	6.52E-01	1.93E+00	-	-	1.00E+01	1.46E+00	2.52E+00	6.52E-01	1.93E+00
	Patterson Lake North Arm - West Basin - West Basin	-	-	3.05E+01	1.88E+00	2.93E+00	1.74E+00	6.33E+00	-	-	3.10E+01	1.90E+00	2.94E+00	3.97E+00	1.42E+01
	Patterson Lake South Arm	-	-	1.17E+01	1.68E+00	2.73E+00	1.21E+00	3.09E+00	-	-	1.17E+01	1.69E+00	2.73E+00	2.39E+00	5.19E+00
	Beet Lake	-	-	1.03E+01	1.57E+00	2.62E+00	9.39E-01	2.36E+00	-	-	1.03E+01	1.58E+00	2.63E+00	1.55E+00	3.12E+00
	Naomi Lake	-	-	1.01E+01	1.54E+00	2.60E+00	8.72E-01	2.23E+00	-	-	1.01E+01	1.55E+00	2.60E+00	1.34E+00	2.77E+00
	Lloyd Lake Inlet	-	-	1.00E+01	1.47E+00	2.53E+00	6.81E-01	1.97E+00	-	-	1.00E+01	1.47E+00	2.53E+00	7.43E-01	2.04E+00
Air (mg/m^3)	Reference (Broach Lake)	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Patterson Lake North Arm - West Basin	-	-	3.00E-08	2.00E-08	1.70E-07	1.20E-07	9.38E-06	-	-	3.00E-08	2.00E-08	1.70E-07	1.20E-07	9.38E-06
	Patterson Lake South Arm	-	-	1.00E-08	1.00E-08	3.00E-08	2.00E-08	1.34E-06	-	-	1.00E-08	1.00E-08	3.00E-08	2.00E-08	1.34E-06
	Beet Lake	-	-	1.00E-08	1.00E-08	2.00E-08	1.00E-08	7.90E-07	-	-	1.00E-08	1.00E-08	2.00E-08	1.00E-08	7.90E-07
	Clearwater River and Mirror River Confluence	-	-	1.00E-08	1.00E-08	1.00E-08	1.00E-08	5.00E-08	-	-	1.00E-08	1.00E-08	1.00E-08	1.00E-08	5.00E-08
	Lloyd Lake	-	-	1.00E-08	1.00E-08	1.00E-08	1.00E-08	3.00E-08	-	-	1.00E-08	1.00E-08	1.00E-08	1.00E-08	3.00E-08
Soil (mg/kg dw)	Reference (Broach Lake)	-	-	5.89E-01	4.32E-01	6.01E-01	1.42E-01	2.47E-01	-	-	5.89E-01	4.32E-01	6.01E-01	1.42E-01	2.47E-01
	Patterson Lake North Arm - West Basin	-	-	5.89E-01	4.34E-01	6.19E-01	1.47E-01	1.30E+00	-	-	5.89E-01	4.34E-01	6.19E-01	1.47E-01	1.30E+00
	Patterson Lake South Arm	-	-	5.89E-01	4.33E-01	6.04E-01	1.43E-01	3.97E-01	-	-	5.89E-01	4.33E-01	6.04E-01	1.43E-01	3.97E-01
	Beet Lake	-	-	5.89E-01	4.33E-01	6.03E-01	1.43E-01	3.36E-01	-	-	5.89E-01	4.33E-01	6.03E-01	1.43E-01	3.36E-01
	Clearwater River and Mirror River Confluence	-	-	5.89E-01	4.33E-01	6.02E-01	1.43E-01	2.53E-01	-	-	5.89E-01	4.33E-01	6.02E-01	1.43E-01	2.53E-01
	Lloyd Lake	-	-	5.89E-01	4.33E-01	6.02E-01	1.43E-01	2.51E-01	-	-	5.89E-01	4.33E-01	6.02E-01	1.43E-01	2.51E-01

Table C.2: Maximum Concentrations of Non-radiological COPCs for the Application Case and Upper Bound Scenario – Far-Future

		Maximum Concentration Far-Future Scenario													
	Location	Application Case							Upper Bound Scenario						
		Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium	Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium
Water (mg/L)	Reference (Broach Lake)	4.22E-01	1.06E+00	1.24E-04	5.83E-04	8.43E-04	2.06E-04	1.00E-04	4.22E-01	1.06E+00	1.24E-04	5.83E-04	8.43E-04	2.06E-04	1.00E-04
	Clearwater River downstream of Broach Lake	4.22E-01	1.06E+00	1.24E-04	5.83E-04	8.43E-04	2.06E-04	1.00E-04	4.22E-01	1.06E+00	1.24E-04	5.83E-04	8.43E-04	2.06E-04	1.00E-04
	Patterson Lake North Arm - East Basin	4.22E-01	1.06E+00	1.24E-04	5.83E-04	8.43E-04	2.06E-04	1.00E-04	4.22E-01	1.06E+00	1.24E-04	5.83E-04	8.43E-04	2.06E-04	1.00E-04
	Patterson Lake North Arm - West Basin	8.39E-01	2.16E+00	1.31E-04	1.43E-03	2.18E-03	4.60E-03	1.00E-03	1.04E+00	2.79E+00	1.35E-04	1.88E-03	2.85E-03	1.71E-02	1.00E-03
	Patterson Lake South Arm	7.27E-01	1.86E+00	1.24E-04	1.10E-03	1.63E-03	2.76E-03	3.50E-04	8.76E-01	2.33E+00	1.25E-04	1.37E-03	2.02E-03	1.00E-02	3.51E-04
	Forrest Lake North Basin	6.07E-01	1.55E+00	1.24E-04	8.94E-04	1.32E-03	1.76E-03	2.52E-04	6.98E-01	1.83E+00	1.24E-04	1.06E-03	1.56E-03	6.16E-03	2.52E-04
	Beet Lake	5.94E-01	1.51E+00	1.24E-04	8.54E-04	1.25E-03	1.54E-03	1.93E-04	6.78E-01	1.77E+00	1.24E-04	9.98E-04	1.46E-03	5.31E-03	1.93E-04
	Naomi Lake	5.56E-01	1.41E+00	1.24E-04	7.92E-04	1.16E-03	1.23E-03	1.66E-04	6.22E-01	1.62E+00	1.24E-04	9.03E-04	1.32E-03	4.12E-03	1.66E-04
	Clearwater River upstream Mirror River Confluence	4.94E-01	1.25E+00	1.24E-04	6.96E-04	1.01E-03	7.56E-04	1.36E-04	5.30E-01	1.36E+00	1.24E-04	7.55E-04	1.10E-03	2.32E-03	1.36E-04
	Clearwater River downstream Mirror River Confluence	4.44E-01	1.12E+00	1.24E-04	6.17E-04	8.94E-04	3.72E-04	1.11E-04	4.54E-01	1.15E+00	1.24E-04	6.35E-04	9.20E-04	8.41E-04	1.11E-04
	Lloyd Lake Inlet	4.40E-01	1.11E+00	1.24E-04	6.11E-04	8.85E-04	3.42E-04	1.09E-04	4.49E-01	1.14E+00	1.24E-04	6.26E-04	9.06E-04	7.27E-04	1.09E-04
Sediment (mg/kg dw)	Reference (Broach Lake)	-	-	1.00E+01	1.45E+00	2.52E+00	6.51E-01	1.93E+00	-	-	1.00E+01	1.45E+00	2.52E+00	6.51E-01	1.93E+00
	Patterson Lake North Arm - West Basin - East Basin	-	-	1.00E+01	1.45E+00	2.52E+00	6.51E-01	1.93E+00	-	-	1.00E+01	1.45E+00	2.52E+00	6.51E-01	1.93E+00
	Patterson Lake North Arm - West Basin - West Basin	-	-	1.06E+01	3.56E+00	6.51E+00	1.45E+01	1.93E+01	-	-	1.09E+01	4.68E+00	8.52E+00	5.39E+01	1.93E+01
	Patterson Lake South Arm	-	-	1.00E+01	2.73E+00	4.86E+00	8.71E+00	6.74E+00	-	-	1.01E+01	3.41E+00	6.04E+00	3.16E+01	6.74E+00
	Beet Lake	-	-	1.00E+01	2.13E+00	3.74E+00	4.85E+00	3.72E+00	-	-	1.00E+01	2.49E+00	4.36E+00	1.68E+01	3.72E+00
	Naomi Lake	-	-	1.00E+01	1.97E+00	3.46E+00	3.87E+00	3.19E+00	-	-	1.00E+01	2.25E+00	3.93E+00	1.30E+01	3.19E+00
	Lloyd Lake Inlet	-	-	1.00E+01	1.52E+00	2.64E+00	1.08E+00	2.09E+00	-	-	1.00E+01	1.56E+00	2.71E+00	2.29E+00	2.09E+00
Air (mg/m^3)	Reference (Broach Lake)	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Patterson Lake North Arm - West Basin	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Patterson Lake South Arm	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Beet Lake	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Clearwater River and Mirror River Confluence	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Lloyd Lake	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Soil (mg/kg dw)	Reference (Broach Lake)	-	-	5.89E-01	4.32E-01	6.01E-01	1.42E-01	2.47E-01	-	-	5.89E-01	4.32E-01	6.01E-01	1.42E-01	2.47E-01
	Patterson Lake North Arm - West Basin	-	-	5.89E-01	4.33E-01	6.02E-01	1.42E-01	3.57E-01	-	-	5.89E-01	4.33E-01	6.02E-01	1.42E-01	3.57E-01
	Patterson Lake South Arm	-	-	5.89E-01	4.33E-01	6.01E-01	1.42E-01	2.63E-01	-	-	5.89E-01	4.33E-01	6.01E-01	1.42E-01	2.63E-01
	Beet Lake	-	-	5.89E-01	4.33E-01	6.01E-01	1.42E-01	2.57E-01	-	-	5.89E-01	4.33E-01	6.01E-01	1.42E-01	2.57E-01
	Clearwater River and Mirror River Confluence	-	-	5.89E-01	4.33E-01	6.01E-01	1.42E-01	2.48E-01	-	-	5.89E-01	4.33E-01	6.01E-01	1.42E-01	2.48E-01
	Lloyd Lake	-	-	5.89E-01	4.33E-01	6.01E-01	1.42E-01	2.48E-01	-	-	5.89E-01	4.33E-01	6.01E-01	1.42E-01	2.48E-01

Table C.3: Maximum Concentrations of Non-radiological COPCs for the RFD Scenario - Project Lifespan and Far-Future

		Maximum Concentration RFD case													
	Location	Project Lifespan							Far-Future						
		Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium	Chloride	Sulphate	Arsenic	Cobalt	Copper	Molybdenum	Uranium
Water (mg/L)	Reference (Broach Lake)	4.22E-01	1.06E+00	1.24E-04	5.83E-04	8.43E-04	2.06E-04	1.00E-04	4.22E-01	1.06E+00	1.24E-04	5.83E-04	8.43E-04	2.06E-04	1.00E-04
	Clearwater River downstream of Broach Lake	4.22E-01	1.06E+00	1.24E-04	5.83E-04	8.43E-04	2.06E-04	1.00E-04	4.22E-01	1.06E+00	1.24E-04	5.83E-04	8.43E-04	2.06E-04	1.00E-04
	Patterson Lake North Arm - East Basin	4.32E-01	1.07E+00	1.25E-04	5.88E-04	8.44E-04	2.07E-04	1.00E-04	4.22E-01	1.06E+00	1.24E-04	5.83E-04	8.43E-04	2.06E-04	1.00E-04
	Patterson Lake North Arm - West Basin	4.35E+00	2.14E+02	4.36E-04	7.71E-04	9.95E-04	5.98E-04	3.84E-04	8.39E-01	2.16E+00	1.31E-04	1.43E-03	2.18E-03	4.60E-03	1.00E-03
	Patterson Lake South Arm	4.27E+00	2.14E+02	6.93E-04	7.82E-04	1.01E-03	5.72E-04	5.37E-04	7.27E-01	1.86E+00	1.24E-04	1.10E-03	1.63E-03	2.76E-03	3.50E-04
	Forrest Lake North Basin	2.85E+00	1.36E+02	4.84E-04	7.08E-04	9.47E-04	4.37E-04	3.76E-04	6.07E-01	1.55E+00	1.24E-04	8.94E-04	1.32E-03	1.76E-03	2.52E-04
	Beet Lake	2.37E+00	1.09E+02	2.21E-04	6.71E-04	9.15E-04	3.69E-04	2.52E-04	5.94E-01	1.51E+00	1.24E-04	8.54E-04	1.25E-03	1.54E-03	1.93E-04
	Naomi Lake	1.95E+00	8.57E+01	1.74E-04	6.50E-04	8.97E-04	3.30E-04	2.06E-04	5.56E-01	1.41E+00	1.24E-04	7.92E-04	1.16E-03	1.23E-03	1.66E-04
	Clearwater River upstream Mirror River Confluence	1.25E+00	4.69E+01	1.52E-04	6.19E-04	8.72E-04	2.73E-04	1.59E-04	4.94E-01	1.25E+00	1.24E-04	6.96E-04	1.01E-03	7.56E-04	1.36E-04
	Clearwater River downstream Mirror River Confluence	6.72E-01	1.49E+01	1.32E-04	5.94E-04	8.52E-04	2.26E-04	1.18E-04	4.44E-01	1.12E+00	1.24E-04	6.17E-04	8.94E-04	3.72E-04	1.11E-04
	Lloyd Lake Inlet	6.28E-01	1.25E+01	1.30E-04	5.92E-04	8.50E-04	2.23E-04	1.14E-04	4.40E-01	1.11E+00	1.24E-04	6.11E-04	8.85E-04	3.42E-04	1.09E-04
Sediment (mg/kg dw)	Reference (Broach Lake)	-	-	1.00E+01	1.45E+00	2.52E+00	6.51E-01	1.93E+00	-	-	1.00E+01	1.45E+00	2.52E+00	6.51E-01	1.93E+00
	Patterson Lake North Arm - West Basin - East Basin	-	-	1.00E+01	1.46E+00	2.52E+00	6.52E-01	1.93E+00	-	-	1.00E+01	1.45E+00	2.52E+00	6.51E-01	1.93E+00
	Patterson Lake North Arm - West Basin - West Basin	-	-	3.05E+01	1.88E+00	2.93E+00	1.74E+00	6.33E+00	-	-	1.06E+01	3.56E+00	6.51E+00	1.45E+01	1.93E+01
	Patterson Lake South Arm	-	-	2.29E+01	1.77E+00	2.82E+00	1.39E+00	4.46E+00	-	-	1.00E+01	2.73E+00	4.86E+00	8.71E+00	6.74E+00
	Beet Lake	-	-	1.22E+01	1.62E+00	2.68E+00	1.03E+00	2.86E+00	-	-	1.00E+01	2.13E+00	3.74E+00	4.85E+00	3.72E+00
	Naomi Lake	-	-	1.11E+01	1.58E+00	2.64E+00	9.46E-01	2.58E+00	-	-	1.00E+01	1.97E+00	3.46E+00	3.87E+00	3.19E+00
	Lloyd Lake Inlet	-	-	1.01E+01	1.47E+00	2.53E+00	6.91E-01	2.01E+00	-	-	1.00E+01	1.52E+00	2.64E+00	1.08E+00	2.09E+00
Air (mg/m^3)	Reference (Broach Lake)	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Patterson Lake North Arm - West Basin	-	-	1.00E-08	1.00E-08	1.72E-07	1.23E-07	9.47E-06	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Patterson Lake South Arm	-	-	1.00E-08	1.00E-08	1.00E-08	1.00E-08	1.51E-06	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Beet Lake	-	-	1.00E-08	1.00E-08	1.00E-08	1.00E-08	8.45E-07	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Clearwater River and Mirror River Confluence	-	-	1.00E-08	1.00E-08	1.00E-08	1.00E-08	6.36E-08	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Lloyd Lake	-	-	1.00E-08	1.00E-08	1.00E-08	1.00E-08	1.00E-08	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Soil (mg/kg dw)	Reference (Broach Lake)	-	-	5.89E-01	4.32E-01	6.01E-01	1.42E-01	2.47E-01	-	-	5.89E-01	4.32E-01	6.01E-01	1.42E-01	2.47E-01
	Patterson Lake North Arm - West Basin	-	-	5.89E-01	4.33E-01	6.19E-01	1.47E-01	1.31E+00	-	-	5.89E-01	4.33E-01	6.02E-01	1.42E-01	3.59E-01
	Patterson Lake South Arm	-	-	5.89E-01	4.33E-01	6.02E-01	1.43E-01	4.16E-01	-	-	5.89E-01	4.33E-01	6.01E-01	1.42E-01	2.65E-01
	Beet Lake	-	-	5.89E-01	4.33E-01	6.02E-01	1.43E-01	3.42E-01	-	-	5.89E-01	4.33E-01	6.01E-01	1.42E-01	2.57E-01
	Clearwater River and Mirror River Confluence	-	-	5.89E-01	4.33E-01	6.02E-01	1.43E-01	2.54E-01	-	-	5.89E-01	4.33E-01	6.01E-01	1.42E-01	2.48E-01
	Lloyd Lake	-	-	5.89E-01	4.33E-01	6.02E-01	1.43E-01	2.48E-01	-	-	5.89E-01	4.33E-01	6.01E-01	1.42E-01	2.47E-01

Table C.4: Maximum Concentrations of Radiological COPCs for the Application Case and Upper Bound Scenario - Project Lifespan

	Location	Maximum Concentration Project Lifespan											
		Application Case						Upper Bound Scenario					
		Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210
Water (Bq/L)	Reference (Broach Lake)	3.56E-04	3.56E-04	9.09E-03	5.54E-03	5.07E-03	5.15E-03	3.56E-04	3.56E-04	9.09E-03	5.54E-03	5.07E-03	5.15E-03
	Clearwater River downstream of Broach Lake	3.56E-04	3.56E-04	9.09E-03	5.54E-03	5.07E-03	5.15E-03	3.56E-04	3.56E-04	9.09E-03	5.54E-03	5.07E-03	5.15E-03
	Patterson Lake North Arm - East Basin	3.58E-04	3.58E-04	9.12E-03	5.55E-03	5.08E-03	5.16E-03	3.58E-04	3.58E-04	9.12E-03	5.55E-03	5.08E-03	5.16E-03
	Patterson Lake North Arm - West Basin	3.88E-03	3.89E-03	5.17E-02	9.63E-03	7.74E-03	7.82E-03	1.06E-02	1.06E-02	5.22E-02	9.82E-03	1.94E-02	1.99E-02
	Patterson Lake South Arm	1.30E-03	1.31E-03	3.41E-02	6.99E-03	5.22E-03	5.31E-03	2.95E-03	2.96E-03	3.44E-02	7.05E-03	5.86E-03	5.96E-03
	Forrest Lake North Basin	9.38E-04	9.40E-04	2.44E-02	6.43E-03	5.16E-03	5.25E-03	1.94E-03	1.95E-03	2.46E-02	6.47E-03	5.55E-03	5.65E-03
	Beet Lake	7.04E-04	7.06E-04	2.22E-02	6.15E-03	5.09E-03	5.17E-03	1.31E-03	1.31E-03	2.24E-02	6.18E-03	5.17E-03	5.26E-03
	Naomi Lake	6.01E-04	6.02E-04	1.92E-02	5.99E-03	5.08E-03	5.16E-03	1.03E-03	1.03E-03	1.94E-02	6.01E-03	5.11E-03	5.20E-03
	Clearwater River upstream Mirror River Confluence	4.89E-04	4.89E-04	1.46E-02	5.78E-03	5.07E-03	5.16E-03	7.20E-04	7.22E-04	1.46E-02	5.79E-03	5.09E-03	5.18E-03
	Clearwater River downstream Mirror River Confluence	3.96E-04	3.96E-04	1.07E-02	5.61E-03	5.07E-03	5.16E-03	4.66E-04	4.67E-04	1.08E-02	5.62E-03	5.07E-03	5.16E-03
	Lloyd Lake Inlet	3.88E-04	3.88E-04	1.04E-02	5.60E-03	5.07E-03	5.15E-03	4.43E-04	4.44E-04	1.05E-02	5.60E-03	5.07E-03	5.16E-03
Sediment (Bq/kg dw)	Reference (Broach Lake)	6.84E+00	6.84E+00	2.09E+01	6.47E+01	3.59E+02	3.65E+02	6.84E+00	6.84E+00	2.09E+01	6.47E+01	3.59E+02	3.65E+02
	Patterson Lake North Arm - East Basin	6.86E+00	6.86E+00	2.09E+01	6.48E+01	3.59E+02	3.66E+02	6.86E+00	6.86E+00	2.09E+01	6.48E+01	3.59E+02	3.66E+02
	Patterson Lake North Arm - West Basin	6.16E+01	6.18E+01	1.16E+02	1.04E+02	4.92E+02	5.00E+02	1.59E+02	1.59E+02	1.17E+02	1.06E+02	9.84E+02	1.00E+03
	Patterson Lake South Arm	2.13E+01	2.14E+01	7.49E+01	7.82E+01	3.68E+02	3.74E+02	4.72E+01	4.74E+01	7.57E+01	7.88E+01	4.01E+02	4.08E+02
	Beet Lake	1.22E+01	1.22E+01	4.93E+01	7.04E+01	3.60E+02	3.67E+02	2.17E+01	2.17E+01	4.97E+01	7.07E+01	3.65E+02	3.71E+02
	Naomi Lake	1.06E+01	1.06E+01	4.28E+01	6.89E+01	3.60E+02	3.66E+02	1.72E+01	1.73E+01	4.31E+01	6.91E+01	3.62E+02	3.68E+02
	Lloyd Lake Inlet	7.33E+00	7.33E+00	2.38E+01	6.53E+01	3.59E+02	3.65E+02	8.19E+00	8.19E+00	2.38E+01	6.53E+01	3.59E+02	3.66E+02
Air (Bq/m^3)	Reference (Broach Lake)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Patterson Lake North Arm	9.26E-05	9.26E-05	9.26E-05	9.26E-05	9.26E-05	9.26E-05	9.26E-05	9.26E-05	9.26E-05	9.26E-05	9.26E-05	9.26E-05
	Patterson Lake South Arm	1.51E-05	1.51E-05	1.51E-05	1.51E-05	1.51E-05	1.51E-05	1.51E-05	1.51E-05	1.51E-05	1.51E-05	1.51E-05	1.51E-05
	Beet Lake	8.80E-06	8.80E-06	8.80E-06	8.80E-06	8.80E-06	8.80E-06	8.80E-06	8.80E-06	8.80E-06	8.80E-06	8.80E-06	8.80E-06
	Clearwater River and Mirror River Confluence	5.48E-07	5.48E-07	5.48E-07	5.48E-07	5.48E-07	5.48E-07	5.48E-07	5.48E-07	5.48E-07	5.48E-07	5.48E-07	5.48E-07
	Lloyd Lake	2.94E-07	2.94E-07	2.94E-07	2.94E-07	2.94E-07	2.94E-07	2.94E-07	2.94E-07	2.94E-07	2.94E-07	2.94E-07	2.94E-07
Soil (Bq/kg dw)	Reference (Broach Lake)	3.06E+00	3.06E+00	2.00E+01	1.79E+01	4.00E+01	1.12E+01	3.06E+00	3.06E+00	2.00E+01	1.79E+01	4.00E+01	1.12E+01
	Patterson Lake North Arm	1.34E+01	1.34E+01	3.16E+01	2.97E+01	4.76E+01	1.89E+01	1.34E+01	1.34E+01	3.16E+01	2.97E+01	4.76E+01	1.89E+01
	Patterson Lake South Arm	4.74E+00	4.74E+00	2.19E+01	1.98E+01	4.12E+01	1.25E+01	4.74E+00	4.74E+00	2.19E+01	1.98E+01	4.12E+01	1.25E+01
	Beet Lake	4.04E+00	4.04E+00	2.11E+01	1.91E+01	4.07E+01	1.20E+01	4.04E+00	4.04E+00	2.11E+01	1.91E+01	4.07E+01	1.20E+01
	Clearwater River and Mirror River Confluence	3.12E+00	3.12E+00	2.01E+01	1.80E+01	4.00E+01	1.13E+01	3.12E+00	3.12E+00	2.01E+01	1.80E+01	4.00E+01	1.13E+01
	Lloyd Lake	3.09E+00	3.09E+00	2.00E+01	1.80E+01	4.00E+01	1.12E+01	3.09E+00	3.09E+00	2.00E+01	1.80E+01	4.00E+01	1.12E+01

Table C.5: Maximum Concentrations of Radiological COPCs for the Application Case and Upper Bound Scenario - Far-Future

		Maximum Concentration Far Future											
	Location	Application Case						Upper Bound Scenario					
		Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210
Water (Bq/L)	Reference (Broach Lake)	3.56E-04	3.56E-04	9.09E-03	5.54E-03	5.07E-03	5.15E-03	3.56E-04	3.56E-04	9.09E-03	5.54E-03	5.07E-03	5.15E-03
	Clearwater River downstream of Broach Lake	3.56E-04	3.56E-04	9.09E-03	5.54E-03	5.07E-03	5.15E-03	3.56E-04	3.56E-04	9.09E-03	5.54E-03	5.07E-03	5.15E-03
	Patterson Lake North Arm - East Basin	3.56E-04	3.56E-04	9.09E-03	5.54E-03	5.07E-03	5.15E-03	3.56E-04	3.56E-04	9.09E-03	5.54E-03	5.07E-03	5.15E-03
	Patterson Lake North Arm - West Basin	1.15E-02	1.16E-02	9.72E-03	7.14E-03	5.30E-03	5.39E-03	1.15E-02	1.16E-02	9.72E-03	7.15E-03	5.30E-03	5.39E-03
	Patterson Lake South Arm	3.44E-03	3.46E-03	9.48E-03	6.13E-03	5.08E-03	5.17E-03	3.45E-03	3.46E-03	9.48E-03	6.13E-03	5.08E-03	5.17E-03
	Forrest Lake North Basin	2.23E-03	2.24E-03	9.32E-03	5.90E-03	5.08E-03	5.16E-03	2.23E-03	2.24E-03	9.32E-03	5.90E-03	5.08E-03	5.16E-03
	Beet Lake	1.50E-03	1.51E-03	9.29E-03	5.79E-03	5.07E-03	5.16E-03	1.51E-03	1.51E-03	9.29E-03	5.79E-03	5.07E-03	5.16E-03
	Naomi Lake	1.16E-03	1.17E-03	9.25E-03	5.72E-03	5.07E-03	5.15E-03	1.16E-03	1.17E-03	9.25E-03	5.72E-03	5.07E-03	5.15E-03
	Clearwater River upstream Mirror River Confluence	7.91E-04	7.93E-04	9.17E-03	5.64E-03	5.07E-03	5.15E-03	7.92E-04	7.93E-04	9.17E-03	5.64E-03	5.07E-03	5.15E-03
	Clearwater River downstream Mirror River Confluence	4.87E-04	4.87E-04	9.11E-03	5.57E-03	5.07E-03	5.15E-03	4.87E-04	4.87E-04	9.11E-03	5.57E-03	5.07E-03	5.15E-03
	Lloyd Lake Inlet	4.60E-04	4.60E-04	9.11E-03	5.56E-03	5.07E-03	5.15E-03	4.60E-04	4.60E-04	9.11E-03	5.56E-03	5.07E-03	5.15E-03
Sediment (Bq/kg dw)	Reference (Broach Lake)	6.84E+00	6.84E+00	2.09E+01	6.47E+01	3.59E+02	3.65E+02	6.84E+00	6.84E+00	2.09E+01	6.47E+01	3.59E+02	3.65E+02
	Patterson Lake North Arm - East Basin	6.84E+00	6.84E+00	2.09E+01	6.47E+01	3.59E+02	3.65E+02	6.84E+00	6.84E+00	2.09E+01	6.47E+01	3.59E+02	3.65E+02
	Patterson Lake North Arm - West Basin	2.22E+02	2.22E+02	2.23E+01	8.34E+01	3.76E+02	3.82E+02	2.22E+02	2.23E+02	2.23E+01	8.35E+01	3.76E+02	3.82E+02
	Patterson Lake South Arm	6.63E+01	6.65E+01	2.18E+01	7.16E+01	3.60E+02	3.66E+02	6.63E+01	6.65E+01	2.18E+01	7.16E+01	3.60E+02	3.66E+02
	Beet Lake	2.89E+01	2.90E+01	2.13E+01	6.77E+01	3.59E+02	3.66E+02	2.89E+01	2.90E+01	2.13E+01	6.77E+01	3.59E+02	3.66E+02
	Naomi Lake	2.24E+01	2.24E+01	2.12E+01	6.69E+01	3.59E+02	3.65E+02	2.24E+01	2.25E+01	2.12E+01	6.69E+01	3.59E+02	3.65E+02
	Lloyd Lake Inlet	8.84E+00	8.85E+00	2.09E+01	6.50E+01	3.59E+02	3.65E+02	8.84E+00	8.85E+00	2.09E+01	6.50E+01	3.59E+02	3.65E+02
Air (Bq/m^3)	Reference (Broach Lake)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Patterson Lake North Arm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Patterson Lake South Arm	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Beet Lake	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Clearwater River and Mirror River Confluence	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Lloyd Lake	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Soil (Bq/kg dw)	Reference (Broach Lake)	3.06E+00	3.06E+00	2.00E+01	1.79E+01	4.00E+01	1.12E+01	3.06E+00	3.06E+00	2.00E+01	1.79E+01	4.00E+01	1.12E+01
	Patterson Lake North Arm	4.14E+00	4.14E+00	2.65E+01	2.58E+01	4.00E+01	1.12E+01	4.14E+00	4.14E+00	2.65E+01	2.58E+01	4.00E+01	1.12E+01
	Patterson Lake South Arm	3.23E+00	3.23E+00	2.11E+01	1.92E+01	4.00E+01	1.12E+01	3.23E+00	3.23E+00	2.11E+01	1.92E+01	4.00E+01	1.12E+01
	Beet Lake	3.16E+00	3.16E+00	2.06E+01	1.87E+01	4.00E+01	1.12E+01	3.16E+00	3.16E+00	2.06E+01	1.87E+01	4.00E+01	1.12E+01
	Clearwater River and Mirror River Confluence	3.06E+00	3.06E+00	2.00E+01	1.80E+01	4.00E+01	1.12E+01	3.06E+00	3.06E+00	2.00E+01	1.80E+01	4.00E+01	1.12E+01
	Lloyd Lake	3.06E+00	3.06E+00	2.00E+01	1.80E+01	4.00E+01	1.12E+01	3.06E+00	3.06E+00	2.00E+01	1.80E+01	4.00E+01	1.12E+01

Table C.6: Maximum Concentrations of Radiological COPCs for the RFD Scenario - Project Lifespan and Far-Future

		Maximum Concentration RFD Case											
	Location	Project Lifespan						Far future					
		Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210
Water (Bq/L)	Reference (Broach Lake)	3.56E-04	3.56E-04	9.09E-03	5.54E-03	5.07E-03	5.15E-03	3.56E-04	3.56E-04	9.09E-03	5.54E-03	5.07E-03	5.15E-03
	Clearwater River downstream of Broach Lake	3.56E-04	3.56E-04	9.09E-03	5.54E-03	5.07E-03	5.15E-03	3.56E-04	3.56E-04	9.09E-03	5.54E-03	5.07E-03	5.15E-03
	Patterson Lake North Arm - East Basin	3.58E-04	3.58E-04	9.12E-03	5.55E-03	5.08E-03	5.16E-03	3.56E-04	3.56E-04	9.09E-03	5.54E-03	5.07E-03	5.15E-03
	Patterson Lake North Arm - West Basin	3.88E-03	3.89E-03	5.17E-02	9.63E-03	7.74E-03	7.82E-03	1.15E-02	1.16E-02	9.72E-03	7.14E-03	5.30E-03	5.39E-03
	Patterson Lake South Arm	5.79E-03	5.81E-03	5.50E-02	1.13E-02	7.87E-03	7.90E-03	3.44E-03	3.46E-03	9.48E-03	6.13E-03	5.08E-03	5.17E-03
	Forrest Lake North Basin	3.79E-03	3.80E-03	3.81E-02	9.18E-03	6.85E-03	6.89E-03	2.23E-03	2.24E-03	9.32E-03	5.90E-03	5.08E-03	5.16E-03
	Beet Lake	2.24E-03	2.25E-03	2.97E-02	7.76E-03	5.47E-03	5.56E-03	1.50E-03	1.51E-03	9.29E-03	5.79E-03	5.07E-03	5.16E-03
	Naomi Lake	1.68E-03	1.68E-03	2.48E-02	7.14E-03	5.26E-03	5.35E-03	1.16E-03	1.17E-03	9.25E-03	5.72E-03	5.07E-03	5.15E-03
	Clearwater River upstream Mirror River Confluence	1.08E-03	1.08E-03	1.76E-02	6.41E-03	5.17E-03	5.26E-03	7.91E-04	7.93E-04	9.17E-03	5.64E-03	5.07E-03	5.15E-03
	Clearwater River downstream Mirror River Confluence	5.78E-04	5.79E-04	1.17E-02	5.81E-03	5.10E-03	5.19E-03	4.87E-04	4.87E-04	9.11E-03	5.57E-03	5.07E-03	5.15E-03
	Lloyd Lake Inlet	5.31E-04	5.32E-04	1.12E-02	5.75E-03	5.09E-03	5.18E-03	4.60E-04	4.60E-04	9.11E-03	5.56E-03	5.07E-03	5.15E-03
Sediment (Bq/kg dw)	Reference (Broach Lake)	6.84E+00	6.84E+00	2.09E+01	6.47E+01	3.59E+02	3.65E+02	6.84E+00	6.84E+00	2.09E+01	6.47E+01	3.59E+02	3.65E+02
	Patterson Lake North Arm - East Basin	6.86E+00	6.86E+00	2.09E+01	6.48E+01	3.59E+02	3.66E+02	6.84E+00	6.84E+00	2.09E+01	6.47E+01	3.59E+02	3.65E+02
	Patterson Lake North Arm - West Basin	6.16E+01	6.18E+01	1.16E+02	1.04E+02	4.92E+02	5.00E+02	2.22E+02	2.22E+02	2.23E+01	8.34E+01	3.76E+02	3.82E+02
	Patterson Lake South Arm	3.84E+01	3.85E+01	8.94E+01	8.82E+01	4.41E+02	4.48E+02	6.63E+01	6.65E+01	2.18E+01	7.16E+01	3.60E+02	3.66E+02
	Beet Lake	1.85E+01	1.85E+01	5.74E+01	7.49E+01	3.71E+02	3.77E+02	2.89E+01	2.90E+01	2.13E+01	6.77E+01	3.59E+02	3.66E+02
	Naomi Lake	1.50E+01	1.50E+01	4.90E+01	7.22E+01	3.65E+02	3.71E+02	2.24E+01	2.24E+01	2.12E+01	6.69E+01	3.59E+02	3.65E+02
	Lloyd Lake Inlet	7.91E+00	7.91E+00	2.46E+01	6.57E+01	3.60E+02	3.66E+02	8.84E+00	8.85E+00	2.09E+01	6.50E+01	3.59E+02	3.65E+02
Air (Bq/m^3)	Reference (Broach Lake)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Patterson Lake North Arm	9.43E-05	9.43E-05	9.43E-05	9.43E-05	9.43E-05	9.43E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Patterson Lake South Arm	1.81E-05	1.81E-05	1.81E-05	1.81E-05	1.81E-05	1.81E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Beet Lake	9.92E-06	9.92E-06	9.92E-06	9.92E-06	9.92E-06	9.92E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Clearwater River and Mirror River Confluence	7.23E-07	7.23E-07	7.23E-07	7.23E-07	7.23E-07	7.23E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Lloyd Lake	4.73E-07	4.73E-07	4.73E-07	4.73E-07	4.73E-07	4.73E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Soil (Bq/kg dw)	Reference (Broach Lake)	3.06E+00	3.06E+00	2.00E+01	1.79E+01	4.00E+01	1.12E+01	3.06E+00	3.06E+00	2.00E+01	1.79E+01	4.00E+01	1.12E+01
	Patterson Lake North Arm	1.36E+01	1.36E+01	3.18E+01	2.99E+01	4.77E+01	1.91E+01	4.16E+00	4.16E+00	2.66E+01	2.60E+01	4.00E+01	1.12E+01
	Patterson Lake South Arm	5.08E+00	5.08E+00	2.23E+01	2.02E+01	4.15E+01	1.27E+01	3.27E+00	3.27E+00	2.13E+01	1.95E+01	4.00E+01	1.12E+01
	Beet Lake	4.16E+00	4.16E+00	2.12E+01	1.92E+01	4.08E+01	1.20E+01	3.17E+00	3.17E+00	2.07E+01	1.88E+01	4.00E+01	1.12E+01
	Clearwater River and Mirror River Confluence	3.14E+00	3.14E+00	2.01E+01	1.80E+01	4.01E+01	1.13E+01	3.06E+00	3.06E+00	2.01E+01	1.80E+01	4.00E+01	1.12E+01
	Lloyd Lake	3.11E+00	3.11E+00	2.01E+01	1.80E+01	4.00E+01	1.13E+01	3.06E+00	3.06E+00	2.00E+01	1.80E+01	4.00E+01	1.12E+01

Table C.7: Maximum Concentrations of Non-radiological COPCs in Biota for the Application Case and Upper Bound Scenario - Project Lifespan

	Biota	Location	Maximum Concentration Project Lifespan (mg/kg fw)									
			Application Case					Upper Bound Scenario				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
Aquatic Plants	Macrophytes	Reference (Broach Lake)	2.13E-02	9.21E-02	1.83E-01	1.40E-03	5.06E-03	2.13E-02	9.21E-02	1.83E-01	1.40E-03	5.06E-03
		Patterson Lake North Arm - West Basin	7.50E-02	1.22E-01	2.16E-01	4.07E-03	1.93E-02	7.68E-02	1.23E-01	2.17E-01	9.45E-03	4.66E-02
		Patterson Lake South Arm	2.57E-02	1.08E-01	2.00E-01	2.77E-03	8.89E-03	2.58E-02	1.09E-01	2.01E-01	5.54E-03	1.56E-02
		Beet Lake	2.20E-02	1.00E-01	1.92E-01	2.10E-03	6.47E-03	2.20E-02	1.01E-01	1.92E-01	3.54E-03	8.93E-03
		Lloyd Lake	2.13E-02	9.30E-02	1.84E-01	1.48E-03	5.19E-03	2.13E-02	9.30E-02	1.84E-01	1.62E-03	5.41E-03
	Phytoplankton	Reference (Broach Lake)	2.13E-02	9.21E-02	1.83E-01	1.40E-03	5.06E-03	2.13E-02	9.21E-02	1.83E-01	1.40E-03	5.06E-03
		Patterson Lake North Arm - West Basin	7.50E-02	1.22E-01	2.16E-01	4.07E-03	1.93E-02	7.68E-02	1.23E-01	2.17E-01	9.45E-03	4.66E-02
		Patterson Lake South Arm	2.57E-02	1.08E-01	2.00E-01	2.77E-03	8.89E-03	2.58E-02	1.09E-01	2.01E-01	5.54E-03	1.56E-02
		Beet Lake	2.20E-02	1.00E-01	1.92E-01	2.10E-03	6.47E-03	2.20E-02	1.01E-01	1.92E-01	3.54E-03	8.93E-03
		Lloyd Lake	2.13E-02	9.30E-02	1.84E-01	1.48E-03	5.19E-03	2.13E-02	9.30E-02	1.84E-01	1.62E-03	5.41E-03
Aquatic Animals	Benthic Invertebrates	Reference (Broach Lake)	5.60E-02	1.16E-01	6.53E+00	3.32E-02	9.64E-03	5.60E-02	1.16E-01	6.53E+00	3.32E-02	9.64E-03
		Patterson Lake North Arm - West Basin	1.71E-01	1.50E-01	7.59E+00	8.87E-02	3.16E-02	1.74E-01	1.51E-01	7.62E+00	2.02E-01	7.10E-02
		Patterson Lake South Arm	6.55E-02	1.34E-01	7.07E+00	6.18E-02	1.55E-02	6.57E-02	1.35E-01	7.09E+00	1.22E-01	2.59E-02
		Beet Lake	5.75E-02	1.25E-01	6.80E+00	4.78E-02	1.18E-02	5.76E-02	1.26E-01	6.81E+00	7.88E-02	1.56E-02
		Lloyd Lake	5.61E-02	1.17E-01	6.56E+00	3.47E-02	9.84E-03	5.61E-02	1.17E-01	6.56E+00	3.78E-02	1.02E-02
	Zooplankton	Reference (Broach Lake)	6.68E-02	1.17E-01	6.57E+00	3.34E-02	1.00E-02	6.68E-02	1.17E-01	6.57E+00	3.34E-02	1.00E-02
		Patterson Lake North Arm - West Basin	2.35E-01	1.54E-01	7.76E+00	9.69E-02	3.84E-02	2.41E-01	1.56E-01	7.79E+00	2.25E-01	9.25E-02
		Patterson Lake South Arm	8.07E-02	1.37E-01	7.20E+00	6.59E-02	1.76E-02	8.11E-02	1.38E-01	7.21E+00	1.32E-01	3.09E-02
		Beet Lake	6.91E-02	1.27E-01	6.89E+00	5.01E-02	1.28E-02	6.91E-02	1.28E-01	6.90E+00	8.43E-02	1.77E-02
		Lloyd Lake	6.69E-02	1.18E-01	6.61E+00	3.51E-02	1.03E-02	6.69E-02	1.18E-01	6.61E+00	3.87E-02	1.07E-02
	Northern Pike	Reference (Broach Lake)	3.71E-02	7.00E-03	4.21E-01	2.06E-05	2.01E-03	3.71E-02	7.00E-03	4.21E-01	2.06E-05	2.01E-03
		Patterson Lake North Arm - West Basin	1.31E-01	9.25E-03	4.97E-01	5.98E-05	7.67E-03	1.34E-01	9.34E-03	5.00E-01	1.39E-04	1.85E-02
		Patterson Lake South Arm	4.49E-02	8.22E-03	4.61E-01	4.07E-05	3.53E-03	4.51E-02	8.27E-03	4.62E-01	8.15E-05	6.19E-03
		Beet Lake	3.84E-02	7.63E-03	4.42E-01	3.09E-05	2.57E-03	3.84E-02	7.66E-03	4.42E-01	5.20E-05	3.54E-03
		Lloyd Lake	3.72E-02	7.06E-03	4.23E-01	2.17E-05	2.06E-03	3.72E-02	7.06E-03	4.24E-01	2.39E-05	2.15E-03
	Whitefish	Reference (Broach Lake)	3.56E-02	6.99E-03	4.21E-02	2.06E-05	4.97E-04	3.56E-02	6.99E-03	4.21E-02	2.06E-05	4.97E-04
		Patterson Lake North Arm - West Basin	1.22E-01	9.18E-03	4.95E-02	5.83E-05	1.83E-03	1.24E-01	9.27E-03	4.97E-02	1.34E-04	4.30E-03
		Patterson Lake South Arm	4.27E-02	8.16E-03	4.59E-02	3.98E-05	8.50E-04	4.29E-02	8.21E-03	4.60E-02	7.95E-05	1.47E-03
		Beet Lake	3.68E-02	7.60E-03	4.40E-02	3.04E-05	6.26E-04	3.68E-02	7.62E-03	4.41E-02	5.09E-05	8.55E-04
		Lloyd Lake	3.57E-02	7.05E-03	4.23E-02	2.16E-05	5.09E-04	3.57E-02	7.05E-03	4.23E-02	2.37E-05	5.30E-04
Terrestrial Plants	Blueberries	Reference (Broach Lake)	2.51E-02	2.51E-02	3.99E-01	1.42E-02	4.01E-02	2.51E-02	2.51E-02	3.99E-01	1.42E-02	4.01E-02
		Patterson Lake North Arm - West Basin	2.54E-02	2.54E-02	4.12E-01	1.58E-02	2.91E-01	2.54E-02	2.54E-02	4.12E-01	1.58E-02	2.91E-01
		Patterson Lake South Arm	2.52E-02	2.52E-02	4.01E-01	1.45E-02	7.59E-02	2.52E-02	2.52E-02	4.01E-01	1.45E-02	7.59E-02
		Beet Lake	2.52E-02	2.52E-02	4.00E-01	1.44E-02	6.12E-02	2.52E-02	2.52E-02	4.00E-01	1.44E-02	6.12E-02
		Lloyd Lake	2.52E-02	2.52E-02	4.00E-01	1.44E-02	4.09E-02	2.52E-02	2.52E-02	4.00E-01	1.44E-02	4.09E-02
	Browse	Reference (Broach Lake)	5.02E-02	5.01E-02	7.98E-01	2.85E-02	8.01E-02	5.02E-02	5.01E-02	7.98E-01	2.85E-02	8.01E-02
		Patterson Lake North Arm - West Basin	5.10E-02	5.09E-02	8.27E-01	3.27E-02	6.73E-01	5.10E-02	5.09E-02	8.27E-01	3.27E-02	6.73E-01
		Patterson Lake South Arm	5.05E-02	5.05E-02	8.03E-01	2.92E-02	1.65E-01	5.05E-02	5.05E-02	8.03E-01	2.92E-02	1.65E-01
		Beet Lake	5.05E-02	5.05E-02	8.01E-01	2.88E-02	1.30E-01	5.05E-02	5.05E-02	8.01E-01	2.88E-02	1.30E-01
		Lloyd Lake	5.05E-02	5.05E-02	7.99E-01	2.88E-02	8.20E-02	5.05E-02	5.05E-02	7.99E-01	2.88E-02	8.20E-02

Table C.7: Maximum Concentrations of Non-radiological COPCs in Biota for the Application Case and Upper Bound Scenario - Project Lifespan

			Maximum Concentration Project Lifespan (mg/kg fw)									
	Biota	Location	Application Case					Upper Bound Scenario				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
	Labrador Tea	Reference (Broach Lake)	5.02E-02	5.01E-02	7.98E-01	2.85E-02	8.01E-02	5.02E-02	5.01E-02	7.98E-01	2.85E-02	8.01E-02
		Patterson Lake North Arm - West Basin	5.80E-02	5.56E-02	8.66E-01	6.06E-02	2.85E+00	5.80E-02	5.56E-02	8.66E-01	6.06E-02	2.85E+00
		Patterson Lake South Arm	5.28E-02	5.28E-02	8.10E-01	3.38E-02	4.76E-01	5.28E-02	5.28E-02	8.10E-01	3.38E-02	4.76E-01
		Beet Lake	5.28E-02	5.28E-02	8.06E-01	3.11E-02	3.14E-01	5.28E-02	5.28E-02	8.06E-01	3.11E-02	3.14E-01
		Lloyd Lake	5.28E-02	5.28E-02	8.02E-01	3.11E-02	8.90E-02	5.28E-02	5.28E-02	8.02E-01	3.11E-02	8.90E-02
	Lichen	Reference (Broach Lake)	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02
		Patterson Lake North Arm - West Basin	1.00E-01	1.03E-01	1.01E+00	2.46E-01	1.40E+01	1.00E-01	1.03E-01	1.01E+00	2.46E-01	1.40E+01
		Patterson Lake South Arm	7.07E-02	8.82E-02	8.03E-01	9.68E-02	2.01E+00	7.07E-02	8.82E-02	8.03E-01	9.68E-02	2.01E+00
		Beet Lake	7.07E-02	8.82E-02	7.88E-01	8.19E-02	1.19E+00	7.07E-02	8.82E-02	7.88E-01	8.19E-02	1.19E+00
		Lloyd Lake	7.07E-02	8.82E-02	7.73E-01	8.19E-02	6.15E-02	7.07E-02	8.82E-02	7.73E-01	8.19E-02	6.15E-02
Terrestrial Animals	Terrestrial Invertebrate	Reference (Broach Lake)	2.24E-02	2.63E-03	5.26E-02	3.73E-02	2.19E-03	2.24E-02	2.63E-03	5.26E-02	3.73E-02	2.19E-03
		Patterson Lake North Arm - West Basin	2.33E-02	3.19E-03	5.88E-02	4.18E-02	2.67E-01	2.33E-02	3.19E-03	5.88E-02	4.18E-02	2.67E-01
		Patterson Lake South Arm	2.27E-02	2.91E-03	5.37E-02	3.80E-02	4.00E-02	2.27E-02	2.91E-03	5.37E-02	3.80E-02	4.00E-02
		Beet Lake	2.27E-02	2.91E-03	5.33E-02	3.76E-02	2.45E-02	2.27E-02	2.91E-03	5.33E-02	3.76E-02	2.45E-02
		Lloyd Lake	2.27E-02	2.91E-03	5.29E-02	3.76E-02	3.03E-03	2.27E-02	2.91E-03	5.29E-02	3.76E-02	3.03E-03
	Beaver	Reference (Broach Lake)	5.56E-02	1.25E-03	3.78E-01	1.36E-03	1.48E-03	5.56E-02	1.25E-03	3.78E-01	1.36E-03	1.48E-03
		Patterson Lake North Arm - West Basin	7.25E-02	1.33E-03	3.93E-01	1.61E-03	1.23E-02	7.29E-02	1.34E-03	3.93E-01	1.70E-03	1.24E-02
		Patterson Lake South Arm	5.72E-02	1.29E-03	3.81E-01	1.42E-03	3.03E-03	5.72E-02	1.29E-03	3.81E-01	1.47E-03	3.07E-03
		Beet Lake	5.61E-02	1.27E-03	3.80E-01	1.39E-03	2.39E-03	5.61E-02	1.28E-03	3.80E-01	1.41E-03	2.40E-03
		Lloyd Lake	5.59E-02	1.26E-03	3.79E-01	1.38E-03	1.52E-03	5.59E-02	1.26E-03	3.79E-01	1.38E-03	1.52E-03
	Black Bear	Reference (Broach Lake)	5.21E-02	8.47E-04	3.52E-01	1.01E-03	1.10E-03	5.21E-02	8.47E-04	3.52E-01	1.01E-03	1.10E-03
		Patterson Lake North Arm - West Basin	6.97E-02	8.74E-04	3.67E-01	1.07E-03	4.55E-03	7.03E-02	8.75E-04	3.68E-01	1.09E-03	4.60E-03
		Beet Lake	5.46E-02	8.91E-04	3.55E-01	1.04E-03	1.40E-03	5.46E-02	8.91E-04	3.55E-01	1.05E-03	1.40E-03
		Lloyd Lake	5.23E-02	8.58E-04	3.53E-01	1.02E-03	1.12E-03	5.23E-02	8.58E-04	3.53E-01	1.02E-03	1.12E-03
	Grey Wolf	Reference (Broach Lake)	4.71E-02	8.12E-05	1.04E-01	9.04E-05	4.57E-05	4.71E-02	8.12E-05	1.04E-01	9.04E-05	4.57E-05
		Patterson Lake North-West Basin	5.57E-02	8.27E-05	1.06E-01	9.96E-05	1.47E-04	5.59E-02	8.28E-05	1.06E-01	1.08E-04	1.49E-04
		Lloyd Lake	4.78E-02	8.18E-05	1.04E-01	9.27E-05	4.71E-05	4.78E-02	8.18E-05	1.04E-01	9.34E-05	4.72E-05
	Mink	Reference (Broach Lake)	2.80E-02	2.42E-04	2.78E-01	1.40E-04	5.15E-05	2.80E-02	2.42E-04	2.78E-01	1.40E-04	5.15E-05
		Patterson Lake North Arm - West Basin	8.43E-02	3.06E-04	3.24E-01	3.40E-04	1.98E-04	8.56E-02	3.08E-04	3.25E-01	7.49E-04	3.53E-04
		Patterson Lake South Arm	3.27E-02	2.76E-04	3.02E-01	2.43E-04	8.27E-05	3.28E-02	2.77E-04	3.02E-01	4.59E-04	1.24E-04
		Beet Lake	2.88E-02	2.59E-04	2.90E-01	1.92E-04	6.47E-05	2.88E-02	2.60E-04	2.91E-01	3.04E-04	7.99E-05
		Lloyd Lake	2.81E-02	2.44E-04	2.80E-01	1.45E-04	5.24E-05	2.81E-02	2.44E-04	2.80E-01	1.56E-04	5.38E-05
	Moose	Reference (Broach Lake)	5.87E-02	1.37E-03	3.51E-01	1.26E-03	1.37E-03	5.87E-02	1.37E-03	3.51E-01	1.26E-03	1.37E-03
		Patterson Lake North Arm - West Basin	9.28E-02	1.53E-03	3.67E-01	1.53E-03	1.11E-02	9.36E-02	1.54E-03	3.67E-01	1.73E-03	1.14E-02
		Patterson Lake South Arm	9.26E-02	1.52E-03	3.66E-01	1.51E-03	1.11E-02	9.34E-02	1.53E-03	3.66E-01	1.68E-03	1.13E-02
		Beet Lake	5.94E-02	1.42E-03	3.54E-01	1.29E-03	2.19E-03	5.94E-02	1.42E-03	3.54E-01	1.34E-03	2.22E-03
		Lloyd Lake	5.90E-02	1.38E-03	3.52E-01	1.27E-03	1.40E-03	5.90E-02	1.38E-03	3.52E-01	1.28E-03	1.40E-03
	Moose Organs	Reference (Broach Lake)	4.99E-01	3.19E-01	1.40E+01	1.26E-01	2.42E-03	4.99E-01	3.19E-01	1.40E+01	1.26E-01	2.42E-03
		Patterson Lake North Arm - West Basin	7.89E-01	3.56E-01	1.47E+01	1.53E-01	1.97E-02	7.96E-01	3.57E-01	1.47E+01	1.73E-01	2.02E-02
		Patterson Lake South Arm	7.87E-01	3.53E-01	1.46E+01	1.51E-01	1.96E-02	7.94E-01	3.55E-01	1.47E+01	1.68E-01	2.01E-02

Table C.7: Maximum Concentrations of Non-radiological COPCs in Biota for the Application Case and Upper Bound Scenario - Project Lifespan

			Maximum Concentration Project Lifespan (mg/kg fw)									
	Biota	Location	Application Case					Upper Bound Scenario				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
		Beet Lake	5.05E-01	3.30E-01	1.41E+01	1.29E-01	3.88E-03	5.05E-01	3.30E-01	1.41E+01	1.34E-01	3.93E-03
		Lloyd Lake	5.01E-01	3.22E-01	1.41E+01	1.27E-01	2.48E-03	5.01E-01	3.22E-01	1.41E+01	1.28E-01	2.48E-03
	Muskrat	Reference (Broach Lake)	7.19E-02	8.64E-04	5.12E-01	4.59E-04	2.70E-04	7.19E-02	8.64E-04	5.12E-01	4.59E-04	2.70E-04
		Patterson Lake North Arm - West Basin	2.20E-01	1.13E-03	5.96E-01	1.23E-03	8.89E-04	2.24E-01	1.14E-03	5.98E-01	2.80E-03	1.99E-03
		Patterson Lake South Arm	8.41E-02	1.00E-03	5.55E-01	8.54E-04	4.33E-04	8.44E-02	1.01E-03	5.56E-01	1.69E-03	7.27E-04
		Beet Lake	7.38E-02	9.36E-04	5.34E-01	6.61E-04	3.30E-04	7.39E-02	9.39E-04	5.35E-01	1.09E-03	4.38E-04
		Lloyd Lake	7.20E-02	8.71E-04	5.15E-01	4.79E-04	2.75E-04	7.20E-02	8.72E-04	5.15E-01	5.23E-04	2.85E-04
	Red Fox	Reference (Broach Lake)	7.78E-03	7.79E-05	2.78E-02	2.35E-04	8.18E-05	7.78E-03	7.79E-05	2.78E-02	2.35E-04	8.18E-05
		Patterson Lake North Arm - West Basin	8.01E-03	8.08E-05	2.89E-02	2.67E-04	9.88E-04	8.01E-03	8.09E-05	2.89E-02	2.79E-04	9.91E-04
		Patterson Lake South Arm	7.83E-03	7.94E-05	2.80E-02	2.42E-04	2.12E-04	7.83E-03	7.94E-05	2.80E-02	2.48E-04	2.12E-04
		Beet Lake	7.83E-03	7.91E-05	2.79E-02	2.38E-04	1.58E-04	7.83E-03	7.91E-05	2.79E-02	2.41E-04	1.58E-04
		Lloyd Lake	7.82E-03	7.88E-05	2.78E-02	2.37E-04	8.47E-05	7.82E-03	7.88E-05	2.78E-02	2.37E-04	8.47E-05
	Snowshoe Hare	Reference (Broach Lake)	4.69E-02	9.87E-04	3.44E-01	1.27E-03	1.37E-03	4.69E-02	9.87E-04	3.44E-01	1.27E-03	1.37E-03
		Patterson Lake North Arm - West Basin	4.76E-02	1.00E-03	3.57E-01	1.45E-03	1.13E-02	4.76E-02	1.00E-03	3.57E-01	1.46E-03	1.13E-02
		Patterson Lake South Arm	4.71E-02	9.95E-04	3.46E-01	1.30E-03	2.79E-03	4.71E-02	9.95E-04	3.46E-01	1.31E-03	2.79E-03
		Beet Lake	4.71E-02	9.95E-04	3.46E-01	1.29E-03	2.21E-03	4.71E-02	9.95E-04	3.46E-01	1.29E-03	2.21E-03
		Lloyd Lake	4.71E-02	9.95E-04	3.45E-01	1.28E-03	1.40E-03	4.71E-02	9.95E-04	3.45E-01	1.29E-03	1.40E-03
	Southern Red-Backed Vole	Reference (Broach Lake)	1.67E-02	3.54E-04	1.26E-01	4.59E-04	4.98E-04	1.67E-02	3.54E-04	1.26E-01	4.59E-04	4.98E-04
		Patterson Lake North Arm - West Basin	1.69E-02	3.59E-04	1.30E-01	5.19E-04	3.87E-03	1.69E-02	3.59E-04	1.30E-01	5.25E-04	3.87E-03
		Patterson Lake South Arm	1.67E-02	3.57E-04	1.27E-01	4.70E-04	9.79E-04	1.67E-02	3.57E-04	1.27E-01	4.73E-04	9.80E-04
		Beet Lake	1.67E-02	3.57E-04	1.26E-01	4.65E-04	7.82E-04	1.67E-02	3.57E-04	1.26E-01	4.66E-04	7.82E-04
		Lloyd Lake	1.67E-02	3.56E-04	1.26E-01	4.64E-04	5.09E-04	1.67E-02	3.56E-04	1.26E-01	4.64E-04	5.09E-04
	Woodland Caribou	Reference (Broach Lake)	6.30E-02	1.08E-03	1.92E-01	1.03E-03	7.02E-04	6.30E-02	1.08E-03	1.92E-01	1.03E-03	7.02E-04
		Patterson Lake North Arm - West Basin	1.01E-01	1.24E-03	2.05E-01	1.78E-03	1.97E-02	1.02E-01	1.25E-03	2.05E-01	2.07E-03	2.00E-02
		Beet Lake	6.43E-02	1.12E-03	1.93E-01	1.10E-03	2.21E-03	6.43E-02	1.12E-03	1.93E-01	1.15E-03	2.23E-03
		Lloyd Lake	6.49E-02	1.12E-03	1.94E-01	1.13E-03	8.23E-04	6.49E-02	1.12E-03	1.94E-01	1.14E-03	8.27E-04
	Grouse	Reference (Broach Lake)	3.71E-02	2.88E-02	2.59E-01	2.87E-03	3.27E-02	3.71E-02	2.88E-02	2.59E-01	2.87E-03	3.27E-02
		Patterson Lake North Arm - West Basin	3.76E-02	2.92E-02	2.69E-01	3.26E-03	2.61E-01	3.77E-02	2.92E-02	2.69E-01	3.27E-03	2.61E-01
		Patterson Lake South Arm	3.73E-02	2.90E-02	2.61E-01	2.94E-03	6.53E-02	3.73E-02	2.90E-02	2.61E-01	2.95E-03	6.53E-02
		Beet Lake	3.73E-02	2.90E-02	2.61E-01	2.91E-03	5.19E-02	3.73E-02	2.90E-02	2.61E-01	2.91E-03	5.19E-02
		Lloyd Lake	3.73E-02	2.90E-02	2.60E-01	2.91E-03	3.34E-02	3.73E-02	2.90E-02	2.60E-01	2.91E-03	3.34E-02
	Canada Goose	Reference (Broach Lake)	5.23E-03	4.08E-03	3.63E-02	4.06E-04	4.59E-03	5.23E-03	4.08E-03	3.63E-02	4.06E-04	4.59E-03
		Patterson Lake North Arm - West Basin	5.33E-03	4.15E-03	3.77E-02	4.68E-04	3.78E-02	5.33E-03	4.15E-03	3.77E-02	4.81E-04	3.78E-02
		Patterson Lake South Arm	5.25E-03	4.12E-03	3.66E-02	4.18E-04	9.33E-03	5.25E-03	4.12E-03	3.66E-02	4.25E-04	9.34E-03
		Beet Lake	5.25E-03	4.11E-03	3.65E-02	4.12E-04	7.38E-03	5.25E-03	4.11E-03	3.65E-02	4.15E-04	7.38E-03
		Lloyd Lake	5.25E-03	4.11E-03	3.64E-02	4.10E-04	4.69E-03	5.25E-03	4.11E-03	3.64E-02	4.11E-04	4.69E-03
	Little Brown Myotis	Reference (Broach Lake)	1.97E-02	8.78E-04	1.15E+00	5.85E-04	6.64E-05	1.97E-02	8.78E-04	1.15E+00	5.85E-04	6.64E-05
		Patterson Lake North Arm - West Basin	6.02E-02	1.14E-03	1.34E+00	1.56E-03	2.18E-04	6.12E-02	1.15E-03	1.34E+00	3.57E-03	4.89E-04
		Patterson Lake South Arm	2.31E-02	1.02E-03	1.24E+00	1.09E-03	1.06E-04	2.32E-02	1.02E-03	1.25E+00	2.15E-03	1.79E-04
		Beet Lake	2.03E-02	9.50E-04	1.20E+00	8.44E-04	8.11E-05	2.03E-02	9.53E-04	1.20E+00	1.39E-03	1.08E-04

Table C.7: Maximum Concentrations of Non-radiological COPCs in Biota for the Application Case and Upper Bound Scenario - Project Lifespan

			Maximum Concentration Project Lifespan (mg/kg fw)									
	Biota	Location	Application Case					Upper Bound Scenario				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
		Lloyd Lake	1.98E-02	8.86E-04	1.15E+00	6.12E-04	6.77E-05	1.98E-02	8.86E-04	1.15E+00	6.68E-04	7.01E-05
	Loon	Reference (Broach Lake)	1.44E-02	5.39E-03	1.97E-01	1.88E-04	6.47E-04	1.44E-02	5.39E-03	1.97E-01	1.88E-04	6.47E-04
		Patterson Lake North Arm - West Basin	4.98E-02	7.03E-03	2.30E-01	5.03E-04	2.37E-03	5.09E-02	7.09E-03	2.31E-01	1.15E-03	5.49E-03
		Patterson Lake South Arm	1.74E-02	6.26E-03	2.14E-01	3.51E-04	1.10E-03	1.74E-02	6.29E-03	2.15E-01	6.92E-04	1.89E-03
		Beet Lake	1.49E-02	5.84E-03	2.06E-01	2.71E-04	8.13E-04	1.49E-02	5.86E-03	2.06E-01	4.47E-04	1.10E-03
		Lloyd Lake	1.45E-02	5.44E-03	1.98E-01	1.97E-04	6.62E-04	1.45E-02	5.44E-03	1.98E-01	2.15E-04	6.88E-04
	Mallard	Reference (Broach Lake)	5.77E-02	4.36E-02	1.13E+00	2.04E-03	6.80E-03	5.77E-02	4.36E-02	1.13E+00	2.04E-03	6.80E-03
		Patterson Lake North Arm - West Basin	1.77E-01	5.66E-02	1.32E+00	5.44E-03	2.23E-02	1.80E-01	5.71E-02	1.32E+00	1.24E-02	5.02E-02
		Patterson Lake South Arm	6.76E-02	5.05E-02	1.23E+00	3.79E-03	1.09E-02	6.78E-02	5.08E-02	1.23E+00	7.48E-03	1.83E-02
		Beet Lake	5.93E-02	4.72E-02	1.18E+00	2.94E-03	8.30E-03	5.94E-02	4.74E-02	1.18E+00	4.83E-03	1.10E-02
		Lloyd Lake	5.78E-02	4.40E-02	1.14E+00	2.13E-03	6.93E-03	5.78E-02	4.40E-02	1.14E+00	2.32E-03	7.18E-03
	Rusty Blackbird	Reference (Broach Lake)	7.99E-02	1.09E-01	3.39E+00	6.19E-03	1.83E-02	7.99E-02	1.09E-01	3.39E+00	6.19E-03	1.83E-02
		Patterson Lake North Arm - West Basin	1.93E-01	1.36E-01	3.93E+00	1.44E-02	1.00E-01	1.96E-01	1.37E-01	3.95E+00	3.12E-02	1.24E-01
		Patterson Lake South Arm	8.92E-02	1.23E-01	3.67E+00	1.04E-02	3.15E-02	8.95E-02	1.24E-01	3.67E+00	1.93E-02	3.75E-02
		Beet Lake	8.14E-02	1.16E-01	3.53E+00	8.35E-03	2.53E-02	8.14E-02	1.16E-01	3.54E+00	1.29E-02	2.74E-02
		Lloyd Lake	8.00E-02	1.09E-01	3.40E+00	6.41E-03	1.86E-02	8.00E-02	1.09E-01	3.41E+00	6.88E-03	1.88E-02

Table C.8: Maximum Concentrations of Non-radiological COPCs in Biota for the Application Case and Upper Bound Scenario – Far-Future

			Maximum Concentration Far-Future (mg/kg fw)									
	Biota	Location	Application Case					Upper Bound Scenario				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
Aquatic Plants	Macrophytes	Reference (Broach Lake)	2.13E-02	9.21E-02	1.83E-01	1.40E-03	5.06E-03	2.13E-02	9.21E-02	1.83E-01	1.40E-03	5.06E-03
		Patterson Lake North Arm - West Basin	2.26E-02	2.26E-01	4.73E-01	3.13E-02	5.06E-02	2.33E-02	2.96E-01	6.19E-01	1.16E-01	5.06E-02
		Patterson Lake South Arm	2.14E-02	1.73E-01	3.53E-01	1.88E-02	1.77E-02	2.14E-02	2.16E-01	4.39E-01	6.80E-02	1.77E-02
		Beet Lake	2.13E-02	1.35E-01	2.72E-01	1.04E-02	9.74E-03	2.13E-02	1.58E-01	3.17E-01	3.61E-02	9.74E-03
		Lloyd Lake	2.13E-02	9.65E-02	1.92E-01	2.32E-03	5.48E-03	2.13E-02	9.88E-02	1.97E-01	4.94E-03	5.48E-03
	Phytoplankton	Reference (Broach Lake)	2.13E-02	9.21E-02	1.83E-01	1.40E-03	5.06E-03	2.13E-02	9.21E-02	1.83E-01	1.40E-03	5.06E-03
		Patterson Lake North Arm - West Basin	2.26E-02	2.26E-01	4.73E-01	3.13E-02	5.06E-02	2.33E-02	2.96E-01	6.19E-01	1.16E-01	5.06E-02
		Patterson Lake South Arm	2.14E-02	1.73E-01	3.53E-01	1.88E-02	1.77E-02	2.14E-02	2.16E-01	4.39E-01	6.80E-02	1.77E-02
		Beet Lake	2.13E-02	1.35E-01	2.72E-01	1.04E-02	9.74E-03	2.13E-02	1.58E-01	3.17E-01	3.61E-02	9.74E-03
		Lloyd Lake	2.13E-02	9.65E-02	1.92E-01	2.32E-03	5.48E-03	2.13E-02	9.88E-02	1.97E-01	4.94E-03	5.48E-03
Aquatic Animals	Benthic Invertebrates	Reference (Broach Lake)	5.60E-02	1.16E-01	6.53E+00	3.32E-02	9.64E-03	5.60E-02	1.16E-01	6.53E+00	3.32E-02	9.64E-03
		Patterson Lake North Arm - West Basin	5.94E-02	2.84E-01	1.69E+01	7.40E-01	9.65E-02	6.12E-02	3.73E-01	2.21E+01	2.75E+00	9.66E-02
		Patterson Lake South Arm	5.63E-02	2.18E-01	1.26E+01	4.44E-01	3.37E-02	5.64E-02	2.72E-01	1.57E+01	1.61E+00	3.37E-02
		Beet Lake	5.61E-02	1.70E-01	9.71E+00	2.47E-01	1.86E-02	5.61E-02	1.98E-01	1.13E+01	8.54E-01	1.86E-02
		Lloyd Lake	5.60E-02	1.21E-01	6.85E+00	5.50E-02	1.05E-02	5.60E-02	1.24E-01	7.01E+00	1.17E-01	1.05E-02
	Zooplankton	Reference (Broach Lake)	6.68E-02	1.17E-01	6.57E+00	3.34E-02	1.00E-02	6.68E-02	1.17E-01	6.57E+00	3.34E-02	1.00E-02
		Patterson Lake North Arm - West Basin	7.08E-02	2.85E-01	1.70E+01	7.46E-01	1.00E-01	7.30E-02	3.75E-01	2.23E+01	2.77E+00	1.00E-01
		Patterson Lake South Arm	6.71E-02	2.19E-01	1.27E+01	4.47E-01	3.50E-02	6.73E-02	2.74E-01	1.58E+01	1.62E+00	3.51E-02
		Beet Lake	6.69E-02	1.71E-01	9.78E+00	2.49E-01	1.93E-02	6.69E-02	2.00E-01	1.14E+01	8.60E-01	1.93E-02
		Lloyd Lake	6.68E-02	1.22E-01	6.90E+00	5.54E-02	1.09E-02	6.68E-02	1.25E-01	7.06E+00	1.18E-01	1.09E-02
	Northern Pike	Reference (Broach Lake)	3.71E-02	7.00E-03	4.21E-01	2.06E-05	2.01E-03	3.71E-02	7.00E-03	4.21E-01	2.06E-05	2.01E-03
		Patterson Lake North Arm - West Basin	3.94E-02	1.71E-02	1.09E+00	4.60E-04	2.01E-02	4.06E-02	2.25E-02	1.43E+00	1.71E-03	2.01E-02
		Patterson Lake South Arm	3.73E-02	1.31E-02	8.14E-01	2.76E-04	7.01E-03	3.74E-02	1.64E-02	1.01E+00	1.00E-03	7.01E-03
		Beet Lake	3.71E-02	1.02E-02	6.27E-01	1.54E-04	3.87E-03	3.72E-02	1.20E-02	7.30E-01	5.31E-04	3.87E-03
		Lloyd Lake	3.71E-02	7.33E-03	4.42E-01	3.42E-05	2.17E-03	3.71E-02	7.51E-03	4.53E-01	7.27E-05	2.17E-03
	Whitefish	Reference (Broach Lake)	3.56E-02	6.99E-03	4.21E-02	2.06E-05	4.97E-04	3.56E-02	6.99E-03	4.21E-02	2.06E-05	4.97E-04
		Patterson Lake North Arm - West Basin	3.78E-02	1.71E-02	1.09E-01	4.60E-04	4.97E-03	3.89E-02	2.25E-02	1.42E-01	1.71E-03	4.97E-03
		Patterson Lake South Arm	3.58E-02	1.31E-02	8.12E-02	2.75E-04	1.73E-03	3.59E-02	1.64E-02	1.01E-01	9.99E-04	1.74E-03
		Beet Lake	3.56E-02	1.02E-02	6.25E-02	1.53E-04	9.57E-04	3.57E-02	1.20E-02	7.28E-02	5.30E-04	9.57E-04
		Lloyd Lake	3.56E-02	7.32E-03	4.42E-02	3.41E-05	5.38E-04	3.56E-02	7.50E-03	4.52E-02	7.25E-05	5.38E-04
Terrestrial Plants	Blueberries	Reference (Broach Lake)	2.51E-02	2.51E-02	3.99E-01	1.42E-02	4.01E-02	2.51E-02	2.51E-02	3.99E-01	1.42E-02	4.01E-02
		Patterson Lake North Arm - West Basin	2.51E-02	2.51E-02	4.00E-01	1.42E-02	5.79E-02	2.51E-02	2.51E-02	4.00E-01	1.42E-02	5.79E-02
		Patterson Lake South Arm	2.51E-02	2.51E-02	3.99E-01	1.42E-02	4.26E-02	2.51E-02	2.51E-02	3.99E-01	1.42E-02	4.26E-02
		Beet Lake	2.51E-02	2.51E-02	3.99E-01	1.42E-02	4.16E-02	2.51E-02	2.51E-02	3.99E-01	1.42E-02	4.16E-02
		Lloyd Lake	2.51E-02	2.51E-02	3.99E-01	1.42E-02	4.01E-02	2.51E-02	2.51E-02	3.99E-01	1.42E-02	4.01E-02
	Browse	Reference (Broach Lake)	5.02E-02	5.01E-02	7.98E-01	2.85E-02	8.01E-02	5.02E-02	5.01E-02	7.98E-01	2.85E-02	8.01E-02
		Patterson Lake North Arm - West Basin	5.02E-02	5.03E-02	7.99E-01	2.85E-02	1.16E-01	5.02E-02	5.03E-02	7.99E-01	2.85E-02	1.16E-01
		Patterson Lake South Arm	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.52E-02	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.52E-02
		Beet Lake	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.31E-02	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.31E-02
		Lloyd Lake	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.02E-02	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.02E-02

