



CMD 26-H105.1-REF3

Part 1 of 5

Date: 2026-06-29

**Written Submission from
Orano Canada Inc.**

**Mémoire d'
Orano Canada Inc.**

In the matter of

À l'égard d'

Orano Canada Inc.

Orano Canada Inc.

Application to renew the McClean Lake
Operating Licence for 2-year term

Demande pour le renouvellement du
permis d'exploitation de McClean Lake
pour une période de deux ans

**Hearing in writing based on written
submissions**

**Audience par écrit fondée sur des
mémoires**

September 2026

Septembre 2026



Reference 3 - CMD 26-H105.1

December 5, 2025

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Dear Mr. Akhter & Ms Frantik,

Re: McClean Lake Operation – 2025 Environmental Performance Technical Information Document Volume 2

On behalf of Orano Canada Inc. (Orano), please find enclosed Volume 2 of the 2025 Environmental Performance Technical Information Document (EP TID), presenting an updated Environmental Risk Assessment (ERA) for the McClean Lake Operation. The ERA update is based on the most recent environmental data, refined model inputs based on the new monitoring data, recent and anticipated operational performance, adjustments to the mine plan, scientific advancements in ERA methodology, and changes in the regulatory framework.

The purpose of the EP TID Volume 2 is:

- to support current and future licensing applications and environmental assessments,
- inform environmental protection and monitoring, and
- identify opportunities for continual improvement and the need for additional mitigation measures, where required.

Updates of the ERA in Volume 2 were performed in line with the *CSA Standard N288.6 Environmental Risk Assessments at Nuclear Facilities and Uranium Mines and Mills*.

EP TID Volume 2 is a companion document to EP TID Volume 1 – Environmental Performance Assessment, which focuses on assessing the McClean Lake Operation environmental performance based on the most recent monitoring and operational data. EP TID Volume 1 is planned for submission by the end of December 2025.



To: Mr. Salman Akhter Ms. Casey Frantik
Re: McClean Lake Operation – 2025 Environmental Performance Technical Information Document

It is Orano's view that the 2025 EP TID Volume 2 satisfies regulatory requirements for the ERA update, demonstrates that the McClean Lake Operation stays within bounds of the approved environmental assessments, provides necessary information to facilitate the ongoing McClean Lake Operation licensing process, and informs timelines for the next ERA update.

Should you have any questions, please contact me at (306) 343-4619 or Lesley Schmalz, Regulatory Manager at (306) 343-4525.

Sincerely,

DocuSigned by:
Kelli Hughes
472B5B5E2E364B7...

Kebbi Hughes
Manager Environment and Geosciences

Attachment: McClean Lake Operation — Environmental Performance Technical Information Report Volume 2 – Environmental Risk Assessment

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Orano Canada Inc.

McClellan Lake Operation

Environmental Performance Technical Information Document

Volume 2 of 2 – Environmental Risk Assessment

Version 1 Revision 0

December 2025

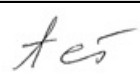
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History of Revisions

Version	Date	Details of Revision
Version 1 Revision 0	December 2025	Initial submission to Canadian Nuclear Safety Commission and Saskatchewan Ministry of Environment.

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Acronyms and Abbreviations

Term	Definition
AAQC	Ambient Air Quality Criteria
ACB	Air Contaminants Benchmarks
ADEPT	Assessment of the Dispersion and Effects of Parameter Transport
AECB	Atomic Energy Control Board
AMLSA	Air Modelling Local Study Area
AMRSA	Air Modelling Regional Study Area
ATSDR	Agency for Toxic Substances and Disease Registry
BPIP	Building Profile Input Program
BTEX	Benzene, Ethylbenzene, Toluene, Xylenes
CCD	Counter-Current Decantation
CCME	Canadian Council of Ministers of the Environment
CLE	Critical Effects Level
CNSC	Canadian Nuclear Safety Commission
COPC	Constituent Of Potential Concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPUE	Catch Per Unit Effort
CSA	Canadian Standards Association
CSD	Contaminated Sites Division
CWQG	Canadian Water Quality Guidelines
CWRP	Clean Waste Rock Pile
D&F	Dioxins and Furans
DC	Dose Coefficient (conversion)
DFO	Fisheries and Oceans Canada
DOC	Dissolved Organic Carbon
DWG	Drinking Water Guidelines
DWS	Dewatering Well System
EA	Environmental Assessment
EAA	Environmental Assessment Act
EARMP	Eastern Athabasca Regional Monitoring Program
EBRL	Exposure Based Release Limit
ECCC/HC	Environment and Climate Change Canada and Health Canada
ECOP	Environmental Code of Practice
Eco-SSL	Ecological Soil Screening Level
EE TID	Existing Environment Technical Information Document
EEM	Environmental Effects Monitoring
EIS	Environmental Impact Statement

Term	Definition
EMP	Environmental Monitoring Program
EP TID	Environmental Performance Technical Information Document
EPP	Environmental Protection Plan
ERA	Environmental Risk Assessment
ERICA	Equal Representation in Construction Apprenticeship
ESDM	Emission Summary and Dispersion Modelling
FCV	Fish Egg/Ovary
FEQG	Federal Environmental Quality Guidelines
FNFNES	First Nations Food, Nutrition and Environment Study
HADD	Harmful Alteration, Disruption or Destruction
HCs	Hydrocarbons
HVAS	High Volume Air Samplers
IC	Inhibitory Concentration
ISAQ	Industrial Source Air Quality
JSL	Jurisdictional Screening Level
LAB	Local Assessment Boundary
LEL	Lowest Effect Level
LOAEL	Lowest Observed Adverse Effect Level
LSA	Local Study Area
MATC	Maximum Acceptable Toxicant Concentration
MDMER	Metal And Diamond Mining Effluent Regulations
MECP	Ministry of Environment, Conservation and Parks
MED	Mining Equipment Development
NAM	North American Mesoscale
NE2	No-Effect
NOAEC	No Observed Adverse Effect Concentration
NOAEL	No Observable Adverse Effects Level
NOEC	No-Observed-Effect Concentration
non-NEW	Non-Nuclear Energy Workers
NORM	Naturally Occurring Radioactive Materials
Nox	Nitrogen Oxides
NPI	National Pollutant Inventory
NPRI	National Pollutant Release Inventory
OEL	Occupational Exposure Limit
OHS	Occupation Health and Safety
OLM	Ozone Limiting Method
PDF	Probability Distribution Function
PEL	Probably Effect Level
PHREEQC	PH REdox EQUilibrium in C+ code

Term	Definition
PM	Particulate Matter
RBE	Relative Biological Effectiveness
S/V TEMS	Sink/Vulture Treated Effluent Management System
SAAQS	Saskatchewan Ambient Air Quality Standards
SABRE	Surface Access Borehole Resource Extraction
SAR	Species at Risk
SARA	Species at Risk Act
SEL	Severe Effect Level
SEQG	Saskatchewan Environmental Quality Guidelines
SI	Screening Index
SMOE	Saskatchewan Ministry of Environment
SSD	Species Sensitivity Distribution
SSO	Site-Specific Objective
SUC	Sink Upper Compartment
SX	Solvent Extraction
TCM	Total Conversion Method
TDS	Total Dissolved Solids
TEL	Threshold Effect Levels
TID	Technical Information Document
TMF	Tailings Management Facility
TRV	Toxicity Reference Value
TSP	Total Suspended Particulate
TSS	Total Suspended Solids
U.S. EPA	United States Environmental Protection Agency
UCLM	Upper Confidence Limit of Mean
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
VC	Valued Component
VOC	Volatile Organic Compounds
WHO	World Health Organization
WQG	Water Quality Guidelines
WRAP	Western Regional Air Partnership
WRF-NMM	Weather Research Forecast Non-Hydrostatic Mesoscale Model
WTP	Water Treatment Plant
YOY	Young-Of-Year

Executive Summary

Volume 2 of the Environmental Performance Technical Information Document (EP TID) presents predictive risk modelling based on current and future anticipated activities and provides comparisons to risk and impact predictions previously presented for the McClean Lake Operation. The goal of Volume 2 of the EP TID is to support current and future licensing applications and environmental assessments as well as incorporate refined model inputs derived from new information, and in response to comments and concerns raised in previous licensing and environmental assessment (EA) documents.

The predicted future case is defined both by previously assessed projects at the McClean Lake Operation that are anticipated to be executed, as well as any foreseeable new projects that are proposed to take place over the life cycle of the McClean Lake Operation. Future activities include expansion of the JEB tailings management facility (TMF), development of McClean North, Sue F, and Midwest deposits with the SABRE mining method; milling ore from the Cigar Lake Operation, McClean North, Sue F, Sue B, and Midwest deposits through to 2036; water treatment operations at the JEB and Sue Water Treatment Plants to 2038 and 2040, respectively; and eventual demolition and reclamation activities.

Air dispersion modelling was completed to provide information about potential effects on ambient air quality due to emissions from the planned and future activities at the McClean Lake Operation. Potential effects to air quality were assessed using Saskatchewan Ambient Air Quality Standards (SAAQS). The modelling outcome indicated that potential effects from the McClean Lake Operation are minimal, with only occasional exceedances of 24-hour TSP and PM₁₀ standards beyond the lease boundary. For all other COPCs and averaging periods, concentrations were predicted to be less than the applicable standards, criteria or guidelines at all locations beyond the property boundary. Results from the air dispersion model were also used as inputs to the pathways model and risk assessment completed for ecological and human health.

Predictive modelling was completed to evaluate the potential for effects of the treated effluent discharge at the McClean Lake Operation on the receiving environment. The assessment focused on predicted water and sediment quality within and downstream of the Sink/Vulture Treated Effluent Management System (S/V TEMS). The S/V TEMS has been in operation since 1996 and an extensive record of monitoring information has been acquired. This information provides a comprehensive basis to derive model inputs to facilitate the accurate prediction of water and sediment quality expected within continued operation.

The results from the air dispersion and wastewater modelling were used in the pathways assessment for the evaluation of risks to ecological and human receptors using accepted risk assessment methodologies. The assessment was conducted in a manner that is consistent with CSA Standard N288.6 *Environmental Risk Assessments at Nuclear Facilities and Uranium Mines and Mills*. The assessment of spatial and temporal project-environment interactions during the operational and near-term post-decommissioning periods of the McClean Lake Operation required a comprehensive and integrated assessment framework. To account for variability in effluent and emission rates and uncertainty in constituent behaviour in the environment, a probabilistic modelling framework was adopted to predict constituent dispersion in air and water from proposed project activities and to estimate constituent uptake and exposure of plants, animals, and people.

The assessment of water and sediment quality indicates that concentrations of contaminants decrease progressively downstream due to dilution and natural attenuation processes. While some water quality guidelines are exceeded within the S/V TEMS for a few parameters (aluminum, chloride, fluoride, nitrate, sulphate, TDS, arsenic, cobalt, selenium, silver, and thallium), no exceedances are predicted downstream. Sediment concentrations of most metals and radionuclides remain below toxicity benchmarks, with localized exceedances of lowest effect levels for arsenic, molybdenum, and nickel within the S/V TEMS. For selenium, the predicted sediment concentrations are above the severe effect levels within S/V TEMS, but not within McClean Lake east basin, although selenium concentrations in sediment do exceed the lowest effect level at this location. Selenium concentrations are significantly lower than those predicted in the 2016 ERA, reflecting the effectiveness of adaptive management measures undertaken by Orano.

The ecological risk assessment concludes that potential effects on terrestrial species are negligible, while localized risks to aquatic biota within the S/V TEMS may occur due to elevated total dissolved solids, aluminum, chloride, and sulphate. The potential selenium-related effects are limited to the S/V TEMS and a few terrestrial species at McClean Lake east basin under the Base Case scenario with selenium treatment, and no downstream impacts are anticipated. The effects of these Constituents of Potential Concern (COPC) are not permanent, and it is expected that concentrations will return to background when water treatment stops and aquatic biota re-adjust to prevailing conditions. Although some terrestrial wildlife is present in the S/V TEMS, due to the on-going activities and small area, no effects at the populational level are expected.

The human health risk assessment indicates that predicted exposures to air contaminants, metals, and radionuclides remain below applicable health-based thresholds and occupational limits. Incremental radiation doses and cancer risks are negligible, consistent with previous environmental assessments. No adverse effects on human health are expected.

Special consideration was given to elevated nitrate concentrations observed in Bena Lake, which could be associated with groundwater flows from the Sue E Clean Waste Rock Pile. Groundwater modelling indicated that this pathway alone does not fully explain the observed trends. A risk evaluation based on current conditions concluded that recent nitrate levels pose a low potential risk to sensitive fish species in Bena Lake and no risk to the aquatic community in downstream Candy Lake. A site-specific nitrate objective for Bena Lake has been established.

Looking forward, Orano will continue to manage selenium risks under the Selenium Adaptive Management Plan, update the Industrial Source Air Quality Environmental Protection Plan, and adjust the radon monitoring program to improve characterisation of radon concentrations in vicinity of current and future mining activities. Additional studies will be undertaken to inform future air dispersion modelling and investigate nitrate pathways to Bena Lake. Monitoring frequency in Bena and Candy Lakes will be increased, and ecological risk assessments will be implemented based on new data.

It is proposed that the next EP TID update will be staged to improve efficiency and data integrity. Orano is proposing Volume 1 with an ERA review will be prepared in 2030, the review findings and regulatory feedback will be used to complete Volume 2 with the ERA update in 2031. This approach ensures compliance with CSA N288.6 requirements for regular ERA reviews and updates while maintaining efficiency, high quality

deliverables, and the effective use of resources. Additionally, this timeline provides an opportunity for regulatory input following the ERA review, ensuring that the ERA update reflects current expectations.

In conclusion, the 2025 ERA confirms that environmental risks associated with the McClean Lake Operation remain well-controlled and consistent with the findings presented in the previous environmental assessments. Continued monitoring and targeted studies will ensure environmental protection and regulatory compliance throughout the operational lifecycle.

1 Introduction

1.1 Background

The McClean Lake Operation is a uranium mine and milling facility located approximately 15 km west of Wollaston Lake in northeastern Saskatchewan, Canada (Figure 1.1-1). It also includes the Midwest Project located about 15 km west of the McClean Lake Mill (Figure 1.1-2). Orano Canada Inc. (Orano) is the majority owner and operator of the McClean Lake Operation (77.5%) and Midwest Project (74.83%). Orano is a Canadian company with its head office located in Saskatoon, Saskatchewan and is a wholly owned subsidiary of Orano group, a France-based company active in all aspects of the nuclear fuel cycle. Denison Mines Incorporated is a joint venture partner for the McClean Lake Operation (22.5%) and Midwest Project (25.17%).

The McClean Lake Operation is based on Crown land owned by the Government of Saskatchewan. The Surface Lease Agreement between the Government of Saskatchewan and the joint venture partners was signed on April 10, 2002. The agreement term is thirty-three years.

The telephone number for the McClean Lake Operation is (306) 633-2177. The email address of the General Manager, McClean Lake Operation is yann.baradello@orano.group. The business address of Orano is 100-833 45th Street West, Saskatoon, SK, S7L 5X2.

Uranium mineralization was first discovered in the McClean Lake region in early 1979. Since that time, a large number of environmental baseline and monitoring studies have been conducted in the vicinity of the McClean Lake Operation (MacClaren and SRC, 1979; Minatco, 1991; COGEMA, 1995; Orano, 2022a). In 2003, Orano undertook the initiative to summarize the relevant environmental studies related to the McClean Lake Operation into the Existing Environment Technical Information Document (EE TID). The EE TID was subsequently updated as the McClean Lake Operation Environmental Performance Technical Information Document (EP TID) which is comprised of two volumes:

- Volume 1 - Environmental Performance Assessment, which focuses on assessing the McClean Lake Operation environmental performance based on the most recent monitoring and operational data. The EP TID Volume 1 also summarizes key environmental aspects of the McClean Lake Operation and Midwest Project areas as well as results of the supplementary studies and follow-up programs.
- Volume 2 - Environmental Risk Assessment (ERA), which presents an updated ERA based on the most recent environmental data, refined model inputs based on the new monitoring data, recent and anticipated operational performance, adjustments to the mine plan, scientific advancements in ERA methodology, and changes in the regulatory framework. Volume 2 aims:
 - to support current and future licensing applications and environmental assessments,
 - inform environmental protection and monitoring, and
 - identify opportunities for continual improvement and the need for additional mitigation measures, where required.

The EP TID is updated periodically in line with regulatory requirements. Updates to Volume 1 are guided by requirements specified in the provincial Approval to Operate; updates of the ERA in Volume 2 are subject to the Canadian Nuclear Safety Commission (CNSC) REGDOC 2.9.1 requirements and CSA 288.6 guidance. The previous editions of EP TID Volumes 1 and 2 were released in 2012 and 2016. In 2020, the CNSC and the Saskatchewan Ministry of Environment (SMOE) accepted Orano's proposal to re-align the McClean Lake Operation environmental monitoring and reporting requirements, which included deferral of the EP TID Volume 1 submission from 2021 to 2022 and the EP TID Volume 2 submission from 2021 to 2025 (Orano, 2020a; CNSC, 2020; SMOE, 2020). The approval conditions included the following requirements:

1. The environmental performance report including the applicable 2016-2021 environmental monitoring information as described in the most recent version of the Environmental Performance Reporting Guideline to be submitted to the SMOE no later than September 30, 2022 (SMOE, 2020).
2. "Adequacy review" for CSA N288.6 to be included in the Annual Report and will fully demonstrate that Orano: (1) updated risk assessment(s) for any individual contaminants of concern identified during the review process; (2) thoroughly documented the review process, findings and any follow-up actions; and that (3) there have been no major facility changes (CNSC, 2020).
3. Future EP TID Volume 2 ERA updates to be submitted to the CNSC in 2030 and in 2035, subject to change based on the review of the "adequacy review" in the Annual reports, review of the 2025 EP TID Volume 2 - ERA, and following the CNSC relicensing hearings in 2027 (CNSC, 2020).

The proposed alignment and above requirements have been addressed as follows:

- The previous EP TID update was limited only to revision of Volume 1, which was submitted for regulatory review in 2022 (Orano, 2022a).
- The ERA adequacy reviews were included into the 2019 to 2024 Annual Reports (Orano 2020b; Orano 2021a; Orano 2022b; Orano 2023a; Orano 2024a; Orano 2025b).CSA
- Submission of the ERA update presented in the 2025 EP TID Volume 2, will inform timelines for future ERA updates.

It is Orano's view that the 2025 EP TID Volume 2 satisfies regulatory requirements for the ERA update, demonstrates that the McClean Lake Operation stays within bounds of the approved environmental assessments, provides necessary information to facilitate the McClean Lake Operation ongoing relicensing process, and informs timelines for the next ERA update.

1.1.1 Site Layout

The current configuration of the major infrastructure comprising the McClean Lake Operation is illustrated in Figure 1.1-3. The site comprises of the following areas:

- the JEB area which includes the permanent camp (JEB camp), the McClean Lake Mill (previously referred to as the JEB Mill), the JEB Clean Waste Rock Pile (CWRP), the JEB Tailings Management Facility (TMF) and the JEB water treatment plant (WTP);
- the Sue mining area which includes the mined-out Sue C/A (which contains the contaminated landfill), Sue B, and Sue E pits, the Sue C CWRP, the Sue E CWRP, the Sue WTP, and the undeveloped Sue F Project (formerly known as the Caribou Project) deposit;
- the Sink/Vulture Treated Effluent Management System (S/V TEMS) which includes Sink Reservoir and its control structure, and Vulture Lake and the effluent diffuser system which discharges effluent into the east basin of McClean Lake; and
- McClean Mining site which served as a testing ground for development of the Surface Access Borehole Resource Extraction (SABRE) mining method in 2007-2021 and is scheduled for mining in 2025.

An important environmental protection design feature of the site is the comprehensive water management strategy that has been implemented across operational areas. This water management strategy entails the capture and treatment of excess process water and site runoff from each of the operational areas, and the interception and diversion of surface runoff away from disturbed areas to minimize water treatment requirements. Infrastructure associated with the water management strategy includes water collection systems, two WTPs (the JEB and Sue WTPs), and a single treated effluent management system S/V TEMS to regulate treated effluent released to the receiving environment. The S/V TEMS is the final repository for wastewater generated at the operation. Wastewater inputs to the S/V TEMS currently consist of treated effluent from the JEB and Sue WTPs. The JEB dewatering well system (DWS), previously used to intercept and divert clean groundwater entering the JEB TMF, ceased operation in 2014 and its infrastructure has been decommissioned. As such, the JEB TMF hydraulic containment is provided exclusively by pumping water from the TMF base drain.

The Midwest Project site has been in care and maintenance status since 1989. Existing infrastructure includes a building that formerly served as a WTP, two settling ponds, Mink Arm Dam (with spillway), and the headframe from the test mine that operated during the 1980s (Figure 1.1-4). There is no liquid effluent discharged from the site, and the only source of air emissions are vehicles that travel to and from the site.

1.2 Environmental Assessment and Authorized Activities

The McClean Lake Operation has previously undergone several environmental assessments to assess the potential and expected effects to the environment from the initial development, additional projects, through to the post-decommissioning period. Table 1.2-1 provides an overview of the environmental assessment history for the McClean Lake Operation. Appendix I.1 details the McClean Lake Operation history along with the evolution of the environmental assessment and legislation since 1990s.

The following Environmental Impact Statements (EIS) have been completed and received federal and provincial environmental assessment approval:

- 1991 McClean Lake Project EIS (Minatco, 1991);
- 1995 Midwest Project EIS (COGEMA, 1995);
- 1995 Cigar Lake Project EIS (CLMC, 1995);

- 2001 Cigar Lake Waste Rock Disposal (COGEMA and CLMC, 2001);
- 2004 Sue E Project EIS (AREVA, 2004);
- 2009 Caribou (now Sue F) Project Screening EIS (AREVA, 2009a); and
- 2011 Midwest Project EIS (AREVA, 2011).

In addition to EISs listed above, several federal and provincial screenings and determinations were completed to review proposed projects or changes to previously approved projects related to McClean Lake Operation (Table 1.2-1).

The 1991 and 1995 EISs were reviewed by a joint federal-provincial Environmental Assessment (EA) review panel (Joint Panel) appointed to study uranium mine developments in northern Saskatchewan. While the environmental assessments reviewed by the Joint Panel provide the broad context of the types of environmental interactions and effects that would occur with project development, the Joint Panel also recognized that changes in science and technology would occur over the life of the Project and acknowledged that it would be the responsibility of the province and the CNSC to evaluate the effects of such changes in science and technology in the context of their licensing responsibilities and the prevention of unreasonable risk to the environment. Table 1.2-1 presents a list of EISs reviewed by the federal and provincial governments under the Canadian Environmental Assessment Act and Saskatchewan Environmental Assessment Act (EAA) as applicable. Orano has no projects that were reviewed under the Impact Assessment Act, 2019.

The McClean Lake Operation is governed by approvals and permits issued by the SMOE and licences issued by the CNSC. In 1994, the Atomic Energy Control Board (AECB) (predecessor to the CNSC) issued COGEMA (predecessor to AREVA; now Orano) a Licence for the McClean Lake Operation. This Licence has since been subject to several renewals and amendments (Table 1.2-2). The McClean Lake Operation currently operates under operating licence, UML-MINEMILL-McClean.02/2027, renewed by the CNSC on July 1, 2017 for a 10-year term, expiring June 30, 2027. Table 1.2-2 provides cross-references to the EA processes in which the activities were considered, and under which the CNSC licence(s) or amendment(s) the activity was granted.

The first McClean Lake Approval to Operate Pollutant Control Facilities IO-112 (Approval to Operate) was issued on February 29, 1996 by Saskatchewan Environment and Resource Management (predecessor of SMOE). The Approval to Operate has been revised and amended to reflect the changes in operations and regulations. The Approval provides authorization to operate and specifies facility conditions for management of materials, waste, emissions, water and wastewater. The current Approval to Operate was issued by SMOE Environmental Protection Branch on January 31, 2024 and will expire on October 31, 2029.

As of 2024 the following activities are approved for the McClean Lake Operation:

- Operate the McClean Lake Mill and produce uranium concentrate up to 24 million pounds annually;
- Receive and process Cigar Lake mine ore slurry;
- Vertically expand the JEB TMF pit perimeter to 468 mASL;
- Import, possess, use, store, transfer, and dispose of nuclear substances and radiation devices;
- Package and transport nuclear substances;
- Operate the SABRE Project;

- Store waste rock;
- Dispose of tailings and operate the JEB TMF;
- Operate the JEB Dewatering and Water Management Systems and JEB WTP;
- Operate the Sue WTP;
- Operate the JEB Office/Mill and Camp Potable Water supply systems;
- Operate the S/V TEMS;
- Handle and store hazardous materials and dispose of hazardous wastes;
- Operate landfills for disposal of contaminated and industrial waste;
- Operate landfills and an incinerator for disposal of domestic waste;
- Conduct sewage treatment associated with the McClean Lake Operation;
- Conduct remediation of hydrocarbon contaminated soil;
- Operate air pollution monitoring and abatement equipment; and
- Manage care and maintenance activities at the Midwest Project site.

1.3 McClean Lake Operation History

The uranium mineralization in the McClean Lake region was initially discovered in 1979, and an initial proposal to develop the McClean Lake Project dates back to the early 1990s. Subsequent to regulatory approval, extraction of the uranium ore at the McClean Lake Operation commenced in 1996 and processing ore into a yellowcake product began in 1999.

Table 1.3-1 provides timelines for key events that have occurred at the McClean Lake Operation since 1995 including

- the open pit mining of the JEB and Sue A, B, C, and E deposits, the operation of the McClean Lake Mill and JEB TMF, the JEB and Sue WTPs, and the S/V TEMS in 1995-2009;
- temporary cessation of the milling activities due to depletion of uranium ore sources in 2010-2011;
- resumption of the mill operations with processing of ore from the Cigar Lake Mine in 2014;
- upgrade of the mill from its previous back-end capacity of 13 Mlbs U_3O_8 to 24 Mlbs U_3O_8 equivalent to accommodate the Cigar Lake Mine production rates,
- the JEB TMF optimization and expansion starting from 2012;
- the SABRE Project (previously referred as the Mining Equipment Development (MED) Research program) starting from 2007;
- implementation of selenium mitigation measures to reduce selenium loadings to the S/V TEMS and upgrade of the JEB WTP with the integrated ferrous sulphate treatment system to enhance selenium removal from the mill effluent;
- temporary cessation of milling activities in response to the COVID-19 pandemic (2020 – 2021);

- McClean Mining Pad expansion (formerly known as SABRE pad) and drilling of four access holes for future mining; and
- other activities related to the mill operation and maintenance.

Appendix I.1 provides a more detailed discussion of the McClean Lake Operation history.

1.4 Environmental Effects Science Evolution

The understanding of environmental effects science has evolved significantly since the initial McClean Lake Operation EA. The scientific information associated with potential environmental effects comes from a variety of sources including the peer reviewed scientific literature and ecological risk assessment guidelines developed in support of environmental protection goals. Advances in air, water, and sediment quality guidelines and standards have been driven by new scientific information. Constituents of concern once thought to be relatively benign have been determined to be more interactive in the environment than previously thought. The federal and provincial environmental quality guidelines have continued to evolve to address a wider range of constituents of potential concern along with refinement of scientific understanding of their potential impact on ecosystems and human health.

Examples of the most prominent scientific advancements related to assessment of environmental effects from the McClean Lake Operation include:

- **Sediment Benchmark Development:** The influence of contaminants of potential concern in sediments and their influence on benthic invertebrates and benthic invertebrate communities has been extensively researched. Thompson et al. applied the screening level concentration approach to derive lowest effect level (LEL) and severe effect level (SEL) concentrations for a number of contaminants of potential concern in uranium mining and milling regions of Canada (Thompson et al., 2005). Liber et al. using laboratory spiked sediment toxicity tests, derived northern Saskatchewan sediment threshold values for uranium, molybdenum, nickel and arsenic based on amphipod and midge species responses (Liber et al., 2011). Finally, sediment quality values were derived for northern Saskatchewan based on co-occurring sediment chemistry and benthic invertebrate community metrics for reference and no-effects sites by Burnett-Seidel and Liber (Burnett-Seidel and Liber, 2013).
- **Selenium Toxicity Assessment Framework:** The environmental risks of selenium to aquatic ecosystems were first recognized in the 1980s by North American scientists and government agencies, following ecological damage observed at the Kesterson Reservoir in California. Since then, the understanding of the potential effects from exposure to selenium to cause environmental effects has significantly evolved (Chapman et al., 2010; DeForest et al., 2012; Palace and Gilron, 2025), which led to the introduction of regulatory benchmarks for selenium (USEPA, 2016a; ECCC, 2022). The scientific knowledge and regulatory guidelines were used to develop site specific selenium benchmarks and exposure-based release limit for the McClean Lake Operation (Orano, 2018; Orano, 2019a).
- The scientific literature has also identified molybdenum exposure as a potential cause of molybdenosis in ungulates (BCMOE, 2021) which is addressed by using the wildlife-specific benchmarks in the current ERA update.

To incorporate the continued evolution of environmental effects science into the assessment of environment effects at the McClean Lake Operation, an adaptive management framework was developed as presented in the Section 1.5 below.

1.5 Sustainable Development Framework

Orano recognizes that continued economic and social development depend on a healthy environment and incorporates environmental protection considerations into company activities to ensure sustainable development. Orano is committed to continually improve approaches and technology to minimize the effects of its activities on the environment. Early in the life of the McClean Lake Operation, it was recognized that to advance new activities, it was necessary to adopt a flexible, iterative approach which embraces the sustainable development objectives of the EA process and provides opportunities to incorporate enhanced EA methodologies, and new environmental effects science. The approach also needed to support the identification of continuous improvement opportunities and the need for adaptive management, where required.

Orano's sustainable development strategy, first outlined in the Sue E EIS (AREVA, 2004) and shown on Figure 1.5-1, embraces a number of environmental principles: innovation in advanced environmental protection technologies, responsible management of the consumption of natural resources, and limiting and managing environmental risks and effects of waste emissions from project activities; As outlined in Figure 1.5-1, this sustainable development framework represents an integrated environmental protection approach encompassing three main processes: EA, continual improvement, and adaptive management. This framework aligns with the environmental protection framework outlined in the CNSC *REGDOC 2.9.1. Environmental Protection: Environmental Principles, Assessments and Protection Measures* and *CSA N288 Series of Standards for Environmental Management of Nuclear Facilities*.

Figure 1.5-1 shows that the EA process generates several important elements including a set of environmental effects predictions, compliance and environmental effects monitoring programs, a follow-up program to address uncertainties in the prediction of environmental effects, and the identification of contingency measures that could be implemented should non-conservative assumptions be identified in the original assessment framework. Each of these elements are integrated into the environmental management system for the development and operation of a project.

The environmental monitoring results are reviewed versus the most recent ERA predictions and applicable benchmarks in the EP TID Volume 1, which also includes results of the follow-up programs and supplementary studies. The updated environmental risk assessment (EP TID Volume 2) utilizes refined model inputs from environmental monitoring programs and most recent science advancements to facilitate the prediction of potential future environmental effects and their alignment with impacts predicted at the EA stage. Thus, the EP TID Volume 1 and 2 provide an appropriate forum to verify accuracy of EA predictions, identify opportunities to improve performance, assess risks, and remain proactive and adaptable in ways that reflect the increasing level of information available throughout operations. These documents also ensure monitoring and follow-up programs are appropriately focused, and that the results are documented, and communicated.

1.6 Current Environmental Risk Assessment

1.6.1 Objectives and Scope

The purpose of the 2025 EP TID Volume 2 is to provide a comparative basis to evaluate predicted future performance relative to previous EA predictions based on the current anticipated McClean Lake Operation mining and milling plan (Section 1.6.2). The 2025 EP TID Volume 2 includes an updated ERA with the following objectives:

- to examine potential future environmental effects based on updated modelling that incorporates current, planned and anticipated activities at the McClean Lake Operation;
- to identify areas for potential additional mitigation measures; and
- to communicate predicted performance and any associated risks.

The predicted future performance, as assessed in this report, is the continued operation of the McClean Lake Operation inclusive of any new or previously assessed projects that are anticipated to commence in the foreseeable future. It is understood that some of the projected activities require regulatory approvals prior to construction and operation. Previously assessed projects outline potential project-environment interactions and the resulting potential environmental impacts. These impact predictions provide the basis for the ongoing evaluation of operational performance and future performance. Therefore, the 2025 ERA scope is consistent with the scope of the previous McClean Lake Operation ERAs including:

- predictive modelling for air, water, and sediment quality, and
- evaluation of potential environmental effects of emission release and effluent discharge at the McClean Lake Operation including the ecological and human health risk assessments.

In addition, the ERA scope was extended to evaluate potential ecological effects due to nitrate transfer from the Sue E Clean Waste Rock Pile to Bena Lake.

Volume 1 of the 2025 EP TID, and associated data, is to function as a repository of environmental information to be updated periodically to provide current representation of the environment surrounding the McClean Lake Operation and provide inputs to predictive modelling and updated ERA presented in Volume 2 of the EP TID. Volume 2 of the 2025 EP TID refines future predicted performance and supersedes the EP TID Volume 2 submitted to regulators in 2016 (AREVA, 2016b) and Selenium Review and Risk Assessment Report submitted to regulators in 2018 (Orano 2018). The report addresses requirements of the applicable regulatory guidelines and standards (i.e., the *2025 Saskatchewan Air Dispersion Modelling Guideline* and *CSA Standard N288.6:22 Environmental Risk Assessments at Nuclear Facilities and Uranium Mines and Mills*) as shown in *Appendix I.2* as discussed in Sections 2 and 3, and regulatory comments on the risk assessments submitted for the regulatory review in 2016-2024 as shown in *Appendix I.3*.

1.6.2 Mine Plan and Approved Activities

As part of long-term planning, a mining plan outlines the future activities and their expected timelines. The mining plan is updated periodically to reflect any changes in expected timelines for future projects, the addition of future projects, and removal of projects that are no longer contemplated. The mining plan encompasses mining, milling, and water management activities as well as other major projects required to achieve these planned core activities. A summary of the mining plan is shown in [Figure 1.6-1](#). Table 1.6-1 presents an anticipated mill production schedule. For this assessment, it is assumed that the McClean Lake Operation will extend into 2036, with decommissioning beginning in 2037. Activities summarized in the mining plan are discussed in sections 1.6.2.1 - 1.6.2.3.

Section 1.2 provides a summary of activities approved for the McClean Lake Operation as of 2024. Section 1.3 and Table 1.3-1 outline key activities that have occurred since the 2016 ERA update. In 2024, it was announced that Orano will be resuming mining operations. In 2025, the uranium ore mining with the SABRE mining method was initiated at the McClean Mining site. Subject to regulatory approval, the SABRE mining method will be implemented in 2029 at the Sue F (formerly referred to as the Caribou Project) site, and 2030 at the Midwest site. The milling of the Midwest ore and Cigar Lake Extension ore is expected to require upgrades to the McClean Lake mill, which is included in the mine plan for 2028 and 2029. These changes are reflected in the updated air, water, and sediment assessment.

1.6.2.1 Future Activities at JEB Site

Expansion of the Tailings Management Facility

The JEB TMF Expansion was approved in 2022 when the McClean Lake Operation CNSC licence was amended to allow the JEB TMF embankment expansion to 468.8 mASL (Table 1.2-2). The JEB TMF Expansion Project is scheduled to occur in stages from 2027 to 2036. A pit perimeter embankment will be raised and the inside slope of the embankment will be lined with a waste rock/till bentonite-amended liner to contain the tailings over the long-term. The project will be conducted in a series of staged embankment raises and liner expansions, with the construction materials sourced from the JEB clean waste rock and overburden piles.

The current JEB TMF embankment elevation is 457.5 mASL with the soil bentonite liner crest at an approximate elevation of 452.5 mASL. A survey of the tailings surface conducted on September 26, 2024, estimated the remaining capacity of the JEB TMF at approximately 1.55 million m³, assuming a maximum tailings surface elevation of 450 mASL. Future embankment and liner expansions will increase available tailings storage capacity.

Milling

As of 2024 the sole ore source for the McClean Lake Mill was ore slurry from the Cigar Lake Mine. Milling of Cigar Lake ore is expected until the end of 2036. The McClean Lake Mill started milling uranium ore from the McClean Mining site in 2025, and, subject to regulatory approval, from Sue F in 2029 and from Midwest in 2030. Milling of Sue B ore (currently stockpiled at the Sue and JEB sites) is scheduled for 2034-2036.

Mill Modifications

Several Mill upgrade projects are planned for upcoming years. These improvements will facilitate milling of the Midwest ore and Cigar Lake Extension ore. The projects include Sulphuric Acid Plant and Ferric Sulphate Plant expansion, modifications to the Leaching Circuit, and potentially, construction of additional storage in the Grinding Circuit.

JEB WTP

In 2026-2027 JEB WTP will be upgraded to enable effective sulphate management to prevent gypsum scaling in the WTP infrastructure. The JEB WTP will continue to operate the entire duration of the planned McClean Lake Operation (i.e. until 2036) and for additional 13 years during decommissioning period (i.e. until 2049). The JEB WTP will be required to treat porewater expelled during the tailings dewatering and tailings consolidation phase of the JEB TMF decommissioning. The JEB WTP will be one of the last facilities to be decommissioned after tailings consolidation is complete, prior to construction of the final cover on the JEB TMF.

Arsenic Flotation project

Management of arsenic in the Tailings Preparation Circuit is required to control contaminant transport source terms from the tailings after decommissioning to ensure the water quality of the nearby lakes is not impacted. The Arsenic Flotation Project is a conceptual project which will concentrate the un-leached arsenic in solid phase and remove it from the mill process before the tailings preparation circuit to be managed separately. Although no final decision has been made on this conceptual project, and the regulatory approval is still to be obtained, the Arsenic Flotation Project has been included in the mine plan and in the ERA as a potential future option.

1.6.2.2 Future Activities at McClean Mining Site

Mining of the McClean North ore deposit commenced in 2025 on the existing mining pad, which was constructed initially for mining tests under the SABRE Project (Section 1.3). This mining method accesses the ore from surface through a drilled hole that then uses jet boring to create an ore slurry that is pumped to surface for processing. Once the SABRE mining method was proven to be a viable option for extracting the high-grade uranium ore, it was implemented for mining the McClean North deposit. The mine plan considers progressive extension of the existing mining pad over pods of the McClean North deposit in 2025 and 2027-2028. There is no underground infrastructure required. The mining pad will be decommissioned and reclaimed in 2030-2031.