Table C.8: Maximum Concentrations of Non-radiological COPCs in Biota for the Application Case and Upper Bound Scenario – Far-Future

			Maximum Concentration Far-Future (mg/kg fw)									
	Biota	Location	Application Case					Upper Bound Scenario				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
	Labrador Tea	Reference (Broach Lake)	5.02E-02	5.01E-02	7.98E-01	2.85E-02	8.01E-02	5.02E-02	5.01E-02	7.98E-01	2.85E-02	8.01E-02
		Patterson Lake North Arm - West Basin	5.02E-02	5.03E-02	7.99E-01	2.85E-02	1.16E-01	5.02E-02	5.03E-02	7.99E-01	2.85E-02	1.16E-01
		Patterson Lake South Arm	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.52E-02	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.52E-02
		Beet Lake	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.31E-02	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.31E-02
		Lloyd Lake	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.02E-02	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.02E-02
	Lichen	Reference (Broach Lake)	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02
		Patterson Lake North Arm - West Basin	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02
		Patterson Lake South Arm	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02
		Beet Lake	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02
		Lloyd Lake	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02
Terrestrial Animals	Terrestrial Invertebrate	Reference (Broach Lake)	2.24E-02	2.63E-03	5.26E-02	3.73E-02	2.19E-03	2.24E-02	2.63E-03	5.26E-02	3.73E-02	2.19E-03
		Patterson Lake North Arm - West Basin	2.24E-02	2.63E-03	5.27E-02	3.73E-02	3.16E-03	2.24E-02	2.63E-03	5.27E-02	3.73E-02	3.16E-03
		Patterson Lake South Arm	2.24E-02	2.63E-03	5.26E-02	3.73E-02	2.33E-03	2.24E-02	2.63E-03	5.26E-02	3.73E-02	2.33E-03
		Beet Lake	2.24E-02	2.63E-03	5.26E-02	3.73E-02	2.27E-03	2.24E-02	2.63E-03	5.26E-02	3.73E-02	2.27E-03
		Lloyd Lake	2.24E-02	2.63E-03	5.26E-02	3.73E-02	2.19E-03	2.24E-02	2.63E-03	5.26E-02	3.73E-02	2.19E-03
	Beaver	Reference (Broach Lake)	5.56E-02	1.25E-03	3.78E-01	1.36E-03	1.48E-03	5.56E-02	1.25E-03	3.78E-01	1.36E-03	1.48E-03
		Patterson Lake North Arm - West Basin	5.60E-02	1.57E-03	3.94E-01	1.96E-03	2.39E-03	5.63E-02	1.74E-03	4.02E-01	3.64E-03	2.39E-03
		Patterson Lake South Arm	5.56E-02	1.44E-03	3.87E-01	1.71E-03	1.65E-03	5.57E-02	1.55E-03	3.92E-01	2.69E-03	1.65E-03
		Beet Lake	5.56E-02	1.35E-03	3.83E-01	1.54E-03	1.56E-03	5.56E-02	1.41E-03	3.85E-01	2.05E-03	1.56E-03
		Lloyd Lake	5.56E-02	1.26E-03	3.78E-01	1.38E-03	1.49E-03	5.56E-02	1.26E-03	3.79E-01	1.43E-03	1.49E-03
	Black Bear	Reference (Broach Lake)	5.21E-02	8.47E-04	3.52E-01	1.01E-03	1.10E-03	5.21E-02	8.47E-04	3.52E-01	1.01E-03	1.10E-03
		Patterson Lake North Arm - West Basin	5.26E-02	9.25E-04	4.49E-01	1.10E-03	1.43E-03	5.28E-02	9.63E-04	4.98E-01	1.34E-03	1.43E-03
		Beet Lake	5.43E-02	9.00E-04	3.72E-01	1.05E-03	1.15E-03	5.43E-02	9.08E-04	3.82E-01	1.10E-03	1.15E-03
		Lloyd Lake	5.22E-02	8.57E-04	3.56E-01	1.02E-03	1.10E-03	5.22E-02	8.58E-04	3.58E-01	1.03E-03	1.10E-03
	Grey Wolf	Reference (Broach Lake)	4.71E-02	8.12E-05	1.04E-01	9.04E-05	4.57E-05	4.71E-02	8.12E-05	1.04E-01	9.04E-05	4.57E-05
		Patterson Lake North-West Basin	4.73E-02	8.70E-05	1.08E-01	1.40E-04	5.54E-05	4.74E-02	9.01E-05	1.10E-01	2.83E-04	5.54E-05
		Lloyd Lake	4.71E-02	8.18E-05	1.04E-01	9.51E-05	4.59E-05	4.71E-02	8.21E-05	1.04E-01	1.09E-04	4.59E-05
	Mink	Reference (Broach Lake)	2.80E-02	2.42E-04	2.78E-01	1.40E-04	5.15E-05	2.80E-02	2.42E-04	2.78E-01	1.40E-04	5.15E-05
		Patterson Lake North Arm - West Basin	2.96E-02	5.54E-04	7.19E-01	2.69E-03	3.95E-04	3.05E-02	7.20E-04	9.40E-01	9.92E-03	3.96E-04
		Patterson Lake South Arm	2.82E-02	4.31E-04	5.37E-01	1.62E-03	1.46E-04	2.82E-02	5.32E-04	6.67E-01	5.82E-03	1.46E-04
		Beet Lake	2.81E-02	3.42E-04	4.14E-01	9.09E-04	8.68E-05	2.81E-02	3.95E-04	4.82E-01	3.10E-03	8.68E-05
		Lloyd Lake	2.80E-02	2.52E-04	2.92E-01	2.18E-04	5.47E-05	2.80E-02	2.58E-04	2.99E-01	4.41E-04	5.47E-05
	Moose	Reference (Broach Lake)	5.87E-02	1.37E-03	3.51E-01	1.26E-03	1.37E-03	5.87E-02	1.37E-03	3.51E-01	1.26E-03	1.37E-03
		Patterson Lake North Arm - West Basin	5.96E-02	2.03E-03	3.84E-01	2.45E-03	2.49E-03	6.01E-02	2.37E-03	4.00E-01	5.83E-03	2.49E-03
		Patterson Lake South Arm	5.96E-02	2.01E-03	3.83E-01	2.31E-03	2.47E-03	6.01E-02	2.35E-03	4.00E-01	5.33E-03	2.47E-03
		Beet Lake	5.87E-02	1.58E-03	3.61E-01	1.62E-03	1.47E-03	5.87E-02	1.69E-03	3.66E-01	2.64E-03	1.47E-03
		Lloyd Lake	5.87E-02	1.39E-03	3.52E-01	1.29E-03	1.38E-03	5.87E-02	1.41E-03	3.53E-01	1.40E-03	1.38E-03
	Moose Organs	Reference (Broach Lake)	4.99E-01	3.19E-01	1.40E+01	1.26E-01	2.42E-03	4.99E-01	3.19E-01	1.40E+01	1.26E-01	2.42E-03
		Patterson Lake North Arm - West Basin	5.07E-01	4.71E-01	1.54E+01	2.45E-01	4.40E-03	5.11E-01	5.52E-01	1.60E+01	5.83E-01	4.40E-03
		Patterson Lake South Arm	5.06E-01	4.67E-01	1.53E+01	2.31E-01	4.37E-03	5.11E-01	5.46E-01	1.60E+01	5.33E-01	4.37E-03

Table C.8: Maximum Concentrations of Non-radiological COPCs in Biota for the Application Case and Upper Bound Scenario – Far-Future

		Maximum Concentration Far-Future (mg/kg fw)									
Biota	Location	Application Case					Upper Bound Scenario				
		Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
	Beet Lake	4.99E-01	3.68E-01	1.44E+01	1.62E-01	2.61E-03	4.99E-01	3.94E-01	1.46E+01	2.64E-01	2.61E-03
	Lloyd Lake	4.99E-01	3.24E-01	1.41E+01	1.29E-01	2.44E-03	4.99E-01	3.27E-01	1.41E+01	1.40E-01	2.44E-03
Muskrat	Reference (Broach Lake)	7.19E-02	8.64E-04	5.12E-01	4.59E-04	2.70E-04	7.19E-02	8.64E-04	5.12E-01	4.59E-04	2.70E-04
	Patterson Lake North Arm - West Basin	7.62E-02	2.12E-03	1.33E+00	1.02E-02	2.70E-03	7.85E-02	2.78E-03	1.73E+00	3.80E-02	2.70E-03
	Patterson Lake South Arm	7.22E-02	1.62E-03	9.90E-01	6.13E-03	9.43E-04	7.24E-02	2.03E-03	1.23E+00	2.22E-02	9.44E-04
	Beet Lake	7.19E-02	1.27E-03	7.62E-01	3.41E-03	5.20E-04	7.20E-02	1.48E-03	8.88E-01	1.18E-02	5.20E-04
	Lloyd Lake	7.19E-02	9.05E-04	5.38E-01	7.60E-04	2.93E-04	7.19E-02	9.27E-04	5.51E-01	1.62E-03	2.93E-04
Red Fox	Reference (Broach Lake)	7.78E-03	7.79E-05	2.78E-02	2.35E-04	8.18E-05	7.78E-03	7.79E-05	2.78E-02	2.35E-04	8.18E-05
	Patterson Lake North Arm - West Basin	7.79E-03	8.36E-05	2.80E-02	3.01E-04	1.23E-04	7.79E-03	8.66E-05	2.81E-02	4.91E-04	1.23E-04
	Patterson Lake South Arm	7.78E-03	8.13E-05	2.79E-02	2.73E-04	8.84E-05	7.78E-03	8.31E-05	2.80E-02	3.83E-04	8.84E-05
	Beet Lake	7.78E-03	7.98E-05	2.78E-02	2.55E-04	8.54E-05	7.78E-03	8.07E-05	2.79E-02	3.12E-04	8.54E-05
	Lloyd Lake	7.78E-03	7.82E-05	2.78E-02	2.37E-04	8.20E-05	7.78E-03	7.82E-05	2.78E-02	2.42E-04	8.20E-05
Snowshoe Hare	Reference (Broach Lake)	4.69E-02	9.87E-04	3.44E-01	1.27E-03	1.37E-03	4.69E-02	9.87E-04	3.44E-01	1.27E-03	1.37E-03
	Patterson Lake North Arm - West Basin	4.69E-02	9.95E-04	3.45E-01	1.33E-03	1.99E-03	4.69E-02	9.97E-04	3.45E-01	1.49E-03	1.99E-03
	Patterson Lake South Arm	4.69E-02	9.91E-04	3.44E-01	1.30E-03	1.46E-03	4.69E-02	9.93E-04	3.45E-01	1.40E-03	1.46E-03
	Beet Lake	4.69E-02	9.90E-04	3.44E-01	1.29E-03	1.42E-03	4.69E-02	9.91E-04	3.44E-01	1.34E-03	1.42E-03
	Lloyd Lake	4.69E-02	9.89E-04	3.44E-01	1.27E-03	1.37E-03	4.69E-02	9.89E-04	3.44E-01	1.28E-03	1.37E-03
Southern Red-Backed Vole	Reference (Broach Lake)	1.67E-02	3.54E-04	1.26E-01	4.59E-04	4.98E-04	1.67E-02	3.54E-04	1.26E-01	4.59E-04	4.98E-04
	Patterson Lake North Arm - West Basin	1.67E-02	3.58E-04	1.26E-01	4.91E-04	7.22E-04	1.67E-02	3.59E-04	1.26E-01	5.81E-04	7.22E-04
	Patterson Lake South Arm	1.67E-02	3.56E-04	1.26E-01	4.78E-04	5.31E-04	1.67E-02	3.57E-04	1.26E-01	5.30E-04	5.31E-04
	Beet Lake	1.67E-02	3.55E-04	1.26E-01	4.69E-04	5.17E-04	1.67E-02	3.56E-04	1.26E-01	4.96E-04	5.17E-04
	Lloyd Lake	1.67E-02	3.55E-04	1.26E-01	4.60E-04	4.99E-04	1.67E-02	3.55E-04	1.26E-01	4.63E-04	4.99E-04
Woodland Caribou	Reference (Broach Lake)	6.30E-02	1.08E-03	1.92E-01	1.03E-03	7.02E-04	6.30E-02	1.08E-03	1.92E-01	1.03E-03	7.02E-04
	Patterson Lake North Arm - West Basin	6.39E-02	1.59E-03	2.17E-01	2.94E-03	1.50E-03	6.44E-02	1.87E-03	2.29E-01	8.37E-03	1.50E-03
	Beet Lake	6.29E-02	1.18E-03	1.97E-01	1.40E-03	7.67E-04	6.29E-02	1.24E-03	1.99E-01	2.45E-03	7.67E-04
	Lloyd Lake	6.30E-02	1.10E-03	1.93E-01	1.11E-03	7.14E-04	6.30E-02	1.11E-03	1.94E-01	1.34E-03	7.14E-04
Grouse	Reference (Broach Lake)	3.71E-02	2.88E-02	2.59E-01	2.87E-03	3.27E-02	3.71E-02	2.88E-02	2.59E-01	2.87E-03	3.27E-02
	Patterson Lake North Arm - West Basin	3.71E-02	2.89E-02	2.60E-01	2.96E-03	4.73E-02	3.71E-02	2.90E-02	2.60E-01	3.19E-03	4.73E-02
	Patterson Lake South Arm	3.71E-02	2.88E-02	2.60E-01	2.92E-03	3.48E-02	3.71E-02	2.89E-02	2.60E-01	3.06E-03	3.48E-02
	Beet Lake	3.71E-02	2.88E-02	2.60E-01	2.90E-03	3.39E-02	3.71E-02	2.88E-02	2.60E-01	2.97E-03	3.39E-02
	Lloyd Lake	3.71E-02	2.88E-02	2.59E-01	2.88E-03	3.27E-02	3.71E-02	2.88E-02	2.59E-01	2.88E-03	3.27E-02
Canada Goose	Reference (Broach Lake)	5.23E-03	4.08E-03	3.63E-02	4.06E-04	4.59E-03	5.23E-03	4.08E-03	3.63E-02	4.06E-04	4.59E-03
	Patterson Lake North Arm - West Basin	5.23E-03	4.16E-03	3.65E-02	4.76E-04	6.68E-03	5.23E-03	4.20E-03	3.65E-02	6.78E-04	6.68E-03
	Patterson Lake South Arm	5.23E-03	4.13E-03	3.64E-02	4.47E-04	4.89E-03	5.23E-03	4.15E-03	3.64E-02	5.63E-04	4.89E-03
	Beet Lake	5.23E-03	4.10E-03	3.64E-02	4.27E-04	4.76E-03	5.23E-03	4.12E-03	3.64E-02	4.88E-04	4.76E-03
	Lloyd Lake	5.23E-03	4.08E-03	3.63E-02	4.08E-04	4.59E-03	5.23E-03	4.09E-03	3.63E-02	4.14E-04	4.59E-03
Little Brown Myotis	Reference (Broach Lake)	1.97E-02	8.78E-04	1.15E+00	5.85E-04	6.64E-05	1.97E-02	8.78E-04	1.15E+00	5.85E-04	6.64E-05
	Patterson Lake North Arm - West Basin	2.09E-02	2.15E-03	2.97E+00	1.31E-02	6.64E-04	2.16E-02	2.83E-03	3.89E+00	4.85E-02	6.65E-04
	Patterson Lake South Arm	1.98E-02	1.65E-03	2.22E+00	7.82E-03	2.32E-04	1.99E-02	2.06E-03	2.76E+00	2.84E-02	2.32E-04
	Beet Lake	1.97E-02	1.29E-03	1.71E+00	4.35E-03	1.28E-04	1.98E-02	1.50E-03	1.99E+00	1.51E-02	1.28E-04

Table C.8: Maximum Concentrations of Non-radiological COPCs in Biota for the Application Case and Upper Bound Scenario – Far-Future

			Maximum Concentration Far-Future (mg/kg fw)									
	Biota	Location	Application Case					Upper Bound Scenario				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
		Lloyd Lake	1.97E-02	9.20E-04	1.21E+00	9.69E-04	7.20E-05	1.97E-02	9.42E-04	1.23E+00	2.06E-03	7.20E-05
	Loon	Reference (Broach Lake)	1.44E-02	5.39E-03	1.97E-01	1.88E-04	6.47E-04	1.44E-02	5.39E-03	1.97E-01	1.88E-04	6.47E-04
		Patterson Lake North Arm - West Basin	1.53E-02	1.32E-02	5.10E-01	4.20E-03	6.47E-03	1.58E-02	1.74E-02	6.68E-01	1.56E-02	6.48E-03
		Patterson Lake South Arm	1.45E-02	1.01E-02	3.81E-01	2.52E-03	2.26E-03	1.45E-02	1.27E-02	4.73E-01	9.13E-03	2.26E-03
		Beet Lake	1.44E-02	7.90E-03	2.93E-01	1.40E-03	1.25E-03	1.45E-02	9.24E-03	3.42E-01	4.84E-03	1.25E-03
		Lloyd Lake	1.44E-02	5.65E-03	2.07E-01	3.12E-04	7.01E-04	1.44E-02	5.79E-03	2.12E-01	6.63E-04	7.01E-04
	Mallard	Reference (Broach Lake)	5.77E-02	4.36E-02	1.13E+00	2.04E-03	6.80E-03	5.77E-02	4.36E-02	1.13E+00	2.04E-03	6.80E-03
		Patterson Lake North Arm - West Basin	6.12E-02	1.07E-01	2.93E+00	4.54E-02	6.80E-02	6.31E-02	1.40E-01	3.84E+00	1.69E-01	6.81E-02
		Patterson Lake South Arm	5.80E-02	8.20E-02	2.19E+00	2.72E-02	2.37E-02	5.82E-02	1.02E-01	2.72E+00	9.87E-02	2.37E-02
		Beet Lake	5.78E-02	6.39E-02	1.68E+00	1.51E-02	1.31E-02	5.78E-02	7.47E-02	1.96E+00	5.24E-02	1.31E-02
		Lloyd Lake	5.77E-02	4.57E-02	1.19E+00	3.37E-03	7.37E-03	5.77E-02	4.68E-02	1.22E+00	7.17E-03	7.37E-03
	Rusty Blackbird	Reference (Broach Lake)	7.99E-02	1.09E-01	3.39E+00	6.19E-03	1.83E-02	7.99E-02	1.09E-01	3.39E+00	6.19E-03	1.83E-02
		Patterson Lake North Arm - West Basin	8.32E-02	2.42E-01	8.65E+00	1.11E-01	7.52E-02	8.50E-02	3.13E-01	1.13E+01	4.07E-01	7.52E-02
		Patterson Lake South Arm	8.01E-02	1.90E-01	6.48E+00	6.68E-02	3.35E-02	8.03E-02	2.33E-01	8.03E+00	2.39E-01	3.35E-02
		Beet Lake	7.99E-02	1.51E-01	5.01E+00	3.77E-02	2.40E-02	7.99E-02	1.74E-01	5.82E+00	1.27E-01	2.40E-02
		Lloyd Lake	7.99E-02	1.13E-01	3.56E+00	9.40E-03	1.88E-02	7.99E-02	1.15E-01	3.64E+00	1.85E-02	1.88E-02

Table C.9: Maximum Concentrations of Non-radiological COPCs in Biota for the RFD Scenario - Project Lifespan and Far-Future

			Maximum Concentration RFD Case (mg/kg fw)									
	Biota	Location	Project Lifespan					Far-Future				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
Aquatic Plants	Macrophytes	Reference (Broach Lake)	2.13E-02	9.21E-02	1.83E-01	1.40E-03	5.06E-03	2.13E-02	9.21E-02	1.83E-01	1.40E-03	5.06E-03
		Patterson Lake North Arm - West Basin	7.50E-02	1.22E-01	2.16E-01	4.07E-03	1.93E-02	2.26E-02	2.26E-01	4.73E-01	3.13E-02	5.06E-02
		Patterson Lake South Arm	1.19E-01	1.23E-01	2.19E-01	3.89E-03	2.70E-02	2.14E-02	1.73E-01	3.53E-01	1.88E-02	1.77E-02
		Beet Lake	3.80E-02	1.06E-01	1.98E-01	2.51E-03	1.27E-02	2.13E-02	1.35E-01	2.72E-01	1.04E-02	9.74E-03
		Lloyd Lake	2.23E-02	9.35E-02	1.84E-01	1.51E-03	5.77E-03	2.13E-02	9.65E-02	1.92E-01	2.32E-03	5.48E-03
	Phytoplankton	Reference (Broach Lake)	2.13E-02	9.21E-02	1.83E-01	1.40E-03	5.06E-03	2.13E-02	9.21E-02	1.83E-01	1.40E-03	5.06E-03
		Patterson Lake North Arm - West Basin	7.50E-02	1.22E-01	2.16E-01	4.07E-03	1.93E-02	2.26E-02	2.26E-01	4.73E-01	3.13E-02	5.06E-02
		Patterson Lake South Arm	1.19E-01	1.23E-01	2.19E-01	3.89E-03	2.70E-02	2.14E-02	1.73E-01	3.53E-01	1.88E-02	1.77E-02
		Beet Lake	3.80E-02	1.06E-01	1.98E-01	2.51E-03	1.27E-02	2.13E-02	1.35E-01	2.72E-01	1.04E-02	9.74E-03
		Lloyd Lake	2.23E-02	9.35E-02	1.84E-01	1.51E-03	5.77E-03	2.13E-02	9.65E-02	1.92E-01	2.32E-03	5.48E-03
Aquatic Animals	Benthic Invertebrates	Reference (Broach Lake)	5.60E-02	1.16E-01	6.53E+00	3.32E-02	9.64E-03	5.60E-02	1.16E-01	6.53E+00	3.32E-02	9.64E-03
		Patterson Lake North Arm - West Basin	1.71E-01	1.50E-01	7.59E+00	8.87E-02	3.16E-02	5.94E-02	2.84E-01	1.69E+01	7.40E-01	9.65E-02
		Patterson Lake South Arm	1.28E-01	1.41E-01	7.32E+00	7.07E-02	2.23E-02	5.63E-02	2.18E-01	1.26E+01	4.44E-01	3.37E-02
		Beet Lake	6.84E-02	1.29E-01	6.94E+00	5.27E-02	1.43E-02	5.61E-02	1.70E-01	9.71E+00	2.47E-01	1.86E-02
		Lloyd Lake	5.68E-02	1.17E-01	6.57E+00	3.52E-02	1.01E-02	5.60E-02	1.21E-01	6.85E+00	5.50E-02	1.05E-02
	Zooplankton	Reference (Broach Lake)	6.68E-02	1.17E-01	6.57E+00	3.34E-02	1.00E-02	6.68E-02	1.17E-01	6.57E+00	3.34E-02	1.00E-02
		Patterson Lake North Arm - West Basin	2.35E-01	1.54E-01	7.76E+00	9.69E-02	3.84E-02	7.08E-02	2.85E-01	1.70E+01	7.46E-01	1.00E-01
		Patterson Lake South Arm	3.74E-01	1.56E-01	7.87E+00	9.26E-02	5.37E-02	6.71E-02	2.19E-01	1.27E+01	4.47E-01	3.50E-02
		Beet Lake	1.19E-01	1.34E-01	7.13E+00	5.98E-02	2.52E-02	6.69E-02	1.71E-01	9.78E+00	2.49E-01	1.93E-02
		Lloyd Lake	7.00E-02	1.18E-01	6.63E+00	3.61E-02	1.14E-02	6.68E-02	1.22E-01	6.90E+00	5.54E-02	1.09E-02
	Northern Pike	Reference (Broach Lake)	3.71E-02	7.00E-03	4.21E-01	2.06E-05	2.01E-03	3.71E-02	7.00E-03	4.21E-01	2.06E-05	2.01E-03
		Patterson Lake North Arm - West Basin	1.31E-01	9.25E-03	4.97E-01	5.98E-05	7.67E-03	3.94E-02	1.71E-02	1.09E+00	4.60E-04	2.01E-02
		Patterson Lake South Arm	2.08E-01	9.38E-03	5.04E-01	5.72E-05	1.07E-02	3.73E-02	1.31E-02	8.14E-01	2.76E-04	7.01E-03
		Beet Lake	6.62E-02	8.05E-03	4.57E-01	3.69E-05	5.04E-03	3.71E-02	1.02E-02	6.27E-01	1.54E-04	3.87E-03
		Lloyd Lake	3.89E-02	7.10E-03	4.25E-01	2.23E-05	2.29E-03	3.71E-02	7.33E-03	4.42E-01	3.42E-05	2.17E-03
	Whitefish	Reference (Broach Lake)	3.56E-02	6.99E-03	4.21E-02	2.06E-05	4.97E-04	3.56E-02	6.99E-03	4.21E-02	2.06E-05	4.97E-04
		Patterson Lake North Arm - West Basin	1.22E-01	9.18E-03	4.95E-02	5.83E-05	1.83E-03	3.78E-02	1.71E-02	1.09E-01	4.60E-04	4.97E-03
		Patterson Lake South Arm	1.73E-01	8.97E-03	4.89E-02	5.11E-05	2.24E-03	3.58E-02	1.31E-02	8.12E-02	2.75E-04	1.73E-03
		Beet Lake	5.89E-02	7.88E-03	4.51E-02	3.43E-05	1.10E-03	3.56E-02	1.02E-02	6.25E-02	1.53E-04	9.57E-04
		Lloyd Lake	3.70E-02	7.08E-03	4.24E-02	2.20E-05	5.53E-04	3.56E-02	7.32E-03	4.42E-02	3.41E-05	5.38E-04
Terrestrial Plants	Blueberries	Reference (Broach Lake)	2.51E-02	2.51E-02	3.99E-01	1.42E-02	4.01E-02	2.51E-02	2.51E-02	3.99E-01	1.42E-02	4.01E-02
		Patterson Lake North Arm - West Basin	2.52E-02	2.52E-02	4.13E-01	1.58E-02	2.93E-01	2.51E-02	2.51E-02	4.00E-01	1.42E-02	5.81E-02
		Patterson Lake South Arm	2.52E-02	2.52E-02	4.00E-01	1.44E-02	8.05E-02	2.51E-02	2.51E-02	3.99E-01	1.42E-02	4.29E-02
		Beet Lake	2.52E-02	2.52E-02	4.00E-01	1.44E-02	6.26E-02	2.51E-02	2.51E-02	3.99E-01	1.42E-02	4.17E-02
		Lloyd Lake	2.52E-02	2.52E-02	4.00E-01	1.44E-02	4.03E-02	2.51E-02	2.51E-02	3.99E-01	1.42E-02	4.01E-02
	Browse	Reference (Broach Lake)	5.02E-02	5.01E-02	7.98E-01	2.85E-02	8.01E-02	5.02E-02	5.01E-02	7.98E-01	2.85E-02	8.01E-02
		Patterson Lake North Arm - West Basin	5.05E-02	5.05E-02	8.27E-01	3.28E-02	6.79E-01	5.02E-02	5.02E-02	7.99E-01	2.85E-02	1.16E-01
		Patterson Lake South Arm	5.05E-02	5.05E-02	7.99E-01	2.88E-02	1.76E-01	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.59E-02
		Beet Lake	5.05E-02	5.05E-02	7.99E-01	2.88E-02	1.34E-01	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.33E-02
		Lloyd Lake	5.05E-02	5.05E-02	7.99E-01	2.88E-02	8.07E-02	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.02E-02

Table C.9: Maximum Concentrations of Non-radiological COPCs in Biota for the RFD Scenario - Project Lifespan and Far-Future

	Biota	Location	Maximum Concentration RFD Case (mg/kg fw)									
			Project Lifespan					Far-Future				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
	Labrador Tea	Reference (Broach Lake)	5.02E-02	5.01E-02	7.98E-01	2.85E-02	8.01E-02	5.02E-02	5.01E-02	7.98E-01	2.85E-02	8.01E-02
		Patterson Lake North Arm - West Basin	5.28E-02	5.28E-02	8.67E-01	6.14E-02	2.88E+00	5.02E-02	5.02E-02	7.99E-01	2.85E-02	1.16E-01
		Patterson Lake South Arm	5.28E-02	5.28E-02	8.02E-01	3.11E-02	5.27E-01	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.59E-02
		Beet Lake	5.28E-02	5.28E-02	8.02E-01	3.11E-02	3.30E-01	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.33E-02
		Lloyd Lake	5.28E-02	5.28E-02	8.02E-01	3.11E-02	8.31E-02	5.02E-02	5.02E-02	7.98E-01	2.85E-02	8.02E-02
	Lichen	Reference (Broach Lake)	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02
		Patterson Lake North Arm - West Basin	7.07E-02	8.82E-02	1.01E+00	2.50E-01	1.41E+01	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02
		Patterson Lake South Arm	7.07E-02	8.82E-02	7.73E-01	8.19E-02	2.27E+00	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02
		Beet Lake	7.07E-02	8.82E-02	7.73E-01	8.19E-02	1.27E+00	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02
		Lloyd Lake	7.07E-02	8.82E-02	7.73E-01	8.19E-02	3.17E-02	5.58E-02	7.33E-02	7.58E-01	6.70E-02	1.68E-02
Terrestrial Animals	Terrestrial Invertebrate	Reference (Broach Lake)	2.24E-02	2.63E-03	5.26E-02	3.73E-02	2.19E-03	2.24E-02	2.63E-03	5.26E-02	3.73E-02	2.19E-03
		Patterson Lake North Arm - West Basin	2.27E-02	2.91E-03	5.89E-02	4.19E-02	2.70E-01	2.24E-02	2.63E-03	5.27E-02	3.73E-02	3.17E-03
		Patterson Lake South Arm	2.27E-02	2.91E-03	5.29E-02	3.76E-02	4.49E-02	2.24E-02	2.63E-03	5.26E-02	3.73E-02	2.34E-03
		Beet Lake	2.27E-02	2.91E-03	5.29E-02	3.76E-02	2.61E-02	2.24E-02	2.63E-03	5.26E-02	3.73E-02	2.27E-03
		Lloyd Lake	2.27E-02	2.91E-03	5.29E-02	3.76E-02	2.47E-03	2.24E-02	2.63E-03	5.26E-02	3.73E-02	2.19E-03
	Beaver	Reference (Broach Lake)	5.56E-02	1.25E-03	3.78E-01	1.36E-03	1.48E-03	5.56E-02	1.25E-03	3.78E-01	1.36E-03	1.48E-03
		Patterson Lake North Arm - West Basin	7.20E-02	1.33E-03	3.93E-01	1.61E-03	1.24E-02	5.60E-02	1.57E-03	3.94E-01	1.96E-03	2.40E-03
		Patterson Lake South Arm	7.19E-02	1.32E-03	3.80E-01	1.41E-03	3.24E-03	5.56E-02	1.44E-03	3.87E-01	1.71E-03	1.66E-03
		Beet Lake	5.86E-02	1.28E-03	3.79E-01	1.39E-03	2.46E-03	5.56E-02	1.35E-03	3.83E-01	1.54E-03	1.57E-03
		Lloyd Lake	5.60E-02	1.26E-03	3.79E-01	1.38E-03	1.50E-03	5.56E-02	1.26E-03	3.78E-01	1.38E-03	1.49E-03
	Black Bear	Reference (Broach Lake)	5.21E-02	8.47E-04	3.52E-01	1.01E-03	1.10E-03	5.21E-02	8.47E-04	3.52E-01	1.01E-03	1.10E-03
		Patterson Lake North Arm - West Basin	1.03E-01	8.74E-04	3.68E-01	1.07E-03	4.65E-03	5.26E-02	9.25E-04	4.49E-01	1.10E-03	1.44E-03
		Beet Lake	5.97E-02	8.91E-04	3.56E-01	1.04E-03	1.42E-03	5.43E-02	9.00E-04	3.72E-01	1.05E-03	1.15E-03
		Lloyd Lake	5.30E-02	8.58E-04	3.53E-01	1.02E-03	1.11E-03	5.22E-02	8.57E-04	3.56E-01	1.02E-03	1.10E-03
	Grey Wolf	Reference (Broach Lake)	4.71E-02	8.12E-05	1.04E-01	9.04E-05	4.57E-05	4.71E-02	8.12E-05	1.04E-01	9.04E-05	4.57E-05
		Patterson Lake North-West Basin	5.66E-02	8.27E-05	1.06E-01	9.97E-05	1.49E-04	4.73E-02	8.70E-05	1.08E-01	1.40E-04	5.55E-05
		Lloyd Lake	4.81E-02	8.19E-05	1.04E-01	9.28E-05	4.62E-05	4.71E-02	8.18E-05	1.04E-01	9.51E-05	4.59E-05
	Mink	Reference (Broach Lake)	2.80E-02	2.42E-04	2.78E-01	1.40E-04	5.15E-05	2.80E-02	2.42E-04	2.78E-01	1.40E-04	5.15E-05
		Patterson Lake North Arm - West Basin	8.43E-02	3.06E-04	3.24E-01	3.40E-04	1.98E-04	2.96E-02	5.54E-04	7.19E-01	2.69E-03	3.95E-04
		Patterson Lake South Arm	7.57E-02	2.89E-04	3.12E-01	2.75E-04	1.07E-04	2.82E-02	4.31E-04	5.37E-01	1.62E-03	1.46E-04
		Beet Lake	3.60E-02	2.67E-04	2.96E-01	2.10E-04	7.32E-05	2.81E-02	3.42E-04	4.14E-01	9.09E-04	8.68E-05
		Lloyd Lake	2.85E-02	2.44E-04	2.80E-01	1.47E-04	5.33E-05	2.80E-02	2.52E-04	2.92E-01	2.18E-04	5.47E-05
	Moose	Reference (Broach Lake)	5.87E-02	1.37E-03	3.51E-01	1.26E-03	1.37E-03	5.87E-02	1.37E-03	3.51E-01	1.26E-03	1.37E-03
		Patterson Lake North Arm - West Basin	9.24E-02	1.52E-03	3.67E-01	1.53E-03	1.12E-02	5.96E-02	2.02E-03	3.84E-01	2.45E-03	2.49E-03
		Patterson Lake South Arm	9.21E-02	1.51E-03	3.66E-01	1.51E-03	1.12E-02	5.96E-02	2.01E-03	3.83E-01	2.31E-03	2.48E-03
		Beet Lake	6.45E-02	1.44E-03	3.53E-01	1.30E-03	2.26E-03	5.87E-02	1.58E-03	3.61E-01	1.62E-03	1.48E-03
		Lloyd Lake	5.93E-02	1.38E-03	3.52E-01	1.27E-03	1.38E-03	5.87E-02	1.39E-03	3.52E-01	1.29E-03	1.38E-03
	Moose Organs	Reference (Broach Lake)	4.99E-01	3.19E-01	1.40E+01	1.26E-01	2.42E-03	4.99E-01	3.19E-01	1.40E+01	1.26E-01	2.42E-03
		Patterson Lake North Arm - West Basin	7.85E-01	3.54E-01	1.47E+01	1.53E-01	1.99E-02	5.07E-01	4.71E-01	1.54E+01	2.45E-01	4.41E-03
		Patterson Lake South Arm	7.83E-01	3.52E-01	1.47E+01	1.51E-01	1.98E-02	5.06E-01	4.67E-01	1.53E+01	2.31E-01	4.38E-03

Table C.9: Maximum Concentrations of Non-radiological COPCs in Biota for the RFD Scenario - Project Lifespan and Far-Future

			Maximum Concentration RFD Case (mg/kg fw)									
	Biota	Location	Project Lifespan					Far-Future				
			Arsenic	Cobalt	Copper	Molybdenum	Uranium	Arsenic	Cobalt	Copper	Molybdenum	Uranium
		Beet Lake	5.48E-01	3.35E-01	1.41E+01	1.30E-01	4.01E-03	4.99E-01	3.68E-01	1.44E+01	1.62E-01	2.61E-03
		Lloyd Lake	5.04E-01	3.22E-01	1.41E+01	1.27E-01	2.45E-03	4.99E-01	3.24E-01	1.41E+01	1.29E-01	2.43E-03
	Muskrat	Reference (Broach Lake)	7.19E-02	8.64E-04	5.12E-01	4.59E-04	2.70E-04	7.19E-02	8.64E-04	5.12E-01	4.59E-04	2.70E-04
		Patterson Lake North Arm - West Basin	2.20E-01	1.13E-03	5.96E-01	1.23E-03	8.89E-04	7.62E-02	2.12E-03	1.33E+00	1.02E-02	2.70E-03
		Patterson Lake South Arm	1.68E-01	1.05E-03	5.74E-01	9.78E-04	6.26E-04	7.22E-02	1.62E-03	9.90E-01	6.13E-03	9.43E-04
		Beet Lake	8.81E-02	9.64E-04	5.45E-01	7.29E-04	4.01E-04	7.19E-02	1.27E-03	7.62E-01	3.41E-03	5.20E-04
		Lloyd Lake	7.28E-02	8.74E-04	5.16E-01	4.87E-04	2.82E-04	7.19E-02	9.05E-04	5.38E-01	7.60E-04	2.93E-04
	Red Fox	Reference (Broach Lake)	7.78E-03	7.79E-05	2.78E-02	2.35E-04	8.18E-05	7.78E-03	7.79E-05	2.78E-02	2.35E-04	8.18E-05
		Patterson Lake North Arm - West Basin	7.93E-03	8.00E-05	2.89E-02	2.67E-04	9.97E-04	7.79E-03	8.35E-05	2.80E-02	3.01E-04	1.23E-04
		Patterson Lake South Arm	8.01E-03	7.99E-05	2.79E-02	2.42E-04	2.28E-04	7.78E-03	8.13E-05	2.79E-02	2.73E-04	8.91E-05
		Beet Lake	7.86E-03	7.92E-05	2.78E-02	2.39E-04	1.64E-04	7.78E-03	7.98E-05	2.78E-02	2.55E-04	8.56E-05
		Lloyd Lake	7.83E-03	7.88E-05	2.78E-02	2.37E-04	8.28E-05	7.78E-03	7.82E-05	2.78E-02	2.37E-04	8.19E-05
	Snowshoe Hare	Reference (Broach Lake)	4.69E-02	9.87E-04	3.44E-01	1.27E-03	1.37E-03	4.69E-02	9.87E-04	3.44E-01	1.27E-03	1.37E-03
		Patterson Lake North Arm - West Basin	4.72E-02	9.96E-04	3.57E-01	1.46E-03	1.14E-02	4.69E-02	9.93E-04	3.45E-01	1.33E-03	1.99E-03
		Patterson Lake South Arm	4.72E-02	9.96E-04	3.45E-01	1.29E-03	2.97E-03	4.69E-02	9.91E-04	3.44E-01	1.30E-03	1.47E-03
		Beet Lake	4.71E-02	9.95E-04	3.45E-01	1.29E-03	2.27E-03	4.69E-02	9.90E-04	3.44E-01	1.29E-03	1.43E-03
		Lloyd Lake	4.71E-02	9.95E-04	3.45E-01	1.28E-03	1.38E-03	4.69E-02	9.89E-04	3.44E-01	1.27E-03	1.37E-03
	Southern Red-Backed Vole	Reference (Broach Lake)	1.67E-02	3.54E-04	1.26E-01	4.59E-04	4.98E-04	1.67E-02	3.54E-04	1.26E-01	4.59E-04	4.98E-04
		Patterson Lake North Arm - West Basin	1.68E-02	3.57E-04	1.30E-01	5.21E-04	3.90E-03	1.67E-02	3.57E-04	1.26E-01	4.91E-04	7.25E-04
		Patterson Lake South Arm	1.68E-02	3.57E-04	1.26E-01	4.66E-04	1.04E-03	1.67E-02	3.56E-04	1.26E-01	4.78E-04	5.35E-04
		Beet Lake	1.67E-02	3.57E-04	1.26E-01	4.65E-04	8.02E-04	1.67E-02	3.55E-04	1.26E-01	4.69E-04	5.18E-04
		Lloyd Lake	1.67E-02	3.56E-04	1.26E-01	4.64E-04	5.02E-04	1.67E-02	3.55E-04	1.26E-01	4.60E-04	4.98E-04
	Woodland Caribou	Reference (Broach Lake)	6.30E-02	1.08E-03	1.92E-01	1.03E-03	7.02E-04	6.30E-02	1.08E-03	1.92E-01	1.03E-03	7.02E-04
		Patterson Lake North Arm - West Basin	1.09E-01	1.24E-03	2.04E-01	1.76E-03	2.03E-02	6.39E-02	1.59E-03	2.17E-01	2.94E-03	1.50E-03
		Beet Lake	6.81E-02	1.13E-03	1.93E-01	1.11E-03	2.32E-03	6.29E-02	1.18E-03	1.97E-01	1.40E-03	7.67E-04
		Lloyd Lake	6.54E-02	1.13E-03	1.94E-01	1.14E-03	7.47E-04	6.30E-02	1.10E-03	1.93E-01	1.11E-03	7.14E-04
	Grouse	Reference (Broach Lake)	3.71E-02	2.88E-02	2.59E-01	2.87E-03	3.27E-02	3.71E-02	2.88E-02	2.59E-01	2.87E-03	3.27E-02
		Patterson Lake North Arm - West Basin	3.73E-02	2.90E-02	2.69E-01	3.27E-03	2.63E-01	3.71E-02	2.89E-02	2.60E-01	2.96E-03	4.75E-02
		Patterson Lake South Arm	3.74E-02	2.90E-02	2.60E-01	2.91E-03	6.95E-02	3.71E-02	2.88E-02	2.60E-01	2.92E-03	3.51E-02
		Beet Lake	3.73E-02	2.90E-02	2.60E-01	2.91E-03	5.33E-02	3.71E-02	2.88E-02	2.59E-01	2.90E-03	3.40E-02
		Lloyd Lake	3.73E-02	2.90E-02	2.60E-01	2.91E-03	3.29E-02	3.71E-02	2.88E-02	2.59E-01	2.88E-03	3.27E-02
	Canada Goose	Reference (Broach Lake)	5.23E-03	4.08E-03	3.63E-02	4.06E-04	4.59E-03	5.23E-03	4.08E-03	3.63E-02	4.06E-04	4.59E-03
		Patterson Lake North Arm - West Basin	5.28E-03	4.12E-03	3.77E-02	4.70E-04	3.81E-02	5.23E-03	4.15E-03	3.65E-02	4.76E-04	6.70E-03
		Patterson Lake South Arm	5.31E-03	4.12E-03	3.64E-02	4.15E-04	9.95E-03	5.23E-03	4.13E-03	3.64E-02	4.47E-04	4.93E-03
		Beet Lake	5.26E-03	4.11E-03	3.64E-02	4.12E-04	7.58E-03	5.23E-03	4.10E-03	3.64E-02	4.27E-04	4.77E-03
		Lloyd Lake	5.25E-03	4.11E-03	3.64E-02	4.10E-04	4.62E-03	5.23E-03	4.08E-03	3.63E-02	4.08E-04	4.59E-03
	Little Brown Myotis	Reference (Broach Lake)	1.97E-02	8.78E-04	1.15E+00	5.85E-04	6.64E-05	1.97E-02	8.78E-04	1.15E+00	5.85E-04	6.64E-05
		Patterson Lake North Arm - West Basin	6.02E-02	1.14E-03	1.34E+00	1.56E-03	2.18E-04	2.09E-02	2.15E-03	2.97E+00	1.31E-02	6.64E-04
		Patterson Lake South Arm	4.52E-02	1.07E-03	1.29E+00	1.25E-03	1.54E-04	1.98E-02	1.65E-03	2.22E+00	7.82E-03	2.32E-04
		Beet Lake	2.41E-02	9.79E-04	1.22E+00	9.30E-04	9.87E-05	1.97E-02	1.29E-03	1.71E+00	4.35E-03	1.28E-04

Table C.9: Maximum Concentrations of Non-radiological COPCs in Biota for the RFD Scenario - Project Lifespan and Far-Future

		Maximum Concentration RFD Case (mg/kg fw)									
Biota	**Location**	**Project Lifespan**					**Far-Future**				
		Arsenic	**Cobalt**	**Copper**	**Molybdenum**	**Uranium**	**Arsenic**	**Cobalt**	**Copper**	**Molybdenum**	**Uranium**
	Lloyd Lake	2.00E-02	8.89E-04	1.16E+00	6.21E-04	6.94E-05	1.97E-02	9.20E-04	1.21E+00	9.69E-04	7.20E-05
Loon	Reference (Broach Lake)	1.44E-02	5.39E-03	1.97E-01	1.88E-04	6.47E-04	1.44E-02	5.39E-03	1.97E-01	1.88E-04	6.47E-04
	Patterson Lake North Arm - West Basin	4.98E-02	7.03E-03	2.30E-01	5.03E-04	2.37E-03	1.53E-02	1.32E-02	5.10E-01	4.20E-03	6.47E-03
	Patterson Lake South Arm	7.37E-02	6.58E-03	2.21E-01	4.01E-04	2.70E-03	1.45E-02	1.01E-02	3.81E-01	2.52E-03	2.26E-03
	Beet Lake	2.45E-02	6.02E-03	2.10E-01	2.99E-04	1.35E-03	1.44E-02	7.90E-03	2.93E-01	1.40E-03	1.25E-03
	Lloyd Lake	1.51E-02	5.46E-03	1.98E-01	2.00E-04	7.12E-04	1.44E-02	5.65E-03	2.07E-01	3.12E-04	7.01E-04
Mallard	Reference (Broach Lake)	5.77E-02	4.36E-02	1.13E+00	2.04E-03	6.80E-03	5.77E-02	4.36E-02	1.13E+00	2.04E-03	6.80E-03
	Patterson Lake North Arm - West Basin	1.77E-01	5.66E-02	1.32E+00	5.44E-03	2.23E-02	6.12E-02	1.07E-01	2.93E+00	4.54E-02	6.80E-02
	Patterson Lake South Arm	1.34E-01	5.32E-02	1.27E+00	4.34E-03	1.57E-02	5.80E-02	8.20E-02	2.19E+00	2.72E-02	2.37E-02
	Beet Lake	7.07E-02	4.87E-02	1.20E+00	3.24E-03	1.01E-02	5.78E-02	6.39E-02	1.68E+00	1.51E-02	1.31E-02
	Lloyd Lake	5.85E-02	4.42E-02	1.14E+00	2.16E-03	7.10E-03	5.77E-02	4.57E-02	1.19E+00	3.37E-03	7.37E-03
Rusty Blackbird	Reference (Broach Lake)	7.99E-02	1.09E-01	3.39E+00	6.19E-03	1.83E-02	7.99E-02	1.09E-01	3.39E+00	6.19E-03	1.83E-02
	Patterson Lake North Arm - West Basin	1.93E-01	1.36E-01	3.93E+00	1.44E-02	1.01E-01	8.32E-02	2.42E-01	8.65E+00	1.11E-01	7.52E-02
	Patterson Lake South Arm	1.51E-01	1.29E-01	3.79E+00	1.17E-02	3.62E-02	8.01E-02	1.90E-01	6.48E+00	6.68E-02	3.35E-02
	Beet Lake	9.21E-02	1.19E-01	3.60E+00	9.07E-03	2.71E-02	7.99E-02	1.51E-01	5.01E+00	3.77E-02	2.41E-02
	Lloyd Lake	8.06E-02	1.10E-01	3.41E+00	6.48E-03	1.86E-02	7.99E-02	1.13E-01	3.56E+00	9.40E-03	1.88E-02

Table C.10: Maximum Concentrations of Radiological COPCs in Biota for the Application Case and Upper Bound Scenario - Project Lifespan

	Biota	Location	Maximum Concentration Project Lifespan (Bq/kg fw)											
			Application Case						Upper Bound Scenario					
			Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210
Aquatic Plants	Macrophytes	Reference (Broach Lake)	1.79E-02	1.79E-02	2.11E+00	9.03E-01	9.62E+00	1.51E+00	1.79E-02	1.79E-02	2.11E+00	9.03E-01	9.62E+00	1.51E+00
		Patterson Lake North Arm - West Basin	1.96E-01	1.96E-01	1.20E+01	1.57E+00	1.47E+01	2.29E+00	5.33E-01	5.35E-01	1.21E+01	1.60E+00	3.69E+01	5.84E+00
		Patterson Lake South Arm	6.57E-02	6.59E-02	7.91E+00	1.14E+00	9.92E+00	1.55E+00	1.49E-01	1.49E-01	7.99E+00	1.15E+00	1.11E+01	1.74E+00
		Beet Lake	3.55E-02	3.56E-02	5.16E+00	1.00E+00	9.66E+00	1.51E+00	6.60E-02	6.62E-02	5.20E+00	1.01E+00	9.82E+00	1.54E+00
		Lloyd Lake	1.95E-02	1.95E-02	2.42E+00	9.12E-01	9.63E+00	1.51E+00	2.23E-02	2.24E-02	2.43E+00	9.13E-01	9.63E+00	1.51E+00
	Phytoplankton	Reference (Broach Lake)	1.79E-02	1.79E-02	2.11E+00	9.03E-01	9.62E+00	1.51E+00	1.79E-02	1.79E-02	2.11E+00	9.03E-01	9.62E+00	1.51E+00
		Patterson Lake North Arm - West Basin	1.96E-01	1.96E-01	1.20E+01	1.57E+00	1.47E+01	2.29E+00	5.33E-01	5.35E-01	1.21E+01	1.60E+00	3.69E+01	5.84E+00
		Patterson Lake South Arm	6.57E-02	6.59E-02	7.91E+00	1.14E+00	9.92E+00	1.55E+00	1.49E-01	1.49E-01	7.99E+00	1.15E+00	1.11E+01	1.74E+00
		Beet Lake	3.55E-02	3.56E-02	5.16E+00	1.00E+00	9.66E+00	1.51E+00	6.60E-02	6.62E-02	5.20E+00	1.01E+00	9.82E+00	1.54E+00
		Lloyd Lake	1.95E-02	1.95E-02	2.42E+00	9.12E-01	9.63E+00	1.51E+00	2.23E-02	2.24E-02	2.43E+00	9.13E-01	9.63E+00	1.51E+00
Aquatic Animals	Benthic Invertebrates	Reference (Broach Lake)	3.42E-02	3.42E-02	4.52E+00	1.35E+00	6.88E+00	4.80E+01	3.42E-02	3.42E-02	4.52E+00	1.35E+00	6.88E+00	4.80E+01
		Patterson Lake North Arm - West Basin	3.08E-01	3.09E-01	2.51E+01	2.16E+00	9.42E+00	6.58E+01	7.94E-01	7.97E-01	2.54E+01	2.20E+00	1.89E+01	1.32E+02
		Patterson Lake South Arm	1.07E-01	1.07E-01	1.62E+01	1.63E+00	7.05E+00	4.92E+01	2.36E-01	2.37E-01	1.64E+01	1.64E+00	7.69E+00	5.36E+01
		Beet Lake	6.08E-02	6.09E-02	1.07E+01	1.47E+00	6.91E+00	4.82E+01	1.08E-01	1.09E-01	1.08E+01	1.47E+00	6.99E+00	4.88E+01
		Lloyd Lake	3.66E-02	3.66E-02	5.15E+00	1.36E+00	6.88E+00	4.81E+01	4.09E-02	4.10E-02	5.16E+00	1.36E+00	6.89E+00	4.81E+01
	Zooplankton	Reference (Broach Lake)	3.56E-02	3.56E-02	4.54E+00	1.38E+00	1.17E+01	8.13E+01	3.56E-02	3.56E-02	4.54E+00	1.38E+00	1.17E+01	8.13E+01
		Patterson Lake North Arm - West Basin	3.88E-01	3.89E-01	2.58E+01	2.41E+00	1.78E+01	1.23E+02	1.06E+00	1.06E+00	2.61E+01	2.46E+00	4.47E+01	3.15E+02
		Patterson Lake South Arm	1.30E-01	1.31E-01	1.71E+01	1.75E+00	1.20E+01	8.38E+01	2.95E-01	2.96E-01	1.72E+01	1.76E+00	1.35E+01	9.41E+01
		Beet Lake	4.89E-02	4.89E-02	7.28E+00	1.45E+00	1.17E+01	8.14E+01	7.20E-02	7.22E-02	7.32E+00	1.45E+00	1.17E+01	8.17E+01
		Lloyd Lake	3.88E-02	3.88E-02	5.22E+00	1.40E+00	1.17E+01	8.13E+01	4.43E-02	4.44E-02	5.23E+00	1.40E+00	1.17E+01	8.14E+01
	Northern Pike	Reference (Broach Lake)	7.12E-03	7.12E-03	5.45E-02	6.65E-02	3.04E-01	7.73E-01	7.12E-03	7.12E-03	5.45E-02	6.65E-02	3.04E-01	7.73E-01
		Patterson Lake North Arm - West Basin	7.76E-02	7.79E-02	3.10E-01	1.16E-01	4.64E-01	1.17E+00	2.11E-01	2.12E-01	3.13E-01	1.18E-01	1.17E+00	2.99E+00
		Patterson Lake South Arm	2.61E-02	2.61E-02	2.05E-01	8.38E-02	3.13E-01	7.96E-01	5.89E-02	5.91E-02	2.07E-01	8.46E-02	3.51E-01	8.94E-01
		Beet Lake	1.41E-02	1.41E-02	1.33E-01	7.39E-02	3.05E-01	7.76E-01	2.62E-02	2.63E-02	1.35E-01	7.42E-02	3.10E-01	7.89E-01
		Lloyd Lake	7.75E-03	7.76E-03	6.27E-02	6.72E-02	3.04E-01	7.73E-01	8.87E-03	8.88E-03	6.28E-02	6.72E-02	3.04E-01	7.74E-01
	Whitefish	Reference (Broach Lake)	1.76E-03	1.76E-03	5.45E-02	6.60E-02	1.00E-01	6.94E-01	1.76E-03	1.76E-03	5.45E-02	6.60E-02	1.00E-01	6.94E-01
		Patterson Lake North Arm - West Basin	1.83E-02	1.84E-02	3.08E-01	1.12E-01	1.49E-01	1.03E+00	4.88E-02	4.90E-02	3.11E-01	1.15E-01	3.62E-01	2.53E+00
		Patterson Lake South Arm	6.16E-03	6.18E-03	2.02E-01	8.22E-02	1.03E-01	7.14E-01	1.38E-02	1.39E-02	2.03E-01	8.29E-02	1.15E-01	7.96E-01
		Beet Lake	3.38E-03	3.38E-03	1.32E-01	7.29E-02	1.00E-01	6.97E-01	6.20E-03	6.22E-03	1.33E-01	7.32E-02	1.02E-01	7.07E-01
		Lloyd Lake	1.91E-03	1.91E-03	6.24E-02	6.67E-02	1.00E-01	6.94E-01	2.17E-03	2.17E-03	6.25E-02	6.67E-02	1.00E-01	6.95E-01
Terrestrial Plants	Blueberries	Reference (Broach Lake)	4.95E-01	4.95E-01	6.24E-02	1.08E+00	3.20E-01	4.33E-01	4.95E-01	4.95E-01	6.24E-02	1.08E+00	3.20E-01	4.33E-01
		Patterson Lake North Arm - West Basin	2.24E+00	2.24E+00	1.06E-01	2.58E+00	1.19E+00	1.45E+00	2.24E+00	2.24E+00	1.06E-01	2.58E+00	1.19E+00	1.45E+00
		Patterson Lake South Arm	7.80E-01	7.80E-01	6.96E-02	1.32E+00	4.62E-01	6.00E-01	7.80E-01	7.80E-01	6.96E-02	1.32E+00	4.62E-01	6.00E-01
		Beet Lake	6.61E-01	6.61E-01	6.66E-02	1.22E+00	4.03E-01	5.30E-01	6.61E-01	6.61E-01	6.66E-02	1.22E+00	4.03E-01	5.30E-01
		Lloyd Lake	5.01E-01	5.01E-01	6.25E-02	1.08E+00	3.23E-01	4.37E-01	5.01E-01	5.01E-01	6.25E-02	1.08E+00	3.23E-01	4.37E-01
	Browse	Reference (Broach Lake)	9.90E-01	9.90E-01	1.25E-01	2.15E+00	6.40E-01	8.67E-01	9.90E-01	9.90E-01	1.25E-01	2.15E+00	6.40E-01	8.67E-01
		Patterson Lake North Arm - West Basin	4.34E+00	4.34E+00	2.72E+00	6.07E+00	3.28E+00	3.82E+00	4.34E+00	4.34E+00	2.72E+00	6.07E+00	3.28E+00	3.82E+00
		Patterson Lake South Arm	1.54E+00	1.54E+00	5.48E-01	2.79E+00	1.07E+00	1.35E+00	1.54E+00	1.54E+00	5.48E-01	2.79E+00	1.07E+00	1.35E+00
		Beet Lake	1.31E+00	1.31E+00	3.72E-01	2.52E+00	8.91E-01	1.15E+00	1.31E+00	1.31E+00	3.72E-01	2.52E+00	8.91E-01	1.15E+00
		Lloyd Lake	1.00E+00	1.00E+00	1.33E-01	2.16E+00	6.48E-01	8.76E-01	1.00E+00	1.00E+00	1.33E-01	2.16E+00	6.48E-01	8.76E-01

Table C.10: Maximum Concentrations of Radiological COPCs in Biota for the Application Case and Upper Bound Scenario - Project Lifespan

			Maximum Concentration Project Lifespan (Bq/kg fw)											
	Biota	Location	Application Case						Upper Bound Scenario					
			Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210
	Labrador Tea	Reference (Broach Lake)	9.90E-01	9.90E-01	1.25E-01	2.15E+00	6.40E-01	8.67E-01	9.90E-01	9.90E-01	1.25E-01	2.15E+00	6.40E-01	8.67E-01
		Patterson Lake North Arm - West Basin	4.34E+00	4.34E+00	2.42E+01	2.76E+01	2.47E+01	2.21E+01	4.34E+00	4.34E+00	2.42E+01	2.76E+01	2.47E+01	2.21E+01
		Patterson Lake South Arm	1.54E+00	1.54E+00	4.06E+00	6.30E+00	4.57E+00	4.32E+00	1.54E+00	1.54E+00	4.06E+00	6.30E+00	4.57E+00	4.32E+00
		Beet Lake	1.31E+00	1.31E+00	2.42E+00	4.57E+00	2.93E+00	2.88E+00	1.31E+00	1.31E+00	2.42E+00	4.57E+00	2.93E+00	2.88E+00
		Lloyd Lake	1.00E+00	1.00E+00	2.01E-01	2.23E+00	7.17E-01	9.34E-01	1.00E+00	1.00E+00	2.01E-01	2.23E+00	7.17E-01	9.34E-01
	Lichen	Reference (Broach Lake)	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02
		Patterson Lake North Arm - West Basin	2.08E-01	2.08E-01	1.38E+02	1.39E+02	3.22E+02	1.72E+02	2.08E-01	2.08E-01	1.38E+02	1.39E+02	3.22E+02	1.72E+02
		Patterson Lake South Arm	2.08E-01	2.08E-01	2.32E+01	2.38E+01	2.12E+02	1.49E+02	2.08E-01	2.08E-01	2.32E+01	2.38E+01	2.12E+02	1.49E+02
		Beet Lake	2.08E-01	2.08E-01	1.38E+01	1.44E+01	2.04E+02	1.47E+02	2.08E-01	2.08E-01	1.38E+01	1.44E+01	2.04E+02	1.47E+02
		Lloyd Lake	2.08E-01	2.08E-01	1.12E+00	1.77E+00	1.92E+02	1.45E+02	2.08E-01	2.08E-01	1.12E+00	1.77E+00	1.92E+02	1.45E+02
Terrestrial Animals	Terrestrial Invertebrate	Reference (Broach Lake)	2.70E-02	2.70E-02	1.77E-01	1.61E+00	1.14E+00	3.12E-02	2.70E-02	2.70E-02	1.77E-01	1.61E+00	1.14E+00	3.12E-02
		Patterson Lake North Arm - West Basin	1.18E-01	1.18E-01	2.80E+00	5.19E+00	3.88E+00	2.42E+00	1.18E-01	1.18E-01	2.80E+00	5.19E+00	3.88E+00	2.42E+00
		Patterson Lake South Arm	4.19E-02	4.19E-02	6.05E-01	2.20E+00	1.59E+00	4.21E-01	4.19E-02	4.19E-02	6.05E-01	2.20E+00	1.59E+00	4.21E-01
		Beet Lake	3.57E-02	3.57E-02	4.26E-01	1.95E+00	1.40E+00	2.58E-01	3.57E-02	3.57E-02	4.26E-01	1.95E+00	1.40E+00	2.58E-01
		Lloyd Lake	2.73E-02	2.73E-02	1.85E-01	1.63E+00	1.15E+00	3.88E-02	2.73E-02	2.73E-02	1.85E-01	1.63E+00	1.15E+00	3.88E-02
	Beaver	Reference (Broach Lake)	1.81E-02	1.81E-02	4.78E-03	1.84E-01	6.65E-02	2.94E-01	1.81E-02	1.81E-02	4.78E-03	1.84E-01	6.65E-02	2.94E-01
		Patterson Lake North Arm - West Basin	7.98E-02	7.98E-02	4.51E-02	5.01E-01	1.72E-01	1.01E+00	8.13E-02	8.13E-02	4.52E-02	5.02E-01	2.59E-01	1.15E+00
		Patterson Lake South Arm	2.82E-02	2.82E-02	1.62E-02	2.38E-01	8.17E-02	4.08E-01	2.86E-02	2.86E-02	1.63E-02	2.38E-01	8.64E-02	4.16E-01
		Beet Lake	2.39E-02	2.39E-02	1.10E-02	2.15E-01	7.49E-02	3.59E-01	2.41E-02	2.41E-02	1.10E-02	2.15E-01	7.55E-02	3.61E-01
		Lloyd Lake	1.83E-02	1.83E-02	5.23E-03	1.86E-01	6.68E-02	2.96E-01	1.83E-02	1.83E-02	5.24E-03	1.86E-01	6.69E-02	2.96E-01
	Black Bear	Reference (Broach Lake)	1.35E-02	1.35E-02	2.77E-03	1.36E-01	2.87E-02	2.39E-01	1.35E-02	1.35E-02	2.77E-03	1.36E-01	2.87E-02	2.39E-01
		Patterson Lake North Arm - West Basin	3.84E-02	3.84E-02	4.73E-03	2.30E-01	5.20E-02	4.39E-01	3.89E-02	3.89E-02	4.75E-03	2.31E-01	5.59E-02	5.10E-01
		Beet Lake	1.59E-02	1.59E-02	3.94E-03	1.50E-01	3.57E-02	2.66E-01	1.60E-02	1.60E-02	3.94E-03	1.50E-01	3.58E-02	2.67E-01
		Lloyd Lake	1.36E-02	1.36E-02	2.87E-03	1.37E-01	2.89E-02	2.41E-01	1.36E-02	1.36E-02	2.87E-03	1.37E-01	2.89E-02	2.41E-01
	Grey Wolf	Reference (Broach Lake)	5.46E-04	5.46E-04	1.52E-03	1.88E-02	2.07E-02	4.47E-01	5.46E-04	5.46E-04	1.52E-03	1.88E-02	2.07E-02	4.47E-01
		Patterson Lake North-West Basin	1.04E-03	1.04E-03	2.07E-03	3.21E-02	2.31E-02	4.92E-01	1.07E-03	1.07E-03	2.07E-03	3.21E-02	2.41E-02	5.08E-01
		Lloyd Lake	5.52E-04	5.52E-04	1.54E-03	1.90E-02	2.08E-02	4.47E-01	5.53E-04	5.53E-04	1.54E-03	1.90E-02	2.08E-02	4.47E-01
	Mink	Reference (Broach Lake)	3.02E-04	3.02E-04	3.86E-03	1.50E-02	2.57E-02	1.20E+00	3.02E-04	3.02E-04	3.86E-03	1.50E-02	2.57E-02	1.20E+00
		Patterson Lake North Arm - West Basin	1.97E-03	1.97E-03	1.88E-02	2.42E-02	3.46E-02	1.64E+00	3.90E-03	3.91E-03	1.90E-02	2.45E-02	6.48E-02	3.27E+00
		Patterson Lake South Arm	6.81E-04	6.82E-04	1.22E-02	1.76E-02	2.63E-02	1.23E+00	1.20E-03	1.20E-03	1.24E-02	1.77E-02	2.83E-02	1.33E+00
		Beet Lake	4.60E-04	4.61E-04	8.27E-03	1.62E-02	2.58E-02	1.20E+00	6.49E-04	6.50E-04	8.33E-03	1.62E-02	2.61E-02	1.21E+00
		Lloyd Lake	3.14E-04	3.14E-04	4.31E-03	1.51E-02	2.57E-02	1.20E+00	3.31E-04	3.31E-04	4.32E-03	1.51E-02	2.57E-02	1.20E+00
	Moose	Reference (Broach Lake)	1.64E-02	1.64E-02	7.27E-03	1.78E-01	1.06E-01	3.65E-01	1.64E-02	1.64E-02	7.27E-03	1.78E-01	1.06E-01	3.65E-01
		Patterson Lake North Arm - West Basin	7.29E-02	7.29E-02	5.72E-02	4.71E-01	2.24E-01	1.05E+00	7.61E-02	7.61E-02	5.76E-02	4.72E-01	4.01E-01	1.34E+00
		Patterson Lake South Arm	7.23E-02	7.23E-02	5.64E-02	4.68E-01	2.23E-01	1.04E+00	7.55E-02	7.55E-02	5.67E-02	4.69E-01	4.00E-01	1.34E+00
		Beet Lake	2.18E-02	2.18E-02	1.68E-02	2.07E-01	1.14E-01	4.24E-01	2.21E-02	2.21E-02	1.69E-02	2.07E-01	1.15E-01	4.26E-01
		Lloyd Lake	1.66E-02	1.66E-02	8.07E-03	1.79E-01	1.07E-01	3.67E-01	1.66E-02	1.66E-02	8.09E-03	1.79E-01	1.07E-01	3.67E-01
	Moose Organs	Reference (Broach Lake)	2.90E-02	2.90E-02	1.99E+00	9.96E-02	3.34E+00	3.65E-03	2.90E-02	2.90E-02	1.99E+00	9.96E-02	3.34E+00	3.65E-03
		Patterson Lake North Arm - West Basin	1.29E-01	1.29E-01	1.57E+01	2.63E-01	7.04E+00	1.05E-02	1.35E-01	1.35E-01	1.58E+01	2.64E-01	1.26E+01	1.34E-02
		Patterson Lake South Arm	1.28E-01	1.28E-01	1.54E+01	2.62E-01	7.01E+00	1.04E-02	1.34E-01	1.34E-01	1.55E+01	2.62E-01	1.26E+01	1.34E-02

Table C.10: Maximum Concentrations of Radiological COPCs in Biota for the Application Case and Upper Bound Scenario - Project Lifespan

		Maximum Concentration Project Lifespan (Bq/kg fw)											
Biota	**Location**	**Application Case**						**Upper Bound Scenario**					
		Uranium-238	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**
	Beet Lake	3.85E-02	3.85E-02	4.59E+00	1.16E-01	3.58E+00	4.24E-03	3.90E-02	3.90E-02	4.62E+00	1.16E-01	3.62E+00	4.26E-03
	Lloyd Lake	2.93E-02	2.93E-02	2.21E+00	1.00E-01	3.35E+00	3.67E-03	2.94E-02	2.94E-02	2.21E+00	1.00E-01	3.35E+00	3.67E-03
Muskrat	Reference (Broach Lake)	9.58E-04	9.58E-04	1.29E-02	6.20E-02	1.63E-01	2.41E+00	9.58E-04	9.58E-04	1.29E-02	6.20E-02	1.63E-01	2.41E+00
	Patterson Lake North Arm - West Basin	8.65E-03	8.68E-03	7.23E-02	1.00E-01	2.28E-01	3.30E+00	2.23E-02	2.24E-02	7.30E-02	1.02E-01	4.81E-01	6.63E+00
	Patterson Lake South Arm	2.99E-03	3.00E-03	4.68E-02	7.52E-02	1.67E-01	2.47E+00	6.62E-03	6.65E-03	4.72E-02	7.58E-02	1.83E-01	2.70E+00
	Beet Lake	1.70E-03	1.71E-03	3.07E-02	6.76E-02	1.63E-01	2.42E+00	3.04E-03	3.04E-03	3.09E-02	6.78E-02	1.65E-01	2.45E+00
	Lloyd Lake	1.03E-03	1.03E-03	1.48E-02	6.25E-02	1.63E-01	2.41E+00	1.15E-03	1.15E-03	1.48E-02	6.26E-02	1.63E-01	2.42E+00
Red Fox	Reference (Broach Lake)	1.01E-03	1.01E-03	7.96E-04	2.29E-02	7.58E-03	2.12E-02	1.01E-03	1.01E-03	7.96E-04	2.29E-02	7.58E-03	2.12E-02
	Patterson Lake North Arm - West Basin	4.54E-03	4.54E-03	3.99E-03	6.16E-02	1.88E-02	1.11E-01	4.57E-03	4.57E-03	3.99E-03	6.16E-02	1.89E-02	1.11E-01
	Patterson Lake South Arm	1.58E-03	1.58E-03	1.37E-03	2.92E-02	9.41E-03	3.58E-02	1.59E-03	1.59E-03	1.38E-03	2.92E-02	9.42E-03	3.58E-02
	Beet Lake	1.34E-03	1.34E-03	1.13E-03	2.66E-02	8.65E-03	2.97E-02	1.34E-03	1.34E-03	1.13E-03	2.66E-02	8.65E-03	2.97E-02
	Lloyd Lake	1.02E-03	1.02E-03	8.10E-04	2.30E-02	7.62E-03	2.15E-02	1.02E-03	1.02E-03	8.11E-04	2.30E-02	7.62E-03	2.15E-02
Snowshoe Hare	Reference (Broach Lake)	1.69E-02	1.69E-02	2.73E-03	1.67E-01	2.82E-02	2.03E-01	1.69E-02	1.69E-02	2.73E-03	1.67E-01	2.82E-02	2.03E-01
	Patterson Lake North Arm - West Basin	7.44E-02	7.44E-02	2.75E-02	4.54E-01	1.07E-01	8.31E-01	7.44E-02	7.44E-02	2.75E-02	4.54E-01	1.07E-01	8.32E-01
	Patterson Lake South Arm	2.63E-02	2.63E-02	6.82E-03	2.14E-01	4.11E-02	3.06E-01	2.63E-02	2.63E-02	6.82E-03	2.14E-01	4.11E-02	3.06E-01
	Beet Lake	2.24E-02	2.24E-02	5.11E-03	1.94E-01	3.57E-02	2.63E-01	2.24E-02	2.24E-02	5.11E-03	1.94E-01	3.57E-02	2.63E-01
	Lloyd Lake	1.71E-02	1.71E-02	2.81E-03	1.68E-01	2.85E-02	2.05E-01	1.71E-02	1.71E-02	2.81E-03	1.68E-01	2.85E-02	2.05E-01
Southern Red-Backed Vole	Reference (Broach Lake)	6.15E-03	6.15E-03	8.06E-04	5.98E-02	9.13E-03	7.20E-02	6.15E-03	6.15E-03	8.06E-04	5.98E-02	9.13E-03	7.20E-02
	Patterson Lake North Arm - West Basin	2.74E-02	2.74E-02	5.81E-03	1.53E-01	3.34E-02	2.68E-01	2.74E-02	2.74E-02	5.81E-03	1.53E-01	3.35E-02	2.68E-01
	Patterson Lake South Arm	9.62E-03	9.62E-03	1.65E-03	7.50E-02	1.31E-02	1.04E-01	9.62E-03	9.62E-03	1.65E-03	7.50E-02	1.31E-02	1.04E-01
	Beet Lake	8.17E-03	8.17E-03	1.29E-03	6.87E-02	1.14E-02	9.07E-02	8.17E-03	8.17E-03	1.29E-03	6.87E-02	1.14E-02	9.07E-02
	Lloyd Lake	6.22E-03	6.22E-03	8.23E-04	6.01E-02	9.21E-03	7.27E-02	6.22E-03	6.22E-03	8.23E-04	6.01E-02	9.21E-03	7.27E-02
Woodland Caribou	Reference (Broach Lake)	7.48E-03	7.48E-03	8.89E-03	1.16E-01	9.35E-01	4.81E+00	7.48E-03	7.48E-03	8.89E-03	1.16E-01	9.35E-01	4.81E+00
	Patterson Lake North Arm - West Basin	2.11E-02	2.11E-02	1.33E-01	9.28E-01	1.27E+00	5.44E+00	2.50E-02	2.50E-02	1.33E-01	9.29E-01	1.35E+00	5.68E+00
	Beet Lake	8.62E-03	8.62E-03	2.15E-02	1.87E-01	9.66E-01	4.88E+00	8.93E-03	8.93E-03	2.15E-02	1.87E-01	9.66E-01	4.88E+00
	Lloyd Lake	6.22E-03	6.22E-03	8.23E-04	6.01E-02	9.21E-03	7.27E-02	6.22E-03	6.22E-03	8.23E-04	6.01E-02	9.21E-03	7.27E-02
Grouse	Reference (Broach Lake)	4.04E-01	4.04E-01	2.33E-03	3.80E-02	3.34E-02	1.30E+00	4.04E-01	4.04E-01	2.33E-03	3.80E-02	3.34E-02	1.30E+00
	Patterson Lake North Arm - West Basin	1.78E+00	1.78E+00	1.37E-02	9.85E-02	9.94E-02	4.84E+00	1.78E+00	1.78E+00	1.37E-02	9.85E-02	9.95E-02	4.84E+00
	Patterson Lake South Arm	6.28E-01	6.28E-01	4.21E-03	4.79E-02	4.42E-02	1.88E+00	6.28E-01	6.28E-01	4.21E-03	4.79E-02	4.42E-02	1.88E+00
	Beet Lake	5.34E-01	5.34E-01	3.43E-03	4.37E-02	3.97E-02	1.64E+00	5.34E-01	5.34E-01	3.43E-03	4.37E-02	3.97E-02	1.64E+00
	Lloyd Lake	4.08E-01	4.08E-01	2.37E-03	3.82E-02	3.36E-02	1.31E+00	4.08E-01	4.08E-01	2.37E-03	3.82E-02	3.36E-02	1.31E+00
Canada Goose	Reference (Broach Lake)	5.66E-02	5.66E-02	3.38E-04	5.34E-03	4.74E-03	1.83E-01	5.66E-02	5.66E-02	3.38E-04	5.34E-03	4.74E-03	1.83E-01
	Patterson Lake North Arm - West Basin	2.48E-01	2.48E-01	2.40E-03	1.43E-02	1.48E-02	7.18E-01	2.49E-01	2.49E-01	2.40E-03	1.43E-02	1.48E-02	7.19E-01
	Patterson Lake South Arm	8.79E-02	8.79E-02	6.89E-04	6.80E-03	6.37E-03	2.71E-01	8.80E-02	8.80E-02	6.90E-04	6.80E-03	6.38E-03	2.71E-01
	Beet Lake	7.48E-02	7.48E-02	5.41E-04	6.19E-03	5.69E-03	2.34E-01	7.49E-02	7.49E-02	5.42E-04	6.19E-03	5.69E-03	2.34E-01
	Lloyd Lake	5.72E-02	5.72E-02	3.46E-04	5.37E-03	4.77E-03	1.85E-01	5.72E-02	5.72E-02	3.46E-04	5.37E-03	4.77E-03	1.85E-01
Little Brown Myotis	Reference (Broach Lake)	2.36E-04	2.36E-04	1.83E-02	4.04E-02	8.48E-02	4.23E+00	2.36E-04	2.36E-04	1.83E-02	4.04E-02	8.48E-02	4.23E+00
	Patterson Lake North Arm - West Basin	2.12E-03	2.13E-03	1.02E-01	6.47E-02	1.16E-01	5.79E+00	5.47E-03	5.49E-03	1.03E-01	6.59E-02	2.33E-01	1.16E+01
	Patterson Lake South Arm	7.34E-04	7.36E-04	6.57E-02	4.88E-02	8.69E-02	4.33E+00	1.63E-03	1.63E-03	6.64E-02	4.92E-02	9.47E-02	4.72E+00
	Beet Lake	4.19E-04	4.19E-04	4.32E-02	4.39E-02	8.51E-02	4.24E+00	7.45E-04	7.47E-04	4.36E-02	4.41E-02	8.62E-02	4.30E+00