The McClean North ore and the Sue F ore will be transferred to the JEB Site and processed at the McClean Lake Mill over 2025-2031. The SABRE method recycles most of the process water, therefore no additional water treatment facilities will be constructed. The small amount of excess wastewater will be disposed in the Sue C/A Pit.

1.6.2.3 Future Activities at Sue Site

Water Management

The Sue WTP will continue to operate the entire duration of the McClean Lake Operation (i.e. until 2036) and for an additional 4 years during the decommissioning period (i.e. until end of 2040). Upgrades are anticipated for the Sue WTP infrastructure in 2033-2034 to support various activities such as the maintenance of the open pit

hydraulic containment, Sue C/A Pit dewatering followed with the Cigar Lake waste rock placement, potential arsenic froth product disposal, and decommissioning. The Sue WTP will be one of the last facilities decommissioned at the Sue site.

Mine Waste Placement

Orano's preliminary expectation is that the Sue C/A Pit will be dewatered in 2035-2036 to accommodate placement of the Cigar Lake waste rock into the pit in 2037-2038.

Arsenic Froth Product Encapsulation and Disposal

The waste management approach for the froth from the Arsenic Flotation Project is yet to be determined. However, a preliminary analysis identified encapsulation of arsenic froth product in concrete blocks with disposal in the Sue C/A Pit as the most preferred disposal option. Therefore, this option has been included as a scenario into the ERA.

Sue F

The mine plan considers development of the Sue F project to start in 2028 with the access road and mining pad construction in 2028. Sue F mining is expected to continue over two years, 2029 and 2030. Similarly to the McClean Mining, the Sue F uranium ore will be extracted using the SABRE method, which does not require underground infrastructure or dedicated water treatment facilities. The ore will be stored at the JEB site and processed at the McClean Lake Mill over the period of 2029 to 2032. The mining pad will be decommissioned and reclaimed right after the mining completion, in 2031. The Sue F ore will be transferred to the JEB Site and processed at the McClean Lake mill over 2029-2032.

Decommissioning

Based on the current mine plan, the decommissioning of the Sue Site is planned for 2037-2041. It will include initial demolition of infrastructure not required for continued decommissioning and water treatment, on-going water treatment for Cigar Lake waste placement, and final demolishing of remaining infrastructure.

1.6.2.4 Future Activities at Midwest Site

As of 2025, the Midwest Project site is in a safe state of care and maintenance. The mine plan considers development of the Midwest project to start in 2027 with the mining pad construction, and ore extraction with the use of the SABRE mining method to start in 2030. The mining is assumed to occur over a period of seven years starting in 2030 and lasting until the end of 2036. The ore processing and wastewater disposal will occur at the McClean Lake Mill, which is included in the mine plan under activities at the JEB site operation. The Midwest project will include construction of the private haul road to transport ore from the Midwest site to the McClean Lake Mill in 2027-2028. The road will follow the north route as per the 2011 Midwest EIS. The demolition of the mining infrastructure and site reclamation are planned for 2037-2039.

1.6.2.5 Decommissioning

The McClean Lake Operation decommissioning is outlined in the Preliminary Decommissioning Plan (Orano, 2025a), which includes the primary physical decommissioning over approximately 5 years, followed by a period of continued water treatment and environmental monitoring, after which final decommissioning of remaining infrastructure will occur, and commencement of the post-decommissioning environmental monitoring program. The decommissioning period is anticipated to span 20 years and occur in the following phases.

1. Post-Operation: detailed planning, licensing, stakeholder engagement, permitting and clean-up activities to prepare for decommissioning.
2. Initial Decommissioning: demolition of infrastructure not required for continued decommissioning and water treatment.
3. Interim Monitoring and Tailings Consolidation: on-going water treatment will be required to achieve acceptable consolidation of tailings.
4. Final Decommissioning: demolition of remaining infrastructure and placement of cover on tailings management facility.
5. Post-Decommissioning: environmental performance monitoring will occur to ensure that the decommissioning objectives have been met. This will occur until the site can be transferred back to the Province of Saskatchewan through the Institutional Control Program.

Thus, the current mine plan anticipates decommissioning to be implemented in 2037-2050, with the completion of the post-decommissioning period in 2057.

1.6.3 Noise and Vibration

An assessment of foreseeable noise and vibration impacts due to proposed continued operations through to 2048 at the McClean Lake Operation was completed in support of the 2012 EP TID. The assessment of potential impacts considered the continued operation of the McClean Lake Mill, the expansion of the JEB TMF facility, construction and operation of the McClean Underground (MUG) project, and delivery of ore to the McClean Lake Mill from on-site and off-site locations. An analysis of proposed scheduling of these activities was completed to identify the periods in which the maximum simultaneous activity would be occurring on-site, as these would be expected to be associated with the maximum noise output of operations. Only one scenario was assessed for vibration effects, being the MUG development for which blasting was anticipated for ramp construction.

Noise and vibration criteria for use in the assessment of impacts were not adopted for the 2012 EP TID, as the McClean Lake Operation is a remote site with no sensitive off-site human receptors (i.e., communities) nearby. Instead, the assessment was based on perceptibility – predicting the distance at which noise and vibration generated by the operation would no longer be distinguishable from background. Existing and proposed future sources of noise at the McClean Lake Operation were characterized using a combination of source measurement data collected during a site visit by SENES Consultants Limited (SENES) in September 2009, historically measured data for similar sources from SENES' in-house database, or estimated using engineering calculations

based on equipment operating specifications. These were used in conjunction with the site layout (i.e., building configurations) and local terrain data to model sound propagation from the McClean Lake Operation into the surrounding region, using the Cadna-A software (implementing the industry standard calculation method for outdoor sound propagation outlined in ISO Standard 9613 2). Vibration levels were characterized using empirical equations developed in support of the AREVA Kiggavik Project, based on the projected charge mass.

The assessment predicted that noise and vibration from the proposed future McClean Lake Operation would be imperceptible beyond 3 km from the site. Appendix I.4 presents the previous noise and vibration assessment submitted with the 2012 EP TID. As the scenarios and assumptions from the 2012 EP TID remain generally valid, the noise and vibration assessment for the entire McClean Lake Operation has not been updated. The only exception is the McClean Mining site, where mining method was changed from underground to SABRE.

Orano examined potential increases in the noise and vibration levels due to SABRE mining activities and their potential impact on wildlife and habitat use. The assessment showed that the noise levels associated with the SABRE mining will be negligibly higher than the noise levels associated with the previously approved underground mining (i.e., the difference in sound levels between the two methods is within 1%). The SABRE mining vibration will be attenuated to the background levels within 90 meters from the mining pad. Appendix I.5 presents an updated noise and vibration assessment for the McClean Mining site.

1.7 Report Organization

The EP TID is subdivided into eight major sections:

- Section 1 Introduction
- Section 2 Air Dispersion Modelling Assessment
- Section 3 McClean Lake Operation – Wastewater Management Environmental Modelling
- Section 4 McClean Lake Operation ERA – Problem Formulation
- Section 5 McClean Lake Operation ERA – Ecological Risk Assessment
- Section 6 McClean Lake Operation ERA – Human Health Risk Assessment
- Section 7 Bena and Candy Lakes Ecological Risk Assessment
- Section 8 Environmental Monitoring and Study Recommendations
- Section 8 Conclusions and Path Forward

Sections 2 and 3 present predictive modelling for air, water, and sediment quality at the McClean Lake Operation area. Sections 4 to 6 present the McClean Lake Operation Environmental Risk Assessment. Section 7 examines potential ecological effects due to nitrate transfer from the Sue E Clean Waste Rock Pile to Bena Lake. Section 8 provides an overview of adjustments to the environmental monitoring program, as well as any supplementary studies required based on the ERA outcomes. Finally, Section 9 summarizes the ERA methodology, key findings, and recommendations for future monitoring, supplementary studies, and operations.

2 Air Dispersion Modelling Assessment

2.1 Introduction

Various activities at the McClean Lake Operation have the potential to generate emissions of airborne dust (and associated metals and radionuclides), radon-222 (radon gas) and other gaseous species, such as nitrogen oxides (NO_x). The purpose of this air dispersion modelling section is to provide information about the potential effects to ambient air quality due to emissions from the current and planned future activities at the McClean Lake Operation as outlined in Section 1.6. Predicted concentrations of select constituents of potential concern (COPCs) were also used as input to the ERA pathways model, which assesses contaminant transport through the environment. For each of the operating conditions assessed, the following general assessment approach was applied:

- identify the sources of air emissions and develop an emissions inventory for all COPCs;
- screen the potential COPCs for significance using the screening method outlined in Section 2.2.2;
- for the significant COPCs, undertake air dispersion modelling using the developed emissions inventories and predict concentrations at gridded and discrete receptor locations;
- assess the potential effects to air quality using Saskatchewan Ambient Air Quality Standards (SAAQS) where available, or using standards, criteria and guidelines established by other jurisdictions in Canada; and
- provide outputs of the air dispersion model (concentrations and deposition rates) at the ERA receptor locations for the ADEPT model (Section 4).

The following air dispersion modelling sections include detailed information on the assessment approach, including a description of the assessment scenarios, COPCs, criteria, background air quality, study areas, air emissions inventory, modelling methods, and assessment uncertainty. A discussion of the predicted COPC concentrations is then provided, followed by a summary and recommendations.

2.2 Assessment Approach

The air dispersion modelling assessment was undertaken to evaluate potential air quality impacts across all phases of the McClean Lake Operation, from current operations through to post-decommissioning. It is noted that the assessment considered emission sources within the McClean Lake Operation lease area, as well as vehicular travel along the Midwest haul road. Other environmental effects from Midwest Project mining activities were assessed in the Midwest Project EIS (AREVA 2011) and updated in the McClean Lake Operation Status of the Environment Report (AREVA 2009b). Both reports determined that the incremental effects from Midwest open pit mining activities were not significant for radon, Total suspended particulate (TSP) (and associated metals and radionuclides) or standard pollutants (NO₂ and SO₂) in the local and regional study areas. Orano is now considering mining the Midwest deposit using the SABRE method instead

of open pit mining and a screening assessment was completed to confirm that potential air quality effects using SABRE are bounded by the effects predicted in the 2011 Midwest EIS (Appendix II.1). The screening assessment concluded that the potential air quality effects from the Midwest Project using the SABRE method are bounded by the effects predicted in the 2011 EIS. Thus, cumulative effects of the McClean Lake Operation and the Midwest Project site are expected to be minimal and were not evaluated in this assessment. An updated air dispersion modelling assessment for the Midwest Project will be completed upon finalization of detailed engineering design for mining using the SABRE method.

Modelling was completed using the Lakes Software CALMET/CALPUFF modelling system while following the Saskatchewan Air Dispersion Modelling Guideline (GS 2025a) and the requirements of Canadian Standards Association (CSA) N288.6 (CSA 2022). However, some alternatives to the Guideline were needed to develop the air model inputs needed for the ERA, as described in the assessment approach memorandum (IEC 2024) and summarized in the following sections. It is of note that the assessment approach memorandum was reviewed and accepted by the regulators (CNSC 2024a, SMOE 2024a).

2.2.1 Assessment Scenarios

In air dispersion modelling, it is not practical to model every year of a mine's operating life. It is common practice to select a specific year to represent activities that may span several years of operation. The years selected for modelling are chosen to yield conservative estimates of air emissions for the periods that they represent. The assessment scenarios are discussed in detail below.

Additionally, for each of the assessment scenarios outlined below, both maximum short term (e.g., 1- and 24-hour) and average annual air emissions were modelled. Based on experience with past ERA work, applying maximum short term emission rates continuously over a one-year period is often too conservative for risk assessments, and as a result, refined annual scenarios based on average emission rates were required and used to develop the inputs to the ADEPT pathways model (Appendix III.3).

2.2.1.1 Baseline Operations Scenario (2022 to 2025 and 2035 to 2036)

The baseline operations scenario was developed to represent typical operations at the McClean Lake site for the 2022 to 2025 period as well as to represent operations during the 2034 to 2036 period, which is expected to have similar types of activities and production levels compared to the current period. Peak activity levels during the 2022 to 2024 period were used to characterize site emissions and estimate concentrations of COPCs in air. This timeframe was selected to reflect recent operating conditions, with 2022 marking the first full year of post-pandemic production. The 2022 to 2024 period also captured the highest recent mill production rate of approximately 18 million lbs U_3O_8 per year.

In addition to ongoing mill operations, this scenario also included planned 2025 mining activities on Pad 1E and construction of Pad 1W at the McClean Mining site. To ensure a conservative assessment, all activities were assumed to occur concurrently with the peak milling and site operations observed between 2022 and 2024. In summary, the main activities included in the baseline operations scenario were:

- Milling of Cigar Lake ore slurry at the McClean Lake mill;

- Tailings Management Facility (TMF) expansion construction;
- Mining operations on Pad 1E at the McClean Mining site; and
- Construction of Pad 1W at the McClean Mining site.

This scenario is intended to represent current peak operational conditions at the site and will serve as a base case against which future operations, decommissioning and post-decommissioning activities can be compared to assess changes in air quality over the project life-cycle. In addition, the model predictions for this scenario were compared to available dust and radon monitoring data for the most recent five-year period (2020 to 2024) to assess the model's performance (Appendix II.3). It is of note that historical test mining at the McClean Mining site is comparable to the 2025 mining scope. Therefore, historical monitoring data is considered to have captured McClean Mining site activities that are included in the baseline operations scenario.

2.2.1.2 Maximum Future Operations Scenario (2026 to 2034)

The maximum future operations scenario represents a theoretical upper-bound estimate of emissions from the McClean Lake operation during 2026 to 2034 operations. This scenario is intended to evaluate the potential maximum concentrations of COPCs in air during future operations when SABRE production is well underway in the McClean and Sue F Mining sites, and the mill reaches a peak production rate of 23 million lbs of U_3O_8 per year.

The emissions inventory for this scenario is based on the mining plan summary and mill production schedule presented in Section 1. Recognizing that it is neither practical nor necessary to model every individual year of operations, this scenario identifies and combines the highest-emitting activities, even where such activities may not overlap in practice. This results in a conservative worst-case scenario, where key emission sources are assumed to operate simultaneously in order to assess the maximum potential air quality effects.

The main activities that were included in the maximum future operations scenario were:

- Mining of Pad 1W at the McClean Mining site;
- Construction of Pad 2 at the McClean Mining site;
- Mining at the Sue F Mining site;
- TMF expansion construction;
- Vehicular travel along the Midwest haul road; and
- Milling of ore from the Cigar Lake, McClean, Sue F, and Midwest deposits.

It is noted that encapsulation of arsenic in concrete blocks and disposal in Sue C pit is also planned at the Operation; however, emissions from this source are expected to be negligible in comparison to other sources. Due to the conservative nature of the assessment, emissions from arsenic encapsulation are considered to be captured by the above-listed activities.

2.2.1.3 Decommissioning Scenario (2037 to 2050)

The decommissioning scenario represents site conditions and activities expected to occur during the early phases of decommissioning, with a focus on the 2037 calendar year. This scenario is based on information provided in the Preliminary Decommissioning Plan (Orano 2025a) and the Mining Summary Plan (Section 1).

Decommissioning will occur in a series of phased "envelopes," with substantial site reclamation and infrastructure removal expected in 2037. By this time, major components of the McClean and Sue F Mining sites are anticipated to have been demolished and reclaimed, while select operations—particularly those related to water treatment—will remain active. In summary, the main activities considered in the decommissioning scenario were:

- 1) Initial demolition and reclamation activities in the JEB area;
- 2) Dewatering of the Sue C pit;
- 3) Placement of Cigar Lake waste rock into the Sue C pit; and
- 4) Continued operation of the JEB and Sue Water Treatment Plants (WTPs).

This scenario is intended to characterize emissions during a period of reduced industrial activity, while still accounting for specific decommissioning tasks that may generate air emissions, such as cover placement on the JEB TMF.

2.2.1.4 Post-Decommissioning (2051 and beyond)

This scenario assumes that all decommissioning activities have ceased, and the only remaining emissions are radon from the remediated TMF and clean waste rock piles (i.e., JEB CWRP, Sue E CWRP, and Sue C CWRP).

2.2.2 COPC Selection

Selection of COPCs for the air dispersion modelling assessment was performed as follows:

- All COPCs included in the 2016 EP TID air dispersion model were included in the current assessment;

- Additional metals identified as COPCs for the current ERA (Section 3) were included in the current assessment;
- Species having SAAQS but not considered in the 2016 EP TID were included in the current assessment;
- Species having the draft 2025 SAAQS (Section 2.2.3.1) were screened as potential COPCs; and
- Species reported to National Pollutant Release Inventory (NPRI) as air releases but not identified by above were screened as potential COPCs.

Based on the above approach, the following species were identified as COPCs or **potential COPCs** for the current assessment:

- Common air quality species: TSP, particulate matter $\leq 10 \mu\text{m}$ (PM_{10}), particulate matter $\leq 2.5 \mu\text{m}$ ($\text{PM}_{2.5}$), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulphur dioxide (SO_2).
- Metals in TSP: arsenic (As), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), **manganese (Mn)**, molybdenum (Mo), nickel (Ni), selenium (Se), silver (Ag), thallium (Tl), uranium (U), **vanadium (V)**, and zinc (Zn).
- **Ammonia (NH_3)**.
- Organic Compounds: acrolein, **benzene**, **ethylbenzene**, **toluene**, **xylenes (BTEX compounds)**, and **dioxins and furans (D&F)**.
- Radon gas (Rn-222).

For each **potential COPC** identified above, the maximum site-wide emission rate estimated using the methods described in Section 2.2.6 was multiplied by a conservative dispersion factor ($\mu\text{g}/\text{m}^3$ per g/s) to provide an estimate of the maximum concentrations in $\mu\text{g}/\text{m}^3$. The resulting concentrations were combined with representative background concentrations (Section 2.2.4) to estimate the total potential air concentrations. The total concentrations were then compared to applicable air quality standards or criteria (Section 2.2.3) to determine the significance of the potential COPCs. Based on this screening, the additional species identified as COPCs were ammonia, manganese, vanadium, and benzene. Details of the screening assessment are provided in Appendix II.2 and the final COPC selection is summarized in Table 2.2-1.

While there are SAAQS for hydrogen sulphide (H_2S) and ground-level ozone (O_3), there are no significant sources of these species at the McClean Lake Operation. Therefore, H_2S and O_3 were not selected as COPCs (IEC 2024). In addition, radioactivity may be associated with radionuclides present in dust (i.e., decay species of uranium-238, including thorium-230, radium-226, polonium-210 and lead-210). Radionuclide concentrations in dust were not modelled but rather derived from the air model results for uranium in the ERA (see Section 4).

2.2.3 Ambient Air Quality Criteria

Modelled concentrations of COPCs in air were evaluated using (in order of preference) the SAAQS, Ontario Ambient Air Quality Criteria (AAQC), or other applicable guidelines (collectively called the ambient air quality criteria). Per the Saskatchewan Air Dispersion Modelling Guideline (GS 2025a), air quality standards do not apply inside of a 'property boundary'; an area where there is no public access. For this assessment, the 'property boundary' was defined by the lease area (Figure 2.2-1) and areas along and outside of the lease were considered areas where the ambient air quality criteria apply. The Guideline also requires ambient background concentrations to be added to modelled concentrations when comparing to the applicable criteria. As such, background concentrations were added to model predicted concentrations (where available and applicable). The ambient air quality criteria used for this assessment are discussed below, while background air quality is discussed in Section 2.2.4.

While the ambient air quality criteria presented below are generally health-based, they are only meant to evaluate the potential effects to ambient air quality and are not intended to assess the potential risks to ecological or human health. Instead, applicable COPC concentrations and deposition rates derived from the air dispersion model are used as inputs to the ADEPT pathways model (Section 4) to evaluate COPC uptake by terrestrial vegetation (e.g., berries, browse, forage and lichen) and the subsequent exposure of wildlife and human receptors, considering all pathways of exposure.

2.2.3.1 Saskatchewan Ambient Air Quality Standards

On June 1, 2015, the Government of Saskatchewan enacted *The Saskatchewan Environmental Code (The Code)* under *The Environment Management and Protection Act* (GS 2015). The Industrial Source (Air Quality) Chapter of *The Code* repealed *The Clean Air Regulations* under *The Clean Air Act* (Saskatchewan 1989a) (Saskatchewan 1989b), including the ambient air quality standards. As a result, the previous standards were superseded by a new regulatory framework that includes Table 20 SAAQS, which outlines allowable concentration limits for a core set of species, including particulate matter (TSP, PM_{2.5} and PM₁₀), nitrogen dioxide (NO₂), sulphur dioxide (SO₂), ozone (O₃), carbon monoxide (CO), and hydrogen sulphide (H₂S) (SMOE 2025b). These values are defined based on 1-hour, 8-hour, 24-hour, and annual averaging periods, depending on the species.

In 2025, the Government of Saskatchewan proposed revisions to the SAAQS, including the addition of new parameters to Table 20 to better reflect emissions from industrial sources in the province. The changes include the addition of ammonia and BTEX compounds (benzene, toluene, ethylbenzene and xylenes), as well as removal of time-based averaging metrics for PM_{2.5} and O₃. The complete list of the draft 2025 SAAQS is presented in Table 2.2-2 for species identified as COPCs or potential COPCs (Section 2.2.2). According to communications from the SMOE (SMOE 2025c), the standards for ammonia and BTEX compounds do not come into effect until January 1, 2027; however, Orano has elected to apply the draft 2025 SAAQS for these species for the purpose of this assessment.

2.2.3.2 Ontario Ambient Air Quality Criteria

Currently, there are no published standards, criteria or guidelines available in Saskatchewan for metals or acrolein. Consequently, criteria for these COPCs were adopted from the Ontario Ministry of Environment, Conservation and Parks (MECP) list of AAQC (MECP 2020) or the Ontario Air Contaminants Benchmarks (ACB) List (MECP 2023). Most of the Ontario AAQC/ACB are based on a 24-hour averaging period; however, acrolein also has a criterion based on a 1-hour averaging period, lead has a criterion based on a 30-day averaging period, and cadmium, nickel and uranium have criteria based on an annual averaging period. Thallium does not have an Ontario AAQC; however, the Ontario ACB List provides a 24-hour Jurisdictional Screening Level (JSL) which was adopted for this assessment. The complete list of Ontario AAQC/ACB is presented in Table 2.2-3 for species identified as COPCs or potential COPCs (Section 2.2.2).

2.2.3.3 Radon

Currently, there are no outdoor ambient air quality standards for radon. Rather, dose estimates are completed in the ERA (Section 6) using outputs from the air dispersion model. However, to aid in the understanding of radon results, predicted incremental concentrations were compared to background levels (see Section 2.2.4).

2.2.4 Background Air Quality

In accordance with the Saskatchewan Air Dispersion Modelling Guideline (GS 2025a), representative background concentrations must be added to model results before being compared to SAAQS or other applicable criteria or guidelines. The McClean Lake Operation currently has a network of five hi-volume air samplers (HVAS) that measure TSP once per week for a period of 24 hours. Every quarter, the samples are also composited and analyzed for adsorbed metals and radionuclides. Station HVJ4 is located at the south end of Vulture Lake away from mining and milling activities and acts as a reference station. As a result, data collected at HVJ4 for the most recent five-year period (2020 to 2024) were used to establish background concentrations of TSP as well as most metals (arsenic, cadmium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, thallium, uranium, vanadium, and zinc). Prior to using the data, completeness and performance checks were undertaken to ensure the data was of acceptable quality for the assessment (IEC 2025). It is of note that blank filter concentrations for metals were not subtracted from the exposed filters to avoid negative concentrations and minimize the potential for underestimating background metal concentrations. This differs from the methodology used in EP TID Volume 1; therefore, differences in reported values are possible.

Data collected at HVJ4 from 2020 to 2024 were analyzed to determine the maximum 24-hour and annual average background concentrations of TSP as well as metals concentrations for the assessment, as outlined in Table 2.2-4. To determine the 24-hour background concentrations, the average of the maximum measured concentrations over five years was calculated for TSP and metals. This approach resulted in reasonably conservative concentrations that produced good agreement with monitoring data at the exposure HVAS stations, as discussed in Section 2.2.8 and Appendix II.3. It is also of note that the annual background concentration for TSP of $7.4 \mu\text{g}/\text{m}^3$ is within the range of pre-development baseline concentrations collected between 1979 and 1982, which had a low geometric mean of $6.88 \mu\text{g}/\text{m}^3$ and a high geometric mean of $29.42 \mu\text{g}/\text{m}^3$.

$\mu\text{g}/\text{m}^3$ (Minatco 1991). It is also similar to the geometric baseline of $8.8 \mu\text{g}/\text{m}^3$ recorded between 1988 and 2003 at Cigar Lake (Cameco 2004a).

Since site-specific measurements of PM_{10} , $\text{PM}_{2.5}$, CO , NO_2 , and SO_2 were not available, background concentrations for these COPCs were based on the regional background concentrations for rural areas from Appendix J of the Saskatchewan Air Dispersion Modelling Guideline (GS 2025a). Appendix J of the modelling guideline also provides default ratios for PM_{10} and $\text{PM}_{2.5}$ relative to TSP; however, applying these ratios to the background TSP levels calculated from HVJ4 data resulted in overly conservative values, particularly on a 24-hour basis. As a result, the regional background concentrations for PM_{10} and $\text{PM}_{2.5}$ were applied. The background concentrations for PM_{10} , $\text{PM}_{2.5}$, CO , NO_2 , and SO_2 are summarized in Table 2.2-4.

Similarly, measurements of chromium, silver, ammonia, acrolein, and benzene were not available. Background concentrations of ammonia, acrolein, and benzene were assumed to be negligible given the remote location of the McClean Lake Operation and lack of significant emission sources nearby. For chromium and silver, values were obtained from the Wheeler River Project EIS (Denison Mines Corp. 2024) and Patterson Lake South Project EIS (Fission Uranium Corp. 2025), respectively. The selected concentrations for these COPCs are provided in Table 2.2-4.

As discussed in Section 2.2.3.3, predicted incremental activities of radon are compared to background levels to provide context to the model results. The background activity of radon for the McClean Lake Operation is between 15 and $25 \text{ Bq}/\text{m}^3$ based on data collected during the pre-development baseline program (Minatco 1991). These levels are consistent with the northern Saskatchewan background activity of <7.4 to $25 \text{ Bq}/\text{m}^3$ that is reported in *Regulatory Oversight Report for Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2021* (CNSC 2024b).

2.2.5 Air Modelling Study Areas and Points of Reception

For the purposes of the air dispersion modelling assessment, the following air modelling study areas and points of reception were used with consideration to the requirements of the ERA.

2.2.5.1 Air Modelling Local Study Area

The Air Modelling Local Study Area (AMLSA) is the area where measurable changes to COPC concentrations in air are expected. For this assessment, the AMLSA was defined as a 10 km radius approximately centered around the McClean Lake Operation (see Figure 2.2-1). The principal emission sources within the AMLSA include activities associated with ore processing at the JEB mill and development activities at the McClean Mining and Sue F Mining sites.

As noted above, air quality standards only apply outside of a property boundary and for this assessment, the lease area was used to define the 'property boundary' (Figure 2.2-1). COPC levels in the AMLSA are predicted at receptors along the lease boundary and at gridded receptor locations outside of the lease boundary for the purpose of evaluating potential air quality effects (Figure 2.2-2). The model is also used to predict COPC concentrations within defined airsheds and at discrete ecological and human receptors in the AMLSA, which are then used as input to the ADEPT pathways model (Section 4).

2.2.5.2 Air Modelling Regional Study Area

The Air Modelling Regional Study Area (AMRSA) is the area surrounding the AMLSA and was established to assess potential regional air quality effects and to capture the remaining discrete ecological and human locations required for the ERA. For this assessment, the AMRSA was defined by a 40 km by 40 km square area, approximately centered around the McClean Lake Operation (Figure 2.2-1). COPC concentrations were predicted at gridded receptor locations within the AMRSA to evaluate potential air quality effects, as well as at ecological and human receptors used in the ADEPT pathways model (Section 4).

2.2.5.3 Points of Reception

Ground-level concentrations and deposition rates were modelled at property boundary receptors, gridded receptors, and discrete receptor locations within the AMLSA and AMRSA. Figure 2.2-2 shows the gridded CALPUFF receptors used in the air dispersion model.

The receptor grid was established to evaluate the potential effects to air quality, while considering the data requirements for the ERA. Within the AMLSA, various airsheds were established for the ERA:

- a 1 km² airshed approximately centered on the McClean Lake Operation, with a receptor spacing of 100 m (McClean Lake Operation Small Area);
- a 5 km² airshed approximately centered on the McClean Lake Operation, with a receptor spacing of 200 m (McClean Lake Operation Medium Area);
- a 100 km² airshed approximately centered on the McClean Lake Operation, with a receptor spacing of 400 m (Air Modelling Local Study Area/McClean Lake Operation Large Area);
- a 1 km² airshed centered around the mill, with a receptor spacing of 100 m (McClean Mill Area); and
- an airshed along Collins Creek, having a receptor spacing of 200 m (Collins Creek Downstream Area).

In the AMRSA, a receptor spacing of 1 km was used. Additionally, receptors were placed along the lease boundary using a spacing of 100 m. Receptors were also placed at 11 ecological or human receptor locations identified for the ERA and shown in Table 2.2-5 and Figure 2.2-3. It is noted that the ERA also requires predictions for three (3) receptor locations located beyond the AMRSA (the Wollaston Lake Community, Wollaston Lake Lodge [Hidden Bay] and Hatchet Lake). For these locations, model results for the closest gridded receptor were conservatively used as a surrogate, as noted in Table 2.2-5 and Figure 2.2-3.

Lastly, receptors representing the locations of the HVAS monitors, SO₂ monitor, and radon monitors were included (Table 2.2-6 and Figure 2.2-4). The total number of modelled receptors was 5,764.

2.2.6 Air Emissions Inventory

An air emissions inventory for each of the assessment scenarios - baseline operations (2022 to 2025 and 2035 to 2036), maximum future operations (2026 to 2034), decommissioning (2037 to 2050), and post-decommissioning (2051+) – was developed and used as input to the air dispersion model. As noted in Section 2.2.1, both maximum short-term (e.g., 1- and 24-hour) and average annual air emissions were estimated and assessed.

The following sections describe the methods used to develop the air emissions inventories. Generally speaking, emission estimates were developed using a combination of published emission factors, engineering estimates, and where available, site-specific data such as stack testing. Control efficiencies were incorporated to reflect current operating practices at the McClean Lake Operation, and conservative assumptions were applied where uncertainties existed. Uncertainties are discussed further in Section 2.2.8.

2.2.6.1 Sources of Emissions

Air emission estimates were developed using a combination of established methodologies tailored to each source type. A summary of the emission factors and equations used to generate the air emission inventories by source type is provided in Table 2.2-7. The following sections describe the emissions sources and how the emission factors and equations were applied for the assessment. It is noted that the emission sources presented in Table 2.2-7 appear in alphabetical order for ease of reference.

2.2.6.1.1 Dust Emission Sources

Fugitive dust from emission sources at the McClean Lake Operation (e.g., TMF expansion, construction and mining activities in the McClean and Sue F Mining sites, unpaved roads, wind erosion, and material handling) were characterized using published emission factors or equations from various reference sources, while point sources associated with mill operations were quantified directly from recent stack testing data supplemented by earlier representative measurements. Activity-based scaling factors, such as disturbed area, vehicle kilometres travelled, material throughput, and production rates, were applied to match the conditions specific to each scenario, with control efficiencies incorporated to reflect operational practices. To account for particulate size fractions, conservative assumptions were made where necessary, with trace metals and uranium apportioned using composition data for relevant source materials (Table 2.2-8).

Bulldozing

Bulldozing emissions were estimated for “summer” operations (i.e., the non-frozen period from May to October) involving active overburden and clean waste rock storage areas, including the JEB CWRP, the Sue C CWRP, and Cigar Lake waste rock storage within Sue C pit (decommissioning only). Construction-related dozing was accounted for separately under general construction activities. The methodology relates material-specific silt and moisture contents and operating times to characterize dust emissions. Overburden and waste rock at the McLean Lake Operation were represented by a 5% silt content and 3% moisture content, while waste rock from Cigar Lake was characterized by a silt content of 21% and moisture content of 11%.

Bulldozing activities were conservatively assumed to occur for 12 hours per day. No dust control measures were assumed, also providing conservative estimates.

Grading

Grading emissions were estimated using the AP-42 method for western surface coal mining (U.S. EPA 1998). The methodology relates dust generation to vehicle speed and distance graded. For this assessment, calculations assumed a grader speed of 8 km/h and one pass per month across the active site roads in each assessment scenario. The assumed frequency of grading events was representative of routine site maintenance. No dust control measures were applied, providing conservative estimates.

Drilling

Drilling emissions within the McClean Mining and Sue F Mining sites were estimated using emission factors published in the NPRI pits and quarries reporting guide (GC 2022a), with no assumed dust control to provide conservative results. The methodology relates emissions of TSP, PM₁₀, PM_{2.5} to the number of drill holes required. One SABRE access hole can take up to seven days to drill, and two drills can work simultaneously. Therefore, it was assumed that two drills would operate continuously for 24 hours on a worst-case day. To estimate annual average emission rates, the expected annual number of access holes were applied: 20 holes per year for Pad 1E, 23 holes per year for Pad 1W, and 5 holes per year for Sue F. It is noted that the applied emission factor assumes wet drilling. No other dust control measures were applied.

Material Handling

Material handling emissions were estimated using the AP-42 (U.S. EPA 2006b) methodology for aggregate handling and storage piles, which relates dust generation to material moisture content, wind speed and the mass of handled material. For this assessment, an average wind speed of 2.5 m/s (derived from CALMET; Section 2.2.7.2) was applied, and moisture contents were assigned by material type: 16.5% for SABRE ore, 3% for clean or special waste rock, overburden, and soil/aggregate, and 11% for Cigar waste rock. A control efficiency of 75% was considered for drops to the grinding circuit grizzly to account for a three-sided enclosure. No other dust control measures were applied, providing conservative estimates.

Under the baseline operations scenario, material handling was characterized namely by transfers of coarse ore and fines from the McClean Mining site to their designated storage areas. For the maximum future operations scenario, additional material transfers of coarse ore and fines from the Sue F Mining site and Midwest site were also considered. In both operations scenarios, transfers of clean waste rock for construction activities at the TMF and McClean Mining site were also considered. Decommissioning largely focused on the

transfer of JEB clean waste rock and overburden for TMF closure as well as the disposal of Cigar Lake waste rock into Sue C pit.

Unpaved Roads

Unpaved road dust emissions were estimated using the AP-42 methodology for industrial roads (U.S. EPA 2006c), which relates dust generation to material silt content, vehicle weight and number of kilometers travelled. The silt content of roadbed material and clean waste piles was assumed to be 5%. Vehicle types and counts were determined for each modelled road segment to estimate emissions of TSP, PM₁₀, and PM_{2.5}. Control efficiencies reflecting operational practices were incorporated, including summer dust suppression on all roads (80%) and large stockpiles (50%), natural winter mitigation (90%), and a reduction for speeds less than 40 km/hr (44%).

In the baseline operations scenario, vehicle activity primarily included slurry, reagent, and yellowcake shipping trucks along the main access road, light-duty gasoline pick-up trucks and bus traffic on the site roads, and haulage of ore and fines from the McClean Mining site to designated storage areas. The future operations scenario introduced higher aggregate truck traffic associated with TMF expansion work as well as higher haul truck traffic from the McClean and Sue F Mining sites. Traffic to and from Midwest site is also considered in the future operations scenario. Vehicle activity in the decommissioning scenario primarily included haulage of Cigar Lake waste rock to Sue C Pit and clean waste rock to the TMF, with reduced personal vehicle traffic compared to the operations scenarios.

Wind Erosion

Wind erosion emissions were estimated using the approach outlined in the Western Regional Air Partnership (WRAP) Fugitive Dust Handbook (Countess Environmental 2006), which relates emissions to the exposed surface area, silt content of the surface material, and the frequency of wind speeds above the 5.4 m/s threshold for suspension. Wind erosion was evaluated for the ore, waste rock, and overburden storage piles and pads.

The potential for dust release depends on the amount of erodible fines (i.e., silt) present in the material and occurrence of wind speed exceeding the threshold. For this assessment, the wind speed frequency was determined using outputs from the CALMET model, which incorporates site-specific and regional meteorological data. Because the supply of fines in a stockpile is finite, emissions diminish over time if no mechanical disturbance replenishes the surface. Natural crusting, rainfall, snow cover, and frozen conditions also act to suppress emissions until they become negligible for undisturbed surfaces.

For each source, maximum mapped footprints were combined with estimates of the active fraction to define the erodible area. Material-specific silt contents were applied, with ore assigned 22% and clean waste rock, overburden, and other unconsolidated materials set at 5%. Particle size distributions were taken from WRAP size multipliers (Countess Environmental 2006), allowing TSP, PM₁₀, and PM_{2.5} to be estimated. Control factors were applied to represent seasonal suppression, with efficiencies of 90% during winter and 50% during summer.

Crushing and Screening

Crushing and screening emissions were estimated using the NPRI Pits and Quarries Reporting Guide (GC 2022a) for primary operations. Grinding at the mill was addressed separately based on stack testing data (see below). A crushing plant was assumed to operate at the JEB CWRP, while a coarse ore separation unit is used in the McClean and Sue F Mining sites. An additional crushing plant is assumed to operate in the Moffat borrow area for the baseline operations scenario. The crushing and screening emission estimate methodology relates emissions to production rates expressed in tonnes for each source and scenario to reflect maximum throughputs on a daily and annual basis. For the crushing plants, uncontrolled emission factors with no additional mitigation were applied, providing conservative estimates. For the coarse ore separation unit, controlled emission factors were applied, accounting for a moisture content greater than 5%. An additional 50% control efficiency was applied for shrouding at the coarse ore separation unit. Grinding at the mill was addressed separately based on stack testing data (see below).

General Construction

Dust emissions from construction-related activities such as clearing, grubbing, and earthworks were estimated using factors from AP-42 (U.S. EPA 1995) and the WRAP Fugitive Dust Handbook (Countess Environmental 2006) for PM₁₀ and PM_{2.5}. Worst-case emission factors for TSP and PM₁₀ were applied to the total disturbed areas and cut/fill volumes, where available, with PM_{2.5} assumed to represent 10% of PM₁₀. A 50% control efficiency was assumed to account for dust suppression measures such as watering.

Construction-type activities that were considered at the McClean Lake Operation include earthworks activities associated with TMF expansion as well as construction of Pad 1W and Pad 2 in the McClean Mining site. Additionally, the general construction factors were used to estimate dust emissions from restoration activities within the JEB ore pad areas during decommissioning. These activities were assumed to occur during the summer months only.