Table C.10: Maximum Concentrations of Radiological COPCs in Biota for the Application Case and Upper Bound Scenario - Project Lifespan

			Maximum Concentration Project Lifespan (Bq/kg fw)											
	Biota	Location	Application Case						Upper Bound Scenario					
			Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210
		Lloyd Lake	2.52E-04	2.52E-04	2.09E-02	4.07E-02	8.48E-02	4.23E+00	2.82E-04	2.82E-04	2.09E-02	4.07E-02	8.49E-02	4.23E+00
	Loon	Reference (Broach Lake)	2.29E-03	2.29E-03	1.55E-03	1.81E-03	1.48E-02	4.07E+00	2.29E-03	2.29E-03	1.55E-03	1.81E-03	1.48E-02	4.07E+00
		Patterson Lake North Arm - West Basin	2.37E-02	2.38E-02	8.63E-03	2.97E-03	2.08E-02	5.60E+00	6.22E-02	6.25E-02	8.72E-03	3.03E-03	4.36E-02	1.14E+01
		Patterson Lake South Arm	7.92E-03	7.94E-03	5.58E-03	2.21E-03	1.52E-02	4.17E+00	1.77E-02	1.77E-02	5.63E-03	2.23E-03	1.67E-02	4.55E+00
		Beet Lake	4.36E-03	4.37E-03	3.67E-03	1.98E-03	1.49E-02	4.08E+00	7.92E-03	7.95E-03	3.70E-03	1.99E-03	1.51E-02	4.14E+00
		Lloyd Lake	2.48E-03	2.48E-03	1.77E-03	1.83E-03	1.48E-02	4.07E+00	2.81E-03	2.81E-03	1.77E-03	1.83E-03	1.49E-02	4.07E+00
	Mallard	Reference (Broach Lake)	2.41E-02	2.41E-02	1.51E-02	1.96E-02	1.95E-01	3.49E+01	2.41E-02	2.41E-02	1.51E-02	1.96E-02	1.95E-01	3.49E+01
		Patterson Lake North Arm - West Basin	2.17E-01	2.18E-01	8.39E-02	3.16E-02	2.71E-01	4.77E+01	5.61E-01	5.64E-01	8.48E-02	3.22E-02	5.62E-01	9.56E+01
		Patterson Lake South Arm	7.52E-02	7.54E-02	5.42E-02	2.38E-02	1.99E-01	3.57E+01	1.67E-01	1.67E-01	5.47E-02	2.39E-02	2.18E-01	3.89E+01
		Beet Lake	4.29E-02	4.29E-02	3.56E-02	2.14E-02	1.95E-01	3.50E+01	7.64E-02	7.66E-02	3.59E-02	2.15E-02	1.98E-01	3.54E+01
		Lloyd Lake	2.58E-02	2.58E-02	1.72E-02	1.98E-02	1.95E-01	3.49E+01	2.89E-02	2.89E-02	1.72E-02	1.98E-02	1.95E-01	3.49E+01
	Rusty Blackbird	Reference (Broach Lake)	1.74E-01	1.74E-01	4.20E-02	5.45E-02	3.34E-01	9.54E+01	1.74E-01	1.74E-01	4.20E-02	5.45E-02	3.34E-01	9.54E+01
		Patterson Lake North Arm - West Basin	8.71E-01	8.72E-01	2.13E-01	9.47E-02	4.59E-01	1.31E+02	1.16E+00	1.17E+00	2.16E-01	9.56E-02	8.45E-01	2.61E+02
		Patterson Lake South Arm	3.03E-01	3.03E-01	1.38E-01	6.44E-02	3.44E-01	9.79E+01	3.79E-01	3.79E-01	1.40E-01	6.47E-02	3.70E-01	1.07E+02
		Beet Lake	2.39E-01	2.39E-01	9.27E-02	5.91E-02	3.37E-01	9.58E+01	2.66E-01	2.66E-01	9.34E-02	5.92E-02	3.40E-01	9.70E+01
		Lloyd Lake	1.77E-01	1.77E-01	4.72E-02	5.48E-02	3.34E-01	9.54E+01	1.79E-01	1.79E-01	4.72E-02	5.48E-02	3.34E-01	9.55E+01

Table C.11: Maximum Concentrations of Radiological COPCs in Biota for the Application Case and Upper Bound Scenario - Far-Future

	Biota	Location	Maximum Concentration Far Future (Bq/kg fw)											
			Application Case						Upper Bound Scenario					
			Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210
Aquatic Plants	Macrophytes	Reference (Broach Lake)	1.79E-02	1.79E-02	2.11E+00	9.03E-01	9.62E+00	1.51E+00	1.79E-02	1.79E-02	2.11E+00	9.03E-01	9.62E+00	1.51E+00
		Patterson Lake North Arm - West Basin	5.81E-01	5.83E-01	2.25E+00	1.16E+00	1.01E+01	1.58E+00	5.81E-01	5.83E-01	2.25E+00	1.16E+00	1.01E+01	1.58E+00
		Patterson Lake South Arm	1.74E-01	1.74E-01	2.20E+00	9.99E-01	9.65E+00	1.51E+00	1.74E-01	1.74E-01	2.20E+00	9.99E-01	9.65E+00	1.51E+00
		Beet Lake	7.58E-02	7.60E-02	2.16E+00	9.44E-01	9.63E+00	1.51E+00	7.59E-02	7.61E-02	2.16E+00	9.44E-01	9.63E+00	1.51E+00
		Lloyd Lake	2.32E-02	2.32E-02	2.11E+00	9.07E-01	9.63E+00	1.51E+00	2.32E-02	2.32E-02	2.11E+00	9.07E-01	9.63E+00	1.51E+00
	Phytoplankton	Reference (Broach Lake)	1.79E-02	1.79E-02	2.11E+00	9.03E-01	9.62E+00	1.51E+00	1.79E-02	1.79E-02	2.11E+00	9.03E-01	9.62E+00	1.51E+00
		Patterson Lake North Arm - West Basin	5.81E-01	5.83E-01	2.25E+00	1.16E+00	1.01E+01	1.58E+00	5.81E-01	5.83E-01	2.25E+00	1.16E+00	1.01E+01	1.58E+00
		Patterson Lake South Arm	1.74E-01	1.74E-01	2.20E+00	9.99E-01	9.65E+00	1.51E+00	1.74E-01	1.74E-01	2.20E+00	9.99E-01	9.65E+00	1.51E+00
		Beet Lake	7.58E-02	7.60E-02	2.16E+00	9.44E-01	9.63E+00	1.51E+00	7.59E-02	7.61E-02	2.16E+00	9.44E-01	9.63E+00	1.51E+00
		Lloyd Lake	2.32E-02	2.32E-02	2.11E+00	9.07E-01	9.63E+00	1.51E+00	2.32E-02	2.32E-02	2.11E+00	9.07E-01	9.63E+00	1.51E+00
Aquatic Animals	Benthic Invertebrates	Reference (Broach Lake)	3.42E-02	3.42E-02	4.52E+00	1.35E+00	6.88E+00	4.80E+01	3.42E-02	3.42E-02	4.52E+00	1.35E+00	6.88E+00	4.80E+01
		Patterson Lake North Arm - West Basin	1.11E+00	1.11E+00	4.83E+00	1.74E+00	7.20E+00	5.03E+01	1.11E+00	1.11E+00	4.83E+00	1.74E+00	7.20E+00	5.03E+01
		Patterson Lake South Arm	3.31E-01	3.32E-01	4.71E+00	1.49E+00	6.90E+00	4.82E+01	3.31E-01	3.33E-01	4.71E+00	1.49E+00	6.90E+00	4.82E+01
		Beet Lake	1.45E-01	1.45E-01	4.62E+00	1.41E+00	6.89E+00	4.81E+01	1.45E-01	1.45E-01	4.62E+00	1.41E+00	6.89E+00	4.81E+01
		Lloyd Lake	4.42E-02	4.42E-02	4.53E+00	1.35E+00	6.88E+00	4.80E+01	4.42E-02	4.42E-02	4.53E+00	1.35E+00	6.88E+00	4.80E+01
	Zooplankton	Reference (Broach Lake)	3.56E-02	3.56E-02	4.54E+00	1.38E+00	1.17E+01	8.13E+01	3.56E-02	3.56E-02	4.54E+00	1.38E+00	1.17E+01	8.13E+01
		Patterson Lake North Arm - West Basin	1.15E+00	1.16E+00	4.86E+00	1.79E+00	1.22E+01	8.51E+01	1.15E+00	1.16E+00	4.86E+00	1.79E+00	1.22E+01	8.51E+01
		Patterson Lake South Arm	3.44E-01	3.46E-01	4.74E+00	1.53E+00	1.17E+01	8.16E+01	3.45E-01	3.46E-01	4.74E+00	1.53E+00	1.17E+01	8.16E+01
		Beet Lake	1.50E-01	1.51E-01	4.65E+00	1.45E+00	1.17E+01	8.14E+01	1.51E-01	1.51E-01	4.65E+00	1.45E+00	1.17E+01	8.14E+01
		Lloyd Lake	4.60E-02	4.60E-02	4.56E+00	1.39E+00	1.17E+01	8.13E+01	4.60E-02	4.60E-02	4.56E+00	1.39E+00	1.17E+01	8.13E+01
	Northern Pike	Reference (Broach Lake)	7.12E-03	7.12E-03	5.45E-02	6.65E-02	3.04E-01	7.73E-01	7.12E-03	7.12E-03	5.45E-02	6.65E-02	3.04E-01	7.73E-01
		Patterson Lake North Arm - West Basin	2.30E-01	2.31E-01	5.83E-02	8.57E-02	3.18E-01	8.09E-01	2.31E-01	2.31E-01	5.83E-02	8.57E-02	3.18E-01	8.09E-01
		Patterson Lake South Arm	6.89E-02	6.91E-02	5.69E-02	7.35E-02	3.05E-01	7.75E-01	6.90E-02	6.92E-02	5.69E-02	7.35E-02	3.05E-01	7.75E-01
		Beet Lake	3.01E-02	3.02E-02	5.58E-02	6.95E-02	3.04E-01	7.73E-01	3.01E-02	3.02E-02	5.58E-02	6.95E-02	3.04E-01	7.73E-01
		Lloyd Lake	9.20E-03	9.20E-03	5.47E-02	6.67E-02	3.04E-01	7.73E-01	9.20E-03	9.21E-03	5.47E-02	6.67E-02	3.04E-01	7.73E-01
	Whitefish	Reference (Broach Lake)	1.76E-03	1.76E-03	5.45E-02	6.60E-02	1.00E-01	6.94E-01	1.76E-03	1.76E-03	5.45E-02	6.60E-02	1.00E-01	6.94E-01
		Patterson Lake North Arm - West Basin	5.70E-02	5.73E-02	5.82E-02	8.51E-02	1.05E-01	7.26E-01	5.71E-02	5.73E-02	5.82E-02	8.52E-02	1.05E-01	7.26E-01
		Patterson Lake South Arm	1.71E-02	1.71E-02	5.68E-02	7.30E-02	1.00E-01	6.96E-01	1.71E-02	1.71E-02	5.68E-02	7.31E-02	1.00E-01	6.96E-01
		Beet Lake	7.45E-03	7.47E-03	5.57E-02	6.90E-02	1.00E-01	6.94E-01	7.45E-03	7.48E-03	5.57E-02	6.90E-02	1.00E-01	6.94E-01
		Lloyd Lake	2.28E-03	2.28E-03	5.46E-02	6.63E-02	1.00E-01	6.94E-01	2.28E-03	2.28E-03	5.46E-02	6.63E-02	1.00E-01	6.94E-01
Terrestrial Plants	Blueberries	Reference (Broach Lake)	4.95E-01	4.95E-01	6.24E-02	1.08E+00	3.20E-01	4.33E-01	4.95E-01	4.95E-01	6.24E-02	1.08E+00	3.20E-01	4.33E-01
		Patterson Lake North Arm - West Basin	6.71E-01	6.71E-01	8.26E-02	1.55E+00	3.20E-01	4.33E-01	6.71E-01	6.71E-01	8.26E-02	1.55E+00	3.20E-01	4.33E-01
		Patterson Lake South Arm	5.24E-01	5.24E-01	6.57E-02	1.15E+00	3.20E-01	4.33E-01	5.24E-01	5.24E-01	6.57E-02	1.15E+00	3.20E-01	4.33E-01
		Beet Lake	5.12E-01	5.12E-01	6.43E-02	1.12E+00	3.20E-01	4.33E-01	5.12E-01	5.12E-01	6.43E-02	1.12E+00	3.20E-01	4.33E-01
		Lloyd Lake	4.96E-01	4.96E-01	6.25E-02	1.08E+00	3.20E-01	4.33E-01	4.96E-01	4.96E-01	6.25E-02	1.08E+00	3.20E-01	4.33E-01
	Browse	Reference (Broach Lake)	9.90E-01	9.90E-01	1.25E-01	2.15E+00	6.40E-01	8.67E-01	9.90E-01	9.90E-01	1.25E-01	2.15E+00	6.40E-01	8.67E-01
		Patterson Lake North Arm - West Basin	1.34E+00	1.34E+00	1.65E-01	3.10E+00	6.40E-01	8.67E-01	1.34E+00	1.34E+00	1.65E-01	3.10E+00	6.40E-01	8.67E-01
		Patterson Lake South Arm	1.05E+00	1.05E+00	1.31E-01	2.31E+00	6.40E-01	8.67E-01	1.05E+00	1.05E+00	1.31E-01	2.31E+00	6.40E-01	8.67E-01
		Beet Lake	1.02E+00	1.02E+00	1.29E-01	2.24E+00	6.40E-01	8.67E-01	1.02E+00	1.02E+00	1.29E-01	2.24E+00	6.40E-01	8.67E-01
		Lloyd Lake	9.91E-01	9.91E-01	1.25E-01	2.16E+00	6.40E-01	8.67E-01	9.91E-01	9.91E-01	1.25E-01	2.16E+00	6.40E-01	8.67E-01

Table C.11: Maximum Concentrations of Radiological COPCs in Biota for the Application Case and Upper Bound Scenario - Far-Future

			Maximum Concentration Far Future (Bq/kg fw)											
	Biota	Location	Application Case						Upper Bound Scenario					
			Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210
	Labrador Tea	Reference (Broach Lake)	9.90E-01	9.90E-01	1.25E-01	2.15E+00	6.40E-01	8.67E-01	9.90E-01	9.90E-01	1.25E-01	2.15E+00	6.40E-01	8.67E-01
		Patterson Lake North Arm - West Basin	1.34E+00	1.34E+00	1.65E-01	3.10E+00	6.40E-01	8.67E-01	1.34E+00	1.34E+00	1.65E-01	3.10E+00	6.40E-01	8.67E-01
		Patterson Lake South Arm	1.05E+00	1.05E+00	1.31E-01	2.31E+00	6.40E-01	8.67E-01	1.05E+00	1.05E+00	1.31E-01	2.31E+00	6.40E-01	8.67E-01
		Beet Lake	1.02E+00	1.02E+00	1.29E-01	2.24E+00	6.40E-01	8.67E-01	1.02E+00	1.02E+00	1.29E-01	2.24E+00	6.40E-01	8.67E-01
		Lloyd Lake	9.91E-01	9.91E-01	1.25E-01	2.16E+00	6.40E-01	8.67E-01	9.91E-01	9.91E-01	1.25E-01	2.16E+00	6.40E-01	8.67E-01
	Lichen	Reference (Broach Lake)	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02
		Patterson Lake North Arm - West Basin	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02
		Patterson Lake South Arm	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02
		Beet Lake	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02
		Lloyd Lake	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02
Terrestrial Animals	Terrestrial Invertebrate	Reference (Broach Lake)	2.70E-02	2.70E-02	1.77E-01	1.61E+00	1.14E+00	3.12E-02	2.70E-02	2.70E-02	1.77E-01	1.61E+00	1.14E+00	3.12E-02
		Patterson Lake North Arm - West Basin	3.66E-02	3.66E-02	2.34E-01	2.33E+00	1.14E+00	3.12E-02	3.66E-02	3.66E-02	2.34E-01	2.33E+00	1.14E+00	3.12E-02
		Patterson Lake South Arm	2.86E-02	2.86E-02	1.86E-01	1.73E+00	1.14E+00	3.12E-02	2.86E-02	2.86E-02	1.86E-01	1.73E+00	1.14E+00	3.12E-02
		Beet Lake	2.79E-02	2.79E-02	1.82E-01	1.68E+00	1.14E+00	3.12E-02	2.79E-02	2.79E-02	1.82E-01	1.68E+00	1.14E+00	3.12E-02
		Lloyd Lake	2.70E-02	2.70E-02	1.77E-01	1.62E+00	1.14E+00	3.12E-02	2.70E-02	2.70E-02	1.77E-01	1.62E+00	1.14E+00	3.12E-02
	Beaver	Reference (Broach Lake)	1.81E-02	1.81E-02	4.78E-03	1.84E-01	6.65E-02	2.94E-01	1.81E-02	1.81E-02	4.78E-03	1.84E-01	6.65E-02	2.94E-01
		Patterson Lake North Arm - West Basin	2.77E-02	2.77E-02	5.65E-03	2.64E-01	6.84E-02	2.98E-01	2.77E-02	2.77E-02	5.65E-03	2.64E-01	6.85E-02	2.98E-01
		Patterson Lake South Arm	2.00E-02	2.00E-02	5.00E-03	1.98E-01	6.67E-02	2.94E-01	2.00E-02	2.00E-02	5.00E-03	1.98E-01	6.67E-02	2.94E-01
		Beet Lake	1.90E-02	1.90E-02	4.91E-03	1.92E-01	6.66E-02	2.94E-01	1.90E-02	1.90E-02	4.91E-03	1.92E-01	6.66E-02	2.94E-01
		Lloyd Lake	1.81E-02	1.81E-02	4.79E-03	1.85E-01	6.66E-02	2.94E-01	1.81E-02	1.81E-02	4.79E-03	1.85E-01	6.66E-02	2.94E-01
	Black Bear	Reference (Broach Lake)	1.35E-02	1.35E-02	2.77E-03	1.36E-01	2.87E-02	2.39E-01	1.35E-02	1.35E-02	2.77E-03	1.36E-01	2.87E-02	2.39E-01
		Patterson Lake North Arm - West Basin	1.69E-02	1.69E-02	3.26E-03	1.67E-01	2.89E-02	2.41E-01	1.69E-02	1.69E-02	3.26E-03	1.67E-01	2.89E-02	2.41E-01
		Beet Lake	1.40E-02	1.40E-02	3.69E-03	1.44E-01	3.37E-02	2.49E-01	1.40E-02	1.40E-02	3.69E-03	1.44E-01	3.37E-02	2.49E-01
		Lloyd Lake	1.35E-02	1.35E-02	2.82E-03	1.36E-01	2.88E-02	2.39E-01	1.35E-02	1.35E-02	2.82E-03	1.36E-01	2.88E-02	2.39E-01
	Grey Wolf	Reference (Broach Lake)	5.46E-04	5.46E-04	1.52E-03	1.88E-02	2.07E-02	4.47E-01	5.46E-04	5.46E-04	1.52E-03	1.88E-02	2.07E-02	4.47E-01
		Patterson Lake North-West Basin	6.54E-04	6.54E-04	1.63E-03	2.09E-02	2.08E-02	4.48E-01	6.54E-04	6.54E-04	1.63E-03	2.09E-02	2.08E-02	4.48E-01
		Lloyd Lake	5.48E-04	5.48E-04	1.52E-03	1.89E-02	2.07E-02	4.47E-01	5.48E-04	5.48E-04	1.52E-03	1.89E-02	2.07E-02	4.47E-01
	Mink	Reference (Broach Lake)	3.02E-04	3.02E-04	3.86E-03	1.50E-02	2.57E-02	1.20E+00	3.02E-04	3.02E-04	3.86E-03	1.50E-02	2.57E-02	1.20E+00
		Patterson Lake North Arm - West Basin	4.54E-03	4.56E-03	4.28E-03	1.98E-02	2.67E-02	1.25E+00	4.55E-03	4.56E-03	4.28E-03	1.98E-02	2.67E-02	1.25E+00
		Patterson Lake South Arm	1.47E-03	1.48E-03	4.02E-03	1.64E-02	2.57E-02	1.20E+00	1.47E-03	1.48E-03	4.02E-03	1.64E-02	2.57E-02	1.20E+00
		Beet Lake	7.38E-04	7.40E-04	3.95E-03	1.56E-02	2.57E-02	1.20E+00	7.39E-04	7.40E-04	3.95E-03	1.56E-02	2.57E-02	1.20E+00
		Lloyd Lake	3.42E-04	3.42E-04	3.87E-03	1.50E-02	2.57E-02	1.20E+00	3.42E-04	3.42E-04	3.87E-03	1.50E-02	2.57E-02	1.20E+00
	Moose	Reference (Broach Lake)	1.64E-02	1.64E-02	7.27E-03	1.78E-01	1.06E-01	3.65E-01	1.64E-02	1.64E-02	7.27E-03	1.78E-01	1.06E-01	3.65E-01
		Patterson Lake North Arm - West Basin	2.88E-02	2.88E-02	8.24E-03	2.53E-01	1.10E-01	3.73E-01	2.88E-02	2.88E-02	8.24E-03	2.53E-01	1.10E-01	3.73E-01
		Patterson Lake South Arm	2.86E-02	2.86E-02	7.98E-03	2.51E-01	1.10E-01	3.72E-01	2.86E-02	2.86E-02	7.98E-03	2.51E-01	1.10E-01	3.72E-01
		Beet Lake	1.76E-02	1.76E-02	7.44E-03	1.86E-01	1.06E-01	3.65E-01	1.76E-02	1.76E-02	7.44E-03	1.86E-01	1.06E-01	3.65E-01
		Lloyd Lake	1.65E-02	1.65E-02	7.28E-03	1.79E-01	1.06E-01	3.65E-01	1.65E-02	1.65E-02	7.28E-03	1.79E-01	1.06E-01	3.65E-01
	Moose Organs	Reference (Broach Lake)	2.90E-02	2.90E-02	1.99E+00	9.96E-02	3.34E+00	3.65E-03	2.90E-02	2.90E-02	1.99E+00	9.96E-02	3.34E+00	3.65E-03
		Patterson Lake North Arm - West Basin	5.09E-02	5.09E-02	2.26E+00	1.42E-01	3.47E+00	3.73E-03	5.09E-02	5.09E-02	2.26E+00	1.42E-01	3.47E+00	3.73E-03
		Patterson Lake South Arm	5.05E-02	5.06E-02	2.18E+00	1.40E-01	3.46E+00	3.72E-03	5.05E-02	5.06E-02	2.18E+00	1.40E-01	3.46E+00	3.72E-03

Table C.11: Maximum Concentrations of Radiological COPCs in Biota for the Application Case and Upper Bound Scenario - Far-Future

		Maximum Concentration Far Future (Bq/kg fw)											
Biota	Location	Application Case						Upper Bound Scenario					
		Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210
	Beet Lake	3.11E-02	3.11E-02	2.04E+00	1.04E-01	3.34E+00	3.65E-03	3.11E-02	3.11E-02	2.04E+00	1.04E-01	3.34E+00	3.65E-03
	Lloyd Lake	2.91E-02	2.91E-02	1.99E+00	9.98E-02	3.34E+00	3.65E-03	2.91E-02	2.91E-02	1.99E+00	9.98E-02	3.34E+00	3.65E-03
Muskrat	Reference (Broach Lake)	9.58E-04	9.58E-04	1.29E-02	6.20E-02	1.63E-01	2.41E+00	9.58E-04	9.58E-04	1.29E-02	6.20E-02	1.63E-01	2.41E+00
	Patterson Lake North Arm - West Basin	3.10E-02	3.11E-02	1.38E-02	7.99E-02	1.70E-01	2.53E+00	3.10E-02	3.12E-02	1.38E-02	8.00E-02	1.70E-01	2.53E+00
	Patterson Lake South Arm	9.27E-03	9.31E-03	1.35E-02	6.86E-02	1.63E-01	2.42E+00	9.28E-03	9.31E-03	1.35E-02	6.86E-02	1.63E-01	2.42E+00
	Beet Lake	4.05E-03	4.06E-03	1.32E-02	6.48E-02	1.63E-01	2.42E+00	4.05E-03	4.06E-03	1.32E-02	6.48E-02	1.63E-01	2.42E+00
	Lloyd Lake	1.24E-03	1.24E-03	1.30E-02	6.23E-02	1.63E-01	2.41E+00	1.24E-03	1.24E-03	1.30E-02	6.23E-02	1.63E-01	2.41E+00
Red Fox	Reference (Broach Lake)	1.01E-03	1.01E-03	7.96E-04	2.29E-02	7.58E-03	2.12E-02	1.01E-03	1.01E-03	7.96E-04	2.29E-02	7.58E-03	2.12E-02
	Patterson Lake North Arm - West Basin	1.43E-03	1.43E-03	1.05E-03	3.29E-02	7.59E-03	2.13E-02	1.43E-03	1.43E-03	1.05E-03	3.29E-02	7.59E-03	2.13E-02
	Patterson Lake South Arm	1.08E-03	1.08E-03	8.38E-04	2.45E-02	7.58E-03	2.12E-02	1.08E-03	1.08E-03	8.38E-04	2.45E-02	7.58E-03	2.12E-02
	Beet Lake	1.05E-03	1.05E-03	8.21E-04	2.38E-02	7.58E-03	2.12E-02	1.05E-03	1.05E-03	8.21E-04	2.38E-02	7.58E-03	2.12E-02
	Lloyd Lake	1.01E-03	1.01E-03	7.97E-04	2.29E-02	7.58E-03	2.12E-02	1.01E-03	1.01E-03	7.97E-04	2.29E-02	7.58E-03	2.12E-02
Snowshoe Hare	Reference (Broach Lake)	1.69E-02	1.69E-02	2.73E-03	1.67E-01	2.82E-02	2.03E-01	1.69E-02	1.69E-02	2.73E-03	1.67E-01	2.82E-02	2.03E-01
	Patterson Lake North Arm - West Basin	2.30E-02	2.30E-02	3.61E-03	2.40E-01	2.82E-02	2.03E-01	2.30E-02	2.30E-02	3.61E-03	2.40E-01	2.82E-02	2.03E-01
	Patterson Lake South Arm	1.79E-02	1.79E-02	2.87E-03	1.79E-01	2.82E-02	2.03E-01	1.79E-02	1.79E-02	2.87E-03	1.79E-01	2.82E-02	2.03E-01
	Beet Lake	1.75E-02	1.75E-02	2.81E-03	1.74E-01	2.82E-02	2.03E-01	1.75E-02	1.75E-02	2.81E-03	1.74E-01	2.82E-02	2.03E-01
	Lloyd Lake	1.70E-02	1.70E-02	2.73E-03	1.67E-01	2.82E-02	2.03E-01	1.70E-02	1.70E-02	2.73E-03	1.67E-01	2.82E-02	2.03E-01
Southern Red-Backed Vole	Reference (Broach Lake)	6.15E-03	6.15E-03	8.06E-04	5.98E-02	9.13E-03	7.20E-02	6.15E-03	6.15E-03	8.06E-04	5.98E-02	9.13E-03	7.20E-02
	Patterson Lake North Arm - West Basin	8.37E-03	8.37E-03	1.06E-03	8.62E-02	9.13E-03	7.21E-02	8.37E-03	8.37E-03	1.06E-03	8.62E-02	9.13E-03	7.21E-02
	Patterson Lake South Arm	6.52E-03	6.52E-03	8.48E-04	6.41E-02	9.13E-03	7.21E-02	6.52E-03	6.52E-03	8.48E-04	6.41E-02	9.13E-03	7.21E-02
	Beet Lake	6.36E-03	6.36E-03	8.30E-04	6.23E-02	9.13E-03	7.21E-02	6.36E-03	6.36E-03	8.30E-04	6.23E-02	9.13E-03	7.21E-02
	Lloyd Lake	6.16E-03	6.16E-03	8.06E-04	5.99E-02	9.13E-03	7.20E-02	6.16E-03	6.16E-03	8.06E-04	5.99E-02	9.13E-03	7.20E-02
Woodland Caribou	Reference (Broach Lake)	7.48E-03	7.48E-03	8.89E-03	1.16E-01	9.35E-01	4.81E+00	7.48E-03	7.48E-03	8.89E-03	1.16E-01	9.35E-01	4.81E+00
	Patterson Lake North Arm - West Basin	1.71E-02	1.71E-02	9.61E-03	1.38E-01	9.41E-01	4.83E+00	1.71E-02	1.71E-02	9.61E-03	1.38E-01	9.41E-01	4.83E+00
	Beet Lake	8.26E-03	8.27E-03	8.98E-03	1.18E-01	9.39E-01	4.83E+00	8.26E-03	8.27E-03	8.98E-03	1.18E-01	9.39E-01	4.83E+00
	Lloyd Lake	6.16E-03	6.16E-03	8.06E-04	5.99E-02	9.13E-03	7.20E-02	6.16E-03	6.16E-03	8.06E-04	5.99E-02	9.13E-03	7.20E-02
Grouse	Reference (Broach Lake)	4.04E-01	4.04E-01	2.33E-03	3.80E-02	3.34E-02	1.30E+00	4.04E-01	4.04E-01	2.33E-03	3.80E-02	3.34E-02	1.30E+00
	Patterson Lake North Arm - West Basin	5.48E-01	5.48E-01	3.09E-03	5.47E-02	3.34E-02	1.30E+00	5.48E-01	5.48E-01	3.09E-03	5.47E-02	3.34E-02	1.30E+00
	Patterson Lake South Arm	4.28E-01	4.28E-01	2.46E-03	4.07E-02	3.34E-02	1.30E+00	4.28E-01	4.28E-01	2.46E-03	4.07E-02	3.34E-02	1.30E+00
	Beet Lake	4.18E-01	4.18E-01	2.41E-03	3.96E-02	3.34E-02	1.30E+00	4.18E-01	4.18E-01	2.41E-03	3.96E-02	3.34E-02	1.30E+00
	Lloyd Lake	4.04E-01	4.04E-01	2.34E-03	3.80E-02	3.34E-02	1.30E+00	4.04E-01	4.04E-01	2.34E-03	3.80E-02	3.34E-02	1.30E+00
Canada Goose	Reference (Broach Lake)	5.66E-02	5.66E-02	3.38E-04	5.34E-03	4.74E-03	1.83E-01	5.66E-02	5.66E-02	3.38E-04	5.34E-03	4.74E-03	1.83E-01
	Patterson Lake North Arm - West Basin	7.74E-02	7.74E-02	4.45E-04	7.69E-03	4.74E-03	1.84E-01	7.74E-02	7.74E-02	4.45E-04	7.69E-03	4.74E-03	1.84E-01
	Patterson Lake South Arm	6.01E-02	6.01E-02	3.56E-04	5.72E-03	4.74E-03	1.83E-01	6.01E-02	6.01E-02	3.56E-04	5.72E-03	4.74E-03	1.83E-01
	Beet Lake	5.86E-02	5.86E-02	3.48E-04	5.56E-03	4.74E-03	1.83E-01	5.86E-02	5.86E-02	3.48E-04	5.56E-03	4.74E-03	1.83E-01
	Lloyd Lake	5.67E-02	5.67E-02	3.39E-04	5.35E-03	4.74E-03	1.83E-01	5.67E-02	5.67E-02	3.39E-04	5.35E-03	4.74E-03	1.83E-01
Little Brown Myotis	Reference (Broach Lake)	2.36E-04	2.36E-04	1.83E-02	4.04E-02	8.48E-02	4.23E+00	2.36E-04	2.36E-04	1.83E-02	4.04E-02	8.48E-02	4.23E+00
	Patterson Lake North Arm - West Basin	7.62E-03	7.65E-03	1.96E-02	5.20E-02	8.88E-02	4.42E+00	7.63E-03	7.66E-03	1.96E-02	5.21E-02	8.88E-02	4.42E+00
	Patterson Lake South Arm	2.28E-03	2.29E-03	1.91E-02	4.47E-02	8.51E-02	4.24E+00	2.28E-03	2.29E-03	1.91E-02	4.47E-02	8.51E-02	4.24E+00
	Beet Lake	9.96E-04	9.99E-04	1.87E-02	4.22E-02	8.49E-02	4.23E+00	9.96E-04	9.99E-04	1.87E-02	4.22E-02	8.49E-02	4.23E+00

Table C.11: Maximum Concentrations of Radiological COPCs in Biota for the Application Case and Upper Bound Scenario - Far-Future

			Maximum Concentration Far Future (Bq/kg fw)											
	Biota	Location	Application Case						Upper Bound Scenario					
			Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210
		Lloyd Lake	3.04E-04	3.05E-04	1.83E-02	4.05E-02	8.48E-02	4.23E+00	3.04E-04	3.05E-04	1.83E-02	4.05E-02	8.48E-02	4.23E+00
	Loon	Reference (Broach Lake)	2.29E-03	2.29E-03	1.55E-03	1.81E-03	1.48E-02	4.07E+00	2.29E-03	2.29E-03	1.55E-03	1.81E-03	1.48E-02	4.07E+00
		Patterson Lake North Arm - West Basin	7.43E-02	7.45E-02	1.66E-03	2.34E-03	1.55E-02	4.26E+00	7.43E-02	7.46E-02	1.66E-03	2.34E-03	1.55E-02	4.26E+00
		Patterson Lake South Arm	2.22E-02	2.23E-02	1.62E-03	2.01E-03	1.49E-02	4.08E+00	2.22E-02	2.23E-02	1.62E-03	2.01E-03	1.49E-02	4.08E+00
		Beet Lake	9.70E-03	9.73E-03	1.59E-03	1.90E-03	1.48E-02	4.07E+00	9.70E-03	9.73E-03	1.59E-03	1.90E-03	1.48E-02	4.07E+00
		Lloyd Lake	2.96E-03	2.97E-03	1.55E-03	1.82E-03	1.48E-02	4.07E+00	2.96E-03	2.97E-03	1.55E-03	1.82E-03	1.48E-02	4.07E+00
	Mallard	Reference (Broach Lake)	2.41E-02	2.41E-02	1.51E-02	1.96E-02	1.94E-01	3.49E+01	2.41E-02	2.41E-02	1.51E-02	1.96E-02	1.94E-01	3.49E+01
		Patterson Lake North Arm - West Basin	7.80E-01	7.83E-01	1.61E-02	2.53E-02	2.04E-01	3.65E+01	7.81E-01	7.84E-01	1.61E-02	2.53E-02	2.04E-01	3.65E+01
		Patterson Lake South Arm	2.33E-01	2.34E-01	1.57E-02	2.17E-02	1.95E-01	3.50E+01	2.34E-01	2.34E-01	1.57E-02	2.17E-02	1.95E-01	3.50E+01
		Beet Lake	1.02E-01	1.02E-01	1.54E-02	2.05E-02	1.95E-01	3.49E+01	1.02E-01	1.02E-01	1.54E-02	2.05E-02	1.95E-01	3.49E+01
		Lloyd Lake	3.11E-02	3.12E-02	1.51E-02	1.97E-02	1.95E-01	3.49E+01	3.12E-02	3.12E-02	1.51E-02	1.97E-02	1.95E-01	3.49E+01
	Rusty Blackbird	Reference (Broach Lake)	1.74E-01	1.74E-01	4.20E-02	5.45E-02	3.34E-01	9.54E+01	1.74E-01	1.74E-01	4.20E-02	5.45E-02	3.34E-01	9.54E+01
		Patterson Lake North Arm - West Basin	8.67E-01	8.69E-01	4.60E-02	7.30E-02	3.47E-01	9.98E+01	8.67E-01	8.70E-01	4.60E-02	7.30E-02	3.47E-01	9.98E+01
		Patterson Lake South Arm	3.61E-01	3.61E-01	4.38E-02	5.94E-02	3.35E-01	9.57E+01	3.61E-01	3.62E-01	4.38E-02	5.94E-02	3.35E-01	9.57E+01
		Beet Lake	2.44E-01	2.45E-01	4.29E-02	5.68E-02	3.34E-01	9.54E+01	2.44E-01	2.45E-01	4.29E-02	5.68E-02	3.34E-01	9.54E+01
		Lloyd Lake	1.80E-01	1.80E-01	4.20E-02	5.46E-02	3.34E-01	9.54E+01	1.80E-01	1.80E-01	4.20E-02	5.46E-02	3.34E-01	9.54E+01

Table C.12: Maximum Concentrations of Radiological COPCs in Biota for the RFD Scenario - Project Lifespan and Far-Future

	Biota	Location	Maximum Concentration RFD Case (Bq/kg fw)											
			Project Lifespan						Far Future					
			Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210
Aquatic Plants	Macrophytes	Reference (Broach Lake)	1.79E-02	1.79E-02	2.11E+00	9.03E-01	9.62E+00	1.51E+00	1.79E-02	1.79E-02	2.11E+00	9.03E-01	9.62E+00	1.51E+00
		Patterson Lake North Arm - West Basin	1.96E-01	1.96E-01	1.20E+01	1.57E+00	1.47E+01	2.29E+00	5.81E-01	5.83E-01	2.25E+00	1.16E+00	1.01E+01	1.58E+00
		Patterson Lake South Arm	2.92E-01	2.93E-01	1.28E+01	1.84E+00	1.50E+01	2.31E+00	1.74E-01	1.74E-01	2.20E+00	9.99E-01	9.65E+00	1.51E+00
		Beet Lake	1.13E-01	1.13E-01	6.90E+00	1.26E+00	1.04E+01	1.63E+00	7.58E-02	7.60E-02	2.16E+00	9.44E-01	9.63E+00	1.51E+00
		Lloyd Lake	2.68E-02	2.68E-02	2.60E+00	9.38E-01	9.67E+00	1.51E+00	2.32E-02	2.32E-02	2.11E+00	9.07E-01	9.63E+00	1.51E+00
	Phytoplankton	Reference (Broach Lake)	1.79E-02	1.79E-02	2.11E+00	9.03E-01	9.62E+00	1.51E+00	1.79E-02	1.79E-02	2.11E+00	9.03E-01	9.62E+00	1.51E+00
		Patterson Lake North Arm - West Basin	1.96E-01	1.96E-01	1.20E+01	1.57E+00	1.47E+01	2.29E+00	5.81E-01	5.83E-01	2.25E+00	1.16E+00	1.01E+01	1.58E+00
		Patterson Lake South Arm	2.92E-01	2.93E-01	1.28E+01	1.84E+00	1.50E+01	2.31E+00	1.74E-01	1.74E-01	2.20E+00	9.99E-01	9.65E+00	1.51E+00
		Beet Lake	1.13E-01	1.13E-01	6.90E+00	1.26E+00	1.04E+01	1.63E+00	7.58E-02	7.60E-02	2.16E+00	9.44E-01	9.63E+00	1.51E+00
		Lloyd Lake	2.68E-02	2.68E-02	2.60E+00	9.38E-01	9.67E+00	1.51E+00	2.32E-02	2.32E-02	2.11E+00	9.07E-01	9.63E+00	1.51E+00
Aquatic Animals	Benthic Invertebrates	Reference (Broach Lake)	3.42E-02	3.42E-02	4.52E+00	1.35E+00	6.88E+00	4.80E+01	3.42E-02	3.42E-02	4.52E+00	1.35E+00	6.88E+00	4.80E+01
		Patterson Lake North Arm - West Basin	3.08E-01	3.09E-01	2.51E+01	2.16E+00	9.42E+00	6.58E+01	1.11E+00	1.11E+00	4.83E+00	1.74E+00	7.20E+00	5.03E+01
		Patterson Lake South Arm	1.92E-01	1.92E-01	1.94E+01	1.84E+00	8.44E+00	5.89E+01	3.31E-01	3.32E-01	4.71E+00	1.49E+00	6.90E+00	4.82E+01
		Beet Lake	9.24E-02	9.26E-02	1.24E+01	1.56E+00	7.11E+00	4.96E+01	1.45E-01	1.45E-01	4.62E+00	1.41E+00	6.89E+00	4.81E+01
		Lloyd Lake	3.95E-02	3.96E-02	5.33E+00	1.37E+00	6.90E+00	4.81E+01	4.42E-02	4.42E-02	4.53E+00	1.35E+00	6.88E+00	4.80E+01
	Zooplankton	Reference (Broach Lake)	3.56E-02	3.56E-02	4.54E+00	1.38E+00	1.17E+01	8.13E+01	3.56E-02	3.56E-02	4.54E+00	1.38E+00	1.17E+01	8.13E+01
		Patterson Lake North Arm - West Basin	3.88E-01	3.89E-01	2.58E+01	2.41E+00	1.78E+01	1.23E+02	1.15E+00	1.16E+00	4.86E+00	1.79E+00	1.22E+01	8.51E+01
		Patterson Lake South Arm	5.79E-01	5.81E-01	2.75E+01	2.83E+00	1.81E+01	1.25E+02	3.44E-01	3.46E-01	4.74E+00	1.53E+00	1.17E+01	8.16E+01
		Beet Lake	1.08E-01	1.08E-01	8.79E+00	1.60E+00	1.19E+01	8.30E+01	1.50E-01	1.51E-01	4.65E+00	1.45E+00	1.17E+01	8.14E+01
		Lloyd Lake	5.31E-02	5.32E-02	5.59E+00	1.44E+00	1.17E+01	8.17E+01	4.60E-02	4.60E-02	4.56E+00	1.39E+00	1.17E+01	8.13E+01
	Northern Pike	Reference (Broach Lake)	7.12E-03	7.12E-03	5.45E-02	6.65E-02	3.04E-01	7.73E-01	7.12E-03	7.12E-03	5.45E-02	6.65E-02	3.04E-01	7.73E-01
		Patterson Lake North Arm - West Basin	7.76E-02	7.79E-02	3.10E-01	1.16E-01	4.64E-01	1.17E+00	2.30E-01	2.31E-01	5.83E-02	8.57E-02	3.18E-01	8.09E-01
		Patterson Lake South Arm	1.16E-01	1.16E-01	3.30E-01	1.36E-01	4.72E-01	1.18E+00	6.89E-02	6.91E-02	5.69E-02	7.35E-02	3.05E-01	7.75E-01
		Beet Lake	4.49E-02	4.50E-02	1.78E-01	9.31E-02	3.28E-01	8.34E-01	3.01E-02	3.02E-02	5.58E-02	6.95E-02	3.04E-01	7.73E-01
		Lloyd Lake	1.06E-02	1.06E-02	6.71E-02	6.90E-02	3.05E-01	7.76E-01	9.20E-03	9.20E-03	5.47E-02	6.67E-02	3.04E-01	7.73E-01
	Whitefish	Reference (Broach Lake)	1.76E-03	1.76E-03	5.45E-02	6.60E-02	1.00E-01	6.94E-01	1.76E-03	1.76E-03	5.45E-02	6.60E-02	1.00E-01	6.94E-01
		Patterson Lake North Arm - West Basin	1.83E-02	1.84E-02	3.08E-01	1.12E-01	1.49E-01	1.03E+00	5.70E-02	5.73E-02	5.82E-02	8.51E-02	1.05E-01	7.26E-01
		Patterson Lake South Arm	2.35E-02	2.36E-02	2.87E-01	1.22E-01	1.50E-01	1.03E+00	1.71E-02	1.71E-02	5.68E-02	7.30E-02	1.00E-01	6.96E-01
		Beet Lake	9.28E-03	9.31E-03	1.60E-01	8.72E-02	1.07E-01	7.43E-01	7.45E-03	7.47E-03	5.57E-02	6.90E-02	1.00E-01	6.94E-01
		Lloyd Lake	2.46E-03	2.46E-03	6.53E-02	6.80E-02	1.00E-01	6.97E-01	2.28E-03	2.28E-03	5.46E-02	6.63E-02	1.00E-01	6.94E-01
Terrestrial Plants	Blueberries	Reference (Broach Lake)	4.95E-01	4.95E-01	6.24E-02	1.08E+00	3.20E-01	4.33E-01	4.95E-01	4.95E-01	6.24E-02	1.08E+00	3.20E-01	4.33E-01
		Patterson Lake North Arm - West Basin	2.27E+00	2.27E+00	1.07E-01	2.61E+00	1.20E+00	1.47E+00	6.74E-01	6.74E-01	8.29E-02	1.56E+00	3.20E-01	4.33E-01
		Patterson Lake South Arm	8.37E-01	8.37E-01	7.10E-02	1.37E+00	4.90E-01	6.33E-01	5.29E-01	5.29E-01	6.64E-02	1.17E+00	3.20E-01	4.33E-01
		Beet Lake	6.82E-01	6.82E-01	6.71E-02	1.24E+00	4.13E-01	5.43E-01	5.14E-01	5.14E-01	6.46E-02	1.13E+00	3.20E-01	4.33E-01
		Lloyd Lake	5.04E-01	5.04E-01	6.26E-02	1.08E+00	3.24E-01	4.38E-01	4.96E-01	4.96E-01	6.25E-02	1.08E+00	3.20E-01	4.33E-01
	Browse	Reference (Broach Lake)	9.90E-01	9.90E-01	1.25E-01	2.15E+00	6.40E-01	8.67E-01	9.90E-01	9.90E-01	1.25E-01	2.15E+00	6.40E-01	8.67E-01
		Patterson Lake North Arm - West Basin	4.40E+00	4.40E+00	2.77E+00	6.14E+00	3.33E+00	3.88E+00	1.35E+00	1.35E+00	1.66E-01	3.12E+00	6.40E-01	8.67E-01
		Patterson Lake South Arm	1.65E+00	1.65E+00	6.34E-01	2.92E+00	1.16E+00	1.45E+00	1.06E+00	1.06E+00	1.33E-01	2.34E+00	6.40E-01	8.67E-01
		Beet Lake	1.35E+00	1.35E+00	4.03E-01	2.57E+00	9.23E-01	1.18E+00	1.03E+00	1.03E+00	1.29E-01	2.25E+00	6.40E-01	8.67E-01
		Lloyd Lake	1.01E+00	1.01E+00	1.38E-01	2.17E+00	6.53E-01	8.82E-01	9.92E-01	9.92E-01	1.25E-01	2.16E+00	6.40E-01	8.67E-01

Table C.12: Maximum Concentrations of Radiological COPCs in Biota for the RFD Scenario - Project Lifespan and Far-Future

	Biota	Location	Maximum Concentration RFD Case (Bq/kg fw)											
			Project Lifespan						Far Future					
			Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210
	Labrador Tea	Reference (Broach Lake)	9.90E-01	9.90E-01	1.25E-01	2.15E+00	6.40E-01	8.67E-01	9.90E-01	9.90E-01	1.25E-01	2.15E+00	6.40E-01	8.67E-01
		Patterson Lake North Arm - West Basin	4.40E+00	4.40E+00	2.47E+01	2.80E+01	2.52E+01	2.24E+01	1.35E+00	1.35E+00	1.66E-01	3.12E+00	6.40E-01	8.67E-01
		Patterson Lake South Arm	1.65E+00	1.65E+00	4.85E+00	7.14E+00	5.36E+00	5.02E+00	1.06E+00	1.06E+00	1.33E-01	2.34E+00	6.40E-01	8.67E-01
		Beet Lake	1.35E+00	1.35E+00	2.71E+00	4.88E+00	3.22E+00	3.14E+00	1.03E+00	1.03E+00	1.29E-01	2.25E+00	6.40E-01	8.67E-01
		Lloyd Lake	1.01E+00	1.01E+00	2.48E-01	2.28E+00	7.63E-01	9.75E-01	9.92E-01	9.92E-01	1.25E-01	2.16E+00	6.40E-01	8.67E-01
	Lichen	Reference (Broach Lake)	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02
		Patterson Lake North Arm - West Basin	2.08E-01	2.08E-01	1.41E+02	1.42E+02	3.24E+02	1.72E+02	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02
		Patterson Lake South Arm	2.08E-01	2.08E-01	2.77E+01	2.83E+01	2.17E+02	1.50E+02	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02
		Beet Lake	2.08E-01	2.08E-01	1.54E+01	1.61E+01	2.05E+02	1.48E+02	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02
		Lloyd Lake	2.08E-01	2.08E-01	1.38E+00	2.04E+00	1.92E+02	1.45E+02	2.08E-01	2.08E-01	6.77E-01	1.33E+00	1.91E+02	1.45E+02
Terrestrial Animals	Terrestrial Invertebrate	Reference (Broach Lake)	2.70E-02	2.70E-02	1.77E-01	1.61E+00	1.14E+00	3.12E-02	2.70E-02	2.70E-02	1.77E-01	1.61E+00	1.14E+00	3.12E-02
		Patterson Lake North Arm - West Basin	1.20E-01	1.20E-01	2.85E+00	5.25E+00	3.93E+00	2.46E+00	3.68E-02	3.68E-02	2.35E-01	2.34E+00	1.14E+00	3.12E-02
		Patterson Lake South Arm	4.49E-02	4.49E-02	6.91E-01	2.31E+00	1.68E+00	4.99E-01	2.89E-02	2.89E-02	1.88E-01	1.75E+00	1.14E+00	3.12E-02
		Beet Lake	3.68E-02	3.68E-02	4.58E-01	2.00E+00	1.43E+00	2.87E-01	2.80E-02	2.80E-02	1.83E-01	1.69E+00	1.14E+00	3.12E-02
		Lloyd Lake	2.75E-02	2.75E-02	1.90E-01	1.63E+00	1.15E+00	4.34E-02	2.71E-02	2.71E-02	1.77E-01	1.62E+00	1.14E+00	3.12E-02
	Beaver	Reference (Broach Lake)	1.81E-02	1.81E-02	4.78E-03	1.84E-01	6.65E-02	2.94E-01	1.81E-02	1.81E-02	4.78E-03	1.84E-01	6.65E-02	2.94E-01
		Patterson Lake North Arm - West Basin	8.08E-02	8.09E-02	4.56E-02	5.07E-01	1.74E-01	1.02E+00	2.78E-02	2.78E-02	5.66E-03	2.65E-01	6.84E-02	2.98E-01
		Patterson Lake South Arm	3.04E-02	3.04E-02	2.30E-02	2.49E-01	1.03E-01	4.38E-01	2.02E-02	2.02E-02	5.03E-03	2.01E-01	6.67E-02	2.94E-01
		Beet Lake	2.47E-02	2.47E-02	1.35E-02	2.19E-01	7.83E-02	3.68E-01	1.91E-02	1.91E-02	4.91E-03	1.93E-01	6.66E-02	2.94E-01
		Lloyd Lake	1.84E-02	1.84E-02	5.52E-03	1.86E-01	6.71E-02	2.98E-01	1.81E-02	1.81E-02	4.79E-03	1.85E-01	6.66E-02	2.94E-01
	Black Bear	Reference (Broach Lake)	1.35E-02	1.35E-02	2.77E-03	1.36E-01	2.87E-02	2.39E-01	1.35E-02	1.35E-02	2.77E-03	1.36E-01	2.87E-02	2.39E-01
		Patterson Lake North Arm - West Basin	3.96E-02	3.96E-02	4.88E-03	2.35E-01	5.31E-02	4.49E-01	1.71E-02	1.71E-02	3.28E-03	1.69E-01	2.89E-02	2.41E-01
		Beet Lake	1.62E-02	1.62E-02	4.01E-03	1.51E-01	3.60E-02	2.69E-01	1.40E-02	1.40E-02	3.70E-03	1.45E-01	3.37E-02	2.49E-01
		Lloyd Lake	1.37E-02	1.37E-02	2.89E-03	1.37E-01	2.90E-02	2.41E-01	1.35E-02	1.35E-02	2.82E-03	1.36E-01	2.88E-02	2.39E-01
	Grey Wolf	Reference (Broach Lake)	5.46E-04	5.46E-04	1.52E-03	1.88E-02	2.07E-02	4.47E-01	5.46E-04	5.46E-04	1.52E-03	1.88E-02	2.07E-02	4.47E-01
		Patterson Lake North-West Basin	1.06E-03	1.06E-03	2.10E-03	3.27E-02	2.32E-02	4.94E-01	6.56E-04	6.56E-04	1.64E-03	2.10E-02	2.08E-02	4.48E-01
		Lloyd Lake	5.56E-04	5.56E-04	1.55E-03	1.91E-02	2.08E-02	4.47E-01	5.49E-04	5.49E-04	1.52E-03	1.89E-02	2.07E-02	4.47E-01
	Mink	Reference (Broach Lake)	3.02E-04	3.02E-04	3.86E-03	1.50E-02	2.57E-02	1.20E+00	3.02E-04	3.02E-04	3.86E-03	1.50E-02	2.57E-02	1.20E+00
		Patterson Lake North Arm - West Basin	1.98E-03	1.98E-03	1.89E-02	2.43E-02	3.46E-02	1.64E+00	4.54E-03	4.56E-03	4.28E-03	1.98E-02	2.67E-02	1.25E+00
		Patterson Lake South Arm	9.94E-04	9.97E-04	1.45E-02	1.94E-02	3.10E-02	1.47E+00	1.47E-03	1.48E-03	4.03E-03	1.64E-02	2.57E-02	1.20E+00
		Beet Lake	5.69E-04	5.70E-04	9.51E-03	1.69E-02	2.64E-02	1.23E+00	7.38E-04	7.40E-04	3.95E-03	1.56E-02	2.57E-02	1.20E+00
		Lloyd Lake	3.25E-04	3.25E-04	4.44E-03	1.51E-02	2.57E-02	1.20E+00	3.42E-04	3.42E-04	3.87E-03	1.50E-02	2.57E-02	1.20E+00
	Moose	Reference (Broach Lake)	1.64E-02	1.64E-02	7.27E-03	1.78E-01	1.06E-01	3.65E-01	1.64E-02	1.64E-02	7.27E-03	1.78E-01	1.06E-01	3.65E-01
		Patterson Lake North Arm - West Basin	7.39E-02	7.39E-02	5.77E-02	4.76E-01	2.25E-01	1.06E+00	2.89E-02	2.89E-02	8.25E-03	2.55E-01	1.10E-01	3.73E-01
		Patterson Lake South Arm	7.33E-02	7.33E-02	5.68E-02	4.73E-01	2.24E-01	1.05E+00	2.87E-02	2.87E-02	7.99E-03	2.52E-01	1.10E-01	3.72E-01
		Beet Lake	2.26E-02	2.26E-02	2.16E-02	2.12E-01	1.20E-01	4.33E-01	1.77E-02	1.77E-02	7.45E-03	1.87E-01	1.06E-01	3.65E-01
		Lloyd Lake	1.67E-02	1.67E-02	8.59E-03	1.80E-01	1.07E-01	3.68E-01	1.65E-02	1.65E-02	7.28E-03	1.79E-01	1.06E-01	3.65E-01
	Moose Organs	Reference (Broach Lake)	2.90E-02	2.90E-02	1.99E+00	9.96E-02	3.34E+00	3.65E-03	2.90E-02	2.90E-02	1.99E+00	9.96E-02	3.34E+00	3.65E-03
		Patterson Lake North Arm - West Basin	1.31E-01	1.31E-01	1.58E+01	2.66E-01	7.08E+00	1.06E-02	5.11E-02	5.11E-02	2.26E+00	1.42E-01	3.47E+00	3.73E-03
		Patterson Lake South Arm	1.30E-01	1.30E-01	1.56E+01	2.64E-01	7.05E+00	1.05E-02	5.07E-02	5.08E-02	2.19E+00	1.41E-01	3.46E+00	3.72E-03

Table C.12: Maximum Concentrations of Radiological COPCs in Biota for the RFD Scenario - Project Lifespan and Far-Future

		Maximum Concentration RFD Case (Bq/kg fw)											
Biota	**Location**	**Project Lifespan**						**Far Future**					
		Uranium-238	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**
	Beet Lake	3.99E-02	3.99E-02	5.93E+00	1.18E-01	3.78E+00	4.33E-03	3.13E-02	3.13E-02	2.04E+00	1.04E-01	3.34E+00	3.65E-03
	Lloyd Lake	2.95E-02	2.95E-02	2.35E+00	1.01E-01	3.37E+00	3.68E-03	2.91E-02	2.91E-02	1.99E+00	9.99E-02	3.34E+00	3.65E-03
Muskrat	Reference (Broach Lake)	9.58E-04	9.58E-04	1.29E-02	6.20E-02	1.63E-01	2.41E+00	9.58E-04	9.58E-04	1.29E-02	6.20E-02	1.63E-01	2.41E+00
	Patterson Lake North Arm - West Basin	8.65E-03	8.68E-03	7.23E-02	1.00E-01	2.28E-01	3.30E+00	3.10E-02	3.11E-02	1.38E-02	7.99E-02	1.70E-01	2.53E+00
	Patterson Lake South Arm	5.39E-03	5.41E-03	5.58E-02	8.57E-02	2.14E-01	2.96E+00	9.27E-03	9.31E-03	1.35E-02	6.86E-02	1.63E-01	2.42E+00
	Beet Lake	2.59E-03	2.60E-03	3.57E-02	7.18E-02	1.70E-01	2.49E+00	4.05E-03	4.06E-03	1.32E-02	6.48E-02	1.63E-01	2.42E+00
	Lloyd Lake	1.11E-03	1.11E-03	1.53E-02	6.29E-02	1.63E-01	2.42E+00	1.24E-03	1.24E-03	1.30E-02	6.23E-02	1.63E-01	2.41E+00
Red Fox	Reference (Broach Lake)	1.01E-03	1.01E-03	7.96E-04	2.29E-02	7.58E-03	2.12E-02	1.01E-03	1.01E-03	7.96E-04	2.29E-02	7.58E-03	2.12E-02
	Patterson Lake North Arm - West Basin	4.60E-03	4.60E-03	4.04E-03	6.23E-02	1.90E-02	1.12E-01	1.43E-03	1.43E-03	1.05E-03	3.31E-02	7.59E-03	2.13E-02
	Patterson Lake South Arm	1.70E-03	1.70E-03	1.50E-03	3.05E-02	9.78E-03	3.87E-02	1.09E-03	1.09E-03	8.46E-04	2.48E-02	7.58E-03	2.12E-02
	Beet Lake	1.38E-03	1.38E-03	1.18E-03	2.70E-02	8.79E-03	3.08E-02	1.05E-03	1.05E-03	8.24E-04	2.39E-02	7.58E-03	2.12E-02
	Lloyd Lake	1.02E-03	1.02E-03	8.18E-04	2.31E-02	7.64E-03	2.17E-02	1.01E-03	1.01E-03	7.98E-04	2.29E-02	7.58E-03	2.12E-02
Snowshoe Hare	Reference (Broach Lake)	1.69E-02	1.69E-02	2.73E-03	1.67E-01	2.82E-02	2.03E-01	1.69E-02	1.69E-02	2.73E-03	1.67E-01	2.82E-02	2.03E-01
	Patterson Lake North Arm - West Basin	7.54E-02	7.54E-02	2.79E-02	4.59E-01	1.09E-01	8.43E-01	2.31E-02	2.31E-02	3.62E-03	2.42E-01	2.82E-02	2.03E-01
	Patterson Lake South Arm	2.82E-02	2.82E-02	7.65E-03	2.23E-01	4.37E-02	3.26E-01	1.81E-02	1.81E-02	2.90E-03	1.81E-01	2.82E-02	2.03E-01
	Beet Lake	2.31E-02	2.31E-02	5.42E-03	1.98E-01	3.67E-02	2.71E-01	1.76E-02	1.76E-02	2.82E-03	1.75E-01	2.82E-02	2.03E-01
	Lloyd Lake	1.72E-02	1.72E-02	2.86E-03	1.68E-01	2.86E-02	2.06E-01	1.70E-02	1.70E-02	2.74E-03	1.67E-01	2.82E-02	2.03E-01
Southern Red-Backed Vole	Reference (Broach Lake)	6.15E-03	6.15E-03	8.06E-04	5.98E-02	9.13E-03	7.20E-02	6.15E-03	6.15E-03	8.06E-04	5.98E-02	9.13E-03	7.20E-02
	Patterson Lake North Arm - West Basin	2.78E-02	2.78E-02	5.90E-03	1.55E-01	3.39E-02	2.72E-01	8.41E-03	8.41E-03	1.07E-03	8.66E-02	9.13E-03	7.21E-02
	Patterson Lake South Arm	1.03E-02	1.03E-02	1.82E-03	7.81E-02	1.39E-02	1.10E-01	6.59E-03	6.59E-03	8.56E-04	6.50E-02	9.13E-03	7.21E-02
	Beet Lake	8.43E-03	8.43E-03	1.36E-03	6.98E-02	1.17E-02	9.31E-02	6.39E-03	6.39E-03	8.33E-04	6.26E-02	9.13E-03	7.21E-02
	Lloyd Lake	6.26E-03	6.26E-03	8.33E-04	6.03E-02	9.25E-03	7.30E-02	6.16E-03	6.16E-03	8.07E-04	5.99E-02	9.13E-03	7.20E-02
Woodland Caribou	Reference (Broach Lake)	7.48E-03	7.48E-03	8.89E-03	1.16E-01	9.35E-01	4.81E+00	7.48E-03	7.48E-03	8.89E-03	1.16E-01	9.35E-01	4.81E+00
	Patterson Lake North Arm - West Basin	2.22E-02	2.22E-02	1.40E-01	9.70E-01	1.29E+00	5.47E+00	1.71E-02	1.72E-02	9.63E-03	1.38E-01	9.41E-01	4.83E+00
	Beet Lake	8.92E-03	8.93E-03	2.45E-02	1.97E-01	9.72E-01	4.89E+00	8.28E-03	8.28E-03	8.99E-03	1.18E-01	9.39E-01	4.83E+00
	Lloyd Lake	6.26E-03	6.26E-03	8.33E-04	6.03E-02	9.25E-03	7.30E-02	6.16E-03	6.16E-03	8.07E-04	5.99E-02	9.13E-03	7.20E-02
Grouse	Reference (Broach Lake)	4.04E-01	4.04E-01	2.33E-03	3.80E-02	3.34E-02	1.30E+00	4.04E-01	4.04E-01	2.33E-03	3.80E-02	3.34E-02	1.30E+00
	Patterson Lake North Arm - West Basin	1.80E+00	1.80E+00	1.39E-02	9.96E-02	1.01E-01	4.90E+00	5.51E-01	5.51E-01	3.10E-03	5.50E-02	3.34E-02	1.30E+00
	Patterson Lake South Arm	6.73E-01	6.73E-01	4.59E-03	4.98E-02	4.63E-02	1.99E+00	4.32E-01	4.32E-01	2.48E-03	4.13E-02	3.34E-02	1.30E+00
	Beet Lake	5.51E-01	5.51E-01	3.57E-03	4.45E-02	4.05E-02	1.68E+00	4.19E-01	4.19E-01	2.41E-03	3.98E-02	3.34E-02	1.30E+00
	Lloyd Lake	4.11E-01	4.11E-01	2.39E-03	3.83E-02	3.37E-02	1.32E+00	4.05E-01	4.05E-01	2.34E-03	3.81E-02	3.34E-02	1.30E+00
Canada Goose	Reference (Broach Lake)	5.66E-02	5.66E-02	3.38E-04	5.34E-03	4.74E-03	1.83E-01	5.66E-02	5.66E-02	3.38E-04	5.34E-03	4.74E-03	1.83E-01
	Patterson Lake North Arm - West Basin	2.52E-01	2.52E-01	2.44E-03	1.45E-02	1.50E-02	7.27E-01	7.78E-02	7.78E-02	4.47E-04	7.74E-03	4.74E-03	1.84E-01
	Patterson Lake South Arm	9.42E-02	9.42E-02	7.61E-04	7.10E-03	6.71E-03	2.88E-01	6.07E-02	6.07E-02	3.59E-04	5.80E-03	4.74E-03	1.83E-01
	Beet Lake	7.72E-02	7.72E-02	5.69E-04	6.30E-03	5.81E-03	2.41E-01	5.88E-02	5.88E-02	3.50E-04	5.59E-03	4.74E-03	1.83E-01
	Lloyd Lake	5.76E-02	5.76E-02	3.50E-04	5.39E-03	4.79E-03	1.86E-01	5.67E-02	5.67E-02	3.39E-04	5.35E-03	4.74E-03	1.83E-01
Little Brown Myotis	Reference (Broach Lake)	2.36E-04	2.36E-04	1.83E-02	4.04E-02	8.48E-02	4.23E+00	2.36E-04	2.36E-04	1.83E-02	4.04E-02	8.48E-02	4.23E+00
	Patterson Lake North Arm - West Basin	2.12E-03	2.13E-03	1.02E-01	6.47E-02	1.16E-01	5.79E+00	7.62E-03	7.65E-03	1.96E-02	5.20E-02	8.88E-02	4.42E+00
	Patterson Lake South Arm	1.32E-03	1.33E-03	7.85E-02	5.50E-02	1.04E-01	5.18E+00	2.28E-03	2.29E-03	1.91E-02	4.47E-02	8.51E-02	4.24E+00
	Beet Lake	6.38E-04	6.39E-04	5.03E-02	4.67E-02	8.76E-02	4.37E+00	9.96E-04	9.99E-04	1.87E-02	4.22E-02	8.49E-02	4.23E+00

Table C.12: Maximum Concentrations of Radiological COPCs in Biota for the RFD Scenario - Project Lifespan and Far-Future

		Maximum Concentration RFD Case (Bq/kg fw)											
Biota	Location	Project Lifespan						Far Future					
		Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210
	Lloyd Lake	2.72E-04	2.72E-04	2.16E-02	4.10E-02	8.50E-02	4.23E+00	3.04E-04	3.05E-04	1.83E-02	4.05E-02	8.48E-02	4.23E+00
Loon	Reference (Broach Lake)	2.29E-03	2.29E-03	1.55E-03	1.81E-03	1.48E-02	4.07E+00	2.29E-03	2.29E-03	1.55E-03	1.81E-03	1.48E-02	4.07E+00
	Patterson Lake North Arm - West Basin	2.37E-02	2.38E-02	8.63E-03	2.97E-03	2.08E-02	5.60E+00	7.43E-02	7.45E-02	1.66E-03	2.34E-03	1.55E-02	4.26E+00
	Patterson Lake South Arm	2.79E-02	2.80E-02	6.66E-03	2.69E-03	1.94E-02	5.11E+00	2.22E-02	2.23E-02	1.62E-03	2.01E-03	1.49E-02	4.08E+00
	Beet Lake	1.11E-02	1.11E-02	4.27E-03	2.15E-03	1.55E-02	4.22E+00	9.70E-03	9.73E-03	1.59E-03	1.90E-03	1.48E-02	4.07E+00
	Lloyd Lake	3.11E-03	3.11E-03	1.83E-03	1.84E-03	1.49E-02	4.08E+00	2.96E-03	2.97E-03	1.55E-03	1.82E-03	1.48E-02	4.07E+00
Mallard	Reference (Broach Lake)	2.41E-02	2.41E-02	1.51E-02	1.96E-02	1.95E-01	3.49E+01	2.41E-02	2.41E-02	1.51E-02	1.96E-02	1.94E-01	3.49E+01
	Patterson Lake North Arm - West Basin	2.17E-01	2.18E-01	8.39E-02	3.16E-02	2.71E-01	4.77E+01	7.80E-01	7.83E-01	1.61E-02	2.53E-02	2.04E-01	3.65E+01
	Patterson Lake South Arm	1.35E-01	1.36E-01	6.47E-02	2.68E-02	2.51E-01	4.28E+01	2.33E-01	2.34E-01	1.57E-02	2.17E-02	1.95E-01	3.50E+01
	Beet Lake	6.52E-02	6.54E-02	4.15E-02	2.27E-02	2.03E-01	3.60E+01	1.02E-01	1.02E-01	1.54E-02	2.05E-02	1.95E-01	3.49E+01
	Lloyd Lake	2.79E-02	2.79E-02	1.78E-02	1.99E-02	1.95E-01	3.49E+01	3.11E-02	3.12E-02	1.51E-02	1.97E-02	1.95E-01	3.49E+01
Rusty Blackbird	Reference (Broach Lake)	1.74E-01	1.74E-01	4.20E-02	5.45E-02	3.34E-01	9.54E+01	1.74E-01	1.74E-01	4.20E-02	5.45E-02	3.34E-01	9.54E+01
	Patterson Lake North Arm - West Basin	8.81E-01	8.82E-01	2.13E-01	9.51E-02	4.59E-01	1.31E+02	8.67E-01	8.70E-01	4.60E-02	7.32E-02	3.47E-01	9.98E+01
	Patterson Lake South Arm	3.63E-01	3.64E-01	1.64E-01	7.04E-02	4.01E-01	1.17E+02	3.62E-01	3.63E-01	4.38E-02	5.97E-02	3.35E-01	9.57E+01
	Beet Lake	2.63E-01	2.63E-01	1.07E-01	6.19E-02	3.45E-01	9.86E+01	2.45E-01	2.45E-01	4.29E-02	5.69E-02	3.34E-01	9.54E+01
	Lloyd Lake	1.79E-01	1.79E-01	4.87E-02	5.51E-02	3.34E-01	9.56E+01	1.80E-01	1.80E-01	4.20E-02	5.47E-02	3.34E-01	9.54E+01

Table C.13: Estimated Non-carcinogen Total Risk to Human Receptors – Project Lifespan – Application Case and Upper Bound Scenario

		Project Lifespan HQs							
	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	8.58E-04	9.04E-07	1.01E-06	0.00E+00	1.15E-03	7.21E-04	1.97E-02	2.25E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	8.94E-04	2.69E-04	3.89E-02	4.01E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	1.21E-06	1.46E-04	8.23E-02	8.25E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	3.43E-03	1.92E-02	7.29E-02	9.80E-02
	Application Case - Total Project Risk								
	Cobalt	8.63E-04	9.07E-07	1.02E-06	0.00E+00	1.25E-03	7.29E-04	2.01E-02	2.29E-02
	Copper	2.91E-05	3.00E-08	4.12E-08	0.00E+00	9.36E-04	2.71E-04	3.91E-02	4.03E-02
	Molybdenum	1.09E-04	1.08E-07	1.62E-07	0.00E+00	1.79E-06	1.52E-04	8.24E-02	8.26E-02
	Uranium	2.46E-03	2.77E-05	2.24E-05	0.00E+00	4.71E-03	4.06E-02	8.68E-02	1.35E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	8.63E-04	9.07E-07	1.02E-06	0.00E+00	1.25E-03	7.29E-04	2.01E-02	2.29E-02
	Copper	2.91E-05	3.00E-08	4.12E-08	0.00E+00	9.37E-04	2.71E-04	3.91E-02	4.03E-02
	Molybdenum	1.09E-04	1.08E-07	1.62E-07	0.00E+00	2.97E-06	1.52E-04	8.24E-02	8.27E-02
	Uranium	2.47E-03	2.77E-05	2.25E-05	0.00E+00	6.96E-03	4.06E-02	8.74E-02	1.37E-01
Subsistence Harvester (Patterson Lake South Arm)	Base Case								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	2.30E-03	1.44E-03	2.44E-02	2.90E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	1.79E-03	5.38E-04	4.12E-02	4.35E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	2.42E-06	2.92E-04	6.98E-02	7.02E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	6.85E-03	3.84E-02	8.20E-02	1.30E-01
	Application Case - Total Project Risk								
	Cobalt	9.32E-04	9.05E-07	1.09E-06	0.00E+00	2.49E-03	1.46E-03	2.51E-02	3.00E-02
	Copper	3.05E-05	2.96E-08	4.29E-08	0.00E+00	1.87E-03	5.41E-04	4.15E-02	4.39E-02
	Molybdenum	1.61E-04	1.07E-07	2.32E-07	0.00E+00	3.57E-06	3.03E-04	6.99E-02	7.04E-02
	Uranium	3.39E-03	1.12E-05	2.92E-05	0.00E+00	9.42E-03	8.12E-02	1.10E-01	2.04E-01
	Upper Bound Scenario - Total Project Risk								

Table C.13: Estimated Non-carcinogen Total Risk to Human Receptors – Project Lifespan – Application Case and Upper Bound Scenario

		Project Lifespan HQs							
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Cobalt	9.35E-04	9.05E-07	1.10E-06	0.00E+00	2.50E-03	1.46E-03	2.51E-02	3.00E-02
	Copper	3.05E-05	2.96E-08	4.30E-08	0.00E+00	1.87E-03	5.41E-04	4.15E-02	4.39E-02
	Molybdenum	2.68E-04	1.07E-07	3.79E-07	0.00E+00	5.93E-06	3.03E-04	7.01E-02	7.06E-02
	Uranium	5.02E-03	1.12E-05	4.14E-05	0.00E+00	1.39E-02	8.12E-02	1.11E-01	2.11E-01
Subsistence Harvester One-year-old (Patterson Lake South Arm)	Base Case								
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	2.18E-03	2.84E-03	4.78E-02	5.39E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	1.69E-03	1.06E-03	9.70E-02	9.98E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	2.79E-06	7.01E-04	**2.64E-01**	2.64E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	6.49E-03	7.57E-02	1.70E-01	2.57E-01
	Application Case - Total Project Risk								
	Cobalt	1.04E-03	5.91E-05	7.14E-05	0.00E+00	2.36E-03	2.86E-03	4.85E-02	5.49E-02
	Copper	3.40E-05	1.93E-06	2.81E-06	0.00E+00	1.77E-03	1.07E-03	9.73E-02	1.00E-01
	Molybdenum	2.19E-04	8.49E-06	1.85E-05	0.00E+00	4.12E-06	7.20E-04	**2.64E-01**	2.65E-01
	Uranium	3.79E-03	7.34E-04	1.91E-03	0.00E+00	8.93E-03	1.40E-01	1.91E-01	3.46E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	1.04E-03	5.91E-05	7.16E-05	0.00E+00	2.37E-03	2.86E-03	4.85E-02	5.49E-02
	Copper	3.41E-05	1.93E-06	2.81E-06	0.00E+00	1.78E-03	1.07E-03	9.73E-02	1.00E-01
	Molybdenum	3.65E-04	8.49E-06	3.02E-05	0.00E+00	6.84E-06	7.20E-04	**2.64E-01**	2.65E-01
	Uranium	5.61E-03	7.34E-04	2.70E-03	0.00E+00	1.32E-02	1.40E-01	1.91E-01	3.54E-01
Subsistence Harvester (Beet Lake)	Base Case								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	2.30E-03	1.44E-03	2.44E-02	2.90E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	1.79E-03	5.38E-04	4.12E-02	4.35E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	2.42E-06	2.92E-04	6.98E-02	7.02E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	6.85E-03	3.84E-02	8.20E-02	1.30E-01
	Application Case - Total Project Risk								
	Cobalt	8.97E-04	9.05E-07	1.06E-06	0.00E+00	2.40E-03	1.46E-03	2.47E-02	2.94E-02

Table C.13: Estimated Non-carcinogen Total Risk to Human Receptors – Project Lifespan – Application Case and Upper Bound Scenario

		Project Lifespan HQs							
	COPC	**Water (internal)**	**Soil (internal)**	**Sediment (internal)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial Animals**	**Total by COPC**
	Copper	2.98E-05	2.96E-08	4.21E-08	0.00E+00	1.83E-03	5.40E-04	4.12E-02	4.36E-02
	Molybdenum	1.35E-04	1.07E-07	1.98E-07	0.00E+00	3.01E-06	2.98E-04	6.98E-02	7.02E-02
	Uranium	2.80E-03	1.02E-05	2.49E-05	0.00E+00	7.79E-03	6.36E-02	9.24E-02	1.67E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	8.98E-04	9.05E-07	1.06E-06	0.00E+00	2.40E-03	1.46E-03	2.47E-02	2.94E-02
	Copper	2.98E-05	2.96E-08	4.21E-08	0.00E+00	1.83E-03	5.40E-04	4.12E-02	4.36E-02
	Molybdenum	1.91E-04	1.07E-07	2.74E-07	0.00E+00	4.23E-06	2.98E-04	6.98E-02	7.03E-02
	Uranium	3.40E-03	1.02E-05	2.94E-05	0.00E+00	9.44E-03	6.36E-02	9.28E-02	1.69E-01
Subsistence Harvester One-year-old (Beet Lake)	**Base Case**								
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	2.18E-03	2.84E-03	4.78E-02	5.39E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	1.69E-03	1.06E-03	9.70E-02	9.98E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	2.79E-06	7.01E-04	**2.64E-01**	2.64E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	6.49E-03	7.57E-02	1.70E-01	2.57E-01
	Application Case - Total Project Risk								
	Cobalt	1.00E-03	5.91E-05	6.89E-05	0.00E+00	2.27E-03	2.86E-03	4.80E-02	5.43E-02
	Copper	3.33E-05	1.93E-06	2.75E-06	0.00E+00	1.73E-03	1.06E-03	9.71E-02	9.99E-02
	Molybdenum	1.84E-04	8.47E-06	1.58E-05	0.00E+00	3.47E-06	7.11E-04	**2.64E-01**	2.64E-01
	Uranium	3.13E-03	6.64E-04	1.63E-03	0.00E+00	7.39E-03	1.14E-01	1.78E-01	3.04E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	1.00E-03	5.91E-05	6.91E-05	0.00E+00	2.28E-03	2.86E-03	4.81E-02	5.43E-02
	Copper	3.33E-05	1.93E-06	2.75E-06	0.00E+00	1.74E-03	1.06E-03	9.71E-02	9.99E-02
	Molybdenum	2.60E-04	8.47E-06	2.18E-05	0.00E+00	4.88E-06	7.11E-04	**2.64E-01**	2.65E-01
	Uranium	3.80E-03	6.64E-04	1.92E-03	0.00E+00	8.95E-03	1.14E-01	1.78E-01	3.07E-01
Subsistence Harvester (Lloyd Lake)	**Base Case**								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	2.30E-03	1.44E-03	2.44E-02	2.90E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	1.79E-03	5.38E-04	4.12E-02	4.35E-02

Table C.13: Estimated Non-carcinogen Total Risk to Human Receptors – Project Lifespan – Application Case and Upper Bound Scenario

		Project Lifespan HQs							
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	2.42E-06	2.92E-04	6.98E-02	7.02E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	6.85E-03	3.84E-02	8.20E-02	1.30E-01
	Application Case - Total Project Risk								
	Cobalt	8.62E-04	9.05E-07	1.02E-06	0.00E+00	2.31E-03	1.46E-03	2.45E-02	2.91E-02
	Copper	2.92E-05	2.95E-08	4.13E-08	0.00E+00	1.79E-03	5.39E-04	4.12E-02	4.36E-02
	Molybdenum	1.11E-04	1.07E-07	1.66E-07	0.00E+00	2.48E-06	2.98E-04	6.98E-02	7.02E-02
	Uranium	2.49E-03	8.68E-06	2.27E-05	0.00E+00	6.94E-03	3.93E-02	8.24E-02	1.31E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	8.62E-04	9.05E-07	1.02E-06	0.00E+00	2.31E-03	1.46E-03	2.45E-02	2.91E-02
	Copper	2.92E-05	2.95E-08	4.13E-08	0.00E+00	1.79E-03	5.39E-04	4.12E-02	4.36E-02
	Molybdenum	1.17E-04	1.07E-07	1.74E-07	0.00E+00	2.60E-06	2.98E-04	6.98E-02	7.02E-02
	Uranium	2.55E-03	8.68E-06	2.31E-05	0.00E+00	7.09E-03	3.93E-02	8.24E-02	1.31E-01
Subsistence Harvester One-year-old (Lloyd Lake)	Base Case								
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	2.18E-03	2.84E-03	4.78E-02	5.39E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	1.69E-03	1.06E-03	9.70E-02	9.98E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	2.79E-06	7.01E-04	**2.64E-01**	2.64E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	6.49E-03	7.57E-02	1.70E-01	2.57E-01
	Application Case - Total Project Risk								
	Cobalt	9.62E-04	5.91E-05	6.65E-05	0.00E+00	2.19E-03	2.86E-03	4.79E-02	5.40E-02
	Copper	3.26E-05	1.93E-06	2.70E-06	0.00E+00	1.70E-03	1.06E-03	9.70E-02	9.98E-02
	Molybdenum	1.51E-04	8.47E-06	1.32E-05	0.00E+00	2.86E-06	7.11E-04	**2.64E-01**	2.64E-01
	Uranium	2.78E-03	5.67E-04	1.48E-03	0.00E+00	6.58E-03	7.71E-02	1.71E-01	2.59E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	9.62E-04	5.91E-05	6.65E-05	0.00E+00	2.19E-03	2.86E-03	4.79E-02	5.40E-02
	Copper	3.26E-05	1.93E-06	2.70E-06	0.00E+00	1.70E-03	1.06E-03	9.70E-02	9.98E-02
	Molybdenum	1.59E-04	8.47E-06	1.38E-05	0.00E+00	3.01E-06	7.11E-04	**2.64E-01**	2.64E-01

Table C.13: Estimated Non-carcinogen Total Risk to Human Receptors – Project Lifespan – Application Case and Upper Bound Scenario

		Project Lifespan HQs							
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Uranium	2.84E-03	5.67E-04	1.51E-03	0.00E+00	6.72E-03	7.71E-02	1.71E-01	2.59E-01
Seasonal Resident (Patterson Lake South Arm)	Base Case								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	7.27E-04	1.13E-03	1.88E-02	2.15E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	5.66E-04	4.22E-04	3.86E-02	3.96E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	7.66E-07	2.29E-04	8.60E-02	8.63E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	2.17E-03	3.01E-02	6.79E-02	1.03E-01
	Application Case - Total Project Risk								
	Cobalt	9.02E-04	9.05E-07	1.06E-06	0.00E+00	7.65E-04	1.13E-03	1.89E-02	2.17E-02
	Copper	2.99E-05	2.95E-08	4.22E-08	0.00E+00	5.82E-04	4.23E-04	3.87E-02	3.97E-02
	Molybdenum	1.40E-04	1.07E-07	2.04E-07	0.00E+00	9.85E-07	2.32E-04	8.60E-02	8.64E-02
	Uranium	3.02E-03	1.02E-05	2.65E-05	0.00E+00	2.66E-03	4.35E-02	7.31E-02	1.22E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	9.04E-04	9.05E-07	1.06E-06	0.00E+00	7.66E-04	1.13E-03	1.89E-02	2.18E-02
	Copper	3.00E-05	2.95E-08	4.23E-08	0.00E+00	5.82E-04	4.23E-04	3.87E-02	3.97E-02
	Molybdenum	2.04E-04	1.07E-07	2.92E-07	0.00E+00	1.43E-06	2.32E-04	8.61E-02	8.65E-02
	Uranium	4.00E-03	1.02E-05	3.38E-05	0.00E+00	3.51E-03	4.35E-02	7.34E-02	1.24E-01
Seasonal Resident One-year-old (Patterson Lake South Arm)	Base Case								
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	6.89E-04	2.47E-03	4.13E-02	4.56E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	5.36E-04	9.22E-04	9.32E-02	9.47E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	8.84E-07	6.10E-04	**2.77E-01**	2.78E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	2.06E-03	6.58E-02	1.60E-01	2.33E-01
	Application Case - Total Project Risk								
	Cobalt	1.01E-03	5.91E-05	6.94E-05	0.00E+00	7.25E-04	2.48E-03	4.15E-02	4.59E-02
	Copper	3.34E-05	1.93E-06	2.76E-06	0.00E+00	5.52E-04	9.24E-04	9.32E-02	9.47E-02
	Molybdenum	1.90E-04	8.48E-06	1.62E-05	0.00E+00	1.14E-06	6.16E-04	**2.77E-01**	2.78E-01
	Uranium	3.37E-03	6.66E-04	1.73E-03	0.00E+00	2.52E-03	8.97E-02	1.64E-01	2.62E-01

Table C.13: Estimated Non-carcinogen Total Risk to Human Receptors – Project Lifespan – Application Case and Upper Bound Scenario

		Project Lifespan HQs							
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Upper Bound Scenario - Total Project Risk								
	Cobalt	1.01E-03	5.91E-05	6.95E-05	0.00E+00	7.26E-04	2.48E-03	4.15E-02	4.59E-02
	Copper	3.34E-05	1.93E-06	2.76E-06	0.00E+00	5.52E-04	9.24E-04	9.32E-02	9.47E-02
	Molybdenum	2.78E-04	8.48E-06	2.33E-05	0.00E+00	1.65E-06	6.16E-04	**2.77E-01**	2.78E-01
	Uranium	4.46E-03	6.66E-04	2.21E-03	0.00E+00	3.33E-03	8.97E-02	1.64E-01	2.65E-01
Seasonal Resident (Lloyd Lake)	**Base Case**								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	7.27E-04	1.13E-03	1.88E-02	2.15E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	5.66E-04	4.22E-04	3.86E-02	3.96E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	7.66E-07	2.29E-04	8.60E-02	8.63E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	2.17E-03	3.01E-02	6.79E-02	1.03E-01
	Application Case - Total Project Risk								
	Cobalt	8.60E-04	9.05E-07	1.02E-06	0.00E+00	7.31E-04	1.13E-03	1.88E-02	2.15E-02
	Copper	2.91E-05	2.95E-08	4.13E-08	0.00E+00	7.53E-04	4.22E-04	3.86E-02	3.98E-02
	Molybdenum	1.10E-04	1.06E-07	1.64E-07	0.00E+00	7.86E-07	2.31E-04	8.60E-02	8.64E-02
	Uranium	2.48E-03	8.66E-06	2.26E-05	0.00E+00	2.73E-03	3.04E-02	6.80E-02	1.04E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	8.60E-04	9.05E-07	1.02E-06	0.00E+00	7.31E-04	1.13E-03	1.88E-02	2.15E-02
	Copper	2.91E-05	2.95E-08	4.13E-08	0.00E+00	7.53E-04	4.22E-04	3.86E-02	3.98E-02
	Molybdenum	1.14E-04	1.06E-07	1.69E-07	0.00E+00	8.26E-07	2.31E-04	8.60E-02	8.64E-02
	Uranium	2.51E-03	8.66E-06	2.28E-05	0.00E+00	2.79E-03	3.04E-02	6.80E-02	1.04E-01
Seasonal Resident One-year-old (Lloyd Lake)	**Base Case**								
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	6.89E-04	2.47E-03	4.13E-02	4.56E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	5.36E-04	9.22E-04	9.32E-02	9.47E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	8.84E-07	6.10E-04	**2.77E-01**	2.78E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	2.06E-03	6.58E-02	1.60E-01	2.33E-01
	Application Case - Total Project Risk								

Table C.13: Estimated Non-carcinogen Total Risk to Human Receptors – Project Lifespan – Application Case and Upper Bound Scenario

		Project Lifespan HQs							
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Cobalt	9.60E-04	5.91E-05	6.64E-05	0.00E+00	6.91E-04	2.48E-03	4.14E-02	4.56E-02
	Copper	3.25E-05	1.93E-06	2.70E-06	0.00E+00	5.37E-04	9.23E-04	9.32E-02	9.47E-02
	Molybdenum	1.50E-04	8.47E-06	1.31E-05	0.00E+00	8.97E-07	6.13E-04	**2.77E-01**	2.78E-01
	Uranium	2.77E-03	5.66E-04	1.47E-03	0.00E+00	2.07E-03	6.63E-02	1.60E-01	2.34E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	9.60E-04	5.91E-05	6.64E-05	0.00E+00	6.91E-04	2.48E-03	4.14E-02	4.56E-02
	Copper	3.25E-05	1.93E-06	2.70E-06	0.00E+00	5.37E-04	9.23E-04	9.32E-02	9.47E-02
	Molybdenum	1.54E-04	8.47E-06	1.35E-05	0.00E+00	9.25E-07	6.13E-04	**2.77E-01**	2.78E-01
	Uranium	2.80E-03	5.66E-04	1.49E-03	0.00E+00	2.10E-03	6.63E-02	1.60E-01	2.34E-01
Permanent Resident (Patterson Lake North Arm - West Basin)	Base Case								
	Cobalt	-	-	-	-	-	-	-	-
	Copper	-	-	-	-	-	-	-	-
	Molybdenum	-	-	-	-	-	-	-	-
	Uranium	-	-	-	-	-	-	-	-
	Application Case - Total Project Risk								
	Cobalt	-	-	-	-	-	-	-	-
	Copper	-	-	-	-	-	-	-	-
	Molybdenum	-	-	-	-	-	-	-	-
	Uranium	-	-	-	-	-	-	-	-
	Upper Bound Scenario - Total Project Risk								
	Cobalt	-	-	-	-	-	-	-	-
	Copper	-	-	-	-	-	-	-	-
	Molybdenum	-	-	-	-	-	-	-	-
	Uranium	-	-	-	-	-	-	-	-
	Base Case								
	Cobalt	-	-	-	-	-	-	-	-

Table C.13: Estimated Non-carcinogen Total Risk to Human Receptors – Project Lifespan – Application Case and Upper Bound Scenario

		Project Lifespan HQs							
	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)	Copper	-	-	-	-	-	-	-	-
	Molybdenum	-	-	-	-	-	-	-	-
	Uranium	-	-	-	-	-	-	-	-
	Application Case - Total Project Risk								
	Cobalt	-	-	-	-	-	-	-	-
	Copper	-	-	-	-	-	-	-	-
	Molybdenum	-	-	-	-	-	-	-	-
	Uranium	-	-	-	-	-	-	-	-
	Upper Bound Scenario - Total Project Risk								
	Cobalt	-	-	-	-	-	-	-	-
	Copper	-	-	-	-	-	-	-	-
	Molybdenum	-	-	-	-	-	-	-	-
	Uranium	-	-	-	-	-	-	-	-

Table C.14: Estimated Non-carcinogen Total Risk to Human Receptors – Far Future – Application Case and Upper Bound Scenario

		Far Future HQs							
	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	-	-	-	-	-	-	-	-
	Copper	-	-	-	-	-	-	-	-
	Molybdenum	-	-	-	-	-	-	-	-
	Uranium	-	-	-	-	-	-	-	-
	Application Case - Total Project Risk								
	Cobalt	-	-	-	-	-	-	-	-
	Copper	-	-	-	-	-	-	-	-
	Molybdenum	-	-	-	-	-	-	-	-
	Uranium	-	-	-	-	-	-	-	-
	Upper Bound Scenario - Total Project Risk								
	Cobalt	-	-	-	-	-	-	-	-
	Copper	-	-	-	-	-	-	-	-
	Molybdenum	-	-	-	-	-	-	-	-
	Uranium	-	-	-	-	-	-	-	-
Subsistence Harvester (Patterson Lake South Arm)	Base Case								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	2.30E-03	1.44E-03	2.44E-02	2.90E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	1.79E-03	5.38E-04	4.12E-02	4.35E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	2.42E-06	2.92E-04	6.98E-02	7.02E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	6.85E-03	3.84E-02	8.20E-02	1.30E-01
	Application Case - Total Project Risk								
	Cobalt	1.23E-03	9.05E-07	1.46E-06	0.00E+00	3.30E-03	1.44E-03	2.73E-02	3.33E-02
	Copper	4.27E-05	2.95E-08	6.04E-08	0.00E+00	2.62E-03	5.38E-04	4.19E-02	4.51E-02
	Molybdenum	7.79E-04	1.06E-07	1.17E-06	0.00E+00	1.74E-05	2.92E-04	7.05E-02	7.16E-02
	Uranium	5.52E-03	8.90E-06	5.04E-05	0.00E+00	1.54E-02	3.96E-02	8.62E-02	1.47E-01

Table C.14: Estimated Non-carcinogen Total Risk to Human Receptors – Far Future – Application Case and Upper Bound Scenario

		Far Future HQs							
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Upper Bound Scenario - Total Project Risk								
	Cobalt	1.44E-03	9.05E-07	1.70E-06	0.00E+00	3.84E-03	1.44E-03	2.89E-02	3.56E-02
	Copper	4.95E-05	2.95E-08	7.01E-08	0.00E+00	3.04E-03	5.38E-04	4.23E-02	4.60E-02
	Molybdenum	2.68E-03	1.06E-07	4.01E-06	0.00E+00	5.98E-05	2.92E-04	7.27E-02	7.57E-02
	Uranium	5.53E-03	8.90E-06	5.04E-05	0.00E+00	1.54E-02	3.96E-02	8.62E-02	1.47E-01
Subsistence Harvester One-year-old (Patterson Lake South Arm)	Base Case								
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	2.18E-03	2.84E-03	4.78E-02	5.39E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	1.69E-03	1.06E-03	9.70E-02	9.98E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	2.79E-06	7.01E-04	**2.64E-01**	2.64E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	6.49E-03	7.57E-02	1.70E-01	2.57E-01
	Application Case - Total Project Risk								
	Cobalt	1.38E-03	5.91E-05	9.54E-05	0.00E+00	3.13E-03	2.84E-03	5.08E-02	5.83E-02
	Copper	4.76E-05	1.93E-06	3.95E-06	0.00E+00	2.48E-03	1.06E-03	9.77E-02	1.01E-01
	Molybdenum	1.06E-03	8.46E-06	9.27E-05	0.00E+00	2.00E-05	7.01E-04	**2.64E-01**	2.66E-01
	Uranium	6.17E-03	5.81E-04	3.29E-03	0.00E+00	1.46E-02	7.81E-02	1.73E-01	2.76E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	1.60E-03	5.91E-05	1.11E-04	0.00E+00	3.64E-03	2.84E-03	5.25E-02	6.07E-02
	Copper	5.52E-05	1.93E-06	4.58E-06	0.00E+00	2.88E-03	1.06E-03	9.81E-02	1.02E-01
	Molybdenum	3.65E-03	8.46E-06	3.19E-04	0.00E+00	6.91E-05	7.01E-04	**2.67E-01**	2.72E-01
	Uranium	6.17E-03	5.81E-04	3.29E-03	0.00E+00	1.46E-02	7.81E-02	1.73E-01	2.76E-01
Subsistence Harvester (Beet Lake)	Base Case								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	2.30E-03	1.44E-03	2.44E-02	2.90E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	1.79E-03	5.38E-04	4.12E-02	4.35E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	2.42E-06	2.92E-04	6.98E-02	7.02E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	6.85E-03	3.84E-02	8.20E-02	1.30E-01
	Application Case - Total Project Risk								

Table C.14: Estimated Non-carcinogen Total Risk to Human Receptors – Far Future – Application Case and Upper Bound Scenario

		Far Future HQs							
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Cobalt	1.06E-03	9.05E-07	1.25E-06	0.00E+00	2.83E-03	1.44E-03	2.54E-02	3.08E-02
	Copper	3.62E-05	2.95E-08	5.13E-08	0.00E+00	2.22E-03	5.38E-04	4.15E-02	4.43E-02
	Molybdenum	4.57E-04	1.06E-07	6.85E-07	0.00E+00	1.02E-05	2.92E-04	7.00E-02	7.08E-02
	Uranium	3.60E-03	8.79E-06	3.28E-05	0.00E+00	1.00E-02	3.91E-02	8.34E-02	1.36E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	1.16E-03	9.05E-07	1.38E-06	0.00E+00	3.11E-03	1.44E-03	2.60E-02	3.17E-02
	Copper	3.97E-05	2.95E-08	5.63E-08	0.00E+00	2.44E-03	5.38E-04	4.16E-02	4.46E-02
	Molybdenum	1.45E-03	1.06E-07	2.17E-06	0.00E+00	3.23E-05	2.92E-04	7.08E-02	7.26E-02
	Uranium	3.60E-03	8.79E-06	3.28E-05	0.00E+00	1.00E-02	3.91E-02	8.34E-02	1.36E-01
Subsistence Harvester One-year-old (Beet Lake)	Base Case								
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	2.18E-03	2.84E-03	4.78E-02	5.39E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	1.69E-03	1.06E-03	9.70E-02	9.98E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	2.79E-06	7.01E-04	**2.64E-01**	2.64E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	6.49E-03	7.57E-02	1.70E-01	2.57E-01
	Application Case - Total Project Risk								
	Cobalt	1.18E-03	5.91E-05	8.17E-05	0.00E+00	2.68E-03	2.84E-03	4.89E-02	5.57E-02
	Copper	4.04E-05	1.93E-06	3.35E-06	0.00E+00	2.11E-03	1.06E-03	9.73E-02	1.00E-01
	Molybdenum	6.22E-04	8.46E-06	5.45E-05	0.00E+00	1.18E-05	7.01E-04	**2.64E-01**	2.65E-01
	Uranium	4.02E-03	5.74E-04	2.14E-03	0.00E+00	9.50E-03	7.71E-02	1.71E-01	2.65E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	1.30E-03	5.91E-05	8.99E-05	0.00E+00	2.95E-03	2.84E-03	4.94E-02	5.66E-02
	Copper	4.44E-05	1.93E-06	3.68E-06	0.00E+00	2.31E-03	1.06E-03	9.74E-02	1.01E-01
	Molybdenum	1.97E-03	8.46E-06	1.72E-04	0.00E+00	3.73E-05	7.01E-04	**2.65E-01**	2.68E-01
	Uranium	4.02E-03	5.74E-04	2.15E-03	0.00E+00	9.51E-03	7.71E-02	1.71E-01	2.65E-01
Subsistence Harvester (Lloyd Lake)	Base Case								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	2.30E-03	1.44E-03	2.44E-02	2.90E-02

Table C.14: Estimated Non-carcinogen Total Risk to Human Receptors – Far Future – Application Case and Upper Bound Scenario

		Far Future HQs							
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	1.79E-03	5.38E-04	4.12E-02	4.35E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	2.42E-06	2.92E-04	6.98E-02	7.02E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	6.85E-03	3.84E-02	8.20E-02	1.30E-01
	Application Case - Total Project Risk								
	Cobalt	8.78E-04	9.05E-07	1.04E-06	0.00E+00	2.35E-03	1.44E-03	2.45E-02	2.92E-02
	Copper	2.98E-05	2.95E-08	4.22E-08	0.00E+00	1.83E-03	5.38E-04	4.12E-02	4.36E-02
	Molybdenum	1.44E-04	1.06E-07	2.15E-07	0.00E+00	3.21E-06	2.92E-04	6.98E-02	7.02E-02
	Uranium	2.56E-03	8.63E-06	2.34E-05	0.00E+00	7.14E-03	3.84E-02	8.21E-02	1.30E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	8.89E-04	9.05E-07	1.05E-06	0.00E+00	2.38E-03	1.44E-03	2.46E-02	2.93E-02
	Copper	3.02E-05	2.95E-08	4.28E-08	0.00E+00	1.85E-03	5.38E-04	4.12E-02	4.37E-02
	Molybdenum	2.45E-04	1.06E-07	3.67E-07	0.00E+00	5.47E-06	2.92E-04	6.99E-02	7.04E-02
	Uranium	2.56E-03	8.63E-06	2.34E-05	0.00E+00	7.14E-03	3.84E-02	8.21E-02	1.30E-01
Subsistence Harvester One-year-old (Lloyd Lake)	Base Case								
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	2.18E-03	2.84E-03	4.78E-02	5.39E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	1.69E-03	1.06E-03	9.70E-02	9.98E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	2.79E-06	7.01E-04	**2.64E-01**	2.64E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	6.49E-03	7.57E-02	1.70E-01	2.57E-01
	Application Case - Total Project Risk								
	Cobalt	9.80E-04	5.91E-05	6.78E-05	0.00E+00	2.23E-03	2.84E-03	4.79E-02	5.41E-02
	Copper	3.33E-05	1.93E-06	2.76E-06	0.00E+00	1.74E-03	1.06E-03	9.70E-02	9.99E-02
	Molybdenum	1.96E-04	8.46E-06	1.71E-05	0.00E+00	3.71E-06	7.01E-04	**2.64E-01**	2.64E-01
	Uranium	2.86E-03	5.64E-04	1.53E-03	0.00E+00	6.77E-03	7.57E-02	1.70E-01	2.58E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	9.93E-04	5.91E-05	6.87E-05	0.00E+00	2.26E-03	2.84E-03	4.80E-02	5.42E-02
	Copper	3.37E-05	1.93E-06	2.79E-06	0.00E+00	1.76E-03	1.06E-03	9.71E-02	9.99E-02

Table C.14: Estimated Non-carcinogen Total Risk to Human Receptors – Far Future – Application Case and Upper Bound Scenario

		Far Future HQs							
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Molybdenum	3.33E-04	8.46E-06	2.92E-05	0.00E+00	6.31E-06	7.01E-04	**2.64E-01**	2.65E-01
	Uranium	2.86E-03	5.64E-04	1.53E-03	0.00E+00	6.77E-03	7.57E-02	1.70E-01	2.58E-01
Seasonal Resident (Patterson Lake South Arm)	Base Case								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	7.27E-04	1.13E-03	1.88E-02	2.15E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	5.66E-04	4.22E-04	3.86E-02	3.96E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	7.66E-07	2.29E-04	8.60E-02	8.63E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	2.17E-03	3.01E-02	6.79E-02	1.03E-01
	Application Case - Total Project Risk								
	Cobalt	1.08E-03	9.04E-07	1.28E-06	0.00E+00	9.19E-04	1.13E-03	1.95E-02	2.26E-02
	Copper	3.72E-05	2.95E-08	5.27E-08	0.00E+00	7.24E-04	4.22E-04	3.88E-02	4.00E-02
	Molybdenum	5.11E-04	1.06E-07	7.64E-07	0.00E+00	3.61E-06	2.29E-04	8.62E-02	8.69E-02
	Uranium	4.30E-03	8.79E-06	3.92E-05	0.00E+00	3.79E-03	3.07E-02	6.90E-02	1.08E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	1.20E-03	9.04E-07	1.42E-06	0.00E+00	1.02E-03	1.13E-03	1.99E-02	2.32E-02
	Copper	4.13E-05	2.95E-08	5.85E-08	0.00E+00	8.04E-04	4.22E-04	3.89E-02	4.02E-02
	Molybdenum	1.65E-03	1.06E-07	2.47E-06	0.00E+00	1.17E-05	2.29E-04	8.67E-02	8.86E-02
	Uranium	4.30E-03	8.79E-06	3.92E-05	0.00E+00	3.79E-03	3.07E-02	6.90E-02	1.08E-01
Seasonal Resident One-year-old (Patterson Lake South Arm)	Base Case								
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	6.89E-04	2.47E-03	4.13E-02	4.56E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	5.36E-04	9.22E-04	9.32E-02	9.47E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	8.84E-07	6.10E-04	**2.77E-01**	2.78E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	2.06E-03	6.58E-02	1.60E-01	2.33E-01
	Application Case - Total Project Risk								
	Cobalt	1.21E-03	5.91E-05	8.37E-05	0.00E+00	8.71E-04	2.47E-03	4.21E-02	4.68E-02
	Copper	4.16E-05	1.93E-06	3.45E-06	0.00E+00	6.86E-04	9.22E-04	9.33E-02	9.50E-02
	Molybdenum	6.94E-04	8.46E-06	6.08E-05	0.00E+00	4.16E-06	6.10E-04	**2.78E-01**	2.79E-01

Table C.14: Estimated Non-carcinogen Total Risk to Human Receptors – Far Future – Application Case and Upper Bound Scenario

		Far Future HQs							
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Uranium	4.80E-03	5.74E-04	2.56E-03	0.00E+00	3.60E-03	6.70E-02	1.61E-01	2.40E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	1.34E-03	5.91E-05	9.30E-05	0.00E+00	9.68E-04	2.47E-03	4.25E-02	4.74E-02
	Copper	4.61E-05	1.93E-06	3.82E-06	0.00E+00	7.62E-04	9.22E-04	9.34E-02	9.52E-02
	Molybdenum	2.25E-03	8.46E-06	1.97E-04	0.00E+00	1.35E-05	6.10E-04	**2.78E-01**	2.81E-01
	Uranium	4.80E-03	5.74E-04	2.56E-03	0.00E+00	3.60E-03	6.70E-02	1.61E-01	2.40E-01
Seasonal Resident (Lloyd Lake)	Base Case								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	7.27E-04	1.13E-03	1.88E-02	2.15E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	5.66E-04	4.22E-04	3.86E-02	3.96E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	7.66E-07	2.29E-04	8.60E-02	8.63E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	2.17E-03	3.01E-02	6.79E-02	1.03E-01
	Application Case - Total Project Risk								
	Cobalt	8.70E-04	9.04E-07	1.03E-06	0.00E+00	7.45E-04	1.13E-03	1.88E-02	2.16E-02
	Copper	2.95E-05	2.95E-08	4.18E-08	0.00E+00	7.70E-04	4.22E-04	3.86E-02	3.99E-02
	Molybdenum	1.30E-04	1.06E-07	1.94E-07	0.00E+00	1.02E-06	2.29E-04	8.60E-02	8.64E-02
	Uranium	2.52E-03	8.63E-06	2.30E-05	0.00E+00	2.81E-03	3.01E-02	6.80E-02	1.03E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	8.76E-04	9.04E-07	1.04E-06	0.00E+00	7.54E-04	1.13E-03	1.88E-02	2.16E-02
	Copper	2.98E-05	2.95E-08	4.21E-08	0.00E+00	7.79E-04	4.22E-04	3.86E-02	3.99E-02
	Molybdenum	1.90E-04	1.06E-07	2.85E-07	0.00E+00	1.73E-06	2.29E-04	8.60E-02	8.65E-02
	Uranium	2.52E-03	8.63E-06	2.30E-05	0.00E+00	2.81E-03	3.01E-02	6.80E-02	1.03E-01
Seasonal Resident One-year-old (Lloyd Lake)	Base Case								
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	6.89E-04	2.47E-03	4.13E-02	4.56E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	5.36E-04	9.22E-04	9.32E-02	9.47E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	8.84E-07	6.10E-04	**2.77E-01**	2.78E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	2.06E-03	6.58E-02	1.60E-01	2.33E-01

Table C.14: Estimated Non-carcinogen Total Risk to Human Receptors – Far Future – Application Case and Upper Bound Scenario

		Far Future HQs							
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
		Application Case - Total Project Risk							
	Cobalt	9.71E-04	5.91E-05	6.72E-05	0.00E+00	6.99E-04	2.47E-03	4.14E-02	4.56E-02
	Copper	3.30E-05	1.93E-06	2.73E-06	0.00E+00	5.44E-04	9.22E-04	9.32E-02	9.47E-02
	Molybdenum	1.76E-04	8.46E-06	1.54E-05	0.00E+00	1.06E-06	6.10E-04	**2.77E-01**	2.78E-01
	Uranium	2.82E-03	5.64E-04	1.50E-03	0.00E+00	2.11E-03	6.58E-02	1.60E-01	2.33E-01
		Upper Bound Scenario - Total Project Risk							
	Cobalt	9.79E-04	5.91E-05	6.77E-05	0.00E+00	7.05E-04	2.47E-03	4.14E-02	4.57E-02
	Copper	3.32E-05	1.93E-06	2.75E-06	0.00E+00	5.48E-04	9.22E-04	9.32E-02	9.47E-02
	Molybdenum	2.59E-04	8.46E-06	2.27E-05	0.00E+00	1.55E-06	6.10E-04	**2.77E-01**	2.78E-01
	Uranium	2.82E-03	5.64E-04	1.50E-03	0.00E+00	2.11E-03	6.58E-02	1.60E-01	2.33E-01
Permanent Resident (Patterson Lake North Arm - West Basin)		Base Case							
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	2.30E-03	1.44E-03	2.44E-02	2.90E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	1.79E-03	5.38E-04	4.12E-02	4.35E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	2.42E-06	2.92E-04	6.98E-02	7.02E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	6.85E-03	3.84E-02	8.20E-02	1.30E-01
		Application Case - Total Project Risk							
	Cobalt	2.10E-03	9.07E-07	2.48E-06	0.00E+00	5.62E-03	1.44E-03	3.08E-02	4.00E-02
	Copper	7.53E-05	2.96E-08	1.07E-07	0.00E+00	4.62E-03	5.39E-04	4.30E-02	4.82E-02
	Molybdenum	2.42E-03	1.06E-07	3.62E-06	0.00E+00	5.39E-05	2.92E-04	7.16E-02	7.43E-02
	Uranium	2.46E-02	1.25E-05	2.24E-04	0.00E+00	6.85E-02	5.55E-02	1.13E-01	2.62E-01
		Upper Bound Scenario - Total Project Risk							
	Cobalt	2.76E-03	9.07E-07	3.26E-06	0.00E+00	7.39E-03	1.44E-03	3.42E-02	4.58E-02
	Copper	9.85E-05	2.96E-08	1.40E-07	0.00E+00	6.05E-03	5.39E-04	4.39E-02	5.06E-02
	Molybdenum	8.98E-03	1.06E-07	1.34E-05	0.00E+00	2.00E-04	2.92E-04	7.67E-02	8.62E-02
	Uranium	2.46E-02	1.25E-05	2.25E-04	0.00E+00	6.86E-02	5.55E-02	1.13E-01	2.62E-01
		Base Case							

Table C.14: Estimated Non-carcinogen Total Risk to Human Receptors – Far Future – Application Case and Upper Bound Scenario

		Far Future HQs							
	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)	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	2.18E-03	2.84E-03	4.78E-02	5.39E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	1.69E-03	1.06E-03	9.70E-02	9.98E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	2.79E-06	7.01E-04	**2.64E-01**	2.64E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	6.49E-03	7.57E-02	1.70E-01	2.57E-01
	Application Case - Total Project Risk								
	Cobalt	2.34E-03	5.92E-05	1.62E-04	0.00E+00	5.33E-03	2.85E-03	5.43E-02	6.50E-02
	Copper	8.41E-05	1.93E-06	6.97E-06	0.00E+00	4.38E-03	1.06E-03	9.87E-02	1.04E-01
	Molybdenum	3.29E-03	8.46E-06	2.88E-04	0.00E+00	6.23E-05	7.01E-04	**2.66E-01**	2.70E-01
	Uranium	2.75E-02	8.15E-04	1.47E-02	0.00E+00	6.50E-02	1.09E-01	1.93E-01	4.10E-01
	Upper Bound Scenario - Total Project Risk								
	Cobalt	3.08E-03	5.92E-05	2.13E-04	0.00E+00	7.01E-03	2.85E-03	5.77E-02	7.09E-02
	Copper	1.10E-04	1.93E-06	9.12E-06	0.00E+00	5.73E-03	1.06E-03	9.95E-02	1.06E-01
	Molybdenum	1.22E-02	8.46E-06	1.07E-03	0.00E+00	2.31E-04	7.01E-04	**2.72E-01**	2.86E-01
	Uranium	2.75E-02	8.15E-04	1.47E-02	0.00E+00	6.50E-02	1.09E-01	1.93E-01	4.10E-01

Table C.15: Estimated Non-carcinogen Total Risk to Human Receptors – Operations – Reasonably Foreseeable Development Case

	RFD Case HQs								
	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	8.58E-04	9.04E-07	1.01E-06	0.00E+00	1.15E-03	7.21E-04	1.97E-02	2.25E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	8.94E-04	2.69E-04	3.89E-02	4.01E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	1.21E-06	1.46E-04	8.23E-02	8.25E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	3.43E-03	1.92E-02	7.29E-02	9.80E-02
	Project Lifespan - Total Project Risk								
	Cobalt	8.63E-04	9.06E-07	1.02E-06	0.00E+00	1.33E-03	7.29E-04	2.01E-02	2.30E-02
	Copper	2.91E-05	3.00E-08	4.12E-08	0.00E+00	9.80E-04	2.70E-04	3.91E-02	4.03E-02
	Molybdenum	1.09E-04	1.08E-07	1.62E-07	0.00E+00	2.19E-06	1.49E-04	8.24E-02	8.26E-02
	Uranium	2.46E-03	2.80E-05	2.24E-05	0.00E+00	1.06E-02	4.34E-02	8.81E-02	1.45E-01
	Far Future - Total Project Risk								
	Cobalt	-	-	-	-	-	-	-	-
	Copper	-	-	-	-	-	-	-	-
	Molybdenum	-	-	-	-	-	-	-	-
	Uranium	-	-	-	-	-	-	-	-
Subsistence Harvester (Patterson Lake South Arm)	Base Case								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	2.30E-03	1.44E-03	2.44E-02	2.90E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	1.79E-03	5.38E-04	4.12E-02	4.35E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	2.42E-06	2.92E-04	6.98E-02	7.02E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	6.85E-03	3.84E-02	8.20E-02	1.30E-01
	Project Lifespan - Total Project Risk								
	Cobalt	1.00E-03	9.05E-07	1.12E-06	0.00E+00	2.65E-03	1.46E-03	2.51E-02	3.02E-02
	Copper	3.20E-05	2.95E-08	4.37E-08	0.00E+00	1.96E-03	5.39E-04	4.15E-02	4.40E-02
	Molybdenum	2.04E-04	1.07E-07	2.54E-07	0.00E+00	4.38E-06	2.98E-04	6.99E-02	7.05E-02
	Uranium	7.81E-03	1.16E-05	3.71E-05	0.00E+00	2.12E-02	8.67E-02	1.12E-01	2.28E-01
	Far Future - Total Project Risk								

Table C.15: Estimated Non-carcinogen Total Risk to Human Receptors – Operations – Reasonably Foreseeable Development Case

	RFD Case HQs								
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Cobalt	1.23E-03	9.05E-07	1.46E-06	0.00E+00	3.30E-03	1.44E-03	2.73E-02	3.33E-02
	Copper	4.27E-05	2.95E-08	6.04E-08	0.00E+00	2.62E-03	5.38E-04	4.19E-02	4.51E-02
	Molybdenum	7.79E-04	1.06E-07	1.17E-06	0.00E+00	1.74E-05	2.92E-04	7.05E-02	7.16E-02
	Uranium	5.52E-03	8.93E-06	5.04E-05	0.00E+00	1.54E-02	3.98E-02	8.64E-02	1.47E-01
Subsistence Harvester One-year-old (Patterson Lake South Arm)	Base Case								
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	2.18E-03	2.84E-03	4.78E-02	5.39E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	1.69E-03	1.06E-03	9.70E-02	9.98E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	2.79E-06	7.01E-04	**2.64E-01**	2.64E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	6.49E-03	7.57E-02	1.70E-01	2.57E-01
	Project Lifespan - Total Project Risk								
	Cobalt	1.12E-03	5.91E-05	7.34E-05	0.00E+00	2.52E-03	2.86E-03	4.85E-02	5.51E-02
	Copper	3.57E-05	1.93E-06	2.86E-06	0.00E+00	1.86E-03	1.06E-03	9.73E-02	1.00E-01
	Molybdenum	2.78E-04	8.47E-06	2.02E-05	0.00E+00	5.06E-06	7.11E-04	**2.64E-01**	2.65E-01
	Uranium	8.72E-03	7.56E-04	2.43E-03	0.00E+00	2.01E-02	1.48E-01	1.92E-01	3.73E-01
	Far Future - Total Project Risk								
	Cobalt	1.38E-03	5.91E-05	9.54E-05	0.00E+00	3.13E-03	2.84E-03	5.08E-02	5.83E-02
	Copper	4.76E-05	1.93E-06	3.95E-06	0.00E+00	2.48E-03	1.06E-03	9.77E-02	1.01E-01
	Molybdenum	1.06E-03	8.46E-06	9.27E-05	0.00E+00	2.00E-05	7.01E-04	**2.64E-01**	2.66E-01
	Uranium	6.17E-03	5.84E-04	3.29E-03	0.00E+00	1.46E-02	7.84E-02	1.74E-01	2.77E-01
Subsistence Harvester (Beet Lake)	Base Case								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	2.30E-03	1.44E-03	2.44E-02	2.90E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	1.79E-03	5.38E-04	4.12E-02	4.35E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	2.42E-06	2.92E-04	6.98E-02	7.02E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	6.85E-03	3.84E-02	8.20E-02	1.30E-01
	Project Lifespan - Total Project Risk								
	Cobalt	9.22E-04	9.05E-07	1.07E-06	0.00E+00	2.45E-03	1.46E-03	2.47E-02	2.96E-02

Table C.15: Estimated Non-carcinogen Total Risk to Human Receptors – Operations – Reasonably Foreseeable Development Case

	RFD Case HQs								
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Copper	3.03E-05	2.95E-08	4.25E-08	0.00E+00	1.86E-03	5.39E-04	4.12E-02	4.37E-02
	Molybdenum	1.51E-04	1.07E-07	2.10E-07	0.00E+00	3.30E-06	2.98E-04	6.98E-02	7.03E-02
	Uranium	4.32E-03	1.03E-05	2.79E-05	0.00E+00	1.18E-02	6.54E-02	9.34E-02	1.75E-01
	Far Future - Total Project Risk								
	Cobalt	1.06E-03	9.05E-07	1.25E-06	0.00E+00	2.83E-03	1.44E-03	2.54E-02	3.08E-02
	Copper	3.62E-05	2.95E-08	5.13E-08	0.00E+00	2.22E-03	5.38E-04	4.15E-02	4.43E-02
	Molybdenum	4.57E-04	1.06E-07	6.85E-07	0.00E+00	1.02E-05	2.92E-04	7.00E-02	7.08E-02
	Uranium	3.60E-03	8.80E-06	3.28E-05	0.00E+00	1.00E-02	3.92E-02	8.35E-02	1.36E-01
Subsistence Harvester One-year-old (Beet Lake)	**Base Case**								
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	2.18E-03	2.84E-03	4.78E-02	5.39E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	1.69E-03	1.06E-03	9.70E-02	9.98E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	2.79E-06	7.01E-04	**2.64E-01**	2.64E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	6.49E-03	7.57E-02	1.70E-01	2.57E-01
	Project Lifespan - Total Project Risk								
	Cobalt	1.03E-03	5.91E-05	7.01E-05	0.00E+00	2.33E-03	2.86E-03	4.81E-02	5.45E-02
	Copper	3.39E-05	1.93E-06	2.78E-06	0.00E+00	1.76E-03	1.06E-03	9.71E-02	9.99E-02
	Molybdenum	2.06E-04	8.47E-06	1.67E-05	0.00E+00	3.80E-06	7.11E-04	**2.64E-01**	2.65E-01
	Uranium	4.82E-03	6.71E-04	1.82E-03	0.00E+00	1.12E-02	1.16E-01	1.78E-01	3.13E-01
	Far Future - Total Project Risk								
	Cobalt	1.18E-03	5.91E-05	8.17E-05	0.00E+00	2.68E-03	2.84E-03	4.89E-02	5.57E-02
	Copper	4.04E-05	1.93E-06	3.35E-06	0.00E+00	2.11E-03	1.06E-03	9.73E-02	1.00E-01
	Molybdenum	6.22E-04	8.46E-06	5.45E-05	0.00E+00	1.18E-05	7.01E-04	**2.64E-01**	2.65E-01
	Uranium	4.02E-03	5.75E-04	2.14E-03	0.00E+00	9.50E-03	7.72E-02	1.71E-01	2.65E-01
Subsistence Harvester (Lloyd Lake)	**Base Case**								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	2.30E-03	1.44E-03	2.44E-02	2.90E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	1.79E-03	5.38E-04	4.12E-02	4.35E-02

Table C.15: Estimated Non-carcinogen Total Risk to Human Receptors – Operations – Reasonably Foreseeable Development Case

	RFD Case HQs								
	COPC	**Water (internal)**	**Soil (internal)**	**Sediment (internal)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial Animals**	**Total by COPC**
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	2.42E-06	2.92E-04	6.98E-02	7.02E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	6.85E-03	3.84E-02	8.20E-02	1.30E-01
	Project Lifespan - Total Project Risk								
	Cobalt	8.64E-04	9.05E-07	1.02E-06	0.00E+00	2.31E-03	1.46E-03	2.45E-02	2.91E-02
	Copper	2.92E-05	2.95E-08	4.14E-08	0.00E+00	1.79E-03	5.39E-04	4.12E-02	4.36E-02
	Molybdenum	1.13E-04	1.07E-07	1.67E-07	0.00E+00	2.51E-06	2.98E-04	6.98E-02	7.02E-02
	Uranium	2.63E-03	8.64E-06	2.29E-05	0.00E+00	7.31E-03	3.87E-02	8.22E-02	1.31E-01
	Far Future - Total Project Risk								
	Cobalt	8.78E-04	9.05E-07	1.04E-06	0.00E+00	2.35E-03	1.44E-03	2.45E-02	2.92E-02
	Copper	2.98E-05	2.95E-08	4.22E-08	0.00E+00	1.83E-03	5.38E-04	4.12E-02	4.36E-02
	Molybdenum	1.44E-04	1.06E-07	2.15E-07	0.00E+00	3.21E-06	2.92E-04	6.98E-02	7.02E-02
	Uranium	2.56E-03	8.63E-06	2.34E-05	0.00E+00	7.14E-03	3.84E-02	8.21E-02	1.30E-01
Subsistence Harvester One-year-old (Lloyd Lake)		**Base Case**							
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	2.18E-03	2.84E-03	4.78E-02	5.39E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	1.69E-03	1.06E-03	9.70E-02	9.98E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	2.79E-06	7.01E-04	**2.64E-01**	2.64E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	6.49E-03	7.57E-02	1.70E-01	2.57E-01
	Project Lifespan - Total Project Risk								
	Cobalt	9.65E-04	5.91E-05	6.66E-05	0.00E+00	2.19E-03	2.86E-03	4.79E-02	5.40E-02
	Copper	3.26E-05	1.93E-06	2.70E-06	0.00E+00	1.70E-03	1.06E-03	9.70E-02	9.98E-02
	Molybdenum	1.53E-04	8.47E-06	1.33E-05	0.00E+00	2.89E-06	7.11E-04	**2.64E-01**	2.64E-01
	Uranium	2.94E-03	5.65E-04	1.50E-03	0.00E+00	6.93E-03	7.61E-02	1.70E-01	2.59E-01
	Far Future - Total Project Risk								
	Cobalt	9.80E-04	5.91E-05	6.78E-05	0.00E+00	2.23E-03	2.84E-03	4.79E-02	5.41E-02
	Copper	3.33E-05	1.93E-06	2.76E-06	0.00E+00	1.74E-03	1.06E-03	9.70E-02	9.99E-02
	Molybdenum	1.96E-04	8.46E-06	1.71E-05	0.00E+00	3.71E-06	7.01E-04	**2.64E-01**	2.64E-01

Table C.15: Estimated Non-carcinogen Total Risk to Human Receptors – Operations – Reasonably Foreseeable Development Case

	RFD Case HQs								
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Uranium	2.86E-03	5.64E-04	1.53E-03	0.00E+00	6.77E-03	7.57E-02	1.70E-01	2.58E-01
Seasonal Resident (Patterson Lake South Arm)	Base Case								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	7.27E-04	1.13E-03	1.88E-02	2.15E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	5.66E-04	4.22E-04	3.86E-02	3.96E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	7.66E-07	2.29E-04	8.60E-02	8.63E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	2.17E-03	3.01E-02	6.79E-02	1.03E-01
	Project Lifespan - Total Project Risk								
	Cobalt	9.45E-04	9.05E-07	1.08E-06	0.00E+00	7.96E-04	1.13E-03	1.89E-02	2.18E-02
	Copper	3.08E-05	2.95E-08	4.27E-08	0.00E+00	5.99E-04	4.22E-04	3.87E-02	3.97E-02
	Molybdenum	1.66E-04	1.06E-07	2.17E-07	0.00E+00	1.14E-06	2.31E-04	8.60E-02	8.64E-02
	Uranium	5.67E-03	1.04E-05	3.13E-05	0.00E+00	4.90E-03	4.52E-02	7.36E-02	1.29E-01
	Far Future - Total Project Risk								
	Cobalt	1.08E-03	9.04E-07	1.28E-06	0.00E+00	9.19E-04	1.13E-03	1.95E-02	2.26E-02
	Copper	3.72E-05	2.95E-08	5.27E-08	0.00E+00	7.24E-04	4.22E-04	3.88E-02	4.00E-02
	Molybdenum	5.11E-04	1.06E-07	7.64E-07	0.00E+00	3.61E-06	2.29E-04	8.62E-02	8.69E-02
	Uranium	4.30E-03	8.81E-06	3.92E-05	0.00E+00	3.79E-03	3.08E-02	6.90E-02	1.08E-01
Seasonal Resident One-year-old (Patterson Lake South Arm)	Base Case								
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	6.89E-04	2.47E-03	4.13E-02	4.56E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	5.36E-04	9.22E-04	9.32E-02	9.47E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	8.84E-07	6.10E-04	**2.77E-01**	2.78E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	2.06E-03	6.58E-02	1.60E-01	2.33E-01
	Project Lifespan - Total Project Risk								
	Cobalt	1.06E-03	5.91E-05	7.06E-05	0.00E+00	7.54E-04	2.48E-03	4.15E-02	4.59E-02
	Copper	3.44E-05	1.93E-06	2.79E-06	0.00E+00	5.68E-04	9.23E-04	9.32E-02	9.48E-02
	Molybdenum	2.26E-04	8.47E-06	1.73E-05	0.00E+00	1.32E-06	6.13E-04	**2.77E-01**	2.78E-01
	Uranium	6.33E-03	6.79E-04	2.04E-03	0.00E+00	4.64E-03	9.28E-02	1.65E-01	2.71E-01

Table C.15: Estimated Non-carcinogen Total Risk to Human Receptors – Operations – Reasonably Foreseeable Development Case

	RFD Case HQs								
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Far Future - Total Project Risk								
	Cobalt	1.21E-03	5.91E-05	8.37E-05	0.00E+00	8.71E-04	2.47E-03	4.21E-02	4.68E-02
	Copper	4.16E-05	1.93E-06	3.45E-06	0.00E+00	6.86E-04	9.22E-04	9.33E-02	9.50E-02
	Molybdenum	6.94E-04	8.46E-06	6.08E-05	0.00E+00	4.16E-06	6.10E-04	**2.78E-01**	2.79E-01
	Uranium	4.80E-03	5.76E-04	2.56E-03	0.00E+00	3.60E-03	6.72E-02	1.61E-01	2.40E-01
Seasonal Resident (Lloyd Lake)	Base Case								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	7.27E-04	1.13E-03	1.88E-02	2.15E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	5.66E-04	4.22E-04	3.86E-02	3.96E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	7.66E-07	2.29E-04	8.60E-02	8.63E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	2.17E-03	3.01E-02	6.79E-02	1.03E-01
	Project Lifespan - Total Project Risk								
	Cobalt	8.62E-04	9.05E-07	1.02E-06	0.00E+00	7.33E-04	1.13E-03	1.88E-02	2.15E-02
	Copper	2.92E-05	2.95E-08	4.13E-08	0.00E+00	7.54E-04	4.22E-04	3.86E-02	3.98E-02
	Molybdenum	1.11E-04	1.06E-07	1.65E-07	0.00E+00	7.95E-07	2.31E-04	8.60E-02	8.64E-02
	Uranium	2.56E-03	8.64E-06	2.27E-05	0.00E+00	2.88E-03	3.02E-02	6.80E-02	1.04E-01
	Far Future - Total Project Risk								
	Cobalt	8.70E-04	9.04E-07	1.03E-06	0.00E+00	7.45E-04	1.13E-03	1.88E-02	2.16E-02
	Copper	2.95E-05	2.95E-08	4.18E-08	0.00E+00	7.70E-04	4.22E-04	3.86E-02	3.99E-02
	Molybdenum	1.30E-04	1.06E-07	1.94E-07	0.00E+00	1.02E-06	2.29E-04	8.60E-02	8.64E-02
	Uranium	2.52E-03	8.63E-06	2.30E-05	0.00E+00	2.81E-03	3.01E-02	6.80E-02	1.03E-01
Seasonal Resident One-year-old (Lloyd Lake)	Base Case								
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	6.89E-04	2.47E-03	4.13E-02	4.56E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	5.36E-04	9.22E-04	9.32E-02	9.47E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	8.84E-07	6.10E-04	**2.77E-01**	2.78E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	2.06E-03	6.58E-02	1.60E-01	2.33E-01
	Project Lifespan - Total Project Risk								

Table C.15: Estimated Non-carcinogen Total Risk to Human Receptors – Operations – Reasonably Foreseeable Development Case

		RFD Case HQs							
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Cobalt	9.62E-04	5.91E-05	6.65E-05	0.00E+00	6.92E-04	2.48E-03	4.14E-02	4.56E-02
	Copper	3.26E-05	1.93E-06	2.70E-06	0.00E+00	5.38E-04	9.23E-04	9.32E-02	9.47E-02
	Molybdenum	1.51E-04	8.47E-06	1.31E-05	0.00E+00	9.03E-07	6.13E-04	**2.77E-01**	2.78E-01
	Uranium	2.86E-03	5.64E-04	1.49E-03	0.00E+00	2.14E-03	6.60E-02	1.60E-01	2.33E-01
	Far Future - Total Project Risk								
	Cobalt	9.71E-04	5.91E-05	6.72E-05	0.00E+00	6.99E-04	2.47E-03	4.14E-02	4.56E-02
	Copper	3.30E-05	1.93E-06	2.73E-06	0.00E+00	5.44E-04	9.22E-04	9.32E-02	9.47E-02
	Molybdenum	1.76E-04	8.46E-06	1.54E-05	0.00E+00	1.06E-06	6.10E-04	**2.77E-01**	2.78E-01
	Uranium	2.82E-03	5.64E-04	1.50E-03	0.00E+00	2.11E-03	6.58E-02	1.60E-01	2.33E-01
Permanent Resident (Patterson Lake North Arm - West Basin)	Base Case Adult								
	Cobalt	8.58E-04	9.04E-07	1.01E-06	0.00E+00	2.30E-03	1.44E-03	2.44E-02	2.90E-02
	Copper	2.91E-05	2.95E-08	4.12E-08	0.00E+00	1.79E-03	5.38E-04	4.12E-02	4.35E-02
	Molybdenum	1.08E-04	1.06E-07	1.62E-07	0.00E+00	2.42E-06	2.92E-04	6.98E-02	7.02E-02
	Uranium	2.46E-03	8.62E-06	2.24E-05	0.00E+00	6.85E-03	3.84E-02	8.20E-02	1.30E-01
	Base Case One-year-old								
	Cobalt	9.58E-04	5.91E-05	6.62E-05	0.00E+00	2.18E-03	2.84E-03	4.78E-02	5.39E-02
	Copper	3.25E-05	1.93E-06	2.69E-06	0.00E+00	1.69E-03	1.06E-03	9.70E-02	9.98E-02
	Molybdenum	1.47E-04	8.46E-06	1.29E-05	0.00E+00	2.79E-06	7.01E-04	**2.64E-01**	2.64E-01
	Uranium	2.75E-03	5.64E-04	1.47E-03	0.00E+00	6.49E-03	7.57E-02	1.70E-01	2.57E-01
	Far future Adult - Total Project Risk								
	Cobalt	2.10E-03	9.05E-07	2.48E-06	0.00E+00	5.62E-03	1.44E-03	3.08E-02	3.99E-02
	Copper	7.53E-05	2.96E-08	1.07E-07	0.00E+00	4.62E-03	5.39E-04	4.30E-02	4.82E-02
	Molybdenum	2.42E-03	1.06E-07	3.62E-06	0.00E+00	5.39E-05	2.92E-04	7.16E-02	7.43E-02
	Uranium	2.46E-02	1.25E-05	2.24E-04	0.00E+00	6.85E-02	5.57E-02	1.13E-01	2.62E-01
	Far future One-year-old - Total Project Risk								
	Cobalt	2.34E-03	5.92E-05	1.62E-04	0.00E+00	5.33E-03	2.84E-03	5.43E-02	6.50E-02

Table C.15: Estimated Non-carcinogen Total Risk to Human Receptors – Operations – Reasonably Foreseeable Development Case

	RFD Case HQs								
	COPC	Water (internal)	Soil (internal)	Sediment (internal)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial Animals	Total by COPC
	Copper	8.41E-05	1.93E-06	6.97E-06	0.00E+00	4.38E-03	1.06E-03	9.87E-02	1.04E-01
	Molybdenum	3.29E-03	8.46E-06	2.88E-04	0.00E+00	6.23E-05	7.01E-04	**2.66E-01**	2.70E-01
	Uranium	2.75E-02	8.17E-04	1.47E-02	0.00E+00	6.50E-02	1.10E-01	1.93E-01	4.10E-01

Table C.16: Estimated Total Radiation Doses to Human Receptors – Operations – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Project Lifespan (mSv/yr)												
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
Camp Worker (Patterson Lake North Arm - West Basin)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	8.47E-06	1.65E-04	4.15E-04	1.42E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	9.22E-06	1.80E-04	4.52E-04	6.52E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	4.85E-04	9.73E-05	2.70E-03	4.05E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	7.86E-04	2.24E-03	9.32E-03	8.35E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	5.91E-03	1.64E-03	2.93E-02	4.17E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	3.73E-02	3.86E-03	1.32E-01	1.75E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	4.45E-02	8.18E-03	1.74E-01	**0.31**
	Application Case													
	Uranium-238	8.41E-04	2.31E-12	6.10E-06	4.63E-11	2.07E-07	2.29E-03	5.55E-08	5.92E-07	0.00E+00	1.96E-05	2.12E-04	4.77E-04	3.85E-03
	Uranium-234	1.01E-03	5.64E-12	6.64E-06	8.07E-12	2.25E-07	1.15E-05	6.04E-08	2.15E-09	0.00E+00	2.14E-05	2.31E-04	5.20E-04	1.81E-03
	Thorium-230	4.06E-03	1.37E-11	7.26E-04	4.92E-10	2.96E-06	4.53E-05	7.90E-07	1.95E-08	0.00E+00	1.15E-03	6.07E-04	9.26E-03	1.58E-02
	Radium-226	1.01E-03	2.62E-10	5.89E-04	2.63E-07	3.65E-06	9.44E-02	3.26E-06	3.91E-04	0.00E+00	8.86E-04	3.12E-03	1.01E-02	1.10E-01
	Lead-210	3.19E-04	4.12E-11	1.33E-03	1.17E-09	1.64E-05	3.80E-03	4.46E-05	2.53E-06	0.00E+00	6.00E-03	3.54E-03	3.57E-02	5.07E-02
	Polonium-210	9.56E-04	3.59E-13	2.35E-03	7.06E-12	9.90E-06	2.93E-07	7.90E-05	1.08E-08	0.00E+00	3.79E-02	6.90E-03	1.41E-01	1.89E-01
	Total by Pathway	8.20E-03	3.25E-10	5.01E-03	2.65E-07	3.33E-05	1.01E-01	1.28E-04	3.94E-04	0.00E+00	4.59E-02	1.46E-02	1.97E-01	**0.37**
	Upper Bound Scenario													
	Uranium-238	8.41E-04	2.31E-12	6.10E-06	4.63E-11	2.07E-07	2.29E-03	5.55E-08	5.92E-07	0.00E+00	3.90E-05	2.12E-04	4.82E-04	3.87E-03
	Uranium-234	1.01E-03	5.64E-12	6.64E-06	8.07E-12	2.25E-07	1.15E-05	6.04E-08	2.15E-09	0.00E+00	4.25E-05	2.31E-04	5.25E-04	1.83E-03
	Thorium-230	4.06E-03	1.37E-11	7.26E-04	4.92E-10	2.96E-06	4.53E-05	7.90E-07	1.95E-08	0.00E+00	1.16E-03	6.07E-04	9.31E-03	1.59E-02
	Radium-226	1.01E-03	2.62E-10	5.89E-04	2.63E-07	3.65E-06	9.44E-02	3.26E-06	3.91E-04	0.00E+00	8.90E-04	3.12E-03	1.01E-02	1.10E-01
	Lead-210	3.19E-04	4.12E-11	1.33E-03	1.17E-09	1.64E-05	3.80E-03	4.46E-05	2.53E-06	0.00E+00	6.36E-03	3.54E-03	4.51E-02	6.06E-02
	Polonium-210	9.56E-04	3.59E-13	2.35E-03	7.06E-12	9.90E-06	2.93E-07	7.90E-05	1.08E-08	0.00E+00	4.02E-02	6.90E-03	1.46E-01	1.96E-01
	Total by Pathway	8.20E-03	3.25E-10	5.01E-03	2.65E-07	3.33E-05	1.01E-01	1.28E-04	3.94E-04	0.00E+00	4.87E-02	1.46E-02	2.11E-01	**0.39**
Subsistence Harvester (Patterson Lake South Arm)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	1.69E-05	3.30E-04	5.22E-04	1.70E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	1.84E-05	3.60E-04	5.68E-04	9.57E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	9.70E-04	1.94E-04	4.54E-03	6.47E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	1.57E-03	4.47E-03	1.03E-02	8.76E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.08E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	8.90E-02	1.63E-02	2.78E-01	**0.46**

Table C.16: Estimated Total Radiation Doses to Human Receptors – Operations – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Project Lifespan (mSv/yr)												
	Radionuclide	**Air (Internal)**	**Air (External)**	**Water (Internal)**	**Water (External)**	**Soil (Internal)**	**Soil (External)**	**Sediment (Internal)**	**Sediment (External)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial animals**	**Total by Radionuclide**
		Application Case												
	Uranium-238	1.30E-04	3.57E-13	1.42E-05	1.08E-10	9.47E-08	1.05E-03	1.14E-07	1.22E-06	0.00E+00	3.92E-05	4.24E-04	6.47E-04	2.31E-03
	Uranium-234	1.57E-04	8.74E-13	1.55E-05	1.88E-11	1.03E-07	5.30E-06	1.25E-07	4.42E-09	0.00E+00	4.28E-05	4.62E-04	7.04E-04	1.39E-03
	Thorium-230	6.29E-04	2.12E-12	1.72E-03	1.17E-09	2.38E-06	3.64E-05	1.81E-06	4.48E-08	0.00E+00	2.29E-03	1.21E-03	1.76E-02	2.35E-02
	Radium-226	1.57E-04	4.06E-11	6.66E-04	2.97E-07	2.86E-06	7.40E-02	3.60E-06	4.32E-04	0.00E+00	1.77E-03	6.23E-03	1.18E-02	9.50E-02
	Lead-210	4.94E-05	6.39E-12	1.35E-03	1.19E-09	1.51E-05	3.51E-03	4.52E-05	2.56E-06	0.00E+00	1.20E-02	7.08E-03	5.23E-02	7.63E-02
	Polonium-210	1.48E-04	5.57E-14	2.38E-03	7.16E-12	7.68E-06	2.28E-07	7.99E-05	1.10E-08	0.00E+00	7.57E-02	1.38E-02	2.41E-01	3.33E-01
	Total by Pathway	1.27E-03	5.04E-11	6.15E-03	3.00E-07	2.82E-05	7.86E-02	1.31E-04	4.35E-04	0.00E+00	9.18E-02	2.92E-02	3.24E-01	**0.53**
	Upper Bound Scenario													
	Uranium-238	1.30E-04	3.57E-13	2.82E-05	2.14E-10	9.47E-08	1.05E-03	2.19E-07	2.34E-06	0.00E+00	7.79E-05	4.24E-04	6.57E-04	2.37E-03
	Uranium-234	1.57E-04	8.74E-13	3.08E-05	3.74E-11	1.03E-07	5.30E-06	2.39E-07	8.49E-09	0.00E+00	8.50E-05	4.62E-04	7.15E-04	1.46E-03
	Thorium-230	6.29E-04	2.12E-12	1.74E-03	1.18E-09	2.38E-06	3.64E-05	1.82E-06	4.51E-08	0.00E+00	2.31E-03	1.21E-03	1.77E-02	2.36E-02
	Radium-226	1.57E-04	4.06E-11	6.69E-04	2.99E-07	2.86E-06	7.40E-02	3.62E-06	4.33E-04	0.00E+00	1.78E-03	6.23E-03	1.18E-02	9.50E-02
	Lead-210	4.94E-05	6.39E-12	1.43E-03	1.26E-09	1.51E-05	3.51E-03	4.72E-05	2.67E-06	0.00E+00	1.27E-02	7.08E-03	7.12E-02	9.60E-02
	Polonium-210	1.48E-04	5.57E-14	2.53E-03	7.61E-12	7.68E-06	2.28E-07	8.35E-05	1.15E-08	0.00E+00	8.03E-02	1.38E-02	2.51E-01	3.48E-01
	Total by Pathway	1.27E-03	5.04E-11	6.43E-03	3.01E-07	2.82E-05	7.86E-02	1.37E-04	4.39E-04	0.00E+00	9.72E-02	2.92E-02	3.54E-01	**0.57**
Subsistence Harvester One-Year-Old (Patterson Lake South Arm)		**Base Case**												
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	9.99E-06	4.05E-04	5.67E-04	2.09E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	1.08E-05	4.39E-04	6.15E-04	1.08E-03
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	4.19E-04	1.75E-04	2.77E-03	3.86E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	1.19E-03	7.05E-03	1.67E-02	1.20E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	1.36E-01	4.20E-02	4.98E-01	**0.80**
		Application Case												
	Uranium-238	1.30E-04	4.65E-13	9.85E-06	2.66E-11	3.85E-06	1.41E-03	4.64E-06	1.58E-06	0.00E+00	2.31E-05	5.21E-04	6.24E-04	2.72E-03
	Uranium-234	1.52E-04	1.14E-12	1.07E-05	4.65E-12	4.17E-06	7.09E-06	5.04E-06	5.75E-09	0.00E+00	2.51E-05	5.64E-04	6.76E-04	1.44E-03
	Thorium-230	4.84E-04	2.75E-12	8.76E-04	2.89E-10	7.07E-05	4.14E-05	5.39E-05	5.82E-08	0.00E+00	9.90E-04	7.31E-04	9.09E-03	1.23E-02
	Radium-226	1.52E-04	5.27E-11	5.95E-04	7.36E-08	1.49E-04	9.90E-02	1.88E-04	5.63E-04	0.00E+00	1.34E-03	9.05E-03	1.74E-02	1.28E-01
	Lead-210	5.11E-05	8.29E-12	1.83E-03	2.41E-10	1.20E-03	4.70E-03	3.59E-03	3.32E-06	0.00E+00	1.38E-02	1.41E-02	9.85E-02	1.38E-01
	Polonium-210	1.52E-04	7.25E-14	4.55E-03	1.77E-12	8.59E-04	2.97E-07	8.94E-03	1.42E-08	0.00E+00	1.23E-01	4.04E-02	4.13E-01	5.90E-01
	Total by Pathway	1.12E-03	6.55E-11	7.88E-03	7.41E-08	2.29E-03	1.05E-01	1.28E-02	5.68E-04	0.00E+00	1.39E-01	6.53E-02	5.39E-01	**0.87**