Grinding

The grinding circuit is used to crush incoming ore from the McClean, Sue F, and Midwest deposits prior to being fed to the mill. Emissions of TSP are controlled by a dust collection system which exit to the atmosphere via a dedicated stack. Stack testing was last completed at the grinding stack in 2021 (SRC 2022d). The maximum measured emission rates from this testing were applied directly to estimate emissions of TSP, with a conservative assumption that all PM₁₀ and PM_{2.5} were equivalent to TSP. Emissions were determined by scaling the measured stack concentrations to grinding feed rates.

Mill Operations

The McClean Lake mill is comprised of a number of processing circuits that extract uranium from the ore to produce the packaged uranium product commonly referred to as yellowcake, using a counter-current decantation (CCD)/solvent extraction (SX) process. Emissions of particulate matter from the calciner stack, crystallizer stack, and yellowcake packaging stacks in the mill were characterized using available stack testing data collected between 2019 and 2024 (SRC 2019a, 2020a, 2021a, 2022a, 2022b, 2022c, 2022e, 2023a,

2023b, 2023c, 2023d, 2023e, 2024a, 2024b, 2025). Testing provided measurements of TSP, uranium, and other trace metals. The maximum measured emission rates from this testing data were conservatively applied, with the assumption that all PM₁₀ and PM_{2.5} were equivalent to TSP. Emission estimates for the operations scenarios were scaled to production, with annual yellowcake outputs assumed at 18 million lbs U₃O₈ for the baseline operations scenario and 23 million lbs U₃O₈ for the maximum future operations scenario. These values were paired with a plant availability of 85% and 95% for the baseline and future operations scenarios, respectively, and converted into hourly production rates for use in the calculations.

Grout Plant

Emissions from the grout plant used in the McClean and Sue F Mining sites were estimated using AP-42 emission factors for central mix batching (U.S. EPA 2006a). No control measures were assumed, resulting in conservative emission estimates. The grout mixture was assumed to be composed of 63% cement and 38% water by weight, resulting in a concrete product mass of approximately 1,600 kg per batch. Emissions were determined by scaling emission factors with daily and annual throughput volumes under the baseline and maximum operating scenarios.

Cement is stored in two silos equipped with baghouses. Emissions from cement silo loading were estimated following the method outlined in the Ontario Emission Summary and Dispersion Modelling (ESDM) Procedure Document (MECP 2018), which assumes a concentration of 10 mg/m³ for TSP, conservatively treated as equivalent to PM₁₀ and PM_{2.5}. Airflow through the cement silo dust collectors was assumed to be 2000 Nm³/hr, with unloading events occurring over two-hour periods, consistent with typical operating data for cement and fly ash silos.

Metal content in cement was characterized using AP-42 factors from Chapter 11.2 (U.S. EPA 2006a), with trace levels of arsenic, cadmium, chromium, manganese, nickel, and lead included in the emissions inventory. These were calculated as fractions of the TSP emission rate, yielding conservative but representative estimates of trace metal emissions from central batch mixing and cement silo loading.

Waste Incineration

To minimize potential interactions with wildlife, domestic waste generated from the McClean Lake Operation is incinerated near the JEB Camp. The majority of domestic waste consists of food scraps and packaging from the kitchen, along with paper towels and sharps from washrooms, and discarded clothing and personal effects from the dormitories. It is likely that small quantities of plastics are sent to the incinerator from the dormitories. A number of recycling collection options are made available to encourage the diversion of recyclables from the domestic waste stream. The incinerator is used for disposal of domestic waste only; no radiological or hazardous materials are incinerated.

Emissions of TSP from the incinerator were estimated based on the 2019 stack testing campaign (SRC 2019a). The maximum measured stack concentrations from the testing data were conservatively applied to estimate emissions of TSP, and assuming that the ratios of PM₁₀ and PM_{2.5} to TSP were 79% and 45%, respectively, consistent with the 2016 EP TID (AREVA 2016a). Trace metal emissions were estimated using U.S. Environmental Protection Agency (EPA) AP-42 composition ratios for municipal solid waste (U.S. EPA

1996), with lead and chromium representing the dominant contributors. The concentrations were applied to the stack flow rate of 0.22 Nm³/s obtained from the 2019 stack test data.

Maximum emission rates were scaled using waste throughput to estimate annual average emission rates. The maximum daily throughput was assumed to be 13.5 m³ per day based on technical specifications for Eco Waste Solutions Model No. ECO 1.75TN 1P MS 60L (a unit similar to that installed at the Operation), while the annual throughput was approximately 500 m³ per year based on data summarized in the 2022 to 2024 Annual Reports (Orano 2023a, Orano 2024a, Orano 2025).

Fuel Combustion

Stationary and mobile fuel combustion sources are primarily sources of gases (e.g., NO_x) and to a lesser extent, particulate matter in the finer fractions (i.e., PM₁₀ and PM_{2.5}). As such, the methods used to estimate particulate matter from fuel combustion sources are discussed in Section 2.2.6.1.2.

Uranium and Metals in Dust

Unless source-specific information was available, it was assumed that the dust released into the atmosphere would have the same composition as the in-situ surface material from which it is emitted. Therefore, emissions of uranium and metals were calculated by scaling the calculated emission rates of TSP using the percentage of uranium and metals in the parent material. The uranium and metal contents of the ore and other material types considered in the assessments are outlined in Table 2.2-8.

2.2.6.1.2 Gaseous Emission Sources

Gaseous emissions from the McClean Lake Operation primarily include NO_x, SO₂, CO, and volatile organic compounds (VOCs) from stationary combustion sources and mobile mining equipment and vehicles.

The calciner stack is also a source of ammonia (NH₃) at the Operation, while the incinerator is a source of D&F. The emission rates for these sources were estimated based on stack test data and the Canada-Wide Standard for D&F (CCME 2001), respectively. Table 2.2-7 provides a summary of the methods used to estimate gaseous emissions, while the following sections provide an overview of the methods used for each emissions category. It is noted that stationary and mobile fuel combustion sources are also sources of fine particulate matter (i.e., PM₁₀ and PM_{2.5}), which is captured in the following sections.

Mining Equipment and Vehicles

Off-road mining equipment such as drills, loaders, shovels, mine haul trucks, etc. as well as on-road vehicles like transport trucks and pickup trucks, are all sources of NO_x, SO₂, CO and to a lesser extent, fine particulate

matter (PM₁₀ and PM_{2.5}) and VOCs like acrolein and BTEX compounds. Majority of equipment and vehicles consume diesel fuel while personal transport vehicles consume gasoline.

Emissions from these sources were estimated using fuel-based emission factors from the Australian Government's National Pollutant Inventory (NPI) Emission Estimation Technique Manual for Combustion Engines (AG 2008), which are largely based on historical U.S. EPA emission factor data and considered conservative. VOCs were speciated into acrolein and BTEX compounds using guidance from the U.S. EPA for speciation of VOCs in on- and off-road diesel engines (U.S. EPA 2020, U.S. EPA 2023a, U.S. EPA 2023b).

Combustion emissions from off-road equipment were estimated using fuel consumption rates for the various areas of the Operation (e.g., McClean Mining site, Sue F Mining site, mill, etc.), which were applied to fuel-based emission factors from the Australia NPI Emission Estimation Technique Manual for Combustion Engines (AG 2008). Fuel estimates for the McClean and Sue F Mining sites included consumption used by the generators at these sites. Where off-road equipment types were unavailable, annual litres of diesel were assigned to "miscellaneous off-road" sources, while road graders, for example, were handled with power-based factors and explicit utilization. Similarly, fuel consumption rates along the access road, site roads, and Midwest haul road were used in conjunction with fuel-based Australia NPI factors. Vehicle types were assigned to the light-, medium-, and heavy-duty categories specified by the NPI document, as appropriate.

Instead of emission factors, sulphur dioxide emissions were derived from fuel sulphur content and fuel density, assuming 100% oxidation of sulphur to SO₂. For diesel, a sulphur content of 15 ppm (GC 2017), while gasoline was assumed to contain 12 ppm sulphur (GC 2020). For diesel, a sulphur content of 15 ppm (GC 2017), while gasoline was assumed to contain 12 ppm sulphur (GC 2020). Lastly, for consistency with prior ERA assumptions, TSP was conservatively assumed to equal PM₁₀ and PM_{2.5} (AREVA 2016a).

Acid Plant

The acid plant stack is the main source of sulphur dioxide (SO₂) emissions at the Operation and also emits some NO_x and CO. Baseline operations emissions estimates were developed using the maximum measured emission rate from stack testing data from 2019 to 2023 (SRC 2020b, 2021b, 2022b, 2023f). Stack testing data were selected in preference to annual report estimates, as they are considered to provide higher data quality and greater accuracy for dispersion modelling. For consistency with the 2016 EP TID, an upper-bound engineering estimate of 3.4 g/s was applied to the maximum future operations scenario (AREVA 2016a).

NO_x and CO have not been tested since 2017. In the absence of recent stack testing data, scaling factors for NO_x and CO derived from testing campaigns during the period 2015 to 2017 were used (AREVA 2016). Emission rates for the operations scenarios were derived by applying the NO_x and CO scaling factors to the calculated SO₂ emission rate. Annual operating hours were used to prorate the maximum emission rates to estimate an annual average emission rate, reflecting typical operations for the acid plant.

Mill Operations

The calciner scrubber stack, crystallizer stack, and packaging stack are all sources of NO_x and CO, while the calciner and packaging stacks are also minor sources of SO₂. The calciner stack is also a source of NH₃.

Emissions from these mill sources were characterized using stack testing data from 2019 and 2024 (SRC 2019a, 2019b, 2020a, 2020b, 2021a, 2021b, 2022a, 2022b, 2022e, 2022f, 2022g, 2023a, 2023c, 2023d, 2023f, 2023g, 2024a, 2024b), where available. The maximum measured emission rates from this testing data were conservatively applied. NO_x emissions from the packaging stack were not measured during the 2019 to 2024 period, therefore, the emission rate used in the 2016 EP TID and based on 2015 and 2016 stack testing data were applied (AREVA 2016a).

Emission estimates for the operations scenarios were scaled to production, with annual yellowcake outputs assumed at 18 million lbs U₃O₈ for the baseline operations scenario and 23 million lbs U₃O₈ for the maximum future operations scenario. These values were paired with a plant availability of 85% and 95% for the baseline and future operations scenarios, respectively, and converted into maximum and average hourly production rates for the calculations.

Waste Incineration

Incinerator emissions were estimated using a combination of published emission factors and vendor specifications. Combustion gases (i.e., NO_x, SO₂, and CO) were derived from technical specifications for Eco Waste Solutions Incinerator Model No. ECO 1.75TN 1P MS 60L (a model similar to that installed at the Operation). These emission factors are consistent with the 2016 EP TID (AREVA 2016a). Emissions of dioxins/furans were assumed to equal the Canada-Wide Standard for solid waste combustion of 80 pg TEQ/N/m³ (CCME 2001). The concentrations were applied to the stack flow rate of 0.22 Nm³/s obtained from the 2019 stack test data (SRC 2019a). Maximum emission rates were scaled using waste throughput to estimate annual average emission rates. The maximum daily throughput was assumed to be 13.5 m³ per day based on technical specifications for Model No. ECO 1.75TN 1P MS 60L, while the annual throughput was approximately 500 m³ per year based on data summarized in the 2022 to 2024 Annual Reports (Orano 2023a, 2024, 2025b).

Back-up Power Generation

The McClean Lake Operation receives its primary electrical supply from SaskPower. Prior to ramping up mill production, the site relied on emergency diesel generators that operated infrequently and were used only to maintain essential mill equipment during grid power outages. As such, the generators emissions were not considered a significant source of air emissions in the 2012 EP TID (AREVA 2012) but were modelled as part of the 2016 EP TID (AREVA 2016a).

To support continuous mill production, six (6) 2,250-kilowatt (kW) back-up diesel generators are installed, providing sufficient capacity to power the entire mill complex in the event of a grid outage. While the units are expected to operate only 50 to 100 hours per year, and typically for short durations of two to three consecutive days, they represent a significant source of short-term NO_x emissions, with the potential to affect 1-hour and 24-hour ambient concentrations of NO₂, SO₂ and fine particulate (i.e., PM_{2.5}) are also released, though in lesser amounts. As a result, maximum short-term and annual average emissions from the back-up generators were considered in the assessment.

Particulate matter emissions (TSP, PM₁₀, PM_{2.5}) from the back-up generators were estimated using Caterpillar specifications for the 3516B generator model, with all size fractions conservatively treated as equivalent. Emissions of NO_x, CO and total hydrocarbons were also derived using Caterpillar performance specifications. Emissions were calculated assuming the units operate at 80% engine load. Emissions of hydrocarbons were used to characterize emissions of acrolein and BTEX compounds by applying the U.S. EPA ratio for VOC/hydrocarbons for Tier 2 non-road diesel engines and the associated toxic fractions for each VOC (U.S EPA 2023a).

Sulphur dioxide emissions were derived from the fuel consumption rate and sulphur content, assuming 100% oxidation of sulphur to SO₂. Emission estimates were based on a fuel consumption rate of approximately 594 L/hr per unit at 80% load and a sulphur content of 15 ppm (GC 2017).

As noted above in the Mining Equipment and Vehicles section, generators used at the McClean and Sue F Mining sites were estimated based on fuel consumption and emission factors for off-road combustion equipment.

Other Stationary Combustion Sources

Space heating and process heating at the McClean Lake Operation are primarily supplied by propane-fired boilers, with additional propane use at the camp, mill, and satellite areas such as the Sue WTP area. Annual propane consumption varies by location, with the largest demand in the Operation's boilers. Heating was assumed to occur during all months except June through August, ensuring coverage of the extended heating season typical of northern Saskatchewan.

Emission factors for propane combustion were obtained from AP-42 for industrial and commercial boilers (U.S. EPA 2008), supplemented by the NPRI propane combustion calculator (GC 2022b). These sources provide values for particulate matter, CO, and NO_x, while noting that SO₂ and VOC emissions from propane are negligible. For conservatism, TSP was assumed equal to PM₁₀ and PM_{2.5}. Trace metals were not carried forward in the analysis, as combustion of propane and butane contributes negligible quantities relative to other sources.

2.2.6.1.3 Radon Emission Sources

Radon gas (radon-222 or Rn-222) is created when its precursor, radium-226 (Ra-226), decays. This decay process is continuous, resulting in the ongoing release of Rn-222 into the pores and fissures of the radium bearing material. A portion of the radon gas will be released into the atmosphere when these radium-bearing materials are mined, handled, or processed in the mill. Radon emissions were estimated for all major sources at the Operation using calculation methods consistent with the 2016 EP TID (AREVA 2016a). It is noted that only average annual emission rates were calculated for radon as short-term exposures are not evaluated in the ERA.

For this assessment, the base assumptions were that every gram of uranium in ore or mine rock will generate an equivalent equilibrium radon activity level of 1.22×10^4 Bq and the radon generation rate per Bq of Ra-226 is 2.1×10^{-6} Bq/s. The main sources of radon from the McClean Lake Operation include:

- **Exposed surfaces of rock containing U-238:** Radon is passively and continuously released from exposed surfaces containing U-238 (and subsequently Ra-226) bearing materials in ore and waste rock stockpiles and is a function of the uranium grade and size of the exposed surface area. Radon emissions were calculated using a flux of 0.5 (Bq/m²-s), which was applied to the exposed surface area, uranium content, and Ra-226 activity of the ore and waste rock stockpiles considered in the assessment. Radon emitting stockpiles considered in the assessment include the Sue C and E CWRPs, the JEB and Sue ore pads, and the ore storage areas in the McClean and Sue F Mining sites.
- **Rock breaking and handling:** Rn-222 is released when a mass of ore or waste rock is removed during the SABRE mining process. Similar to mining, if a material containing U-238/Ra-226 is stored for more than a few days it will have a “fresh” inventory or build-up of radon gas that is available for release upon handling the material once again. The emission rate is a function of the uranium grade and the mass of ore or waste rock that is mined and/or handled per day. An emanation factor of 0.20 was applied to account for the fraction of radon that can escape during active handling of ore and waste rock. At the mill, it was also assumed that 20% of radon from ore storage is released at the JEB ore pad, with the remainder released when the ore is processed through the grinding circuit.
- **Mill ore storage and processing:** Whenever there is an inventory of radium-bearing material in agitated storage in the mill, radon will be generated and is released to the atmosphere via general ventilation of the mill work areas. To account for fugitive emissions of radon from general ventilation in the mill, it was conservatively assumed that a three-day mass (or supply) of ore at various stages of the yellowcake production process will be releasing radon gas at any given time. An emanation factor of 1 was applied, recognizing the continuous agitation and high potential for release. It was also assumed that the production of radon gas during transport of slurry from the Cigar Lake mine to the McClean Lake mill would be negligible, which is based on a travel time of one hour between the two sites (AREVA 2016a).
- **Tailings management:** During operations, tailings produced in the McClean Lake mill will be neutralized and stored within the JEB TMF under water cover. Tailings, which are both neutralized and discharged below water, are known to have negligible emissions of radon gas relative to other sources but were nonetheless included in this assessment. Since the tailings will be covered with water, no dust will be released from the JEB TMF. For the operations scenarios, radon emissions from the TMF pond were estimated using the surface area of the pond, the Ra-226 activity (Bq/L) of the tailings water, and wave depth, which was conservatively assumed to be 5 m and consistent with the 2016 EP TID (AREVA 2016a). During closure, the TMF will be consolidated a layer of sand fill and drain rock will be placed on top of the tailings and remain water-covered (Orano 2025a). Radon emanation from the TMF was also considered in the post-decommissioning period and emissions were estimated using a conservative surface flux of 1 Bq/m²/s applied to the reclaimed tailings area (AREVA 2016).
- **De-watered Sue C Pit:** Radon emissions from the mined out open pits were considered only where dewatering exposes pit walls. For this assessment, the Sue C pit during decommissioning was the only open pit source of radon, with emissions estimated as described above for exposed surfaces. All other mined out pits remain water-filled, and radon releases were assumed negligible from these sources.

2.2.6.2 Summary of Air Emission Rates

Air emissions were estimated for the baseline operations, maximum future operations, decommissioning, and post-decommissioning scenarios. A comparison of total air emissions by scenario is presented in Table 2.2-9 (particulate and metals) and Table 2.2-10 (gases), while a detailed breakdown of emissions by source and scenario is provided in Tables 2.2-11 to 2.2-16 and discussed in the following sections.

Baseline Operations Scenario (2022-2025 and 2035-2036)

Tables 2.2-11 and 2.2-12 summarize the maximum short-term air emission rates by source for the baseline operations scenario. Particulate releases are highest during the summer months and primarily driven by fugitive dust sources, with unpaved roads as the largest source of dust (3.71 g/s), followed by the JEB CWRP due to crushing and handling of waste rock for TMF expansion work (2.25 g/s). The calciner stack and activities in McClean Mining Pad 1E were also notable contributors with emission rates of around 1 g/s each. Seasonal differences are significant, with summer emissions from unpaved roads and stockpiles several times greater than in winter due to natural mitigation (see Section 2.2.6.1.1).

For finer particulate matter (i.e., PM₁₀ and PM_{2.5}), process-related point sources become more prominent. Specifically, the calciner scrubber stack is the dominant fine particulate matter source, having a PM₁₀/PM_{2.5} emission rate of 1.22 g/s, while the crystallizer stack, JEB CWRP, McClean Mining site, and Sue C CWRP each contribute in the range of 0.2 to 0.7 g/s for the summer months. The calciner is also the dominant source of uranium, cadmium, molybdenum, and zinc and a notable contributor to arsenic and nickel emissions. The ore storage areas and grinding stack also add to uranium and arsenic emissions on the order of 0.0001 g/s. Due to the conservative calculation methods employed, the incinerator stack is the most significant source of lead at about 0.00065 g/s and also contributes to nickel, cadmium, and mercury emissions (see Section 2.2.6.1.1).

The standby diesel generators are the dominant contributors of combustion gases on a short-term basis, producing about 25 g/s of NO_x along with a few grams per second of CO and trace amounts of acrolein and benzene – acrolein and benzene are dominated by off-road diesel equipment. Sulphur dioxide releases are dominated by the acid plant tail gas stack, while the calciner scrubber adds some SO₂, CO, and NO_x and is the sole source of NH₃ emissions. For radon, emissions are dominated by general ventilation at the mill and the ore pads, with the mill alone releasing about 1.9 million Bq/s, and the JEB ore pad releasing around 1.5 million Bq/s. The next highest source is the Sue ore transfer pad at around 0.8 million Bq/s. Additional, though smaller contributions come from the grinding stack, TMF, McClean Mining site, and Sue C and E CWRP.

On an annual basis, it is noted that the contribution from the standby generators to NO_x emissions is minimal due to the infrequent operation of the back-up generators. This shifts dominance to off-road equipment sources within the McClean Mining and TMF construction areas.

Maximum Future Operations Scenario (2026 to 2034)

Tables 2.2-13 and 2.2-14 summarize the maximum short-term air emission rates by source for the future operations scenario. Emissions under this scenario are also highest during summer and driven primarily by

fugitive dust from unpaved roads, TMF construction activities, and the ore and waste rock storage areas. Similar to the baseline operations scenario, TSP emissions during summer are dominated by unpaved site roads (5.12 g/s), as well as the JEB CWRP, TMF construction, and Midwest haul road, which each contribute on the order of 2 to 3 g/s during summer. For PM₁₀, the calciner scrubber stack is a dominant source, with TMF construction, the JEB CWRP, site access road, and Midwest haul road contributing in the range of 0.6 to 0.9 g/s. Fine particulate matter (PM_{2.5}) reflects a similar profile with the calciner scrubber dominating, while the SABRE mining areas, unpaved roads, and the JEB CWRP remain important.

For metals, the calciner scrubber is the principal source of uranium, cadmium, molybdenum, and zinc, while also contributing to other trace metals. The grinding stack is also a dominant contributor for many COPCs, particularly arsenic, nickel, selenium, vanadium, and copper and is also a notable contributor to uranium emissions. Like the baseline operations scenario, the incinerator stands out as the key source of lead and contributes to nickel and cadmium emissions. The ore storage areas also add measurable loadings of various metals.

Gaseous emissions under the maximum future operations scenario are shaped by a few distinct sources. SO₂ is overwhelmingly associated with the acid plant tail gas stack, making it the clear driver of this pollutant at 3.4 g/s. In contrast, NO_x emissions are dominated by the back-up generator sets, with each unit contributing comparably; collectively they form the single largest source category for NO_x (~25 g/s). The McClean and Sue F Mining sites also contribute meaningfully to NO_x, reflecting diesel equipment use in those areas. Carbon monoxide emissions show a similar split with the mining areas, back-up generators, and calciner scrubber being principal sources. As noted under the baseline operations scenario, the contribution from the back-up generators to NO_x on an annual basis is reduced and dominance is shifted to off-road equipment used within the McClean and Sue F Mining sites. TMF construction equipment also becomes a notable source of NO_x.

Acrolein and benzene emissions are dominated by releases from diesel equipment use in the McClean and Sue F Mining sites. As in the baseline operations scenario, ammonia emissions are entirely attributed to the calciner scrubber.

Radon emissions are led by the JEB ore pad, with a total of approximately 3 million Bq/s from the storage of ore and fines. General ventilation from the mill, which is the next largest source at 2 million Bq/s. Other notable sources include ore and fines storage at the Sue ore transfer pad (1.5 million Bq/s). Additional, though smaller contributions come from the grinding stack, TMF, McClean and Sue F Mining areas, and Sue C and E CWRP.

Decommissioning Scenario (2037 to 2050)

Tables 2.2-15 and 2.2-16 summarize the maximum short-term air emission rates for the decommissioning scenario. Under this scenario, particulate matter emissions are dominated by fugitive dust sources. TSP during summer continue to be dominated by the unpaved road network (5.64 g/s) and the JEB CWRP (2.39 g/s), where aggregate for TMF closure originates. Decommissioning activities at the TMF and disposal of Cigar Lake waste rock at Sue C Pit are additional contributors to particulate matter emissions. By contrast, the standby diesel generators and smaller propane use during decommissioning are negligible sources of TSP relative to these activities. The same pattern holds for PM₁₀ and PM_{2.5}, with the JEB CWRP and unpaved

roads dominating, while TMF decommissioning, activities at Sue C Pit, and propane use are secondary contributors to fine particulate matter.

Metal emissions during decommissioning largely track the fugitive dust sources, with copper, zinc, and manganese common in unpaved road- and pile-related emissions. The Sue C Pit stands out for the highest levels of arsenic, and notable levels of cadmium and chromium. Like the operations scenarios, the incinerator is distinct as the dominant source of lead, and also contributes trace levels of cadmium, chromium, and selenium.

Emissions of NO_x and CO under the decommissioning scenario are dominated by the back-up generator sets, with off-road diesel equipment use in the TMF, mill, and JEB CWRP also contributing meaningfully. However, on an annual basis, the contribution from the back-up generators is reduced and dominance is shifted to off-road equipment for NO_x and CO. Emissions of acrolein and benzene are also driven by off-road diesel equipment, while the incinerator contributes the most to sulphur dioxide emissions. Since the calciner is not operational during decommissioning, ammonia emissions are zero.

During decommissioning, a limited number of radon sources remain, including the TMF, Sue C and E CWRP, dewatering of Sue C pit, and handling of Cigar Lake waste rock, also at Sue C pit. Emissions from the TMF and Sue C and E CWRP range from approximately 28,000 to 57,000 Bq/s, while total emissions from Sue C pit are on the order of 6,000 Bq/s.

Post-Decommissioning Scenario (2051+)

In the post-decommissioning scenario, the only continuing release of note is radon, which remains associated with the closed TMF and Sue C and E waste rock piles. As a result, no tables are presented for this scenario.

The TMF continues to release radon on the order of 220,000 Bq/s, while the Sue C CWRP emissions are roughly 57,000 Bq/s and the Sue E CWRP emissions are 32,000 Bq/s.

2.2.7 Air Dispersion Modelling

Air dispersion modelling was undertaken to predict ground-level COPC concentrations and deposition rates associated with atmospheric emissions from the McClean Lake Operation. This section of the report provides an overview of the air dispersion modelling approach, including the model selection, dispersion model meteorology, and brief description of the model source setup. Further details regarding the air dispersion modelling are provided in Appendix II.3.

2.2.7.1 Model Selection

With the approval of the Saskatchewan Ministry of the Environment (SMOE 2024a), air dispersion modelling was undertaken using CALMET/CALPUFF, an advanced, three-dimensional (3-D), non-steady-state dispersion modelling system from Lakes Environmental. CALPUFF is an approved regulatory model in Saskatchewan for long-range transport studies and has the ability to handle multiple sources and COPCs (GS

2025a). This creates efficiencies and enables detailed study of complex operating scenarios like those specified in Section 2.2.1. The CALPUFF model was also used in the 2012 and 2016 EP TIDs for the McClean Lake Operation (AREVA 2012, AREVA 2016a); therefore, its use in this assessment ensures continuity with prior studies.

CALMET, the meteorological pre-processor to CALPUFF, generates hourly 3-D gridded wind fields using site-specific meteorological data, terrain information and land use inputs (Scire *et al.* 2000a). These outputs form the basis for the CALPUFF simulations. For this assessment, Version 6.5.0 of CALMET and Version 7.2.1 of CALPUFF were applied.

2.2.7.2 Meteorology

For the current assessment, a one-year site-specific meteorological dataset was developed using a combination of on-site observations from the McClean Lake meteorological station and prognostic weather data from the Weather Research Forecast Non-Hydrostatic Mesoscale Model (WRF-NMM). The 2021 calendar year was selected for the assessment after a detailed review of on-site meteorological data for the period 2019 to 2024 showed that this year was the most recent year with an acceptable completeness record (> 90%) and met all quality assurance checks (IEC 2025).

The on-site meteorological station is a 10 m tower that collects hourly measurements of temperature, relative humidity, station pressure, total precipitation, wind speed, and wind direction. The WRF-NMM model was run in hindcast mode to provide the necessary cloud cover, ceiling, and upper air data for CALMET, with boundary and initial conditions from the U.S. National Centers for Environmental Prediction North American Mesoscale (NAM) analyses. The surface observations and WRF-NMM data were subsequently formatted and processed through CALMET in “Hybrid” mode to generate a 3-D hourly meteorological dataset for input to CALPUFF. Two CALMET modelling domains were used: a 44 × 44 km domain with a horizontal grid spacing of 1 km covering the AMRSA, and a 20 × 20 km domain with a horizontal grid spacing of 200 m covering the AMLSA.

High-resolution terrain and land use input data were assembled using the FABDEM V1-2 terrain elevation model (REF; 30 m resolution) and the EOSD land use dataset (REF; 25 m resolution), which were modified to reflect local mine features, waterbodies, and seasonal land use cover types in accordance with the Saskatchewan Air Dispersion Modelling Guideline (GS 2025a). Separate land use files were generated for five seasonal categories (spring, summer, autumn, and winter with and without snow). These inputs provide refined surface characteristics for CALMET to improve wind flow and stability simulations in both modelling domains. Additional details are provided in Appendix II.3.

The CALMET results were benchmarked against short- and long-term meteorological observations at the Collins Bay station, including the modelled year (2021), the most recent five-year observing period (2020 to 2024), and the extended 30-year climate record (1995 to 2024). This comparison, detailed in Appendix II.3, confirmed that the modelling successfully generated a representative meteorological dataset for the McClean Lake Operation, consistent with both short-term observations and long-term climatological trends.

2.2.7.3 Model Configuration

To evaluate atmospheric emissions from the McClean Lake Operation, three source types were represented in CALPUFF: point sources, area sources, and volume sources. Each was selected to reflect the physical characteristics of the emission release and to ensure consistency with historical ERA models (AREVA 2012, AREVA 2016a) and regulatory modelling practices (GS 2025a).

Modelled point sources included the process stacks at the McClean Lake mill, namely the grinding stack, calciner stack, crystallizer stack, packaging stack, acid plant stack as well as the standby generator stacks, the incinerator stack, and the SABRE air buster tank stacks. Area sources were applied to ground-based features, including the JEB TMF and the Sue C Pit, while volume sources were used to represent more diffuse or vertically distributed emission sources, such as the ore and waste stockpiles, unpaved roads, and various activities within the McClean and Sue F Mining sites.

Buildings or other solid structures may affect the flow of air in the vicinity of a point source and cause eddies to form on the downwind side of a building; an effect known as building downwash. The Plume Rise Model Enhancements version of the Building Profile Input Program (BPIP PRIME) was used to simulate building downwash in CALPUFF for the modelled point sources in accordance with the Saskatchewan Air Dispersion Modelling Guideline (GS 2025a). BPIP PRIME is designed to incorporate two fundamental features associated with building downwash: enhanced plume dispersion coefficients due to turbulent wake, and reduced plume rise caused by a combination of the descending streamlines in the lee of the building and the increased entrainment in the wake.

Additional details on the CALPUFF model source and building configuration are provided in Appendix II.3.

2.2.7.4 NO_x to NO₂ Conversion

In this assessment, oxides of nitrogen were modelled as NO_x (the sum of nitrogen dioxide (NO₂) and nitric oxide (NO) levels). Since the SAAQS are based on NO₂, modelled NO_x concentrations were converted to NO₂ so that predicted levels could be compared to these standards. In this assessment, the ozone limiting method (OLM), which is one of the refined conversion methods outlined in the Saskatchewan Air Dispersion Modelling Guideline (GS 2025a). It is of note that the Guideline indicates that the Total Conversion Method (TCM) should be used first and then refined. However, the 2016 EP TID (AREVA 2016a) showed that TCM is overly conservative for the purposes of the ERA, and a refined method is required. As such, the OLM was applied in this assessment.

Combustion sources emit NO_x primarily in the form of NO with some NO₂. Over time, NO converts to NO₂ in the presence of ozone (O₃). If there is more NO than ozone, then the formation of NO₂ is limited by ozone. The following equation specified in the Saskatchewan Air Dispersion Modelling Guideline (GS 2025a) was applied:

$$\text{If } O_3 > 1.59 \times (1-ISR) \times NO_x, \text{ then } NO_2 = ISR \times NO_x + 1.53 \times (1-ISR) \times NO_x$$

Otherwise, $NO_2 = 0.96 \times O_3 + ISR \times NO_x$

Where,

ISR is the in-stack ratio of NO_2 to NO_x .

An ISR of 0.50 was used in the assessment, which is the U.S. EPA recommended default when source-specific data are not available (U.S. EPA 2015). The choice of 0.5 for the ISR is considered conservative for most sources, particularly the back-up generators, and a reasonable choice to ensure the model results are not underpredicted.

Local measurements of O_3 were not available. In the absence of local data, Appendix J of the Saskatchewan Air Dispersion Modelling Guideline provides regional 1-hour background concentrations of O_3 for rural areas by month (GS 2025a). The maximum value of $72 \mu\text{g}/\text{m}^3$ specified in Table J-2 was used for calculating 1- and 24-hour NO_2 concentrations, while the average monthly concentration of $55.8 \mu\text{g}/\text{m}^3$ was used for determining annual averages.

2.2.8 Uncertainty

All predictive modelling exercises inherently involve a degree of uncertainty, reflecting the simplifications, assumptions, and data limitations that are necessary to translate complex real-world industrial operations into computational systems. In the context of air quality effects assessments, identifying and acknowledging these uncertainties is important for ensuring that the results are interpreted appropriately. Rather than diminishing the value of the modelling, the explicit consideration of uncertainty strengthens the assessment by demonstrating transparency, defensibility, and an understanding of the factors that may influence the possible outcomes of the modelling exercise.

The principal sources of uncertainty that affect modelled COPC concentrations, include model formulation, meteorological data inputs, source and site characterization, emission estimation methods, and existing background. Identifying these elements and discussing their implications provides the context needed to understand the degree of uncertainty inherent in the model predictions.

- **Model formulation:** Dispersion models reduce complex atmospheric dynamics (transport, mixing, reactions, and deposition) into simplified algorithms, which can omit finer-scale or site-specific variability;
- **Meteorological data:** Uncertainty arises from the spatial and temporal representativeness, resolution, quality of meteorological datasets (wind fields, mixing heights, stability classes, precipitation, etc.) and potential biases introduced through prognostic weather modelling (i.e., a hindcast dataset);
- **Source and site characterization:** Model accuracy is influenced by assumptions about source and building geometry, release parameters (e.g., exit velocity, temperature), terrain, and land cover, which are typically generalized.

- **Emission rate estimates:** Uncertainty arises from the inherent variability in stack testing data, the reliance on default emission factors such as those published in the U.S. EPA AP-42, and the application of scaling assumptions often used to represent future data. Differences in operating conditions, measurement techniques, and representativeness of emission factors can lead to uncertainty; and
- **Background air quality:** Constant background levels for COPCs were derived from a combination of local and regional monitoring datasets, recognizing that these values do not represent the day-to-day variability in background levels that occur in reality.

To overcome these uncertainties, conservatism has been incorporated into the assessment wherever possible, ensuring that the results are more likely to over- than underpredict potential air quality effects. This aligns with established guidance (CSA 2022, GS 2025a), which emphasizes precaution in the presence of uncertainty and supports defensible conclusions for the assessment. The following describe the specific measures applied in this assessment to manage uncertainty:

- **Dispersion model selection:** An advanced dispersion model was selected for assessing the McClean Lake Operation in order to minimize some of these uncertainties (Section 2.2.7.1). The main reasons for choosing a model package like CALMET/CALPUFF include:
 - Applicable to spatial scales ranging from a few kilometres to more than 100 kilometres, accommodating both local and regional effects;
 - Explicit treatment of wet and dry removal processes (i.e., deposition);
 - Wind speed and wind direction vary in three spatial dimensions and in time, allowing a more realistic simulation of plume movement;
 - Capable of handling calm wind conditions (i.e., wind speeds less than 0.5 m/s); and
 - Grounded in well-established scientific principles, with transparent documentation, extensive validation studies, and a strong record of regulatory and independent peer review.
- **Meteorological inputs:** Meteorological uncertainty was addressed by strengthening the input dataset. CALMET was driven using a hybrid of on-site surface monitoring data and prognostic modelling using WRF-NMM, improving representativeness of wind fields, stability classes, and mixing heights within the AMLSA and AMRSA. These data were further validated against short- and long-term records from the nearby Collins Bay station to ensure representativeness of the local and regional conditions. See Section 2.2.7.2 and Appendix II.3.
- **Source and site characterization:** Source and site characterization within the model were refined using the best available site-specific information, consistent with the most recent modelling guidance in Saskatchewan (GS 2025a). Particular attention was given to accurately representing local conditions that influence plume behaviour. Fine resolution terrain and land use cover data were explicitly coded into the model, while building downwash effects were modelled to more accurately predict dispersion from modelled point sources. See Section 2.2.7.3 and Appendix II.3.

- **Air emissions inventory:** Emission-related uncertainty was managed through the development of a conservative air emissions inventories for each assessment scenario (Section 2.2.6). Conservative assumptions included maximum production and activity rates, continuous operating conditions, and limited controls, ensuring that modelled emission rates represent upper bound estimates. Where available, measurements from stack testing were applied to refine key sources; however, maximum measured values were used for conservatism. For sources without testing data, operating records and engineering calculations were used, supplemented by published emission factors and default input parameters to avoid underestimation as best as possible.
- **Background Concentrations:** Uncertainty in background air quality concentrations was addressed by applying monitoring data in a conservative manner (Section 2.2.4). For TSP and adsorbed metals, background concentrations were established using five years of monitoring data (2020 to 2024) from the reference HVAS located at Vulture Lake (HVJ4). Observed maximums averaged over five years were used to establish 24-hour background concentrations for TSP and metals. Where no monitoring data was available, conservative regional background concentrations of NO₂, CO, SO₂, PM₁₀ and PM_{2.5} referenced in the Saskatchewan Air Dispersion Modelling Guideline for rural areas were applied (GS 2025a).

In addition, as detailed in Appendix II.3, model verification was performed as another means to reduce uncertainty. It was completed by comparing predictions from the baseline operations scenario to available monitoring data for the most recent five-year period (2020 to 2024). Specifically, total predictions of TSP concentrations (i.e., modelled + background concentrations), uranium, and metals were compared to HVAS data at the Operations' four exposure stations (HVJ1A, HVJ2, HVJ3, and HVS1A). In addition, total predictions of SO₂ were compared to data from the continuous SO₂ monitor, JM02, while total predictions of radon were compared to data from the radon monitors. A model is considered to perform well if predictions are within a factor of two of monitored data. Majority of the COPCs were within an acceptable factor of two compared to monitoring data, lending confidence to the model results; however, some metals including arsenic, cobalt, lead, selenium, thallium, uranium, and vanadium were overpredicted by 2.5 (lead) to 19 times (selenium), indicating that the model results for these COPCs are conservative.