Table C.16: Estimated Total Radiation Doses to Human Receptors – Operations – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Project Lifespan (mSv/yr)												
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
		Upper Bound Scenario												
	Uranium-238	1.30E-04	4.65E-13	1.96E-05	5.29E-11	3.85E-06	1.41E-03	8.90E-06	3.04E-06	0.00E+00	4.59E-05	5.21E-04	6.28E-04	2.77E-03
	Uranium-234	1.52E-04	1.14E-12	2.13E-05	9.27E-12	4.17E-06	7.09E-06	9.67E-06	1.10E-08	0.00E+00	4.99E-05	5.64E-04	6.81E-04	1.49E-03
	Thorium-230	4.84E-04	2.75E-12	8.83E-04	2.91E-10	7.07E-05	4.14E-05	5.43E-05	5.86E-08	0.00E+00	9.98E-04	7.31E-04	9.14E-03	1.24E-02
	Radium-226	1.52E-04	5.27E-11	5.98E-04	7.39E-08	1.49E-04	9.90E-02	1.89E-04	5.66E-04	0.00E+00	1.35E-03	9.05E-03	1.74E-02	1.28E-01
	Lead-210	5.11E-05	8.29E-12	1.94E-03	2.56E-10	1.20E-03	4.70E-03	3.76E-03	3.47E-06	0.00E+00	1.47E-02	1.41E-02	1.22E-01	1.63E-01
	Polonium-210	1.52E-04	7.25E-14	4.84E-03	1.88E-12	8.59E-04	2.97E-07	9.34E-03	1.49E-08	0.00E+00	1.30E-01	4.04E-02	4.24E-01	6.10E-01
	Total by Pathway	1.12E-03	6.55E-11	8.30E-03	7.46E-08	2.29E-03	1.05E-01	1.34E-02	5.72E-04	0.00E+00	1.47E-01	6.53E-02	5.74E-01	**0.92**
Subsistence Harvester (Beet Lake)		Base Case												
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	1.69E-05	3.30E-04	5.22E-04	1.70E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	1.84E-05	3.60E-04	5.68E-04	9.57E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	9.70E-04	1.94E-04	4.54E-03	6.47E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	1.57E-03	4.47E-03	1.03E-02	8.76E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.08E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	8.90E-02	1.63E-02	2.78E-01	**0.46**
		Application Case												
	Uranium-238	7.59E-05	2.08E-13	9.05E-06	6.87E-11	8.62E-08	9.56E-04	7.70E-08	8.21E-07	0.00E+00	2.51E-05	3.85E-04	5.71E-04	2.02E-03
	Uranium-234	9.16E-05	5.10E-13	9.87E-06	1.20E-11	9.39E-08	4.82E-06	8.39E-08	2.98E-09	0.00E+00	2.74E-05	4.19E-04	6.22E-04	1.17E-03
	Thorium-230	3.67E-04	1.24E-12	1.25E-03	8.46E-10	2.33E-06	3.57E-05	1.33E-06	3.28E-08	0.00E+00	1.66E-03	7.87E-04	7.10E-03	1.12E-02
	Radium-226	9.16E-05	2.36E-11	6.21E-04	2.77E-07	2.80E-06	7.24E-02	3.41E-06	4.08E-04	0.00E+00	1.66E-03	5.50E-03	1.07E-02	9.14E-02
	Lead-210	2.88E-05	3.72E-12	1.33E-03	1.17E-09	1.50E-05	3.49E-03	4.47E-05	2.53E-06	0.00E+00	1.18E-02	5.49E-03	4.06E-02	6.28E-02
	Polonium-210	8.64E-05	3.25E-14	2.35E-03	7.07E-12	7.51E-06	2.23E-07	7.91E-05	1.08E-08	0.00E+00	7.47E-02	1.13E-02	2.28E-01	3.17E-01
	Total by Pathway	7.41E-04	2.94E-11	5.57E-03	2.79E-07	2.79E-05	7.69E-02	1.29E-04	4.12E-04	0.00E+00	8.99E-02	2.38E-02	2.88E-01	**0.49**
		Upper Bound Scenario												
	Uranium-238	7.59E-05	2.08E-13	1.42E-05	1.08E-10	8.62E-08	9.56E-04	1.15E-07	1.23E-06	0.00E+00	3.93E-05	3.85E-04	5.74E-04	2.05E-03
	Uranium-234	9.16E-05	5.10E-13	1.55E-05	1.88E-11	9.39E-08	4.82E-06	1.26E-07	4.47E-09	0.00E+00	4.29E-05	4.19E-04	6.25E-04	1.20E-03
	Thorium-230	3.67E-04	1.24E-12	1.26E-03	8.51E-10	2.33E-06	3.57E-05	1.33E-06	3.30E-08	0.00E+00	1.67E-03	7.87E-04	7.13E-03	1.13E-02
	Radium-226	9.16E-05	2.36E-11	6.23E-04	2.78E-07	2.80E-06	7.24E-02	3.41E-06	4.09E-04	0.00E+00	1.66E-03	5.50E-03	1.07E-02	9.14E-02
	Lead-210	2.88E-05	3.72E-12	1.34E-03	1.18E-09	1.50E-05	3.49E-03	4.50E-05	2.54E-06	0.00E+00	1.19E-02	5.49E-03	4.07E-02	6.31E-02
	Polonium-210	8.64E-05	3.25E-14	2.37E-03	7.12E-12	7.51E-06	2.23E-07	7.96E-05	1.09E-08	0.00E+00	7.53E-02	1.13E-02	2.29E-01	3.19E-01
	Total by Pathway	7.41E-04	2.94E-11	5.62E-03	2.80E-07	2.79E-05	7.69E-02	1.30E-04	4.13E-04	0.00E+00	9.07E-02	2.38E-02	2.89E-01	**0.49**

Table C.16: Estimated Total Radiation Doses to Human Receptors – Operations – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Project Lifespan (mSv/yr)												
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
Subsistence Harvester One-Year-Old (Beet Lake)	**Base Case**													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	9.99E-06	4.05E-04	5.67E-04	2.09E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	1.08E-05	4.39E-04	6.15E-04	1.08E-03
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	4.19E-04	1.75E-04	2.77E-03	3.86E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	1.19E-03	7.05E-03	1.67E-02	1.20E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	1.36E-01	4.20E-02	4.98E-01	**0.80**
	Application Case													
	Uranium-238	7.57E-05	2.71E-13	6.29E-06	1.70E-11	3.51E-06	1.28E-03	3.13E-06	1.07E-06	0.00E+00	1.48E-05	4.73E-04	5.89E-04	2.45E-03
	Uranium-234	8.86E-05	6.62E-13	6.83E-06	2.97E-12	3.80E-06	6.45E-06	3.39E-06	3.87E-09	0.00E+00	1.61E-05	5.12E-04	6.38E-04	1.28E-03
	Thorium-230	2.82E-04	1.61E-12	6.35E-04	2.10E-10	6.94E-05	4.06E-05	3.95E-05	4.26E-08	0.00E+00	7.19E-04	4.99E-04	4.00E-03	6.28E-03
	Radium-226	8.86E-05	3.07E-11	5.55E-04	6.87E-08	1.46E-04	9.69E-02	1.78E-04	5.32E-04	0.00E+00	1.26E-03	8.22E-03	1.69E-02	1.25E-01
	Lead-210	2.98E-05	4.83E-12	1.81E-03	2.38E-10	1.20E-03	4.67E-03	3.56E-03	3.29E-06	0.00E+00	1.37E-02	1.15E-02	8.39E-02	1.20E-01
	Polonium-210	8.86E-05	4.22E-14	4.50E-03	1.75E-12	8.40E-04	2.91E-07	8.84E-03	1.41E-08	0.00E+00	1.21E-01	3.44E-02	4.00E-01	5.70E-01
	Total by Pathway	6.53E-04	3.81E-11	7.51E-03	6.91E-08	2.26E-03	1.03E-01	1.26E-02	5.37E-04	0.00E+00	1.37E-01	5.56E-02	5.06E-01	**0.83**
	Upper Bound Scenario													
	Uranium-238	7.57E-05	2.71E-13	9.88E-06	2.67E-11	3.51E-06	1.28E-03	4.69E-06	1.60E-06	0.00E+00	2.32E-05	4.73E-04	5.91E-04	2.46E-03
	Uranium-234	8.86E-05	6.62E-13	1.07E-05	4.67E-12	3.80E-06	6.45E-06	5.10E-06	5.81E-09	0.00E+00	2.52E-05	5.12E-04	6.40E-04	1.29E-03
	Thorium-230	2.82E-04	1.61E-12	6.39E-04	2.11E-10	6.94E-05	4.06E-05	3.97E-05	4.28E-08	0.00E+00	7.23E-04	4.99E-04	4.01E-03	6.31E-03
	Radium-226	8.86E-05	3.07E-11	5.56E-04	6.88E-08	1.46E-04	9.69E-02	1.78E-04	5.34E-04	0.00E+00	1.26E-03	8.22E-03	1.69E-02	1.25E-01
	Lead-210	2.98E-05	4.83E-12	1.82E-03	2.40E-10	1.20E-03	4.67E-03	3.58E-03	3.31E-06	0.00E+00	1.38E-02	1.15E-02	8.41E-02	1.21E-01
	Polonium-210	8.86E-05	4.22E-14	4.53E-03	1.77E-12	8.40E-04	2.91E-07	8.90E-03	1.42E-08	0.00E+00	1.22E-01	3.44E-02	4.01E-01	5.72E-01
	Total by Pathway	6.53E-04	3.81E-11	7.57E-03	6.93E-08	2.26E-03	1.03E-01	1.27E-02	5.39E-04	0.00E+00	1.38E-01	5.56E-02	5.08E-01	**0.83**
Subsistence Harvester (Lloyd Lake)	**Base Case**													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	1.69E-05	3.30E-04	5.22E-04	1.70E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	1.84E-05	3.60E-04	5.68E-04	9.57E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	9.70E-04	1.94E-04	4.54E-03	6.47E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	1.57E-03	4.47E-03	1.03E-02	8.76E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.08E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	8.90E-02	1.63E-02	2.78E-01	**0.46**

Table C.16: Estimated Total Radiation Doses to Human Receptors – Operations – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Project Lifespan (mSv/yr)												
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
	Application Case													
	Uranium-238	2.54E-06	6.97E-15	6.35E-06	4.82E-11	7.46E-08	8.28E-04	5.74E-08	6.12E-07	0.00E+00	1.77E-05	3.32E-04	5.23E-04	1.71E-03
	Uranium-234	3.07E-06	1.70E-14	6.92E-06	8.40E-12	8.13E-08	4.17E-06	6.25E-08	2.22E-09	0.00E+00	1.92E-05	3.62E-04	5.70E-04	9.65E-04
	Thorium-230	1.23E-05	4.13E-14	7.79E-04	5.28E-10	2.27E-06	3.48E-05	8.44E-07	2.09E-08	0.00E+00	1.04E-03	2.14E-04	4.76E-03	6.84E-03
	Radium-226	3.07E-06	7.91E-13	5.92E-04	2.64E-07	2.71E-06	7.03E-02	3.27E-06	3.92E-04	0.00E+00	1.58E-03	4.50E-03	1.03E-02	8.77E-02
	Lead-210	9.63E-07	1.25E-13	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.35E-03	3.96E-02	5.96E-02
	Polonium-210	2.89E-06	1.09E-15	2.35E-03	7.05E-12	7.28E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.83E-03	2.23E-01	3.08E-01
	Total by Pathway	2.48E-05	9.82E-13	5.06E-03	2.66E-07	2.73E-05	7.46E-02	1.28E-04	3.96E-04	0.00E+00	8.91E-02	1.66E-02	2.79E-01	**0.46**
	Upper Bound Scenario													
	Uranium-238	2.54E-06	6.97E-15	6.83E-06	5.18E-11	7.46E-08	8.28E-04	6.09E-08	6.49E-07	0.00E+00	1.90E-05	3.32E-04	5.24E-04	1.71E-03
	Uranium-234	3.07E-06	1.70E-14	7.44E-06	9.03E-12	8.13E-08	4.17E-06	6.63E-08	2.35E-09	0.00E+00	2.07E-05	3.62E-04	5.70E-04	9.68E-04
	Thorium-230	1.23E-05	4.13E-14	7.79E-04	5.28E-10	2.27E-06	3.48E-05	8.45E-07	2.09E-08	0.00E+00	1.04E-03	2.14E-04	4.76E-03	6.85E-03
	Radium-226	3.07E-06	7.91E-13	5.92E-04	2.64E-07	2.71E-06	7.03E-02	3.28E-06	3.93E-04	0.00E+00	1.58E-03	4.50E-03	1.03E-02	8.77E-02
	Lead-210	9.63E-07	1.25E-13	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.35E-03	3.96E-02	5.96E-02
	Polonium-210	2.89E-06	1.09E-15	2.35E-03	7.06E-12	7.28E-06	2.16E-07	7.90E-05	1.08E-08	0.00E+00	7.46E-02	7.83E-03	2.23E-01	3.08E-01
	Total by Pathway	2.48E-05	9.82E-13	5.06E-03	2.66E-07	2.73E-05	7.46E-02	1.28E-04	3.96E-04	0.00E+00	8.91E-02	1.66E-02	2.79E-01	**0.46**
Subsistence Harvester One-Year-Old (Lloyd Lake)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	9.99E-06	4.05E-04	5.67E-04	2.09E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	1.08E-05	4.39E-04	6.15E-04	1.08E-03
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	4.19E-04	1.75E-04	2.77E-03	3.86E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	1.19E-03	7.05E-03	1.67E-02	1.20E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	1.36E-01	4.20E-02	4.98E-01	**0.80**
	Application Case													
	Uranium-238	2.53E-06	9.06E-15	4.41E-06	1.19E-11	3.04E-06	1.11E-03	2.33E-06	7.96E-07	0.00E+00	1.04E-05	4.08E-04	5.68E-04	2.11E-03
	Uranium-234	2.96E-06	2.22E-14	4.78E-06	2.08E-12	3.29E-06	5.58E-06	2.53E-06	2.89E-09	0.00E+00	1.13E-05	4.42E-04	6.15E-04	1.09E-03
	Thorium-230	9.43E-06	5.37E-14	3.96E-04	1.31E-10	6.76E-05	3.95E-05	2.51E-05	2.71E-08	0.00E+00	4.50E-04	1.85E-04	2.88E-03	4.05E-03
	Radium-226	2.96E-06	1.03E-12	5.29E-04	6.54E-08	1.42E-04	9.41E-02	1.71E-04	5.12E-04	0.00E+00	1.20E-03	7.09E-03	1.67E-02	1.20E-01
	Lead-210	9.97E-07	1.62E-13	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.98E-03	8.28E-02	1.16E-01
	Polonium-210	2.96E-06	1.41E-15	4.49E-03	1.75E-12	8.14E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.63E-02	3.95E-01	5.56E-01
	Total by Pathway	2.18E-05	1.28E-12	7.22E-03	6.58E-08	2.22E-03	9.98E-02	1.26E-02	5.16E-04	0.00E+00	1.36E-01	4.24E-02	4.98E-01	**0.80**

Table C.16: Estimated Total Radiation Doses to Human Receptors – Operations – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Project Lifespan (mSv/yr)												
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
	Upper Bound Scenario													
	Uranium-238	2.53E-06	9.06E-15	4.74E-06	1.28E-11	3.04E-06	1.11E-03	2.48E-06	8.44E-07	0.00E+00	1.12E-05	4.08E-04	5.68E-04	2.11E-03
	Uranium-234	2.96E-06	2.22E-14	5.14E-06	2.24E-12	3.29E-06	5.58E-06	2.68E-06	3.06E-09	0.00E+00	1.21E-05	4.42E-04	6.16E-04	1.09E-03
	Thorium-230	9.43E-06	5.37E-14	3.97E-04	1.31E-10	6.76E-05	3.95E-05	2.51E-05	2.71E-08	0.00E+00	4.50E-04	1.85E-04	2.88E-03	4.05E-03
	Radium-226	2.96E-06	1.03E-12	5.29E-04	6.54E-08	1.42E-04	9.41E-02	1.71E-04	5.12E-04	0.00E+00	1.20E-03	7.09E-03	1.67E-02	1.20E-01
	Lead-210	9.97E-07	1.62E-13	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.98E-03	8.28E-02	1.16E-01
	Polonium-210	2.96E-06	1.41E-15	4.49E-03	1.75E-12	8.14E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.63E-02	3.95E-01	5.56E-01
	Total by Pathway	2.18E-05	1.28E-12	7.23E-03	6.58E-08	2.22E-03	9.98E-02	1.26E-02	5.16E-04	0.00E+00	1.36E-01	4.24E-02	4.98E-01	**0.80**
Seasonal Resident (Patterson Lake South Arm)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	5.36E-06	2.59E-04	3.62E-04	1.46E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	5.84E-06	2.82E-04	3.95E-04	6.94E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	3.07E-04	1.52E-04	2.32E-03	3.54E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	4.98E-04	3.51E-03	8.84E-03	8.40E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	3.74E-03	2.57E-03	2.70E-02	3.82E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	2.36E-02	6.05E-03	1.23E-01	1.56E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	2.82E-02	1.28E-02	1.62E-01	**0.28**
	Application Case													
	Uranium-238	7.82E-05	2.14E-13	1.09E-05	8.30E-11	8.65E-08	9.60E-04	9.07E-08	9.67E-07	0.00E+00	9.59E-06	3.04E-04	3.86E-04	1.75E-03
	Uranium-234	9.43E-05	5.25E-13	1.19E-05	1.45E-11	9.42E-08	4.84E-06	9.89E-08	3.51E-09	0.00E+00	1.05E-05	3.31E-04	4.20E-04	8.72E-04
	Thorium-230	3.77E-04	1.27E-12	1.32E-03	8.97E-10	2.33E-06	3.57E-05	1.40E-06	3.47E-08	0.00E+00	5.59E-04	3.66E-04	5.37E-03	8.04E-03
	Radium-226	9.43E-05	2.43E-11	6.35E-04	2.83E-07	2.80E-06	7.25E-02	3.47E-06	4.15E-04	0.00E+00	5.36E-04	4.01E-03	9.13E-03	8.73E-02
	Lead-210	2.97E-05	3.83E-12	1.34E-03	1.18E-09	1.50E-05	3.49E-03	4.49E-05	2.54E-06	0.00E+00	3.78E-03	3.55E-03	2.99E-02	4.22E-02
	Polonium-210	8.90E-05	3.34E-14	2.37E-03	7.12E-12	7.52E-06	2.23E-07	7.95E-05	1.09E-08	0.00E+00	2.38E-02	7.70E-03	1.27E-01	1.61E-01
	Total by Pathway	7.63E-04	3.02E-11	5.69E-03	2.85E-07	2.79E-05	7.69E-02	1.30E-04	4.19E-04	0.00E+00	2.87E-02	1.63E-02	1.72E-01	**0.30**
	Upper Bound Scenario													
	Uranium-238	7.82E-05	2.14E-13	1.94E-05	1.47E-10	8.65E-08	9.60E-04	1.54E-07	1.64E-06	0.00E+00	1.69E-05	3.04E-04	3.88E-04	1.77E-03
	Uranium-234	9.43E-05	5.25E-13	2.11E-05	2.57E-11	9.42E-08	4.84E-06	1.68E-07	5.95E-09	0.00E+00	1.85E-05	3.31E-04	4.23E-04	8.93E-04
	Thorium-230	3.77E-04	1.27E-12	1.33E-03	9.02E-10	2.33E-06	3.57E-05	1.41E-06	3.49E-08	0.00E+00	5.62E-04	3.66E-04	5.39E-03	8.07E-03
	Radium-226	9.43E-05	2.43E-11	6.37E-04	2.84E-07	2.80E-06	7.25E-02	3.47E-06	4.16E-04	0.00E+00	5.37E-04	4.01E-03	9.13E-03	8.73E-02
	Lead-210	2.97E-05	3.83E-12	1.39E-03	1.22E-09	1.50E-05	3.49E-03	4.62E-05	2.61E-06	0.00E+00	3.91E-03	3.55E-03	3.43E-02	4.67E-02
	Polonium-210	8.90E-05	3.34E-14	2.46E-03	7.38E-12	7.52E-06	2.23E-07	8.17E-05	1.12E-08	0.00E+00	2.47E-02	7.70E-03	1.30E-01	1.65E-01
	Total by Pathway	7.63E-04	3.02E-11	5.86E-03	2.87E-07	2.79E-05	7.69E-02	1.33E-04	4.21E-04	0.00E+00	2.98E-02	1.63E-02	1.79E-01	**0.31**

Table C.16: Estimated Total Radiation Doses to Human Receptors – Operations – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Project Lifespan (mSv/yr)												
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
Seasonal Resident One-Year-Old (Patterson Lake South Arm)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	3.16E-06	3.52E-04	4.97E-04	1.96E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	3.43E-06	3.82E-04	5.38E-04	9.40E-04
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	1.33E-04	1.52E-04	1.68E-03	2.46E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	3.78E-04	6.13E-03	1.65E-02	1.18E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	4.32E-03	6.84E-03	6.72E-02	8.95E-02
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	3.83E-02	2.26E-02	2.73E-01	3.49E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	4.32E-02	3.65E-02	3.60E-01	**0.56**
	Application Case													
	Uranium-238	7.79E-05	2.79E-13	7.60E-06	2.05E-11	3.52E-06	1.28E-03	3.69E-06	1.26E-06	0.00E+00	5.66E-06	4.13E-04	5.08E-04	2.30E-03
	Uranium-234	9.12E-05	6.82E-13	8.24E-06	3.59E-12	3.81E-06	6.48E-06	4.00E-06	4.56E-09	0.00E+00	6.14E-06	4.47E-04	5.50E-04	1.12E-03
	Thorium-230	2.90E-04	1.65E-12	6.73E-04	2.22E-10	6.94E-05	4.06E-05	4.17E-05	4.50E-08	0.00E+00	2.41E-04	2.70E-04	3.17E-03	4.80E-03
	Radium-226	9.12E-05	3.16E-11	5.67E-04	7.02E-08	1.46E-04	9.70E-02	1.81E-04	5.42E-04	0.00E+00	4.06E-04	6.80E-03	1.66E-02	1.22E-01
	Lead-210	3.07E-05	4.97E-12	1.82E-03	2.39E-10	1.20E-03	4.67E-03	3.58E-03	3.31E-06	0.00E+00	4.36E-03	8.67E-03	7.09E-02	9.52E-02
	Polonium-210	9.12E-05	4.35E-14	4.53E-03	1.76E-12	8.41E-04	2.91E-07	8.89E-03	1.42E-08	0.00E+00	3.87E-02	2.72E-02	2.77E-01	3.57E-01
	Total by Pathway	6.72E-04	3.93E-11	7.60E-03	7.06E-08	2.26E-03	1.03E-01	1.27E-02	5.46E-04	0.00E+00	4.37E-02	4.38E-02	3.69E-01	**0.58**
	Upper Bound Scenario													
	Uranium-238	7.79E-05	2.79E-13	1.35E-05	3.63E-11	3.52E-06	1.28E-03	6.24E-06	2.13E-06	0.00E+00	1.00E-05	4.13E-04	5.09E-04	2.32E-03
	Uranium-234	9.12E-05	6.82E-13	1.46E-05	6.36E-12	3.81E-06	6.48E-06	6.78E-06	7.74E-09	0.00E+00	1.09E-05	4.47E-04	5.51E-04	1.13E-03
	Thorium-230	2.90E-04	1.65E-12	6.77E-04	2.23E-10	6.94E-05	4.06E-05	4.20E-05	4.53E-08	0.00E+00	2.43E-04	2.70E-04	3.18E-03	4.81E-03
	Radium-226	9.12E-05	3.16E-11	5.69E-04	7.04E-08	1.46E-04	9.70E-02	1.82E-04	5.43E-04	0.00E+00	4.08E-04	6.80E-03	1.66E-02	1.22E-01
	Lead-210	3.07E-05	4.97E-12	1.89E-03	2.48E-10	1.20E-03	4.67E-03	3.67E-03	3.40E-06	0.00E+00	4.52E-03	8.67E-03	7.64E-02	1.01E-01
	Polonium-210	9.12E-05	4.35E-14	4.70E-03	1.83E-12	8.41E-04	2.91E-07	9.13E-03	1.46E-08	0.00E+00	4.01E-02	2.72E-02	2.80E-01	3.62E-01
	Total by Pathway	6.72E-04	3.93E-11	7.86E-03	7.09E-08	2.26E-03	1.03E-01	1.30E-02	5.49E-04	0.00E+00	4.53E-02	4.38E-02	3.77E-01	**0.59**
Seasonal Resident (Lloyd Lake)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	5.36E-06	2.59E-04	3.62E-04	1.46E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	5.84E-06	2.82E-04	3.95E-04	6.94E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	3.07E-04	1.52E-04	2.32E-03	3.54E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	4.98E-04	3.51E-03	8.84E-03	8.40E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	3.74E-03	2.57E-03	2.70E-02	3.82E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	2.36E-02	6.05E-03	1.23E-01	1.56E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	2.82E-02	1.28E-02	1.62E-01	**0.28**

Table C.16: Estimated Total Radiation Doses to Human Receptors – Operations – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Project Lifespan (mSv/yr)												
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
	Application Case													
	Uranium-238	1.52E-06	4.18E-15	6.24E-06	4.74E-11	7.45E-08	8.26E-04	5.66E-08	6.04E-07	0.00E+00	6.95E-06	2.60E-04	3.63E-04	1.46E-03
	Uranium-234	1.84E-06	1.02E-14	6.80E-06	8.25E-12	8.11E-08	4.16E-06	6.16E-08	2.19E-09	0.00E+00	7.57E-06	2.83E-04	3.95E-04	6.99E-04
	Thorium-230	7.36E-06	2.48E-14	7.57E-04	5.13E-10	2.27E-06	3.48E-05	8.22E-07	2.03E-08	0.00E+00	3.30E-04	1.57E-04	2.37E-03	3.66E-03
	Radium-226	1.84E-06	4.75E-13	5.90E-04	2.64E-07	2.71E-06	7.02E-02	3.27E-06	3.92E-04	0.00E+00	5.01E-04	3.52E-03	8.84E-03	8.41E-02
	Lead-210	5.78E-07	7.47E-14	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	4.50E-03	2.59E-03	2.70E-02	3.89E-02
	Polonium-210	1.73E-06	6.52E-16	2.35E-03	7.05E-12	7.28E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	2.41E-02	6.08E-03	1.23E-01	1.56E-01
	Total by Pathway	1.49E-05	5.89E-13	5.04E-03	2.65E-07	2.73E-05	7.46E-02	1.28E-04	3.95E-04	0.00E+00	2.95E-02	1.29E-02	1.62E-01	**0.28**
	Upper Bound Scenario													
	Uranium-238	1.52E-06	4.18E-15	6.53E-06	4.95E-11	7.45E-08	8.26E-04	5.87E-08	6.26E-07	0.00E+00	7.47E-06	2.60E-04	3.63E-04	1.47E-03
	Uranium-234	1.84E-06	1.02E-14	7.11E-06	8.63E-12	8.11E-08	4.16E-06	6.39E-08	2.27E-09	0.00E+00	8.14E-06	2.83E-04	3.95E-04	7.00E-04
	Thorium-230	7.36E-06	2.48E-14	7.57E-04	5.13E-10	2.27E-06	3.48E-05	8.22E-07	2.03E-08	0.00E+00	3.30E-04	1.57E-04	2.37E-03	3.66E-03
	Radium-226	1.84E-06	4.75E-13	5.91E-04	2.64E-07	2.71E-06	7.02E-02	3.27E-06	3.92E-04	0.00E+00	5.01E-04	3.52E-03	8.84E-03	8.41E-02
	Lead-210	5.78E-07	7.47E-14	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	4.50E-03	2.59E-03	2.70E-02	3.90E-02
	Polonium-210	1.73E-06	6.52E-16	2.35E-03	7.06E-12	7.28E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	2.42E-02	6.08E-03	1.23E-01	1.56E-01
	Total by Pathway	1.49E-05	5.89E-13	5.04E-03	2.65E-07	2.73E-05	7.46E-02	1.28E-04	3.95E-04	0.00E+00	2.95E-02	1.29E-02	1.62E-01	**0.28**
Seasonal Resident One-Year-Old (Lloyd Lake)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	3.16E-06	3.52E-04	4.97E-04	1.96E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	3.43E-06	3.82E-04	5.38E-04	9.40E-04
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	1.33E-04	1.52E-04	1.68E-03	2.46E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	3.78E-04	6.13E-03	1.65E-02	1.18E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	4.32E-03	6.84E-03	6.72E-02	8.95E-02
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	3.83E-02	2.26E-02	2.73E-01	3.49E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	4.32E-02	3.65E-02	3.60E-01	**0.56**
	Application Case													
	Uranium-238	1.52E-06	5.44E-15	4.34E-06	1.17E-11	3.03E-06	1.11E-03	2.30E-06	7.85E-07	0.00E+00	3.25E-06	3.54E-04	4.97E-04	1.97E-03
	Uranium-234	1.78E-06	1.33E-14	4.70E-06	2.04E-12	3.28E-06	5.57E-06	2.49E-06	2.85E-09	0.00E+00	3.52E-06	3.83E-04	5.39E-04	9.43E-04
	Thorium-230	5.66E-06	3.22E-14	3.85E-04	1.27E-10	6.76E-05	3.95E-05	2.45E-05	2.64E-08	0.00E+00	1.39E-04	1.54E-04	1.70E-03	2.52E-03
	Radium-226	1.78E-06	6.17E-13	5.28E-04	6.53E-08	1.42E-04	9.40E-02	1.71E-04	5.11E-04	0.00E+00	3.79E-04	6.14E-03	1.65E-02	1.18E-01
	Lead-210	5.98E-07	9.70E-14	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	4.32E-03	6.87E-03	6.72E-02	8.96E-02
	Polonium-210	1.78E-06	8.48E-16	4.49E-03	1.75E-12	8.14E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	3.83E-02	2.27E-02	2.74E-01	3.49E-01
	Total by Pathway	1.31E-05	7.66E-13	7.21E-03	6.56E-08	2.22E-03	9.98E-02	1.26E-02	5.15E-04	0.00E+00	4.32E-02	3.66E-02	3.60E-01	**0.56**

Table C.16: Estimated Total Radiation Doses to Human Receptors – Operations – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Project Lifespan (mSv/yr)												
	Radionuclide	**Air (Internal)**	**Air (External)**	**Water (Internal)**	**Water (External)**	**Soil (Internal)**	**Soil (External)**	**Sediment (Internal)**	**Sediment (External)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial animals**	**Total by Radionuclide**
	Upper Bound Scenario													
	Uranium-238	1.52E-06	5.44E-15	4.54E-06	1.22E-11	3.03E-06	1.11E-03	2.39E-06	8.14E-07	0.00E+00	3.40E-06	3.54E-04	4.97E-04	1.97E-03
	Uranium-234	1.78E-06	1.33E-14	4.92E-06	2.14E-12	3.28E-06	5.57E-06	2.59E-06	2.95E-09	0.00E+00	3.68E-06	3.83E-04	5.39E-04	9.44E-04
	Thorium-230	5.66E-06	3.22E-14	3.85E-04	1.27E-10	6.76E-05	3.95E-05	2.45E-05	2.64E-08	0.00E+00	1.39E-04	1.54E-04	1.70E-03	2.52E-03
	Radium-226	1.78E-06	6.17E-13	5.28E-04	6.53E-08	1.42E-04	9.40E-02	1.71E-04	5.11E-04	0.00E+00	3.79E-04	6.14E-03	1.65E-02	1.18E-01
	Lead-210	5.98E-07	9.70E-14	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	4.32E-03	6.87E-03	6.72E-02	8.96E-02
	Polonium-210	1.78E-06	8.48E-16	4.49E-03	1.75E-12	8.14E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	3.84E-02	2.27E-02	2.74E-01	3.49E-01
	Total by Pathway	1.31E-05	7.66E-13	7.21E-03	6.56E-08	2.22E-03	9.98E-02	1.26E-02	5.15E-04	0.00E+00	4.32E-02	3.66E-02	3.60E-01	**0.56**
Permanent Resident (Patterson Lake North Arm - West Basin)	**Base Case**													
	Uranium-238	-	-	-	-	-	-	-	-	-	-	-	-	-
	Uranium-234	-	-	-	-	-	-	-	-	-	-	-	-	-
	Thorium-230	-	-	-	-	-	-	-	-	-	-	-	-	-
	Radium-226	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Polonium-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total by Pathway	-	-	-	-	-	-	-	-	-	-	-	-	-
	Application Case													
	Uranium-238	-	-	-	-	-	-	-	-	-	-	-	-	-
	Uranium-234	-	-	-	-	-	-	-	-	-	-	-	-	-
	Thorium-230	-	-	-	-	-	-	-	-	-	-	-	-	-
	Radium-226	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Polonium-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total by Pathway	-	-	-	-	-	-	-	-	-	-	-	-	-
	Upper Bound Scenario													
	Uranium-238	-	-	-	-	-	-	-	-	-	-	-	-	-
	Uranium-234	-	-	-	-	-	-	-	-	-	-	-	-	-
	Thorium-230	-	-	-	-	-	-	-	-	-	-	-	-	-
	Radium-226	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Polonium-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total by Pathway	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C.16: Estimated Total Radiation Doses to Human Receptors – Operations – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Project Lifespan (mSv/yr)												
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
Permanent Resident One-Year-Old (Patterson Lake North Arm - West Basin)	Base Case													
	Uranium-238	-	-	-	-	-	-	-	-	-	-	-	-	-
	Uranium-234	-	-	-	-	-	-	-	-	-	-	-	-	-
	Thorium-230	-	-	-	-	-	-	-	-	-	-	-	-	-
	Radium-226	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Polonium-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total by Pathway	-	-	-	-	-	-	-	-	-	-	-	-	-
	Application Case													
	Uranium-238	-	-	-	-	-	-	-	-	-	-	-	-	-
	Uranium-234	-	-	-	-	-	-	-	-	-	-	-	-	-
	Thorium-230	-	-	-	-	-	-	-	-	-	-	-	-	-
	Radium-226	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Polonium-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total by Pathway	-	-	-	-	-	-	-	-	-	-	-	-	-
	Upper Bound Scenario													
	Uranium-238	-	-	-	-	-	-	-	-	-	-	-	-	-
	Uranium-234	-	-	-	-	-	-	-	-	-	-	-	-	-
	Thorium-230	-	-	-	-	-	-	-	-	-	-	-	-	-
	Radium-226	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Polonium-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total by Pathway	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C.17: Estimated Total Radiation Doses to Human Receptors – Far-Future – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Far-Future (mSv/yr)												
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
Camp Worker (Patterson Lake North Arm - West Basin)	Base Case													
	Uranium-238	-	-	-	-	-	-	-	-	-	-	-	-	-
	Uranium-234	-	-	-	-	-	-	-	-	-	-	-	-	-
	Thorium-230	-	-	-	-	-	-	-	-	-	-	-	-	-
	Radium-226	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Polonium-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total by Pathway	-	-	-	-	-	-	-	-	-	-	-	-	-
	Application Case													
	Uranium-238	-	-	-	-	-	-	-	-	-	-	-	-	-
	Uranium-234	-	-	-	-	-	-	-	-	-	-	-	-	-
	Thorium-230	-	-	-	-	-	-	-	-	-	-	-	-	-
	Radium-226	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Polonium-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total by Pathway	-	-	-	-	-	-	-	-	-	-	-	-	-
	Upper Bound Scenario													
	Uranium-238	-	-	-	-	-	-	-	-	-	-	-	-	-
	Uranium-234	-	-	-	-	-	-	-	-	-	-	-	-	-
	Thorium-230	-	-	-	-	-	-	-	-	-	-	-	-	-
	Radium-226	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Polonium-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total by Pathway	-	-	-	-	-	-	-	-	-	-	-	-	-
Subsistence Harvester (Patterson Lake South Arm)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	1.69E-05	3.30E-04	5.22E-04	1.70E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	1.84E-05	3.60E-04	5.68E-04	9.57E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	9.70E-04	1.94E-04	4.54E-03	6.47E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	1.57E-03	4.47E-03	1.03E-02	8.76E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.07E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	8.90E-02	1.63E-02	2.78E-01	**0.46**

Table C.17: Estimated Total Radiation Doses to Human Receptors – Far-Future – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Far-Future (mSv/yr)												
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
	Application Case													
	Uranium-238	0.00E+00	0.00E+00	3.25E-05	2.46E-10	7.64E-08	8.47E-04	2.96E-07	3.16E-06	0.00E+00	9.04E-05	3.40E-04	5.56E-04	1.87E-03
	Uranium-234	0.00E+00	0.00E+00	3.55E-05	4.31E-11	8.32E-08	4.27E-06	3.23E-07	1.15E-08	0.00E+00	9.88E-05	3.70E-04	6.06E-04	1.12E-03
	Thorium-230	0.00E+00	0.00E+00	7.40E-04	5.01E-10	2.33E-06	3.57E-05	8.05E-07	1.99E-08	0.00E+00	9.90E-04	2.00E-04	4.73E-03	6.70E-03
	Radium-226	0.00E+00	0.00E+00	6.20E-04	2.77E-07	2.81E-06	7.27E-02	3.43E-06	4.12E-04	0.00E+00	1.66E-03	4.63E-03	1.07E-02	9.08E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.47E-05	2.53E-06	0.00E+00	1.18E-02	3.28E-03	4.00E-02	5.99E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.06E-12	7.27E-06	2.16E-07	7.90E-05	1.08E-08	0.00E+00	7.47E-02	7.71E-03	2.23E-01	3.08E-01
	Total by Pathway	0.00E+00	0.00E+00	5.11E-03	2.79E-07	2.75E-05	7.71E-02	1.29E-04	4.17E-04	0.00E+00	8.94E-02	1.65E-02	2.80E-01	**0.47**
	Upper Bound Scenario													
	Uranium-238	0.00E+00	0.00E+00	3.25E-05	2.47E-10	7.64E-08	8.47E-04	2.96E-07	3.16E-06	0.00E+00	9.05E-05	3.40E-04	5.56E-04	1.87E-03
	Uranium-234	0.00E+00	0.00E+00	3.55E-05	4.31E-11	8.32E-08	4.27E-06	3.24E-07	1.15E-08	0.00E+00	9.88E-05	3.70E-04	6.06E-04	1.12E-03
	Thorium-230	0.00E+00	0.00E+00	7.40E-04	5.01E-10	2.33E-06	3.57E-05	8.05E-07	1.99E-08	0.00E+00	9.90E-04	2.00E-04	4.73E-03	6.70E-03
	Radium-226	0.00E+00	0.00E+00	6.20E-04	2.77E-07	2.81E-06	7.27E-02	3.44E-06	4.12E-04	0.00E+00	1.66E-03	4.63E-03	1.07E-02	9.08E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.47E-05	2.53E-06	0.00E+00	1.18E-02	3.28E-03	4.00E-02	5.99E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.06E-12	7.27E-06	2.16E-07	7.90E-05	1.08E-08	0.00E+00	7.47E-02	7.71E-03	2.23E-01	3.08E-01
	Total by Pathway	0.00E+00	0.00E+00	5.11E-03	2.79E-07	2.75E-05	7.71E-02	1.29E-04	4.17E-04	0.00E+00	8.94E-02	1.65E-02	2.80E-01	**0.47**
Subsistence Harvester One-Year-Old (Patterson Lake South Arm)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	9.99E-06	4.05E-04	5.67E-04	2.09E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	1.08E-05	4.39E-04	6.15E-04	1.08E-03
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	4.19E-04	1.75E-04	2.77E-03	3.86E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	1.19E-03	7.05E-03	1.67E-02	1.20E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	1.36E-01	4.20E-02	4.98E-01	**0.80**
	Application Case													
	Uranium-238	0.00E+00	0.00E+00	2.26E-05	6.09E-11	3.11E-06	1.13E-03	1.20E-05	4.11E-06	0.00E+00	5.33E-05	4.17E-04	5.83E-04	2.23E-03
	Uranium-234	0.00E+00	0.00E+00	2.45E-05	1.07E-11	3.37E-06	5.72E-06	1.31E-05	1.49E-08	0.00E+00	5.80E-05	4.52E-04	6.32E-04	1.19E-03
	Thorium-230	0.00E+00	0.00E+00	3.76E-04	1.24E-10	6.93E-05	4.06E-05	2.40E-05	2.59E-08	0.00E+00	4.28E-04	1.79E-04	2.86E-03	3.98E-03
	Radium-226	0.00E+00	0.00E+00	5.54E-04	6.85E-08	1.47E-04	9.73E-02	1.80E-04	5.37E-04	0.00E+00	1.26E-03	7.31E-03	1.69E-02	1.24E-01
	Lead-210	0.00E+00	0.00E+00	1.81E-03	2.38E-10	1.19E-03	4.63E-03	3.55E-03	3.29E-06	0.00E+00	1.37E-02	7.86E-03	8.33E-02	1.16E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.84E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.95E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.28E-03	6.89E-08	2.22E-03	1.03E-01	1.26E-02	5.44E-04	0.00E+00	1.37E-01	4.22E-02	4.99E-01	**0.80**

Table C.17: Estimated Total Radiation Doses to Human Receptors – Far-Future – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Far-Future (mSv/yr)												
	Radionuclide	**Air (Internal)**	**Air (External)**	**Water (Internal)**	**Water (External)**	**Soil (Internal)**	**Soil (External)**	**Sediment (Internal)**	**Sediment (External)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial animals**	**Total by Radionuclide**
	Upper Bound Scenario													
	Uranium-238	0.00E+00	0.00E+00	2.26E-05	6.09E-11	3.11E-06	1.13E-03	1.20E-05	4.11E-06	0.00E+00	5.34E-05	4.17E-04	5.83E-04	2.23E-03
	Uranium-234	0.00E+00	0.00E+00	2.45E-05	1.07E-11	3.37E-06	5.72E-06	1.31E-05	1.49E-08	0.00E+00	5.80E-05	4.52E-04	6.32E-04	1.19E-03
	Thorium-230	0.00E+00	0.00E+00	3.76E-04	1.24E-10	6.93E-05	4.06E-05	2.40E-05	2.59E-08	0.00E+00	4.28E-04	1.79E-04	2.86E-03	3.98E-03
	Radium-226	0.00E+00	0.00E+00	5.54E-04	6.85E-08	1.47E-04	9.73E-02	1.80E-04	5.37E-04	0.00E+00	1.26E-03	7.31E-03	1.69E-02	1.24E-01
	Lead-210	0.00E+00	0.00E+00	1.81E-03	2.38E-10	1.19E-03	4.63E-03	3.55E-03	3.29E-06	0.00E+00	1.37E-02	7.86E-03	8.33E-02	1.16E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.84E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.95E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.28E-03	6.90E-08	2.22E-03	1.03E-01	1.26E-02	5.45E-04	0.00E+00	1.37E-01	4.22E-02	4.99E-01	**0.80**
Subsistence Harvester (Beet Lake)	**Base Case**													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	1.69E-05	3.30E-04	5.22E-04	1.70E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	1.84E-05	3.60E-04	5.68E-04	9.57E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	9.70E-04	1.94E-04	4.54E-03	6.47E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	1.57E-03	4.47E-03	1.03E-02	8.76E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.07E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	8.90E-02	1.63E-02	2.78E-01	**0.46**
	Application Case													
	Uranium-238	0.00E+00	0.00E+00	1.59E-05	1.21E-10	7.55E-08	8.37E-04	1.45E-07	1.55E-06	0.00E+00	4.42E-05	3.36E-04	5.34E-04	1.77E-03
	Uranium-234	0.00E+00	0.00E+00	1.73E-05	2.11E-11	8.22E-08	4.22E-06	1.58E-07	5.62E-09	0.00E+00	4.83E-05	3.66E-04	5.81E-04	1.02E-03
	Thorium-230	0.00E+00	0.00E+00	7.33E-04	4.97E-10	2.30E-06	3.53E-05	7.97E-07	1.97E-08	0.00E+00	9.81E-04	1.97E-04	4.59E-03	6.54E-03
	Radium-226	0.00E+00	0.00E+00	6.02E-04	2.69E-07	2.77E-06	7.17E-02	3.34E-06	4.00E-04	0.00E+00	1.61E-03	4.56E-03	1.04E-02	8.93E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.08E-01
	Total by Pathway	0.00E+00	0.00E+00	5.04E-03	2.71E-07	2.74E-05	7.60E-02	1.28E-04	4.04E-04	0.00E+00	8.91E-02	1.65E-02	2.78E-01	**0.47**
	Upper Bound Scenario													
	Uranium-238	0.00E+00	0.00E+00	1.59E-05	1.21E-10	7.55E-08	8.37E-04	1.45E-07	1.55E-06	0.00E+00	4.43E-05	3.36E-04	5.34E-04	1.77E-03
	Uranium-234	0.00E+00	0.00E+00	1.74E-05	2.11E-11	8.22E-08	4.22E-06	1.58E-07	5.62E-09	0.00E+00	4.83E-05	3.66E-04	5.81E-04	1.02E-03
	Thorium-230	0.00E+00	0.00E+00	7.33E-04	4.97E-10	2.30E-06	3.53E-05	7.97E-07	1.97E-08	0.00E+00	9.81E-04	1.97E-04	4.59E-03	6.54E-03
	Radium-226	0.00E+00	0.00E+00	6.02E-04	2.69E-07	2.77E-06	7.17E-02	3.34E-06	4.00E-04	0.00E+00	1.61E-03	4.56E-03	1.04E-02	8.93E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.08E-01
	Total by Pathway	0.00E+00	0.00E+00	5.04E-03	2.71E-07	2.74E-05	7.60E-02	1.28E-04	4.04E-04	0.00E+00	8.91E-02	1.65E-02	2.78E-01	**0.47**

Table C.17: Estimated Total Radiation Doses to Human Receptors – Far-Future – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Far-Future (mSv/yr)												
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
Subsistence Harvester One-Year-Old (Beet Lake)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	9.99E-06	4.05E-04	5.67E-04	2.09E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	1.08E-05	4.39E-04	6.15E-04	1.08E-03
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	4.19E-04	1.75E-04	2.77E-03	3.86E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	1.19E-03	7.05E-03	1.67E-02	1.20E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	1.36E-01	4.20E-02	4.98E-01	**0.80**
	Application Case													
	Uranium-238	0.00E+00	0.00E+00	1.10E-05	2.98E-11	3.07E-06	1.12E-03	5.89E-06	2.01E-06	0.00E+00	2.61E-05	4.12E-04	5.73E-04	2.15E-03
	Uranium-234	0.00E+00	0.00E+00	1.20E-05	5.21E-12	3.33E-06	5.65E-06	6.40E-06	7.30E-09	0.00E+00	2.83E-05	4.47E-04	6.20E-04	1.12E-03
	Thorium-230	0.00E+00	0.00E+00	3.73E-04	1.23E-10	6.86E-05	4.01E-05	2.37E-05	2.56E-08	0.00E+00	4.24E-04	1.77E-04	2.79E-03	3.90E-03
	Radium-226	0.00E+00	0.00E+00	5.38E-04	6.65E-08	1.45E-04	9.59E-02	1.74E-04	5.22E-04	0.00E+00	1.22E-03	7.20E-03	1.68E-02	1.23E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.23E-03	6.69E-08	2.22E-03	1.02E-01	1.26E-02	5.27E-04	0.00E+00	1.36E-01	4.21E-02	4.98E-01	**0.80**
	Upper Bound Scenario													
	Uranium-238	0.00E+00	0.00E+00	1.10E-05	2.98E-11	3.07E-06	1.12E-03	5.89E-06	2.01E-06	0.00E+00	2.61E-05	4.12E-04	5.73E-04	2.15E-03
	Uranium-234	0.00E+00	0.00E+00	1.20E-05	5.22E-12	3.33E-06	5.65E-06	6.40E-06	7.31E-09	0.00E+00	2.84E-05	4.47E-04	6.20E-04	1.12E-03
	Thorium-230	0.00E+00	0.00E+00	3.73E-04	1.23E-10	6.86E-05	4.01E-05	2.37E-05	2.56E-08	0.00E+00	4.24E-04	1.77E-04	2.79E-03	3.90E-03
	Radium-226	0.00E+00	0.00E+00	5.38E-04	6.65E-08	1.45E-04	9.59E-02	1.74E-04	5.22E-04	0.00E+00	1.22E-03	7.20E-03	1.68E-02	1.23E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.23E-03	6.69E-08	2.22E-03	1.02E-01	1.26E-02	5.27E-04	0.00E+00	1.36E-01	4.21E-02	4.98E-01	**0.80**
Subsistence Harvester (Lloyd Lake)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	1.69E-05	3.30E-04	5.22E-04	1.70E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	1.84E-05	3.60E-04	5.68E-04	9.57E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	9.70E-04	1.94E-04	4.54E-03	6.47E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	1.57E-03	4.47E-03	1.03E-02	8.76E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.07E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	8.90E-02	1.63E-02	2.78E-01	**0.46**

Table C.17: Estimated Total Radiation Doses to Human Receptors – Far-Future – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Far-Future (mSv/yr)												
	Radionuclide	**Air (Internal)**	**Air (External)**	**Water (Internal)**	**Water (External)**	**Soil (Internal)**	**Soil (External)**	**Sediment (Internal)**	**Sediment (External)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial animals**	**Total by Radionuclide**
	Application Case													
	Uranium-238	0.00E+00	0.00E+00	6.97E-06	5.29E-11	7.43E-08	8.24E-04	6.35E-08	6.78E-07	0.00E+00	1.94E-05	3.31E-04	5.22E-04	1.70E-03
	Uranium-234	0.00E+00	0.00E+00	7.59E-06	9.22E-12	8.09E-08	4.15E-06	6.92E-08	2.46E-09	0.00E+00	2.11E-05	3.60E-04	5.69E-04	9.62E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.92E-10	2.27E-06	3.48E-05	7.89E-07	1.95E-08	0.00E+00	9.71E-04	1.95E-04	4.54E-03	6.47E-03
	Radium-226	0.00E+00	0.00E+00	5.90E-04	2.63E-07	2.71E-06	7.03E-02	3.27E-06	3.92E-04	0.00E+00	1.57E-03	4.47E-03	1.03E-02	8.76E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.07E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.65E-07	2.73E-05	7.46E-02	1.28E-04	3.95E-04	0.00E+00	8.90E-02	1.63E-02	2.78E-01	**0.46**
	Upper Bound Scenario													
	Uranium-238	0.00E+00	0.00E+00	6.97E-06	5.29E-11	7.43E-08	8.24E-04	6.35E-08	6.78E-07	0.00E+00	1.94E-05	3.31E-04	5.22E-04	1.70E-03
	Uranium-234	0.00E+00	0.00E+00	7.59E-06	9.22E-12	8.09E-08	4.15E-06	6.92E-08	2.46E-09	0.00E+00	2.11E-05	3.60E-04	5.69E-04	9.62E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.92E-10	2.27E-06	3.48E-05	7.89E-07	1.95E-08	0.00E+00	9.71E-04	1.95E-04	4.54E-03	6.47E-03
	Radium-226	0.00E+00	0.00E+00	5.90E-04	2.63E-07	2.71E-06	7.03E-02	3.27E-06	3.92E-04	0.00E+00	1.57E-03	4.47E-03	1.03E-02	8.76E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.07E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.65E-07	2.73E-05	7.46E-02	1.28E-04	3.95E-04	0.00E+00	8.90E-02	1.63E-02	2.78E-01	**0.46**
Subsistence Harvester One-Year-Old (Lloyd Lake)	**Base Case**													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	9.99E-06	4.05E-04	5.67E-04	2.09E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	1.08E-05	4.39E-04	6.15E-04	1.08E-03
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	4.19E-04	1.75E-04	2.77E-03	3.86E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	1.19E-03	7.05E-03	1.67E-02	1.20E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	1.36E-01	4.20E-02	4.98E-01	**0.80**
	Application Case													
	Uranium-238	0.00E+00	0.00E+00	4.84E-06	1.31E-11	3.02E-06	1.10E-03	2.58E-06	8.81E-07	0.00E+00	1.14E-05	4.06E-04	5.68E-04	2.10E-03
	Uranium-234	0.00E+00	0.00E+00	5.25E-06	2.28E-12	3.27E-06	5.56E-06	2.80E-06	3.20E-09	0.00E+00	1.24E-05	4.39E-04	6.15E-04	1.08E-03
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.76E-05	3.95E-05	2.35E-05	2.54E-08	0.00E+00	4.19E-04	1.75E-04	2.77E-03	3.87E-03
	Radium-226	0.00E+00	0.00E+00	5.27E-04	6.52E-08	1.42E-04	9.40E-02	1.71E-04	5.11E-04	0.00E+00	1.19E-03	7.06E-03	1.67E-02	1.20E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.20E-03	6.56E-08	2.22E-03	9.98E-02	1.26E-02	5.15E-04	0.00E+00	1.36E-01	4.20E-02	4.98E-01	**0.80**

Table C.17: Estimated Total Radiation Doses to Human Receptors – Far-Future – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Far-Future (mSv/yr)												
	Radionuclide	**Air (Internal)**	**Air (External)**	**Water (Internal)**	**Water (External)**	**Soil (Internal)**	**Soil (External)**	**Sediment (Internal)**	**Sediment (External)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial animals**	**Total by Radionuclide**
	Upper Bound Scenario													
	Uranium-238	0.00E+00	0.00E+00	4.84E-06	1.31E-11	3.02E-06	1.10E-03	2.58E-06	8.81E-07	0.00E+00	1.14E-05	4.06E-04	5.68E-04	2.10E-03
	Uranium-234	0.00E+00	0.00E+00	5.25E-06	2.28E-12	3.27E-06	5.56E-06	2.80E-06	3.20E-09	0.00E+00	1.24E-05	4.39E-04	6.15E-04	1.08E-03
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.76E-05	3.95E-05	2.35E-05	2.54E-08	0.00E+00	4.19E-04	1.75E-04	2.77E-03	3.87E-03
	Radium-226	0.00E+00	0.00E+00	5.27E-04	6.52E-08	1.42E-04	9.40E-02	1.71E-04	5.11E-04	0.00E+00	1.19E-03	7.06E-03	1.67E-02	1.20E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.20E-03	6.56E-08	2.22E-03	9.98E-02	1.26E-02	5.15E-04	0.00E+00	1.36E-01	4.20E-02	4.98E-01	**0.80**
Seasonal Resident (Patterson Lake South Arm)	**Base Case**													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	5.36E-06	2.59E-04	3.62E-04	1.46E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	5.84E-06	2.82E-04	3.95E-04	6.94E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	3.07E-04	1.52E-04	2.32E-03	3.54E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	4.98E-04	3.51E-03	8.84E-03	8.40E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	3.74E-03	2.57E-03	2.70E-02	3.82E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	2.36E-02	6.05E-03	1.23E-01	1.55E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	2.82E-02	1.28E-02	1.62E-01	**0.28**
	Application Case													
	Uranium-238	0.00E+00	0.00E+00	2.19E-05	1.66E-10	7.55E-08	8.38E-04	2.00E-07	2.13E-06	0.00E+00	1.93E-05	2.64E-04	3.71E-04	1.52E-03
	Uranium-234	0.00E+00	0.00E+00	2.39E-05	2.91E-11	8.23E-08	4.22E-06	2.18E-07	7.75E-09	0.00E+00	2.11E-05	2.87E-04	4.04E-04	7.40E-04
	Thorium-230	0.00E+00	0.00E+00	7.34E-04	4.97E-10	2.30E-06	3.53E-05	7.99E-07	1.97E-08	0.00E+00	3.11E-04	1.55E-04	2.36E-03	3.60E-03
	Radium-226	0.00E+00	0.00E+00	6.07E-04	2.71E-07	2.77E-06	7.17E-02	3.37E-06	4.03E-04	0.00E+00	5.14E-04	3.58E-03	8.91E-03	8.57E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.53E-06	0.00E+00	3.75E-03	2.57E-03	2.71E-02	3.83E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.06E-12	7.27E-06	2.16E-07	7.90E-05	1.08E-08	0.00E+00	2.37E-02	6.05E-03	1.23E-01	1.56E-01
	Total by Pathway	0.00E+00	0.00E+00	5.06E-03	2.73E-07	2.74E-05	7.61E-02	1.28E-04	4.08E-04	0.00E+00	2.83E-02	1.29E-02	1.63E-01	**0.29**
	Upper Bound Scenario													
	Uranium-238	0.00E+00	0.00E+00	2.19E-05	1.66E-10	7.55E-08	8.38E-04	2.00E-07	2.13E-06	0.00E+00	1.93E-05	2.64E-04	3.71E-04	1.52E-03
	Uranium-234	0.00E+00	0.00E+00	2.39E-05	2.91E-11	8.23E-08	4.22E-06	2.18E-07	7.75E-09	0.00E+00	2.11E-05	2.87E-04	4.04E-04	7.40E-04
	Thorium-230	0.00E+00	0.00E+00	7.34E-04	4.97E-10	2.30E-06	3.53E-05	7.99E-07	1.97E-08	0.00E+00	3.11E-04	1.55E-04	2.36E-03	3.60E-03
	Radium-226	0.00E+00	0.00E+00	6.07E-04	2.71E-07	2.77E-06	7.17E-02	3.37E-06	4.03E-04	0.00E+00	5.14E-04	3.58E-03	8.91E-03	8.57E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.53E-06	0.00E+00	3.75E-03	2.57E-03	2.71E-02	3.83E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.06E-12	7.27E-06	2.16E-07	7.90E-05	1.08E-08	0.00E+00	2.37E-02	6.05E-03	1.23E-01	1.56E-01
	Total by Pathway	0.00E+00	0.00E+00	5.06E-03	2.73E-07	2.74E-05	7.61E-02	1.28E-04	4.08E-04	0.00E+00	2.83E-02	1.29E-02	1.63E-01	**0.29**

Table C.17: Estimated Total Radiation Doses to Human Receptors – Far-Future – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Far-Future (mSv/yr)												
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
Seasonal Resident One-Year-Old (Patterson Lake South Arm)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	3.16E-06	3.52E-04	4.97E-04	1.96E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	3.43E-06	3.82E-04	5.38E-04	9.40E-04
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	1.33E-04	1.52E-04	1.68E-03	2.46E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	3.78E-04	6.13E-03	1.65E-02	1.18E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	4.32E-03	6.84E-03	6.72E-02	8.95E-02
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	3.83E-02	2.26E-02	2.73E-01	3.49E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	4.32E-02	3.65E-02	3.60E-01	**0.56**
	Application Case													
	Uranium-238	0.00E+00	0.00E+00	1.52E-05	4.11E-11	3.07E-06	1.12E-03	8.12E-06	2.77E-06	0.00E+00	1.14E-05	3.59E-04	5.01E-04	2.02E-03
	Uranium-234	0.00E+00	0.00E+00	1.65E-05	7.19E-12	3.33E-06	5.65E-06	8.83E-06	1.01E-08	0.00E+00	1.24E-05	3.88E-04	5.43E-04	9.78E-04
	Thorium-230	0.00E+00	0.00E+00	3.73E-04	1.23E-10	6.86E-05	4.01E-05	2.38E-05	2.57E-08	0.00E+00	1.34E-04	1.54E-04	1.70E-03	2.49E-03
	Radium-226	0.00E+00	0.00E+00	5.43E-04	6.71E-08	1.45E-04	9.60E-02	1.76E-04	5.26E-04	0.00E+00	3.90E-04	6.26E-03	1.65E-02	1.21E-01
	Lead-210	0.00E+00	0.00E+00	1.81E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	4.32E-03	6.84E-03	6.73E-02	8.96E-02
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	3.84E-02	2.26E-02	2.74E-01	3.49E-01
	Total by Pathway	0.00E+00	0.00E+00	7.24E-03	6.75E-08	2.22E-03	1.02E-01	1.26E-02	5.32E-04	0.00E+00	4.32E-02	3.66E-02	3.60E-01	**0.56**
	Upper Bound Scenario													
	Uranium-238	0.00E+00	0.00E+00	1.52E-05	4.11E-11	3.07E-06	1.12E-03	8.13E-06	2.77E-06	0.00E+00	1.14E-05	3.59E-04	5.01E-04	2.02E-03
	Uranium-234	0.00E+00	0.00E+00	1.66E-05	7.20E-12	3.33E-06	5.65E-06	8.83E-06	1.01E-08	0.00E+00	1.24E-05	3.88E-04	5.43E-04	9.78E-04
	Thorium-230	0.00E+00	0.00E+00	3.73E-04	1.23E-10	6.86E-05	4.01E-05	2.38E-05	2.57E-08	0.00E+00	1.34E-04	1.54E-04	1.70E-03	2.49E-03
	Radium-226	0.00E+00	0.00E+00	5.43E-04	6.71E-08	1.45E-04	9.60E-02	1.76E-04	5.26E-04	0.00E+00	3.90E-04	6.26E-03	1.65E-02	1.21E-01
	Lead-210	0.00E+00	0.00E+00	1.81E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	4.32E-03	6.84E-03	6.73E-02	8.96E-02
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	3.84E-02	2.26E-02	2.74E-01	3.49E-01
	Total by Pathway	0.00E+00	0.00E+00	7.24E-03	6.75E-08	2.22E-03	1.02E-01	1.26E-02	5.32E-04	0.00E+00	4.32E-02	3.66E-02	3.60E-01	**0.56**
Seasonal Resident (Lloyd Lake)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	5.36E-06	2.59E-04	3.62E-04	1.46E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	5.84E-06	2.82E-04	3.95E-04	6.94E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	3.07E-04	1.52E-04	2.32E-03	3.54E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	4.98E-04	3.51E-03	8.84E-03	8.40E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	3.74E-03	2.57E-03	2.70E-02	3.82E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	2.36E-02	6.05E-03	1.23E-01	1.55E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	2.82E-02	1.28E-02	1.62E-01	**0.28**

Table C.17: Estimated Total Radiation Doses to Human Receptors – Far-Future – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Far-Future (mSv/yr)												
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
	Application Case													
	Uranium-238	0.00E+00	0.00E+00	6.61E-06	5.02E-11	7.43E-08	8.24E-04	6.03E-08	6.43E-07	0.00E+00	7.63E-06	2.59E-04	3.63E-04	1.46E-03
	Uranium-234	0.00E+00	0.00E+00	7.20E-06	8.74E-12	8.09E-08	4.15E-06	6.57E-08	2.33E-09	0.00E+00	8.31E-06	2.82E-04	3.95E-04	6.97E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.48E-05	7.89E-07	1.95E-08	0.00E+00	3.08E-04	1.53E-04	2.32E-03	3.54E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.27E-06	3.91E-04	0.00E+00	5.00E-04	3.51E-03	8.84E-03	8.41E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	4.50E-03	2.57E-03	2.70E-02	3.89E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	2.41E-02	6.05E-03	1.23E-01	1.56E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.65E-07	2.73E-05	7.46E-02	1.28E-04	3.95E-04	0.00E+00	2.95E-02	1.28E-02	1.62E-01	**0.28**
	Upper Bound Scenario													
	Uranium-238	0.00E+00	0.00E+00	6.61E-06	5.02E-11	7.43E-08	8.24E-04	6.03E-08	6.43E-07	0.00E+00	7.63E-06	2.59E-04	3.63E-04	1.46E-03
	Uranium-234	0.00E+00	0.00E+00	7.20E-06	8.75E-12	8.09E-08	4.15E-06	6.57E-08	2.33E-09	0.00E+00	8.31E-06	2.82E-04	3.95E-04	6.97E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.48E-05	7.89E-07	1.95E-08	0.00E+00	3.08E-04	1.53E-04	2.32E-03	3.54E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.27E-06	3.91E-04	0.00E+00	5.00E-04	3.51E-03	8.84E-03	8.41E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	4.50E-03	2.57E-03	2.70E-02	3.89E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	2.41E-02	6.05E-03	1.23E-01	1.56E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.65E-07	2.73E-05	7.46E-02	1.28E-04	3.95E-04	0.00E+00	2.95E-02	1.28E-02	1.62E-01	**0.28**
Seasonal Resident One-Year-Old (Lloyd Lake)	**Base Case**													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	3.16E-06	3.52E-04	4.97E-04	1.96E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	3.43E-06	3.82E-04	5.38E-04	9.40E-04
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	1.33E-04	1.52E-04	1.68E-03	2.46E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	3.78E-04	6.13E-03	1.65E-02	1.18E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	4.32E-03	6.84E-03	6.72E-02	8.95E-02
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	3.83E-02	2.26E-02	2.73E-01	3.49E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	4.32E-02	3.65E-02	3.60E-01	**0.56**
	Application Case													
	Uranium-238	0.00E+00	0.00E+00	4.59E-06	1.24E-11	3.02E-06	1.10E-03	2.45E-06	8.36E-07	0.00E+00	3.44E-06	3.53E-04	4.97E-04	1.97E-03
	Uranium-234	0.00E+00	0.00E+00	4.98E-06	2.17E-12	3.27E-06	5.56E-06	2.66E-06	3.03E-09	0.00E+00	3.73E-06	3.82E-04	5.39E-04	9.41E-04
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.54E-08	0.00E+00	1.33E-04	1.52E-04	1.68E-03	2.46E-03
	Radium-226	0.00E+00	0.00E+00	5.27E-04	6.51E-08	1.42E-04	9.40E-02	1.71E-04	5.11E-04	0.00E+00	3.78E-04	6.13E-03	1.65E-02	1.18E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	4.32E-03	6.84E-03	6.72E-02	8.95E-02
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	3.83E-02	2.26E-02	2.73E-01	3.49E-01
	Total by Pathway	0.00E+00	0.00E+00	7.20E-03	6.55E-08	2.21E-03	9.98E-02	1.26E-02	5.15E-04	0.00E+00	4.32E-02	3.65E-02	3.60E-01	**0.56**

Table C.17: Estimated Total Radiation Doses to Human Receptors – Far-Future – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Far-Future (mSv/yr)												
	Radionuclide	**Air (Internal)**	**Air (External)**	**Water (Internal)**	**Water (External)**	**Soil (Internal)**	**Soil (External)**	**Sediment (Internal)**	**Sediment (External)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial animals**	**Total by Radionuclide**
	Upper Bound Scenario													
	Uranium-238	0.00E+00	0.00E+00	4.59E-06	1.24E-11	3.02E-06	1.10E-03	2.45E-06	8.36E-07	0.00E+00	3.44E-06	3.53E-04	4.97E-04	1.97E-03
	Uranium-234	0.00E+00	0.00E+00	4.98E-06	2.17E-12	3.27E-06	5.56E-06	2.66E-06	3.03E-09	0.00E+00	3.73E-06	3.82E-04	5.39E-04	9.41E-04
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.54E-08	0.00E+00	1.33E-04	1.52E-04	1.68E-03	2.46E-03
	Radium-226	0.00E+00	0.00E+00	5.27E-04	6.51E-08	1.42E-04	9.40E-02	1.71E-04	5.11E-04	0.00E+00	3.78E-04	6.13E-03	1.65E-02	1.18E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	4.32E-03	6.84E-03	6.72E-02	8.95E-02
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	3.83E-02	2.26E-02	2.73E-01	3.49E-01
	Total by Pathway	0.00E+00	0.00E+00	7.20E-03	6.55E-08	2.21E-03	9.98E-02	1.26E-02	5.15E-04	0.00E+00	4.32E-02	3.65E-02	3.60E-01	**0.56**
Permanent Resident (Patterson Lake North Arm - West Basin)	**Base Case**													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	1.69E-05	3.30E-04	5.22E-04	1.70E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	1.84E-05	3.60E-04	5.68E-04	9.57E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	9.70E-04	1.94E-04	4.54E-03	6.47E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	1.57E-03	4.47E-03	1.03E-02	8.76E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.07E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	8.90E-02	1.63E-02	2.78E-01	**0.46**
	Application Case													
	Uranium-238	0.00E+00	0.00E+00	1.97E-04	1.49E-09	1.01E-07	1.12E-03	1.79E-06	1.91E-05	0.00E+00	5.48E-04	4.48E-04	7.60E-04	3.09E-03
	Uranium-234	0.00E+00	0.00E+00	2.15E-04	2.61E-10	1.10E-07	5.63E-06	1.96E-06	6.97E-08	0.00E+00	5.99E-04	4.88E-04	8.28E-04	2.14E-03
	Thorium-230	0.00E+00	0.00E+00	7.75E-04	5.25E-10	3.00E-06	4.60E-05	8.43E-07	2.08E-08	0.00E+00	1.04E-03	2.57E-04	5.07E-03	7.19E-03
	Radium-226	0.00E+00	0.00E+00	7.59E-04	3.39E-07	3.91E-06	1.01E-01	4.20E-06	5.04E-04	0.00E+00	2.03E-03	6.44E-03	1.22E-02	1.23E-01
	Lead-210	0.00E+00	0.00E+00	1.39E-03	1.22E-09	1.49E-05	3.46E-03	4.67E-05	2.64E-06	0.00E+00	1.24E-02	3.28E-03	4.05E-02	6.10E-02
	Polonium-210	0.00E+00	0.00E+00	2.46E-03	7.38E-12	7.28E-06	2.16E-07	8.26E-05	1.13E-08	0.00E+00	7.80E-02	7.72E-03	2.30E-01	3.18E-01
	Total by Pathway	0.00E+00	0.00E+00	5.79E-03	3.42E-07	2.93E-05	1.06E-01	1.38E-04	5.26E-04	0.00E+00	9.46E-02	1.86E-02	2.89E-01	**0.51**
	Upper Bound Scenario													
	Uranium-238	0.00E+00	0.00E+00	1.97E-04	1.49E-09	1.01E-07	1.12E-03	1.80E-06	1.92E-05	0.00E+00	5.48E-04	4.48E-04	7.60E-04	3.09E-03
	Uranium-234	0.00E+00	0.00E+00	2.15E-04	2.61E-10	1.10E-07	5.63E-06	1.96E-06	6.97E-08	0.00E+00	6.00E-04	4.88E-04	8.28E-04	2.14E-03
	Thorium-230	0.00E+00	0.00E+00	7.75E-04	5.25E-10	3.00E-06	4.60E-05	8.43E-07	2.08E-08	0.00E+00	1.04E-03	2.57E-04	5.07E-03	7.19E-03
	Radium-226	0.00E+00	0.00E+00	7.59E-04	3.39E-07	3.91E-06	1.01E-01	4.21E-06	5.04E-04	0.00E+00	2.03E-03	6.44E-03	1.22E-02	1.23E-01
	Lead-210	0.00E+00	0.00E+00	1.39E-03	1.22E-09	1.49E-05	3.46E-03	4.67E-05	2.64E-06	0.00E+00	1.24E-02	3.28E-03	4.05E-02	6.10E-02
	Polonium-210	0.00E+00	0.00E+00	2.46E-03	7.38E-12	7.28E-06	2.16E-07	8.26E-05	1.13E-08	0.00E+00	7.80E-02	7.72E-03	2.30E-01	3.18E-01
	Total by Pathway	0.00E+00	0.00E+00	5.79E-03	3.42E-07	2.93E-05	1.06E-01	1.38E-04	5.26E-04	0.00E+00	9.46E-02	1.86E-02	2.89E-01	**0.51**