Lastly, a series of quality assurance and quality control (QA/QC) measures were applied to ensure technical reliability and reduce uncertainty. QA/QC processes were applied throughout the assessment to ensure compliance with Saskatchewan modelling guidance (GS 2025a) and N288.6 (CSA 2022). For example, emissions inventories and model inputs were peer reviewed for completeness, consistency, and accuracy, while the CALMET/CALPUFF model setups and CALPUFF source parameterizations were cross-checked against regulatory guidance. The verification of CALMET and CALPUFF results described in Appendix II.3, served as important QA/QC measures to ensure that the models performed as expected.

2.3 Atmospheric Effects of McClean Lake Operations

In order to assess the potential air quality effects from the McClean Lake Operation, a series of assessment scenarios were modelled, including baseline operations, maximum future operations, decommissioning, and post-decommissioning as described in Section 2.2.1. Both maximum short-term (i.e., 1- and 24-hour) and average annual emission rates were modelled to evaluate potential air quality effects. Annual concentrations

and deposition rates for metals, ammonia, and radon were also predicted at the discrete ERA receptor locations and airsheds for input to the ADEPT pathways model (Section 4). Concentrations of PM₁₀, PM_{2.5}, NO₂, SO₂, acrolein, and benzene at discrete ecological and human receptors were also supplied to the ERA for further evaluation (Section 4).

A discussion of the model results for each of the assessment scenarios is presented in the following sections. The air dispersion modelling results have been presented in tabular format showing the maximum off-property concentration (i.e., beyond the lease boundary) for each COPC, as well as the concentrations predicted at the discrete ERA receptors and compared to the applicable ambient air quality standards, criteria, and guidelines. Both incremental and total (i.e., including background) concentrations are presented in the results tables, as appropriate. While predicted concentrations for the ERA receptors are presented, it should be noted that comparison to the air quality criteria is only meant to provide context to the model results. Similarly, comparison of predicted radon concentrations to background levels is provided to aid in the understanding of the results. As discussed in Section 2.2.3, potential risks to ecological or human health are evaluated in the ERA (Sections 5 and 6) considering all pathways of exposure.

For COPCs that exceed their criteria at an off-property location or at a discrete ERA receptor, the frequency of predicted exceedances was also determined and presented in the tabular results. In addition to tabular results, contour plots of concentrations have been created for those COPCs having current or draft SAAQS (TSP, PM₁₀, PM_{2.5}, CO, NO₂, SO₂, ammonia, and benzene), as well as radon. For the remaining COPCs, contour plots were only created if predicted concentrations in any assessment scenario were more than 10% of their applicable criteria at the maximum off-property location. As a result, contour plots for other COPCs are limited to uranium, arsenic, nickel, and acrolein. Exceedance plots were also created for those COPCs showing an exceedance of an air quality criteria in the results tables. As a result, the contour plots for various scenarios are presented as follows:

- Baseline Operations Scenario (2022 to 2025 and 2035 to 2036) contour plots are shown on Figures 2.3-1 to 2.3-27.
- Maximum Future Operations Scenario (2026 to 2034) contour plots are shown on Figures 2.3-28 to 2.3-54.
- Decommissioning Scenario (2037 to 2050) contour plots are shown on Figures 2.3-55 to 2.3-79.
- Post-Decommissioning (2051 and beyond) contour plot is shown on Figure 2.3-80.

For refined air dispersion modelling assessments, the Saskatchewan Air Dispersion Modelling Guideline (GS 2025a) allows for the elimination of the top concentrations at each receptor location to account for rare and usual meteorological events or anomalies. Therefore, in this assessment, the top eight concentrations for COPCs having 1-hour air quality criteria and the highest overall concentration for COPCs with 8-hour criteria were removed. In other words, the 1-hour concentrations presented in the tables and contour plots represent the 9th rank, while 8-hour concentrations represent the 2nd rank. For all other averaging periods, the highest overall concentration is presented in accordance with the modelling guide.

2.3.1 Baseline Operations Scenario

The baseline operations scenario represents activities at the McClean Lake Operation for the period 2022 to 2025 that primarily include mining and construction activities in the McClean Mining site, milling of Cigar Lake ore slurry and McClean Mining ore, and TMF expansion work. Results from this scenario are also considered representative of future activities for the period 2035 to 2036. The maximum predicted off-property concentrations for the COPCs along with the results for the discrete ERA receptors are provided in Tables 2.3-1 to 2.3-6. Where exceedances of the air quality criteria are predicted, the frequency of exceedances has also been determined and presented in the tables. Concentrations and exceedances for select COPCs are also presented as contour plots in Figures 2.3-1 through 2.3-27.

As shown in Table 2.3-1, the maximum off-property concentration for 24-hour TSP is $144.2 \mu\text{g}/\text{m}^3$ or 144% of the SAAQS of $100 \mu\text{g}/\text{m}^3$, while the maximum annual TSP concentration is $12.0 \mu\text{g}/\text{m}^3$ or 20% of the SAAQS of $60 \mu\text{g}/\text{m}^3$. At the ERA receptors, 24-hour TSP concentrations range from a low of $76.8 \mu\text{g}/\text{m}^3$ in the Wollaston Lake Community Area to a high of $96.3 \mu\text{g}/\text{m}^3$ at the JEB Camp receptor, which is below the SAAQS. For annual TSP, the highest concentration at the ERA receptors is $10.1 \mu\text{g}/\text{m}^3$, also at JEB Camp. Similarly, the maximum off-property 24-hour PM_{10} concentration of $63.6 \mu\text{g}/\text{m}^3$ exceeds the SAAQS of $50 \mu\text{g}/\text{m}^3$ by 20%; however, no exceedances are predicted at the ERA receptors. As suggested by Figures 2.3-1 and 2.3-4, 24-hour TSP and PM_{10} concentrations are elevated in and around the McClean Mining site and the JEB TMF, reflecting two of the dominate emission sources discussed in Section 2.2.6.2. Concentrations are also elevated near the JEB CWRP and Moffat Lake borrow area, showing the effect of conservative crushing emissions in these locations. Figure 2.3-2 also illustrates the influence of unpaved road dust on annual TSP concentrations, with contours closely following the main access road.

To examine the nature of the predicted 24-hour TSP and PM_{10} exceedances, a frequency analysis was completed, and the results are presented in Table 2.3-1 alongside the predicted concentrations. The analysis showed that the highest number of predicted TSP exceedances is 57 days per year (16% of the time) at the maximum off-property location, while the maximum number of PM_{10} exceedances is 20 days per year (5% of the time) at the maximum off-property location. Figures 2.3-3 and 2.3-5 also show that exceedances outside of the property boundary are restricted to areas near the JEB TMF and JEB CWRP and occur within about 600 m of the lease area. As discussed in Section 2.2.8, several conservative assumptions were applied in the assessment and as a result, the actual number of exceedances is expected to be lower than the model predictions. Based on these results, the potential effects of the McClean Lake Operation on TSP and PM_{10} concentrations beyond the property boundary are likely to be minimal and restricted to areas in the vicinity of JEB TMF expansion work.

For $\text{PM}_{2.5}$, the maximum off-property concentrations are below the applicable 24-hour and annual SAAQS of $28 \mu\text{g}/\text{m}^3$ and $10 \mu\text{g}/\text{m}^3$, with predictions of $21.5 \mu\text{g}/\text{m}^3$ and $4.9 \mu\text{g}/\text{m}^3$, respectively. $\text{PM}_{2.5}$ concentrations at the ERA receptors are also below the SAAQS, ranging from 12.2 to $26.9 \mu\text{g}/\text{m}^3$ on a 24-hour basis, and from 4.0 to $4.7 \mu\text{g}/\text{m}^3$ on an annual basis. As suggested by Figures 2.3-6 and 2.3-7, $\text{PM}_{2.5}$ concentrations are highest near areas with large amounts of fuel combustion, namely the McClean Lake Mill and the McClean Mining site. Concentrations are also elevated near the mill due to emissions from the calciner stack and near the JEB CWRP as a result of the conservative crushing emissions on the pile (Section 2.2.6.2).

Model results for metals are provided in Tables 2.3-2 and 2.3-3, which show that the maximum predicted off-property concentrations are all below the criteria. The metal with the highest predicted concentration relative to its criteria is uranium, with a 24-hour concentration of $0.0704 \mu\text{g}/\text{m}^3$ (47% of the criterion of $0.15 \mu\text{g}/\text{m}^3$) and an annual concentration of $0.00787 \mu\text{g}/\text{m}^3$ (26% of the criterion of $0.03 \mu\text{g}/\text{m}^3$) at the maximum off-property receptor. All other metals are less than 5% of the criteria at the maximum off-property locations. For most metals, the JEB Camp is the ERA receptor with the highest predicted concentration due to its proximity to the mill and the waste incinerator – both notable contributors to metal emissions (Section 2.2.6.2). At the JEB Camp, uranium is predicted to be 35% of the 24-hour criterion and 9% of the annual criterion. This is reflected in the uranium contour plots provided in Figures 2.3-8 and 2.3-9, which show exceedances of the 24-hour and annual Ontario AAQC for uranium near the mill, with notable influences near the McClean Mining site and Sue ore transfer pad. For all other ERA receptors, metal concentrations are less than 10% of the criteria.

In addition to contour plots for uranium, contour plots for arsenic (Figure 2.3-10) and nickel (Figures 2.3-11 and 2.3-12) were created since these COPC are more than 10% of their criteria in the Maximum Future Operations Scenario (see Section 2.3.2). As seen in Figure 2.3-10, 24-hour concentrations of arsenic exceed the Ontario AAQC in close proximity to the mill, owed primarily to emissions from the calciner and grinding stacks (see Section 2.2.6.2), and are also elevated near the Sue ore transfer pad. Similarly, Figures 2.3-11 and 2.3-12 show that nickel concentrations are influenced by emissions from the mill and Sue ore transfer pad and to a lesser extent, emissions from the McClean Mining site.

Table 2.3-4 summarizes the predicted concentrations for CO , NO_2 , and SO_2 , while ammonia, acrolein, and benzene are summarized in Table 2.3-5. At the maximum off-property locations, predicted concentrations for these gaseous COPCs are all below the SAAQS or other criteria. The COPC with the highest predicted concentration outside of the property is NO_2 at 87% of the 1-hour SAAQS of $300 \mu\text{g}/\text{m}^3$ and 85% of the 24-hour SAAQS of $200 \mu\text{g}/\text{m}^3$. The next highest COPC is SO_2 at 26% of the 24-hour SAAQS of $125 \mu\text{g}/\text{m}^3$. For all other gaseous COPCs, predicted concentrations are less than 15% of the SAAQS or criteria at the maximum off-property location.

Contour plots for the gaseous COPCs are provided in Figures 2.3-13 to 2.3-26, which show that most species have concentrations below the criteria at all receptor locations in the air modelling study areas. The exceptions are the plots of 1-hour and 24-hour NO_2 and 24-hour acrolein concentrations, which show contours at or above the criteria at locations inside the property boundary. As seen in Figures 2.3-15 and 2.3-16, 1-hour and 24-hour NO_2 concentrations are above the criteria in the vicinity of the mill due to generator emissions and near the McClean Mining site due to off-road diesel equipment emissions. Similarly, 24-hour acrolein concentrations shown in Figure 2.3-24 are above the criterion near the McClean Mining site, owed to emissions from off-road diesel equipment. However, these figures illustrate that predicted concentrations drop off quickly with distance and areas that exceed the criteria are limited to within 1 km of the predominant emission sources. Additionally, due to the conservative nature of the assessment (described in Section 2.2.8), it is expected that actual NO_2 and acrolein concentrations will be less than those predicted by the model.

Predicted incremental annual radon concentrations are provided in Table 2.3-6 for the maximum off-property location and ERA receptors. The highest predicted activity outside the property boundary is $11.9 \text{ Bq}/\text{m}^3$, while activities at the ERA receptors range from $0.02 \text{ Bq}/\text{m}^3$ at the Wollaston Lake Community Area to approximately $9.2 \text{ Bq}/\text{m}^3$ at the JEB Camp. The maximum of $11.9 \text{ Bq}/\text{m}^3$ and the predictions at the ERA receptors are less than the nominal background activity of 15 to $25 \text{ Bq}/\text{m}^3$ for the McClean Lake Operation

area (see Section 2.2.4). As shown in Figure 2.3-27, radon concentrations are predicted to be highest near the JEB ore storage pad with values of 200 Bq/m³ but quickly fall off with distance and return to background levels near the property boundary. Figure 2.3-27 also shows the influence of radon emissions from the McClean Mining site and Sue ore transfer pad; however, radon concentrations in these areas are predicted to be within the range of background.

2.3.2 Maximum Future Operations Scenario

The maximum future operations scenario represents activities at the McClean Lake Operation for the period 2026 to 2034 when the mill production rate is expected to peak at 23 million lbs U₃O₈ per year. Activities primarily include ongoing TMF expansion work, mining and construction activities in the McClean Mining site, mining in Sue F, and milling of Cigar Lake ore slurry and ore from the McClean, Sue F, and Midwest deposits. The maximum predicted off-property concentrations for the COPCs are provided in Tables 2.3-7 to 2.3-12 along with the results for the discrete ERA receptors. Where exceedances of the air quality criteria are predicted, the frequency of exceedances has also been determined and presented in the tables. Concentrations and exceedances for select COPCs are also presented as contour plots in Figures 2.3-28 through 2.3-54.

As shown in Table 2.3-7, particulate matter concentrations are generally higher than the baseline operations scenario. The maximum off-property concentration for 24-hour TSP is 174.8 µg/m³ or 175% of the SAAQS of 100 µg/m³, while the maximum annual TSP concentration is 14.9 µg/m³ or 25% of the SAAQS of 60 µg/m³. At the ERA receptors, 24-hour TSP concentrations range from a low of 76.9 µg/m³ in the Wollaston Lake Community Area to a high of 112.2 µg/m³ at JEB Camp, which is 12% above the SAAQS. For annual TSP, the highest concentration at the ERA receptors is 11.9 µg/m³ at JEB Camp. Similarly, the maximum off-property 24-hour PM₁₀ concentration of 82.7 µg/m³ exceeds the SAAQS of 50 µg/m³ by 65% and at the ERA receptors, JEB Camp is predicted to be slightly above the SAAQS at 50.7 µg/m³. As suggested by Figure 2.3-28, 24-hour TSP concentrations are elevated in and around the McClean and Sue F Mining sites and near the Sue ore transfer pad and Sue C CWRP, reflecting emissions from activities in these areas. Concentrations of 24-hour TSP are also elevated around the JEB site, largely owed to emissions from TMF expansion work. Similar to TSP, Figure 2.3-31 shows that 24-hour PM₁₀ concentrations are elevated around the McClean and Sue F Mining sites and around the JEB site. The influence of unpaved road dust is also evident in Figures 2.3-28 and 2.3-31 as well as Figure 2.3-29, which shows how annual TSP contours closely follow the main access road.

To examine the nature of the predicted 24-hour TSP and PM₁₀ exceedances, a frequency analysis was completed, and the results are presented in Table 2.3-7 alongside the predicted concentrations. The analysis showed that the highest number of predicted TSP exceedances is 46 days per year (13% of the time) at the maximum off-property location, while the maximum number of PM₁₀ exceedances is 20 days per year (5% of the time) at the maximum off-property location. Figures 2.3-30 and 2.3-32 also show that exceedances outside of the property boundary are restricted to areas north of the JEB TMF and JEB CWRP and occur within about 1 km of the lease area. Like the baseline operations scenario, several conservative assumptions have been applied in the assessment; therefore, it is likely that the number of exceedances will be less than what has been predicted by the model. Based on these results, the potential effects of the McClean Lake Operation on TSP and PM₁₀ concentrations beyond the property boundary are likely to be minimal and restricted to areas in the vicinity of JEB TMF expansion work.

For PM_{2.5}, the maximum off-property concentrations are below the 24-hour and annual SAAQS of 28 µg/m³ and 10 µg/m³, with predictions of 22.9 µg/m³ and 5.2 µg/m³, respectively. PM_{2.5} concentrations at the ERA receptors range from 12.3 to 22.5 µg/m³ on a 24-hour basis, and from 4.0 to 4.6 µg/m³ on an annual basis. As suggested by Figures 2.3-33 and 2.3-34, PM_{2.5} concentrations show a similar pattern to the baseline operations scenario and are elevated near the mill and the JEB CWRP. Concentrations are also elevated in the vicinity of the McClean and Sue F Mining sites, which have significant PM_{2.5} emissions from off-road diesel equipment (Section 2.2.6.2).

Model results for metals are provided in Tables 2.3-8 and Table 2.3-9, which generally show an increase in concentrations relative to the baseline operations scenario. Despite the increases, all predicted concentrations at the maximum off-property locations and at the ERA receptors remain below the criteria. Like the baseline operations scenario, the metal with the highest predicted concentration relative to its criteria is uranium, with a 24-hour concentration of 0.109 µg/m³ (73% of the criterion of 0.15 µg/m³) and an annual concentration of 0.0148 µg/m³ (49% of the criterion of 0.03 µg/m³) at the maximum off-property receptor. Two other metals have predicted concentrations greater than 10% of the criteria at the maximum off-property locations: arsenic and nickel. The maximum off-property concentration for 24-hour arsenic is 33% of the criterion, while 24-hour and annual nickel concentrations are 12% and 9% of the criteria. All other metals are less than 5% of the criteria at the maximum off-property locations. Except for manganese, the JEB Camp is the ERA receptor with the highest predicted metal concentration due to its proximity to the mill and the waste incinerator – both notable contributors to metal emissions (Section 2.2.6.2). At the JEB Camp, uranium is predicted to be 61% of the 24-hour criterion and 21% of the annual criterion, while 24-hour concentrations of arsenic and nickel are 25% and 10% of their respective criteria. This is reflected in the contour plots provided in Figures 2.3-35 to 2.3-39, which show the elevated concentrations of uranium, arsenic, and nickel near the mill that, except for annual nickel, exceed the applicable Ontario AAQC. The plots also show influences near the McClean and Sue F Mining sites, as well as the Sue ore transfer pad where there are also exceedances of the 24-hour Ontario AAQC for arsenic and uranium. For all other ERA receptors, metal concentrations are less than 10% of the criteria.

Table 2.3-10 summarizes the predicted concentrations for CO, NO₂, and SO₂, while ammonia, acrolein, and benzene are summarized in Table 2.3-11. At the maximum off-property locations, predicted concentrations for these gaseous COPCs are all below the SAAQS or other criteria. The COPC with the highest predicted concentration outside of the property is NO₂ at 87% of the 1-hour SAAQS of 300 µg/m³ and 85% of the 24-hour SAAQS of 200 µg/m³. The next highest COPC is 24-hour SO₂, which is 34% of the SAAQS of 125 µg/m³ followed by acrolein at 24% of the criterion of 0.4 µg/m³. For all other gaseous COPCs, predicted concentrations are less than 10% of the criteria at the maximum off-property location. For the ERA receptors, all predicted concentrations are below their applicable criteria. Contour plots for the gaseous COPCs are provided in Figures 2.3-40 to 2.3-53, which show that most species have concentrations below the criteria at all receptor locations in the air modelling study areas. The exceptions are the plots of 1-hour and 24-hour NO₂ and acrolein concentrations, which show contours at or above the criteria at locations inside the property boundary. As seen in Figures 2.3-42 and 2.3-43, 1-hour and 24-hour NO₂ concentrations are influenced by the generators and off-road diesel equipment in the McClean and Sue F Mining sites. Similarly, 1- and 24-hour acrolein concentrations are highest near the McClean and Sue F Mining sites, owed to emissions from off-road diesel equipment (Figures 2.3-50 and 2.3-51). Due to the conservative nature of the assessment (described in Section 2.2.8), it is expected that actual concentrations of NO₂ and acrolein will be less than those predicted by the model.

Predicted incremental annual radon concentrations are provided in Table 2.3-12 for the maximum off-property location and ERA receptors. The highest predicted activity outside the property boundary is 16.8 Bq/m³, which is marginally higher than the baseline operations scenario but still within the range of background (15 to 25 Bq/m³). At the ERA receptors, radon activities are predicted to remain low and less than background, ranging from 0.03 Bq/m³ at the Wollaston Lake Community Area to approximately 12.2 Bq/m³ at the JEB Camp. As shown in Figure 2.3-54, radon activities show a similar distribution compared to the baseline operations scenario, with the highest levels (approximately 200 Bq/m³) predicted near the JEB ore storage pad that quickly return to background levels near the property boundary. Figure 2.3-54 also shows the influence of radon emissions from the McClean and Sue F Mining sites as well as the Sue ore transfer pad; however, radon concentrations in these areas are predicted to be within the range of background.

2.3.3 Decommissioning Scenario

The decommissioning scenario represents the 2037 to 2050 period when all milling has ceased, and site reclamation is occurring. As discussed in Section 2.2.1.3, this assessment scenario considered activities related to TMF closure, decommissioning of the mill area, and the disposal of Cigar Lake waste rock in the Sue C pit. The maximum predicted off-property concentrations for the COPCs are provided in Tables 2.3-13 to 2.3-18 along with the results for the discrete ERA receptors. Where exceedances of the air quality criteria are predicted, the frequency of exceedances has also been determined and presented in the tables. Concentrations and exceedances for select COPCs are also presented as contour plots in Figures 2.3-55 through 2.3-79.

As shown in Table 2.3-13, particulate matter concentrations are generally higher than the baseline operations scenario but lower than the maximum future operations scenario. This is expected since significant emissions of fugitive dust are expected from handling the fill and cover materials required for decommissioning. The maximum off-property concentration for 24-hour TSP is 155.3 µg/m³ or 155% of the SAAQS of 100 µg/m³, while the maximum annual TSP concentration is 18.5 µg/m³ or 31% of the SAAQS of 60 µg/m³. At the ERA receptors, 24-hour TSP concentrations range from a low of 76.8 µg/m³ in the Wollaston Lake Community Area to a high of 106.2 µg/m³ at the JEB Camp, which is marginally above the SAAQS. For annual TSP, the highest concentration at the ERA receptors is 9.6 µg/m³ at JEB Camp. Similarly, the maximum off-property 24-hour PM₁₀ concentration of 70.9 µg/m³ exceeds the SAAQS of 50 µg/m³ by 42% but is below the SAAQS at all ERA receptors. As suggested by Figures 2.3-55 and 2.3-58, 24-hour TSP and PM₁₀ concentrations are elevated in and around the JEB site and Sue C pit, reflecting emissions from activities in these areas. The influence of unpaved road dust is also evident in Figure 2.3-56, which shows how annual TSP contours closely follow the road, particularly along the route to Sue C pit where truck traffic is highest due to Cigar Lake waste rock shipments.

To examine the nature of the predicted 24-hour TSP and PM₁₀ exceedances, a frequency analysis was completed, and the results are presented in Table 2.3-13 alongside the predicted concentrations. The analysis showed that the highest number of predicted TSP exceedances is 62 days per year (17% of the time) at the maximum off-property location, while the maximum number of PM₁₀ exceedances is 28 days per year (8% of the time) at the maximum off-property location. Figures 2.3-57 and 2.3-59 also show that exceedances outside of the property boundary are largely restricted to areas north of the JEB site and occur within about 700 m of the lease area. There is also a small area near the southern property boundary along the access road where 24-hour TSP exceedances are predicted; however, the number of predicted exceedances is limited to one

day per year in this area. This exceedance is attributable to the Cigar Lake waste rock truck traffic and the close proximity of the modelled road sources to the property boundary receptors (see Appendix II.3). Like the operations scenarios, several conservative assumptions have been applied in the assessment; therefore, it is likely that the number of exceedances will be less than what has been predicted by the model. Based on these results, the potential effects of the McClean Lake Operation on TSP and PM₁₀ concentrations beyond the property boundary are likely to be minimal.

For PM_{2.5}, the maximum off-property concentrations are below the 24-hour and annual SAAQS of 28 µg/m³ and 10 µg/m³, with predictions of 20.2 µg/m³ and 4.6 µg/m³, respectively. PM_{2.5} concentrations at the ERA receptors are also below the SAAQS and range from 12.1 to 16.2 µg/m³ on a 24-hour basis, and from 4.0 to 4.2 µg/m³ on an annual basis. As suggested by Figures 2.3-60 and 2.3-61, PM_{2.5} concentrations show a similar pattern to TSP and PM₁₀ and are elevated near the JEB site and Sue C pit.

Model results for metals are provided in Tables 2.3-14 and Table 2.3-15. For most metals, concentrations are lower compared to the operations scenarios since milling has ceased. The exceptions are cadmium, cobalt, and chromium, which have the highest predicted off-property concentrations since the Cigar Lake waste rock has high concentrations of these metals compared to other materials (see Table 2.2-7). Despite this, all predicted concentrations at the maximum off-property locations and at the ERA receptors remain below the criteria. The metal with the highest predicted concentration relative to its criteria is cadmium, with a 24-hour concentration of 0.00219 µg/m³ (9% of the criterion of 0.025 µg/m³) at the maximum off-property receptor. All other metals are less than 5% of the criteria at the maximum off-property locations and at the ERA receptors. For consistency with the operations scenarios, contour plots for uranium, arsenic, and nickel are provided in Figures 2.3-62 to 2.3-66, which show that concentrations are very low during decommissioning.

Table 2.3-16 summarizes the predicted concentrations for CO, NO₂, and SO₂, while acrolein and benzene are summarized in Table 2.3-17. At the maximum off-property locations and ERA receptors, predicted concentrations for the gaseous COPCs remain below the SAAQS or other criteria. Since the mill does not operate during decommissioning, ammonia emissions and therefore concentrations, are zero. There is also a notable decrease in SO₂ concentrations compared to operations since the acid plant is not in operation during this scenario. The maximum off-property concentrations of NO₂ are 87% of the 1-hour SAAQS of 300 µg/m³ and 85% of the 24-hour SAAQS of 200 µg/m³. This result is the same as the operations scenarios and reflects the short-term operation of the standby diesel generators. Acrolein is 20% of the 24-hour criterion of 0.4 µg/m³ at the maximum off property location, while all other gaseous COPCs are less than 10% of the criteria. Contour plots for the gaseous COPCs are provided in Figures 2.3-67 to 2.3-78, which show that NO₂ is the only gaseous COPC having levels greater than its applicable 1- and 24-hour criteria at locations inside the property boundary. As seen in Figures 2.3-69 and 2.3-70, 1-hour and 24-hour NO₂ concentrations are strongly influenced by the generators during the decommissioning scenario. Due to the conservative nature of the assessment (described in Section 2.2.8), it is expected that actual concentrations of NO₂ will be less than those predicted by the model.

Predicted incremental annual radon concentrations are provided in Table 2.3-18 for the maximum off-property location and ERA receptors. The activities predicted during the decommissioning scenario are low and would be indiscernible from the background of 15 to 25 Bq/m³. The maximum off-property activity is predicted to be 0.3 Bq/m³, while at the ERA receptors, radon activities range from 0.001 Bq/m³ at the Wollaston Lake

Community Area to 0.04 Bq/m³ at the JEB Camp receptor. As shown in Figure 2.3-79, radon activities are only 0.5 Bq/m³ near the JEB TMF and in close proximity to the Sue C waste rock pile.

2.3.4 Post-Decommissioning

Following completion of reclamation activities at the McClean Lake Operation, only radon gas will be emitted on a continuous basis from the large clean waste rock piles (Sue C and Sue E CWRP) and from a rehabilitated JEB TMF covered with waste rock and soil. The predicted incremental concentrations of radon at the maximum off-property receptor and the ERA receptors are summarized in Table 2.3-19. The maximum off-property activity of radon is 1.6 Bq/m³. Activities at the ERA receptors range from a low of 0.001 Bq/m³ at the Wollaston Lake Community Area to a high of 0.3 Bq/m³ at the JEB Camp. Activities of this magnitude would not be measurable and are far less than the background of 15 to 25 Bq/m³. Figure 2.3-80 shows that incremental radon activities close to the JEB site are predicted to be approximately 5 Bq/m³, while at the Sue site, activities are predicted to be about 0.5 Bq/m³ in close proximity to the Sue C waste rock pile.

2.3.5 Comparison to Applicable Environmental Assessments

2.3.5.1 Standard Pollutants

In the 1991 McClean EIS (Minatco 1991), the maximum long-term (i.e., annual) TSP, SO₂, and NO₂ concentrations were below the federal and provincial air quality standard from that time. Annual TSP was predicted to be between 40 µg/m³ and 50 µg/m³ near the Sue B pit and fell off rapidly with distance, with values predicted to be below 20 µg/m³ beyond the property boundary. Annual SO₂ was predicted to be between 2 and 3 µg/m³ on site, while annual NO₂ was between 20 and 30 µg/m³. Off-site, annual SO₂ and NO₂ were <1 µg/m³ and <5 µg/m³, respectively. On a short-term basis, SO₂ was below the 1-hour standard of 450 µg/m³, while some exceedances of the 1-hour NO₂ standard from that time (400 µg/m³) were predicted on site due to emissions from the back-up generators. Overall, the impacts from the McClean Lake Operation on local air quality were predicted to be minor (Minatco 1991).

The 2009 Caribou EIS summarized that maximum short-term (i.e., 1- and 24-hour) concentrations of TSP, NO₂, and SO₂ due to mining activities at the Caribou Project site would remain below the federal and provincial air quality standards from that time at locations beyond the surface lease boundary; however, elevated levels of dust were possible. Annual concentrations for all contaminants assessed were below provincial and federal limits from that time (AREVA 2009a).

The 1995 and 2011 Midwest EISs concluded that without mitigation, the transfer of ore from Midwest to the JEB mill may result in periodic exceedances of the 24-hour TSP standard from that time, however, the effects would be localized to the road and drop off quickly with distance. Annual TSP concentrations along the haul road would remain below applicable federal and provincial standards from that time (COGEMA 1995, AREVA 2011). The 2011 Midwest EIS also concluded that SO₂ and NO₂ from vehicular emissions along the haul road would be below applicable federal and provincial standards (AREVA 2011).

For long-term concentrations of TSP, SO₂, and NO₂, the findings from the current assessment are consistent with the conclusions of the previous EISs; that is, annual concentrations of TSP, SO₂, and NO₂ are below the

applicable provincial standards at all receptor locations. Current values are also at or below the 1991 EIS results, with maximum annual off-property concentrations ranging from 12.0 to 18.5 $\mu\text{g}/\text{m}^3$ for TSP, 0.2 to 3.5 $\mu\text{g}/\text{m}^3$ for SO_2 , and 4.7 to 6.3 $\mu\text{g}/\text{m}^3$ for NO_2 . Similar to the 1991 EIS, occasional exceedances of the NO_2 1-hour standard are also predicted within the property boundary. The current assessment also predicted occasional exceedances of the 24-hour TSP standard, consistent with the 2009 EIS findings; however, unlike the previous EIS, occasional TSP exceedances are predicted beyond the lease boundary related to TMF expansion work as well as TMF closure activities. This is consistent with the 2016 EP TID which also predicted 24-hour TSP exceedances related to TMF expansion activities (AREVA 216). No exceedances of the 24-hour TSP SAAQS are predicted along the Midwest haul road due to refined traffic estimates and the inclusion of natural and active mitigation measures.

2.3.5.2 Radon

In the 1991 EIS, the McClean Lake project was expected to contribute, at maximum, an additional 15 to 20 Bq/m^3 to radon activities on the project site, which was an approximate two-fold increase in normal background activities. Overall, the project was not expected to have a significant impact on air quality with respect to radon activities (Minatco 1991). The 2009 Caribou EIS also showed low incremental activities, with a prediction of 0.295 Bq/m^3 in the McClean Lake Operation Area airshed for a period of maximum atmospheric emissions (AREVA 2009a).

In the current assessment, the maximum annual incremental radon prediction at the property boundary is 16.8 Bq/m^3 , consistent with the range of values predicted in the 1991 EIS. While there is no direct comparison to the McClean Lake Operation Area airshed from the 2009 EIS, predictions at the discrete ERA receptors in the current assessment (excluding JEB Camp) were predicted to be low, ranging from 0.001 Bq/m^3 to 1.6 Bq/m^3 .

2.4 Conclusions

Air dispersion modelling of atmospheric emissions from the McClean Lake Operation was undertaken to evaluate the potential short- and long-term effects to ambient air quality from mining and milling operations. Specifically, a baseline operations scenario representing the period 2022 to 2025 and 2035 to 2036 was used to evaluate SABRE activities in the McClean Mining site and milling at an annual production rate of around 18 million lbs U_3O_8 . A maximum future operations scenario representing the period 2026 to 2034 was used to evaluate peak SABRE activity rates in the McClean and Sue F Mining sites and an annual mill production rate of 23 million lbs U_3O_8 . In both operations scenarios, TMF expansion work was also evaluated. In addition, the potential short- and long-term effects to air quality from the decommissioning (2037 to 2050) and post-decommissioning (2050+) phases were evaluated. Annual predicted concentrations and deposition rates for select COPCs (metals and radon) were also used to create inputs for the ADEPT pathways model (Section 4) for discrete ERA receptors and airsheds, covering a broad area from on-site locations (e.g., JEB Camp) to the Wollaston Lake Community, more than 40 km from the site.

The CALMET/CALPUFF air dispersion modeling package was used to predict the potential effects of the McClean Lake Operation on local and regional air quality at gridded receptor locations and at the discrete ERA receptors and ERA airsheds. Where applicable, background concentrations were added to model

predicted COPC concentrations and compared to either SAAQS or Ontario ambient air quality criteria or guidelines. Majority of the COPCs were predicted to be below their applicable short-term and long-term standards, criteria or guidelines at receptors located beyond the lease area, which was defined as the property boundary. The exceptions were 24-hour TSP and PM₁₀ concentrations, which were predicted to exceed the SAAQS of 100 µg/m³ and 50 µg/m³ at locations beyond the property boundary north of the JEB site for both operations scenarios and the decommissioning scenario, attributable to TMF expansion work and TMF closure activities, respectively. Frequency analyses showed that exceedances would be limited to areas within 1 km of the JEB site and would not occur more than 17% of the time for TSP and 8% of the time for PM₁₀ at locations beyond the property boundary. At the ERA receptors, some exceedances of the particulate matter SAAQS were predicted at JEB Camp but were very limited; the maximum number of 24-hour TSP exceedances was only 6 days per year, while 24-hour PM₁₀ exceedances were limited to a single day per year. Exceedances of the 1- and 24-hour NO₂ SAAQS were predicted at gridded receptor locations within property boundary in the vicinity of the McClean Mill and the McClean and Sue F Mining sites, but concentrations drop off quickly, and exceedances do not extend beyond the lease boundary. It is noted that emission estimates from the assessment scenarios are considered conservative and as a result, actual concentrations of COPCs and the number of exceedances is likely to be less than what has been predicted.

For the operations scenarios, exceedances of the Ontario AAQC for uranium (24-hour and annual), arsenic (24-hour), and nickel (24-hour and maximum future operations, only) are predicted near the mill and Sue ore transfer pad; however, concentrations at all ERA receptors are predicted to be below the criteria and as noted above, concentrations do not exceed the criteria beyond the property boundary. Exceedances of the 24-hour Ontario AAQC for acrolein were also predicted at gridded receptors within the property boundary in the vicinity of combustion sources like the back-up generators and off-road diesel equipment in the McClean and Sue F Mining sites. Like metals, there are no exceedances of the acrolein criteria at any ERA receptors or at locations beyond the property boundary.

Near the mill and JEB ore storage area, radon activities were predicted to be as high as 200 Bq/m³ during operations but quickly fell off with distance, approaching the background activity of 15 to 25 Bq/m³ near the property boundary. Influences on radon activities were also observed near the McClean Mining site, the Sue F Mining site, and Sue ore transfer pad; however, values in these locations were predicted to be in the range of background activities. Across all assessment scenarios, the incremental radon activities predicted at the maximum property boundary location ranged from 0.3 Bq/m³ to 16.8 µg/m³, while at the ERA receptors, activities ranged from a low of 0.001 Bq/m³ for the Wollaston Lake Community Area to 12.2 Bq/m³ at JEB Camp.

Overall, the air quality assessment showed that the potential effects of the McClean Lake Operation on ambient air quality in the air modelling local and regional study areas are minimal and limited to occasional exceedances of 24-hour TSP and PM₁₀ standards in areas to the north of the JEB site and within 1 km of the lease boundary. For all other COPCs and averaging periods, concentrations were predicted to be less than the applicable standards, criteria or guidelines at all locations beyond the property boundary. In addition, radon activities across the various assessment scenarios were predicted to be at or less than the background level of 15 to 25 Bq/m³ at locations beyond the property boundary. These findings are consistent with the findings presented in the previous 2016 TID and the EISs for the McClean Lake Operation, including those presented in the 1991 McClean Lake EIS, the Caribou Project EIS (AREVA 2009a), and Midwest Project EISs (COGEMA 1995 and AREVA 2011).

3 McClean Lake Operation – Wastewater Management Environmental Modelling

This section describes the assessment methodology used to evaluate potential effects of effluent discharge at the McClean Lake Operation. The assessment focuses on the prediction of water and sediment quality within and downstream of the S/V TEMS. At the McClean Lake Operation, the S/V TEMS has been in operation since 1996 and an extensive record of monitoring information has been acquired during this time. This information provides a comprehensive basis to derive model inputs to facilitate the accurate prediction of water and sediment quality expected within continued operation. The use of actual monitoring data to characterize each of the waste water sources for model inputs is outlined in the following sections.

At the McClean Lake Operation, the potential effects of effluent discharge within the Collins Creek watershed associated with current and proposed future activities depends on the quantity and quality of discharge from the JEB and Sue WTPs and Collins Creek flow conditions. The assessment of potential effects associated with the continuation of activities at the McClean Lake Operation has the benefit of substantial operational and monitoring data acquired to date.

The effluent performance predictions for the McClean Lake Operation were initially made in 1991 (Minatco 1991) and 1995 (COGEMA 1995) EAs. The latest update of these predictions was performed as part of the 2016 ERA, in support of the 2016 EP TID (AREVA 2016a). These predictions indicated an increasing trend in selenium concentrations in the McClean Lake mill effluent, which is processed at the JEB WTP, and potential exceedances of the selenium levels projected at the EA stage and environmental quality guidelines in the downstream environment if no additional control on selenium is implemented (AREVA 2016a).