Table C.17: Estimated Total Radiation Doses to Human Receptors – Far-Future – Application Case, Upper Bound Scenario

		Total Dose by Pathway - Far-Future (mSv/yr)												
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
Permanent Resident One-Year-Old (Patterson Lake North Arm - West Basin)	**Base Case**													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	9.99E-06	4.05E-04	5.67E-04	2.09E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	1.08E-05	4.39E-04	6.15E-04	1.08E-03
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	4.19E-04	1.75E-04	2.77E-03	3.86E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	1.19E-03	7.05E-03	1.67E-02	1.20E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	1.36E-01	4.20E-02	4.98E-01	**0.80**
	Application Case													
	Uranium-238	0.00E+00	0.00E+00	1.37E-04	3.69E-10	4.09E-06	1.49E-03	7.30E-05	2.49E-05	0.00E+00	3.23E-04	5.50E-04	6.75E-04	3.28E-03
	Uranium-234	0.00E+00	0.00E+00	1.49E-04	6.47E-11	4.44E-06	7.53E-06	7.94E-05	9.06E-08	0.00E+00	3.52E-04	5.96E-04	7.32E-04	1.92E-03
	Thorium-230	0.00E+00	0.00E+00	3.94E-04	1.30E-10	8.94E-05	5.23E-05	2.51E-05	2.71E-08	0.00E+00	4.48E-04	2.31E-04	3.02E-03	4.26E-03
	Radium-226	0.00E+00	0.00E+00	6.78E-04	8.39E-08	2.04E-04	1.35E-01	2.20E-04	6.57E-04	0.00E+00	1.54E-03	1.02E-02	1.75E-02	1.66E-01
	Lead-210	0.00E+00	0.00E+00	1.89E-03	2.48E-10	1.19E-03	4.63E-03	3.71E-03	3.43E-06	0.00E+00	1.43E-02	7.86E-03	8.39E-02	1.17E-01
	Polonium-210	0.00E+00	0.00E+00	4.69E-03	1.83E-12	8.14E-04	2.82E-07	9.23E-03	1.47E-08	0.00E+00	1.27E-01	2.60E-02	4.04E-01	5.71E-01
	Total by Pathway	0.00E+00	0.00E+00	7.94E-03	8.47E-08	2.30E-03	1.42E-01	1.33E-02	6.86E-04	0.00E+00	1.44E-01	4.54E-02	5.09E-01	**0.86**
	Upper Bound Scenario													
	Uranium-238	0.00E+00	0.00E+00	1.37E-04	3.69E-10	4.09E-06	1.49E-03	7.30E-05	2.49E-05	0.00E+00	3.24E-04	5.50E-04	6.75E-04	3.28E-03
	Uranium-234	0.00E+00	0.00E+00	1.49E-04	6.47E-11	4.44E-06	7.53E-06	7.94E-05	9.06E-08	0.00E+00	3.52E-04	5.96E-04	7.32E-04	1.92E-03
	Thorium-230	0.00E+00	0.00E+00	3.94E-04	1.30E-10	8.94E-05	5.23E-05	2.51E-05	2.71E-08	0.00E+00	4.48E-04	2.31E-04	3.02E-03	4.26E-03
	Radium-226	0.00E+00	0.00E+00	6.79E-04	8.39E-08	2.04E-04	1.35E-01	2.20E-04	6.58E-04	0.00E+00	1.54E-03	1.02E-02	1.75E-02	1.66E-01
	Lead-210	0.00E+00	0.00E+00	1.89E-03	2.48E-10	1.19E-03	4.63E-03	3.71E-03	3.43E-06	0.00E+00	1.43E-02	7.86E-03	8.39E-02	1.17E-01
	Polonium-210	0.00E+00	0.00E+00	4.69E-03	1.83E-12	8.14E-04	2.82E-07	9.24E-03	1.47E-08	0.00E+00	1.27E-01	2.60E-02	4.04E-01	5.71E-01
	Total by Pathway	0.00E+00	0.00E+00	7.94E-03	8.47E-08	2.30E-03	1.42E-01	1.33E-02	6.86E-04	0.00E+00	1.44E-01	4.54E-02	5.09E-01	**0.86**

Table C.18: Estimated Total Radiation Doses to Human Receptors – Reasonably Foreseeable Development Case

	Camp Worker (Patterson Lake North Arm - West Basin) Incremental Dose by Pathway RFD Case (mSv/yr)													
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
Camp Worker (Patterson Lake North Arm - West Basin)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	8.47E-06	1.65E-04	4.15E-04	1.42E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	9.22E-06	1.80E-04	4.52E-04	6.52E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	4.85E-04	9.73E-05	2.70E-03	4.05E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	7.86E-04	2.24E-03	9.32E-03	8.35E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	5.91E-03	1.64E-03	2.93E-02	4.17E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	3.73E-02	3.86E-03	1.32E-01	1.75E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	4.45E-02	8.18E-03	1.74E-01	**0.31**
	RFD Case													
	Uranium-238	8.63E-04	2.37E-12	6.10E-06	4.63E-11	2.10E-07	2.33E-03	5.55E-08	5.92E-07	0.00E+00	7.07E-05	2.22E-04	4.87E-04	3.98E-03
	Uranium-234	1.04E-03	5.79E-12	6.64E-06	8.07E-12	2.29E-07	1.17E-05	6.04E-08	2.15E-09	0.00E+00	7.72E-05	2.41E-04	5.31E-04	1.91E-03
	Thorium-230	4.17E-03	1.40E-11	7.26E-04	4.92E-10	2.98E-06	4.56E-05	7.90E-07	1.95E-08	0.00E+00	1.62E-03	7.09E-04	9.33E-03	1.66E-02
	Radium-226	1.04E-03	2.69E-10	5.89E-04	2.63E-07	3.67E-06	9.50E-02	3.26E-06	3.91E-04	0.00E+00	1.16E-03	3.30E-03	1.01E-02	1.12E-01
	Lead-210	3.27E-04	4.23E-11	1.33E-03	1.17E-09	1.64E-05	3.81E-03	4.46E-05	2.53E-06	0.00E+00	7.50E-03	3.93E-03	3.58E-02	5.28E-02
	Polonium-210	9.82E-04	3.69E-13	2.35E-03	7.06E-12	9.97E-06	2.95E-07	7.90E-05	1.08E-08	0.00E+00	4.68E-02	7.51E-03	1.48E-01	2.05E-01
	Total by Pathway	8.42E-03	3.34E-10	5.01E-03	2.65E-07	3.35E-05	1.01E-01	1.28E-04	3.94E-04	0.00E+00	5.72E-02	1.59E-02	2.04E-01	**0.39**
	Far-Future													
	Uranium-238	-	-	-	-	-	-	-	-	-	-	-	-	-
	Uranium-234	-	-	-	-	-	-	-	-	-	-	-	-	-
	Thorium-230	-	-	-	-	-	-	-	-	-	-	-	-	-
	Radium-226	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Polonium-210	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total by Pathway	-	-	-	-	-	-	-	-	-	-	-	-	-
Subsistence Harvester (Patterson Lake South Arm)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	1.69E-05	3.30E-04	5.22E-04	1.70E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	1.84E-05	3.60E-04	5.68E-04	9.57E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	9.70E-04	1.94E-04	4.54E-03	6.47E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	1.57E-03	4.47E-03	1.03E-02	8.76E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.08E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	8.90E-02	1.63E-02	2.78E-01	**0.46**

Table C.18: Estimated Total Radiation Doses to Human Receptors – Reasonably Foreseeable Development Case

	Camp Worker (Patterson Lake North Arm - West Basin) Incremental Dose by Pathway RFD Case (mSv/yr)												
	Radionuclide	**Air (Internal)**	**Air (External)**	**Water (Internal)**	**Water (External)**	**Soil (Internal)**	**Soil (External)**	**Sediment (Internal)**	**Sediment (External)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial animals**	**Total by Radionuclide**
	RFD Case													
	Uranium-238	1.57E-04	4.30E-13	5.25E-05	3.98E-10	9.89E-08	1.10E-03	1.83E-07	1.95E-06	0.00E+00	1.41E-04	4.43E-04	6.66E-04	2.56E-03
	Uranium-234	1.89E-04	1.05E-12	5.73E-05	6.96E-11	1.08E-07	5.53E-06	2.00E-07	7.10E-09	0.00E+00	1.54E-04	4.82E-04	7.26E-04	1.61E-03
	Thorium-230	7.56E-04	2.55E-12	2.56E-03	1.73E-09	2.40E-06	3.67E-05	2.08E-06	5.15E-08	0.00E+00	3.23E-03	1.42E-03	1.78E-02	2.58E-02
	Radium-226	1.89E-04	4.88E-11	8.95E-04	4.00E-07	2.89E-06	7.47E-02	3.85E-06	4.62E-04	0.00E+00	2.31E-03	6.59E-03	1.19E-02	9.71E-02
	Lead-210	5.94E-05	7.68E-12	1.69E-03	1.49E-09	1.52E-05	3.52E-03	4.97E-05	2.81E-06	0.00E+00	1.50E-02	7.85E-03	5.26E-02	8.07E-02
	Polonium-210	1.78E-04	6.70E-14	2.97E-03	8.93E-12	7.76E-06	2.30E-07	8.78E-05	1.21E-08	0.00E+00	9.35E-02	1.50E-02	2.55E-01	3.67E-01
	Total by Pathway	1.53E-03	6.05E-11	8.23E-03	4.03E-07	2.84E-05	7.94E-02	1.44E-04	4.67E-04	0.00E+00	1.14E-01	3.18E-02	3.39E-01	**0.57**
	Far-Future													
	Uranium-238	0.00E+00	0.00E+00	3.25E-05	2.46E-10	7.68E-08	8.52E-04	2.96E-07	3.16E-06	0.00E+00	9.04E-05	3.42E-04	5.58E-04	1.88E-03
	Uranium-234	0.00E+00	0.00E+00	3.55E-05	4.31E-11	8.37E-08	4.30E-06	3.23E-07	1.15E-08	0.00E+00	9.88E-05	3.72E-04	6.08E-04	1.12E-03
	Thorium-230	0.00E+00	0.00E+00	7.40E-04	5.01E-10	2.34E-06	3.58E-05	8.05E-07	1.99E-08	0.00E+00	9.90E-04	2.01E-04	4.73E-03	6.70E-03
	Radium-226	0.00E+00	0.00E+00	6.20E-04	2.77E-07	2.83E-06	7.32E-02	3.43E-06	4.12E-04	0.00E+00	1.66E-03	4.66E-03	1.07E-02	9.13E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.47E-05	2.53E-06	0.00E+00	1.18E-02	3.28E-03	4.00E-02	5.99E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.06E-12	7.27E-06	2.16E-07	7.90E-05	1.08E-08	0.00E+00	7.47E-02	7.71E-03	2.23E-01	3.08E-01
	Total by Pathway	0.00E+00	0.00E+00	5.11E-03	2.79E-07	2.75E-05	7.76E-02	1.29E-04	4.17E-04	0.00E+00	8.94E-02	1.66E-02	2.80E-01	**0.47**
Subsistence Harvester One-Year-Old (Patterson Lake South Arm)	**Base Case**													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	9.99E-06	4.05E-04	5.67E-04	2.09E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	1.08E-05	4.39E-04	6.15E-04	1.08E-03
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	4.19E-04	1.75E-04	2.77E-03	3.86E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	1.19E-03	7.05E-03	1.67E-02	1.20E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	1.36E-01	4.20E-02	4.98E-01	**0.80**
	RFD Case													
	Uranium-238	1.56E-04	5.59E-13	3.65E-05	9.84E-11	4.02E-06	1.47E-03	7.45E-06	2.54E-06	0.00E+00	8.33E-05	5.44E-04	6.33E-04	2.93E-03
	Uranium-234	1.83E-04	1.37E-12	3.96E-05	1.72E-11	4.36E-06	7.40E-06	8.09E-06	9.23E-09	0.00E+00	9.06E-05	5.90E-04	6.85E-04	1.61E-03
	Thorium-230	5.81E-04	3.31E-12	1.30E-03	4.29E-10	7.14E-05	4.18E-05	6.21E-05	6.70E-08	0.00E+00	1.40E-03	8.44E-04	9.16E-03	1.35E-02
	Radium-226	1.83E-04	6.34E-11	8.00E-04	9.90E-08	1.51E-04	1.00E-01	2.01E-04	6.02E-04	0.00E+00	1.75E-03	9.46E-03	1.74E-02	1.31E-01
	Lead-210	6.14E-05	9.96E-12	2.30E-03	3.03E-10	1.21E-03	4.71E-03	3.95E-03	3.65E-06	0.00E+00	1.73E-02	1.53E-02	9.88E-02	1.44E-01
	Polonium-210	1.83E-04	8.71E-14	5.68E-03	2.21E-12	8.68E-04	3.01E-07	9.82E-03	1.57E-08	0.00E+00	1.52E-01	4.33E-02	4.31E-01	6.42E-01
	Total by Pathway	1.35E-03	7.87E-11	1.02E-02	9.98E-08	2.31E-03	1.06E-01	1.41E-02	6.09E-04	0.00E+00	1.72E-01	7.00E-02	5.58E-01	**0.93**

Table C.18: Estimated Total Radiation Doses to Human Receptors – Reasonably Foreseeable Development Case

	Camp Worker (Patterson Lake North Arm - West Basin) Incremental Dose by Pathway RFD Case (mSv/yr)													
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
	Far-Future													
	Uranium-238	0.00E+00	0.00E+00	2.26E-05	6.09E-11	3.12E-06	1.14E-03	1.20E-05	4.11E-06	0.00E+00	5.33E-05	4.20E-04	5.84E-04	2.24E-03
	Uranium-234	0.00E+00	0.00E+00	2.45E-05	1.07E-11	3.38E-06	5.75E-06	1.31E-05	1.49E-08	0.00E+00	5.80E-05	4.55E-04	6.33E-04	1.19E-03
	Thorium-230	0.00E+00	0.00E+00	3.76E-04	1.24E-10	6.97E-05	4.08E-05	2.40E-05	2.59E-08	0.00E+00	4.28E-04	1.80E-04	2.86E-03	3.98E-03
	Radium-226	0.00E+00	0.00E+00	5.54E-04	6.85E-08	1.48E-04	9.80E-02	1.80E-04	5.37E-04	0.00E+00	1.26E-03	7.36E-03	1.69E-02	1.25E-01
	Lead-210	0.00E+00	0.00E+00	1.81E-03	2.38E-10	1.19E-03	4.63E-03	3.55E-03	3.29E-06	0.00E+00	1.37E-02	7.86E-03	8.33E-02	1.16E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.84E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.95E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.28E-03	6.89E-08	2.22E-03	1.04E-01	1.26E-02	5.44E-04	0.00E+00	1.37E-01	4.23E-02	4.99E-01	**0.80**
Subsistence Harvester (Beet Lake)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	1.69E-05	3.30E-04	5.22E-04	1.70E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	1.84E-05	3.60E-04	5.68E-04	9.57E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	9.70E-04	1.94E-04	4.54E-03	6.47E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	1.57E-03	4.47E-03	1.03E-02	8.76E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.08E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	8.90E-02	1.63E-02	2.78E-01	**0.46**
	RFD Case													
	Uranium-238	8.56E-05	2.35E-13	2.22E-05	1.68E-10	8.77E-08	9.73E-04	1.03E-07	1.09E-06	0.00E+00	6.01E-05	3.92E-04	5.79E-04	2.11E-03
	Uranium-234	1.03E-04	5.75E-13	2.42E-05	2.94E-11	9.55E-08	4.90E-06	1.12E-07	3.97E-09	0.00E+00	6.56E-05	4.27E-04	6.30E-04	1.26E-03
	Thorium-230	4.13E-04	1.39E-12	1.55E-03	1.05E-09	2.34E-06	3.58E-05	1.48E-06	3.65E-08	0.00E+00	1.99E-03	8.63E-04	8.41E-03	1.33E-02
	Radium-226	1.03E-04	2.67E-11	7.07E-04	3.15E-07	2.81E-06	7.27E-02	3.52E-06	4.22E-04	0.00E+00	1.86E-03	5.63E-03	1.07E-02	9.21E-02
	Lead-210	3.25E-05	4.20E-12	1.38E-03	1.22E-09	1.51E-05	3.49E-03	4.53E-05	2.57E-06	0.00E+00	1.23E-02	5.77E-03	4.13E-02	6.43E-02
	Polonium-210	9.74E-05	3.66E-14	2.44E-03	7.33E-12	7.54E-06	2.23E-07	8.02E-05	1.10E-08	0.00E+00	7.74E-02	1.17E-02	2.30E-01	3.22E-01
	Total by Pathway	8.35E-04	3.31E-11	6.12E-03	3.18E-07	2.79E-05	7.72E-02	1.31E-04	4.25E-04	0.00E+00	9.36E-02	2.48E-02	2.92E-01	**0.50**
	Far-Future													
	Uranium-238	0.00E+00	0.00E+00	1.59E-05	1.21E-10	7.57E-08	8.39E-04	1.45E-07	1.55E-06	0.00E+00	4.42E-05	3.37E-04	5.34E-04	1.77E-03
	Uranium-234	0.00E+00	0.00E+00	1.73E-05	2.11E-11	8.24E-08	4.23E-06	1.58E-07	5.62E-09	0.00E+00	4.83E-05	3.67E-04	5.82E-04	1.02E-03
	Thorium-230	0.00E+00	0.00E+00	7.33E-04	4.97E-10	2.31E-06	3.53E-05	7.97E-07	1.97E-08	0.00E+00	9.81E-04	1.98E-04	4.59E-03	6.54E-03
	Radium-226	0.00E+00	0.00E+00	6.02E-04	2.69E-07	2.78E-06	7.19E-02	3.34E-06	4.00E-04	0.00E+00	1.61E-03	4.58E-03	1.04E-02	8.95E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.08E-01
	Total by Pathway	0.00E+00	0.00E+00	5.04E-03	2.71E-07	2.74E-05	7.62E-02	1.28E-04	4.04E-04	0.00E+00	8.91E-02	1.65E-02	2.78E-01	**0.47**

Table C.18: Estimated Total Radiation Doses to Human Receptors – Reasonably Foreseeable Development Case

	Camp Worker (Patterson Lake North Arm - West Basin) Incremental Dose by Pathway RFD Case (mSv/yr)													
	Radionuclide	**Air (Internal)**	**Air (External)**	**Water (Internal)**	**Water (External)**	**Soil (Internal)**	**Soil (External)**	**Sediment (Internal)**	**Sediment (External)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial animals**	**Total by Radionuclide**
Subsistence Harvester One-Year-Old (Beet Lake)	**Base Case**													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	9.99E-06	4.05E-04	5.67E-04	2.09E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	1.08E-05	4.39E-04	6.15E-04	1.08E-03
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	4.19E-04	1.75E-04	2.77E-03	3.86E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	1.19E-03	7.05E-03	1.67E-02	1.20E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	1.36E-01	4.20E-02	4.98E-01	**0.80**
	RFD Case													
	Uranium-238	8.53E-05	3.05E-13	1.54E-05	4.16E-11	3.57E-06	1.30E-03	4.17E-06	1.42E-06	0.00E+00	3.54E-05	4.81E-04	5.93E-04	2.52E-03
	Uranium-234	9.99E-05	7.47E-13	1.68E-05	7.29E-12	3.86E-06	6.56E-06	4.53E-06	5.17E-09	0.00E+00	3.85E-05	5.21E-04	6.42E-04	1.33E-03
	Thorium-230	3.18E-04	1.81E-12	7.88E-04	2.60E-10	6.96E-05	4.07E-05	4.40E-05	4.75E-08	0.00E+00	8.59E-04	5.40E-04	4.63E-03	7.29E-03
	Radium-226	9.99E-05	3.46E-11	6.31E-04	7.81E-08	1.47E-04	9.73E-02	1.84E-04	5.50E-04	0.00E+00	1.41E-03	8.37E-03	1.69E-02	1.26E-01
	Lead-210	3.36E-05	5.45E-12	1.88E-03	2.47E-10	1.20E-03	4.67E-03	3.61E-03	3.33E-06	0.00E+00	1.42E-02	1.19E-02	8.48E-02	1.22E-01
	Polonium-210	9.99E-05	4.76E-14	4.66E-03	1.82E-12	8.43E-04	2.92E-07	8.97E-03	1.43E-08	0.00E+00	1.26E-01	3.55E-02	4.03E-01	5.78E-01
	Total by Pathway	7.36E-04	4.30E-11	7.99E-03	7.86E-08	2.26E-03	1.03E-01	1.28E-02	5.55E-04	0.00E+00	1.42E-01	5.73E-02	5.10E-01	**0.84**
	Far-Future													
	Uranium-238	0.00E+00	0.00E+00	1.10E-05	2.98E-11	3.08E-06	1.12E-03	5.89E-06	2.01E-06	0.00E+00	2.61E-05	4.13E-04	5.73E-04	2.16E-03
	Uranium-234	0.00E+00	0.00E+00	1.20E-05	5.21E-12	3.33E-06	5.66E-06	6.40E-06	7.30E-09	0.00E+00	2.83E-05	4.48E-04	6.21E-04	1.12E-03
	Thorium-230	0.00E+00	0.00E+00	3.73E-04	1.23E-10	6.87E-05	4.02E-05	2.37E-05	2.56E-08	0.00E+00	4.24E-04	1.78E-04	2.79E-03	3.90E-03
	Radium-226	0.00E+00	0.00E+00	5.38E-04	6.65E-08	1.45E-04	9.62E-02	1.74E-04	5.22E-04	0.00E+00	1.22E-03	7.22E-03	1.68E-02	1.23E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.23E-03	6.69E-08	2.22E-03	1.02E-01	1.26E-02	5.27E-04	0.00E+00	1.36E-01	4.21E-02	4.98E-01	**0.80**
Subsistence Harvester (Lloyd Lake)	**Base Case**													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	1.69E-05	3.30E-04	5.22E-04	1.70E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	1.84E-05	3.60E-04	5.68E-04	9.57E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	9.70E-04	1.94E-04	4.54E-03	6.47E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	1.57E-03	4.47E-03	1.03E-02	8.76E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.08E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	8.90E-02	1.63E-02	2.78E-01	**0.46**

Table C.18: Estimated Total Radiation Doses to Human Receptors – Reasonably Foreseeable Development Case

	Camp Worker (Patterson Lake North Arm - West Basin) Incremental Dose by Pathway RFD Case (mSv/yr)													
	Radionuclide	**Air (Internal)**	**Air (External)**	**Water (Internal)**	**Water (External)**	**Soil (Internal)**	**Soil (External)**	**Sediment (Internal)**	**Sediment (External)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial animals**	**Total by Radionuclide**
	RFD Case													
	Uranium-238	4.08E-06	1.12E-14	7.58E-06	5.75E-11	7.49E-08	8.31E-04	5.98E-08	6.37E-07	0.00E+00	2.09E-05	3.33E-04	5.25E-04	1.72E-03
	Uranium-234	4.92E-06	2.74E-14	8.26E-06	1.00E-11	8.15E-08	4.19E-06	6.51E-08	2.31E-09	0.00E+00	2.28E-05	3.63E-04	5.71E-04	9.75E-04
	Thorium-230	1.97E-05	6.64E-14	8.08E-04	5.48E-10	2.27E-06	3.48E-05	8.60E-07	2.13E-08	0.00E+00	1.07E-03	2.26E-04	4.90E-03	7.06E-03
	Radium-226	4.92E-06	1.27E-12	6.00E-04	2.68E-07	2.72E-06	7.03E-02	3.29E-06	3.94E-04	0.00E+00	1.60E-03	4.53E-03	1.03E-02	8.78E-02
	Lead-210	1.55E-06	2.00E-13	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.53E-06	0.00E+00	1.18E-02	3.40E-03	3.97E-02	5.97E-02
	Polonium-210	4.64E-06	1.75E-15	2.35E-03	7.07E-12	7.29E-06	2.16E-07	7.90E-05	1.08E-08	0.00E+00	7.47E-02	7.90E-03	2.23E-01	3.08E-01
	Total by Pathway	3.98E-05	1.58E-12	5.11E-03	2.70E-07	2.73E-05	7.47E-02	1.28E-04	3.97E-04	0.00E+00	8.93E-02	1.67E-02	2.79E-01	**0.47**
	Far-Future													
	Uranium-238	0.00E+00	0.00E+00	6.97E-06	5.29E-11	7.43E-08	8.24E-04	6.35E-08	6.78E-07	0.00E+00	1.94E-05	3.31E-04	5.23E-04	1.70E-03
	Uranium-234	0.00E+00	0.00E+00	7.59E-06	9.22E-12	8.09E-08	4.15E-06	6.92E-08	2.46E-09	0.00E+00	2.11E-05	3.60E-04	5.69E-04	9.62E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.92E-10	2.27E-06	3.48E-05	7.89E-07	1.95E-08	0.00E+00	9.71E-04	1.95E-04	4.54E-03	6.47E-03
	Radium-226	0.00E+00	0.00E+00	5.90E-04	2.63E-07	2.71E-06	7.03E-02	3.27E-06	3.92E-04	0.00E+00	1.57E-03	4.48E-03	1.03E-02	8.77E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.07E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.65E-07	2.73E-05	7.46E-02	1.28E-04	3.95E-04	0.00E+00	8.90E-02	1.64E-02	2.78E-01	**0.46**
Subsistence Harvester One-Year-Old (Lloyd Lake)	**Base Case**													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	9.99E-06	4.05E-04	5.67E-04	2.09E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	1.08E-05	4.39E-04	6.15E-04	1.08E-03
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	4.19E-04	1.75E-04	2.77E-03	3.86E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	1.19E-03	7.05E-03	1.67E-02	1.20E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	1.36E-01	4.20E-02	4.98E-01	**0.80**
	RFD Case													
	Uranium-238	4.07E-06	1.46E-14	5.27E-06	1.42E-11	3.05E-06	1.11E-03	2.43E-06	8.29E-07	0.00E+00	1.24E-05	4.09E-04	5.69E-04	2.12E-03
	Uranium-234	4.76E-06	3.56E-14	5.71E-06	2.48E-12	3.30E-06	5.60E-06	2.63E-06	3.00E-09	0.00E+00	1.34E-05	4.43E-04	6.16E-04	1.09E-03
	Thorium-230	1.51E-05	8.63E-14	4.11E-04	1.36E-10	6.76E-05	3.96E-05	2.56E-05	2.76E-08	0.00E+00	4.64E-04	1.92E-04	2.94E-03	4.16E-03
	Radium-226	4.76E-06	1.65E-12	5.36E-04	6.63E-08	1.42E-04	9.41E-02	1.72E-04	5.14E-04	0.00E+00	1.21E-03	7.11E-03	1.67E-02	1.21E-01
	Lead-210	1.60E-06	2.60E-13	1.81E-03	2.38E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.37E-02	8.06E-03	8.29E-02	1.16E-01
	Polonium-210	4.76E-06	2.27E-15	4.50E-03	1.75E-12	8.15E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.65E-02	3.95E-01	5.57E-01
	Total by Pathway	3.51E-05	2.05E-12	7.26E-03	6.67E-08	2.22E-03	9.99E-02	1.26E-02	5.18E-04	0.00E+00	1.37E-01	4.27E-02	4.99E-01	**0.80**

Table C.18: Estimated Total Radiation Doses to Human Receptors – Reasonably Foreseeable Development Case

	Camp Worker (Patterson Lake North Arm - West Basin) Incremental Dose by Pathway RFD Case (mSv/yr)													
	Radionuclide	**Air (Internal)**	**Air (External)**	**Water (Internal)**	**Water (External)**	**Soil (Internal)**	**Soil (External)**	**Sediment (Internal)**	**Sediment (External)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial animals**	**Total by Radionuclide**
	Far-Future													
	Uranium-238	0.00E+00	0.00E+00	4.84E-06	1.31E-11	3.02E-06	1.10E-03	2.58E-06	8.81E-07	0.00E+00	1.14E-05	4.06E-04	5.68E-04	2.10E-03
	Uranium-234	0.00E+00	0.00E+00	5.25E-06	2.28E-12	3.27E-06	5.56E-06	2.80E-06	3.20E-09	0.00E+00	1.24E-05	4.40E-04	6.15E-04	1.08E-03
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.76E-05	3.95E-05	2.35E-05	2.54E-08	0.00E+00	4.19E-04	1.75E-04	2.77E-03	3.87E-03
	Radium-226	0.00E+00	0.00E+00	5.27E-04	6.52E-08	1.42E-04	9.41E-02	1.71E-04	5.11E-04	0.00E+00	1.19E-03	7.06E-03	1.67E-02	1.20E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.20E-03	6.56E-08	2.22E-03	9.98E-02	1.26E-02	5.15E-04	0.00E+00	1.36E-01	4.20E-02	4.98E-01	**0.80**
Seasonal Resident (Patterson Lake South Arm)	**Base Case**													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	5.36E-06	2.59E-04	3.62E-04	1.46E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	5.84E-06	2.82E-04	3.95E-04	6.94E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	3.07E-04	1.52E-04	2.32E-03	3.54E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	4.98E-04	3.51E-03	8.84E-03	8.40E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	3.74E-03	2.57E-03	2.70E-02	3.82E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	2.36E-02	6.05E-03	1.23E-01	1.56E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	2.82E-02	1.28E-02	1.62E-01	**0.28**
	RFD Case													
	Uranium-238	9.39E-05	2.58E-13	3.39E-05	2.57E-10	8.90E-08	9.87E-04	1.32E-07	1.41E-06	0.00E+00	2.90E-05	3.13E-04	3.90E-04	1.85E-03
	Uranium-234	1.13E-04	6.30E-13	3.70E-05	4.50E-11	9.69E-08	4.98E-06	1.44E-07	5.12E-09	0.00E+00	3.17E-05	3.40E-04	4.24E-04	9.52E-04
	Thorium-230	4.54E-04	1.53E-12	1.82E-03	1.24E-09	2.35E-06	3.59E-05	1.57E-06	3.87E-08	0.00E+00	7.37E-04	4.09E-04	5.40E-03	8.87E-03
	Radium-226	1.13E-04	2.93E-11	7.73E-04	3.45E-07	2.82E-06	7.29E-02	3.62E-06	4.33E-04	0.00E+00	6.39E-04	4.11E-03	9.15E-03	8.81E-02
	Lead-210	3.56E-05	4.61E-12	1.55E-03	1.36E-09	1.51E-05	3.50E-03	4.76E-05	2.70E-06	0.00E+00	4.35E-03	3.75E-03	3.00E-02	4.32E-02
	Polonium-210	1.07E-04	4.02E-14	2.72E-03	8.18E-12	7.57E-06	2.24E-07	8.43E-05	1.16E-08	0.00E+00	2.72E-02	8.03E-03	1.31E-01	1.69E-01
	Total by Pathway	9.17E-04	3.63E-11	6.94E-03	3.48E-07	2.80E-05	7.74E-02	1.37E-04	4.38E-04	0.00E+00	3.30E-02	1.69E-02	1.77E-01	**0.31**
	Far-Future													
	Uranium-238	0.00E+00	0.00E+00	2.19E-05	1.66E-10	7.58E-08	8.41E-04	2.00E-07	2.13E-06	0.00E+00	1.93E-05	2.65E-04	3.71E-04	1.52E-03
	Uranium-234	0.00E+00	0.00E+00	2.39E-05	2.91E-11	8.25E-08	4.24E-06	2.18E-07	7.75E-09	0.00E+00	2.11E-05	2.88E-04	4.04E-04	7.42E-04
	Thorium-230	0.00E+00	0.00E+00	7.34E-04	4.97E-10	2.31E-06	3.54E-05	7.99E-07	1.97E-08	0.00E+00	3.11E-04	1.55E-04	2.36E-03	3.60E-03
	Radium-226	0.00E+00	0.00E+00	6.07E-04	2.71E-07	2.78E-06	7.20E-02	3.37E-06	4.03E-04	0.00E+00	5.14E-04	3.60E-03	8.92E-03	8.61E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.53E-06	0.00E+00	3.75E-03	2.57E-03	2.71E-02	3.83E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.06E-12	7.27E-06	2.16E-07	7.90E-05	1.08E-08	0.00E+00	2.37E-02	6.05E-03	1.23E-01	1.56E-01
	Total by Pathway	0.00E+00	0.00E+00	5.06E-03	2.73E-07	2.74E-05	7.64E-02	1.28E-04	4.08E-04	0.00E+00	2.83E-02	1.29E-02	1.63E-01	**0.29**

Table C.18: Estimated Total Radiation Doses to Human Receptors – Reasonably Foreseeable Development Case

	Camp Worker (Patterson Lake North Arm - West Basin) Incremental Dose by Pathway RFD Case (mSv/yr)													
	Radionuclide	**Air (Internal)**	**Air (External)**	**Water (Internal)**	**Water (External)**	**Soil (Internal)**	**Soil (External)**	**Sediment (Internal)**	**Sediment (External)**	**Aquatic Plants**	**Aquatic Animals**	**Terrestrial Plants**	**Terrestrial animals**	**Total by Radionuclide**
Seasonal Resident One-Year-Old (Patterson Lake South Arm)	**Base Case**													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	3.16E-06	3.52E-04	4.97E-04	1.96E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	3.43E-06	3.82E-04	5.38E-04	9.40E-04
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	1.33E-04	1.52E-04	1.68E-03	2.46E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	3.78E-04	6.13E-03	1.65E-02	1.18E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	4.32E-03	6.84E-03	6.72E-02	8.95E-02
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	3.83E-02	2.26E-02	2.73E-01	3.49E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	4.32E-02	3.65E-02	3.60E-01	**0.56**
	RFD Case													
	Uranium-238	9.37E-05	3.35E-13	2.36E-05	6.36E-11	3.62E-06	1.32E-03	5.37E-06	1.83E-06	0.00E+00	1.71E-05	4.25E-04	5.09E-04	2.40E-03
	Uranium-234	1.10E-04	8.20E-13	2.56E-05	1.11E-11	3.92E-06	6.66E-06	5.83E-06	6.65E-09	0.00E+00	1.86E-05	4.61E-04	5.52E-04	1.18E-03
	Thorium-230	3.49E-04	1.99E-12	9.28E-04	3.06E-10	6.98E-05	4.09E-05	4.66E-05	5.03E-08	0.00E+00	3.18E-04	2.94E-04	3.18E-03	5.23E-03
	Radium-226	1.10E-04	3.80E-11	6.90E-04	8.54E-08	1.47E-04	9.76E-02	1.89E-04	5.65E-04	0.00E+00	4.84E-04	6.93E-03	1.66E-02	1.23E-01
	Lead-210	3.69E-05	5.98E-12	2.10E-03	2.77E-10	1.20E-03	4.68E-03	3.79E-03	3.50E-06	0.00E+00	5.02E-03	9.04E-03	7.09E-02	9.68E-02
	Polonium-210	1.10E-04	5.23E-14	5.20E-03	2.03E-12	8.46E-04	2.93E-07	9.43E-03	1.50E-08	0.00E+00	4.42E-02	2.81E-02	2.82E-01	3.70E-01
	Total by Pathway	8.08E-04	4.72E-11	8.97E-03	8.60E-08	2.27E-03	1.04E-01	1.35E-02	5.71E-04	0.00E+00	5.00E-02	4.52E-02	3.74E-01	**0.60**
	Far-Future													
	Uranium-238	0.00E+00	0.00E+00	1.52E-05	4.11E-11	3.08E-06	1.12E-03	8.12E-06	2.77E-06	0.00E+00	1.14E-05	3.60E-04	5.01E-04	2.03E-03
	Uranium-234	0.00E+00	0.00E+00	1.65E-05	7.19E-12	3.34E-06	5.67E-06	8.83E-06	1.01E-08	0.00E+00	1.24E-05	3.90E-04	5.43E-04	9.79E-04
	Thorium-230	0.00E+00	0.00E+00	3.73E-04	1.23E-10	6.88E-05	4.03E-05	2.38E-05	2.57E-08	0.00E+00	1.34E-04	1.55E-04	1.70E-03	2.50E-03
	Radium-226	0.00E+00	0.00E+00	5.43E-04	6.71E-08	1.45E-04	9.64E-02	1.76E-04	5.26E-04	0.00E+00	3.90E-04	6.29E-03	1.65E-02	1.21E-01
	Lead-210	0.00E+00	0.00E+00	1.81E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	4.32E-03	6.84E-03	6.73E-02	8.96E-02
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	3.84E-02	2.26E-02	2.74E-01	3.49E-01
	Total by Pathway	0.00E+00	0.00E+00	7.24E-03	6.75E-08	2.22E-03	1.02E-01	1.26E-02	5.32E-04	0.00E+00	4.32E-02	3.67E-02	3.60E-01	**0.56**
Seasonal Resident (Lloyd Lake)	**Base Case**													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	5.36E-06	2.59E-04	3.62E-04	1.46E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	5.84E-06	2.82E-04	3.95E-04	6.94E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	3.07E-04	1.52E-04	2.32E-03	3.54E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	4.98E-04	3.51E-03	8.84E-03	8.40E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	3.74E-03	2.57E-03	2.70E-02	3.82E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	2.36E-02	6.05E-03	1.23E-01	1.56E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	2.82E-02	1.28E-02	1.62E-01	**0.28**

Table C.18: Estimated Total Radiation Doses to Human Receptors – Reasonably Foreseeable Development Case

	Camp Worker (Patterson Lake North Arm - West Basin) Incremental Dose by Pathway RFD Case (mSv/yr)													
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
	RFD Case													
	Uranium-238	2.45E-06	6.72E-15	6.98E-06	5.30E-11	7.46E-08	8.28E-04	5.80E-08	6.19E-07	0.00E+00	8.27E-06	2.61E-04	3.63E-04	1.47E-03
	Uranium-234	2.95E-06	1.64E-14	7.60E-06	9.23E-12	8.13E-08	4.17E-06	6.32E-08	2.24E-09	0.00E+00	9.01E-06	2.84E-04	3.95E-04	7.03E-04
	Thorium-230	1.18E-05	3.98E-14	7.75E-04	5.25E-10	2.27E-06	3.48E-05	8.31E-07	2.05E-08	0.00E+00	3.41E-04	1.59E-04	2.40E-03	3.72E-03
	Radium-226	2.95E-06	7.62E-13	5.95E-04	2.66E-07	2.71E-06	7.03E-02	3.28E-06	3.93E-04	0.00E+00	5.08E-04	3.52E-03	8.84E-03	8.41E-02
	Lead-210	9.29E-07	1.20E-13	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.53E-06	0.00E+00	4.51E-03	2.60E-03	2.70E-02	3.90E-02
	Polonium-210	2.79E-06	1.05E-15	2.35E-03	7.06E-12	7.28E-06	2.16E-07	7.90E-05	1.08E-08	0.00E+00	2.42E-02	6.10E-03	1.23E-01	1.56E-01
	Total by Pathway	2.39E-05	9.47E-13	5.06E-03	2.68E-07	2.73E-05	7.46E-02	1.28E-04	3.96E-04	0.00E+00	2.96E-02	1.29E-02	1.62E-01	**0.29**
	Far-Future													
	Uranium-238	0.00E+00	0.00E+00	6.61E-06	5.02E-11	7.43E-08	8.24E-04	6.03E-08	6.43E-07	0.00E+00	7.63E-06	2.59E-04	3.63E-04	1.46E-03
	Uranium-234	0.00E+00	0.00E+00	7.20E-06	8.74E-12	8.09E-08	4.15E-06	6.57E-08	2.33E-09	0.00E+00	8.31E-06	2.82E-04	3.95E-04	6.97E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.48E-05	7.89E-07	1.95E-08	0.00E+00	3.08E-04	1.53E-04	2.32E-03	3.54E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.03E-02	3.27E-06	3.91E-04	0.00E+00	5.00E-04	3.51E-03	8.84E-03	8.41E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	4.50E-03	2.57E-03	2.70E-02	3.89E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	2.41E-02	6.05E-03	1.23E-01	1.56E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.65E-07	2.73E-05	7.46E-02	1.28E-04	3.95E-04	0.00E+00	2.95E-02	1.28E-02	1.62E-01	**0.28**
Seasonal Resident One-Year-Old (Lloyd Lake)	Base Case													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	3.16E-06	3.52E-04	4.97E-04	1.96E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	3.43E-06	3.82E-04	5.38E-04	9.40E-04
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	1.33E-04	1.52E-04	1.68E-03	2.46E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	3.78E-04	6.13E-03	1.65E-02	1.18E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	4.32E-03	6.84E-03	6.72E-02	8.95E-02
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	3.83E-02	2.26E-02	2.73E-01	3.49E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	4.32E-02	3.65E-02	3.60E-01	**0.56**
	RFD Case													
	Uranium-238	2.44E-06	8.73E-15	4.85E-06	1.31E-11	3.03E-06	1.11E-03	2.36E-06	8.05E-07	0.00E+00	3.61E-06	3.54E-04	4.97E-04	1.98E-03
	Uranium-234	2.86E-06	2.14E-14	5.26E-06	2.29E-12	3.29E-06	5.58E-06	2.56E-06	2.92E-09	0.00E+00	3.92E-06	3.84E-04	5.39E-04	9.46E-04
	Thorium-230	9.09E-06	5.18E-14	3.94E-04	1.30E-10	6.76E-05	3.95E-05	2.47E-05	2.67E-08	0.00E+00	1.41E-04	1.56E-04	1.72E-03	2.55E-03
	Radium-226	2.86E-06	9.91E-13	5.32E-04	6.58E-08	1.42E-04	9.41E-02	1.71E-04	5.12E-04	0.00E+00	3.82E-04	6.15E-03	1.65E-02	1.18E-01
	Lead-210	9.61E-07	1.56E-13	1.81E-03	2.38E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	4.32E-03	6.89E-03	6.72E-02	8.96E-02
	Polonium-210	2.86E-06	1.36E-15	4.49E-03	1.75E-12	8.14E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	3.84E-02	2.28E-02	2.74E-01	3.49E-01
	Total by Pathway	2.11E-05	1.23E-12	7.23E-03	6.62E-08	2.22E-03	9.98E-02	1.26E-02	5.16E-04	0.00E+00	4.32E-02	3.67E-02	3.60E-01	**0.56**

Table C.18: Estimated Total Radiation Doses to Human Receptors – Reasonably Foreseeable Development Case

	Camp Worker (Patterson Lake North Arm - West Basin) Incremental Dose by Pathway RFD Case (mSv/yr)													
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
	Far-Future													
	Uranium-238	0.00E+00	0.00E+00	4.59E-06	1.24E-11	3.02E-06	1.10E-03	2.45E-06	8.36E-07	0.00E+00	3.44E-06	3.53E-04	4.97E-04	1.97E-03
	Uranium-234	0.00E+00	0.00E+00	4.98E-06	2.17E-12	3.27E-06	5.56E-06	2.66E-06	3.03E-09	0.00E+00	3.73E-06	3.82E-04	5.39E-04	9.41E-04
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.76E-05	3.95E-05	2.35E-05	2.54E-08	0.00E+00	1.33E-04	1.52E-04	1.68E-03	2.46E-03
	Radium-226	0.00E+00	0.00E+00	5.27E-04	6.51E-08	1.42E-04	9.40E-02	1.71E-04	5.11E-04	0.00E+00	3.78E-04	6.13E-03	1.65E-02	1.18E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	4.32E-03	6.84E-03	6.72E-02	8.95E-02
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	3.83E-02	2.26E-02	2.73E-01	3.49E-01
	Total by Pathway	0.00E+00	0.00E+00	7.20E-03	6.55E-08	2.22E-03	9.98E-02	1.26E-02	5.15E-04	0.00E+00	4.32E-02	3.65E-02	3.60E-01	**0.56**
Permanent Resident (Patterson Lake North Arm - West Basin)	Base Case Adult													
	Uranium-238	0.00E+00	0.00E+00	6.08E-06	4.61E-11	7.42E-08	8.23E-04	5.54E-08	5.91E-07	0.00E+00	1.69E-05	3.30E-04	5.22E-04	1.70E-03
	Uranium-234	0.00E+00	0.00E+00	6.62E-06	8.04E-12	8.08E-08	4.15E-06	6.04E-08	2.14E-09	0.00E+00	1.84E-05	3.60E-04	5.68E-04	9.57E-04
	Thorium-230	0.00E+00	0.00E+00	7.25E-04	4.91E-10	2.27E-06	3.47E-05	7.89E-07	1.95E-08	0.00E+00	9.70E-04	1.94E-04	4.54E-03	6.47E-03
	Radium-226	0.00E+00	0.00E+00	5.89E-04	2.63E-07	2.71E-06	7.02E-02	3.26E-06	3.91E-04	0.00E+00	1.57E-03	4.47E-03	1.03E-02	8.76E-02
	Lead-210	0.00E+00	0.00E+00	1.33E-03	1.17E-09	1.49E-05	3.46E-03	4.46E-05	2.52E-06	0.00E+00	1.18E-02	3.28E-03	3.96E-02	5.95E-02
	Polonium-210	0.00E+00	0.00E+00	2.35E-03	7.05E-12	7.27E-06	2.16E-07	7.89E-05	1.08E-08	0.00E+00	7.46E-02	7.71E-03	2.23E-01	3.07E-01
	Total by Pathway	0.00E+00	0.00E+00	5.00E-03	2.64E-07	2.73E-05	7.45E-02	1.28E-04	3.94E-04	0.00E+00	8.90E-02	1.63E-02	2.78E-01	**0.46**
	Base Case One-Year-Old													
	Uranium-238	0.00E+00	0.00E+00	4.22E-06	1.14E-11	3.02E-06	1.10E-03	2.25E-06	7.69E-07	0.00E+00	9.99E-06	4.05E-04	5.67E-04	2.09E-03
	Uranium-234	0.00E+00	0.00E+00	4.58E-06	1.99E-12	3.27E-06	5.56E-06	2.44E-06	2.79E-09	0.00E+00	1.08E-05	4.39E-04	6.15E-04	1.08E-03
	Thorium-230	0.00E+00	0.00E+00	3.69E-04	1.22E-10	6.75E-05	3.95E-05	2.35E-05	2.53E-08	0.00E+00	4.19E-04	1.75E-04	2.77E-03	3.86E-03
	Radium-226	0.00E+00	0.00E+00	5.26E-04	6.50E-08	1.42E-04	9.40E-02	1.71E-04	5.10E-04	0.00E+00	1.19E-03	7.05E-03	1.67E-02	1.20E-01
	Lead-210	0.00E+00	0.00E+00	1.80E-03	2.37E-10	1.19E-03	4.63E-03	3.55E-03	3.28E-06	0.00E+00	1.36E-02	7.86E-03	8.28E-02	1.15E-01
	Polonium-210	0.00E+00	0.00E+00	4.49E-03	1.75E-12	8.13E-04	2.82E-07	8.83E-03	1.41E-08	0.00E+00	1.21E-01	2.60E-02	3.94E-01	5.56E-01
	Total by Pathway	0.00E+00	0.00E+00	7.19E-03	6.54E-08	2.21E-03	9.97E-02	1.26E-02	5.14E-04	0.00E+00	1.36E-01	4.20E-02	4.98E-01	**0.80**
	Far-Future Adult													
	Uranium-238	0.00E+00	0.00E+00	1.97E-04	1.49E-09	1.01E-07	1.12E-03	1.79E-06	1.91E-05	0.00E+00	5.48E-04	4.50E-04	7.62E-04	3.10E-03
	Uranium-234	0.00E+00	0.00E+00	2.15E-04	2.61E-10	1.10E-07	5.66E-06	1.96E-06	6.97E-08	0.00E+00	5.99E-04	4.90E-04	8.30E-04	2.14E-03
	Thorium-230	0.00E+00	0.00E+00	7.75E-04	5.25E-10	3.01E-06	4.62E-05	8.43E-07	2.08E-08	0.00E+00	1.04E-03	2.58E-04	5.08E-03	7.20E-03
	Radium-226	0.00E+00	0.00E+00	7.59E-04	3.39E-07	3.93E-06	1.02E-01	4.20E-06	5.04E-04	0.00E+00	2.03E-03	6.48E-03	1.22E-02	1.24E-01
	Lead-210	0.00E+00	0.00E+00	1.39E-03	1.22E-09	1.49E-05	3.46E-03	4.67E-05	2.64E-06	0.00E+00	1.24E-02	3.28E-03	4.05E-02	6.10E-02
	Polonium-210	0.00E+00	0.00E+00	2.46E-03	7.38E-12	7.28E-06	2.16E-07	8.26E-05	1.13E-08	0.00E+00	7.80E-02	7.72E-03	2.30E-01	3.18E-01
	Total by Pathway	0.00E+00	0.00E+00	5.79E-03	3.42E-07	2.93E-05	1.06E-01	1.38E-04	5.26E-04	0.00E+00	9.46E-02	1.87E-02	2.89E-01	**0.52**

Table C.18: Estimated Total Radiation Doses to Human Receptors – Reasonably Foreseeable Development Case

	Camp Worker (Patterson Lake North Arm - West Basin) Incremental Dose by Pathway RFD Case (mSv/yr)													
	Radionuclide	Air (Internal)	Air (External)	Water (Internal)	Water (External)	Soil (Internal)	Soil (External)	Sediment (Internal)	Sediment (External)	Aquatic Plants	Aquatic Animals	Terrestrial Plants	Terrestrial animals	Total by Radionuclide
	Far-Future One-Year-Old													
	Uranium-238	0.00E+00	0.00E+00	1.37E-04	3.69E-10	4.11E-06	1.50E-03	7.30E-05	2.49E-05	0.00E+00	3.23E-04	5.52E-04	6.76E-04	3.29E-03
	Uranium-234	0.00E+00	0.00E+00	1.49E-04	6.47E-11	4.46E-06	7.57E-06	7.94E-05	9.06E-08	0.00E+00	3.52E-04	5.98E-04	7.32E-04	1.92E-03
	Thorium-230	0.00E+00	0.00E+00	3.94E-04	1.30E-10	8.98E-05	5.25E-05	2.51E-05	2.71E-08	0.00E+00	4.48E-04	2.32E-04	3.03E-03	4.27E-03
	Radium-226	0.00E+00	0.00E+00	6.78E-04	8.39E-08	2.05E-04	1.36E-01	2.20E-04	6.57E-04	0.00E+00	1.54E-03	1.02E-02	1.75E-02	1.67E-01
	Lead-210	0.00E+00	0.00E+00	1.89E-03	2.48E-10	1.19E-03	4.63E-03	3.71E-03	3.43E-06	0.00E+00	1.43E-02	7.86E-03	8.39E-02	1.17E-01
	Polonium-210	0.00E+00	0.00E+00	4.69E-03	1.83E-12	8.14E-04	2.82E-07	9.23E-03	1.47E-08	0.00E+00	1.27E-01	2.60E-02	4.04E-01	5.71E-01
	Total by Pathway	0.00E+00	0.00E+00	7.94E-03	8.47E-08	2.30E-03	1.42E-01	1.33E-02	6.86E-04	0.00E+00	1.44E-01	4.55E-02	5.09E-01	**0.87**

Table C.19: Maximum Radiation Dose to Ecological Receptors for the Application Case and Upper Bound Scenario - Project Lifespan

Benthic Invertebrates Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	4.73E-09	6.18E-09	1.80E-08	8.07E-05	3.79E-05	1.72E-09	**1.19E-04**
Patterson Lake North Arm - West Basin	4.26E-08	5.58E-08	1.00E-07	1.30E-04	5.19E-05	2.35E-09	**1.82E-04**
Patterson Lake South Arm	1.47E-08	1.93E-08	6.47E-08	9.76E-05	3.89E-05	1.76E-09	**1.37E-04**
Beet Lake	8.41E-09	1.10E-08	4.26E-08	8.79E-05	3.81E-05	1.72E-09	**1.26E-04**
Lloyd Lake	5.06E-09	6.61E-09	2.06E-08	8.14E-05	3.79E-05	1.72E-09	**1.19E-04**
Upper Bound Scenario							
Reference (Broach Lake)	4.73E-09	6.18E-09	1.80E-08	8.07E-05	3.79E-05	1.72E-09	**1.19E-04**
Patterson Lake North Arm - West Basin	1.10E-07	1.44E-07	1.01E-07	1.32E-04	1.04E-04	4.71E-09	**2.36E-04**
Patterson Lake South Arm	3.26E-08	4.28E-08	6.54E-08	9.84E-05	4.23E-05	1.92E-09	**1.41E-04**
Beet Lake	1.50E-08	1.96E-08	4.29E-08	8.82E-05	3.85E-05	1.75E-09	**1.27E-04**
Lloyd Lake	5.66E-09	7.39E-09	2.06E-08	8.15E-05	3.80E-05	1.72E-09	**1.19E-04**

Zooplankton Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	2.05E-05	2.39E-05	2.94E-03	4.57E-03	2.80E-05	6.05E-02	**6.81E-02**
Patterson Lake North Arm - West Basin	2.23E-04	2.62E-04	1.67E-02	7.95E-03	4.28E-05	9.18E-02	**1.17E-01**
Patterson Lake South Arm	7.51E-05	8.78E-05	1.11E-02	5.76E-03	2.88E-05	6.23E-02	**7.93E-02**
Beet Lake	4.06E-05	4.74E-05	7.21E-03	5.08E-03	2.81E-05	6.07E-02	**7.31E-02**
Lloyd Lake	2.23E-05	2.61E-05	3.38E-03	4.62E-03	2.80E-05	6.05E-02	**6.86E-02**
Upper Bound Scenario							
Reference (Broach Lake)	2.05E-05	2.39E-05	2.94E-03	4.57E-03	2.80E-05	6.05E-02	**6.81E-02**
Patterson Lake North Arm - West Basin	6.09E-04	7.13E-04	1.69E-02	8.10E-03	1.07E-04	2.34E-01	**2.61E-01**
Patterson Lake South Arm	1.70E-04	1.99E-04	1.12E-02	5.82E-03	3.23E-05	7.00E-02	**8.74E-02**
Beet Lake	7.54E-05	8.82E-05	7.26E-03	5.10E-03	2.85E-05	6.17E-02	**7.43E-02**
Lloyd Lake	2.55E-05	2.98E-05	3.39E-03	4.62E-03	2.80E-05	6.06E-02	**6.87E-02**

Northern Pike Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	4.13E-06	4.70E-06	3.54E-05	2.22E-04	1.79E-06	5.64E-04	**8.33E-04**
Patterson Lake North Arm - West Basin	4.50E-05	5.14E-05	2.02E-04	3.87E-04	2.74E-06	8.56E-04	**1.54E-03**
Patterson Lake South Arm	1.51E-05	1.72E-05	1.33E-04	2.80E-04	1.85E-06	5.81E-04	**1.03E-03**
Beet Lake	8.17E-06	9.31E-06	8.67E-05	2.47E-04	1.80E-06	5.67E-04	**9.20E-04**
Lloyd Lake	4.50E-06	5.12E-06	4.07E-05	2.25E-04	1.79E-06	5.64E-04	**8.41E-04**
Upper Bound Scenario							
Reference (Broach Lake)	4.13E-06	4.70E-06	3.54E-05	2.22E-04	1.79E-06	5.64E-04	**8.33E-04**
Patterson Lake North Arm - West Basin	1.23E-04	1.40E-04	2.03E-04	3.94E-04	6.88E-06	2.18E-03	**3.05E-03**
Patterson Lake South Arm	3.42E-05	3.90E-05	1.34E-04	2.83E-04	2.07E-06	6.53E-04	**1.15E-03**
Beet Lake	1.52E-05	1.73E-05	8.74E-05	2.48E-04	1.83E-06	5.76E-04	**9.46E-04**
Lloyd Lake	5.14E-06	5.86E-06	4.08E-05	2.25E-04	1.80E-06	5.65E-04	**8.43E-04**

Whitefish Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	7.69E-07	8.97E-07	2.65E-05	1.86E-04	8.29E-07	4.31E-05	**2.58E-04**
Patterson Lake North Arm - West Basin	8.38E-06	9.82E-06	1.51E-04	3.21E-04	1.22E-06	6.55E-05	**5.57E-04**
Patterson Lake South Arm	2.81E-06	3.29E-06	9.95E-05	2.33E-04	8.53E-07	4.44E-05	**3.84E-04**
Beet Lake	1.52E-06	1.78E-06	6.49E-05	2.06E-04	8.33E-07	4.33E-05	**3.18E-04**
Lloyd Lake	8.37E-07	9.77E-07	3.05E-05	1.88E-04	8.30E-07	4.31E-05	**2.64E-04**
Upper Bound Scenario							
Reference (Broach Lake)	7.69E-07	8.97E-07	2.65E-05	1.86E-04	8.29E-07	4.31E-05	**2.58E-04**
Patterson Lake North Arm - West Basin	2.28E-05	2.67E-05	1.52E-04	3.27E-04	2.82E-06	1.67E-04	**6.99E-04**
Patterson Lake South Arm	6.37E-06	7.45E-06	1.00E-04	2.36E-04	9.46E-07	4.99E-05	**4.01E-04**
Beet Lake	2.83E-06	3.31E-06	6.54E-05	2.07E-04	8.45E-07	4.40E-05	**3.23E-04**
Lloyd Lake	9.58E-07	1.12E-06	3.05E-05	1.88E-04	8.30E-07	4.32E-05	**2.64E-04**

Table C.19: Maximum Radiation Dose to Ecological Receptors for the Application Case and Upper Bound Scenario - Project Lifespan

Macrophytes Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.04E-05	1.18E-05	1.37E-03	2.99E-03	5.06E-05	1.10E-03	**5.53E-03**
Patterson Lake North Arm - West Basin	1.13E-04	1.30E-04	7.79E-03	5.20E-03	7.73E-05	1.67E-03	**1.50E-02**
Patterson Lake South Arm	3.81E-05	4.35E-05	5.14E-03	3.77E-03	5.22E-05	1.13E-03	**1.02E-02**
Beet Lake	2.06E-05	2.35E-05	3.35E-03	3.32E-03	5.08E-05	1.11E-03	**7.88E-03**
Lloyd Lake	1.13E-05	1.29E-05	1.57E-03	3.02E-03	5.06E-05	1.10E-03	**5.77E-03**
Upper Bound Scenario							
Reference (Broach Lake)	1.04E-05	1.18E-05	1.37E-03	2.99E-03	5.06E-05	1.10E-03	**5.53E-03**
Patterson Lake North Arm - West Basin	3.09E-04	3.53E-04	7.87E-03	5.30E-03	1.94E-04	4.26E-03	**1.83E-02**
Patterson Lake South Arm	8.62E-05	9.84E-05	5.19E-03	3.81E-03	5.85E-05	1.27E-03	**1.05E-02**
Beet Lake	3.83E-05	4.37E-05	3.38E-03	3.34E-03	5.17E-05	1.12E-03	**7.97E-03**
Lloyd Lake	1.30E-05	1.48E-05	1.58E-03	3.02E-03	5.07E-05	1.10E-03	**5.78E-03**

Phytoplankton Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.04E-05	1.18E-05	1.36E-03	3.00E-03	1.93E-05	1.11E-03	**5.51E-03**
Patterson Lake North Arm - West Basin	1.13E-04	1.29E-04	7.75E-03	5.21E-03	2.96E-05	1.68E-03	**1.49E-02**
Patterson Lake South Arm	3.81E-05	4.34E-05	5.12E-03	3.78E-03	1.99E-05	1.14E-03	**1.01E-02**
Beet Lake	2.06E-05	2.34E-05	3.34E-03	3.33E-03	1.94E-05	1.11E-03	**7.84E-03**
Lloyd Lake	1.13E-05	1.29E-05	1.57E-03	3.03E-03	1.94E-05	1.11E-03	**5.75E-03**
Upper Bound Scenario							
Reference (Broach Lake)	1.04E-05	1.18E-05	1.36E-03	3.00E-03	1.93E-05	1.11E-03	**5.51E-03**
Patterson Lake North Arm - West Basin	3.09E-04	3.52E-04	7.83E-03	5.31E-03	7.42E-05	4.28E-03	**1.82E-02**
Patterson Lake South Arm	8.61E-05	9.82E-05	5.17E-03	3.82E-03	2.24E-05	1.28E-03	**1.05E-02**
Beet Lake	3.82E-05	4.36E-05	3.36E-03	3.35E-03	1.97E-05	1.13E-03	**7.94E-03**
Lloyd Lake	1.30E-05	1.47E-05	1.57E-03	3.03E-03	1.94E-05	1.11E-03	**5.75E-03**

Terrestrial Invertebrate Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.57E-05	1.78E-05	1.15E-04	5.73E-03	6.72E-06	2.28E-05	**5.91E-03**
Patterson Lake North Arm - West Basin	6.88E-05	7.83E-05	1.82E-03	1.78E-02	2.16E-05	1.77E-03	**2.16E-02**
Patterson Lake South Arm	2.43E-05	2.77E-05	3.93E-04	7.71E-03	9.14E-06	3.07E-04	**8.47E-03**
Beet Lake	2.07E-05	2.36E-05	2.77E-04	6.88E-03	8.13E-06	1.88E-04	**7.40E-03**
Lloyd Lake	1.58E-05	1.80E-05	1.20E-04	5.77E-03	6.76E-06	2.83E-05	**5.96E-03**
Upper Bound Scenario							
Reference (Broach Lake)	1.57E-05	1.78E-05	1.15E-04	5.73E-03	6.72E-06	2.28E-05	**5.91E-03**
Patterson Lake North Arm - West Basin	6.88E-05	7.83E-05	1.82E-03	1.78E-02	2.16E-05	1.77E-03	**2.16E-02**
Patterson Lake South Arm	2.43E-05	2.77E-05	3.93E-04	7.71E-03	9.14E-06	3.07E-04	**8.47E-03**
Beet Lake	2.07E-05	2.36E-05	2.77E-04	6.88E-03	8.13E-06	1.88E-04	**7.40E-03**
Lloyd Lake	1.58E-05	1.80E-05	1.20E-04	5.77E-03	6.76E-06	2.83E-05	**5.96E-03**

Browse Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Patterson Lake North Arm - West Basin	2.53E-03	2.88E-03	1.80E-03	2.15E-02	2.10E-04	2.79E-03	**3.18E-02**
Patterson Lake South Arm	8.97E-04	1.02E-03	3.80E-04	1.02E-02	1.73E-04	9.85E-04	**1.36E-02**
Upper Bound Scenario							
Patterson Lake North Arm - West Basin	2.53E-03	2.88E-03	1.80E-03	2.15E-02	2.10E-04	2.79E-03	**3.18E-02**
Patterson Lake South Arm	8.97E-04	1.02E-03	3.80E-04	1.02E-02	1.73E-04	9.85E-04	**1.36E-02**

Table C.19: Maximum Radiation Dose to Ecological Receptors for the Application Case and Upper Bound Scenario - Project Lifespan

Labrador Tea Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Patterson Lake North Arm - West Basin	2.53E-03	2.88E-03	1.58E-02	9.27E-02	3.26E-04	1.61E-02	**1.30E-01**
Patterson Lake South Arm	8.97E-04	1.02E-03	2.66E-03	2.18E-02	1.92E-04	3.16E-03	**2.97E-02**
Upper Bound Scenario							
Patterson Lake North Arm - West Basin	2.53E-03	2.88E-03	1.58E-02	9.27E-02	3.26E-04	1.61E-02	**1.30E-01**
Patterson Lake South Arm	8.97E-04	1.02E-03	2.66E-03	2.18E-02	1.92E-04	3.16E-03	**2.97E-02**

Lichen Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Patterson Lake North Arm - West Basin	1.21E-04	1.37E-04	8.96E-02	4.62E-01	1.40E-03	1.26E-01	**6.79E-01**
Patterson Lake South Arm	1.21E-04	1.37E-04	1.50E-02	7.91E-02	9.26E-04	1.09E-01	**2.05E-01**
Upper Bound Scenario							
Patterson Lake North Arm - West Basin	1.21E-04	1.37E-04	8.96E-02	4.62E-01	1.40E-03	1.26E-01	**6.79E-01**
Patterson Lake South Arm	1.21E-04	1.37E-04	1.50E-02	7.91E-02	9.26E-04	1.09E-01	**2.05E-01**

Blueberries Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Patterson Lake North Arm - West Basin	1.31E-03	1.49E-03	6.96E-05	9.15E-03	8.42E-06	1.06E-03	**1.31E-02**
Patterson Lake South Arm	4.53E-04	5.16E-04	4.55E-05	4.74E-03	3.88E-06	4.38E-04	**6.20E-03**
Upper Bound Scenario							
Patterson Lake North Arm - West Basin	1.31E-03	1.49E-03	6.96E-05	9.15E-03	8.42E-06	1.06E-03	**1.31E-02**
Patterson Lake South Arm	4.53E-04	5.16E-04	4.55E-05	4.74E-03	3.88E-06	4.38E-04	**6.20E-03**

Beaver Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.05E-05	1.19E-05	3.11E-06	6.36E-04	4.75E-07	2.15E-04	**8.77E-04**
Patterson Lake North Arm - West Basin	4.63E-05	5.27E-05	2.94E-05	1.72E-03	1.13E-06	7.41E-04	**2.59E-03**
Patterson Lake South Arm	1.64E-05	1.86E-05	1.08E-05	8.19E-04	5.66E-07	2.98E-04	**1.16E-03**
Beet Lake	1.39E-05	1.58E-05	7.32E-06	7.41E-04	5.24E-07	2.62E-04	**1.04E-03**
Lloyd Lake	1.06E-05	1.21E-05	3.42E-06	6.40E-04	4.77E-07	2.16E-04	**8.83E-04**
Upper Bound Scenario							
Reference (Broach Lake)	1.05E-05	1.19E-05	3.11E-06	6.36E-04	4.75E-07	2.15E-04	**8.77E-04**
Patterson Lake North Arm - West Basin	4.73E-05	5.38E-05	2.95E-05	1.72E-03	1.76E-06	8.55E-04	**2.70E-03**
Patterson Lake South Arm	1.66E-05	1.89E-05	1.09E-05	8.19E-04	6.02E-07	3.05E-04	**1.17E-03**
Beet Lake	1.40E-05	1.59E-05	7.36E-06	7.41E-04	5.28E-07	2.63E-04	**1.04E-03**
Lloyd Lake	1.06E-05	1.21E-05	3.43E-06	6.40E-04	4.77E-07	2.16E-04	**8.83E-04**

Black Bear Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	7.81E-06	8.89E-06	1.88E-06	8.19E-04	8.32E-07	1.74E-04	**1.01E-03**
Patterson Lake North Arm - West Basin	2.23E-05	2.54E-05	3.20E-06	1.26E-03	1.04E-06	3.23E-04	**1.64E-03**
Beet Lake	9.24E-06	1.05E-05	2.69E-06	1.08E-03	1.23E-06	1.94E-04	**1.30E-03**
Lloyd Lake	7.90E-06	8.99E-06	1.94E-06	8.23E-04	8.34E-07	1.76E-04	**1.02E-03**
Upper Bound Scenario							
Reference (Broach Lake)	7.81E-06	8.89E-06	1.88E-06	8.19E-04	8.32E-07	1.74E-04	**1.01E-03**
Patterson Lake North Arm - West Basin	2.26E-05	2.58E-05	3.21E-06	1.26E-03	1.06E-06	3.82E-04	**1.70E-03**
Beet Lake	9.27E-06	1.06E-05	2.70E-06	1.08E-03	1.23E-06	1.95E-04	**1.30E-03**
Lloyd Lake	7.91E-06	9.00E-06	1.94E-06	8.23E-04	8.34E-07	1.76E-04	**1.02E-03**

Table C.19: Maximum Radiation Dose to Ecological Receptors for the Application Case and Upper Bound Scenario - Project Lifespan

Grey Wolf Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	3.26E-07	3.77E-07	1.17E-06	7.63E-04	1.92E-06	3.26E-04	**1.09E-03**
Patterson Lake North Arm - West Basin	6.21E-07	7.18E-07	1.56E-06	9.19E-04	2.02E-06	3.59E-04	**1.28E-03**
Lloyd Lake	3.29E-07	3.81E-07	1.19E-06	7.65E-04	1.92E-06	3.26E-04	**1.10E-03**
Upper Bound Scenario							
Reference (Broach Lake)	3.26E-07	3.77E-07	1.17E-06	7.63E-04	1.92E-06	3.26E-04	**1.09E-03**
Patterson Lake North Arm - West Basin	6.39E-07	7.38E-07	1.56E-06	9.19E-04	2.02E-06	3.71E-04	**1.29E-03**
Lloyd Lake	3.30E-07	3.82E-07	1.19E-06	7.65E-04	1.92E-06	3.26E-04	**1.10E-03**

Mink Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.76E-07	2.00E-07	2.51E-06	6.44E-05	2.38E-07	8.73E-04	**9.40E-04**
Patterson Lake North Arm - West Basin	1.15E-06	1.32E-06	1.23E-05	1.04E-04	3.23E-07	1.20E-03	**1.32E-03**
Patterson Lake South Arm	3.99E-07	4.55E-07	7.97E-06	7.64E-05	2.44E-07	8.95E-04	**9.80E-04**
Beet Lake	2.69E-07	3.07E-07	5.38E-06	6.97E-05	2.39E-07	8.76E-04	**9.52E-04**
Lloyd Lake	1.82E-07	2.07E-07	2.80E-06	6.48E-05	2.38E-07	8.73E-04	**9.41E-04**
Upper Bound Scenario							
Reference (Broach Lake)	1.76E-07	2.00E-07	2.51E-06	6.44E-05	2.38E-07	8.73E-04	**9.40E-04**
Patterson Lake North Arm - West Basin	2.29E-06	2.62E-06	1.25E-05	1.06E-04	6.21E-07	2.39E-03	**2.51E-03**
Patterson Lake South Arm	7.00E-07	7.99E-07	8.05E-06	7.68E-05	2.64E-07	9.75E-04	**1.06E-03**
Beet Lake	3.80E-07	4.33E-07	5.42E-06	6.99E-05	2.42E-07	8.87E-04	**9.63E-04**
Lloyd Lake	1.92E-07	2.19E-07	2.81E-06	6.48E-05	2.38E-07	8.73E-04	**9.42E-04**

Moose Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	9.50E-06	1.08E-05	4.80E-06	9.61E-04	1.30E-06	2.66E-04	**1.25E-03**
Patterson Lake North Arm - West Basin	4.24E-05	4.82E-05	3.75E-05	2.18E-03	2.14E-06	7.71E-04	**3.09E-03**
Patterson Lake South Arm	4.20E-05	4.78E-05	3.69E-05	1.97E-03	2.03E-06	7.67E-04	**2.87E-03**
Beet Lake	1.26E-05	1.44E-05	1.14E-05	1.08E-03	1.36E-06	3.10E-04	**1.43E-03**
Lloyd Lake	9.61E-06	1.09E-05	5.37E-06	9.66E-04	1.30E-06	2.68E-04	**1.26E-03**
Upper Bound Scenario							
Reference (Broach Lake)	9.50E-06	1.08E-05	4.80E-06	9.61E-04	1.30E-06	2.66E-04	**1.25E-03**
Patterson Lake North Arm - West Basin	4.44E-05	5.05E-05	3.77E-05	2.19E-03	3.22E-06	1.01E-03	**3.33E-03**
Patterson Lake South Arm	4.40E-05	5.01E-05	3.71E-05	1.98E-03	3.10E-06	1.00E-03	**3.11E-03**
Beet Lake	1.28E-05	1.46E-05	1.14E-05	1.08E-03	1.36E-06	3.11E-04	**1.43E-03**
Lloyd Lake	9.63E-06	1.10E-05	5.38E-06	9.66E-04	1.30E-06	2.68E-04	**1.26E-03**

Muskrat Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	5.56E-07	6.32E-07	8.41E-06	2.23E-04	1.03E-06	1.76E-03	**2.00E-03**
Patterson Lake North Arm - West Basin	5.07E-06	5.79E-06	4.71E-05	3.63E-04	1.46E-06	2.42E-03	**2.84E-03**
Patterson Lake South Arm	1.75E-06	2.00E-06	3.06E-05	2.72E-04	1.06E-06	1.81E-03	**2.11E-03**
Beet Lake	9.95E-07	1.13E-06	2.01E-05	2.44E-04	1.04E-06	1.77E-03	**2.04E-03**
Lloyd Lake	5.96E-07	6.78E-07	9.61E-06	2.25E-04	1.03E-06	1.76E-03	**2.00E-03**
Upper Bound Scenario							
Reference (Broach Lake)	5.56E-07	6.32E-07	8.41E-06	2.23E-04	1.03E-06	1.76E-03	**2.00E-03**
Patterson Lake North Arm - West Basin	1.31E-05	1.50E-05	4.76E-05	3.70E-04	3.15E-06	4.88E-03	**5.33E-03**
Patterson Lake South Arm	3.88E-06	4.43E-06	3.09E-05	2.74E-04	1.16E-06	1.97E-03	**2.28E-03**
Beet Lake	1.78E-06	2.03E-06	2.02E-05	2.45E-04	1.05E-06	1.79E-03	**2.06E-03**
Lloyd Lake	6.67E-07	7.59E-07	9.63E-06	2.25E-04	1.03E-06	1.76E-03	**2.00E-03**

Table C.19: Maximum Radiation Dose to Ecological Receptors for the Application Case and Upper Bound Scenario - Project Lifespan

Red Fox Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	5.92E-07	6.79E-07	6.84E-07	7.09E-04	1.59E-06	1.55E-05	**7.28E-04**
Patterson Lake North Arm - West Basin	2.67E-06	3.06E-06	2.86E-06	1.25E-03	1.95E-06	8.07E-05	**1.34E-03**
Patterson Lake South Arm	9.33E-07	1.07E-06	1.08E-06	7.97E-04	1.65E-06	2.61E-05	**8.28E-04**
Beet Lake	7.90E-07	9.06E-07	9.11E-07	7.60E-04	1.62E-06	2.17E-05	**7.86E-04**
Lloyd Lake	5.99E-07	6.87E-07	6.94E-07	7.10E-04	1.59E-06	1.57E-05	**7.30E-04**
Upper Bound Scenario							
Reference (Broach Lake)	5.92E-07	6.79E-07	6.84E-07	7.09E-04	1.59E-06	1.55E-05	**7.28E-04**
Patterson Lake North Arm - West Basin	2.70E-06	3.09E-06	2.86E-06	1.25E-03	1.95E-06	8.14E-05	**1.34E-03**
Patterson Lake South Arm	9.38E-07	1.08E-06	1.08E-06	7.97E-04	1.65E-06	2.62E-05	**8.28E-04**
Beet Lake	7.92E-07	9.08E-07	9.12E-07	7.60E-04	1.62E-06	2.17E-05	**7.86E-04**
Lloyd Lake	5.99E-07	6.87E-07	6.94E-07	7.10E-04	1.59E-06	1.57E-05	**7.30E-04**

Snowshoe Hare Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	9.84E-06	1.12E-05	1.96E-06	1.26E-03	1.96E-06	1.48E-04	**1.44E-03**
Patterson Lake North Arm - West Basin	4.32E-05	4.92E-05	1.82E-05	2.69E-03	2.76E-06	6.07E-04	**3.41E-03**
Patterson Lake South Arm	1.53E-05	1.74E-05	4.64E-06	1.50E-03	2.09E-06	2.23E-04	**1.76E-03**
Beet Lake	1.30E-05	1.48E-05	3.52E-06	1.40E-03	2.04E-06	1.92E-04	**1.62E-03**
Lloyd Lake	9.95E-06	1.13E-05	2.01E-06	1.27E-03	1.97E-06	1.50E-04	**1.44E-03**
Upper Bound Scenario							
Reference (Broach Lake)	9.84E-06	1.12E-05	1.96E-06	1.26E-03	1.96E-06	1.48E-04	**1.44E-03**
Patterson Lake North Arm - West Basin	4.32E-05	4.92E-05	1.82E-05	2.69E-03	2.76E-06	6.07E-04	**3.41E-03**
Patterson Lake South Arm	1.53E-05	1.74E-05	4.64E-06	1.50E-03	2.09E-06	2.23E-04	**1.76E-03**
Beet Lake	1.30E-05	1.48E-05	3.52E-06	1.40E-03	2.04E-06	1.92E-04	**1.62E-03**
Lloyd Lake	9.95E-06	1.13E-05	2.01E-06	1.27E-03	1.97E-06	1.50E-04	**1.44E-03**

Southern Red-Backed Vole Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	3.58E-06	4.08E-06	7.10E-07	9.01E-04	1.85E-06	5.26E-05	**9.64E-04**
Patterson Lake North Arm - West Basin	1.59E-05	1.82E-05	4.07E-06	1.67E-03	2.33E-06	1.96E-04	**1.91E-03**
Patterson Lake South Arm	5.59E-06	6.37E-06	1.28E-06	1.03E-03	1.93E-06	7.59E-05	**1.12E-03**
Beet Lake	4.75E-06	5.42E-06	1.04E-06	9.75E-04	1.90E-06	6.62E-05	**1.05E-03**
Lloyd Lake	3.62E-06	4.12E-06	7.22E-07	9.04E-04	1.85E-06	5.31E-05	**9.67E-04**
Upper Bound Scenario							
Reference (Broach Lake)	3.58E-06	4.08E-06	7.10E-07	9.01E-04	1.85E-06	5.26E-05	**9.64E-04**
Patterson Lake North Arm - West Basin	1.59E-05	1.82E-05	4.07E-06	1.67E-03	2.33E-06	1.96E-04	**1.91E-03**
Patterson Lake South Arm	5.60E-06	6.38E-06	1.28E-06	1.03E-03	1.93E-06	7.60E-05	**1.12E-03**
Beet Lake	4.75E-06	5.42E-06	1.04E-06	9.75E-04	1.90E-06	6.62E-05	**1.05E-03**
Lloyd Lake	3.62E-06	4.12E-06	7.22E-07	9.04E-04	1.85E-06	5.31E-05	**9.67E-04**

WoodLand Caribou Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	4.34E-06	4.94E-06	5.85E-06	7.54E-04	6.27E-06	3.51E-03	**4.28E-03**
Patterson Lake North Arm - West Basin	1.23E-05	1.40E-05	8.67E-05	3.59E-03	8.33E-06	3.97E-03	**7.69E-03**
Beet Lake	5.01E-06	5.70E-06	1.42E-05	1.00E-03	6.46E-06	3.56E-03	**4.59E-03**
Lloyd Lake	4.40E-06	5.01E-06	6.78E-06	7.72E-04	6.28E-06	3.51E-03	**4.31E-03**
Upper Bound Scenario							
Reference (Broach Lake)	4.34E-06	4.94E-06	5.85E-06	7.54E-04	6.27E-06	3.51E-03	**4.28E-03**
Patterson Lake North Arm - West Basin	1.47E-05	1.67E-05	8.69E-05	3.60E-03	8.87E-06	4.16E-03	**7.88E-03**
Beet Lake	5.20E-06	5.92E-06	1.43E-05	1.00E-03	6.46E-06	3.56E-03	**4.60E-03**
Lloyd Lake	4.44E-06	5.05E-06	6.78E-06	7.72E-04	6.28E-06	3.51E-03	**4.31E-03**

Table C.19: Maximum Radiation Dose to Ecological Receptors for the Application Case and Upper Bound Scenario - Project Lifespan

Grouse Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	2.34E-04	2.67E-04	1.70E-06	7.73E-04	1.88E-06	9.49E-04	**2.23E-03**
Patterson Lake North Arm - West Basin	1.03E-03	1.17E-03	9.22E-06	1.40E-03	2.58E-06	3.53E-03	**7.15E-03**
Patterson Lake South Arm	3.64E-04	4.14E-04	2.94E-06	8.75E-04	1.99E-06	1.37E-03	**3.03E-03**
Beet Lake	3.10E-04	3.53E-04	2.42E-06	8.32E-04	1.94E-06	1.19E-03	**2.69E-03**
Lloyd Lake	2.37E-04	2.69E-04	1.72E-06	7.75E-04	1.88E-06	9.57E-04	**2.24E-03**
Upper Bound Scenario							
Reference (Broach Lake)	2.34E-04	2.67E-04	1.70E-06	7.73E-04	1.88E-06	9.49E-04	**2.23E-03**
Patterson Lake North Arm - West Basin	1.03E-03	1.17E-03	9.22E-06	1.40E-03	2.58E-06	3.54E-03	**7.15E-03**
Patterson Lake South Arm	3.64E-04	4.15E-04	2.94E-06	8.75E-04	1.99E-06	1.37E-03	**3.03E-03**
Beet Lake	3.10E-04	3.53E-04	2.42E-06	8.32E-04	1.94E-06	1.19E-03	**2.69E-03**
Lloyd Lake	2.37E-04	2.69E-04	1.72E-06	7.75E-04	1.88E-06	9.57E-04	**2.24E-03**

Canada Goose Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	3.28E-05	3.74E-05	4.00E-07	6.64E-04	1.71E-06	1.34E-04	**8.70E-04**
Patterson Lake North Arm - West Basin	1.44E-04	1.64E-04	1.85E-06	1.12E-03	2.09E-06	5.24E-04	**1.95E-03**
Patterson Lake South Arm	5.10E-05	5.80E-05	6.46E-07	7.37E-04	1.77E-06	1.97E-04	**1.05E-03**
Beet Lake	4.34E-05	4.94E-05	5.42E-07	7.07E-04	1.74E-06	1.71E-04	**9.73E-04**
Lloyd Lake	3.32E-05	3.78E-05	4.05E-07	6.65E-04	1.71E-06	1.35E-04	**8.73E-04**
Upper Bound Scenario							
Reference (Broach Lake)	3.28E-05	3.74E-05	4.00E-07	6.64E-04	1.71E-06	1.34E-04	**8.70E-04**
Patterson Lake North Arm - West Basin	1.44E-04	1.64E-04	1.85E-06	1.12E-03	2.09E-06	5.26E-04	**1.95E-03**
Patterson Lake South Arm	5.11E-05	5.81E-05	6.46E-07	7.37E-04	1.77E-06	1.98E-04	**1.05E-03**
Beet Lake	4.34E-05	4.94E-05	5.43E-07	7.07E-04	1.74E-06	1.71E-04	**9.73E-04**
Lloyd Lake	3.32E-05	3.78E-05	4.05E-07	6.65E-04	1.71E-06	1.35E-04	**8.73E-04**

Little Brown Myotis Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.37E-07	1.55E-07	1.19E-05	1.36E-04	4.92E-07	3.09E-03	**3.24E-03**
Patterson Lake North Arm - West Basin	1.24E-06	1.41E-06	6.61E-05	2.19E-04	6.74E-07	4.22E-03	**4.51E-03**
Patterson Lake South Arm	4.27E-07	4.88E-07	4.27E-05	1.65E-04	5.04E-07	3.16E-03	**3.37E-03**
Beet Lake	2.44E-07	2.78E-07	2.81E-05	1.48E-04	4.94E-07	3.10E-03	**3.27E-03**
Lloyd Lake	1.46E-07	1.67E-07	1.36E-05	1.37E-04	4.92E-07	3.09E-03	**3.24E-03**
Upper Bound Scenario							
Reference (Broach Lake)	1.37E-07	1.55E-07	1.19E-05	1.36E-04	4.92E-07	3.09E-03	**3.24E-03**
Patterson Lake North Arm - West Basin	3.18E-06	3.63E-06	6.68E-05	2.22E-04	1.35E-06	8.46E-03	**8.76E-03**
Patterson Lake South Arm	9.45E-07	1.08E-06	4.32E-05	1.66E-04	5.49E-07	3.45E-03	**3.66E-03**
Beet Lake	4.33E-07	4.94E-07	2.83E-05	1.49E-04	5.00E-07	3.14E-03	**3.31E-03**
Lloyd Lake	1.64E-07	1.86E-07	1.36E-05	1.37E-04	4.92E-07	3.09E-03	**3.24E-03**

Loon Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.33E-06	1.51E-06	1.01E-06	6.06E-06	8.76E-08	2.97E-03	**2.98E-03**
Patterson Lake North Arm - West Basin	1.37E-05	1.57E-05	5.65E-06	9.94E-06	1.23E-07	4.09E-03	**4.14E-03**
Patterson Lake South Arm	4.59E-06	5.24E-06	3.63E-06	7.38E-06	8.99E-08	3.05E-03	**3.07E-03**
Beet Lake	2.53E-06	2.89E-06	2.39E-06	6.62E-06	8.79E-08	2.98E-03	**3.00E-03**
Lloyd Lake	1.44E-06	1.64E-06	1.15E-06	6.11E-06	8.76E-08	2.97E-03	**2.98E-03**
Upper Bound Scenario							
Reference (Broach Lake)	1.33E-06	1.51E-06	1.01E-06	6.06E-06	8.76E-08	2.97E-03	**2.98E-03**
Patterson Lake North Arm - West Basin	3.61E-05	4.12E-05	5.71E-06	1.01E-05	2.57E-07	8.35E-03	**8.45E-03**
Patterson Lake South Arm	1.03E-05	1.17E-05	3.67E-06	7.45E-06	9.84E-08	3.32E-03	**3.36E-03**
Beet Lake	4.61E-06	5.27E-06	2.41E-06	6.65E-06	8.91E-08	3.02E-03	**3.04E-03**
Lloyd Lake	1.63E-06	1.86E-06	1.15E-06	6.12E-06	8.76E-08	2.97E-03	**2.98E-03**

Table C.19: Maximum Radiation Dose to Ecological Receptors for the Application Case and Upper Bound Scenario - Project Lifespan

Mallard Total Dose Operations (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	1.40E-05	1.59E-05	9.79E-06	7.84E-05	1.23E-06	2.55E-02	**2.56E-02**
Patterson Lake North Arm - West Basin	1.27E-04	1.45E-04	5.46E-05	1.27E-04	1.73E-06	3.49E-02	**3.53E-02**
Patterson Lake South Arm	4.40E-05	5.02E-05	3.54E-05	9.52E-05	1.26E-06	2.61E-02	**2.63E-02**
Beet Lake	2.50E-05	2.85E-05	2.33E-05	8.56E-05	1.23E-06	2.55E-02	**2.57E-02**
Lloyd Lake	1.50E-05	1.71E-05	1.12E-05	7.91E-05	1.23E-06	2.55E-02	**2.56E-02**
Upper Bound Scenario							
Reference (Broach Lake)	1.40E-05	1.59E-05	9.79E-06	7.84E-05	1.23E-06	2.55E-02	**2.56E-02**
Patterson Lake North Arm - West Basin	3.29E-04	3.76E-04	5.51E-05	1.29E-04	3.66E-06	7.01E-02	**7.10E-02**
Patterson Lake South Arm	9.75E-05	1.11E-04	3.57E-05	9.60E-05	1.38E-06	2.84E-02	**2.88E-02**
Beet Lake	4.46E-05	5.09E-05	2.34E-05	8.59E-05	1.25E-06	2.59E-02	**2.61E-02**
Lloyd Lake	1.68E-05	1.91E-05	1.12E-05	7.92E-05	1.23E-06	2.55E-02	**2.56E-02**

Rusty Blackbird Total Dose Operations (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	1.01E-04	1.15E-04	2.74E-05	8.28E-04	3.65E-06	6.96E-02	**7.07E-02**
Patterson Lake North Arm - West Basin	5.07E-04	5.77E-04	1.39E-04	1.39E-03	4.70E-06	9.59E-02	**9.85E-02**
Patterson Lake South Arm	1.77E-04	2.01E-04	9.02E-05	9.31E-04	3.76E-06	7.15E-02	**7.29E-02**
Beet Lake	1.40E-04	1.59E-04	6.05E-05	8.84E-04	3.70E-06	7.00E-02	**7.12E-02**
Lloyd Lake	1.03E-04	1.17E-04	3.08E-05	8.30E-04	3.65E-06	6.97E-02	**7.07E-02**
Upper Bound Scenario							
Reference (Broach Lake)	1.01E-04	1.15E-04	2.74E-05	8.28E-04	3.65E-06	6.96E-02	**7.07E-02**
Patterson Lake North Arm - West Basin	6.81E-04	7.76E-04	1.41E-04	1.39E-03	6.99E-06	1.91E-01	**1.94E-01**
Patterson Lake South Arm	2.23E-04	2.54E-04	9.10E-05	9.32E-04	3.92E-06	7.78E-02	**7.93E-02**
Beet Lake	1.57E-04	1.78E-04	6.09E-05	8.85E-04	3.72E-06	7.08E-02	**7.21E-02**
Lloyd Lake	1.04E-04	1.19E-04	3.09E-05	8.30E-04	3.65E-06	6.97E-02	**7.08E-02**

Table C.20: Maximum Radiation Dose to Ecological Receptors for the Application Case and Upper Bound Scenario - Far-Future

Benthic Invertebrates Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	4.73E-09	6.18E-09	1.80E-08	8.07E-05	3.79E-05	1.72E-09	**1.19E-04**
Patterson Lake North Arm - West Basin	1.53E-07	2.01E-07	1.93E-08	1.04E-04	3.97E-05	1.80E-09	**1.44E-04**
Patterson Lake South Arm	4.58E-08	6.00E-08	1.88E-08	8.93E-05	3.80E-05	1.72E-09	**1.28E-04**
Beet Lake	2.00E-08	2.62E-08	1.84E-08	8.44E-05	3.79E-05	1.72E-09	**1.22E-04**
Lloyd Lake	6.11E-09	7.99E-09	1.81E-08	8.11E-05	3.79E-05	1.72E-09	**1.19E-04**
Upper Bound Scenario							
Reference (Broach Lake)	4.73E-09	6.18E-09	1.80E-08	8.07E-05	3.79E-05	1.72E-09	**1.19E-04**
Patterson Lake North Arm - West Basin	1.53E-07	2.01E-07	1.93E-08	1.04E-04	3.97E-05	1.80E-09	**1.44E-04**
Patterson Lake South Arm	4.58E-08	6.01E-08	1.88E-08	8.94E-05	3.80E-05	1.72E-09	**1.28E-04**
Beet Lake	2.00E-08	2.62E-08	1.84E-08	8.45E-05	3.79E-05	1.72E-09	**1.22E-04**
Lloyd Lake	6.11E-09	7.99E-09	1.81E-08	8.11E-05	3.79E-05	1.72E-09	**1.19E-04**

Zooplankton Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	2.05E-05	2.39E-05	2.94E-03	4.57E-03	2.80E-05	6.05E-02	**6.81E-02**
Patterson Lake North Arm - West Basin	6.63E-04	7.77E-04	3.15E-03	5.89E-03	2.93E-05	6.33E-02	**7.38E-02**
Patterson Lake South Arm	1.98E-04	2.32E-04	3.07E-03	5.05E-03	2.81E-05	6.07E-02	**6.93E-02**
Beet Lake	8.66E-05	1.01E-04	3.01E-03	4.78E-03	2.80E-05	6.05E-02	**6.85E-02**
Lloyd Lake	2.65E-05	3.09E-05	2.95E-03	4.59E-03	2.80E-05	6.05E-02	**6.81E-02**
Upper Bound Scenario							
Reference (Broach Lake)	2.05E-05	2.39E-05	2.94E-03	4.57E-03	2.80E-05	6.05E-02	**6.81E-02**
Patterson Lake North Arm - West Basin	6.64E-04	7.78E-04	3.15E-03	5.89E-03	2.93E-05	6.33E-02	**7.38E-02**
Patterson Lake South Arm	1.99E-04	2.33E-04	3.07E-03	5.06E-03	2.81E-05	6.07E-02	**6.93E-02**
Beet Lake	8.67E-05	1.01E-04	3.01E-03	4.78E-03	2.80E-05	6.05E-02	**6.85E-02**
Lloyd Lake	2.65E-05	3.09E-05	2.95E-03	4.59E-03	2.80E-05	6.05E-02	**6.81E-02**

Northern Pike Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	4.13E-06	4.70E-06	3.54E-05	2.22E-04	1.79E-06	5.64E-04	**8.33E-04**
Patterson Lake North Arm - West Basin	1.34E-04	1.53E-04	3.79E-05	2.87E-04	1.88E-06	5.90E-04	**1.20E-03**
Patterson Lake South Arm	4.00E-05	4.56E-05	3.69E-05	2.46E-04	1.80E-06	5.66E-04	**9.36E-04**
Beet Lake	1.74E-05	1.99E-05	3.62E-05	2.32E-04	1.79E-06	5.65E-04	**8.72E-04**
Lloyd Lake	5.33E-06	6.07E-06	3.55E-05	2.23E-04	1.79E-06	5.64E-04	**8.36E-04**
Upper Bound Scenario							
Reference (Broach Lake)	4.13E-06	4.70E-06	3.54E-05	2.22E-04	1.79E-06	5.64E-04	**8.33E-04**
Patterson Lake North Arm - West Basin	1.34E-04	1.53E-04	3.79E-05	2.87E-04	1.88E-06	5.90E-04	**1.20E-03**
Patterson Lake South Arm	4.00E-05	4.57E-05	3.69E-05	2.46E-04	1.80E-06	5.66E-04	**9.36E-04**
Beet Lake	1.75E-05	1.99E-05	3.62E-05	2.32E-04	1.79E-06	5.65E-04	**8.72E-04**
Lloyd Lake	5.34E-06	6.08E-06	3.55E-05	2.23E-04	1.79E-06	5.64E-04	**8.36E-04**

Whitefish Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	7.69E-07	8.97E-07	2.65E-05	1.86E-04	8.29E-07	4.31E-05	**2.58E-04**
Patterson Lake North Arm - West Basin	2.49E-05	2.91E-05	2.83E-05	2.39E-04	8.68E-07	4.51E-05	**3.68E-04**
Patterson Lake South Arm	7.44E-06	8.71E-06	2.76E-05	2.05E-04	8.32E-07	4.33E-05	**2.93E-04**
Beet Lake	3.25E-06	3.80E-06	2.71E-05	1.94E-04	8.30E-07	4.32E-05	**2.72E-04**
Lloyd Lake	9.93E-07	1.16E-06	2.66E-05	1.86E-04	8.29E-07	4.31E-05	**2.59E-04**
Upper Bound Scenario							
Reference (Broach Lake)	7.69E-07	8.97E-07	2.65E-05	1.86E-04	8.29E-07	4.31E-05	**2.58E-04**
Patterson Lake North Arm - West Basin	2.49E-05	2.92E-05	2.83E-05	2.39E-04	8.68E-07	4.51E-05	**3.68E-04**
Patterson Lake South Arm	7.45E-06	8.72E-06	2.76E-05	2.05E-04	8.32E-07	4.33E-05	**2.93E-04**
Beet Lake	3.25E-06	3.81E-06	2.71E-05	1.94E-04	8.30E-07	4.32E-05	**2.72E-04**
Lloyd Lake	9.94E-07	1.16E-06	2.66E-05	1.86E-04	8.29E-07	4.31E-05	**2.59E-04**

Table C.20: Maximum Radiation Dose to Ecological Receptors for the Application Case and Upper Bound Scenario - Far-Future

Macrophytes Total Dose Far Future (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	1.04E-05	1.18E-05	1.37E-03	2.99E-03	5.06E-05	1.10E-03	**5.53E-03**
Patterson Lake North Arm - West Basin	3.37E-04	3.85E-04	1.47E-03	3.85E-03	5.30E-05	1.15E-03	**7.25E-03**
Patterson Lake South Arm	1.01E-04	1.15E-04	1.43E-03	3.31E-03	5.08E-05	1.10E-03	**6.11E-03**
Beet Lake	4.40E-05	5.02E-05	1.40E-03	3.13E-03	5.07E-05	1.10E-03	**5.77E-03**
Lloyd Lake	1.34E-05	1.53E-05	1.37E-03	3.00E-03	5.06E-05	1.10E-03	**5.56E-03**
Upper Bound Scenario							
Reference (Broach Lake)	1.04E-05	1.18E-05	1.37E-03	2.99E-03	5.06E-05	1.10E-03	**5.53E-03**
Patterson Lake North Arm - West Basin	3.37E-04	3.85E-04	1.47E-03	3.86E-03	5.30E-05	1.15E-03	**7.25E-03**
Patterson Lake South Arm	1.01E-04	1.15E-04	1.43E-03	3.31E-03	5.08E-05	1.10E-03	**6.11E-03**
Beet Lake	4.40E-05	5.02E-05	1.40E-03	3.13E-03	5.07E-05	1.10E-03	**5.77E-03**
Lloyd Lake	1.34E-05	1.53E-05	1.37E-03	3.00E-03	5.06E-05	1.10E-03	**5.56E-03**

Phytoplankton Total Dose Far Future (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	1.04E-05	1.18E-05	1.36E-03	3.00E-03	1.93E-05	1.11E-03	**5.51E-03**
Patterson Lake North Arm - West Basin	3.37E-04	3.84E-04	1.46E-03	3.86E-03	2.02E-05	1.16E-03	**7.22E-03**
Patterson Lake South Arm	1.01E-04	1.15E-04	1.42E-03	3.32E-03	1.94E-05	1.11E-03	**6.08E-03**
Beet Lake	4.39E-05	5.01E-05	1.39E-03	3.13E-03	1.94E-05	1.11E-03	**5.75E-03**
Lloyd Lake	1.34E-05	1.53E-05	1.37E-03	3.01E-03	1.93E-05	1.11E-03	**5.53E-03**
Upper Bound Scenario							
Reference (Broach Lake)	1.04E-05	1.18E-05	1.36E-03	3.00E-03	1.93E-05	1.11E-03	**5.51E-03**
Patterson Lake North Arm - West Basin	3.37E-04	3.84E-04	1.46E-03	3.87E-03	2.03E-05	1.16E-03	**7.22E-03**
Patterson Lake South Arm	1.01E-04	1.15E-04	1.42E-03	3.32E-03	1.94E-05	1.11E-03	**6.08E-03**
Beet Lake	4.40E-05	5.01E-05	1.39E-03	3.13E-03	1.94E-05	1.11E-03	**5.75E-03**
Lloyd Lake	1.34E-05	1.53E-05	1.37E-03	3.01E-03	1.93E-05	1.11E-03	**5.53E-03**

Terrestrial Invertebrate Total Dose Far Future (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	1.57E-05	1.78E-05	1.15E-04	5.73E-03	6.72E-06	2.28E-05	**5.91E-03**
Patterson Lake North Arm - West Basin	2.13E-05	2.42E-05	1.52E-04	8.26E-03	6.72E-06	2.28E-05	**8.49E-03**
Patterson Lake South Arm	1.66E-05	1.89E-05	1.21E-04	6.15E-03	6.72E-06	2.28E-05	**6.33E-03**
Beet Lake	1.62E-05	1.84E-05	1.19E-04	5.97E-03	6.72E-06	2.28E-05	**6.16E-03**
Lloyd Lake	1.57E-05	1.79E-05	1.15E-04	5.74E-03	6.72E-06	2.28E-05	**5.92E-03**
Upper Bound Scenario							
Reference (Broach Lake)	1.57E-05	1.78E-05	1.15E-04	5.73E-03	6.72E-06	2.28E-05	**5.91E-03**
Patterson Lake North Arm - West Basin	2.13E-05	2.42E-05	1.52E-04	8.26E-03	6.72E-06	2.28E-05	**8.49E-03**
Patterson Lake South Arm	1.66E-05	1.89E-05	1.21E-04	6.15E-03	6.72E-06	2.28E-05	**6.33E-03**
Beet Lake	1.62E-05	1.84E-05	1.19E-04	5.97E-03	6.72E-06	2.28E-05	**6.16E-03**
Lloyd Lake	1.57E-05	1.79E-05	1.15E-04	5.74E-03	6.72E-06	2.28E-05	**5.92E-03**

Browse Total Dose Far Future (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Patterson Lake North Arm - West Basin	7.83E-04	8.91E-04	1.36E-04	1.15E-02	1.65E-04	6.33E-04	**1.41E-02**
Patterson Lake South Arm	6.11E-04	6.96E-04	1.08E-04	8.55E-03	1.65E-04	6.33E-04	**1.08E-02**
Upper Bound Scenario							
Patterson Lake North Arm - West Basin	7.83E-04	8.91E-04	1.36E-04	1.15E-02	1.65E-04	6.33E-04	**1.41E-02**
Patterson Lake South Arm	6.11E-04	6.96E-04	1.08E-04	8.55E-03	1.65E-04	6.33E-04	**1.08E-02**

Table C.20: Maximum Radiation Dose to Ecological Receptors for the Application Case and Upper Bound Scenario - Far-Future

Labrador Tea Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Patterson Lake North Arm - West Basin	7.83E-04	8.91E-04	1.36E-04	1.15E-02	1.65E-04	6.33E-04	**1.41E-02**
Patterson Lake South Arm	6.11E-04	6.96E-04	1.08E-04	8.55E-03	1.65E-04	6.33E-04	**1.08E-02**
Upper Bound Scenario							
Patterson Lake North Arm - West Basin	7.83E-04	8.91E-04	1.36E-04	1.15E-02	1.65E-04	6.33E-04	**1.41E-02**
Patterson Lake South Arm	6.11E-04	6.96E-04	1.08E-04	8.55E-03	1.65E-04	6.33E-04	**1.08E-02**

Lichen Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Patterson Lake North Arm - West Basin	1.21E-04	1.37E-04	4.38E-04	4.44E-03	8.33E-04	1.06E-01	**1.12E-01**
Patterson Lake South Arm	1.21E-04	1.37E-04	4.38E-04	4.44E-03	8.33E-04	1.06E-01	**1.12E-01**
Upper Bound Scenario							
Patterson Lake North Arm - West Basin	1.21E-04	1.37E-04	4.38E-04	4.44E-03	8.33E-04	1.06E-01	**1.12E-01**
Patterson Lake South Arm	1.21E-04	1.37E-04	4.38E-04	4.44E-03	8.33E-04	1.06E-01	**1.12E-01**

Blueberries Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Patterson Lake North Arm - West Basin	3.89E-04	4.43E-04	5.39E-05	5.59E-03	3.00E-06	3.16E-04	**6.80E-03**
Patterson Lake South Arm	3.04E-04	3.46E-04	4.29E-05	4.16E-03	3.00E-06	3.16E-04	**5.17E-03**
Upper Bound Scenario							
Patterson Lake North Arm - West Basin	3.89E-04	4.43E-04	5.39E-05	5.59E-03	3.00E-06	3.16E-04	**6.80E-03**
Patterson Lake South Arm	3.04E-04	3.46E-04	4.29E-05	4.16E-03	3.00E-06	3.16E-04	**5.17E-03**

Beaver Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.05E-05	1.19E-05	3.11E-06	6.36E-04	4.75E-07	2.15E-04	**8.77E-04**
Patterson Lake North Arm - West Basin	1.61E-05	1.84E-05	3.68E-06	9.09E-04	4.90E-07	2.18E-04	**1.17E-03**
Patterson Lake South Arm	1.16E-05	1.32E-05	3.26E-06	6.84E-04	4.76E-07	2.15E-04	**9.27E-04**
Beet Lake	1.10E-05	1.26E-05	3.19E-06	6.63E-04	4.75E-07	2.15E-04	**9.05E-04**
Lloyd Lake	1.05E-05	1.20E-05	3.11E-06	6.37E-04	4.75E-07	2.15E-04	**8.78E-04**
Upper Bound Scenario							
Reference (Broach Lake)	1.05E-05	1.19E-05	3.11E-06	6.36E-04	4.75E-07	2.15E-04	**8.77E-04**
Patterson Lake North Arm - West Basin	1.61E-05	1.84E-05	3.68E-06	9.09E-04	4.90E-07	2.18E-04	**1.17E-03**
Patterson Lake South Arm	1.16E-05	1.32E-05	3.26E-06	6.84E-04	4.76E-07	2.15E-04	**9.27E-04**
Beet Lake	1.10E-05	1.26E-05	3.19E-06	6.63E-04	4.75E-07	2.15E-04	**9.05E-04**
Lloyd Lake	1.05E-05	1.20E-05	3.11E-06	6.37E-04	4.75E-07	2.15E-04	**8.78E-04**

Black Bear Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	7.81E-06	8.89E-06	1.88E-06	8.19E-04	8.32E-07	1.74E-04	**1.01E-03**
Patterson Lake North Arm - West Basin	9.86E-06	1.12E-05	2.21E-06	1.01E-03	8.33E-07	1.76E-04	**1.21E-03**
Beet Lake	8.12E-06	9.24E-06	2.52E-06	1.05E-03	1.21E-06	1.82E-04	**1.26E-03**
Lloyd Lake	7.83E-06	8.91E-06	1.91E-06	8.21E-04	8.33E-07	1.75E-04	**1.02E-03**
Upper Bound Scenario							
Reference (Broach Lake)	7.81E-06	8.89E-06	1.88E-06	8.19E-04	8.32E-07	1.74E-04	**1.01E-03**
Patterson Lake North Arm - West Basin	9.86E-06	1.12E-05	2.21E-06	1.01E-03	8.33E-07	1.76E-04	**1.21E-03**
Beet Lake	8.12E-06	9.24E-06	2.52E-06	1.05E-03	1.21E-06	1.82E-04	**1.26E-03**
Lloyd Lake	7.83E-06	8.91E-06	1.91E-06	8.21E-04	8.33E-07	1.75E-04	**1.02E-03**

Table C.20: Maximum Radiation Dose to Ecological Receptors for the Application Case and Upper Bound Scenario - Far-Future

Grey Wolf Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	3.26E-07	3.77E-07	1.17E-06	7.63E-04	1.92E-06	3.26E-04	**1.09E-03**
Patterson Lake North Arm - West Basin	3.90E-07	4.50E-07	1.26E-06	8.45E-04	1.92E-06	3.27E-04	**1.18E-03**
Lloyd Lake	3.27E-07	3.79E-07	1.18E-06	7.64E-04	1.92E-06	3.26E-04	**1.09E-03**
Upper Bound Scenario							
Reference (Broach Lake)	3.26E-07	3.77E-07	1.17E-06	7.63E-04	1.92E-06	3.26E-04	**1.09E-03**
Patterson Lake North Arm - West Basin	3.90E-07	4.50E-07	1.26E-06	8.45E-04	1.92E-06	3.27E-04	**1.18E-03**
Lloyd Lake	3.27E-07	3.79E-07	1.18E-06	7.64E-04	1.92E-06	3.26E-04	**1.09E-03**

Mink Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.76E-07	2.00E-07	2.51E-06	6.44E-05	2.38E-07	8.73E-04	**9.40E-04**
Patterson Lake North Arm - West Basin	2.66E-06	3.04E-06	2.79E-06	8.52E-05	2.48E-07	9.13E-04	**1.01E-03**
Patterson Lake South Arm	8.59E-07	9.81E-07	2.62E-06	7.07E-05	2.38E-07	8.75E-04	**9.51E-04**
Beet Lake	4.31E-07	4.92E-07	2.57E-06	6.72E-05	2.38E-07	8.73E-04	**9.44E-04**
Lloyd Lake	1.98E-07	2.26E-07	2.51E-06	6.46E-05	2.38E-07	8.73E-04	**9.40E-04**
Upper Bound Scenario							
Reference (Broach Lake)	1.76E-07	2.00E-07	2.51E-06	6.44E-05	2.38E-07	8.73E-04	**9.40E-04**
Patterson Lake North Arm - West Basin	2.66E-06	3.04E-06	2.79E-06	8.52E-05	2.48E-07	9.13E-04	**1.01E-03**
Patterson Lake South Arm	8.60E-07	9.82E-07	2.62E-06	7.07E-05	2.38E-07	8.75E-04	**9.51E-04**
Beet Lake	4.31E-07	4.92E-07	2.57E-06	6.72E-05	2.38E-07	8.73E-04	**9.44E-04**
Lloyd Lake	1.98E-07	2.26E-07	2.51E-06	6.46E-05	2.38E-07	8.73E-04	**9.40E-04**

Moose Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	9.50E-06	1.08E-05	4.80E-06	9.61E-04	1.30E-06	2.66E-04	**1.25E-03**
Patterson Lake North Arm - West Basin	1.69E-05	1.92E-05	5.47E-06	1.37E-03	1.32E-06	2.73E-04	**1.69E-03**
Patterson Lake South Arm	1.67E-05	1.91E-05	5.28E-06	1.23E-03	1.32E-06	2.72E-04	**1.55E-03**
Beet Lake	1.02E-05	1.16E-05	4.92E-06	1.00E-03	1.30E-06	2.67E-04	**1.30E-03**
Lloyd Lake	9.55E-06	1.09E-05	4.81E-06	9.63E-04	1.30E-06	2.66E-04	**1.26E-03**
Upper Bound Scenario							
Reference (Broach Lake)	9.50E-06	1.08E-05	4.80E-06	9.61E-04	1.30E-06	2.66E-04	**1.25E-03**
Patterson Lake North Arm - West Basin	1.69E-05	1.92E-05	5.47E-06	1.37E-03	1.32E-06	2.73E-04	**1.69E-03**
Patterson Lake South Arm	1.68E-05	1.91E-05	5.28E-06	1.23E-03	1.32E-06	2.72E-04	**1.55E-03**
Beet Lake	1.02E-05	1.16E-05	4.92E-06	1.00E-03	1.30E-06	2.67E-04	**1.30E-03**
Lloyd Lake	9.55E-06	1.09E-05	4.81E-06	9.63E-04	1.30E-06	2.66E-04	**1.26E-03**

Muskrat Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	5.56E-07	6.32E-07	8.41E-06	2.23E-04	1.03E-06	1.76E-03	**2.00E-03**
Patterson Lake North Arm - West Basin	1.80E-05	2.06E-05	8.99E-06	2.88E-04	1.08E-06	1.84E-03	**2.18E-03**
Patterson Lake South Arm	5.38E-06	6.14E-06	8.77E-06	2.47E-04	1.04E-06	1.77E-03	**2.04E-03**
Beet Lake	2.35E-06	2.68E-06	8.60E-06	2.33E-04	1.03E-06	1.76E-03	**2.01E-03**
Lloyd Lake	7.18E-07	8.18E-07	8.43E-06	2.24E-04	1.03E-06	1.76E-03	**2.00E-03**
Upper Bound Scenario							
Reference (Broach Lake)	5.56E-07	6.32E-07	8.41E-06	2.23E-04	1.03E-06	1.76E-03	**2.00E-03**
Patterson Lake North Arm - West Basin	1.80E-05	2.06E-05	8.99E-06	2.88E-04	1.08E-06	1.84E-03	**2.18E-03**
Patterson Lake South Arm	5.38E-06	6.15E-06	8.77E-06	2.47E-04	1.04E-06	1.77E-03	**2.04E-03**
Beet Lake	2.35E-06	2.68E-06	8.60E-06	2.33E-04	1.03E-06	1.76E-03	**2.01E-03**
Lloyd Lake	7.18E-07	8.18E-07	8.43E-06	2.24E-04	1.03E-06	1.76E-03	**2.00E-03**

Table C.20: Maximum Radiation Dose to Ecological Receptors for the Application Case and Upper Bound Scenario - Far-Future

Red Fox Total Dose Far Future (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	5.92E-07	6.79E-07	6.84E-07	7.09E-04	1.59E-06	1.55E-05	**7.28E-04**
Patterson Lake North Arm - West Basin	8.41E-07	9.64E-07	9.00E-07	1.02E-03	1.59E-06	1.55E-05	**1.04E-03**
Patterson Lake South Arm	6.37E-07	7.30E-07	7.20E-07	7.59E-04	1.59E-06	1.55E-05	**7.79E-04**
Beet Lake	6.16E-07	7.06E-07	7.05E-07	7.38E-04	1.59E-06	1.55E-05	**7.57E-04**
Lloyd Lake	5.93E-07	6.80E-07	6.85E-07	7.10E-04	1.59E-06	1.55E-05	**7.29E-04**
Upper Bound Scenario							
Reference (Broach Lake)	5.92E-07	6.79E-07	6.84E-07	7.09E-04	1.59E-06	1.55E-05	**7.28E-04**
Patterson Lake North Arm - West Basin	8.41E-07	9.64E-07	9.00E-07	1.02E-03	1.59E-06	1.55E-05	**1.04E-03**
Patterson Lake South Arm	6.37E-07	7.30E-07	7.20E-07	7.59E-04	1.59E-06	1.55E-05	**7.79E-04**
Beet Lake	6.16E-07	7.06E-07	7.05E-07	7.38E-04	1.59E-06	1.55E-05	**7.57E-04**
Lloyd Lake	5.93E-07	6.80E-07	6.85E-07	7.10E-04	1.59E-06	1.55E-05	**7.29E-04**

Snowshoe Hare Total Dose Far Future (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	9.84E-06	1.12E-05	1.96E-06	1.26E-03	1.96E-06	1.48E-04	**1.44E-03**
Patterson Lake North Arm - West Basin	1.34E-05	1.52E-05	2.59E-06	1.82E-03	1.96E-06	1.48E-04	**2.00E-03**
Patterson Lake South Arm	1.04E-05	1.19E-05	2.06E-06	1.35E-03	1.96E-06	1.48E-04	**1.53E-03**
Beet Lake	1.02E-05	1.16E-05	2.02E-06	1.32E-03	1.96E-06	1.48E-04	**1.49E-03**
Lloyd Lake	9.85E-06	1.12E-05	1.96E-06	1.26E-03	1.96E-06	1.48E-04	**1.44E-03**
Upper Bound Scenario							
Reference (Broach Lake)	9.84E-06	1.12E-05	1.96E-06	1.26E-03	1.96E-06	1.48E-04	**1.44E-03**
Patterson Lake North Arm - West Basin	1.34E-05	1.52E-05	2.59E-06	1.82E-03	1.96E-06	1.48E-04	**2.00E-03**
Patterson Lake South Arm	1.04E-05	1.19E-05	2.06E-06	1.35E-03	1.96E-06	1.48E-04	**1.53E-03**
Beet Lake	1.02E-05	1.16E-05	2.02E-06	1.32E-03	1.96E-06	1.48E-04	**1.49E-03**
Lloyd Lake	9.85E-06	1.12E-05	1.96E-06	1.26E-03	1.96E-06	1.48E-04	**1.44E-03**

Southern Red-Backed Vole Total Dose Far Future (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	3.58E-06	4.08E-06	7.10E-07	9.01E-04	1.85E-06	5.26E-05	**9.64E-04**
Patterson Lake North Arm - West Basin	4.87E-06	5.55E-06	9.37E-07	1.30E-03	1.85E-06	5.26E-05	**1.36E-03**
Patterson Lake South Arm	3.79E-06	4.32E-06	7.47E-07	9.66E-04	1.85E-06	5.26E-05	**1.03E-03**
Beet Lake	3.70E-06	4.22E-06	7.31E-07	9.39E-04	1.85E-06	5.26E-05	**1.00E-03**
Lloyd Lake	3.58E-06	4.08E-06	7.10E-07	9.03E-04	1.85E-06	5.26E-05	**9.65E-04**
Upper Bound Scenario							
Reference (Broach Lake)	3.58E-06	4.08E-06	7.10E-07	9.01E-04	1.85E-06	5.26E-05	**9.64E-04**
Patterson Lake North Arm - West Basin	4.87E-06	5.55E-06	9.37E-07	1.30E-03	1.85E-06	5.26E-05	**1.36E-03**
Patterson Lake South Arm	3.79E-06	4.32E-06	7.47E-07	9.66E-04	1.85E-06	5.26E-05	**1.03E-03**
Beet Lake	3.70E-06	4.22E-06	7.31E-07	9.39E-04	1.85E-06	5.26E-05	**1.00E-03**
Lloyd Lake	3.58E-06	4.08E-06	7.10E-07	9.03E-04	1.85E-06	5.26E-05	**9.65E-04**

WoodLand Caribou Total Dose Far Future (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	4.34E-06	4.94E-06	5.85E-06	7.54E-04	6.27E-06	3.51E-03	**4.28E-03**
Patterson Lake North Arm - West Basin	1.01E-05	1.16E-05	6.35E-06	9.11E-04	6.31E-06	3.53E-03	**4.47E-03**
Beet Lake	4.82E-06	5.48E-06	5.92E-06	7.67E-04	6.29E-06	3.52E-03	**4.31E-03**
Lloyd Lake	4.43E-06	5.04E-06	5.86E-06	7.55E-04	6.27E-06	3.51E-03	**4.29E-03**
Upper Bound Scenario							
Reference (Broach Lake)	4.34E-06	4.94E-06	5.85E-06	7.54E-04	6.27E-06	3.51E-03	**4.28E-03**
Patterson Lake North Arm - West Basin	1.01E-05	1.16E-05	6.35E-06	9.11E-04	6.31E-06	3.53E-03	**4.47E-03**
Beet Lake	4.82E-06	5.48E-06	5.92E-06	7.67E-04	6.29E-06	3.52E-03	**4.31E-03**
Lloyd Lake	4.43E-06	5.04E-06	5.86E-06	7.55E-04	6.27E-06	3.51E-03	**4.29E-03**

Table C.20: Maximum Radiation Dose to Ecological Receptors for the Application Case and Upper Bound Scenario - Far-Future

Grouse Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	2.34E-04	2.67E-04	1.70E-06	7.73E-04	1.88E-06	9.49E-04	**2.23E-03**
Patterson Lake North Arm - West Basin	3.18E-04	3.62E-04	2.24E-06	1.11E-03	1.88E-06	9.49E-04	**2.75E-03**
Patterson Lake South Arm	2.48E-04	2.82E-04	1.79E-06	8.28E-04	1.88E-06	9.49E-04	**2.31E-03**
Beet Lake	2.42E-04	2.76E-04	1.75E-06	8.05E-04	1.88E-06	9.49E-04	**2.28E-03**
Lloyd Lake	2.35E-04	2.67E-04	1.70E-06	7.74E-04	1.88E-06	9.49E-04	**2.23E-03**
Upper Bound Scenario							
Reference (Broach Lake)	2.34E-04	2.67E-04	1.70E-06	7.73E-04	1.88E-06	9.49E-04	**2.23E-03**
Patterson Lake North Arm - West Basin	3.18E-04	3.62E-04	2.24E-06	1.11E-03	1.88E-06	9.49E-04	**2.75E-03**
Patterson Lake South Arm	2.48E-04	2.82E-04	1.79E-06	8.28E-04	1.88E-06	9.49E-04	**2.31E-03**
Beet Lake	2.42E-04	2.76E-04	1.75E-06	8.05E-04	1.88E-06	9.49E-04	**2.28E-03**
Lloyd Lake	2.35E-04	2.67E-04	1.70E-06	7.74E-04	1.88E-06	9.49E-04	**2.23E-03**

Canada Goose Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	3.28E-05	3.74E-05	4.00E-07	6.64E-04	1.71E-06	1.34E-04	**8.70E-04**
Patterson Lake North Arm - West Basin	4.50E-05	5.12E-05	5.28E-07	9.56E-04	1.71E-06	1.34E-04	**1.19E-03**
Patterson Lake South Arm	3.49E-05	3.97E-05	4.21E-07	7.11E-04	1.71E-06	1.34E-04	**9.22E-04**
Beet Lake	3.40E-05	3.87E-05	4.12E-07	6.91E-04	1.71E-06	1.34E-04	**9.00E-04**
Lloyd Lake	3.29E-05	3.74E-05	4.00E-07	6.64E-04	1.71E-06	1.34E-04	**8.71E-04**
Upper Bound Scenario							
Reference (Broach Lake)	3.28E-05	3.74E-05	4.00E-07	6.64E-04	1.71E-06	1.34E-04	**8.70E-04**
Patterson Lake North Arm - West Basin	4.50E-05	5.12E-05	5.28E-07	9.56E-04	1.71E-06	1.34E-04	**1.19E-03**
Patterson Lake South Arm	3.49E-05	3.97E-05	4.21E-07	7.11E-04	1.71E-06	1.34E-04	**9.22E-04**
Beet Lake	3.40E-05	3.87E-05	4.12E-07	6.91E-04	1.71E-06	1.34E-04	**9.00E-04**
Lloyd Lake	3.29E-05	3.74E-05	4.00E-07	6.64E-04	1.71E-06	1.34E-04	**8.71E-04**

Little Brown Myotis Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.37E-07	1.55E-07	1.19E-05	1.36E-04	4.92E-07	3.09E-03	**3.23E-03**
Patterson Lake North Arm - West Basin	4.42E-06	5.05E-06	1.27E-05	1.76E-04	5.15E-07	3.23E-03	**3.43E-03**
Patterson Lake South Arm	1.32E-06	1.51E-06	1.24E-05	1.51E-04	4.93E-07	3.10E-03	**3.26E-03**
Beet Lake	5.78E-07	6.59E-07	1.22E-05	1.42E-04	4.92E-07	3.09E-03	**3.24E-03**
Lloyd Lake	1.77E-07	2.01E-07	1.19E-05	1.37E-04	4.92E-07	3.09E-03	**3.24E-03**
Upper Bound Scenario							
Reference (Broach Lake)	1.37E-07	1.55E-07	1.19E-05	1.36E-04	4.92E-07	3.09E-03	**3.23E-03**
Patterson Lake North Arm - West Basin	4.43E-06	5.06E-06	1.27E-05	1.76E-04	5.15E-07	3.23E-03	**3.43E-03**
Patterson Lake South Arm	1.32E-06	1.51E-06	1.24E-05	1.51E-04	4.94E-07	3.10E-03	**3.26E-03**
Beet Lake	5.78E-07	6.60E-07	1.22E-05	1.42E-04	4.92E-07	3.09E-03	**3.24E-03**
Lloyd Lake	1.77E-07	2.01E-07	1.19E-05	1.37E-04	4.92E-07	3.09E-03	**3.24E-03**

Loon Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.33E-06	1.51E-06	1.01E-06	6.06E-06	8.76E-08	2.97E-03	**2.98E-03**
Patterson Lake North Arm - West Basin	4.31E-05	4.92E-05	1.08E-06	7.81E-06	9.16E-08	3.11E-03	**3.21E-03**
Patterson Lake South Arm	1.29E-05	1.47E-05	1.05E-06	6.70E-06	8.78E-08	2.98E-03	**3.02E-03**
Beet Lake	5.62E-06	6.42E-06	1.03E-06	6.34E-06	8.76E-08	2.97E-03	**2.99E-03**
Lloyd Lake	1.72E-06	1.96E-06	1.01E-06	6.09E-06	8.76E-08	2.97E-03	**2.98E-03**
Upper Bound Scenario							
Reference (Broach Lake)	1.33E-06	1.51E-06	1.01E-06	6.06E-06	8.76E-08	2.97E-03	**2.98E-03**
Patterson Lake North Arm - West Basin	4.31E-05	4.92E-05	1.08E-06	7.82E-06	9.16E-08	3.11E-03	**3.21E-03**
Patterson Lake South Arm	1.29E-05	1.47E-05	1.05E-06	6.71E-06	8.78E-08	2.98E-03	**3.02E-03**
Beet Lake	5.63E-06	6.42E-06	1.03E-06	6.34E-06	8.76E-08	2.97E-03	**2.99E-03**
Lloyd Lake	1.72E-06	1.96E-06	1.01E-06	6.09E-06	8.76E-08	2.97E-03	**2.98E-03**

Table C.20: Maximum Radiation Dose to Ecological Receptors for the Application Case and Upper Bound Scenario - Far-Future

Mallard Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.40E-05	1.59E-05	9.79E-06	7.84E-05	1.23E-06	2.55E-02	**2.56E-02**
Patterson Lake North Arm - West Basin	4.53E-04	5.17E-04	1.05E-05	1.01E-04	1.29E-06	2.66E-02	**2.77E-02**
Patterson Lake South Arm	1.35E-04	1.55E-04	1.02E-05	8.68E-05	1.23E-06	2.55E-02	**2.59E-02**
Beet Lake	5.91E-05	6.75E-05	1.00E-05	8.20E-05	1.23E-06	2.55E-02	**2.57E-02**
Lloyd Lake	1.81E-05	2.06E-05	9.82E-06	7.88E-05	1.23E-06	2.55E-02	**2.56E-02**
Upper Bound Scenario							
Reference (Broach Lake)	1.40E-05	1.59E-05	9.79E-06	7.84E-05	1.23E-06	2.55E-02	**2.56E-02**
Patterson Lake North Arm - West Basin	4.53E-04	5.17E-04	1.05E-05	1.01E-04	1.29E-06	2.66E-02	**2.77E-02**
Patterson Lake South Arm	1.35E-04	1.55E-04	1.02E-05	8.68E-05	1.23E-06	2.55E-02	**2.59E-02**
Beet Lake	5.91E-05	6.75E-05	1.00E-05	8.20E-05	1.23E-06	2.55E-02	**2.57E-02**
Lloyd Lake	1.81E-05	2.06E-05	9.82E-06	7.88E-05	1.23E-06	2.55E-02	**2.56E-02**

Rusty Blackbird Total Dose Far Future (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.01E-04	1.15E-04	2.74E-05	8.28E-04	3.65E-06	6.96E-02	**7.07E-02**
Patterson Lake North Arm - West Basin	5.15E-04	5.88E-04	3.02E-05	1.18E-03	3.73E-06	7.28E-02	**7.52E-02**
Patterson Lake South Arm	2.12E-04	2.42E-04	2.87E-05	8.91E-04	3.65E-06	6.99E-02	**7.12E-02**
Beet Lake	1.43E-04	1.63E-04	2.81E-05	8.63E-04	3.65E-06	6.97E-02	**7.09E-02**
Lloyd Lake	1.04E-04	1.19E-04	2.75E-05	8.29E-04	3.65E-06	6.96E-02	**7.07E-02**
Upper Bound Scenario							
Reference (Broach Lake)	1.01E-04	1.15E-04	2.74E-05	8.28E-04	3.65E-06	6.96E-02	**7.07E-02**
Patterson Lake North Arm - West Basin	5.16E-04	5.89E-04	3.02E-05	1.18E-03	3.73E-06	7.29E-02	**7.52E-02**
Patterson Lake South Arm	2.12E-04	2.42E-04	2.87E-05	8.91E-04	3.65E-06	6.99E-02	**7.12E-02**
Beet Lake	1.43E-04	1.63E-04	2.81E-05	8.63E-04	3.65E-06	6.97E-02	**7.09E-02**
Lloyd Lake	1.04E-04	1.19E-04	2.75E-05	8.29E-04	3.65E-06	6.96E-02	**7.07E-02**

Table C.21: Maximum Radiation Dose to Ecological Receptors for the RFD Scenario - Project Lifespan and Far-Future

Benthic Invertebrates Total Dose RFD Case (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	4.73E-09	6.18E-09	1.80E-08	8.07E-05	3.79E-05	1.72E-09	**1.19E-04**
Patterson Lake North Arm - West Basin	4.26E-08	5.58E-08	1.00E-07	1.30E-04	5.19E-05	2.35E-09	**1.82E-04**
Patterson Lake South Arm	2.65E-08	3.47E-08	7.73E-08	1.10E-04	4.65E-05	2.11E-09	**1.57E-04**
Beet Lake	1.28E-08	1.67E-08	4.96E-08	9.35E-05	3.92E-05	1.78E-09	**1.33E-04**
Lloyd Lake	5.47E-09	7.14E-09	2.13E-08	8.20E-05	3.80E-05	1.72E-09	**1.20E-04**
Upper Bound Scenario							
Reference (Broach Lake)	4.73E-09	6.18E-09	1.80E-08	8.07E-05	3.79E-05	1.72E-09	**1.19E-04**
Patterson Lake North Arm - West Basin	1.53E-07	2.01E-07	1.93E-08	1.04E-04	3.97E-05	1.80E-09	**1.44E-04**
Patterson Lake South Arm	4.58E-08	6.00E-08	1.88E-08	8.93E-05	3.80E-05	1.72E-09	**1.28E-04**
Beet Lake	2.00E-08	2.62E-08	1.84E-08	8.44E-05	3.79E-05	1.72E-09	**1.22E-04**
Lloyd Lake	6.11E-09	7.99E-09	1.81E-08	8.11E-05	3.79E-05	1.72E-09	**1.19E-04**

Zooplankton Total Dose RFD Case (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	2.05E-05	2.39E-05	2.94E-03	4.57E-03	2.80E-05	6.05E-02	**6.81E-02**
Patterson Lake North Arm - West Basin	2.23E-04	2.62E-04	1.67E-02	7.95E-03	4.28E-05	9.18E-02	**1.17E-01**
Patterson Lake South Arm	3.33E-04	3.90E-04	1.78E-02	9.33E-03	4.35E-05	9.27E-02	**1.21E-01**
Beet Lake	1.29E-04	1.51E-04	9.64E-03	6.40E-03	3.02E-05	6.52E-02	**8.16E-02**
Lloyd Lake	3.06E-05	3.58E-05	3.63E-03	4.75E-03	2.81E-05	6.08E-02	**6.92E-02**
Upper Bound Scenario							
Reference (Broach Lake)	2.05E-05	2.39E-05	2.94E-03	4.57E-03	2.80E-05	6.05E-02	**6.81E-02**
Patterson Lake North Arm - West Basin	6.63E-04	7.77E-04	3.15E-03	5.89E-03	2.93E-05	6.33E-02	**7.38E-02**
Patterson Lake South Arm	1.98E-04	2.32E-04	3.07E-03	5.05E-03	2.81E-05	6.07E-02	**6.93E-02**
Beet Lake	8.66E-05	1.01E-04	3.01E-03	4.78E-03	2.80E-05	6.05E-02	**6.85E-02**
Lloyd Lake	2.65E-05	3.09E-05	2.95E-03	4.59E-03	2.80E-05	6.05E-02	**6.81E-02**

Northern Pike Total Dose RFD Case (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	4.13E-06	4.70E-06	3.54E-05	2.22E-04	1.79E-06	5.64E-04	**8.33E-04**
Patterson Lake North Arm - West Basin	4.50E-05	5.14E-05	2.02E-04	3.87E-04	2.74E-06	8.56E-04	**1.54E-03**
Patterson Lake South Arm	6.71E-05	7.67E-05	2.15E-04	4.54E-04	2.79E-06	8.65E-04	**1.68E-03**
Beet Lake	2.60E-05	2.97E-05	1.16E-04	3.11E-04	1.94E-06	6.08E-04	**1.09E-03**
Lloyd Lake	6.16E-06	7.02E-06	4.36E-05	2.31E-04	1.80E-06	5.67E-04	**8.56E-04**
Upper Bound Scenario							
Reference (Broach Lake)	4.13E-06	4.70E-06	3.54E-05	2.22E-04	1.79E-06	5.64E-04	**8.33E-04**
Patterson Lake North Arm - West Basin	1.34E-04	1.53E-04	3.79E-05	2.87E-04	1.88E-06	5.90E-04	**1.20E-03**
Patterson Lake South Arm	4.00E-05	4.56E-05	3.69E-05	2.46E-04	1.80E-06	5.66E-04	**9.36E-04**
Beet Lake	1.74E-05	1.99E-05	3.62E-05	2.32E-04	1.79E-06	5.65E-04	**8.72E-04**
Lloyd Lake	5.33E-06	6.07E-06	3.55E-05	2.23E-04	1.79E-06	5.64E-04	**8.36E-04**

Whitefish Total Dose RFD Case (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	7.69E-07	8.97E-07	2.65E-05	1.86E-04	8.29E-07	4.31E-05	**2.58E-04**
Patterson Lake North Arm - West Basin	8.38E-06	9.82E-06	1.51E-04	3.21E-04	1.22E-06	6.55E-05	**5.57E-04**
Patterson Lake South Arm	1.25E-05	1.46E-05	1.60E-04	3.69E-04	1.18E-06	6.61E-05	**6.24E-04**
Beet Lake	4.84E-06	5.67E-06	8.68E-05	2.57E-04	8.81E-07	4.65E-05	**4.01E-04**
Lloyd Lake	1.15E-06	1.34E-06	3.26E-05	1.92E-04	8.32E-07	4.33E-05	**2.72E-04**
Upper Bound Scenario							
Reference (Broach Lake)	7.69E-07	8.97E-07	2.65E-05	1.86E-04	8.29E-07	4.31E-05	**2.58E-04**
Patterson Lake North Arm - West Basin	2.49E-05	2.91E-05	2.83E-05	2.39E-04	8.68E-07	4.51E-05	**3.68E-04**
Patterson Lake South Arm	7.44E-06	8.71E-06	2.76E-05	2.05E-04	8.32E-07	4.33E-05	**2.93E-04**
Beet Lake	3.25E-06	3.80E-06	2.71E-05	1.94E-04	8.30E-07	4.32E-05	**2.72E-04**
Lloyd Lake	9.93E-07	1.16E-06	2.66E-05	1.86E-04	8.29E-07	4.31E-05	**2.59E-04**

Table C.21: Maximum Radiation Dose to Ecological Receptors for the RFD Scenario - Project Lifespan and Far-Future

Macrophytes Total Dose RFD Case (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.04E-05	1.18E-05	1.37E-03	2.99E-03	5.06E-05	1.10E-03	**5.53E-03**
Patterson Lake North Arm - West Basin	1.13E-04	1.30E-04	7.79E-03	5.20E-03	7.73E-05	1.67E-03	**1.50E-02**
Patterson Lake South Arm	1.69E-04	1.93E-04	8.30E-03	6.10E-03	7.85E-05	1.69E-03	**1.65E-02**
Beet Lake	6.56E-05	7.49E-05	4.49E-03	4.19E-03	5.47E-05	1.19E-03	**1.01E-02**
Lloyd Lake	1.55E-05	1.77E-05	1.69E-03	3.10E-03	5.09E-05	1.11E-03	**5.98E-03**
Upper Bound Scenario							
Reference (Broach Lake)	1.04E-05	1.18E-05	1.37E-03	2.99E-03	5.06E-05	1.10E-03	**5.53E-03**
Patterson Lake North Arm - West Basin	3.37E-04	3.85E-04	1.47E-03	3.85E-03	5.30E-05	1.15E-03	**7.25E-03**
Patterson Lake South Arm	1.01E-04	1.15E-04	1.43E-03	3.31E-03	5.08E-05	1.10E-03	**6.11E-03**
Beet Lake	4.40E-05	5.02E-05	1.40E-03	3.13E-03	5.07E-05	1.10E-03	**5.77E-03**
Lloyd Lake	1.34E-05	1.53E-05	1.37E-03	3.00E-03	5.06E-05	1.10E-03	**5.56E-03**

Phytoplankton Total Dose RFD Case (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.04E-05	1.18E-05	1.36E-03	3.00E-03	1.93E-05	1.11E-03	**5.51E-03**
Patterson Lake North Arm - West Basin	1.13E-04	1.29E-04	7.75E-03	5.21E-03	2.96E-05	1.68E-03	**1.49E-02**
Patterson Lake South Arm	1.69E-04	1.93E-04	8.26E-03	6.12E-03	3.01E-05	1.69E-03	**1.65E-02**
Beet Lake	6.55E-05	7.47E-05	4.46E-03	4.20E-03	2.09E-05	1.19E-03	**1.00E-02**
Lloyd Lake	1.55E-05	1.77E-05	1.68E-03	3.11E-03	1.94E-05	1.11E-03	**5.95E-03**
Upper Bound Scenario							
Reference (Broach Lake)	1.04E-05	1.18E-05	1.36E-03	3.00E-03	1.93E-05	1.11E-03	**5.51E-03**
Patterson Lake North Arm - West Basin	3.37E-04	3.84E-04	1.46E-03	3.86E-03	2.02E-05	1.16E-03	**7.22E-03**
Patterson Lake South Arm	1.01E-04	1.15E-04	1.42E-03	3.32E-03	1.94E-05	1.11E-03	**6.08E-03**
Beet Lake	4.39E-05	5.01E-05	1.39E-03	3.13E-03	1.94E-05	1.11E-03	**5.75E-03**
Lloyd Lake	1.34E-05	1.53E-05	1.37E-03	3.01E-03	1.93E-05	1.11E-03	**5.53E-03**

Terrestrial Invertebrate Total Dose RFD Case (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.57E-05	1.78E-05	1.15E-04	5.73E-03	6.72E-06	2.28E-05	**5.91E-03**
Patterson Lake North Arm - West Basin	6.97E-05	7.93E-05	1.85E-03	1.81E-02	2.19E-05	1.80E-03	**2.19E-02**
Patterson Lake South Arm	2.61E-05	2.97E-05	4.50E-04	8.11E-03	9.63E-06	3.64E-04	**8.99E-03**
Beet Lake	2.14E-05	2.43E-05	2.98E-04	7.03E-03	8.31E-06	2.10E-04	**7.59E-03**
Lloyd Lake	1.59E-05	1.81E-05	1.24E-04	5.80E-03	6.79E-06	3.17E-05	**5.99E-03**
Upper Bound Scenario							
Reference (Broach Lake)	1.57E-05	1.78E-05	1.15E-04	5.73E-03	6.72E-06	2.28E-05	**5.91E-03**
Patterson Lake North Arm - West Basin	2.14E-05	2.43E-05	1.53E-04	8.31E-03	6.72E-06	2.28E-05	**8.54E-03**
Patterson Lake South Arm	1.68E-05	1.91E-05	1.22E-04	6.23E-03	6.72E-06	2.28E-05	**6.42E-03**
Beet Lake	1.63E-05	1.85E-05	1.19E-04	6.01E-03	6.72E-06	2.28E-05	**6.19E-03**
Lloyd Lake	1.57E-05	1.79E-05	1.15E-04	5.75E-03	6.72E-06	2.28E-05	**5.93E-03**

Browse Total Dose RFD Case (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Patterson Lake North Arm - West Basin	2.57E-03	2.92E-03	1.83E-03	2.18E-02	2.11E-04	2.83E-03	**3.22E-02**
Patterson Lake South Arm	9.61E-04	1.09E-03	4.36E-04	1.06E-02	1.74E-04	1.06E-03	**1.44E-02**
Upper Bound Scenario							
Patterson Lake North Arm - West Basin	7.87E-04	8.96E-04	1.37E-04	1.16E-02	1.65E-04	6.33E-04	**1.42E-02**
Patterson Lake South Arm	6.18E-04	7.03E-04	1.10E-04	8.67E-03	1.65E-04	6.33E-04	**1.09E-02**

Table C.21: Maximum Radiation Dose to Ecological Receptors for the RFD Scenario - Project Lifespan and Far-Future

Labrador Tea Total Dose RFD Case (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Patterson Lake North Arm - West Basin	2.57E-03	2.92E-03	1.61E-02	9.42E-02	3.29E-04	1.64E-02	**1.32E-01**
Patterson Lake South Arm	9.61E-04	1.09E-03	3.18E-03	2.46E-02	1.97E-04	3.67E-03	**3.37E-02**
Upper Bound Scenario							
Patterson Lake North Arm - West Basin	7.87E-04	8.96E-04	1.37E-04	1.16E-02	1.65E-04	6.33E-04	**1.42E-02**
Patterson Lake South Arm	6.18E-04	7.03E-04	1.10E-04	8.67E-03	1.65E-04	6.33E-04	**1.09E-02**

Lichen Total Dose Operations (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Patterson Lake North Arm - West Basin	1.21E-04	1.37E-04	9.12E-02	4.70E-01	1.41E-03	1.26E-01	**6.90E-01**
Patterson Lake South Arm	1.21E-04	1.37E-04	1.79E-02	9.42E-02	9.45E-04	1.10E-01	**2.23E-01**
Upper Bound Scenario							
Patterson Lake North Arm - West Basin	1.21E-04	1.37E-04	4.38E-04	4.44E-03	8.33E-04	1.06E-01	**1.12E-01**
Patterson Lake South Arm	1.21E-04	1.37E-04	4.38E-04	4.44E-03	8.33E-04	1.06E-01	**1.12E-01**

Blueberries Total Dose RFD Case (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Patterson Lake North Arm - West Basin	1.33E-03	1.51E-03	7.01E-05	9.25E-03	8.51E-06	1.08E-03	**1.32E-02**
Patterson Lake South Arm	4.87E-04	5.54E-04	4.64E-05	4.91E-03	4.06E-06	4.63E-04	**6.47E-03**
Upper Bound Scenario							
Patterson Lake North Arm - West Basin	3.91E-04	4.45E-04	5.42E-05	5.62E-03	3.00E-06	3.16E-04	**6.83E-03**
Patterson Lake South Arm	3.07E-04	3.50E-04	4.33E-05	4.22E-03	3.00E-06	3.16E-04	**5.23E-03**

Beaver Total Dose RFD Case (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.05E-05	1.19E-05	3.11E-06	6.36E-04	4.75E-07	2.15E-04	**8.77E-04**
Patterson Lake North Arm - West Basin	4.69E-05	5.34E-05	2.97E-05	1.74E-03	1.14E-06	7.50E-04	**2.62E-03**
Patterson Lake South Arm	1.79E-05	2.04E-05	1.52E-05	8.78E-04	7.12E-07	3.35E-04	**1.27E-03**
Beet Lake	1.44E-05	1.64E-05	8.93E-06	7.63E-04	5.49E-07	2.72E-04	**1.07E-03**
Lloyd Lake	1.07E-05	1.21E-05	3.60E-06	6.43E-04	4.79E-07	2.17E-04	**8.87E-04**
Upper Bound Scenario							
Reference (Broach Lake)	1.05E-05	1.19E-05	3.11E-06	6.36E-04	4.75E-07	2.15E-04	**8.77E-04**
Patterson Lake North Arm - West Basin	1.62E-05	1.84E-05	3.69E-06	9.14E-04	4.90E-07	2.18E-04	**1.17E-03**
Patterson Lake South Arm	1.17E-05	1.34E-05	3.27E-06	6.92E-04	4.76E-07	2.15E-04	**9.36E-04**
Beet Lake	1.11E-05	1.26E-05	3.20E-06	6.66E-04	4.75E-07	2.15E-04	**9.08E-04**
Lloyd Lake	1.05E-05	1.20E-05	3.12E-06	6.38E-04	4.75E-07	2.15E-04	**8.79E-04**

Black Bear Total Dose RFD Case (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	7.81E-06	8.89E-06	1.88E-06	8.19E-04	8.32E-07	1.74E-04	**1.01E-03**
Patterson Lake North Arm - West Basin	2.32E-05	2.64E-05	3.30E-06	1.29E-03	1.05E-06	3.42E-04	**1.68E-03**
Beet Lake	9.48E-06	1.08E-05	2.78E-06	1.09E-03	1.23E-06	1.98E-04	**1.31E-03**
Lloyd Lake	7.97E-06	9.07E-06	1.96E-06	8.25E-04	8.35E-07	1.76E-04	**1.02E-03**
Upper Bound Scenario							
Reference (Broach Lake)	7.81E-06	8.89E-06	1.88E-06	8.19E-04	8.32E-07	1.74E-04	**1.01E-03**
Patterson Lake North Arm - West Basin	9.93E-06	1.13E-05	2.22E-06	1.02E-03	8.33E-07	1.76E-04	**1.22E-03**
Beet Lake	8.14E-06	9.26E-06	2.53E-06	1.06E-03	1.21E-06	1.82E-04	**1.26E-03**
Lloyd Lake	7.84E-06	8.92E-06	1.91E-06	8.22E-04	8.33E-07	1.75E-04	**1.02E-03**

Table C.21: Maximum Radiation Dose to Ecological Receptors for the RFD Scenario - Project Lifespan and Far-Future

Grey Wolf Total Dose RFD Case (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	3.26E-07	3.77E-07	1.17E-06	7.63E-04	1.92E-06	3.26E-04	**1.09E-03**
Patterson Lake North Arm - West Basin	6.35E-07	7.34E-07	1.58E-06	9.25E-04	2.02E-06	3.60E-04	**1.29E-03**
Lloyd Lake	3.32E-07	3.85E-07	1.19E-06	7.66E-04	1.92E-06	3.27E-04	**1.10E-03**
Upper Bound Scenario							
Reference (Broach Lake)	3.26E-07	3.77E-07	1.17E-06	7.63E-04	1.92E-06	3.26E-04	**1.09E-03**
Patterson Lake North Arm - West Basin	3.91E-07	4.52E-07	1.27E-06	8.48E-04	1.92E-06	3.27E-04	**1.18E-03**
Lloyd Lake	3.27E-07	3.79E-07	1.18E-06	7.65E-04	1.92E-06	3.26E-04	**1.09E-03**

Mink Total Dose RFD Case (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	1.76E-07	2.00E-07	2.51E-06	6.44E-05	2.38E-07	8.73E-04	**9.40E-04**
Patterson Lake North Arm - West Basin	1.16E-06	1.32E-06	1.23E-05	1.04E-04	3.23E-07	1.20E-03	**1.32E-03**
Patterson Lake South Arm	6.81E-07	7.77E-07	9.46E-06	8.47E-05	2.90E-07	1.07E-03	**1.17E-03**
Beet Lake	3.67E-07	4.18E-07	6.20E-06	7.33E-05	2.46E-07	9.02E-04	**9.82E-04**
Lloyd Lake	1.91E-07	2.18E-07	2.89E-06	6.52E-05	2.38E-07	8.74E-04	**9.43E-04**
Upper Bound Scenario							
Reference (Broach Lake)	1.76E-07	2.00E-07	2.51E-06	6.44E-05	2.38E-07	8.73E-04	**9.40E-04**
Patterson Lake North Arm - West Basin	2.66E-06	3.04E-06	2.79E-06	8.53E-05	2.48E-07	9.13E-04	**1.01E-03**
Patterson Lake South Arm	8.60E-07	9.83E-07	2.62E-06	7.09E-05	2.38E-07	8.75E-04	**9.51E-04**
Beet Lake	4.31E-07	4.92E-07	2.57E-06	6.73E-05	2.38E-07	8.73E-04	**9.44E-04**
Lloyd Lake	1.99E-07	2.26E-07	2.51E-06	6.46E-05	2.38E-07	8.73E-04	**9.40E-04**