In 2018, the selenium risk assessment was updated based on additional local and regional selenium fish data and revised effluent forecast (Orano 2018). The 2018 selenium risk assessment (2018 Selenium RA) showed that the anticipated selenium risks should remain consistent with the environmental effects predicted at the EA stage. Additionally, the site-specific selenium objective for fish and effluent exposure based release limit (EBRL) for selenium in the JEB WTP effluent were developed and approved by the regulators to ensure proper management of risks associated with the selenium release due to the mill operations. In 2022, a selenium treatment technology was integrated into the JEB WTP to reduce selenium loading to the JEB WTP effluent. The commissioning was initiated in 2023 but put on hold due to lower than expected selenium levels in the JEB WTP feed. The final commissioning and transfer to operations will commence once selenium concentrations increase. The initial commissioning results exceeded the selenium removal target of 60%, which was determined based on the pilot and plant trials.

The Base Case (presented in the main report) includes selenium treatment at the upgraded JEB WTP. Additionally, the Base Case without Selenium Treatment was considered and presented in Appendix III.4.

3.1 Model Problem Formulation

This section provides aspects of the problem formulation needed for contaminant dispersion modelling, such as the identification of COPCs and description of the wastewater components of the project. As outlined in N288.6 (CSA 2022), the purpose of the problem formulation is to identify contaminants, pathways, and receptors, and their relationships to the site, in order to focus the assessment on relevant aspects. The focus of the assessment for wastewater management is on predicted water and sediment quality. Valued components (VCs), pathways, receptors, conceptual models, and problem formulation checklists are provided in Section 4.0.

3.1.1 Identification of Constituents of Potential Concern

The current assessment considers the COPCs from previous assessments for the McClean Lake Operation, with the addition of aluminum, nitrate, cadmium, chromium, iron, silver, and thallium. Appendix III.1 discusses the selection process for the COPCs to be included in the 2025 ERA. The complete list of COPCs, shown in Table 3.1-1, includes the general water quality parameters ammonia, chloride, fluoride, nitrate, potassium, sulphate, and total dissolved solids (TDS); the metals/metalloids aluminum, arsenic, cadmium, chromium, cobalt, copper, iron, lead, molybdenum, nickel, selenium, silver, thallium, and zinc; and the radionuclides uranium, thorium-230, radium-226, lead-210, and polonium-210. Calcium was also included as additional modelled parameter to predict future hardness levels. Iron was included previously to facilitate enhanced geochemical considerations but now it is also included as a COPC. In addition, ammonia degradation is considered within the watershed model (see Appendix III.3 for more details). TDS is a composite parameter that includes dissolved ions in water, such as calcium, magnesium, potassium, and sodium, as well as carbonates, bicarbonates, chlorides, and sulphate. TDS is monitored in the effluent this information is used directly the model to represent a range of ions.

3.1.2 Sink Vulture Treated Effluent Management System

3.1.2.1 Physical Description

Section 1.1.1 provides an overview of the McClean Lake Operation site layout. A central component of the McClean Lake Operation waste water management strategy is the S/V TEMS. This system is the final, common repository for all waste water generated at the McClean Lake Operation. Waste water inputs to the S/V TEMS consist of treated effluent from the JEB WTP and treated effluent from the Sue WTP. Previously the JEB DWS contributed to the waste water inputs. The operation of these wells ceased in 2014. Descriptions of these individual facilities are provided in the current licencing documentation (CNSC 2024; SMOE 2024b).

3.1.2.2 Operational History

Sections 1.2 and 1.3 provide an overview of activities authorized for the McClean Lake Operation and its operational history. A summary of operational controls and McClean Lake Operation effluent quality characterization is provided in the current licencing documentation (CNSC 2024, SMOE 2024b). The varied operating conditions and accumulated monitoring information related to the quality and quantity of waste water

generated at each of the sites provide important information for the evaluation of the potential environmental effects associated with waste water discharge.

3.2 Overview of ADEPT Modelling Approach

The probabilistic watershed model Assessment of the Dispersion and Effects of Parameter Transport (ADEPT) is used to assess the fate of constituents of concern in the surface waters and sediments within the S/V TEMS and the downstream lake and river segments of the Collins Creek watershed. The model accounts for mixing of effluent and freshwater flow, and contaminant removal to sediments on settling solids and diffusive exchange. Contaminant inputs, particulate-contaminant interactions, sedimentation, and water exchange processes all play a role in determining contaminant fate in the receiving environment. Diffusive exchange is a two-way process; that is, contaminants may diffuse from the water column to the sediment porewater, or from the sediment porewater back to the water column, depending on the concentration gradient.

The prediction of the potential effects of McClean Lake Operation effluent discharges in the receiving environment requires the consideration of constituent concentrations (effluent quality), operational and expected source flows (discharge rates), receiving environment flow conditions (Collins Creek flow), and baseline surface water and sediment quality data. Of these elements, the types and temporal sequence of planned activities are important considerations in the prediction of water and sediment quality downstream of effluent release.

3.2.1 Model Description

The probabilistic watershed model ADEPT was used to assess the fate of constituents of concern in the surface waters and sediments within the S/V TEMS, McClean Lake east basin, Keweenaw Lake, Wollaston Lake (Collins Bay and the main lake area), and river segments of Collins Creek (from McClean Lake to Wollaston Lake). The model was implemented within a probabilistic modelling framework, which incorporates the explicit consideration of uncertainty in the magnitude of many of the model input parameters. For this application, the model was run using monthly time steps to assess the effects of variations in watershed flows on receiving water quality. An overview of the model is provided below.

The ADEPT model simulates the effects of contaminant input on surface water and sediment quality, simultaneously, in downstream waterbodies. Each segment in the ADEPT model comprises a waterbody of a given area, mean depth, and underlying sediment exchange zone. The change of water quality in each segment is formulated by a pair of differential equations (one for the waterbody and one for sediment porewater). Sediment solids concentrations are calculated after the integration step from an exchangeable COPC mass and a non-exchangeable COPC mass. Previously ten water segments were modelled; for the current simulation of the McClean Lake Operation, eleven connected water segments were modelled (Figure 3.2-1). The same ten waterbodies are included in the modelled domain, however, for the current work the McClean Lake east basin was subdivided into two segments for greater resolution. The “steady-state” concentrations for eleven water columns and eleven sediment porewaters are simultaneously determined by obtaining the determinants of the matrix which defines mass transfer throughout the modelled environment. The model was run with a monthly timestep ($t = 1$ month). However, the internal time step for computing is

adjusted iteratively within the model software to obtain the optimal solution. Therefore, the internal timestep may be considerably smaller than a month.

ADEPT considers advective and dispersive transport between segments. The important processes incorporated into the ADEPT model include horizontal (lateral) and vertical transport of dissolved species, chemical and biochemical transformation, settling of particulate matter, and sediment exchange. Chemical reactions comprise both equilibrium and dynamic processes. Important equilibrium processes are adsorption to sediments and speciation. Dynamic processes comprise oxidative and reductive chemical reactions and consumption of nutrients by aquatic microbiota and macrobiota.

The most important transport modes include advective transport, horizontal dispersion, vertical dispersion, sediment exchange, and settling of Particulate Matter. The basic principle of conservation of mass is a fundamental pillar of ADEPT. The primary cause of net convective flow is hydraulic inputs and outputs due to river discharges and direct precipitation on lake surfaces.

The movement of various chemical species in the sediment exchange zone is particularly important. Since the solubility of most metal ions is considerably higher under aerobic than anaerobic conditions, most exchange occurs from the oxidized zone of sediments (Davé et al. 1997). A portion of the sedimented material may be re-introduced into the water column by diffusive processes; the remaining part becomes buried over time by the continual deposition of fresh settling matter.

The ADEPT model is constructed within a probabilistic framework, incorporating natural variability and uncertainty of model parameters into the calculations. This approach is particularly pertinent to environmental modelling as a way to incorporate uncertainty as input parameters can be variable due to limitations of the availability of observational data and measurements, and due to natural variation in environmental conditions. Uncertain parameters are assigned distributions of values, as opposed to single values used in deterministic analyses. In this way, uncertainty is propagated through the component models to produce distributions of output values.

Appendix III.3 provides a more detailed description of the ADEPT model used for the assessment.

3.3 Wastewater Scenario Description and Model Inputs

Consistent with the previous ERAs (AREVA 2016a; Orano 2018) the model simulation begins in January 1996, with the actual initiation of waste water management activities at the McClean Lake Operation beginning in March 1996. For the period from March 1996 to December 2024, actual measured flows and measured effluent quality from each of the two current effluent sources (JEB WTP and Sue WTP) which reported to the S/V TEMS were used directly in the model. Similarly, the actual measured flows and concentrations for the JEB DWS are considered until the JEB DWS ceased operating in July 2014; contributions beyond June 2014 were not considered.

For the period extending from January 2025 to the end of the simulations, the quantity and quality of effluent from JEB WTP and Sue WTP were derived from a combination of operational monitoring information and engineering design and are described in the following section. Previous ERAs for the McClean Lake Operation

considered two proposed future Midwest Project sources, however, these are not considered in the current assessment as they are no longer a part of the mine plan presented in Section 1.

As discussed above, the Base Case (presented in the main report) includes selenium treatment at the upgraded JEB WTP. Additionally, the Base Case without Selenium Treatment was considered and presented in Appendix III.4. The model inputs for these two scenarios are discussed in the following sub-sections.

3.3.1 Model Inputs – Flows

3.3.1.1 Collins Creek

Measured flows in Collins Creek downstream of McClean Lake were used to determine runoff rates for the watershed. The monthly flow record, summarized in Table 2.3-7 of Volume 1 of the 2025 EP TID (Orano 2025c) for the 1979 to 1994 and 1997 to 2024 periods, was used to generate the net precipitation values (i.e. unit area runoff rates). The unit area runoff rates were used to estimate flows at various locations in the Collins Creek watershed and to account for monthly variations in runoff. For the operations period from 1997 to 2024, the adjusted monthly mean discharge values were used in the model simulation of past activities. As outlined in the table, the adjustments account for S/V TEMS discharge and Pat Lake freshwater supply withdrawal.

The unit area runoff rates and average monthly flow factors were updated for the current work based on the historic flow records and are used in all model simulations. In the probabilistic simulation of future conditions, a beta distribution was sampled for each year and monthly flow factors were applied. The beta distribution and monthly flow factors were calculated based on the historical data record. These model inputs are summarized in Attachment A of Appendix III.3.

3.3.1.2 Sink Reservoir

As outlined previously, the Sink Reservoir discharge is managed with a number of environmental protection safeguards outlined in the environmental code of practice (ECOP; Orano 2023b). The ADEPT code accounts for the controlled release of treated effluent from Sink Reservoir based on two constraints: i) ratio of at least 5 parts natural Collins Creek flow to 1 part treated effluent discharge is maintained and ii) streamflow in Collins Creek must not exceed 4.52 m³/s. The flow constraint in Collins Creek is set to protect against stream bed erosion and protect fish habitat. In 2023, Orano proposed to increase the bankfull capacity of Collins Creek from 4.52 m³/s to 5.6 m³/s. This increase was approved by SMOE (SMOE 2024c). Therefore, this constraint was modified in the ADEPT model starting in May 2024.

As noted in the ECOP, when inflows to the reservoir lessened in 2014 due to the cessation of dewatering well discharge, the McClean Lake Operation reassessed the target stage elevation and raised the target elevation to 441 mASL from 440 mASL. The intent was to allow for better effluent mixing throughout Sink Reservoir, which also would increase the COPC retention time and settling within the reservoir. This change was reflected in the model calibration for the current work.

3.3.1.3 Waste Water Flows

The assessment of potential effects of waste water releases from the McClean Lake Operation considers numerous site activities which potentially affect the quantity of waste water generated. There are two waste water sources from the McClean Lake Operation, namely, the JEB WTP and the Sue WTP. The previous ERAs also included two additional waste water sources associated with development of Midwest deposits with the open pit mining method. As outlined in Section 1.6.2.4, the current mine plan considers development of the Midwest project with SABRE method, so these two waste water sources have been excluded from the ERA scenarios.

As with any mining project, mining and milling activities are intrinsically variable, and subject to changes in market conditions. The approach used to address potential variations in mining schedule and milling rates in this EP TID is to evaluate a scenario which provides an envelope with respect to potential environmental effects.

The scenarios considered in this evaluation consider the annual production rate of up to 23 million lbs U_3O_8 . This includes completion of processing of Cigar Lake ore and SABRE mining at McClean Mining Site, Sue F, and Midwest. The scenarios consider flows from the Sue WTP stepped improvements, and the JEB WTP anticipated performance.

JEB WTP flows consider future maximum mill production. As detailed in Table 3.3-1, a flow of 4,203 m^3/d is assumed from 2025 through 2036, decreasing to 2,000 m^3/d over the 2037-2049 period. These flows are applicable to all evaluated scenarios.

Sue WTP flows (Table 3.3-2) were based on the pumping of Sue C and Sue B pit water to maintain pit water elevations and dewatering of the Sue C pit for placement of Cigar Lake special waste. The Cigar Lake special waste is anticipated to be placed over the 2037-2038 period, which will be associated with the Sue C/A pit dewatering in 2035-2036.

Within the probabilistic modelling framework for each of these cases, the JEB and Sue WTP discharges were varied by up to 1,000 m^3/d about the mean daily expected flows to account for natural variability in the flow estimates (i.e., the flows used in the simulations from January 2025 onward were sampled from triangular distributions with minimum and maximum values set at $\pm 1,000 m^3/d$ about the nominal flow from each source). This approach is consistent with that taken in previous assessments.

3.3.2 Model Inputs - Concentrations

The McClean Lake Operation has acquired substantial operational experience from conducting a wide range of activities (Section 1.3). This experience, and the associated monitoring data generated during the conduct of these activities, provides the basis to predict future water and sediment quality associated with proposed activities in the future. To derive model input distributions for each constituent of concern for each waste water source (JEB WTP and Sue WTP), the available monitoring data were used extensively, as outlined below.

The model simulations begin in January 1996 and source contaminant inputs for each waste water source for the period March 1996 (the actual initiation of waste water management activities at the McClean Lake Operation) to December 2024 are based on actual measured monthly average concentrations and, as was done with flows, directly input into the model.

The derivation of individual source effluent characteristics for the period from January 2025 to the end of the model simulation required several considerations. First, it is necessary to acknowledge the temporal sequence of the wide range of mining and milling activities which have occurred at the site to date, and the potential influence of these activities on the effluent quality of each waste water source, as reflected in their respective monitoring records. Second, for each of the waste water sources, it is also necessary to consider the milling schedule, as well as water treatment performance improvements (such as selenium treatment), with the use of operational data.

Aluminum, nitrate (as N), cadmium, chromium, iron, silver, and thallium were added as new modelled COPCs for the 2025 McClean ERA. To investigate uncertainty around future selenium treatment a scenario looking at the results assuming no selenium treatment was considered. This scenario is detailed in Appendix III.4 and is called Base Case without Selenium Treatment.

3.3.2.1 Baseline Water and Sediment Quality

The ADEPT model uses baseline concentrations of water and sediments as inputs to the model. Water concentrations for the McClean Lake Operation area were derived from non-exposed waterbodies from the McClean Lake Operation 2002 Annual Report (COGEMA 2003) and are consistent with those applied in previous assessments (AREVA 2012, 2016a; Orano 2018) . Mean values from grab samples taken at Mallen Lake, McClean Lake West and Henday Lake were averaged to develop representative baseline (background) water concentrations for the area. Baseline levels of general water quality parameters were developed from data for the pre-operational period 1979 to 1995 from the Midwest Project Environmental Impact Statement (COGEMA 1995). For COPCs that are consistently below the method detection limit (e.g., selenium), baseline levels were derived through the calibration process.

Baseline sediment concentrations were defined during the calibration process. Data collected from non-exposed waterbodies in the area are used as the starting point of the calibration process, and concentrations are modified to improve the model results fit with measured data at the S/V TEMS and downstream waterbodies.

3.3.2.2 JEB Water Treatment Plant

The historical operational performance data for the JEB WTP is summarized in Table 3.3-3 and Appendix III.2. Future effluent quality was determined based on the milling schedule and historical operational performance of the mill and WTP. Based on the geochemical parameters of the mill, validated through past experience, effluent quality at the JEB WTP has generally consistent chemistry regardless of ore source. The processing Cigar Lake ore at the McClean Lake Mill over the last nine years (i.e., 2016-2024) continues to validate this past experience with the exception of a few parameters for which a different performance was expected. Based on this, some predicted effluent concentrations were adjusted from the 2016 EP TID (AREVA

2016a) assumptions for the current work while many remain unchanged. Appendix III.2 provides more details on the effluent forecast approach.

To inform distributions for future JEB WTP concentrations, operational monitoring data for the JEB WTP over the 2016-2024 period were considered to be representative of future operating conditions, as they are the most representative of processing the Cigar Lake ore, which is the main feed to the mill.

As discussed in Appendix III.2, the forecasting approach used to develop selenium release in JEB WTP effluent for the current work are based on the 2025 mine plan and mill production rates ranging mostly between 18 to 23 million pounds U_3O_8 from 2025 to 2036 with and without application of the selenium treatment technology at the JEB WTP. For the 2025 ERA, selenium treatment in the JEB WTP is assumed for the Base Case scenario while the Base Case with no Selenium Treatment is presented in Appendix III.4.

Model inputs for the lognormal distributions derived for each of the key COPCs are provided in Table 3.3-4. For COPCs which are time variable (presented in Table 3.3-5) the geometric standard deviations listed in 3.3-4 were used to define the distributions.

3.3.2.3 Sue Water Treatment Plant

The operational performance data for the Sue WTP is summarized in Table 3.3-6 and Appendix III.2. Future effluent quality was determined by Orano based on the Sue WTP test program and other assumptions for continued operation; Appendix III.2 provides a rationale for the selection of the Sue WTP future effluent quality.

Model inputs for the lognormal distributions derived for each of the key constituents of concern are provided in Table 3.3-7. The variability in future effluent quality for the Sue WTP was characterized using the available operational monitoring data. The geometric standard deviations presented in Table 3.3-7 are based on the available effluent data from 1996 to 2024.

3.3.2.4 JEB Dewatering Well System

Table 3.3-8 provides a summary of the operational performance data for JEB DWS from March 1996 to June 2014. The JEB DWS ceased operations in July 2014 and is not considered as part of the future scenario.

3.3.3 Model Update, Parameterization, and Calibration

Various improvements have been made over the years to the modelling of the McClean Lake Operation through the incorporation of additional/updated site-specific information and further refinements to the modelling of the S/V TEMS. The current evaluation builds on improvements implemented in previous assessments, including the addition of a wetland located between the JEB treated effluent discharge pipeline and Sink Reservoir (so called Sink Upper Compartment (SUC)) to incorporate the observed removal of solids in this area; this resulted in substantial improvements to the model calibration. The initial SUC investigation was completed in 2011, then repeated in 2023 (Orano 2025c). The 2011 data were used for modelling

purposes in the previous ERAs (AREVA 2016, Orano 2018). The 2024 data have been considered in the predictive modelling to improve model parameterization and validation.

Previous assessments for the McClean Lake Operation have noted high removal efficiencies in the S/V TEMS, related to settling solids and iron removal. Several metals and metalloids (e.g. arsenic, molybdenum, nickel, selenium, uranium) are known to be removed with iron oxy-hydroxide complexes. To improve the modelling of the demonstrated removal efficiencies, the ADEPT model incorporated geochemical considerations for several key constituents. The water column solubility and surface complexation calculations were based upon detailed geochemical modelling performed for the 2016 ERA (Appendix III.5) and applied to arsenic, sulphate, and uranium. Precipitation and redissolution of calcium and sulphate as gypsum was considered, as well as surface sorption for uranium and arsenic (associated with ferrihydrite [iron] formation). For gypsum formation, the PH REDox EQUilibrium in C+ code (PHREEQC) results were used as reference to confirm that solubility calculations within ADEPT are reasonable. Estimation of ferrihydrite formation and subsequent surface complexation of arsenic and uranium is a much more complex calculation requiring many more detailed inputs; for this reason, the PHREEQC results were used directly to estimate parameters dictating iron solubility and surface sorption within ADEPT. Consistent with finding of the PHREEQC modelling work, formation of precipitates (as well as associated surface complexation) is limited largely to the initial area within the SUC.

Additional information was collected in 2023 on the SUC to provide further information on the formation of gypsum and removal in this compartment. As part of the assessment of these data, an investigation into how ADEPT represented the conditions was undertaken (CanNorth 2024). In general, it was found that the measured and modelled data line up well, although the comparison was complicated by high variability in the 2023 surface water samples. It was found that the ADEPT model was underpredicting molybdenum in the sediments of Sink Reservoir and nickel removal to the sediments in both the SUC and Sink Reservoir may benefit from some adjustment. Molybdenum and nickel removal was updated during model calibration performed as part of the current work.

One change made to the model set up for the 2025 McClean Lake Operation ERA is that the McClean Lake east basin was sub-divided to better reflect the mixing characteristics of the waterbody. Plume delineation studies undertaken during open water and under ice seasons of 2005, 2021, and 2022 (Orano 2022a, 2023b) found the highest specific conductance levels recovered around the diffuser through the entire water column (i.e., from surface to 2 m deep). In winter, with ice cover, the highest levels were recorded in the deepest areas of the lake. As modelling for the McClean Lake Operation ERA is conducted in monthly timesteps, this influence of ice cover has already been included. To better capture the differences between the near-diffuser region and the other portions of the lake the McClean Lake east basin was divided, for modelling purposes, into the following:

- Segment A: The near-diffuser area, which generally has higher concentrations. This segment would be reasonably represented by samples taken at station WQ11E.
- Segment B: The remainder of the lake, which includes the outflow. Water quality predictions within this segment are compared to samples from WQ12E. Although WQ12E is located downstream in Collins Creek, it can approximate the well-mixed conditions in the McClean Lake east basin Segment B area.

The attributes of these new McClean Lake east basin segments as well as all other modelled waterbodies are presented in Attachment A of Appendix III.3.

Attachment A of Appendix III.3 provides a summary of the distribution coefficients used in this assessment. The parameter values were initially calculated from measured data and then modified for the calibration of the model to best fit the available measured water and sediment quality in the various water bodies considered in the assessment. Other parameters modified as part of the model calibration are also provided in Attachment A of Appendix III.3. Total suspended solids (TSS) concentrations were based on the available measured data, however, settling velocities were adjusted, as well as extractable fractions and other sediment characteristics, to calibrate the model predictions with the available measured data. The predicted mean monthly water and sediment concentrations for each of the modelled constituents were compared to the measured mean monthly concentrations; these results are presented and discussed in Attachment D of Appendix III.3.

3.4 Selection of Guidelines

Water and sediment quality predictions can be compared to, and screened against water and sediment quality standards, objectives, and guidelines. Where generic guidelines are exceeded, environmental risk assessment (see Section 4), consistent with N288.6 (CSA 2022), is used to evaluate potential risks based on predicted exposures of selected VCs, relative to measurement endpoints or toxicity benchmarks, which are commonly derived through experimentation. A summary of the selected water and sediment quality guidelines is provided in the following sections for evaluation of the water and sediment quality predictions.

3.4.1 Water Quality Guidelines

The potential impacts of effluent on water quality in the receiving environment were evaluated by comparing predicted COPC concentrations in water to available water quality guidelines (WQGs). Selected WQGs were based on Saskatchewan Environmental Quality Guidelines (SEQGs) for the Protection of Aquatic Life, Drinking Water, and Livestock Watering (ENV 2025), or, alternatively, Canadian Water Quality Guidelines (CWQGs) for the Protection of Aquatic Life (CCME 2025) or Health Canada Guidelines for Canadian Drinking Water Quality (Health Canada 2025). If a value was not available from these sources, then other jurisdictions (federal or provincial guidelines) were also considered. Selected WQGs used in the assessment for the COPCs are summarized in Table 3.4-1. These values are consistent with those selected for environmental performance assessment presented in Volume 1 of the 2025 EP TID (Orano 2025c) with the exception of fluoride and molybdenum (the selected value is based on livestock watering and not aquatic life). More information on the selection of the guidelines for the current study, including molybdenum, can be found in Appendix III.1.

There are three potential aluminum guidelines that could be appropriate for the current work. The SEQG for the protection of aquatic life (0.05 mg/L, dissolved (GS 2025b), the Federal Environmental Quality Guidelines (FEQG) for the protection of aquatic life (variable, dependent on dissolved organic carbon (DOC), pH, and hardness; (ECCC 2022), and the British Columbia (B.C.) EQG for the protection of aquatic life (variable, dependent on DOC, pH, and hardness; (B.C. WLRs 2025)). The SEQG is based on the Alberta water quality guidelines, as published in 2014 (ESRD 2014). In this document it is stated that the aluminum guideline was adopted from B.C. (BC 2001). It is noted that B.C. have subsequently updated their guideline. In addition, as

the SEQG applies only to the dissolved fraction, it is overly conservative to apply in this setting to modelled total aluminum levels. The B.C. EQG is the equivalent to one-third of the FEQG and so is the more conservative of the two. For these reasons, the B.C. EQG was selected as the most appropriate guideline for evaluating potential impacts of effluent on water quality in the receiving environment.

3.4.2 Sediment Toxicity Guidelines

The potential impacts of effluent on sediment quality in the receiving environment were evaluated by comparing predicted COPC concentrations in sediment to sediment quality guidelines (SQGs) or toxicity benchmarks, as presented in Table 3.4-2.

The national CCME guidelines provide what are designated Threshold Effect Levels (TELs) and the Probable Effect Levels (PELs). In narrative description, a TEL represents the concentration below which negative biological effects are expected to occur rarely (i.e., fewer than 25% of negative effects occur below the TEL). A PEL defines the level above which negative effects are expected to occur frequently (i.e., more than 50% of negative effects occur above the PEL, or above which negative effects are usually or always observed).

The Canadian sediment quality guidelines are developed with the intention of being conservative (CCME 1999). When derived using the National Status and Trends Program (NTSP) approach, a TEL is calculated as the geometric mean of the lower 15th percentile of the effect data set and the 50th percentile of the no-effect data set, with an application factor applied if the uncertainty is high. A PEL is the geometric mean of the 50th percentile in the effects data set and the 85th percentile in the no effects data set. Therefore, a TEL represents the upper limit of the range of sediment constituent concentrations dominated by no effects data. A PEL represents the lower limit of the range of constituent concentrations that are usually or always associated with negative biological effects (MacDonald et al. 1994). The CCME acknowledge the associative basis of the guidelines and maintain that the use of SQGs (TELs) in exclusion of other information (such as background concentrations of naturally occurring substances and biological tests) can lead to erroneous conclusions.

Table 3.4-2 also outlines the toxicity benchmarks from Thompson et al. (2005) that are specific to uranium-bearing regions of Canada (e.g. northern Saskatchewan and northern Ontario) and are considered CNSC working reference values. They have proposed benchmarks for the radionuclides of interest in the current assessment; however, no sediment toxicity benchmarks exist for cobalt or thorium-230. The potential negative effects of thorium-230 in sediment on benthic organisms are considered through the radiological assessment (see Section 5). The potential negative effects of cobalt in water on various aquatic receptors including forage fish and benthic invertebrates are evaluated in the aquatic ecological assessment (see Section 5). Liber et al. (2011) also provide sediment toxicity benchmarks for Saskatchewan.

In addition to the sediment quality toxicity benchmarks discussed above, benchmark values from Burnett-Seidel and Liber (2013) are also summarized in Table 3.4-2. These benchmarks were determined specifically for Saskatchewan waterbodies and are considered in the Eastern Athabasca Regional Monitoring Program (EARMP), which was established to monitor long-term changes in the aquatic environment downstream of uranium mines (CanNorth 2014).

As seen from Table 3.4-2, Thompson et al. (2005) have proposed both LEL and SEL for benchmarks. The LEL represents the COPC concentration below which harmful effects on benthic invertebrates are not expected. In an evaluation of data from northern Saskatchewan uranium operations with the sediment objectives, it was shown that although LELs generally align correctly with effects observations at 95% of sites that had effects, exceedances of LEL values were also observed at 60% of the no-effect sites (Burnett-Seidel and Liber 2012). The SEL represents the COPC concentration above which harmful effects on benthic invertebrates are expected. Two statistical methods were used by Thompson et al. (2005) to define the percentiles corresponding to LEL and SEL concentrations. A “weighted method” produced somewhat higher values than a “closest observation method”. When the predictive ability of the sediment quality guidelines was assessed, all of the LELs derived using the weighted method, with the exception of the chromium LEL, were found to be highly reliable (> 85% accuracy) in predicting sites unimpacted by uranium mining/milling. Thus, caution is to be employed when using the SEL values as they may not be a reliable predictor of potential effects. A weight-of-evidence approach is used in this assessment, where the use of these sediment quality benchmarks are considered with field observations on benthic diversity and richness, as presented in Volume 1 of the 2025 EP TID (Orano 2025c).

Burnett-Seidel and Liber (2013) have proposed no effect (NE2) sediment values. NE2 values refer to exposed areas with no significant effect on benthic invertebrates abundance, richness, and evenness. These benchmark values were derived using an approach based on no-effects field data that reflect local benthic invertebrate tolerances to elevated concentrations of some metals in sediment. The derived NE2 values may not always protect individual species; however, they should be protective of aquatic habitats in general. Burnett-Seidel and Liber (2013) concluded that concentrations of copper and lead in sediment are not noticeably influenced by uranium operations.

3.5 Predicted Future Performance

To assess the effects of treated effluent discharge within and downstream of the S/V TEMS, three groups of constituents of concern were modelled. The constituents of concern included general parameters (ammonia, chloride, fluoride, nitrate, potassium, sulphate, and TDS), metals (aluminum, arsenic, cadmium, chromium, cobalt, copper, iron, lead, molybdenum, nickel, selenium, silver, thallium, uranium, and zinc), and radioactive elements (thorium-230, radium-226, lead-210, and polonium-210). As noted above, calcium was also modelled to predict levels of hardness in the future.

A common discussion format is adopted to describe the predicted behaviour of individual constituents of concern. The discussion first considers predicted water quality, followed by the corresponding predicted sediment quality. Within each of the water and sediment quality sections, each constituent of concern is presented sequentially, as outlined in the groups described above. For each constituent of concern, the model-predicted mean, 5th, and 95th percentiles (based on 100 trials) are presented graphically through time as a series of four graphs, with each set of graphs illustrating the model predictions spatially, at four locations progressively downstream of effluent release. The simulation period extends for more than 100 years.

The probabilistic approach is used to represent variability and uncertainties inherent in the prediction of future concentrations. The results provide a range for the future predictions due the model input distributions and assumptions. The measured COPC concentrations used in the assessment were based on data from the

environmental monitoring programs and these data were used to calibrate and confirm that the ADEPT model provides a reasonable representation of the McClean Lake Operation environment. The model is used to predict concentrations in the future and these predictions are based on an understanding of source loads and precipitation. As stated, these are the best estimates, but it is still a theoretical exercise. The future conditions could also be subject to external forces that are not related to the McClean Lake Operation and not within the historical experience. The modelling of future conditions has been completed using reasonable estimates, but it remains an illustration of what might happen, and may not represent an exact reflection of what will happen.

3.5.1 Comparative Framework and General Comments

A comparative framework is provided to evaluate predicted water and sediment concentrations downstream of effluent release to several established benchmarks, as outlined below.

As indicated earlier, the McClean Lake Operation has undergone several previous EAs (COGEMA 1995; Minatco 1991), reviewed by the Joint Federal-Provincial Panel. As part of these assessments, potential constituents of concern were modelled to assess potential water and sediment quality changes related to the effluent release. To provide a comparison of current predictions to those previously reviewed by the Joint Panel, for each constituent of concern, the maximum mean concentration predicted in each of those assessments is presented at specified locations, where available. The maximum predicted mean concentrations from the 2012 EP TID (AREVA 2012), 2016 EP TID (AREVA 2016a), and 2018 Selenium RA (Orano 2018) are also considered in the figures and tables, along with the selected water and sediment quality guidelines (Tables 3.4-1 and 3.4-2), as appropriate.

In the sections below, the water quality and sediment quality predictions are provided graphically to provide the reader with an understanding of temporal changes. Predicted maximum mean and maximum 95th percentile concentrations are also numerically tabulated. As outlined above, the discussions in the following sections are limited to comparisons to previous EIS predictions, the 2012 EP TID (AREVA 2012), the 2016 EP TID (AREVA 2016a), the 2018 Selenium RA (Orano 2018), and objectives and guidelines. Comparisons between the current Base Case and predictions previously presented in the Caribou Project EIS (AREVA 2009a) are also provided in the tables. The results for McClean lake east basin Segment B is provided as this segment represents the outflow from McClean and this is the best for comparison to previous results. This segment also represents the compliance point for meeting water quality guidelines.

3.5.2 Water Quality Predictions

The model-predicted concentrations for each constituent of concern, in the water columns of Sink Reservoir, Vulture Lake, McClean Lake east basin segment B (McClean Lake E - B) and Collins Creek at the inlet to Kewen Lake (Collins Creek at Kewen Inlet) are shown in Figures 3.5-1 to 3.5-28 for the proposed future activities at the McClean Lake Operation. Table 3.5-1 shows the maximum predicted concentrations (after 2024) for both the mean and 95th percentiles for each COPC as well as the mean 1991 and 1995 EA predictions (COGEMA 1995; Minatco 1991), mean Caribou Project EIS (AREVA 2009a) results, mean 2012 EP TID (AREVA 2012) results, mean 2016 EP TID (AREVA 2016b), the 2018 Selenium RA (Orano 2018) results, and appropriate WQGs.

3.5.2.1 General Comments

For each constituent of concern, the predictions for the period March 1996 to December 2024 were based on actual measured treated effluent and JEB dewatering well system quality and quantity data, and actual Collins Creek flow data (through 2024). From January 2025, the model predictions were based on expected quality and quantity of the treated effluents and estimates of future flow conditions in Collins Creek were based on historic records. To account for uncertainty in these estimated future conditions, a range of possible values was specified in the input files and the model was run probabilistically, as outlined previously.

Among the water quality predictions for the various constituents of concern, the predictions illustrate several general spatial and temporal patterns. These general patterns are discussed here to aid the reader in the interpretation of the predicted concentrations.

An obvious spatial pattern of lower predicted water column concentrations at any given time is evident progressively downstream for each constituent of concern. This is due to the substantial increase in watershed drainage area, and the corresponding increased influence of runoff progressively downstream. The increase in watershed drainage area is evident in the cumulative watershed drainage area at each modelled location, summarized as part of the waterbody attributes in Attachment A of Appendix III.3. As illustrated there, the drainage area from Sink Reservoir outlet (3,000,000 m²) to Vulture Lake outlet (6,500,000 m²) increases by a factor of 2.2 and between Sink Reservoir outlet and McClean Lake outlet (276,000,000 m²) by a factor of about 92. By looking at the general patterns among locations for the constituents of concern, similar factors of decrease can be seen. Although the increase in watershed drainage area progressively downstream is a primary factor influencing water column concentrations, other factors (e.g., removal to sediment, dispersion between segments), as previously described also play an important role in the determination of predicted concentrations.

Also illustrated in the predicted water quality, particularly at McClean Lake east basin segment B and Collins Creek at Keweenaw Lake, there is a general, relatively short temporal pattern for each constituent of concern. These fluctuations illustrate variation predicted from month-to-month and represents temporal flow patterns in Collins Creek. On average, the month with the highest flow is May and the months with the lowest flows are January, February, and March (Appendix III.3, Table A.6). Months with higher flows provide the most dilution, resulting in correspondingly lower predicted concentrations of constituents of concern.

3.5.2.2 General Parameters

General parameters considered include total ammonia, chloride, fluoride, nitrate, potassium, sulphate, and TDS. Calcium predictions are shown in Figure 3.5-1. While it is not a COPC, calcium was included in the ADEPT model for the purposes of predicting future hardness.

The ADEPT model uses site-specific temperature data and waterbody-specific pH data (provided in Attachment A of Appendix III.3) to convert monthly concentrations of total ammonia to un-ionized ammonia. This improves the comparison to the available WQG. For comparison with ammonia predictions in previous assessment, total ammonia concentrations are presented in Figure 3.5-2. The model predictions for un-ionized ammonia, chloride, fluoride, nitrate, potassium, sulphate, and TDS are presented within Figures 3.5-

2 to 3.5-9, each as a series of four graphs presenting the 5th, mean, and 95th percentile predictions for each location progressively downstream.

Predicted mean **total ammonia** concentrations after 2024 at the Sink Reservoir are slightly above levels predicted in the 1991 EA and are at similar levels, or lower than, the 1995 EA and 2016 EP TID. In Vulture Lake and McClean Lake east basin, mean predicted levels are lower than levels predicted in the previous assessments. The comparison to SEQG requires the consideration of pH and temperature to determine the un-ionized ammonia fraction, which is considered the toxic species of total ammonia. For comparison purposes, the un-ionized ammonia concentrations are presented in Figure 3.5-3. The **un-ionized ammonia** concentration is not predicted to exceed the SEQG in Sink Reservoir, Vulture Lake, McClean Lake east basin segment B, or in Collins Creek at Kewen Inlet.

Figure 3.5-4 shows the predicted **chloride** concentrations. In the S/V TEMS, predicted concentrations are shown to exceed the CCME WQG for the protection of aquatic life while remaining well below the maximum mean from the 2016 EP TID. Downstream of the S/V TEMS, predicted chloride concentrations remain below the CCME WQG as well as the mean from the 2016 EP TID

Figure 3.5-5 shows the predicted **fluoride** concentrations in water. Fluoride concentrations in the S/V TEMS are predicted to exceed the CCME WQG for the protection of aquatic life for 95th percentile predictions. Downstream of the S/V TEMS, predicted fluoride concentrations are expected to remain below the CCME WQG. Predictions in the S/V TEMS are predicted to be higher than the maximum mean predictions from the 2016 EP TID, however, predictions in McClean Lake east basin segment B and Collins Creek at Kewen Inlet are predicted to be below the 2016 maximum mean levels.

Predicted **nitrate** levels are shown in Figure 3.5-6. Levels are predicted to exceed the guideline within the S/V TEMS while remaining well below the guideline at the outlet of McClean Lake and within Collins Creek at the inlet to Kewen Lake. As nitrate is a new COPC there are no historical predictions for comparison.

Figure 3.5-7 shows the predicted **potassium** concentrations in water. A WQG is not available for potassium however, levels at all four locations are well below the maximum mean from the 2016 EP TID. Potassium illustrates the expected pattern of decreasing concentrations with increasing distance from the S/V TEMS.