Moose Total Dose RFD Case (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	9.50E-06	1.08E-05	4.80E-06	9.61E-04	1.30E-06	2.66E-04	**1.25E-03**
Patterson Lake North Arm - West Basin	4.29E-05	4.89E-05	3.78E-05	2.21E-03	2.15E-06	7.80E-04	**3.12E-03**
Patterson Lake South Arm	4.26E-05	4.85E-05	3.72E-05	2.00E-03	2.04E-06	7.75E-04	**2.90E-03**
Beet Lake	1.33E-05	1.51E-05	1.44E-05	1.11E-03	1.40E-06	3.21E-04	**1.48E-03**
Lloyd Lake	9.70E-06	1.10E-05	5.68E-06	9.70E-04	1.30E-06	2.69E-04	**1.27E-03**
Upper Bound Scenario							
Reference (Broach Lake)	9.50E-06	1.08E-05	4.80E-06	9.61E-04	1.30E-06	2.66E-04	**1.25E-03**
Patterson Lake North Arm - West Basin	1.69E-05	1.93E-05	5.48E-06	1.38E-03	1.32E-06	2.73E-04	**1.70E-03**
Patterson Lake South Arm	1.68E-05	1.91E-05	5.29E-06	1.24E-03	1.32E-06	2.72E-04	**1.56E-03**
Beet Lake	1.03E-05	1.17E-05	4.92E-06	1.01E-03	1.30E-06	2.67E-04	**1.30E-03**
Lloyd Lake	9.56E-06	1.09E-05	4.81E-06	9.64E-04	1.30E-06	2.66E-04	**1.26E-03**

Muskrat Total Dose RFD Case (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	5.56E-07	6.32E-07	8.41E-06	2.23E-04	1.03E-06	1.76E-03	**2.00E-03**
Patterson Lake North Arm - West Basin	5.07E-06	5.79E-06	4.71E-05	3.63E-04	1.46E-06	2.42E-03	**2.84E-03**
Patterson Lake South Arm	3.45E-06	3.94E-06	4.03E-05	3.31E-04	1.36E-06	2.17E-03	**2.55E-03**
Beet Lake	1.62E-06	1.84E-06	2.44E-05	2.68E-04	1.08E-06	1.82E-03	**2.12E-03**
Lloyd Lake	6.53E-07	7.44E-07	1.00E-05	2.27E-04	1.03E-06	1.77E-03	**2.01E-03**
Upper Bound Scenario							
Reference (Broach Lake)	0.00E+00	3.32E-03	6.32E-07	8.39E-06	1.76E-03	2.23E-04	**5.31E-03**
Patterson Lake North Arm - West Basin	0.00E+00	3.76E-03	2.05E-05	9.01E-06	1.84E-03	2.87E-04	**5.92E-03**
Patterson Lake South Arm	0.00E+00	3.40E-03	6.14E-06	8.76E-06	1.77E-03	2.46E-04	**5.43E-03**
Beet Lake	0.00E+00	3.35E-03	2.68E-06	8.59E-06	1.76E-03	2.33E-04	**5.36E-03**
Lloyd Lake	0.00E+00	3.32E-03	8.18E-07	8.41E-06	1.76E-03	2.24E-04	**5.31E-03**

Table C.21: Maximum Radiation Dose to Ecological Receptors for the RFD Scenario - Project Lifespan and Far-Future

Red Fox Total Dose RFD Case (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	5.92E-07	6.79E-07	6.84E-07	7.09E-04	1.59E-06	1.55E-05	**7.28E-04**
Patterson Lake North Arm - West Basin	2.71E-06	3.11E-06	2.89E-06	1.26E-03	1.95E-06	8.19E-05	**1.36E-03**
Patterson Lake South Arm	1.02E-06	1.17E-06	1.19E-06	8.16E-04	1.66E-06	2.84E-05	**8.49E-04**
Beet Lake	8.20E-07	9.40E-07	9.53E-07	7.67E-04	1.63E-06	2.25E-05	**7.94E-04**
Lloyd Lake	6.03E-07	6.92E-07	6.99E-07	7.11E-04	1.59E-06	1.58E-05	**7.31E-04**
Upper Bound Scenario							
Reference (Broach Lake)	5.92E-07	6.79E-07	6.84E-07	7.09E-04	1.59E-06	1.55E-05	**7.28E-04**
Patterson Lake North Arm - West Basin	8.45E-07	9.69E-07	9.04E-07	1.03E-03	1.59E-06	1.55E-05	**1.05E-03**
Patterson Lake South Arm	6.44E-07	7.38E-07	7.27E-07	7.70E-04	1.59E-06	1.55E-05	**7.89E-04**
Beet Lake	6.18E-07	7.09E-07	7.08E-07	7.42E-04	1.59E-06	1.55E-05	**7.61E-04**
Lloyd Lake	5.93E-07	6.81E-07	6.85E-07	7.10E-04	1.59E-06	1.55E-05	**7.29E-04**

Snowshoe Hare Total Dose RFD Case (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	9.84E-06	1.12E-05	1.96E-06	1.26E-03	1.96E-06	1.48E-04	**1.44E-03**
Patterson Lake North Arm - West Basin	4.38E-05	4.98E-05	1.85E-05	2.72E-03	2.78E-06	6.15E-04	**3.45E-03**
Patterson Lake South Arm	1.64E-05	1.87E-05	5.21E-06	1.54E-03	2.12E-06	2.38E-04	**1.82E-03**
Beet Lake	1.34E-05	1.53E-05	3.73E-06	1.42E-03	2.05E-06	1.98E-04	**1.65E-03**
Lloyd Lake	1.00E-05	1.14E-05	2.05E-06	1.27E-03	1.97E-06	1.51E-04	**1.45E-03**
Upper Bound Scenario							
Reference (Broach Lake)	9.84E-06	1.12E-05	1.96E-06	1.26E-03	1.96E-06	1.48E-04	**1.44E-03**
Patterson Lake North Arm - West Basin	1.34E-05	1.53E-05	2.60E-06	1.83E-03	1.96E-06	1.48E-04	**2.01E-03**
Patterson Lake South Arm	1.05E-05	1.20E-05	2.08E-06	1.37E-03	1.96E-06	1.48E-04	**1.55E-03**
Beet Lake	1.02E-05	1.16E-05	2.03E-06	1.32E-03	1.96E-06	1.48E-04	**1.50E-03**
Lloyd Lake	9.86E-06	1.12E-05	1.96E-06	1.27E-03	1.96E-06	1.48E-04	**1.44E-03**

Southern Red-Backed Vole Total Dose RFD Case (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	3.58E-06	4.08E-06	7.10E-07	9.01E-04	1.85E-06	5.26E-05	**9.64E-04**
Patterson Lake North Arm - West Basin	1.62E-05	1.84E-05	4.13E-06	1.69E-03	2.34E-06	1.98E-04	**1.93E-03**
Patterson Lake South Arm	6.01E-06	6.85E-06	1.41E-06	1.05E-03	1.95E-06	8.07E-05	**1.15E-03**
Beet Lake	4.90E-06	5.59E-06	1.09E-06	9.84E-04	1.90E-06	6.79E-05	**1.07E-03**
Lloyd Lake	3.64E-06	4.15E-06	7.29E-07	9.05E-04	1.86E-06	5.33E-05	**9.69E-04**
Upper Bound Scenario							
Reference (Broach Lake)	3.58E-06	4.08E-06	7.10E-07	9.01E-04	1.85E-06	5.26E-05	**9.64E-04**
Patterson Lake North Arm - West Basin	4.89E-06	5.58E-06	9.41E-07	1.31E-03	1.85E-06	5.26E-05	**1.37E-03**
Patterson Lake South Arm	3.83E-06	4.37E-06	7.54E-07	9.79E-04	1.85E-06	5.26E-05	**1.04E-03**
Beet Lake	3.72E-06	4.24E-06	7.34E-07	9.44E-04	1.85E-06	5.26E-05	**1.01E-03**
Lloyd Lake	3.59E-06	4.09E-06	7.11E-07	9.03E-04	1.85E-06	5.26E-05	**9.66E-04**

WoodLand Caribou Total Dose RFD Case (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	4.34E-06	4.94E-06	5.85E-06	7.54E-04	6.27E-06	3.51E-03	**4.28E-03**
Patterson Lake North Arm - West Basin	1.31E-05	1.49E-05	9.13E-05	3.75E-03	8.51E-06	4.01E-03	**7.89E-03**
Beet Lake	5.27E-06	6.00E-06	1.63E-05	1.04E-03	6.50E-06	3.57E-03	**4.65E-03**
Lloyd Lake	4.46E-06	5.08E-06	7.29E-06	7.84E-04	6.29E-06	3.51E-03	**4.32E-03**
Upper Bound Scenario							
Reference (Broach Lake)	4.34E-06	4.94E-06	5.85E-06	7.54E-04	6.27E-06	3.51E-03	**4.28E-03**
Patterson Lake North Arm - West Basin	1.02E-05	1.16E-05	6.36E-06	9.17E-04	6.31E-06	3.53E-03	**4.48E-03**
Beet Lake	4.82E-06	5.49E-06	5.92E-06	7.69E-04	6.29E-06	3.52E-03	**4.32E-03**
Lloyd Lake	4.43E-06	5.04E-06	5.87E-06	7.56E-04	6.27E-06	3.51E-03	**4.29E-03**

Table C.21: Maximum Radiation Dose to Ecological Receptors for the RFD Scenario - Project Lifespan and Far-Future

Grouse Total Dose RFD Case (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	2.34E-04	2.67E-04	1.70E-06	7.73E-04	1.88E-06	9.49E-04	**2.23E-03**
Patterson Lake North Arm - West Basin	1.05E-03	1.19E-03	9.35E-06	1.41E-03	2.60E-06	3.58E-03	**7.24E-03**
Patterson Lake South Arm	3.91E-04	4.45E-04	3.20E-06	8.95E-04	2.02E-06	1.46E-03	**3.19E-03**
Beet Lake	3.20E-04	3.64E-04	2.51E-06	8.40E-04	1.95E-06	1.23E-03	**2.75E-03**
Lloyd Lake	2.38E-04	2.71E-04	1.74E-06	7.76E-04	1.88E-06	9.62E-04	**2.25E-03**
Upper Bound Scenario							
Reference (Broach Lake)	2.34E-04	2.67E-04	1.70E-06	7.73E-04	1.88E-06	9.49E-04	**2.23E-03**
Patterson Lake North Arm - West Basin	3.20E-04	3.64E-04	2.25E-06	1.12E-03	1.88E-06	9.49E-04	**2.76E-03**
Patterson Lake South Arm	2.51E-04	2.85E-04	1.80E-06	8.39E-04	1.88E-06	9.49E-04	**2.33E-03**
Beet Lake	2.43E-04	2.77E-04	1.76E-06	8.09E-04	1.88E-06	9.49E-04	**2.28E-03**
Lloyd Lake	2.35E-04	2.67E-04	1.70E-06	7.74E-04	1.88E-06	9.49E-04	**2.23E-03**

Canada Goose Total Dose RFD Case (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	3.28E-05	3.74E-05	4.00E-07	6.64E-04	1.71E-06	1.34E-04	**8.70E-04**
Patterson Lake North Arm - West Basin	1.46E-04	1.66E-04	1.87E-06	1.12E-03	2.09E-06	5.31E-04	**1.97E-03**
Patterson Lake South Arm	5.48E-05	6.24E-05	7.05E-07	7.52E-04	1.78E-06	2.11E-04	**1.08E-03**
Beet Lake	4.48E-05	5.10E-05	5.64E-07	7.12E-04	1.75E-06	1.76E-04	**9.86E-04**
Lloyd Lake	3.34E-05	3.80E-05	4.08E-07	6.66E-04	1.71E-06	1.36E-04	**8.75E-04**
Upper Bound Scenario							
Reference (Broach Lake)	3.28E-05	3.74E-05	4.00E-07	6.64E-04	1.71E-06	1.34E-04	**8.70E-04**
Patterson Lake North Arm - West Basin	4.52E-05	5.14E-05	5.30E-07	9.61E-04	1.71E-06	1.34E-04	**1.19E-03**
Patterson Lake South Arm	3.52E-05	4.01E-05	4.25E-07	7.21E-04	1.71E-06	1.34E-04	**9.32E-04**
Beet Lake	3.41E-05	3.88E-05	4.14E-07	6.95E-04	1.71E-06	1.34E-04	**9.04E-04**
Lloyd Lake	3.29E-05	3.74E-05	4.00E-07	6.65E-04	1.71E-06	1.34E-04	**8.71E-04**

Little Brown Myotis Total Dose RFD Case (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	1.37E-07	1.55E-07	1.19E-05	1.36E-04	4.92E-07	3.09E-03	**3.24E-03**
Patterson Lake North Arm - West Basin	1.24E-06	1.41E-06	6.61E-05	2.19E-04	6.74E-07	4.22E-03	**4.51E-03**
Patterson Lake South Arm	7.73E-07	8.82E-07	5.10E-05	1.86E-04	6.04E-07	3.78E-03	**4.02E-03**
Beet Lake	3.72E-07	4.24E-07	3.27E-05	1.58E-04	5.08E-07	3.19E-03	**3.38E-03**
Lloyd Lake	1.58E-07	1.80E-07	1.40E-05	1.38E-04	4.93E-07	3.09E-03	**3.24E-03**
Upper Bound Scenario							
Reference (Broach Lake)	1.37E-07	1.55E-07	1.19E-05	1.36E-04	4.92E-07	3.09E-03	**3.23E-03**
Patterson Lake North Arm - West Basin	4.42E-06	5.05E-06	1.27E-05	1.76E-04	5.15E-07	3.23E-03	**3.43E-03**
Patterson Lake South Arm	1.32E-06	1.51E-06	1.24E-05	1.51E-04	4.93E-07	3.10E-03	**3.26E-03**
Beet Lake	5.78E-07	6.59E-07	1.22E-05	1.42E-04	4.92E-07	3.09E-03	**3.24E-03**
Lloyd Lake	1.77E-07	2.01E-07	1.19E-05	1.37E-04	4.92E-07	3.09E-03	**3.24E-03**

Loon Total Dose RFD Case (mGy/d)							
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**	**Total Dose**
Application Case							
Reference (Broach Lake)	1.33E-06	1.51E-06	1.01E-06	6.06E-06	8.76E-08	2.97E-03	**2.98E-03**
Patterson Lake North Arm - West Basin	1.37E-05	1.57E-05	5.65E-06	9.94E-06	1.23E-07	4.09E-03	**4.14E-03**
Patterson Lake South Arm	1.62E-05	1.85E-05	4.35E-06	8.98E-06	1.15E-07	3.73E-03	**3.78E-03**
Beet Lake	6.44E-06	7.36E-06	2.78E-06	7.18E-06	9.15E-08	3.08E-03	**3.10E-03**
Lloyd Lake	1.80E-06	2.05E-06	1.19E-06	6.17E-06	8.78E-08	2.98E-03	**2.99E-03**
Upper Bound Scenario							
Reference (Broach Lake)	1.33E-06	1.51E-06	1.01E-06	6.06E-06	8.76E-08	2.97E-03	**2.98E-03**
Patterson Lake North Arm - West Basin	4.31E-05	4.92E-05	1.08E-06	7.81E-06	9.16E-08	3.11E-03	**3.21E-03**
Patterson Lake South Arm	1.29E-05	1.47E-05	1.05E-06	6.70E-06	8.78E-08	2.98E-03	**3.02E-03**
Beet Lake	5.62E-06	6.42E-06	1.03E-06	6.34E-06	8.76E-08	2.97E-03	**2.99E-03**
Lloyd Lake	1.72E-06	1.96E-06	1.01E-06	6.09E-06	8.76E-08	2.97E-03	**2.98E-03**

Table C.21: Maximum Radiation Dose to Ecological Receptors for the RFD Scenario - Project Lifespan and Far-Future

Mallard Total Dose RFD Case (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.40E-05	1.59E-05	9.79E-06	7.84E-05	1.23E-06	2.55E-02	**2.56E-02**
Patterson Lake North Arm - West Basin	1.27E-04	1.45E-04	5.46E-05	1.27E-04	1.73E-06	3.49E-02	**3.53E-02**
Patterson Lake South Arm	8.62E-05	9.84E-05	4.42E-05	1.13E-04	1.60E-06	3.13E-02	**3.16E-02**
Beet Lake	4.04E-05	4.61E-05	2.76E-05	9.28E-05	1.28E-06	2.63E-02	**2.65E-02**
Lloyd Lake	1.64E-05	1.87E-05	1.16E-05	7.98E-05	1.23E-06	2.55E-02	**2.56E-02**
Upper Bound Scenario							
Reference (Broach Lake)	1.40E-05	1.59E-05	9.79E-06	7.84E-05	1.23E-06	2.55E-02	**2.56E-02**
Patterson Lake North Arm - West Basin	4.53E-04	5.17E-04	1.05E-05	1.01E-04	1.29E-06	2.66E-02	**2.77E-02**
Patterson Lake South Arm	1.35E-04	1.55E-04	1.02E-05	8.68E-05	1.23E-06	2.55E-02	**2.59E-02**
Beet Lake	5.91E-05	6.75E-05	1.00E-05	8.20E-05	1.23E-06	2.55E-02	**2.57E-02**
Lloyd Lake	1.81E-05	2.06E-05	9.82E-06	7.88E-05	1.23E-06	2.55E-02	**2.56E-02**

Rusty Blackbird Total Dose RFD Case (mGy/d)							
Location	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210	Total Dose
Application Case							
Reference (Broach Lake)	1.01E-04	1.15E-04	2.74E-05	8.28E-04	3.65E-06	6.96E-02	**7.07E-02**
Patterson Lake North Arm - West Basin	5.12E-04	5.83E-04	1.39E-04	1.39E-03	4.71E-06	9.59E-02	**9.85E-02**
Patterson Lake South Arm	2.18E-04	2.48E-04	1.07E-04	9.64E-04	4.11E-06	8.54E-02	**8.69E-02**
Beet Lake	1.55E-04	1.76E-04	6.98E-05	8.98E-04	3.75E-06	7.20E-02	**7.33E-02**
Lloyd Lake	1.04E-04	1.19E-04	3.18E-05	8.32E-04	3.66E-06	6.98E-02	**7.09E-02**
Upper Bound Scenario							
Reference (Broach Lake)	1.01E-04	1.15E-04	2.74E-05	8.28E-04	3.65E-06	6.96E-02	**7.07E-02**
Patterson Lake North Arm - West Basin	5.16E-04	5.89E-04	3.02E-05	1.18E-03	3.73E-06	7.28E-02	**7.52E-02**
Patterson Lake South Arm	2.13E-04	2.43E-04	2.87E-05	9.02E-04	3.65E-06	6.99E-02	**7.12E-02**
Beet Lake	1.44E-04	1.64E-04	2.81E-05	8.67E-04	3.65E-06	6.97E-02	**7.09E-02**
Lloyd Lake	1.04E-04	1.19E-04	2.75E-05	8.30E-04	3.65E-06	6.96E-02	**7.07E-02**

Table C.22: Sample Calculation - Mallard (Patterson Lake South) Dose and Risk Calculations for Copper

Parameter	Symbol	Calculation	Copper		
			Value	Unit	Source
Environmental Media Concentration					
Water Concentration	C_w	-	9.23E-04	mg/L	Appendix C
Sediment Concentration (dry weight)	$C_{sed(dw)}$	-	2.73E+00	mg/kg dw	Appendix C
Outdoor Air Concentration	C_{air}	-	3.00E-08	mg/m^3	Appendix C
Aquatic Plant Concentration					
Bioaccumulation Factor (BAF)	$BAF_{aquatic\ plant}$	-	2.17E+02	L/kg fw	Table 3-8, IMPACT Model Report
Aquatic Plant Tissue Concentration	$C_{aquatic\ plant}$	$C_{aquatic\ plant} = C_w * BAF_{aquatic\ plant}$	2.00E-01	mg/kg fw	Calculated
Benthic Invertebrate Concentration					
Water-to-Sediment Partitioning Coefficient	k_d	-	3.00E+03	L/kg	Table 3-6, IMPACT Model Report
Dry Bulk Density	ρ	-	1.10E-01	kg/L	Assumed
Water Content (Volume Basis)	θ	-	9.60E-01	unitless	Assumed
Fraction in Porewater Phase	$C_{pw\ (fraction)}$	$C_{pw\ (fraction)} = 1 - (k_d * \rho / \theta) / (1 + k_d * \rho / \theta)$	2.90E-03	unitless	Calculated
Concentration Ratio – Porewater to Sediment	$Ratio_{pw\text{-}sed}$	$Ratio_{pw\text{-}sed} = C_{pw\ (fraction)} * \rho / \theta$	3.32E-04	kg/L	Calculated
Sediment Porewater Concentration	$C_{pw\ (sed)}$	$C_{pw\ (sed)} = C_{sed(dw)} * Ratio_{pw\text{-}sed}$	9.06E-04	mg/L	Calculated
Bioaccumulation Factor (BAF)	$BAF_{benthic\ inv}$	-	7.80E+03	L/kg fw	Table 3-8, IMPACT Model Report
Sediment Occupancy Factor	OF_{sed}	-	1.00E+02	%	Assumed
Benthic Invertebrate Tissue Concentration	$C_{benthic\ inv}$	$C_{benthic\ inv} = (1 - (OF_{sed}/100) * C_{sed(dw)} + (OF_{sed}/100) * C_{pw\ (sed)}) * BAF_{benthic\ inv}$	7.07E+00	Bq/kg fw	Calculated
Mallard Exposure Factors					
Water Intake	IR_w	-	6.40E-02	L/d	Table 6-8
Sediment Intake	IR_s	-	2.00E-03	kg dw/d	Table 6-8
Air Intake	IR_{air}	-	2.00E-02	m^3/d	Table 6-8
Aquatic Plant Intake	$IR_{aquatic\ plant}$	-	6.00E-02	kg fw/d	Table 6-8
Benthic Invertebrate Intake	$IR_{benthic\ inv}$	-	1.80E-01	kg fw/d	Table 6-8
Body Weight	BW	-	1.13	kg fw	Table 6-8
Toxicological Benchmark	TRV	-	7.52E+01	mg/kg d	Table 6-16
Mallard Dose and HQ					
Total Dose	D_{total}	$D_{total} = (C_w*IR_w + C_{s(dw)}*IR_s + C_{air}*IR_{air} + C_{aquatic\ plant}*IR_{aquatic\ plant} + C_{benthic\ inv}*IR_{benthic\ inv})/BW$	1.14E+00	mg/kg d	Calculated
Hazard Quotient	HQ	$HQ = D_{total}/TRV$	1.52E-02	unitless	Calculated

Table C.23: Sample Calculation - Adult Subsistence Harvester (Patterson Lake South) Dose and Risk Calculations for Copper

Parameter	Symbol	Calculation	Copper		
			Value	Unit	Source
Water Ingestion Dose					
Water Concentration (PLS)	$C_{w\,(PLS)}$	-	9.23E-04	mg/L	Appendix C
Water Concentration (Reference)	$C_{w\,(Ref)}$	-	8.43E-04	mg/L	Appendix C
Local Intake Fraction of Water (PLS)	$IF_{w\,(PLS)}$	-	5.00E-01	Unitless	Assumed
Local Intake Fraction of Water (Reference)	$IF_{w\,(Ref)}$	-	5.00E-01	Unitless	Assumed
Water Intake	IR_w	-	1.04E+00	L/d	CSA N288.1-20 (Table 21)
Human Adult Body Mass	BW	-	7.07E+01	kg	Health Canada, 2021
Ingestion Dose (Water)	D_w	$D_w = ((C_{w\,(PLS)} * IF_{w\,(PLS)} + C_{w\,(Ref)} * IF_{w\,(Ref)}) * IR_w) / BW$	1.30E-05	mg/kg/d fw	Calculated
Soil Ingestion Dose					
Soil Concentration (PLS)	$C_{s\,(PLS)}$	-	6.03E-01	mg/kg dw	Appendix C
Soil Concentration (Reference)	$C_{s\,(Ref)}$	-	6.01E-01	mg/kg dw	Appendix C
Local Intake Fraction of Soil (PLS)	$IF_{s\,(PLS)}$	-	5.00E-01	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Soil (Reference)	$IF_{s\,(Ref)}$	-	5.00E-01	Unitless	Table 2-10, IMPACT Model Report
Soil Intake	IR_s	-	4.00E-06	kg dw/d	Table 2-7, IMPACT Model Report
Days Exposed to Soil per Year	Exp_{days}	-	1.35E+02	d/y	Assumed
Human Adult Body Mass	BW	-	7.07E+01	kg	Health Canada, 2021
Ingestion Dose (Soil)	D_s	$D_s = (((C_{s\,(PLS)} * IF_{s\,(PLS)} + C_{s\,(Ref)} * IF_{s\,(Ref)}) * IR_s) / BW) * (Exp_{days} / 365)$	1.26E-08	mg/kg/d fw	Calculated
Terrestrial Plant Ingestion Dose					
Labrador Tea Concentration (PLS)	$C_{LT\,(PLS)}$	-	8.09E-01	mg/kg fw	Appendix C
Blueberry Concentration (PLS)	$C_{BB\,(PLS)}$	-	4.01E-01	mg/kg fw	Appendix C
Labrador Tea Concentration (Reference)	$C_{LT\,(Ref)}$	-	7.98E-01	mg/kg fw	Appendix C
Blueberry Concentration (Reference)	$C_{BB\,(Ref)}$	-	3.99E-01	mg/kg fw	Appendix C
Food Intake (Terrestrial Plants)	IR_{TP}	-	1.24E+01	kg/y fw	Assumed, site-specific
Local Intake Fraction of Labrador Tea (Reference)	$IF_{LT\,(Ref)}$	-	9.88E-02	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Blueberry (Reference)	$IF_{BB\,(Ref)}$	-	4.01E-01	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Labrador Tea (PLS)	$IF_{LT\,(PLS)}$	-	9.88E-02	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Blueberry (PLS)	$IF_{BB\,(PLS)}$	-	4.01E-01	Unitless	Table 2-10, IMPACT Model Report
Human Adult Body Mass	BW	-	7.07E+01	kg	Health Canada, 2021
Food Processing Factor	FPF	-	1.00E+00	Unitless	Assumed
Ingestion Dose (Terrestrial Plants)	D_{TP}	$D_{TP} = ((C_{LT\,(PLS)} * IF_{LT\,(PLS)} + C_{BB\,(PLS)} * IF_{BB\,(PLS)} + C_{LT\,(Ref)} * IF_{LT\,(Ref)} + C_{BB\,(Ref)} * IF_{BB\,(Ref)}) * IR_{TP} * FPF) / (BW * 365)$	2.30E-04	mg/kg/d fw	Calculated
Aquatic Animal Ingestion Dose					
Northern Pike Concentration (PLS)	$C_{NP\,(PLS)}$	-	4.61E-01	mg/kg fw	Appendix C

Table C.23: Sample Calculation - Adult Subsistence Harvester (Patterson Lake South) Dose and Risk Calculations for Copper

Parameter	Symbol	Calculation	Copper		
			Value	Unit	Source
Whitefish Concentration (PLS)	$C_{WF\ (PLS)}$	-	4.59E-02	mg/kg fw	Appendix C
Northern Pike Concentration (Reference)	$C_{NP\ (Ref)}$	-	4.21E-01	mg/kg fw	Appendix C
Whitefish Concentration (Reference)	$C_{WF\ (Ref)}$	-	4.21E-02	mg/kg fw	Appendix C
Food Intake (Aquatic Animals)	IR_{AA}	-	8.47E+01	kg/y fw	Assumed, site-specific
Local Intake Fraction of Northern Pike (Reference)	$IF_{NP\ (Ref)}$	-	2.50E-01	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Whitefish (Reference)	$IF_{WF\ (Ref)}$	-	2.50E-01	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Northern Pike (PLS)	$IF_{NP\ (PLS)}$	-	2.50E-01	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Whitefish (PLS)	$IF_{WF\ (PLS)}$	-	2.50E-01	Unitless	Table 2-10, IMPACT Model Report
Human Adult Body Mass	BW	-	7.07E+01	kg	Health Canada, 2021
Food Processing Factor	FPF	-	1.00E+00	Unitless	Assumed
Ingestion Dose (Aquatic Animals)	D_{AA}	$D_{AA} = ((C_{NP\ (PLS)} * IF_{NP\ (PLS)} + C_{WF\ (PLS)} * IF_{WF\ (PLS)} + C_{NP\ (Ref)} * IF_{NP\ (Ref)} + C_{WF\ (Ref)} * IF_{WF\ (Ref)}) * IR_{AA} * FPF) / (BW * 365)$	7.97E-04	mg/kg/d fw	Calculated
Terrestrial Animal Ingestion Dose					
Moose Concentration (PLS)	$C_{M\ (PLS)}$	-	3.65E-01	mg/kg fw	Appendix C
Moose Organs Concentration (PLS)	$C_{MO\ (PLS)}$	-	1.46E+01	mg/kg fw	Appendix C
Beaver Concentration (PLS)	$C_{B\ (PLS)}$	-	3.81E-01	mg/kg fw	Appendix C
Mallard Concentration (PLS)	$C_{Mal\ (PLS)}$	-	1.23E+00	mg/kg fw	Appendix C
Grouse Concentration (PLS)	$C_{G\ (PLS)}$	-	2.61E-01	mg/kg fw	Appendix C
Store Food Concentration (PLS)	$C_{SF\ (PLS)}$	-	5.70E-01	mg/kg fw	Appendix C
Moose Concentration (Reference)	$C_{M\ (Ref)}$	-	3.51E-01	mg/kg fw	Appendix C
Moose Organs Concentration (Reference)	$C_{MO\ (Ref)}$	-	1.40E+01	mg/kg fw	Appendix C
Beaver Concentration (Reference)	$C_{B\ (Ref)}$	-	3.78E-01	mg/kg fw	Appendix C
Mallard Concentration (Reference)	$C_{Mal\ (Ref)}$	-	1.13E+00	mg/kg fw	Appendix C
Grouse Concentration (Reference)	$C_{G\ (Ref)}$	-	2.59E-01	mg/kg fw	Appendix C
Store Food Concentration (Reference)	$C_{SF\ (Ref)}$	-	5.70E-01	mg/kg fw	Appendix C
Food Intake (Terrestrial Animals)	IR_{TA}	-	6.09E+02	kg/y fw	Assumed, site-specific
Local Intake Fraction of Moose (PLS)	$IF_{M\ (PLS)}$	-	1.69E-02	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Moose Organs (PLS)	$IF_{MO\ (PLS)}$	-	7.52E-03	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Beaver (PLS)	$IF_{B\ (PLS)}$	-	4.68E-02	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Mallard (PLS)	$IF_{Mal\ (PLS)}$	-	2.84E-03	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Grouse (PLS)	$IF_{G\ (PLS)}$	-	1.01E-02	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Store Food (PLS)	$IF_{SF\ (PLS)}$	-	4.16E-01	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Moose (Reference)	$IF_{M\ (Ref)}$	-	1.69E-02	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Moose Organs (Reference)	$IF_{MO\ (Ref)}$	-	7.52E-03	Unitless	Table 2-10, IMPACT Model Report

Table C.23: Sample Calculation - Adult Subsistence Harvester (Patterson Lake South) Dose and Risk Calculations for Copper

Parameter	Symbol	Calculation	Copper		
			Value	Unit	Source
Local Intake Fraction of Beaver (Reference)	$IF_{B\ (Ref)}$	-	4.68E-02	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Mallard (Reference)	$IF_{Mal\ (Ref)}$	-	2.84E-03	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Grouse (Reference)	$IF_{G\ (Ref)}$	-	1.01E-02	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Store Food (Reference)	$IF_{SF\ (Ref)}$	-	4.16E-01	Unitless	Table 2-10, IMPACT Model Report
Human Adult Body Mass	BW	-	7.07E+01	kg	Health Canada, 2021
Food Processing Factor	FPF	-	1.00E+00	Unitless	Assumed
Ingestion Dose (Terrestrial Animals)	D_{TA}	$D_{AA} = ((C_{M\ (PLS)} * IF_{M\ (PLS)} + C_{MO\ (PLS)} * IF_{MO\ (PLS)} + C_{B\ (PLS)} * IF_{B\ (PLS)} + C_{Mal\ (PLS)} * IF_{Mal\ (PLS)} + C_{G\ (PLS)} * IF_{G\ (PLS)} + C_{SF\ (PLS)} * IF_{SF\ (PLS)} + C_{M\ (Ref)} * IF_{M\ (Ref)} + C_{MO\ (Ref)} * IF_{MO\ (Ref)} + C_{B\ (Ref)} * IF_{B\ (Ref)} + C_{Mal\ (Ref)} * IF_{Mal\ (Ref)} + C_{G\ (Ref)} * IF_{G\ (Ref)} + C_{SF\ (Ref)} * IF_{SF\ (Ref)}) * IR_{TA} * FPF) / (BW * 365)$	1.77E-02	mg/kg/d fw	Calculated
Adult Subsistence Harvester Total Dose and HQ					
Total Ingestion Dose	D_{total}	$D_{total} = D_w + D_s + D_{TP} + D_{AA} + D_{TA}$	1.87E-02	mg/kg/d fw	Calculated
Toxicological Benchmark	TRV	-	4.26E-01	mg/kg d	Table 5-17
Hazard Quotient	HQ	$HQ = D_{total} / TRV$	4.39E-02	Unitless	Calculated

Table C.24: Sample Calculation - Mallard (Patterson Lake South) Radiological Dose for Polonium-210

Parameter	Symbol	Calculation	Polonium-210		
			Value	Unit	Source
Environmental Media Concentrations					
Water Concentration	C_w	-	5.31E-03	Bq/L	Appendix C
Sediment Concentration (dry weight)	$C_{s(dw)}$	-	3.74E+02	Bq/kg dw	Appendix C
Outdoor Air Concentration	C_{air}	-	1.51E-05	Bq/m^3	Appendix C
Sediment Dry Bulk Density	ρ_s	-	1.10E-01	kg dw/ L	CSA N288.1-20 clause 6.6.2.2
Mixing Depth	d	-	3.00E-02	m	Assumed
Sediment Surface Concentration (dry weight)	$C_{s(dw)}'$	$C_{s(dw)}' = C_{s(dw)} * \rho_s * d * 1000$ L/m^3	1.24E+03	Bq dw/ m^2	Calculated
Aquatic Plant Concentration					
Bioaccumulation Factor - Aquatic Plant	$BAF_{aquatic\ plant}$	-	2.93E+02	L/kg fw	Assumed
Aquatic Plant Concentration (fresh weight)	$C_{aquatic\ plant}$	$C_{aquatic\ plant} = C_w * BAF_{aquatic\ plant}$	1.55E+00	Bq/kg fw	Calculated
Benthic Invertebrate Concentration					
Water-to-Sediment Partitioning Coefficient	k_d	-	1.20E+05	L/kg	Assumed
Dry Bulk Density	ρ	-	1.10E-01	kg/L	Assumed
Water Content (Volume Basis)	θ	-	9.60E-01	unitless	Assumed
Fraction in Porewater Phase	$C_{pw\ (fraction)}$	$C_{pw\ (fraction)} = 1 - (k_d * \rho / \theta) / (1 + k_d * \rho / \theta)$	7.27E-05	unitless	Calculated
Concentration Ratio – Porewater to Sediment	$Ratio_{pw\text{-}sed}$	$Ratio_{pw\text{-}sed} = C_{pw\ (fraction)} * \rho / \theta$	8.33E-06	kg/L	Calculated
Sediment Porewater Concentration	$C_{pw\ (sed)}$	$C_{pw\ (sed)} = C_{sed(dw)} * Ratio_{pw\text{-}sed}$	3.12E-03	Bq/L	Calculated
Bioaccumulation Factor (BAF)	$BAF_{benthic\ inv}$	-	1.58E+04	L/kg fw	Assumed
Sediment Occupancy Factor	OF_{sed}	-	1.00E+02	%	Assumed
Benthic Invertebrate Tissue Concentration	$C_{benthic\ inv}$	$C_{benthic\ inv} = (1 - (OF_{sed}/100) * C_{sed(dw)} + (OF_{sed}/100) * C_{pw\ (sed)}) * BAF_{benthic\ inv}$	4.92E+01	Bq/kg fw	Calculated
Mallard Exposure Factors					
Water Intake	IR_w	-	6.40E-02	L/d	Table 6-8
Sediment Intake	IR_s	-	2.00E-03	kg dw/d	Table 6-8
Air Intake	IR_{air}	-	2.00E-02	m^3/d	Table 6-8
Aquatic Plant Intake	$IR_{aquatic\ plant}$	-	6.00E-02	kg fw/d	Table 6-8
Benthic Invertebrate Intake	$IR_{benthic\ inv}$	-	1.80E-01	kg fw/d	Table 6-8
Fraction of Time Spent on Site	f_0	-	1.00E+00	unitless	Assumed
Mallard Internal Dose (Radiological)					
Ingestion Transfer Factor	TF_{ing}	-	3.68E+00	d/kg fw	NCRP 123 (1996)
Mallard Tissue Concentration	C_t	$C_t = f_0 * TF_{ing} * (C_w*IR_w + C_{s(dw)} * IR_s + C_{aquatic\ plant} * IR_{aquatic\ plant} + C_{benthic\ inv} * IR_{benthic\ inv})$	3.57E+01	Bq/kg fw	Calculated
Dose Conversion Factor (Internal) - Duck	DC_{int}	-	3.04E-02	(µGy/hr)/(Bq/kg fw)	ICRP 108 (2008) (Table C.4)
Internal Dose	D_{int}	$D_{int} = C_t * DC_{int}$	1.09E+00	µGy/hr	Calculated
Internal Dose (converted units)	D_{int}'	$D_{int}' = D_{int} * 24$ h/d / 1000 µGy/mGy	2.61E-02	mGy/d	Calculated

Table C.24: Sample Calculation - Mallard (Patterson Lake South) Radiological Dose for Polonium-210

Parameter	Symbol	Calculation	Polonium-210		
			Value	Unit	Source
Mallard External Dose (Radiological)					
Occupancy Factor, Sediment - Riparian Birds	OF_s	-	0.00E+00	unitless	Assumed
Occupancy Factor, Sediment Surface - Riparian Birds	OF_{ss}	-	5.00E-01	unitless	Assumed
Dose Conversion Factor (External) - Duck	$DC_{ext\ (on\ soil)}$	-	2.63E-11	(µGy/hr)/(Bq/m^2)	Table 4.23
External Dose	D_{ext}	$D_{ext} = f_0 * (C_{s(dw)}' * OF_{ss} * DC_{ext\ (on\ soil)})$	4.91E-09	µGy/hr	Calculated (Section 4.2.3.1)
External Dose (converted units)	D_{ext}'	$D_{ext}' = D_{ext}$ * 24 h/d / 1000 µGy/mGy	1.18E-10	mGy/d	Calculated
Mallard Total Dose (Radiological)					
Total Dose	D_{total}	$D_{total} = D_{int} + D_{ext}$	1.09E+00	µGy/hr	Calculated
Total Dose (converted units)	D_{total}'	$D_{total}' = D_{int}' + D_{ext}'$	2.61E-02	mGy/d	Calculated

Table C.25: Sample Calculation - Adult Harvester (Patterson Lake South) Radiological Dose for Polonium-210

Parameter	Symbol	Calculation	Polonium-210		
			Value	Unit	Source
Environmental Media Concentrations					
Water Concentration	C_w	-	5.31E-03	Bq/L	Appendix C
Water Concentration reference	$C_{w\ (Ref)}$	-	5.15E-03	Bq/L	Appendix C
Water Concentration incremental	C_w'	$C_w' = C_w - C_{w\ (Ref)}$	1.55E-04	Bq/L	Calculated
Soil Concentration (dry weight)	$C_{s(dw)}$	-	1.25E+01	Bq/kg dw	Appendix C
Soil Concentration reference (dry weight)	$C_{s(dw)\ (Ref)}$	-	1.12E+01	Bq/kg dw	Appendix C
Soil Concentration incremental (dry weight)	$C_{s(dw)}'$	$C_{s(dw)}' = C_{s(dw)} - C_{s(dw)\ (Ref)}$	1.25E+00	Bq/kg dw	Calculated
Outdoor Air Concentration	C_{air}	-	1.51E-05	Bq/m^3	Appendix C
Soil Dry Bulk Density (Sand)	ρ_s	-	1.50E+00	kg(dw)/ L	CSA N288.1-20 (cl. 6.3.2.2)
Mixing Depth	d	-	2.00E-01	m	CSA N288.1-20 (cl. 6.3.1.1)
Soil Surface Concentration	C_{ss}	$C_{ss} = C_{s(dw)}' * \rho_s * d * 1000\ L/m^3$	3.76E+02	Bq(dw)/m^2	Calculated
Polygon Fraction Outdoor Air	PF_{air}	-	5.00E-01	Unitless	Assumed
Polygon Fraction Soil	PF_s	-	5.00E-01	Unitless	Assumed
Polygon Fraction Water	PF_w	-	5.00E-01	Unitless	Assumed
Air Immersion Dose					
Fraction of Time at Location	f_o	-	1.00E+00	Unitless	CSA N288.1-20 (cl. 6.14.3)
Outdoor Occupancy Factor	f_u	-	2.00E-01	Unitless	CSA N288.1-20 (cl. 6.14.3)
Building Shielding Factor	S_b	-	5.00E-01	Unitless	CSA N288.1-20 (cl. 6.2.5)
Dose Conversion Factor (Immersion)	DCF_a	-	1.23E-11	(Sv/a)/(Bq/m^3)	Assumed
Air Immersion Dose	D_{air}	$D_{air} = C_{air} * f_o * (f_u + (1 - f_u) * S_b) * DCF_a * PF_{air}$	5.57E-17	Sv/a	Calculated
Unit conversion	D_{air}'	$D_{air}' = D_{air} * 1000\ mSv / Sv$	5.57E-14	mSv/a	Calculated
Air Inhalation Dose					
Inhalation Rate	IR_{air}	-	5.95E+03	m^3/a	CSA N288.1-20 (Table 19)
Dose Conversion Factor (Inhalation)	DCF_{inh}	-	3.30E-06	Sv/Bq	Assumed
Air Inhalation Dose	D_{inh}	$D_{inh} = C_{air} * IR_{air} * DCF_{inh} * PF_{air}$	1.48E-07	Sv/a	Calculated
Unit conversion	D_{inh}'	$D_{inh}' = D_{inh} * 1000\ mSv / Sv$	1.48E-04	mSv/a	Calculated
Water Ingestion Dose					
Ingestion Rate	IR_w	-	3.80E+02	L/a	CSA N288.1-20 (Table 21)
Dose Conversion Factor (Food)	DCF_f	-	1.20E-06	Sv/Bq	Assumed
Water Ingestion Dose	D_w	$D_w = C_w' * IR_w * DCF_f * PF_w$	3.54E-08	Sv/a	Calculated
Unit Conversion	D_w'	$D_w' = D_w * 1000\ mSv / Sv$	3.54E-05	mSv/a	Calculated
Water Immersion Dose					
Bathtub Correction Factor	D_c	-	7.00E-01	Unitless	CSA N288.1-20 (cl. 6.16.12)
Occupancy Factor - Swimming Surface Water	OF^s_w	-	1.04E-02	Unitless	CSA N288.1-20 (cl. 6.16.1.3)

Table C.25: Sample Calculation - Adult Harvester (Patterson Lake South) Radiological Dose for Polonium-210

Parameter	Symbol	Calculation	Polonium-210		
			Value	Unit	Source
Occupancy Factor - Pool Water	OF^p_w	-	3.13E-02	Unitless	CSA N288.1-20 (cl. 7.6.1.2)
Occupancy Factor - Bath Water	OF^b_w	-	1.40E-02	Unitless	CSA N288.1-20 (cl. 6.16.1.3)
Removal factor (sedimentation)	ρ	-	1.00E+00	Unitless	CSA N288.1-20 (cl. 7.10.4)
Dose Conversion Factor (Water)	DCF_w	-	2.66E-11	Sv/Bq	Assumed
Water Immersion Dose	D_{imm}	$D_{imm} = C_w' * (k^s_w * PF_w + D_c * PF_w * OF^b_w + PF_w * OF^p_w) * DCF_w$	1.06E-16	Sv/a	Calculated
Unit Conversion	D_{imm}'	$D_{imm}' = D_{imm} * 1000$ mSv / Sv	1.06E-13	mSv/a	Calculated
External Soil Dose					
Dose reduction factor from surface roughness and terrain irregularities	f_r	-	6.80E-01	Unitless	CSA N288.1-20 (cl. 6.4.6.3)
Groundshine Shielding Factor	S_g	-	2.00E-01	Unitless	CSA N288.1-20 (cl. 6.14.3)
Dose Conversion Factor (Soil)	DCF_g	-	2.61E-13	(Sv/a)/(Bq/m^2)	Assumed
Soil External Dose	D_g	$D_g = C_{ss} * f_o * f_r * (f_u + (1 - f_u) * S_g) * DCF_g * PF_s$	1.20E-11	Sv/a	Calculated
Unit conversion	D_g'	$D_g' = D_g * 1000$ mSv / Sv	1.20E-08	mSv/a	Calculated
Internal Soil Dose					
Soil Intake Rate	IR_s	-	4.00E-06	kg(dw)/d	CSA N288.1-20 (Table 20)
Soil Exposure Frequency	t_d	-	1.35E+02	d/y	Assumed
Dose Conversion Factor (Food)	DCF_f	-	1.20E-06	Sv/Bq	Assumed
Internal Soil Dose	D_s	$D_s = C_{s(dw)}' * IR_s * t_d * DCF_f * PF_s$	4.07E-10	Sv/a	Calculated
Unit conversion	D_s'	$D_s' = D_s * 1000$ mSv / Sv	4.07E-07	mSv/a	Calculated
Terrestrial Plant Ingestion Dose					
Labrador Tea Concentration (PLS)	$C_{LT\ (PLS)}$	-	4.32E+00	Bq/kg fw	Appendix C
Blueberry Concentration (PLS)	$C_{BB\ (PLS)}$	-	6.00E-01	Bq/kg fw	Appendix C
Labrador Tea Concentration (Reference)	$C_{LT\ (Ref)}$	-	8.67E-01	Bq/kg fw	Appendix C
Blueberry Concentration (Reference)	$C_{BB\ (Ref)}$	-	4.33E-01	Bq/kg fw	Appendix C
Labrador Tea Concentration (Incremental)	$C_{LT\ (PLS)}'$	$C_{LT\ (PLS)}' = C_{LT\ (PLS)} - C_{LT\ (Ref)}$	3.46E+00	Bq/kg fw	Calculated
Blueberry Concentration (Incremental)	$C_{BB\ (PLS)}'$	$C_{BB\ (PLS)}' = C_{BB\ (PLS)} - C_{BB\ (Ref)}$	1.66E-01	Bq/kg fw	Calculated
Food Intake (Terrestrial Plants)	IR_{TP}	-	1.24E+01	kg/a fw	Assumed, site-specific
Local Intake Fraction of Labrador Tea (PLS)	$IF_{LT\ (PLS)}$	-	9.88E-02	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Blueberry (PLS)	$IF_{BB\ (PLS)}$	-	4.01E-01	Unitless	Table 2-10, IMPACT Model Report
Dose Conversion Factor (Food)	DCF_f	-	1.20E-06	Sv/Bq	Assumed
Ingestion Dose (Terrestrial Plants)	D_{TP}	$D_{TP} = (C_{LT\ (PLS)}' * IF_{LT\ (PLS)} + C_{BB\ (PLS)}' * IF_{BB\ (PLS)}) * IR_{TP} * DCF_f$	6.07E-06	Sv/a	Calculated
Unit conversion	D_{TP}'	$D_{TP}' = D_{TP} * 1000$ mSv / Sv	6.07E-03	mSv/a	Calculated
Aquatic Animal Ingestion Dose					
Northern Pike Concentration (PLS)	$C_{NP\ (PLS)}$	-	7.96E-01	Bq/kg fw	Appendix C

Table C.25: Sample Calculation - Adult Harvester (Patterson Lake South) Radiological Dose for Polonium-210

Parameter	Symbol	Calculation	Polonium-210		
			Value	Unit	Source
Whitefish Concentration (PLS)	$C_{WF\ (PLS)}$	-	7.14E-01	Bq/kg fw	Appendix C
Northern Pike Concentration (Reference)	$C_{NP\ (Ref)}$	-	7.73E-01	Bq/kg fw	Appendix C
Whitefish Concentration (Reference)	$C_{WF\ (Ref)}$	-	6.94E-01	Bq/kg fw	Appendix C
Northern Pike Concentration (Incremental)	$C_{NP\ (PLS)}'$	$C_{NP\ (PLS)}' = C_{NP\ (PLS)} - C_{NP\ (Ref)}$	2.33E-02	Bq/kg fw	Calculated
Whitefish Concentration (Incremental)	$C_{WF\ (PLS)}'$	$C_{WF\ (PLS)}' = C_{WF\ (PLS)} - C_{WF\ (Ref)}$	1.99E-02	Bq/kg fw	Calculated
Food Intake (Aquatic Animals)	IR_{AA}	-	8.47E+01	kg/a fw	Assumed, site-specific
Local Intake Fraction of Northern Pike (PLS)	$IF_{NP\ (PLS)}$	-	2.50E-01	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Whitefish (PLS)	$IF_{WF\ (PLS)}$	-	2.50E-01	Unitless	Table 2-10, IMPACT Model Report
Dose Conversion Factor (Food)	DCF_f	-	1.20E-06	Sv/Bq	Assumed
Ingestion Dose (Aquatic Animals)	D_{AA}	$D_{AA} = ((C_{NP\ (PLS)}' * IF_{NP\ (PLS)} + C_{WF\ (PLS)}' * IF_{WF\ (PLS)}) * IR_{AA} * DCF_f$	1.10E-06	Sv/a	Calculated
Unit conversion	D_{AA}'	$D_{AA}' = D_{AA}$ * 1000 mSv / Sv	1.10E-03	mSv/a	Calculated
Terrestrial Animal Ingestion Dose					
Moose Concentration (PLS)	$C_{M\ (PLS)}$	-	1.04E+00	Bq/kg fw	Appendix C
Moose Organs Concentration (PLS)	$C_{MO\ (PLS)}$	-	1.04E-02	Bq/kg fw	Appendix C
Beaver Concentration (PLS)	$C_{B\ (PLS)}$	-	4.08E-01	Bq/kg fw	Appendix C
Mallard Concentration (PLS)	$C_{Mal\ (PLS)}$	-	3.57E+01	Bq/kg fw	Appendix C
Grouse Concentration (PLS)	$C_{G\ (PLS)}$	-	1.88E+00	Bq/kg fw	Appendix C
Store Food Concentration (PLS)	$C_{SF\ (PLS)}$	-	4.80E-02	Bq/kg fw	Appendix C
Moose Concentration (Reference)	$C_{M\ (Ref)}$	-	3.65E-01	Bq/kg fw	Appendix C
Moose Organs Concentration (Reference)	$C_{MO\ (Ref)}$	-	3.65E-03	Bq/kg fw	Appendix C
Beaver Concentration (Reference)	$C_{B\ (Ref)}$	-	2.94E-01	Bq/kg fw	Appendix C
Mallard Concentration (Reference)	$C_{Mal\ (Ref)}$	-	3.49E+01	Bq/kg fw	Appendix C
Grouse Concentration (Reference)	$C_{G\ (Ref)}$	-	1.30E+00	Bq/kg fw	Appendix C
Store Food Concentration (Reference)	$C_{SF\ (Ref)}$	-	4.80E-02	Bq/kg fw	Appendix C
Moose Concentration (Incremental)	$C_{M\ (PLS)}'$	$C_{M\ (PLS)}' = C_{M\ (PLS)} - C_{M\ (Ref)}$	6.78E-01	Bq/kg fw	Calculated
Moose Organs Concentration (Incremental)	$C_{MO\ (PLS)}'$	$C_{MO\ (PLS)}' = C_{MO\ (PLS)} - C_{MO\ (Ref)}$	6.78E-03	Bq/kg fw	Calculated
Beaver Concentration (Incremental)	$C_{B\ (PLS)}'$	$C_{B\ (PLS)}' = C_{B\ (PLS)} - C_{B\ (Ref)}$	1.14E-01	Bq/kg fw	Calculated
Mallard Concentration (Incremental)	$C_{Mal\ (PLS)}'$	$C_{Mal\ (PLS)}' = C_{Mal\ (PLS)} - C_{Mal\ (Ref)}$	8.64E-01	Bq/kg fw	Calculated
Grouse Concentration (Incremental)	$C_{G\ (PLS)}'$	$C_{G\ (PLS)}' = C_{G\ (PLS)} - C_{G\ (Ref)}$	5.78E-01	Bq/kg fw	Calculated
Store Food Concentration (Incremental)	$C_{SF\ (PLS)}'$	$C_{SF\ (PLS)}' = C_{SF\ (PLS)} - C_{SF\ (Ref)}$	0.00E+00	Bq/kg fw	Calculated
Local Intake Fraction of Moose (PLS)	$IF_{M\ (PLS)}$	-	1.69E-02	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Moose Organs (PLS)	$IF_{MO\ (PLS)}$	-	7.50E-03	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Beaver (PLS)	$IF_{B\ (PLS)}$	-	4.68E-02	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Mallard (PLS)	$IF_{Mal\ (PLS)}$	-	2.85E-03	Unitless	Table 2-10, IMPACT Model Report

Table C.25: Sample Calculation - Adult Harvester (Patterson Lake South) Radiological Dose for Polonium-210

Parameter	Symbol	Calculation	Polonium-210		
			Value	Unit	Source
Local Intake Fraction of Grouse (PLS)	$IF_{G\ (PLS)}$	-	1.01E-02	Unitless	Table 2-10, IMPACT Model Report
Local Intake Fraction of Store Food (PLS)	$IF_{SF\ (PLS)}$	-	1.68E-01	Unitless	Table 2-10, IMPACT Model Report
Food Intake (Terrestrial Animals)	IR_{TA}	-	6.09E+02	kg/a fw	Assumed, site-specific
Dose Conversion Factor (Food)	DCF_f	-	1.20E-06	Sv/Bq	Assumed
Ingestion Dose (Terrestrial Animals)	D_{TA}	$D_{TA} = ((C_{M\ (PLS)}' * IF_{M\ (PLS)} + C_{MO\ (PLS)}' * IF_{MO\ (PLS)} + C_{B\ (PLS)}' * IF_{B\ (PLS)} + C_{Mal\ (PLS)}' * IF_{Mal\ (PLS)} + C_{G\ (PLS)}' * IF_{G\ (PLS)} + C_{SF\ (PLS)}' * IF_{SF\ (PLS))} * IR_{TA} * DCF_f$	1.83E-05	Sv/a	Calculated
Unit conversion	D_{TA}'	$D_{TA}' = D_{TA}$ * 1000 mSv / Sv	1.83E-02	mSv/a	Calculated
Harvester Total Dose					
Total Dose	D_{total}	$D_{total} = D_{air}' + D_{inh}' + D_{w}' + D_{imm}' + D_{g}' + D_{s}' + D_{TP}' + D_{AA}' + D_{TA}'$	2.57E-02	mSv/a	Calculated

Appendix D Iron Exposure Assessment

APPENDIX D IRON EXPOSURE ASSESSMENT

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1.0 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.

In support of the EA for the Project, NexGen prepared an Environmental Impact Statement (EIS), which included baseline studies and development of an Environmental Risk Assessment (ERA) (EIS TSD XXI). Baseline studies conducted for water and sediment included sampling for concentrations of iron, which were then further considered within EIS TSD XXI.

Iron is the fourth most common of elements in the Earth's continental crust. It is an essential element for living organisms and is well regulated in the body. It is not considered to be a toxicant of concern, except to aquatic biota in specific circumstances (ECCC 2024). It is well understood that iron exerts its toxicological effects on aquatic biota through precipitation when receiving water pH is higher than the pH in a discharge. Such precipitation on the gills or on fish eggs can cause respiratory stress or smothering (Brix et al. 2023; ECCC 2024). While iron can affect aquatic biota, there is no risk associated with the quality of the food source and potential accumulation of iron in biological tissues (ECCC 2024).

From baseline studies conducted for the Project, iron concentrations were identified as exceeding water quality guidelines in baseline surface water quality throughout the local study area (LSA), with exceedances of the water quality guideline of 0.3 mg/L from the Canadian Council of Ministers of the Environment (CCME) in eight waterbodies and watercourses and in the reference lakes. As part of EIS TSD XXI, iron was evaluated as a constituent of potential concern (COPC) but was not carried forward (i.e., was screened out), as the predicted upper bound concentrations of iron released to Patterson Lake in treated effluent, sewage, and groundwater, as well as the predicted upper bound concentrations of iron at the boundary of the mixing zone were lower than the selected water quality guideline of 0.3 mg/L from the CCME. Thus, it was concluded that there would be no potential for Project releases to increase iron concentrations in the receiving environment above the CCME guideline. Iron concentrations in sediment were not screened against any sediment quality guidelines (SQGs) in EIS TSD XXI, because there are no federal or provincial guidelines for iron in sediment.

Since the completion of the screening originally conducted as part of the Project EA, an updated Federal Environmental Quality Guideline (FEQG) was published in May 2024 (ECCC 2024), which is more stringent than the previous CCME water quality guideline (Table 1-1). The scope of EIS TSD XXI Appendix D, Iron Exposure Assessment, is to provide the exposure assessment of iron consistent with requirements of CSA N288.6-22 Section 7.2.5.4.2 to determine the Project-related effects to sediment quality and aquatic biota and to support the assessment performed in the TSD XXI, using the new FEQG water quality guidelines.

Table 1-1: Measured Baseline Surface Water Iron Concentrations (mg/L) in the Local Study Area

Water body / Water course	# of Samples	% Above FEQG Water Quality Threshold for Aquatic Life	% Above CCME Water Quality Threshold for Drinking Water Quality	Min.	25th Percentile	Average[(a)]	95th Percentile	Max.
Broach Lake	19	0	0	0.0030	0.012	0.028	0.090	0.12
Lake H	11	27%	27%	0.056	0.087	**0.43**	**1.73**	**2.08**
Lake G	11	73%	73%	0.15	**0.31**	**0.69**	**2.08**	**2.44**
Patterson Lake North Arm – East Basin	19	10%	10%	0.0085	0.085	0.19	**0.59**	**0.79**
Patterson Lake North Arm – West Basin	19	5%	5%	0.0068	0.012	0.051	0.19	**0.47**
Patterson Lake South Arm	19	0	0	0.0012	0.013	0.016	0.025	0.031
Forrest Lake – North Basin	15	0	0	0.0016	0.029	0.043	0.089	0.11
Forrest Lake – South Basin	18	6%	0	0.00020	0.0059	0.024	0.062	**0.26**
Beet Lake	17	6%	6%	0.0039	0.020	0.11	**0.30**	**0.85**
Naomi Lake	12	100%	100%	**0.35**	**0.65**	**0.83**	**1.01**	**1.02**
Clearwater River below Beet Lake	11	0	0	0.0220	0.048	0.09	0.18	0.19
Reference Lake	33	3%	3%	0.0046	0.015	0.12	0.63	1.58

Notes: **Shaded grey and bold** indicates that the value is greater than both the minimum FEQG water quality guideline for protection of aquatic life of 0.23 mg/L calculated for baseline water samples (samples with pH 7.3 – 7.4 and dissolved organic carbon of 1.5 mg/L, see Table 5-1; ECCC, 2024) and the CCME water quality guideline for aquatic life and drinking water quality of 0.3 mg/L (CCREM, 1987; ECCC, 2019). **Shaded black, and bold white font** indicates that the value is greater than the minimum FEQG water quality guideline for protection of aquatic life of 0.23 mg/L but not greater than the CCME guideline.

a) Calculated using half detection limit for any non-detectable samples.

2.0 Development of Model Parameters for Iron

The details on the IMPACT modelling approach applied for the iron assessment are the same as those reported in the main body of EIS TSD XXI and the associated Appendix A of EIS TSD XXI. Section 2.1 and Section 2.2 of EIS TSD XXI Appendix D provide the iron-specific parameters used in the IMPACT model.

2.1 Baseline Water Quality and Sediment Quality

This subsection describes how the baseline water quality and sediment quality were set up in the IMPACT model. The local inflow to each waterbody represents the local watershed inputs to assessed waterbodies (excluding the upstream inflow). The calibrated local inflow values of iron were used in the model to predict stable concentrations in water and sediment within the range of observed values of baseline conditions.

A summary of the modelling assumptions and adjustments is included below:

- The waterbodies included in the calculation of a regional baseline concentration were Patterson Lake (i.e., North Arm – East Basin, North Arm – West Basin, and South Arm), all measurement stations along the Clearwater River, Lake H, Lake G, Forrest Lake, Beet Lake, Naomi Lake, Mirror River, and Lloyd Lake.
- The local inflow concentrations were calculated from the baseline concentrations (Table 1-1), the residence time within each respective waterbody, sedimentation rate, and water-to-sediment partitioning coefficient.
- Since sedimentation processes remove metals from the inflow, the local inflow concentrations for each waterbody were assigned values higher than the baseline concentrations.

Metals in water are expected to interact with sediment. Iron concentrations in sediment were modelled based on concentrations in water using the water-to-sediment partitioning coefficients (K_d). The K_d value for iron used in the IMPACT model is $4.97x10^{+05}$ L/kg (dw), which was calibrated using the measured water and sediment quality data from baseline studies completed from 2018 to 2020.

The measured geometric mean (geomean) and modelled-average baseline concentrations are in agreement (Table 2-1).

Table 2-1: Baseline Water and Sediment Concentrations of Iron Used in the IMPACT Model

Parameter	Water Baseline Concentration	Sediment Baseline Concentration
	mg/L	mg/kg dw
Measured Baseline (Geomean)	$7.25x10^{-2}$	$1.81x10^{4}$
Modelled Baseline	$7.25x10^{-2}$	$1.81x10^{4}$

2.2 Baseline Air Quality and Soil Quality

Risk through air exposure pathways is considered during Operations, because the highest predicted iron concentrations occur during this phase. For the baseline, it is assumed that none of the considered COPCs are present in air. Consequently, any risk increase through the air pathway is due to the operation of the mine. Regional background soil chemistry was derived from baseline data collected in 2019. Table 2-2 presents the selected air and soil baseline concentrations used in the IMPACT model.

Table 2-2: Baseline Air and Soil Concentrations of Iron Used in the IMPACT Model

Air Baseline Concentration	Soil Baseline Concentration
mg/m^3	mg/kg dw
0.0	$1.61x10^{3}$

3.0 Aqueous and Atmospheric Sources for Iron

Similar to other COPCs, the Project-related aqueous releases to Patterson Lake would include releases from the effluent treatment plant, sewage treatment plant, and groundwater as well as non-contact site runoff. The Project-related atmospheric releases considered in the ERA were consistent with the air emissions inventory detailed in the Air Dispersion Modelling Report for Project Construction and Operations (EIS Section 7.2.5, Residual Effects Analysis; EIS Appendix 7A, Air Dispersion Modelling Report).

More details regarding the source terms were reported in Section 4.2 and Section 4.3 of EIS TSD XXI.

4.0 Exposure Point Concentrations in Environmental Media

The estimated maximum iron concentrations in environmental media, including water, sediment, air, and soil, at different locations during Operations for the Application Case and the Upper Bound Scenario are shown in Table 4-1. These values represent the model baseline plus Project effects. The maximum iron concentration in water was predicted at Patterson Lake North Arm – West Basin, which is 0.0726 mg/L for both the Application Case and the Upper Bound Scenario. The predicted values are less than 0.1% above model baseline, indicating the Project has a minimal contribution to the total concentration.

The maximum iron concentration in sediment was predicted at Patterson Lake North Arm – East Basin, which is $1.81x10^4$ mg/kg dw for both the Application Case and the Upper Bound Scenario, again only marginally above the model baseline concentration of $1.81x10^4$ mg/kg dw, indicating the Project contribution to iron in sediment is minimal.

The maximum iron concentrations in air and soil were predicted at Patterson Lake North Arm – West Basin, which are $3.55x10^{-5}$ mg/m^3 and $1.62x10^3$ mg/kg dw, respectively, for both the Application Case and the Upper Bound Scenario. The model baseline for iron in air was assumed to be 0.0 mg/m^3, and the model baseline for soil was $1.62x10^3$ mg/kg dw.

Table 4-1: Estimated Maximum Iron Concentrations in Environmental Media for the Application Case and Upper Bound Scenario - Project Lifespan

Environmental Media	Location	Maximum Concentration during Project Lifespan	
		Application Case	Upper Bound Scenario
Water (mg/L)	Reference (Broach Lake)	$7.25x10^{-2}$	$7.25x10^{-2}$
	Clearwater River downstream of Broach Lake	$7.25x10^{-2}$	$7.25x10^{-2}$
	Patterson Lake North Arm – East Basin	$7.26x10^{-2}$	$7.26x10^{-2}$
	Patterson Lake North Arm – West Basin	**$7.26x10^{-2}$**	**$7.26x10^{-2}$**
	Patterson Lake South Arm	$7.25x10^{-2}$	$7.25x10^{-2}$
	Forrest Lake – North Basin	$7.25x10^{-2}$	$7.25x10^{-2}$
	Beet Lake	$7.25x10^{-2}$	$7.25x10^{-2}$
	Naomi Lake	$7.25x10^{-2}$	$7.25x10^{-2}$
	Clearwater River upstream Mirror River Confluence	$7.25x10^{-2}$	$7.25x10^{-2}$
	Clearwater River downstream Mirror River Confluence	$7.25x10^{-2}$	$7.25x10^{-2}$
	Lloyd Lake Inlet	$7.25x10^{-2}$	$7.25x10^{-2}$

Environmental Media	Location	Maximum Concentration during Project Lifespan	
		Application Case	Upper Bound Scenario
Sediment (mg/kg dw)	Reference (Broach Lake)	$1.81x10^4$	$1.81x10^4$
	Patterson Lake North Arm – East Basin	**$1.81x10^4$**	**$1.81x10^4$**
	Patterson Lake North Arm – West Basin	$1.81x10^4$	$1.81x10^4$
	Patterson Lake South Arm	$1.81x10^4$	$1.81x10^4$
	Beet Lake	$1.81x10^4$	$1.81x10^4$
	Naomi Lake	$1.81x10^4$	$1.81x10^4$
	Lloyd Lake Inlet	$1.81x10^4$	$1.81x10^4$
Air (mg/m^3)	Reference (Broach Lake)	0.00	0.00
	Patterson Lake North Arm – West Basin	**$3.55x10^{-5}$**	**$3.55x10^{-5}$**
	Patterson Lake South Arm	$5.04x10^{-6}$	$5.04x10^{-6}$
	Beet Lake	$1.86x10^{-6}$	$1.86x10^{-6}$
	Clearwater River and Mirror River Confluence	$1.10x10^{-7}$	$1.10x10^{-7}$
	Lloyd Lake	$6.00x10^{-8}$	$6.00x10^{-8}$
Soil (mg/kg dw)	Reference (Broach Lake)	$1.61x10^3$	$1.61x10^3$
	Patterson Lake North Arm – West Basin	**$1.62x10^3$**	**$1.62x10^3$**
	Patterson Lake South Arm	$1.61x10^3$	$1.61x10^3$
	Beet Lake	$1.61x10^3$	$1.61x10^3$
	Clearwater River and Mirror River Confluence	$1.61x10^3$	$1.61x10^3$
	Lloyd Lake	$1.61x10^3$	$1.61x10^3$

Notes: The **bold** values indicate the maximum concentrations in each environmental media.
Project lifespan includes Construction, Operations, and Closure phases (43 years in total).

5.0 Comparison to the Available Media Quality Guidelines

The considered media quality guidelines are reported in Section 4.2.3 of Draft EIS TSD XXI for water and sediment and Section 4.3.3 of Draft EIS TSD XXI for air and soil.

From a human health perspective, iron is an essential element with no evidence for toxic effects unless large quantities of iron are ingested. Accordingly, Health Canada has not set a maximum acceptable concentration for iron; the current guideline for drinking water of 0.3 mg/L represents an aesthetic objective.

With respect to iron in water, it is important to note that an updated FEQG was published in May 2024, which follows the CCME (2007) species sensitivity distribution protocol (ECCC 2024). It is more stringent than the previous FEQG (ECCC 2019). FEQG guidelines are dependent on dissolved organic carbon (DOC) and pH. Table 5-1 shows the calculated FEQG values for iron in freshwater using the 2024 guideline equations and pH and DOC values obtained from the water quality baseline studies (EIS Annex V.1, Aquatic Environment Baseline Report). The calculated FEQG values for iron range from 0.23 mg/L to 0.76 mg/L, which is in the same range as the 1987 CCME guideline of 0.3 mg/L (CCREM 1987).

There are no federal or provincial guidelines for iron in sediment; therefore, the lowest effect level (LEL) of 2.00×10^4 mg/kg dw for the protection and management of aquatic sediment quality in Ontario was applied (MOEE 1993). The only available air quality guideline for iron is the 24-hour Ontario Ambient Air Quality Criteria (OAAQC), which is 4.00×10^{-3} mg/m^3. There are no federal or provincial guidelines for iron in soil.

As shown in Table 5-2, there is no exceedance when comparing the predicted maximum iron concentrations to the available quality guidelines in different environmental media. Therefore, no effects from iron on the environment are expected.

Table 5-1: Summary Statistics of Calculated FEQG Values for Iron in Freshwater and pH and Dissolved Organic Carbon (DOC) Values in Baseline Water Samples Associated with each FEQG Value

Statistical Parameter	Calculated FEQG Values (mg/L)	Associated Sample Values[(a)]	
		DOC (mg/L)	pH
Minimum	0.23	1.5	7.4
		1.5	7.3
25th Percentile	0.26	-	-
50th Percentile	0.38	3.5	6.7
		3.4	6.7
95th Percentile	0.67	-	-
Maximum	0.76	10	7.3
Arithmetic Mean	0.42	-	-
Geometric Mean	0.40	-	-

Notes: Cell with dashes "-" indicate that these FEQG values were computed using all calculated FEQG values (they reflect the distribution of the calculated FEQG values) and are therefore not associated with specific water samples. Although the 50th percentile is computed in this way, the resulting FEQG value of 0.38 mg/L was associated with specific water samples; therefore, associated DOC and pH values are shown.

Only samples with pH 6.0 – 8.5 and DOC 0.3 – 10.9 were used for FEQG calculations, as this is the range of pH and DOC values within which the CCME's water quality guideline conversion table for iron is valid (ECCC 2024). Sub-setting to these pH and DOC ranges omitted one water sample.

a) From measured water baseline data

Table 5-2: Comparison of Maximum Iron Concentrations to Available Quality Guidelines

Maximum Predicted Concentration	Available Quality Guidelines		Is Concentration Greater than Available Quality Guidelines (Yes/No)
Water (mg/L)	**CCME Protection of Aquatic Life, Long Term (a)**	**Federal Environmental Quality Guidelines (FEQG) (b)**	
$7.26x10^{-2}$ (Application Case) $7.26x10^{-2}$ (Upper Bound Scenario)	0.30	0.23 - 0.76	No
Sediment (mg/kg dw)	**The lowest effect level (LEL) from Ontario (c)**		
$1.81x10^{4}$	$2.00x10^{4}$		No
Air (mg/m³)	**Ontario Ambient Air Quality Criteria (OAAQC), 24-hour (d)**		
$3.55x10^{-5}$	$4.00x10^{-3}$		No
Soil (mg/kg dw)	**Soil Quality Guidelines Unavailable**		
$1.62x10^{3}$	No Data		Not applicable

Notes:
a) CCREM (1987); ECCC (2019).
b) ECCC (2024).
c) MOEE (1993).
d) MECP (2020).

6.0 Discussion of Potential Risk to Ecological And Human Health

Since there are no exceedances when comparing the predicted maximum iron concentrations to their available quality guidelines in different environmental media, there are no anticipated risks to ecological and human health with regards to iron inputs from the Project.

7.0 References

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