Figure 3.5-8 shows the predicted **sulphate** concentrations in water. The predicted concentrations in the S/V TEMS are below the 2016 EP TID predictions and similar to predictions from the 1991 and 1995 EIS projects. Predicted levels in the SV/TEMS are above the guideline. In McClean Lake East Basin Segment B, mean predictions are lower than for previous studies while predictions in Collins Creek at Kewen Inlet are within the range of predicted concentrations from previous assessments.

Predictions for **TDS** are presented in Figure 3.5-9 and follow the same general trends as for sulphate. TDS in the S/V TEMS are much lower than the 2016 EP TID predictions, are in line with the 1991 and 1995 EIS levels, and are above the selected guideline. Predicted levels downstream of the S/V TEMS are in the range of previous predictions and remain below the guideline with the exception of the 95th percentile predictions for the outlet of McClean Lake for a single month.

3.5.2.3 Metals

The metals group, including aluminum, arsenic, cadmium, chromium, cobalt, copper, iron, lead, molybdenum, nickel, selenium, silver, thallium, uranium, and zinc is presented sequentially in Figures 3.5-10 to 3.5-24.

Aluminum predictions presented in Figure 3.5-10 show that levels are anticipated to be well above the guideline in S/V TEMS with predictions in McClean Lake east basin segment B and downstream remaining below the guideline. As this is a new COPC, no historical predictions are available for comparison.

Predicted maximum average **arsenic** concentrations (Figure 3.5-11) within the S/V TEMS are slightly above the 2016 EP TID maximum mean predictions and the SEQG but well below previous assessment (1991 and 1995 EIS) predictions. Downstream predictions are similar to the 2016 EP TID levels and well below the guideline.

Predicted levels of **cadmium** (Figure 3.5-12) and **chromium** (Figure 3.5-13) in surface waters are anticipated to remain well below the guidelines throughout the S/V TEMS and downstream environment. As cadmium and chromium are new COPCs there are no historical results for comparison.

The predicted cobalt concentrations in Sink Reservoir exceed the available WQG but are similar to the concentrations predicted in the 2016 EP TID (see Figure 3.5-14). However, predicted levels in Vulture Lake, at the outlet of McClean Lake, and in Collins Creek at Keweenaw Lake are similar to or lower than the 2016 EP TID and expected to remain below the guideline.

Predicted **copper** concentrations at all four locations are below both the 2016 EP TID predictions and the surface water quality guideline and well below the 1991 and 1995 EIS predictions (see Figure 3.5-15).

Figure 3.5-16 presents the predicted **iron** levels in water. While 95th percentile predictions in the Sink Reservoir just reach the guideline, levels at the three downstream locations are predicted to remain below the SEQG. Due to natural variability, baseline iron levels in the downstream environment (i.e., McClean Lake and Collins Creek) are naturally elevated as compared to levels within the S/V TEMS.

Predicted **lead** concentrations within and downstream of the S/V TEMS are similar to or lower than the 2016 EP TID predictions and well below the 1991 and 1995 EIS predictions. In addition, predicted levels are all well below the hardness dependent lead guidelines (see Figure 3.5-17).

Predicted **molybdenum** concentrations within, and downstream of the S/V TEMS are similar to or lower than predictions in the 2016 EP TID and substantially less than the 1991/1995 EIS predictions. As seen in Figure 3.5-18, future predictions are anticipated to remain well below the livestock watering guideline of 500 µg/g throughout the future modelled period.

As seen in Figure 3.5-19, while predicted **nickel** concentrations within and downstream of the S/V TEMS are slightly higher than predictions in the 2016 EP TID, predicted levels remain below the hardness-dependent guideline throughout the future modelled period.

Predicted **selenium** levels under the current Base Case scenario are presented in Figure 3.5-20. As can be seen, predicted levels are well below levels from the 2016 EP TID, however, the Base Case from the 2016 assessment represented the worst case scenario and assumed that no treatment options would successfully reduce future selenium concentrations (AREVA 2016b) whereas the current Base Case include implementation of selenium treatment at the JEB WTP (Section 3.3). The predicted concentrations are above the 2018 Revised Selenium Forecast (Orano 2018). Current selenium predictions are well below the 1991 and 1995 predictions both in the S/V TEMS and downstream and, while levels are expected to exceed guidelines in the S/V TEMS, no exceedances are anticipated at the downstream locations.

Silver (Figure 3.5-21) and **thallium** (Figure 3.5-22) are new COPCs for the current assessment and so no historical predictions are available for comparison. Silver is predicted to exceed the guideline within the S/V TEMS while thallium is only predicted to exceed the guideline in Sink Reservoir. Levels at all other locations are predicted to remain below the applicable guideline.

Predicted **uranium** (Figure 3.5-23) concentrations within the S/V TEMS and downstream are well below the previous assessment predictions (i.e., 2016 EP TID, 1991 EIS, 1995 EIS) and the applicable guideline throughout the future modelled period.

Predicted **zinc** (Figure 3.5-24) concentrations within and downstream of the S/V TEMS are below the 2016 EP TID predictions and well below the 1991 and 1995 EA predictions. Zinc levels at all four locations are predicted to remain well below the guideline throughout the future modelled period.

3.5.2.4 Radionuclides

The radionuclide group, including thorium-230, radium-226, lead-210, and polonium-210 are presented sequentially in Figures 3.5-25 to 3.5-28.

The predicted mean concentrations for thorium-230 (Figure 3.5-25), radium-226 (Figure 3.5-26), lead-210 (Figure 3.5-27), and polonium-210 (Figure 3.5-28) are generally similar to, or less than, previous assessment predictions. Predicted concentrations are also well below the available WQGs in the S/V TEMS and downstream environment.

3.5.3 Sediment Quality Predictions

The model-predicted concentrations of constituents of concern in the sediments of the Sink Reservoir, Vulture Lake, and McClean Lake east basin (McClean Lake E) are shown in Figures 3.5-29 to 3.5-45. Sediment prediction for Keweenaw Lake are presented, since settling and deposition to sediments is not explicitly modelled for the Collins Creek lotic environment. Table 3.5-2 shows the maximum predicted concentrations for both the mean and 95th percentiles for each constituent as well as 1991 and 1995 EA predictions (COGEMA 1995; Minatco 1991), Caribou EIS results (AREVA 2009a), the 2012 EP TID (AREVA 2012), the 2016 EP TID (AREVA 2016b), and the 2018 Selenium RA (Orano 2018), where available. It is assumed that the general parameters: ammonia, chloride, fluoride, nitrate, potassium, sulphate, and TDS do not undergo any removal from the water column to the sediments due to sorption. Hence, no plots are presented for these constituents. Although aluminum and iron are metals, their behaviour is driven by biogeochemistry processes (e.g., pH,

temperature, dissolved oxygen, dissolved organic carbon, microbial activity) and therefore sediment predictions are not presented.

Table 3.4-2 outlines selected sediment toxicity benchmarks available in the literature. As seen in the table, where several toxicity benchmarks exist for a particular metal, there is a range of data for possible effects. No sediment toxicity benchmarks exist for cobalt, silver, thallium, and thorium-230; hence, they are not included in the table. However, the potential effects from thorium-230 in sediment on benthic organisms are considered through the radiological assessment.

Given that each methodology discussed in Section 3.4.2 has limitations, it is felt that the use of the various toxicity benchmarks in the assessment is appropriate. For discussion purposes, the figures indicate the LEL and SEL from Thompson et al. (2005) for comparison (with some exceptions).

3.5.3.1 General Comments

Some general comments on the patterns that emerge from the sediment quality predictions are as follows. As with the water column predictions, the concentrations of constituents of concern in the sediment decrease progressively downstream of effluent release. In general, the shape of the curves for the constituents of concern follows a similar pattern. Following the completion of operations, sediment concentrations are predicted to decline.

3.5.3.2 Metals

Sediment concentration predictions for the metals group, including arsenic, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, silver, thallium, uranium, and zinc are presented sequentially in Figures 3.5-29 to 3.5-41.

Predicted sediment **arsenic** concentrations in the S/V TEMS and downstream are generally above the 2016 EP TID predictions but well below the predictions presented in the 1991 and 1995 EIS assessments (Figure 3.5-29 and Table 3.5-2). The maximum predicted mean arsenic concentrations in Sink Reservoir, Vulture Lake, and McClean Lake east basin exceed the LEL of 10 µg/g, but not the SEL of 346 µg/g or the NE2 of 522 µg/g. Predicted sediment concentrations in Keweenaw Lake are not expected to exceed the LEL (see Table 3.5-2).

Cadmium (Figure 3.5-30) and **chromium** (Figure 3.5-31) were not identified as COPCs previously and so no historical environmental predictions are available for comparison. 95th percentile cadmium predictions in the S/V TEMS exceed the TEL and slowly decline over time. All other predicted cadmium predictions remain below the TEL and PEL for the future modelled period. For chromium all predicted levels are well below the available sediment benchmarks.

Predicted **cobalt** levels (Figure 3.5-32) in the sediments at all four locations are higher than the 2016 EP TID predictions. No sediment benchmarks are available for cobalt.

For **copper** in Sink Reservoir and Vulture Lake, the maximum 95th percentile sediment concentrations are predicted to exceed the LEL of 22 µg/g (see Figure 3.5-33). However, the maximum mean copper concentrations are below both the LELs and the SELs in the S/V TEMS and both the 95th percentile and mean predictions are below the LELs and SELs at the downstream locations. The predictions within Sink Reservoir are lower than those from the 2016 EP TID while predictions in Vulture Lake are higher than the previous assessment. This is due to an enhanced understanding of removal within S/V TEMS incorporated into the current study (as discussed in Section 3.3.1.2).

For **lead**, the maximum mean and 95th percentile sediment concentrations are below the LEL of 37 µg/g at all locations (see Figure 3.5-34). Table 3.5-2 shows that the predicted lead concentrations in sediment for the current assessment are also below levels predicted in previous assessments.

Predicted **molybdenum** levels in sediment are presented in Figure 3.5-35. The predicted concentrations at all locations for molybdenum in sediment are above the LEL of 13.8 µg/g and mean predictions in S/V TEMS are also above the NE2 value of 245 µg/g (see Table 3.5-2). All predicted molybdenum sediment concentrations are below the SEL of 1238 µg/g, and the mean predicted concentrations in McClean Lake east basin and Kewen Lake remain below the NE2 of 245 µg/g. Molybdenum predictions in Sink Reservoir are higher than those from the 2016 EP TID while predictions in Vulture Lake remain the same; this is due to enhanced molybdenum removal to the sediments within Sink Reservoir incorporated in the current study in combination with a much wider distribution on the JEB WTP future concentration for molybdenum (Table 3.3-4).

Predicted **nickel** concentrations (Figure 3.5-36) are generally within the range of historical predictions. Compared to the 2016 EP TID predictions, predicted nickel concentrations in the S/V TEMS are higher under the current Base Case; this is largely due to enhanced nickel removal within the S/V TEMS incorporated within the current study (as discussed in Section 3.3.1.2). The LEL of 23 µg/g is exceeded at all locations except Kewen Lake. However, predicted concentrations at all locations are below the SEL of 484 µg/g and only 95th percentile predictions within the S/V TEMS exceed the NE2 of 326 µg/g.

Selenium sediment predictions are presented in Figure 3.5-37. As with the water predictions for selenium, sediment predictions are substantially below the 2016 EP TID Base Case predictions, a scenario which did not account for any selenium treatment. The LEL of 1.9 µg/g is exceeded at all locations except Kewen Lake. The SEL of 16 µg/g is only exceeded by predictions in Sink Reservoir with predictions for the other three locations remaining below the SEL. All predictions are below the NE2 of 29.7 µg/g.

Silver and **thallium** sediment predictions are presented in Figures 3.5-38 and 3.5-39, respectively. There are no sediment benchmarks available for silver or thallium and, as these are new COPCs for the current study, there are no historical predictions for comparison.

The current predicted maximum mean **uranium** values at all four locations (Figure 3.5-40) are below the 2016 EP TID. In comparison to the sediment quality benchmark values, the predicted levels in the S/V TEMS and at downstream locations are below the LEL benchmark of 104.4 µg/g, the SEL benchmark value of 5874 µg/g, and the NE2 of 2296 µg/g.

Sediment **zinc** concentrations are predicted to be higher than the 2016 EP TID predictions at all locations but lower than the 1991/1995 EIS predictions within the S/V TEMS. With the exception of 95th percentile predictions in Vulture Lake and at the outlet of McClean Lake, all uranium predictions are below the TEL of 123 µg/g and PEL of 315 µg/g.

3.5.3.3 Radionuclides

The radionuclide group, including thorium-230, lead-210, radium-226 and polonium-210 are the presented sequentially in Figures 3.5-42 to 3.5-45.

Of these radionuclides, sediment quality guidelines have been developed for all but thorium-230. With regards to **thorium-230**, the Sink Reservoir and Vulture Lake predicted maximum mean values are similar to the 2016 EP TID predictions. Downstream of the S/V TEMS, predicted concentrations are comparable to, or lower than the 2016 EP TID.

For **radium-226**, in the S/V TEMS, the maximum mean monthly values are higher than the 2016 EP TID predictions but less than the 1991/1995 EIS predictions. In McClean Lake and Keweenaw Lake, the predicted maximum mean values are low and slightly higher than the previous assessments. Compared to the sediment quality benchmarks, the predicted concentrations in all locations are below the LEL and SEL benchmark values (Figure 3.5-43).

Predicted maximum mean **lead-210** (Figure 3.5-44) and **polonium-210** values (Figure 3.5-45) are generally comparable or slightly higher than the 2016 EP TID predictions. Compared to the sediment quality benchmarks, the predicted mean concentrations in all locations are below the LEL and SEL benchmark values. 95th percentile predictions exceed the LEL for lead-210 at the outlet of McClean Lake and for polonium-210 in the S/V TEMS and at the outlet of McClean Lake.

3.6 Uncertainty

3.6.1 Modelling

The behaviour of contaminants in the environment depends on a number of complex and interconnected processes. The ADEPT model provides predictions based on a simplification of these processes. Therefore, there is uncertainty in the ability to approximate the expected changes in the environment. The measured COPC concentrations used in the assessment are from many decades of environmental monitoring programs. These data were used to calibrate and confirm that the ADEPT model used in the assessment provides a reasonable representation of the immediate and downstream environment. This is a complicated process as environmental data are also variable due to natural conditions.

The ADEPT model is used to predict concentrations in the future based on an understanding of future operating conditions at the site, such as operational activities and ore quality. Predictions for the JEB WTP and Sue WTP are based on anticipated effluent quality, however, there is uncertainty around these future

loads. Distributions were assigned to future effluent loads within the model to capture variability and uncertainty.

Mixing and movement of the effluent within the receiving environment can be complicated and depends on factors such as flow. The precipitation and resulting flows are naturally variable; a historical record of information is available but the specific rate in any future year cannot be accurately predicted. The assumed future unit area runoff within the model is defined as a distribution to capture the natural range of precipitation/flow in the region.

Factors that are used in the water quality predictions, such as partitioning coefficients are not well known and difficult to measure directly. Therefore, many of these parameters are applied within the model as distributions which are adjusted during calibration to provide a reasonable estimate. In the S/V TEMS geochemical processes are also driving factors for movement between the water column and the sediments. There is uncertainty in the representation of the geochemical reactions that are accounted for in the model predictions. Additional information was collected from the SUC to help inform the modelled behaviour specifically in this segment of the model and to reduce the associated uncertainty.

In summary the key areas of uncertainty include:

- Future effluent concentrations and flows
- Hydrology (variability in flow, mixing and dispersion)
- Geochemical and environmental processes (formation of precipitates, sorption/desorption, exchange with sediment, burial)

In acknowledgement of these factors, the model relies on the extensive data available and uses a probabilistic framework to account for the uncertainty.

Predicted water concentrations are evaluated for the potential for negative effects using water quality guidelines established by regulatory agencies, including SMOE SEQGs, Canadian Council of Ministers of the Environment (CCME) CEQGs, and ECCC FEQGs. These guidelines are updated periodically and are likely to change again in the future. This could affect the conclusions of the assessment. However, guidelines are established on the best available information at the current time and also incorporate safety factors to ensure that the values remain protective. Guidelines can also depend on the form of the COPC. For example, chromium can be present in the trivalent form (Cr^{3+}) or hexavalent form (Cr^{6+}). The guideline used in the modelled water prediction figures (8.9 µg/L) is the SEQG for trivalent chromium, which is the most prevalent form in the environment. However, some of the chromium will be present in the hexavalent form, which has a lower guideline. The SEQG for hexavalent chromium is (1 µg/L) and there are exceedances of this concentration within the S/V TEMS. However, a relatively recent evaluation of available toxicity data was conducted to support a FEQG of 5 µg/L for hexavalent chromium (ECCC 2018). Since there are no exceedances of this concentration, including within the S/V TEMS, chromium was not considered further.

The assessment acknowledged the uncertainty in the sediment benchmarks. However, a range of sediment benchmarks was considered in the assessment to address the uncertainty.

A sensitivity study was undertaken and is presented in Appendix III.3. This study investigated the relative sensitivity of the ADEPT model, specifically as parameterized for the 2025 McClean Lake Operation ERA Base Case scenario, to a range of parameters including sorption coefficients, mass transfer coefficients, background concentrations (both surface water and sediment), dispersion coefficient, and precipitation rates. The results of this study are further discussed in Appendix III.3.

3.6.2 Implication of Climate Change

Climate change is expected to result in warmer temperatures (an annual increase of 4.2°C is predicted by 2100 under SSP2-4.5) and increase in total precipitation (annual increase of 57 mm 2100; ClimateData.ca, 2025). This can affect the releases to the environment, as there may be more water to be managed and treated. In addition, there will be a change in the flow of Collins Creek, with a higher baseflow and more extreme conditions likely. As releases from the operation are dependent on the amount of dilution and upper limit to flow within Collins Creek, this may affect the release timing and frequency.

The fate and transport of constituents in the aquatic environment will also be affected by climate change; however, there is uncertainty in how the many aspects of climate change will interact or combine. Higher temperatures may increase plankton growth and therefore additional removal of contaminants into sediment but high flow, particularly sporadic flow associated with more extreme precipitation events, can mobilize depositional sediment. There are other factors, such as increase in wildfires, that can also affect the system through more dust and increased runoff. The biogeochemical processes within lakes may be altered due to these effects.

Some reviews indicate that environmental concentrations are likely to be more variable due to the influence of climate change (Crane et al. 2005; Stahl et al. 2013). A recent article by Bolan et al. (2024) provides an overview of the impacts of extreme weather events on the contaminants and found that the climate change influences the fate of inorganic pollutants, including metals, from both direct and indirect effects.

Water and sediment quality modelling was completed in a probabilistic framework to capture some of the uncertainties and account for, to an extent, possible future variations under a changed climate. For example, distributions were used on partition coefficients between water and sediment, which can in part reflect the potential for more removal from the water column due to warmer temperatures promoting phytoplankton growth.

3.7 Summary of Wastewater Management Predicted Water and Sediment Quality

This section discussed the predicted water and sediment concentrations in the S/V TEMS and downstream environment for the current assessment. A screening for COPCs was conducted and additional parameters were added to the list including aluminum, iron, nitrate, cadmium, chromium, silver and thallium. The information from the investigation on the SUC and plume delineation in McClean Lake were incorporated into the model. The calibration showed that the ADEPT model was generally able to capture the time and load dependent trends in concentrations. The model was used to predict future water and sediment quality, reflecting the estimated loads from JEB and Sue WTPs.

The water quality predictions showed that levels of COPCs are generally similar or lower than previous assessments. It should be noted that the potential implications of these predicted concentrations on the environment and human health are assessed in the following sections. A number of contaminants were identified as exceeding WQGs within the S/V TEMS; however, the water quality in McClean Lake east basin Segment B and downstream is expected to meet applicable WQGs. A spatial summary of maximum mean predictions for each COPC relative to their respective WQGs is provided in Table 3.7-1.

For sediment, the predicted mean concentrations in the current assessment are similar to previous assessments. Sediment benchmarks were exceeded below the S/V TEMS for arsenic, molybdenum, nickel and selenium; the implications of these results are discussed using a weight of evidence approach in the following sections. For these COPCs except selenium, the concentration exceeds the LEL but remains below the SEL. For selenium the sediment concentrations exceed the SEL in Sink Reservoir, but not within Vulture Lake. Although predicted concentrations of radionuclides in sediment were below the available SQG, potential effects from the radionuclides are also considered in the radiological assessment for ecological receptors and human health. A spatial summary of maximum mean predictions for each COPC relative to their respective sediment quality guidelines/benchmarks is provided in Table 3.7-2.

4 McClean Lake Operation ERA – Problem Formulation

The results from the air (Section 2) and wastewater modelling (Section 3) were input to the pathways analysis component of the ADEPT model for the evaluation of risks to ecological species and people using accepted risk assessment methodologies. The environmental risk assessment was conducted in a manner that is consistent with CSA Standard for *Environmental Risk Assessments at nuclear facilities and uranium mines and mills* (N288.6; CSA 2022). A concordance table between this document and N288.6 is provided in Appendix IV.1.

The assessment of spatial and temporal project-environment interactions during the operational and near-term post-decommissioning periods of the McClean Lake Operation required a comprehensive and integrated assessment framework. The McClean Lake Operation involves emissions to the atmospheric and aquatic environments from multiple locations and activities. To account for variability in emission rates and uncertainty in constituent behaviour in the environment, a probabilistic modelling framework was adopted to predict constituent dispersion in air and water from proposed activities and to estimate constituent uptake and exposure of plants, animals and people.

Within the framework adopted, the assessment of effects can be evaluated at several levels. Constituent dispersion predictions can be compared to air, water, and sediment quality standards, objectives, and guidelines (Sections 2 and 3). In addition, ecological risk assessment evaluates predicted exposures of selected VCs against measurement endpoints or toxicity benchmarks, which are commonly derived through experimentation. Similarly, human exposure estimates are compared to reference dose levels published by regulatory agencies, such as Health Canada, which are considered to be protective of human health. Throughout this assessment framework, emphasis was placed on incorporating site-specific information and actual performance data. The utilization of site-specific data and characteristics, combined with the adoption of a probabilistic assessment framework to address uncertainty, provides a robust methodology to identify and assess potential project-related effects. Monitoring and other environmental data presented in Volume 1 of the 2025 EP TID are used in the following sections to provide a weight-of-evidence approach in the assessment for potential effects on the environment and human health and provide context for the predicted levels in the environment.

4.1 Site Characterization

4.1.1 Facilities and Operations

4.1.1.1 Site Location and Layout

The McClean Lake Operation is based on Crown land approximately 15 km west of Wollaston Lake in northern Saskatchewan. The McClean Lake Operation consists of the JEB area (permanent camp, McClean Lake Mill, JEB TMF, JEB CWRP, and JEB WTP), the Sue mining area (mined out Sue A/C [including the contaminated landfill], Sue B, and Sue E pits, Sue C CWRP, Sue E CWRP, Sue WTP, and undeveloped Sue F Project (formerly known as Caribou Project), S/V TEMS (Sink Reservoir with control structure, and Vulture Lake with

the effluent diffuser system discharging effluent to the McClean Lake east basin), McClean Mining Site, and Midwest Project. Additional information is provided in Section 1.1, along with Figures 1.1-3 and 1.1-4 providing the McClean Lake Operation layout.

4.1.1.2 Releases

As described in Section 1.1, flows of treated water from the JEB and Sue WTPs are released to Sink Reservoir, which is part of the S/V TEMS. Historically flow from pit-perimeter dewatering wells was also released to this location, but it was ceased in 2014. Outflow from Sink Reservoir is controlled and subject to downstream flow conditions in Collins Creek. Releases from Sink Reservoir flow to Vulture Lake and then via discharge pipeline to McClean Lake. Collins Creek flows from McClean Lake to Keweenaw Lake, continuing on to Collins Bay of Wollaston Lake. A comprehensive monitoring program is performed to monitor water quality in the S/V TEMS and downstream receiving environment (Orano 2025c).

In addition to the effluent releases to Sink Reservoir, the McClean Lake Operation is also a potential source of atmospheric emissions of standard pollutants, radon gas, TSP, and associated radioactive and non-radioactive elements. Orano operates a comprehensive air quality monitoring program to measure ambient levels of atmospheric pollutants in the local area (Orano 2025c). Section 2 provides an inventory of the air emission sources considered for this ERA.

4.1.2 Description of the Environment

Volume 1 of the 2025 EP TID provides a detailed overview of the existing environment in the McClean Lake Operation local assessment boundary (LAB). Table I.2-3-2 in Appendix I.2 provides a road map for the site characterization as per the CSA N288.6. The below high-level summary is provided here for reference. Many environmental endpoints were characterized through Orano's routine, ongoing environmental monitoring programs. Targeted surveys and field investigations were also completed to support the ERA.

4.1.2.1 Geologic and Hydrogeologic Environment

The site is on the eastern edge of the Athabasca Basin. The local geology is characterized by the Athabasca Group, a thick sequence of Helikian sandstone overlying deformed and metamorphosed Archean and Aphebian basement rocks, intruded by diabase dykes. The region features a glacially derived overburden with variable hydraulic conductivity, influencing surface water and shallow groundwater flow, while deeper groundwater movement is shaped by the sandstone and weathered basement. Regional groundwater generally flows west to east toward Wollaston Lake, while the local groundwater of the site flows from east to west within the Collins Creek drainage basin.

Groundwater quality is typical of the region, with low concentrations of metals and radionuclides and only minor exceedances of surface water guidelines. Groundwater samples collected near the uranium ore depots show elevated COPC concentrations. A more detailed description of the local geology and groundwater is presented in Section 2 of Volume 1 of the 2025 EP TID (Orano 2025c).

4.1.2.2 Atmospheric Environment

The McClean Lake Operation lies in a continental sub-arctic climate zone, with long, cold winters and short, cool summers. Average temperatures range from -26.4 °C (January) to 22.1 °C (July), and annual precipitation averages 433.6 mm, mostly as rain. Ambient air quality data from baseline and operational monitoring show compliance with available ambient air quality standards for TSP, radon, airborne metals, radionuclides, and sulphur dioxide. More detailed description of the local meteorology and air quality is presented in Section 3 of Volume 1 of the 2025 EP TID (Orano 2025c).

4.1.2.3 Aquatic Environment

The LAB includes surface drainage to Collins Creek, Moffat Creek, Smith Creek, and Nicholson Creek drainage basins. The McClean Lake Operation site is in the Upper Collins Creek watershed, which drains into Wollaston Lake. Local lakes are typically oligotrophic, with low nutrient levels and circumneutral pH. Most metal and radionuclide concentrations in surface waters meet water quality guidelines, though localized elevations in aluminum and iron were found in some lakes. Water quality in locations downstream of the S/V TEMS contains elevated concentrations of uranium, molybdenum, arsenic, and other constituents, but concentrations remained at or below the water quality guidelines.

Lakes in the region support diverse phytoplankton, zooplankton, benthic invertebrates, and aquatic plants. Common fish species include northern pike, lake whitefish, white sucker, burbot and slimy sculpin. Lake sediment in certain reference areas show naturally elevated arsenic, cadmium, and chromium. Sediment in locations downstream of the S/V TEMS contains elevated concentrations of uranium, molybdenum, selenium, and other constituents, but concentrations remained at or below the no effect values in terms of toxicity.

More detailed description of the local aquatic environment is presented in Section 4 of Volume 1 of the 2025 EP TID (Orano 2025c).

4.1.2.4 Terrestrial Environment

The soils, landforms, vegetation, and wildlife within the Local Study Area (LSA) are typical of the regional Boreal Shield Ecozone. The landscape is dominated by coniferous forest, shrublands, and lowlands such as bogs and fens. A variety of forest associations characterize the region, but upland jack pine and black spruce stands and lowland bogs dominate the area. On the organic lowland terrains, black spruce (*Picea mariana*) or tamarack (*Larix laricina*) exist in pure or mixed stands forming the primary overstory of the treed bogs while open peatlands are often dominated by bog/scrub birch (*Betula glandulosa*), bog willows (*Salix pedicellaris*), and sedges (*Carex* sp.). Coniferous overstories of the upland sites are a mixture of jack pine (*Pinus banksiana*) and black spruce with some hardwood components, particularly Alaska white birch (*Betula papyrifera* var *neolaskana*) on more productive lands; the nature of these sites is largely dependent upon underlying soils and drainage. Riparian areas within the study block were limited, restricted to shorelines and creeks. Fire plays a significant role in shaping the northern terrestrial environment. Soil and plant chemistry shows low contamination levels, with slightly elevated metals near active mining areas, though still below toxicity thresholds.

Based on the wildlife studies completed by Orano, 123 bird species, 30 mammal species, 2 amphibian, and 1 reptile species have been observed within the LAB. Mammals such as moose (*Alces alces*), black bear (*Ursus americanus*), and caribou (woodland [*Rangifer tarandus caribou*] and barren-ground [*Rangifer tarandus goenlandicus*]) are present, though large mammal activity is limited. Species listed under federal species-at-risk legislation include barn swallow (*Hirundo rustica*), common nighthawk (*Chordeiles minor*), lesser yellowlegs (*Tringa flavipes*), olive-sided flycatcher (*Contopus cooperi*), rusty blackbird (*Euphagus carolinus*), snowy owl (*Bubo scandiacus*), barren-ground caribou (*Rangifer tarandus groenlandicus*), woodland caribou (*Rangifer tarandus caribou*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), little brown myotis (*Myotis lucifugus*), and northern myotis (*Myotis septentrionalis*). No vascular plant species at risks have been recorded within the LAB, though, a total 55 provincially tracked rare vascular plant, bryophyte and lichen species have been observed during vegetation surveys implemented by Orano.

More detailed description of the local wildlife and its habitat environment is presented in Section 5 of Volume 1 of the 2025 EP TID (Orano 2025c).

4.1.2.5 Socio-Economic Environment

The project area overlaps with traditional territory of the Athabasca Denesųliné (Hatchet Lake, Black Lake, and Fond du Lac First Nations). There are 34 precontact and historic archaeological sites in the area. Historic activities in northern Saskatchewan included the fur trade, hunting, trapping, and mining and prospecting.

Traditional activities currently carried out in northern Saskatchewan by Cree and Dene include hunting, trapping, and gathering in the McClean Lake and Collins Creek area, and fishing (which mainly occurs on Wollaston Lake but also may frequent other lakes and streams). The nearest community, Wollaston Lake, lies about 50 km directly east of the site. At the periphery of the local assessment boundary, some subsistence and commercial use has been identified. Commercial fishing is practiced in some areas of the LSA, but only Wollaston Lake has been fished commercially in the last decade (Orano 2025c). There are other operations in the area such as at the Rabbit Lake Operation and Points North. Additionally, lodges are present at Hatchet Lake and Hidden Bay of Wollaston Lake for recreational purposes.

Uranium mineralization was first discovered in the McClean Lake region in early 1979. Following exploration and planning, a proposal to develop what was then referred to as the McClean Lake Operation was developed in the early 1990s. The McClean Lake Operation commenced in 1996 and processing uranium ore into a yellowcake product began in 1999. Approximately 390 people are employed at the McClean Lake Operation, with over 40% from Saskatchewan's north. Section 1.3 provides a more detailed overview of the McClean Lake Operation History.

More detailed description of the local culture and history is presented in Section 6 of Volume 1 of the 2025 EP TID (Orano 2025c).

4.1.3 Environmental Monitoring and Studies

Volume 1 of the 2025 EP TID provides an overview of data collected through baseline studies, environmental monitoring program, and supplementary studies. These data were used in the current assessment to

characterize source loads to the environment (model calibration), background concentrations, and the development of site-specific transfer factors. Information on concentrations in the aquatic environment were used in model calibration (Appendix III.3). Background concentrations are also summarized and used in the ERA modelling (Appendix III.3). The collected environmental data also provide information for the selection of ecological and human receptors and for the assessment of potential impacts on ecological receptors.

4.2 Pathways Assessment Approach

The pathways framework for this assessment involves consideration of various pathways by which humans, animals, and plants may be exposed to emissions from the McClean Lake Operation. Thus, the pathways model or framework assesses the integrated contribution of emissions to the atmospheric and aquatic environments from all sources to determine environmental concentrations of constituents of concern and estimates exposure and dose levels for aquatic and terrestrial biota as well as humans.

As described in the previous section, the assessment of the fate of constituents in the surface waters and sediments of lakes and rivers downstream of the wastewater sources relies on a computer model (i.e. the ADEPT model). The model was developed within a probabilistic modelling framework, which permits uncertainty in the magnitude of many of the model input parameters to be taken explicitly into account. For this application, the model was run using monthly time steps to assess the effects of variations in source discharge loadings and watershed flows on receiving water quality. At the McClean Lake Operation, the treated effluent discharges from the JEB and Sue WTPs are pumped to the S/V TEMS from which flow is released to McClean Lake east basin at a regulated rate to optimize dilution with freshwater flow in McClean Lake. The monthly time steps were deemed to be appropriate for simulation of receiving water quality since day-to-day variations in flow and effluent quality are evened out in the S/V TEMS. Section 3 Wastewater Management (above) provides the results of this modelling. Annual average water and sediment concentrations were calculated within the ADEPT model as input into the pathways component of the model.

Estimates of the air concentrations from discharges to air from the McClean Lake Operation were modelled separately, using the CALPUFF model, and were incorporated into the pathways model. The CALPUFF model is well suited to this type of application and has been used in several previous assessments for the McClean Lake Operation. The air dispersion model was used to estimate mean constituent concentrations at discrete locations in the study area and for defined sub-airsheds around the McClean site. Section 2 Air Dispersion Modelling provides the results of this modelling. It should be noted that radionuclide concentrations in dust were not explicitly modelled but assumed to be in secular equilibrium with uranium. Uncertainty in the predicted air concentrations was taken into account by varying the predicted mean concentrations by up to plus or minus 50% about the mean values. The ranges of possible values were then sampled from a triangular distribution for input to the pathways model.

In this application, the ADEPT model, described in Appendix III.3, was used to estimate exposure to both human and ecological receptors that could potentially be affected by the McClean Lake Operation. Annual timesteps were used for the pathways analysis component as the measurement endpoints (toxicological benchmarks) for plants, animals, and people are typically based on annual exposures.

To calculate potential future exposures, it is necessary to predict future concentrations of constituents in various environmental media. These media concentrations are generally calculated using transfer factors and equations described in Appendix III.3. The use of transfer factors to predict future concentrations of constituents in environmental media is a generally accepted practice in risk assessments.

Transfer factors were developed for the McClean Lake Operation assessment in the following way:

- If there were measured data for the McClean Lake area, site-specific transfer factors were developed.
- If site-specific data were inadequate, data were augmented by northern Saskatchewan (regional) relevant information. This information was obtained from operating and decommissioned projects such as the Key Lake, Beaverlodge and Cluff Lake mine sites.
- In the absence of site-specific or Saskatchewan relevant data, national values (northern Ontario) data were considered and if the information was inadequate then literature values were selected. This was the case for transfer factors for terrestrial birds and mammals.

Transfer factors are necessary only for the metals and radionuclides that are carried through the pathways assessment. Therefore, food chain transfer factors for ammonia, chloride, fluoride, potassium, sulphate, and TDS were not necessary. In addition, aluminum and iron are not carried forward for pathways modelling.

Particular attention is paid to the estimation of selenium concentrations in fish. The development of the fish model was discussed in the 2018 Selenium Review and Assessment Report (Orano 2018). The linear trophic model was used in calculations for the 2025 ERA as per CNSC recommendation (CNSC 2019). The model was updated to incorporate additional information such as the sampling conducted by University of Saskatchewan and additional fish data (Orano 2025c). Appendix III.3 shows the comparison of the measured and predicted concentrations.

Predicted exposures to humans and VCs were calculated using the ADEPT model, which is based on standard equations (CSA 2020, 2022; Health Canada 2010, 2021a; U.S. EPA 2004) provided in Appendix III.3. The predicted exposures were combined with toxicological benchmarks to evaluate the potential negative effects on humans and VCs. In addition to modelling the incremental effects of source emissions on the environment, baseline air quality, surface water quality, and soil quality were also incorporated into the pathways analysis. This feature was included in the pathways assessment to obtain a measure of the potential effect of the McClean Lake Operation facilities relative to natural baseline conditions.

As seen from the above discussion there are essentially two types of information needed to evaluate the potential negative effects on humans or ecological receptors. The first type of information consists of inputs that are necessary for the pathways model (i.e. estimates of environmental concentrations) and the second type of information are effects-based estimates, which are used to gauge potential effects, or risk to identified receptors.

Site-specific data was used extensively to derive model inputs (e.g., operational emissions data, site meteorology, surface hydrology, transfer factors). Exposure estimates were based on transfer factors developed from site-specific measured data, where available, to determine the concentrations of the various constituents in sediments, benthic invertebrates, aquatic plants, and fish. Inputs needed to characterize the

diets and other attributes of the ecological receptors (VCs) selected for the assessment were obtained from literature sources. Information gathered on a regional basis on the dietary habits of people who live in northern Saskatchewan was used in the assessment of exposures and doses to human receptors in the study area. Details on the appropriate selections are provided in the following sections.

4.3 Selection of VCs

VCs in the existing environment are environmental attributes or components identified as having a “legal, scientific, cultural, economic or aesthetic value”. Valued Components are usually individual valued species or represent important groups of species within food webs. All environmental components were assessed with respect to specific features of the natural environment (e.g. water quality or air quality) and their roles in providing pathways and mechanisms for effects on the VCs based on the inter-relationships of the environmental components.

Consistent with N288.6 (CSA 2022), VC selection considers the following aspects:

- Representative of major plant or animal group;
- Receptor of interest to facility;
- Identified by a stakeholder or Indigenous communities;
- Potential to conduct a population effects studies;
- Potential for detectable exposure to contaminant or physical stressor;
- Potential for significant exposure to contaminant or physical stressor;
- Receptors of ecological significance;
- Receptors of socio-economic significance;
- Scientific literature, database, or other information available on populations and stressor levels at the facility or in a reference area.

Additionally, conservation status is a consideration in the selection of VCs, since some species are specifically protected by law, designated as rare, threatened, endangered, or of special concern. Traditional and current importance to Indigenous people and cultural and heritage importance to society was also considered.

The aquatic receptors identified as VCs in previous assessments at the site (pondweed, phytoplankton, benthic invertebrate, zooplankton, northern pike, lake trout, lake whitefish, white sucker) were retained in the current assessment. Similarly, terrestrial receptors identified as VCs in previous assessments were retained for the current assessment, with the exception that a snowy owl was assessed instead of a short-eared owl. Some additional terrestrial receptors were identified for inclusion in the current ERA including soil invertebrates, lesser yellowlegs, little brown myotis, and the red fox.

Other ecological sub-components were considered for inclusion, including soil, terrestrial invertebrates, and vegetation. These are components in the pathways model and are therefore included in the calculations for modelling food chain transfer. These sub-components are largely connected to air emissions and deposition from air.

An important consideration in an environmental risk assessment is the determination of the presence or absence of species at risk. The presence of species at risk can influence the choice of indicator species and toxicity benchmark. Volume 1 of the 2025 EP TID (Orano 2025c) outlined the approach for developing the list of potential plant and wildlife species at risk occurring in the area based on their documented distribution ranges and habitat requirements. The species at risk identified through that work were considered in the selection of VCs for the current assessment.

As outlined in the Project-Specific Guidelines and Comprehensive Scoping Document (CEAA 2007), consultation with northern residents continues to refine and revisit the identification of VCs incorporating traditional knowledge and land use. Table 4.2-1 provides a summary of the selection of VCs and the rationale for the components that are relevant for this study. Valued Components may also be selected for components such as the socio-economic environment; however, these are not included here as they do not impact the objectives of this study.

4.4 Ecological Receptor Characterization

For the assessment of the McClean Lake Operation, a broad array of existing environment information, including interviews with local community leaders and public servants, was collected from the local area (Minatco 1991). During the 2016 ERA process, a list of VCs was created based on: consultations with Athabasca community members at the Environmental Assessment stage (1993), Hatchet Lake dietary surveys (2000), and recommendations from regulators and scientists. Thus, both quantitative and qualitative data were collected. This information was evaluated in the context of a number of other studies that had been conducted in the region.

To enhance community involvement and reflect Indigenous perspectives for the 2025 ERA, Orano presented the approach to the ecological receptor selection and invited members of Hatchet Lake Denesuline First Nation and the Northern Settlement of Wollaston Lake to participate in the online VC survey at the community meetings. The initiative was supported by outreach efforts via local offices and Community Land Technicians, resulting in 29 participants signing up to complete the survey. The 25-question online VC survey, designed to be accessible and quick to complete, with species images included, was distributed to 29 participants in April 2025, followed by personal calls to ensure receipt and offer support. Despite these efforts, only 5 participants completed the survey. The community feedback at the AJES meetings and survey responses were used to inform the ecological receptor selection as discussed below. Additionally, consideration was given to aligning receptors with recent ERAs completed for nearby uranium sites (e.g., Rabbit Lake, Cigar Lake; Cameco 2021, 2022).

4.4.1 Identification of Species at Risk

Volume 1 of the 2025 EP TID (Orano 2025c) provided a summary of species with relevant At Risk designations under the Species at Risk Act (SARA) with the potential to occur within the regional assessment and local assessment boundaries. The potential SARA species for consideration in this assessment were narrowed down by considering only those species which have been recorded in the local assessment boundary and have a Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 'Special Concern', 'Threatened', or 'Endangered' designation. The list of species was augmented by those recently identified by

COSEWIC including the snowy owl and several bat species. The list of species is presented in Table 4.4-1, which also shows the rationale for inclusion/exclusion for the current assessment.

The lesser yellowlegs, little brown myotis, rusty blackbird, snowy owl, and woodland caribou were selected from this list to be considered in the assessment. The woodland caribou has been previously considered as an ecological receptor for assessments at the site and remains an ecological receptor in the current assessment. The other SARA species shown in Table 4.4-1 have dietary characteristics or other considerations that do not warrant specific consideration in the assessment; these species are discussed below.

Due to similarities in diets, the rusty blackbird is considered representative of the barn swallow, common nighthawk, and olive-sided flycatcher. The barren-ground caribou are represented by woodland caribou.

In addition, it is noted that several provincially rare plants have been documented in the area as discussed in the Volume 1 of the 2025 EP TID (Orano 2025c) .

4.4.2 Description of Aquatic Receptors

The aquatic species selected for this assessment cover all trophic levels found in local watershed systems. Figure 4.4-1 portrays the general aquatic ecosystem components considered in the assessment. Aquatic receptor classes screened for assessment include primary producers, primary consumers, secondary consumers, tertiary consumers, amphibians, and reptiles.

Primary producers - are the lowest level in the aquatic food chain. These are organisms which use inorganic molecules and the sun to produce food. Examples of primary producers in the aquatic environment are phytoplankton and other aquatic plants. Phytoplankton, also known as microalgae, are photosynthesizing microorganisms which serve as the primary food source for grazing zooplankton. Larger aquatic plants provide habitat to other aquatic organisms and are consumed by semi-aquatic species (e.g., muskrat) and also by terrestrial species (e.g., moose), which creates a link between the aquatic and terrestrial ecosystems.

Primary consumers - form the second trophic level and feed on the primary producers. Members of this group include zooplankton, benthic invertebrates and small fish. Zooplankton and small forage fish primarily consume phytoplankton; benthic invertebrates live in the sediments and consume decaying organic matter. The larvae of some benthic invertebrates are an important food source for benthic and juvenile pelagic fish while the adult stages of some species are capable of flight and are consumed by birds and bats, creating a link between the aquatic and terrestrial ecosystems. As outlined in previous investigations (Orano 2025c) , mayflies, chironomids, and fingernail clams are in high abundance in the study area.

Secondary consumers - include fish whose diet consists largely of benthic invertebrates and smaller fish. Benthic fish are a major food source for larger, predatory fish, aquatic and terrestrial omnivores (e.g., merganser and bear) and terrestrial carnivores (e.g., eagle) as well as humans. According to Volume 1 of the EP TID, white sucker and lake whitefish are among the predominant benthic fish in the local study area.

Tertiary consumers - are the top of the aquatic food chain and include species of predatory fish. These fish consume other fish species and are consumed by aquatic and terrestrial omnivores, terrestrial carnivores, and humans. As outlined in Volume 1 of the EP TID, northern pike is the most widespread predatory fish in the local study area, with walleye and lake trout also predominant species. Arctic grayling is known to occur in Collins Creek.

First Nation land users who consume fish from nearby Wollaston Lake reported consuming lake whitefish and lake trout most, followed by walleye, northern pike, arctic grayling and sucker species (CanNorth 2000).

Amphibians – The boreal chorus frog and the wood frog has been identified in the local study area (Orano 2025c). The boreal chorus frog was identified by 60% of respondents in the community survey as being of importance. Thus, the boreal chorus frog was selected for evaluation to represent amphibians.

There is generally a lack of appropriate amphibian toxicological information for many COPCs considered in this assessment. However, as the most sensitive life stage for amphibians is aquatic in nature, the use of aquatic biota TRVs is considered protective of this class of receptor. Available information suggests that this approach is reasonable (ENSR 2004). For example, a meta-analysis of amphibian toxicity data showed that heavy metals did not affect amphibian mortality (Egea-Serrano et al. 2012).

While amphibians were selected for inclusion in the current assessment, it should be noted that the McClean Lake Operation region represents the northern limit for most Saskatchewan amphibian species due to the continental climate and short ice-free period available for development of the young (CNSC 2011).

Reptiles – No reptiles were identified through the SARA database screen or potentially located in the area.

4.4.3 Description of Terrestrial and Wildlife Receptors

Terrestrial receptors chosen for the current assessment were selected to represent a wide range of potential exposures and include herbivores, omnivores, and carnivores, as well as terrestrial vegetation and invertebrates. The selected receptors are discussed below and presented in Table 4.4-2 for aquatic birds and semi-aquatic mammals and Table 4.4-3 for terrestrial birds and mammals. The general diet characteristics of the individual receptors are provided in the tables; detailed information on water and food ingestion rates, obtained from literature sources as is the typical approach in ecological risk assessments, are provided in Appendix III.3. The dietary characteristics and time spent in the study area of the selected VCs are input to the ADEPT model so that quantitative estimates of exposure can be obtained.

Terrestrial Vegetation - Terrestrial vegetation was identified as a VC and considered in the assessment. Terrestrial vegetation as foliage, woody vegetation, fruits and flowers, roots, and lichen are considered as dietary components of terrestrial animals and humans. Although, seven plant species listed on Schedule 1 of SARA have ranges that overlap the regional study area, no plants have ranges that overlap the regional study area, none of them have been documented in the local assessment area during surveys of rare plants (Orano 2025c). The community survey confirmed that blueberries, Labrador tea and lichen are important species.

Terrestrial Invertebrates - The terrestrial invertebrate community was identified as a VC. This includes ground-dwelling invertebrates (e.g., earthworms, beetles, spiders) and aerial invertebrates (moths, bees, flies). Invertebrates are important as they provide crucial ecosystem services like pollination and decomposition, as well as they can be a food source for other receptors.

Aquatic Birds

The common loon, scaup, merganser, and the Canada goose were the most commonly observed species in the regional study area. Four avian species that reside in close interaction with the aquatic environment were identified due to their conservation status, cultural importance, and ecological significance, and were selected to encompass a range of dietary characteristics.

Waterfowl represent a pathway that connects the aquatic environment to terrestrial receptors as these species are ingested by some terrestrial species (e.g., mink). These species are also a food source for some human receptors and thus represent a link between the aquatic environment and humans.

The selected aquatic bird receptors are mallard, merganser, scaup, and lesser yellowlegs. Loon were identified from the community survey, with merganser being representative for potential exposure to the loon.

Mallard – mallards are migratory in nature, spending only the breeding season in Canada. Their preferred habitat is wetland areas associated with ponds, lakes, marshes and river bends (Godfrey 1986). The mallard is a dabbling duck whose diet consists primarily of benthic invertebrates and wetland plants, seeds and grains. The foraging territory size ranges from 0.09 to 2.4 km² with the smaller areas seen during breeding season (EC 2012). The mallard serves as a representative for other waterfowl with a diet composed primarily of aquatic plants (e.g., green-winged teal). Mallards have been observed within the study area, including in the S/V TEMS, Collins Creek and Kewen Lake (Orano 2025c). The community survey confirmed that mallard is an important species.

Common Merganser – similar to the mallard, the merganser migrates south in the winter and is present in northern Canada only during breeding season. The preferred habitat during breeding season includes lakes and rivers or near woodlands (Godfrey 1986). The merganser is a diving duck whose diet consists primarily of fish with a small portion of benthic invertebrates and aquatic plants. The foraging territory size ranges from 0.04 to 14 km² with the smaller areas seen during breeding season (EC 2012). The merganser is representative of other piscivorous waterfowl (e.g., loon and cormorant). Mergansers have been observed within the study area, including Kewen Lake (Orano 2025c).

Lesser Scaup – as with the other waterfowl, the scaup is a migratory species. Scaup preferred habitat includes interior lakes and ponds, low islands and sedge meadows (Godfrey 1986). The scaup is an omnivore with foraging territory size ranging from 0.1 to 17 km² (Environment Canada 2012). The scaup is a diving duck and its dietary components consist of primarily of benthic invertebrates and a smaller portion of aquatic plants and seeds. The scaup serves as a representative for other waterfowl with a diet composed primarily of benthic invertebrates (e.g., bufflehead, yellow rail). Scaup have been commonly observed within the study area within the study area, including Collins Creek (Orano 2025c).

Lesser Yellowlegs – diet comprised mostly of benthic invertebrates, terrestrial insects, and some fish. Their foraging territory size ranges from 0.005 to 0.01 km² during winter and forage 3 to 13 km from the nest during breeding season (ADW 2023). Lesser yellowlegs are listed as threatened according to COSEWIC but are currently not listed by SARA. They have been observed within the study area including in the S/V TEMS and Kewen Lake (Orano 2025c).

Based on the home range of these receptors, they were evaluated on each modelled waterbody area.

Semi-Aquatic Mammals

A set of mammalian species closely associated with the aquatic environment were selected for inclusion as receptors in this assessment. The selected aquatic mammalian receptors are beaver, muskrat, and mink. No aquatic mammals were identified through the SARA screening for inclusion in the assessment.

Beaver – beaver are found throughout most of North America. They make their homes in lodges built either in lakes or ponds or on the banks of waterways. The beaver's diet consists primarily of bark and cambium of trees along with buds, roots, and aquatic vegetation (Anderson 2002). The beaver's reported foraging range size is 1.1 km² (Hatler and Beal 2003). The beaver serves as a representative for other herbivore mammals with aquatic and terrestrial based diets. In 2010 a semi-aquatic furbearer study was completed in the McClean Lake Operation local study area. No active beaver houses were observed in Sink Reservoir, Vulture Lake, or Kewen Lake, and Sink Reservoir had no signs of beaver (such as beaver runs, scent marking, or feeding activity)(AREVA 2016b). The semi-aquatic survey was repeated in 2024. It recorded beaver signs and animals at Sink Reservoir, Vulture Lake, Kewen Lake, McClean Lake east basin, and Collins Creek (Orano 2025). The community survey confirmed that beaver is an important species.

Muskrat – muskrat make their homes in permanent wetland areas which contain cattails, bulrushes, and/or sedges (Nagorsen 2005). Their diet consists primarily of aquatic vegetation with a small portion of benthic invertebrates. The reported muskrat foraging area ranges from <0.001 to 0.008 km² (Environment Canada 2012). The muskrat serves as a representative for other herbivore mammals with aquatic based diets. In the 2010 semi-aquatic furbearer study, signs of muskrat were recorded in all surveyed reference and exposure areas. With the exception of muskrat burrows/runs/house, the overall density of muskrat sign observations was slightly higher in exposure areas than in reference sites. Observation density for muskrat runs/burrows/houses was approximately five times greater in reference areas compared with exposure sites; the slow moving waters and increased abundance of emergent and submergent vegetation in the reference areas likely provides better foraging opportunities for muskrat compared to the rocky low-shrub shores of many of the surveyed exposure areas. In the 2024 survey muskrat signs and animals were observed at Collins Creek (Orano 2025). The community survey confirmed that muskrat is an important species.

Mink – mink prefer freshwater habitat include stream banks, lakeshores, forest edges and large swamps. Mink are carnivorous with the largest portion of the diet made up of fish with smaller components of small mammals (e.g. shrew), ducks, and benthic invertebrates. The mink foraging range size varies from 0.06 to 16 km² (EC 2012). Mink serves as a representative for other omnivore mammals with aquatic and terrestrial based diets. During the 2010 semi-aquatic furbearer study (HAB-TECH 2011), signs of mink were not common and only observed in Vulture Lake and Collins Creek Downstream. In the 2024 survey mink signs and/or animals were

observed at Collins Creek, McClean Lake East Basin, and Kewen Lake (Orano 2025). The community survey confirmed that mink is an important species.

Due to the relatively small home range of the beaver, muskrat, and mink, each of these receptors is evaluated at each modelled waterbody area.

Terrestrial Birds

A set of avian species which mainly reside in the terrestrial environment (many of whom are connected to the aquatic environment through diet) were selected as receptors. As shown in Table 4.4-1, two terrestrial birds were identified for inclusion through screening of the SARA database: rusty blackbird and the snowy owl. The snowy owl was identified by all participants in the community survey as being of importance, and the short-eared owl has not been recorded in the area. Therefore the snowy owl and rusty blackbird were added as receptors for direct evaluation, along with ptarmigan and bald eagle.

Willow Ptarmigan – ptarmigan prefer habitat associated with pond edges, streamside thickets and marshy tundra in the summer, and in late fall, they seek more protected areas of dense shrubs and forested areas (Morland 2011). The ptarmigan's diet consists mainly of foliage, fruits and flowers with a smaller component made up of woody vegetation. The ptarmigan foraging range is 0.067 to 0.079 km² (Morland 2011). The ptarmigan serves as a representative for similar terrestrial birds such as grouse. Willow ptarmigan and spruce grouse are reported to occur in the McClean Lake Operation local assessment boundary including in the Kewen Lake area (Orano 2025c). The community survey confirmed that ptarmigan is an important species.

Bald Eagle – bald eagles are a migratory species, spending their breeding season in northern Canada and flying south for the winter. They are carnivorous in nature, eating primarily fish; for this reason their preferred habitat is in areas adjacent to large rivers, lakes, and coastline (Godfrey 1986). The bald eagle foraging range size reported by Environment Canada (2012) is 2.1 to 22 km². The eagle was selected as a representative species for other large piscivore birds such as the osprey, peregrine falcon, and golden eagle. The bald eagle was identified in Volume 1 of the 2025 EP TID as a bird species that has been recorded within the local study area. The community survey confirmed that bald eagle is an important species.

Rusty Blackbird – the rusty blackbird is listed as special concern in the SARA registry (Government of Canada 2024) and has a home range which includes northern Saskatchewan. The rusty blackbird has a foraging range of approximately 0.14 km² (EC 2014) and breeds in boreal forest wetlands. The diet includes aquatic insect larvae and emergent insects as well as crustaceans and snails. Therefore the aquatic benthic organisms serve as a connection between the aquatic and terrestrial ecosystems. The rusty blackbird serves as a representative species for the assessment of potential exposures to other avian insectivores, such as the common nighthawk and olive-sided flycatcher. The rusty blackbird was identified in Volume 1 of the 2025 EP TID as a SARA species of special concern. It been observed within the study area, including in the Collins Creek area (Orano 2025c).

Snowy Owl – the snowy owl typically inhabits open tundra, dune, grassland, and marsh, as well as urban, suburban, and agricultural areas (Atkinson 2002). The snowy owl consumes a carnivorous diet of other vertebrates, including mammals (including lemmings, mice, and rabbits), birds, and fish (Atkinson 2002). The

snowy owl was identified in Volume 1 of EP TID as a bird species that may occur within the local study area, but was not observed during the recent survey (Orano 2025c).

In this assessment, terrestrial avian species that are linked primarily to the aquatic environment through their dietary intakes (e.g., eagle, blackbird) are evaluated on a watershed basis, while those that consume primarily terrestrial-based foods (e.g., ptarmigan, owl) are evaluated on an airshed basis.

Terrestrial Mammals

In this assessment, a wide range of terrestrial mammals were selected for inclusion to evaluate potential influences through both aquatic and terrestrial ecosystems as well as to track potential exposure through food chain transfer. As shown in Table 4.4-1, barren-ground caribou, woodland caribou, and four bat species were identified as Species at Risk which have the potential to be present in the area. Terrestrial mammal species selected for direct assessment include the masked shrew, snowshoe hare, moose, black bear, Canada lynx, grey wolf, red fox, little brown myotis, and woodland and barren-ground caribou.

Masked Shrew – the masked shrew prefer damp, cool forest, tall grass regions and brushy riparian areas (EC 2012). The shrew is an insectivore with the largest portion of the diet consisting of insects followed by a smaller component of terrestrial vegetation. The foraging range of the masked shrew is estimated to be 0.006 km² (Nagorsen 1996). The shrew serves as a representative species for other similar small omnivorous mammals. The masked shrew is among the most common mammal species in the Athabasca Plain Ecoregion (Acton et al. 1998). Of the small mammals captured during a 1979 small mammal trapping survey study (MacLaren and SRC 1979) completed in the local study area in 1979, approximately 8% were shrew species (AREVA 2016b). A small mammal survey conducted in 2024 confirmed masked shrew presence in the area along with Gapper's red-backed vole (CanNorth 2025).

Snowshoe Hare – the snowshoe hare prefers habitats including forests, birch-willow scrub, subalpine parkland, and scrub fens/carrs and has a relatively small foraging range of between 0.02 and 0.1 km² (EC 2012). The hare is an herbivore with the diet consisting of primarily foliage, woody vegetation, fruits, and flowers. The hare serves as a representative for other small herbivore mammals such as squirrels and voles. Snowshoe hare pellet survey were conducted in the local study area in 1989 and 2003; a winter track survey was also completed in 2004 (AREVA 2009c, 2016b). Snowshoe hare were found to be abundant in the local study area, with highest concentrations of pellets found south of Vulture and Moffat lakes and north of Nadia Lake (Minatco 1991). During the 2004 track survey, hare occurrence was observed to have a patchy distribution, with most observations in areas of dense tree and shrub cover. This was believed to be indicative of a cyclic low in the hare population (AREVA 2009c). The snowshoe hare is among the most common mammal species in the Athabasca Plain Ecoregion (Acton et al. 1998). It was also recorded during the 2024 wildlife camera surveys (Orano 2025). The community survey confirmed that hare is an important species.

Moose – moose can be found in both forest and wetland, especially areas with diverse browse species, and have reported foraging range sizes of between 4.6 and 262 km² (EC 2012). The moose is an herbivore whose diet consists of woody vegetation and aquatic plants. The moose serves as a representative for other large herbivores with an aquatic and terrestrial based diet. During aerial surveys conducted from 1976 to 1994, moose were observed within and adjacent to the local study area, with the highest densities observed south

and east of Moffat Lake, in the Mallen Lake area, and Esker plots (AREVA 2016b). A pellet survey was completed in 2003 and a winter track survey was completed in 2004 to assess the presence of moose within the study area (AREVA 2009c). Results from the pellet survey indicated a widespread distribution of moose within the study area; however, higher densities of pellets were observed in preferred habitat areas, such as rock barren, shrub riparian, treed poor fen, white birch-Jack pine mixed wood forest, graminoid rich fen, and treed burn (AREVA 2009c). The lowest densities were observed in marsh/emergent, sedge riparian, recent/low shrub burn, closed-canopy black spruce forest, shrubby bog, open black spruce forest, and shrubby poor fen areas (AREVA 2009c). The moose is among the most common mammal species in the Athabasca Plain Ecoregion (Acton et al. 1998). It was also recorded during the 2024 wildlife camera surveys (Orano 2025). The community survey confirmed that moose is an important species.

Availability of suitable browse species within a given area influences the ability of moose to use the area as habitat. Moose are primarily consumers of woody plant tissues, however the summer diet is supplemented with a variety of nutritious forbs and aquatic plants (Jackson et al. 1991). The McClean Lake Operation is located within secondary moose range due to lower availability of forage and cover, and colder temperatures, consistent with this region of Saskatchewan (AREVA 2016b).

Black Bear – the black bear prefers habitat of deciduous or coniferous forests, swamps, and berry patches (Banfield 1974). The black bear is an omnivore with an estimated foraging size range of 3 to 1147 km² (EC 2012). Fruits and flowers make up the largest portion of the diet with the remainder consisting largely of foliage, roots, carrion (moose and caribou), and fish. The black bear serves as a representative for other large omnivorous mammals. The black bear is among the most common large mammal species in the Athabasca Plain Ecoregion (Acton et al. 1998). During a pellet group survey conducted in 2003, thirty black bear scats were observed in a clumped distribution around the study area, most abundant in areas with high densities of blueberry (AREVA 2009c). It was also recorded during the 2024 wildlife camera surveys (Orano 2025). The community survey confirmed that bear is an important species.

Canada Lynx – the lynx is a wild cat of the boreal forest. It favours boreal forest with dense undercover. The diet consists almost exclusively of snowshoe hare (CWF 2016), so the presence of lynx is often tied to snowshoe hare populations. The territory size for lynx varies with snowshoe hare availability, cover, and season and scientists have measured lynx in Canada moving from less than 1 km per day up to 19 km (CWF 2016). Fox and Murphy (2002) provide a home range of 11 to 300 km². The lynx serves as a representative for other small carnivorous mammals. The lynx is among the most common mammal species in the Athabasca Plain Ecoregion (Acton et al. 1998). In 1990, lynx tracks were incidentally observed at several locations in the regional study area (AREVA 2009c). The community survey confirmed that lynx is an important species.

Grey Wolf – the grey wolf is a carnivore whose diet consists primarily of large mammals such as moose and caribou with some ingestion of smaller mammals such as hare. The wolf has a very large reported foraging range of 130 to 13,000 km² (Smith 2002). The wolf serves as a representative for other large carnivorous mammals. The wolf is among the most common mammal species in the Athabasca Plain Ecoregion (Acton et al. 1998). In a 2003 pellet survey conducted at the site, a single wolf scat was observed, indicating a low level of wolf activity in the area at that time (AREVA 2009c). A lone wolf was observed later that year during other site studies (AREVA 2009c). It was also recorded during the 2024 wildlife camera surveys (Orano 2025). The community survey confirmed that wolf is an important species.

Woodland Caribou – woodland caribou are listed as threatened on the SARA registry and their home range includes northern Saskatchewan. Woodland caribou are not migratory but are always moving within their home range of approximately 300 km² (Government of Saskatchewan 2016). In winter, the primary dietary components are ground and tree lichens while in spring, they switch to a diet of fresh green foliage, fruits and flowers. The woodland caribou have been observed southwest of the site, south of Collins Creek (SMOE 2025a). The community survey confirmed that caribou is an important species. While a survey of the Hatchet Lake community found that barren-ground caribou are hunted and form a part of their diet, woodland caribou are not among the traditional meat sources utilized by the Hatchet Lake Band (CanNorth 2000). The survey found that the community largely hunts caribou in the area to the north and northeast of Wollaston Lake, an area outside of the potential influence of the McClean Lake Operation (CanNorth 2000). For these reasons the barren-ground caribou are not explicitly evaluated in the current assessment.

Red Fox – the fox is an omnivore, primarily consuming small rodents, small mammals such as rabbits and duck, birds, insects, fruits, and berries. Foraging range varies from 2.8 to 34.2 km² (EC 2012). They are present in the area and were observed incidentally during birding surveys (Orano 2025c) and 2024 wildlife camera surveys.

Little Brown Myotis – the little brown myotis is an insectivore, consuming aquatic and terrestrial insects. Foraging range varies from 0.3 to 1.4 km² (COSEWIC 2013; Henry et al. 2002). Five bat species have been identified at the McClean Lake operation including little brown myotis, northern long-eared myotis, eastern red bat, hoary bat, and silver-haired bat (USask 2024). The little brown myotis was found through the majority of all surveyed sites. Detection of bats in abundance during the fall season may indicate bats are using roosts within or around the McClean Lake operation for swarming (fall aggregations for mating), or for ephemeral roosts as they travel to swarming sites or hibernacula. Home ranges can range from 45 ha to 1600 ha (USask 2024). The community survey confirmed that bats are an important species.

In this assessment, terrestrial mammalian species that are primarily linked to the aquatic environment through their dietary intakes (e.g., moose) are evaluated on a watershed basis while those that primarily consume terrestrial-based foods (e.g., hare) are evaluated consistent with air modelling locations.

4.4.4 Location of Ecological Receptors

Figure 4.4.-2 shows the selected locations for the ecological receptors, this information is also summarized in Table 4.4-4. As discussed in the previous section, the selection of location depends on the diet of the receptor and the home range.

A full range of aquatic biota are assessed at each of the selected locations. This includes aquatic plants, benthic invertebrates, phytoplankton, zooplankton, amphibians, and fish (predatory and bottom-feeding forage fish). At the time of project development, it was determined that the conversion of Sink Lake into a reservoir and the construction of the S/V TEMS control structures would result in the Harmful Alteration, Disruption or Destruction (HADD) of fish habitat, as defined in the Fisheries Act. Authorization was therefore sought from provincial and federal agencies to undertake the necessary construction activities. Fisheries and Oceans Canada issued “Authorization SK-90-003 for Works or Undertakings Affecting Fish Habitat” (DFO 1995). This authorization outlines the conditions of authorization and the habitat compensation agreement for the loss of

fish habitat associated with the development of the S/V TEMS. The waste water management plan also acknowledged the potential for large changes in surface water elevation in Sink Reservoir associated with the storage and release of treated effluent. It was considered that such fluctuations in surface water elevation would create conditions adverse to the maintenance of the resident fish community in the reservoir. Authorization was therefore sought and subsequently granted by provincial and federal authorities to remove the resident fish community from Sink Reservoir (DFO 1997; SERM 1997).

Despite the fish removal, fish have returned to Sink Reservoir and therefore are included among the aquatic receptors assessed at Sink Reservoir, along with Vulture Lake, McClean Lake east basin, and Collins Creek (at McClean Lake), and Kewen Lake. In 2001, Orano implemented a habitat compensation project to offset a potential impact on aquatic ecosystems due to the construction and operation of the Sink/Vulture Treated Effluent Management System. Fisheries and Oceans Canada (DFO) accepted the project based on long-term monitoring results in 2012.

The lakes were also selected for the aquatic-based terrestrial species. This includes mallard, merganser, lesser scaup, lesser yellowlegs, muskrat, beaver, and mink.

These waterbody segments were also selected for the aquatic-based terrestrial species. Two watershed averages were considered for various terrestrial species. A perimeter-weighted average was used for the moose to represent potential exposures around the S/V TEMS through shoreline grazing. A watershed average for Collins Creek, from McClean Lake east basin to Collins Creek outlet at Collins Bay, was used for potential exposures to the moose and eagle. These locations are consistent with those evaluated in previous assessments (AREVA 2012c, 2016b).

In this assessment, species that are linked strongly to the aquatic environment through their preferred habitat and dietary intakes (e.g., eagle, moose) are evaluated on a watershed basis while those that consume more terrestrial-based foods (e.g., woodland caribou) are evaluated associated with the discrete receptors locations presented for air modelling (Section 2). Three airshed averages were defined for the purposes of evaluating receptors with a primarily terrestrial-based diet. These locations were selected to be consistent with previous assessments (AREVA 2012c, 2016b) and include the McClean Lake Operation Area (encompassing the S/V TEMS), the Collins Creek Watershed (encompassing Collins Creek downstream of McClean Lake east basin to Kewen Lake), and Kewen Lake (represented by the Collins Creek Airshed). Sessile and low mobility receptors, plants, lichen and soil invertebrates, were included in each of these areas.

Two terrestrial receptors were selected for evaluation on lakes: the rusty blackbird and little brown myotis. These receptors consume insects, including those with an aquatic larval stage. Therefore, they were located close to the waterbodies and it was assumed that the terrestrial insect portion of their diet (estimated from predicted soil concentrations) would come from the McClean Lake Operation Small Area (Figure 4.4-2).

Terrestrial species that consume primarily terrestrial-based foods are assumed to be connected to the areas around the site. The two small areas (McClean Mill area and McClean Lake Operation area on Figure 4.4-2) were used for animals with small home ranges (i.e., ptarmigan, snowshoe hare, masked shrew). The owl, black bear, fox, and lynx are assumed to roam through the McClean Lake Operation Medium Area and the caribou and wolf roam through the McClean Lake Operation Large Area (Figure 4.4-2).

Recent assessments for the McClean Lake Operation have considered the presence of a moose in the area of the S/V TEMS, which represents a conservative estimate of exposure since it is highly unlikely that a moose would exclusively spend the summer in this area and obtain all water and food from this small sub-watershed. The following provides rationale for the selection of the time spent by the moose on the S/V TEMS.

In northern Saskatchewan, it is reported that moose may range over 25 to 100 km² (Cameco 2004b). Published home range studies based on radio-collared individuals were reported for the Copper River Delta in south-central Alaska (MacCracken et al. 1997). The findings from this study indicate a mean home range value of 59 km². Based on this information, it was determined that a moose home range of 60 km² is a reasonable assumption for the purposes of this assessment.

On a daily basis, moose routinely move about to fulfill their various needs. Moose movement data suggest that a mean rate of movement of 0.4 km/day during summer and 0.2 km/day during winter (Garner 1989) is appropriate to use. However, when a marked change in seasonal conditions occurs, moose may shift habitats and areas, for instance from a summer to a winter home range, and thus the distances covered in this shift may be greater than on average.

For the purposes of the assessment of a moose on the S/V TEMS, it was assumed that a moose could spend 1 month of the year in the area of the Sink Reservoir wetland, Sink Reservoir, and Vulture Lake. This assumption was based on consideration of the perimeter of these waterbodies (estimated at 5 km), the rate of daily summer movement, and assumed home range (60 km²). A triangular distribution was assumed for the fraction of time at site, with a minimum of half a month and a maximum of two months. The rest of the year (11 months), the moose was assumed to be at background locations. The moose in the downstream Collins Creek watershed was assumed to be present all year.

4.5 Human Receptor Groups and Assumptions

Human receptor groups/locations were selected based on plausible scenarios of people working and/or living nearby, although there may not be measurable changes to the environment at these locations. Figure 4.5-1 shows the locations of the receptors selected for this assessment. The following provides a brief discussion on the seven receptor locations and representative receptor groups.

The sources of food were linked to different watersheds in the assessment area depending on the human receptor location and expected period of occupancy at these locations. These linkages were based on ability to obtain dietary components from the assessment area.

Wollaston Lake Resident

Three receptor groups were selected for the residents of the Wollaston Lake community: adult, child, and toddler. These human receptors are expected to obtain their dietary components year-round from the local area (i.e., Wollaston Lake and the community area), with the exception of barren-ground caribou. Residents from Wollaston Lake generally hunt barren-ground caribou for consumption in the area north of Wollaston Lake, a region outside of the area potentially affected by emissions from the McClean Lake Operation. The

majority of vegetables were assumed to be obtained from the store (market food), with 5% obtained from backyard gardens.

Wollaston Lake Trapper

A resident adult and accompanying child and toddler of the Wollaston Lake community were considered to spend three months of the year trapping in the assessment area closer to the McClean Lake Operation. Therefore, for nine months of the year, the trapper's diet is similar to the diet of the general Wollaston Lake resident, and for the other three months of the year, the trapper (adult, child, and toddler) obtains food from trap lines in the area around the McClean Lake Operation. The trapper was assumed to hunt moose in the lower Collins Creek watershed, which represents an area of potential higher exposures relative to the Wollaston Lake community area. This is considered a conservative assumption, which will tend to overestimate exposure. Barren-ground caribou were assumed to be hunted from the area north of Wollaston Lake, a region outside of the area potentially affected by emissions from the McClean Lake Operation.

Wollaston Lake Lodge Operator

The operator of the fishing lodge located on Hidden Bay, Wollaston Lake, was considered in the assessment. It is assumed that the lodge operator and his/her family (child and toddler) may spend the entire summer at the lodge. The lodge operator was assumed to be resident for three months of the year, and to obtain drinking water from Hidden Bay on Wollaston Lake. It was assumed that the lodge operator obtains food from the local area. Therefore, beaver, ducks, hare, ptarmigan, berries, and soil were assumed to be obtained from the local airshed and watershed of the Wollaston Lake lodge on Hidden Bay. It was assumed that fish are obtained from Wollaston Lake. As a conservative assumption, it was assumed that the lodge operator obtains moose from the Collins Creek area. The ingestion of local vegetables from a backyard garden was considered for the Wollaston Lake lodge operator while at the fishing lodge. Barren-ground caribou were assumed to be hunted from the area north of Wollaston Lake, a region outside of the area potentially affected by emissions from the McClean Lake Operation.

Rabbit Lake Worker

A Rabbit Lake worker was assumed to spend half the year at site, since most workers are on a two week at camp and two week off site schedule. The other half of the year, the worker was considered to be out of the assessment area. It was assumed that drinking water was obtained from Collins Creek and fish from Collins Bay and Keweenaw Lake. It is understood that the Rabbit Lake worker is restricted on how much fish can be taken (quota of one fish per week); therefore the fraction of fish obtained from the two lakes was selected to represent this quota. Workers are not permitted to hunt while they are on site, therefore ingestion of small and large game was not considered. It was assumed that berries are picked from the Rabbit Lake camp airshed and that soil ingestion occurs with the ingestion of berries from the local area. The assessment considers the impact of releases from the McClean Lake Operation on the Rabbit Lake Camp worker. The effects of the Rabbit Lake operations were not considered. Children are not present at the Rabbit Lake Camp.

JEB Worker

JEB workers (non-NEW) are assumed to reside at the site for half the year due to their shift schedule, and children are not present at the site. The other half of the year, the worker was considered to be a resident of Wollaston Lake. While at the Site, they receive their drinking water from unaffected Pat Lake, upstream of the McClean Lake Operation effluent discharge area, and therefore, the drinking water pathway was not considered for the JEB worker while at Site. Workers at JEB are not permitted to hunt while on-site, and therefore, the ingestion of beaver, caribou, ducks, hare, moose, and ptarmigan were not considered. JEB workers do catch fish while on-site, but primarily from unaffected lakes, such as Dwarf, Pat, Torwalt and Moffat lakes (these are the only lakes on the lease that fishing is permitted). Therefore, the JEB worker was not considered to ingest fish from the affected waterbodies of interest in the assessment area. Potential pathways of exposure for the JEB worker included the ingestion of berries and soil while on site. The ingestion of local vegetables was not considered. While at home at Wollaston Lake, the pathways of exposure are the same as the resident discussed previously.

Points North Worker

Points North workers mostly work two weeks in/two weeks out, resulting in a 50% occupancy factor. The other half of the year, the worker was considered to be out of the assessment area. There are no children at the site. Water is taken from a well and the lake for showers and septic use; all drinking water is purchased from a commercial supplier and hauled in from the south. Therefore, there was no drinking water pathway for these workers at the site. Workers do fish while at the site, with a reasonable use pattern of Collins Creek (Keweenaw Lake) 20%, Glove Lake (near Points North) 50%, Waterbury Lake 20% and Murphy Lake (north along the seasonal road to Black Lake) 10% (COGEMA 2004). In the summer, workers consume a maximum of one fish per shift per employee and in the winter about 0.5 fish per shift. Generally, fish are cooked and consumed at camp and not taken home. Therefore, the Points North worker was assumed to obtain 20% of fish while on site from Keweenaw Lake. The remaining fraction was considered to be from unaffected lakes and thus, not included in the pathways assessment. It was assumed that no hunting is allowed. Some employees pick blueberries in the late summer, with a maximum individual consumption of about 500 grams per year (or 1.4 grams per day) from the site (COGEMA 2004). Therefore, it was reasonable to assume that an employee could eat only berries from the study site during the time at Points North. The ingestion of local vegetables was not considered for the Points North worker.

Hatchet Lake Lodge Operator

The Hatchet Lake Lodge operator was assumed to be in the assessment area for three months of the year and, although drinking water is obtained from Hatchet Lake, significantly downstream from the project area, Wollaston Lake was conservatively assumed as a surrogate for Hatchet Lake water. The lodge operator was assumed to bring his/her family on site and thus a child and toddler were also considered in this assessment. Caribou were assumed to be obtained from outside the assessment area, and beaver, ducks, hare, moose, ptarmigan, berries, and soil were assumed to be obtained from the Hatchet Lake airshed. The ingestion of fish was not included, as the lodge is outside of the area potentially affected by the McClean Lake Operation. Although most of the produce consumed at the lodge is brought in from other areas, the ingestion of local vegetables from a backyard garden was considered for the Hatchet Lake Lodge operator. Information on the Hatchet Lake lodge is available at www.hatchetlake.com.

Table 4.5-1 summarizes the pathways considered in the human health assessment for each receptor location.

4.5.1 Assumed Dietary Characteristics

The consumption of traditional food assumed for the adult and child receptors are based on the Hatchet Lake Band dietary survey (CanNorth 2000). This survey provides information on traditional food intakes for the Wollaston Lake community (Table 4.5-2). An updated traditional foods study was completed for Wollaston Lake as part of a community-based environmental monitoring program (CanNorth 2021). Generally, the rates of traditional food consumption from the CanNorth (2000) survey, are similar to or greater than the rates presented in the more recent survey (CanNorth 2021) and therefore the use of this study represents a conservative approach.

Table 4.5-2 summarizes the pooled mean and maximum intakes of both the adult and child receptors. The diets of male and female adults and children, respectively, were pooled in deriving these values. The pooled maximum values represent a reasonable maximum exposed individual. The maximum reported values were used to specify the upper bound of the probability distributions for dietary intakes.

The toddler was assumed to have 50% of the adult's meat, fish, and poultry ingestion rate. This value was guided by a similar relationship between toddler and adult meat ingestion in Richardson (1997).

Consideration was given to explicitly considering consumption of other parts of the animal (e.g., organs) by people. In the Hatchet Lake Band dietary survey (CanNorth 2000), the respondents did indicate consumption of other tissues (in particular caribou tongue, kidney, heart and bone marrow as well moose kidney, heart and tongue). It was also noted the fish heads and eggs and duck eggs were consumed. Although the meat values reported included all animal parts i.e., flesh, organs, fat, etc. (CanNorth 2000), insufficient information was available from this report to determine the appropriate intake of each of the tissues separately. It is noted that due to their function in the body, organs such as kidneys and livers can have elevated concentrations of contaminants such as metals. Other tissues such as eggs and fish heads would not be expected to contain significantly elevated constituent concentrations. Caribou meat (including all animal parts) is consumed in the largest quantity; however these animals are not from the local area, although organ consumption represents a potential uncertainty in the exposure, it is not expected to affect the overall results and conclusions of the assessment.

Probability Distribution for Dietary Intakes

Probability distributions were derived to describe the traditional food dietary characteristics for the child and adult receptors. The parameter values for the beta distributions were estimated using the mean and maximum values in Table 4.5-2 as two of the attributes, and assigning a coefficient of variation of 30% to characterize the variability in mean annual dietary intakes in traditional meat, poultry, and fish. The coefficient of variation of 30% (i.e., the ratio of standard deviation to the mean expressed as a percentage) corresponds to the variability reported by Richardson (1997) in the total food consumed by Canadians based on 24-hour recall surveys. The coefficients of variation calculated from the data reported by Richardson vary between 35% for children to 39% for adults. The 30% coefficient of variation was selected to account for the expectation that there would be less variability in annual daily intakes compared to 24-hour recall survey results.

In the pathways modelling code, the proportional amounts of the various components of the diet were expressed as fractions of the total meat, fish, and poultry intakes. Since the data reported in the Hatchet Lake Band survey did not include minimum values, it was conservatively assumed that it was equally likely that an individual's big game, small game and fish intake could range anywhere between the mean and maximum values (i.e. no receptor was assumed to be less than the mean). While the data presented in Table 4.5-2 are representative of the diet of a typical composite person, these mean intakes may not be representative of individuals who could have high intakes of dietary components other than caribou.

The toddler was assumed to have the same breakdown of big game, small game, and fish as the child. These fractions of the diet were applied to the meat and fish ingestion rate of a toddler.

Vegetables

It was assumed that residents of the Wollaston Lake community and the fishing lodges would consume vegetables (both above-ground and below-ground) from backyard plots. These backyard gardens were assumed to provide 5% of the daily estimated intake of vegetables throughout the year. This is not an unreasonable assumption given that there is a short growing season in the regional study area due to its northern location. A triangular distribution was used in the pathways model spanning from 0 to 10% to cover a range of intake levels. The estimated total intakes and distributions of above-ground and below-ground vegetables were obtained from Richardson (1997). Table 4.5-3 summarizes the distributions for total vegetable consumption.

Berries

The ingestion rates for berries were derived from the data presented in Table 4.5-2 from the Hatchet Lake Band survey (CanNorth 2000). An assumed geometric standard deviation of 3.0 was used. The resulting distributions (in g/y) are as follows:

toddler – LN (2340, 3.0, 260, 21000);

child – LN (3100, 3.0, 330, 28000); and

adult – LN (650, 3.0, 73, 5600).

where,

LN = truncated Lognormal Distribution (geometric mean, geometric standard deviation, minimum, maximum).

Medicinal Tea Intake

The Yukon dietary survey (Receveur et al. 1998) indicated that in the winter 12% of the population consumes Labrador Tea 1.2 days/week and in the summer 23% of the population consumes Labrador tea 1.4 days/week. This equates to an average Labrador tea consumption of 1.3 days per week. The survey does not provide the amount of Labrador tea or other medicinal teas that are consumed.

To estimate the amount of medicinal tea information was available suggesting that consumption once a day was appropriate because of the ledol and grayanotoxin toxicity (Dampc and Luczkiewicz 2015). Therefore, it was assumed in this assessment that an adult (70 kg body weight) would consume 250 mL (1 cup) of medicinal teas for 1.3 days a week. It was assumed that young children would not consume any significant quantity of Labrador tea. This equates to a consumption rate of 0.17 cups/day. There was no information available on the amount of fresh Labrador tea used in the brewing process. In this assessment, it was assumed that approximately 3 g were used. This is equivalent to a bag of regular tea. A triangular distribution around this value with an assumed range of +/- a factor of 2 to capture a range of possible consumptions was used in this assessment. Labrador tea was assumed to be represented by browse concentrations in the model.

4.5.2 Other Receptor Characteristics

Water Intake

Lognormal distribution functions were derived using geometric mean and geometric standard deviation values reported in L/d by in Richardson (1997) *“Compendium of Canadian Human Exposure Factors for Risk Assessment”*. The distributions on annual intake of water (m³/y) is therefore:

toddler – LN (0.18, 1.84, 0.05, 0.62);

child – LN (0.26, 1.49, 0.12, 0.58); and

adult – LN (0.48, 1.65, 0.18, 1.31).

where:

LN = log normal distribution (geometric mean, geometric standard deviation, minimum, maximum).

Air Intake

A lognormal distribution was assumed for inhalation rate. Mean and standard deviation (m³/d) were taken from Richardson and Stantec (2013) which is based on Allan et al. (2008):

toddler – 7.9 ± 2.2 -> LN (7.6, 1.3, 4.5, 12.8);

child – 14.2 ± 3.4 -> LN (13.8, 1.3, 8.2, 23.3); and

adult – 16.6 ± 4.1 -> LN (16.1, 1.3, 9.5, 27).

Soil Intake

The Contaminated Sites Division (CSD) of Health Canada has undertaken to re-evaluate soil ingestion rates and to define these as lognormal probability distribution functions (PDFs). Numerous studies have been conducted to quantify soil ingestion rate (reviewed by Doyle et al. 2010). Doyle et al. (2010) has indicated that the quantities of soil ingested, as deduced from those studies, are as much an artifact of limited study statistical strength and minimum analytical detection limits, than related to true quantification of actual soil ingestion. The assumptions concerning soil ingestion currently employed and recommended for risk assessment by

Health Canada (2021a) are not associated in any way with the amount of time spent in the outdoor environment.

Based on methods originally developed for estimation of indoor settled dust ingestion rates (WTCWG 2003), and accounting for various factors such as time spent outdoors, soil adherence to hands, rates of hand-to-mouth activity, surface area of hands, etc., Wilson et al. (2013) derived the following parameters (arithmetic mean and standard deviation) which were used to characterize lognormal PDFs for outdoor soil ingestion rate (mg/d):

toddler – 20 ± 26 -> LN (12.2, 2.7, 1.6, 89);

child – 23 ± 32 -> LN (13.4, 2.8, 1.7, 105); and,

adult – 1.6 ± 2.7 -> LN (0.30, 3.2, 0.08, 8.5).

Exposure Duration and Averaging Time

Exposure duration and averaging factors are required to estimate the exposure as outlined in N288.6 (CSA 2022). For this assessment, a lifetime is represented by 4 years as a toddler, 10 years as a child and 60 years as an adult, for a 74 year lifetime duration. Workers are assumed to be present for 35 years. Exposure to workers is averaged over the 60 year adult lifestage, while all other groups are averaged over the lifetime.

Summary

Tables 4.5-4 through 4.5-6 provide a summary of the human characteristics for the adult, child, and toddler described previously. These values were used in the 2016 ERA (AREVA 2016b) and are consistent with guidance provided in CSA Standard N288.6 (CSA 2022).

4.6 Conceptual Model

Consistent with N288.6 (CSA 2022), Figure 4.6-1 provides the conceptual model for the releases and Figure 4.6-2 provides the conceptual model for the pathways assessment at the McClean Lake Operation. Figure 4.6-3 shows exposure pathways for each valued component.

4.7 Assessment Endpoints

To determine the ecological significance of exposure to a constituent, ecological endpoints need to be selected. These endpoints are characteristics of an ecological component (such as fish mortality) that may be affected by exposure to a given constituent (Suter 1993; U.S. EPA 1992). There are two types of endpoints, assessment endpoints and measurement endpoints. Assessment endpoints are explicit expressions of the actual environmental values that are to be protected (U.S. EPA 1992; Warren-Hicks et al. 1989). Due to the difficulty in measuring direct effects on assessment endpoints, “measurement endpoints” are adopted to provide a framework for the evaluation of predicted effects. A measurement endpoint is defined as “...a quantitative summary of the results of a toxicity test, a biological study, or other activity intended to reveal the effects of a substance” (Suter 1993). In lieu of direct assessment endpoint effects measures, the adoption of

measurement endpoints provides a consistent basis for the evaluation of potential effects due to exposure of assessment endpoints.

Measurement endpoints are commonly selected at the individual level of biological organization, and are typically based on exposure responses that represent key population and community characteristics such as reproduction and abundance (EC 1997). Such measurement endpoints are commonly based on literature-derived toxicity dose-response relationships, examined through laboratory experimentation (i.e., the response of a particular organism to a certain level of exposure). When derived from toxicity studies, such measurement endpoints are often referred to as TRVs. For the assessment of potential radiological effects, measurement endpoints are referred to as reference doses.

In this assessment, TRVs were chosen to represent key ecological receptor population and community characteristics of growth, reproduction and abundance. For these characteristics, estimates of low effect (e.g. a Lowest Observed Adverse Effect Level [LOAEL]) or an effect concentration representing a reduction of 25% of the endpoint of interest (EC 1997) were preferentially adopted to provide a realistic probability of the predicted negative effect occurring (Section 5). For humans, appropriate TRVs were selected from Health Canada and the U.S. EPA, as described in Section 6. The selection of appropriate reference doses followed guidance provided in CSA Standard N288.6 (2022).

The assessment endpoints for the assessment include:

Aquatic receptors: potential for population level effects, with consideration of spatial extent.

Terrestrial receptors: potential for population level effects, with consideration of spatial extent.

- Species at risk were assessed on an individual level.

Human receptors: protection (no meaningful health effects) on individual human receptors.

These assessment endpoints were evaluated considering the TRVs which are presented in Sections 5 and 6. Consistent with CSA Standard N288.6 (CSA 2022), TRVs were based on survival, growth, and reproduction in order to more closely link the endpoints with population success.

4.8 Problem Formulation Checklist

Table 4.8-1 and Table 4.8-2 provide the problem formulation checklists for the ecological and human health risk assessments, respectively.

5 McClean Lake Operation ERA - Ecological Risk Assessment

The risk characterization phase combines information on predicted exposures with toxicity assessment data and characterizes the potential for negative ecological effects. This section of the report presents predicted exposures, the selection of TRVs and other measurement endpoints, and evaluates the risks to ecological species.

5.1 Exposure Assessment

5.1.1 Overview

Atmospheric and aquatic emissions from the McClean Lake Operation were used to predict doses and intakes to receptors in the area. As outlined in Section 3, the aquatic environment was explicitly modeled; water and sediment quality predictions were made for the S/V TEMS and downstream waterbodies. Similarly, atmospheric emissions from dust re-suspension and radon releases from the site were included in the assessment as discussed in Section 2.

For the evaluation of potential effects on aquatic receptors (e.g. benthic invertebrates, fish, aquatic plants) the assessment generally relies on predicted water or sediment concentrations. Section 3 provides the details on how these concentrations were derived.

For the evaluation of potential effects of gaseous combustion products (SO_x , NO_x) on terrestrial plants the assessment relies on predicted air concentrations. Section 2 provides the details on how these concentrations were derived.

The ADEPT model was used for the pathways modelling. This is the process of tracing how COPCs move through the environment and estimating concentrations in various environmental media. The exposure can then be estimated using the estimated concentrations and knowledge of the amount of water a receptor drinks and the types and amount of food that is consumed. The approach to the pathways assessment and modeling was described in Section 4.2. The pathways model including consideration of the releases to air (described in Section 2) and water (described in Section 3). The receptors chosen for the current assessment were selected to represent a wide range of potential exposures. The dietary characteristics and time spent in the study area of the selected VCs, discussed in Section 4.4, are used in the ADEPT model to allow for a quantitative estimate of the potential exposure by the selected receptors. The water quality and pathways models are coupled and were run probabilistically to permit uncertainty in the input parameters to be explicitly accounted for in the model predictions. The magnitude of the uncertainties in the model parameters is reflected in the values assigned to the input parameter distributions discussed in prior sections and in the associated appendices. The pathways modelling results presented below are based on 100 trials. Appendix V.1 provides the predicted intakes for the ecological receptors.

To facilitate evaluation of different phases of the McClean Lake Operation several different timesteps were specifically identified as representative years for presentation including:

- **2025 Current conditions.** This year was selected as it represents the current conditions with both JEB WTP and Sue WTP releasing to Sink Reservoir. It uses the results from the air modelling for the Baseline Operations Scenario (2022 to 2025 and 2035 to 2036).
- **2030 Future operations.** This year represents the future operations where JEB WTP and Sue WTP continue to release to Sink Reservoir. It uses the results from the air modelling for the Maximum Future Operations Scenario (2026 to 2034)
- **2040 Decommissioning.** At this time the JEB WTP has decreased to 2000 m³/y and it is the last year of releases from the Sue WTP. It uses the results from the air modelling for the Decommissioning Scenario (2037 to 2050)
- **2050 Decommissioning.** Both JEB WTP and Sue WTP have stopped releasing by this time. It uses the results from the air modelling for the Decommissioning Scenario (2037 to 2050)
- **2100 Post-decommissioning.** This time is over 50 years past when the WTP releases have stopped. It uses the results from the air modelling for the Post-Decommissioning Scenario (2051 to 2100)

5.1.2 Selection of Ecological COPCs

Water quality guidelines are used to screen which of the potential COPCs require an assessment of potential effects on aquatic biota. Based on the results of the assessment in Section 3, there are no exceedances of the water quality guidelines for un-ionized ammonia, cadmium, chromium, copper, lead, molybdenum, nickel, uranium, or zinc. Therefore, an assessment of these COPCs for effects on aquatic biota is not required. There were no exceedances of the radionuclides, however as it is a cumulative effect, the radiation dose is still calculated.

As water quality guidelines are based on the protection of freshwater aquatic life, all COPCs are considered in the assessment of potential effects on wildlife. It is noted that the major ions in water (ammonia, chloride, fluoride, nitrate, potassium, sulphate, TDS) are only assessed in the aquatic environment. As they do not bioaccumulate, pathways modelling was not completed. In addition, aluminum and iron can cycle in the environment but the fate and transport is driven by biogeochemistry and bioaccumulation is low (ECCC/HC 2024a) and therefore pathways modelling was not conducted for these COPCs. The recent review of information on thallium (ECCC/HC 2024b) focussed on the aquatic environment and found that thallium does not appear to bioaccumulate in organisms. In addition, no toxicity data were found for thallium and wildlife; therefore, the assessment of thallium focused on aquatic biota and terrestrial plants and soil invertebrates through the direct exposure and pathways modelling was not performed.

5.2 Toxicity Assessment – Ecological Benchmarks

As presented in Section 4.7, measurement endpoints are commonly selected at the individual level of biological organization, and are typically based on exposure responses that represent key population and

community characteristics such as reproduction and abundance (EC 1997). Such measurement endpoints are commonly based on literature-derived toxicity dose-response relationships, examined through laboratory experimentation (i.e., the response of a particular organism to a certain level of exposure). When derived from toxicity studies, such measurement endpoints are often referred to as TRVs. For the assessment of potential radiological effects, measurement endpoints are referred to as reference doses.

Measurement endpoints are used in risk assessments to judge whether the predicted (estimated) exposures (or doses or intakes) may potentially have a negative effect on ecological species or humans. Where available, site-specific information was incorporated into the TRV selection process. A discussion of selected literature and the associated TRVs and reference doses is discussed in the following sections.

5.2.1 TRVs for Non-Radiological COPC

5.2.1.1 Aquatic Species TRVs

The potential effects on aquatic biota is done through the use of a Species Sensitivity Distribution (SSD) for all COPC, with the exception of selenium.

Species Sensitivity Distribution

The approach for assessing the potential effects on aquatic biota (aquatic plants, phytoplankton, zooplankton, benthic invertebrates and fish) exposed to non-radionuclide COPCs is through the development and application of SSD curves. This method combines all relevant TRVs to estimate the relationship between surface water concentrations and the toxicity of individual aquatic biota. The SSD approach has been adopted for the development of the site-specific water quality objectives and is therefore supported by the CCME protocol (CCME 2007).

The development of the SSDs are described in Appendix V.2. As an overview, the first step in the development of SSDs is the compilation of relevant aquatic toxicity data obtained from literature through a search of the ECOTOX database. Toxicity data are summarized and screened to ensure they are applicable and are acceptable. Preference was given to endpoints such as an EC20 based on endpoints like survival, growth or reproduction. Overall, through the selection of the appropriate endpoint, species and database, the TRVs are consistent with N288.6 guidance. When multiple toxicity values were available for a species then the geometric mean of the toxicity values is calculated and assumed to represent the toxicity value for that species. The geometric mean is selected in order to minimize the bias towards high test results.

SSD curves are presented in the TRV Appendix V.2 for the COPCs that exceeded WQG (i.e., aluminum, chloride, fluoride, iron, nitrate, sulphate, arsenic, cobalt, silver, thallium) and for COPCs with no available WQG (i.e., potassium). A qualitative approach is taken for the assessment of TDS.

Selenium

The SSD approach was not taken for selenium. For selenium, potential effects to aquatic receptors are assessed through consideration of bioaccumulation in fish.

Water quality benchmark

There are several water quality benchmarks available for selenium. The CCME guideline is 1 µg/L (CCME 2025). This value can be traced back to the 1987 guideline document (CCREM 1987). Based on the rationale provided, the value of 1 µg/L was adopted from a 1981 recommendation from the International Joint Commission (IJC) based on concentrations of 5-10 µg/L which caused lethality in predatory fish. The SEQG for selenium is 2 µg/L (ENV 2025). It is stated as being adopted from the Alberta guidelines, but the exact rationale is unclear. BC also provides water quality guideline for aquatic life and the value is 2 µg/L, with an alert level of 1 µg/L. This value is based on a weight of evidence approach including food web modelling and reported relationships between impacts and selenium concentrations in water (BC ENV 2014).

The U.S. EPA developed a chronic criterion to reflect reproductive effects of selenium on fish species (U.S. EPA 2016b). The recommended freshwater selenium ambient chronic water quality criterion for the protection of aquatic life is 1.5 µg/L for lentic aquatic systems. This value was derived from fish tissue values via bioaccumulation modelling and is applicable in the absence of steady-state condition fish tissue data.

The U.S. EPA value was adopted as the water quality benchmark. It is acknowledged that there is uncertainty in this value. The CCME guideline of 1 µg/L does not appear to be well supported. Although a guideline of 2 µg/L could be applied (current SEQG and consistent with BC ENV value, which is a recent analysis of information), in acknowledgement of the uncertainty the value of 1.5 µg/L was selected.

Fish tissue benchmark

Special consideration is given to selenium, since it bioaccumulates in fish tissues. A number of criteria and benchmarks are available from various jurisdictions.

Environment and Climate Change Canada and Health Canada (ECCC/HC) conducted a joint scientific assessment of selenium and its compounds in Canada (ECCC/HC 2017). As part of the assessment, ECCC/HC conducted a review of selenium aquatic toxicity and derived a HC5 of 14.7 µg/g (dw) in fish eggs/ovary based on reproductive effects. ECCC/HC (2017) used species-specific conversion factors from the United States Environmental Protection Agency (U.S. EPA) to convert the fish egg/ovary data to whole-body concentrations resulting in a HC5 of 6.7 µg/g (dw) for fish whole-body concentrations. A HC5 for fish muscle was not calculated.

The U.S. EPA developed a chronic criterion to reflect reproductive effects of selenium on fish species (U.S. EPA 2016a). The U.S. EPA (2016a) states a preference for the criteria for fish tissue concentrations and provides a selenium benchmark of 11.3 µg/g (dw) for fish flesh/muscle concentrations.

Recently, a literature review was conducted of studies in which selenium was the primary constituent of concern, to compare tissue concentrations and results of fish population metrics and deformity assessment studies with current regulatory thresholds for the protection of aquatic life in the United States and Canada (Gilron et al. 2021). The U.S. EPA fish tissue-based criteria were found to be protective of fish populations and, at times, overly protective. Canadian water quality guidelines were consistently found to be overly protective.

As detailed in the Selenium Review and Assessment Report (Orano 2018), a site-specific selenium benchmark was derived from the U.S. EPA (2016a) egg/ovary dataset following the U.S. EPA (2013) guidance on site-specific species deletion procedure. Following this procedure, the McClean Lake Operation site-specific benchmark for selenium in fish egg/ovary (FCV) is 19 mg/kg dw. Site-specific data were also used to develop the conversion fish factor for muscle from egg/ovary. Consistent with the approach of the U.S. EPA, fish that were close to spawning (ripe or gravid; taken to be when the ovary comprised at least 10% of the total body weight) were selected. A muscle benchmark of 13.0 mg/kg dw was derived using the site-specific relationship of 1.46, derived from gravid lake whitefish collected from McClean Lake east basin.

Summary for selenium

The selected benchmarks for the assessment of potential effects to aquatic receptors for selenium are summarized in Table 5.2-1.

In addition, based on a review of available information, ECCC/HC (2017) recommended a threshold concentration of 2.0 µg/g (dw) in sediment to protect benthic-pelagic fish and bird species feeding on benthic organisms. The work completed by ECCC/HC in 2017 was adopted as a FEQG for selenium in ECCC (2021).

5.2.1.2 Terrestrial Plants and Invertebrates

Soil Concentrations

Saskatchewan presents SEQGs for soil in a tiered approach. Tier 1 guidelines are the most conservative values; Tier 2 guidelines are presented separately for protection of human and ecological receptors, as available. The Tier 1 and Tier 2 (ecological) SEQGs for the COPCs are provided in Table 5.2-2. The ecological contact component is based on the protection of plants and soil invertebrates coming into direct contact with contaminants in soil. The other ecological component included is based on the protection of livestock or wildlife ingesting contaminants via the incidental ingestion of soil and ingesting contaminants that have bioaccumulated from soil into feed. If an SEQG was unavailable, then the Alberta soil guidelines were used, as this is the primary source of the SEQGs.

Phytotoxicity

The literature has a number of studies relating to negative effects in vegetation related to exposure to sulphur dioxide (SO₂) and nitrogen oxides.

SO₂ is known to have negative effects on plants. SO₂ penetrates the stomata of plants. External factors such as humidity, temperature, and light intensity influence the rate of uptake of SO₂ and thus the degree of injury.

High concentrations of SO₂ over a short duration of exposure are known to cause acute injury in the form of foliar necrosis. However, longer term effects of SO₂ exposure are more important since they occur at much lower concentrations and are cumulative in nature resulting in negative effects such as reduced growth and yield and increased aging which may not be visible or manifested as chlorosis. Dose-response relationships have been developed for various agricultural crops and some temperate forest tree species but data on native herbaceous vegetation are scarce (WHO 2000). The current World Health Organization (WHO) phytotoxic guidelines for SO₂ are 20 µg/m³ as an annual average for forests and natural vegetation (WHO 2000). A lower value of 10 µg/m³ is also provided for lichen. A value of 100 µg/m³ as a 24 hour average, although not officially adopted by the WHO was also used in the assessment (WHO 2000).

Nitrogen containing air pollutants can affect vegetation indirectly, via chemical reactions in the atmosphere or directly by deposition on vegetation soil or water. NO and NO₂ are precursors to tropospheric ozone which is also known to be phytotoxic. Uptake of NO_x (NO and NO₂) in the leaves from wet deposition is generally via the cuticle. As with SO₂, environmental conditions such as humidity and temperature affect the phytotoxicity of NO_x. The WHO (2000) suggests that threshold values are the best way to evaluate the phytotoxic effects of NO_x. They indicate that a critical effects level (CLE) is a threshold that can be used to examine the direct effects of NO_x since the CLE is the concentration in the atmosphere above which direct negative effects on receptors such as plants and ecosystems may occur according to present information.

The WHO provides a CLE for NO_x of 30 µg/m³ on an annual basis. This level is used in the assessment. It was supported by the recent evaluation of nitrogen oxides by the US EPA (2008) that concluded that the existing secondary for oxides of nitrogen of 0.053 ppm (equivalent to 100 µg/m³) are adequate to protect plants from the direct effects of oxides of nitrogen in the ambient air.

For metals, the plant concentration can be compared to levels known to illicit phytotoxicity. A summary of phytotoxicity benchmarks, or TRVs, used in the assessment is provided in Table 5.2-3.

5.2.1.3 Livestock Watering Guidelines

The Saskatchewan guideline values for livestock watering were considered for the assessment and are provided in Table 5.2-4. The guidelines for livestock water are recommended concentration limits above which possible harm to livestock may result. These guidelines are used for the evaluation of predicted surface water concentrations for the consideration of the drinking water pathway for ecological receptors. There is uncertainty in the application of these values to wildlife, but this comparison was completed to evaluate the potential effects from COPCs that do not bioaccumulate and therefore are not considered in the pathways assessment.

5.2.1.4 Wildlife TRVs

Data used to derive TRVs for terrestrial wildlife were preferentially obtained from the Ecological Soil Screening Level (Eco-SSL) documents prepared by the U.S. EPA (U.S. EPA 2005). The Eco-SSL screening process for wildlife toxicity data included a review of primary data sources. During the screening process, data were preferentially selected from dietary studies (oral exposure) with exposure durations that encompass multiple generations and/or critical life stages, and that reported population relevant endpoints (U.S. EPA 2005). Chronic exposure is generally attributed to an exposure duration encompassing a significant portion of a species' lifespan. However, exposure during sensitive life stages, such as reproduction, may produce negative effects within a few days or even within a few hours during gestation and embryo development (Sample et al. 1996). Based on these critical life stages, reproductive studies with exposure durations as short as five days were considered by the U.S. EPA to represent chronic exposures.

The TRVs for terrestrial species were derived from growth and reproduction related LOAEL and No Observable Adverse Effects Level (NOAELs) selected from the Eco-SSL data. Where available, the LOAELs were paired with NOAELs for reference purposes. However, NOAEL values were not always available for respective LOAELs in the same studies. A review of the data showed no consistent advantage or disadvantage to limiting the LOAEL data set to LOAELs that are bounded by NOAELs, so the full set of LOAELs was preferentially used to calculate a geometric mean NOAEL (where data allowed) and a geometric mean LOAEL for each test species.

Historically, the results of toxicity tests on laboratory animals, which were typically limited to test species, were adjusted for other species by applying allometric equations for weight differences between test species and species of interest in the assessment. More recently, the allometric weight adjustment was found to be inappropriate for most COPCs and species when using intake or diet based values (Allard et al. 2010; U.S. EPA 2021). Therefore, the preferred approach was to find toxicity data for species that most closely represent those species evaluated in a particular assessment, referred to as surrogates. In choosing an appropriate surrogate test species, the closest taxonomic group is preferred. A strong relationship between taxonomic distance and prediction success for inter-species extrapolation models based on acute toxicity has recently been shown (Raimondo et al. 2007). Generally, a surrogate species should be within the same Order as the test species. Thus, the use of an appropriate surrogate TRV (if available) was considered to be more realistic than the use of the lowest TRV for the particular class of organisms, which is precautionary but less realistic. Lowest TRVs were used in those instances when no test species were considered appropriate as a surrogate for the wildlife species of interest.

For COPCs without Eco-SSL data (i.e., uranium), a report produced by Sample et al. (1996) from the Oak Ridge National Laboratory was used as the data source. Sample et al. (1996) examined data from different studies and selected an appropriate TRV based on studies in which reproductive and developmental endpoints were considered (endpoints that may be directly related to potential population-level effects), multiple exposure levels were investigated, and the reported results were evaluated statistically to identify any significant differences from control values.

There is no Eco-SSL document for uranium and thus the Sample et al. (1996) data base provides the TRVs for uranium that have been used in risk assessments for exposure of wildlife to uranium. The Sample et al. data for mammalian species were based on a study by Paternain et al. (1989) related to reproduction in mice.

Sample derived a NOAEL of 3.07 mg/kg-d and a LOAEL of 6.13 mg/kg-d from the study. The TRV quoted by Sample et al. (1996) has 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 than uranyl acetate dehydrate molecular weight in converting the molecular dose to uranium dose. The corrected value (5.6 mg/kg-d) can be found in the ATSDR toxicity profile for uranium. It is the oral dose (to parents) at which viability of F1 offspring was reduced. The lowest dose in the Paternain et al. study was 2.8 mg/kg-d. Total implantations differed between treatment and control at this dose only, but there was no dose response in this endpoint, and all parameters of reproductive success were unimpaired at this dose level. For this reason the lowest dose (2.8 mg/kg-d) is considered to be a NOAEL. In this study the LOAEL for uranium from the Paternain et al. (1989) study was adopted. According to the priority substance list assessment report (EC 2006), this value should be considered the NOAEL.

The Eco-SSL database provides TRVs for a number of different species that could be used as a surrogate TRV for other species with similar diets. For example, for molybdenum the TRV for a calf was used as the surrogate for moose. If none of the test species were similar to the ecological receptors selected in this assessment, then the lowest NOAEL and LOAEL TRVs were selected as the conservative default TRV for the ecological receptor.

Table 5.2-5 and Table 5.2-6 provide the TRVs selected for avian and mammalian receptors, respectively. The TRV background material provided in Appendix V.2 discusses the derivation of the recommended TRVs for avian and mammalian terrestrial species, based on LOAEL and/or NOAEL data available in the literature. If no LOAEL was available, the NOAEL was adopted. If no NOAEL was available, it was taken to be half of the LOAEL.

5.2.2 Radiological Reference Doses for Ecological Receptors

The assessment of effects from exposure to radioactive constituents involves estimation of the combined (total) dose which a VC may receive from radionuclides taken into the body as well as from exposure to radiation fields in the external environment. In addition, it is standard practice to take into account differences in the effects of alpha, beta, and gamma radiation.

When evaluating doses from external or internal exposure, dose coefficients (DCs; in units of mGy/d per Bq/g) are used to convert activities of radionuclides (in Bq/g) to doses (in units of mGy/d). Table 5.2-7 shows the selected DCs used for estimating dose in this assessment. The DCs were obtained from Amiro (1997) and Blaylock et al. (1993).

5.2.2.1 Relative Biological Effectiveness (RBE) Factors

Experimental studies of dose-response relationships for different types of radiation inducing a variety of effects in biological systems, ranging from cells in culture to whole organisms, have shown that knowledge of the absorbed dose is not sufficient to characterize the biological response from a given dose of ionizing radiation. To account for the effects of different types of radiation, the absorbed dose (in gray) is often multiplied by a modifying factor in order to account for the RBE. Strictly, the term RBE only applies to observations from experimental studies and is specific to the endpoint and system studied, and to the environmental and

exposure conditions associated with the studies, reference radiation, dose rate, and total dose amongst other factors. When applied to environmental dose calculations for non-human biota, judgmental dose modifying factors (based on experimental RBE data), are often referred to as (biota) radiation weighting factors, or ecodosimetric weighting factors.

Biota radiation weighting factors, based on experimental RBE data are used to determine the appropriate absorbed doses to tissues in plants and animals from exposure to alpha, beta, and gamma radiation. The presence of an alpha-particle component in the total absorbed dose rate to tissue in a plant or animal raises the question of how to take into account the greater effect of alpha radiation in producing biological damage.

In principal, the biota radiation weighting factor should be based on the biological endpoints most relevant for the protection of ecological receptors (e.g., health of a population). A wide range of RBE values for internally deposited alpha particles have been published. Studies suggesting that the RBE of alpha particles may range as high as 200 to 300 tend to be linked to changes in micronuclei and cells and have large uncertainties in dosimetry. Studies suggesting that the RBE of alpha particles may range from <5 to 10 tend to be linked to deterministic effects especially important to population level effects in most species studied, namely, reproductive impairment and mortality for example (e.g., Chambers et al. 2006). Ongoing research at McMaster University suggests there is no evidence for consistent differences in growth rate in fathead minnows fed radium-226 and exposed to x-rays between alpha and x-ray exposure and hence, no evidence of an RBE for such effects (Mothersill 2015).

Through the Equal Representation in Construction Apprenticeship (ERICA) program, the European community has adopted a default alpha radiation weighting factor of 10 for alpha radiation (Beresford et al. 2007), which in turn was based on information provided in the FASSET project (Pröhl et al. 2003) and Chambers et al. (2006). UNSCEAR (2008, Annex E) recommended a nominal (generic) factor of 10 to reflect the RBE for internally deposited alpha radiation.

An RBE of 10 for internally deposited alpha radiation was used in this assessment, which is consistent with the recommendations provided in the N288.6 CSA Standard (CSA 2022).

5.2.2.2 Aquatic Species Reference Doses

Canadian Standard N288.6-22 (CSA 2022), which addresses environmental risk assessments at nuclear facilities and uranium mines and mills, recommends adopting the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR; 2008) recommendations with respect to radiological dose benchmarks. UNSCEAR (2008; Annex E) conducted a review of the available data on effects to biota, both direct and indirect effects (such as population shifts). Data on the effects of exposure to ionizing radiation were reviewed with a significant amount of information developed from follow-up observations of non-human biota in the zone around the Chernobyl nuclear power plant. There is a considerable range of endpoints and corresponding effects levels presented in the literature. Overall, it was concluded that a chronic dose rate of less than 400 $\mu\text{Gy/h}$ (9.6 mGy/d) to any individual in aquatic populations would be unlikely to have any detrimental effect at the population level.

A dose rate of 9.6 mGy/d (400 µGy/h) is the recommended value for use in ecological assessment, consistent with the N288.6-22 CSA Standard (CSA 2022).

5.2.2.3 Terrestrial Biota and Wildlife Reference Doses

Canadian Standard N288.6-22 (CSA 2022) recommends adopting the UNSCEAR (2008) recommendations with respect to radiological dose benchmarks. UNSCEAR conducted a review of the available data on effects to biota, both direct and indirect effects (such as population shifts). They concluded that reproductive changes are a more sensitive indicator of the effects of radiation exposure than mortality and that mammals are the most sensitive animal organisms. Data on the effects of exposure to ionizing radiation were reviewed with a significant amount of information developed from follow-up observations of non-human biota in the zone around the Chernobyl nuclear power plant. There is a considerable range of endpoints and corresponding effects levels presented in the literature. Overall, UNSCEAR concluded that a chronic dose rate of less than 100 µGy/h (2.4 mGy/d) to the most highly exposed individuals would be unlikely to have significant effects on most terrestrial communities.

Therefore, a dose rate of 2.4 mGy/d, based on UNSCEAR (2008) is the recommended dose benchmark for terrestrial biota (birds and mammals) as it is supported by Canadian Standard N288.6-22 (CSA 2022).

The standard N288.6-22 does not provide specific guidance for the assessment of Species at Risk (SAR). However, IAEA (1992) determined a dose threshold value of 1 mGy/d was associated with no observable effects to biota and, therefore, this value can be used to assess SAR.

5.3 Risk Characterization for Aquatic Receptors

The risk characterization phase combines the information gathered in the exposure and toxicity assessment phases and characterizes the potential for negative ecological effects. This section of the report evaluates the risks to aquatic species via comparison of exposure levels to TRVs and reference doses.

Potential toxic effects of COPCs can be measured at different levels of biological and ecological organization. In this study, the potential ecological effects of different non-radiological COPCs on receptors in the aquatic environment were characterized using SSDs, which are a statistical representation of the available toxicity data that pass quality control criteria. Toxicity data are typically available for aquatic species that represent the various trophic levels in aquatic ecosystems.

The locations considered include Sink Reservoir, Vulture Lake, McClean Lake east basin Segment B, and Kewen Lake. Segment B of McClean Lake east basin is presented as this segment represents the outflow from McClean and is the compliance point for meeting water quality guidelines.

Potential radiological effects from COPCs were evaluated using calculated screening index (SI) values, which are determined as the estimated dose divided by the acceptable reference dose. It should be noted that the SI values reported in this section are not estimates of the probability of ecological effect. Rather, the SI values are positively correlated with the potential of an effect, that is, higher index values imply greater potential of

an effect. In this study, a SI value of 1.0 was used to examine the potential negative effects of radiological COPCs as the assessment is based on chronic effects. SI values less than 1.0 indicate that the predicted levels result in radiological doses that are below the corresponding reference dose. Values greater than 1.0 suggest that there is a potential of observing negative effects on some species.

5.3.1 Radionuclides

To assess the potential negative effects of radionuclides to the aquatic environment, the predicted mean and 95th percentile water and sediment concentrations were used to estimate the radiological dose to aquatic receptors, and dose equivalents were calculated with a RBE value of 10. SI values were calculated by dividing the predicted radiological dose by the acceptable reference dose (Section 5.2) as shown in equation (5.3-1):

$$Screening\ Index = \frac{Dose}{Reference\ Dose} \qquad (5.3-1)$$

The calculated SI values are presented in Table 5.3-1. Appendix V.3 provides the details of the dose calculation. A value greater than 1 indicates that the reference dose for an aquatic receptor is exceeded.

From Table 5.3-1, it can be seen that all calculated doses for aquatic receptors are well below the applicable reference dose. The largest SI value (0.14) was calculated for benthic invertebrates in Sink Reservoir at the 95th percentile.

5.3.2 Non-Radionuclides in Surface Water

Potential risks to aquatic receptors were assessed using SSDs. As discussed in Section 5.2.1, SSDs are a statistical representation of all the available toxicity data that pass quality control criteria. While test species that comprise the SSD may not occur within the geographical area of the McClean Lake Operation, the effects levels are still considered as they may be representative of local biota.

As discussed in Section 5.1.2, un-ionized ammonia, cadmium, chromium, copper, lead, molybdenum, nickel, uranium, and zinc are expected to remain below the WQG throughout the modelled environment. Therefore, these COPCs are not discussed in detail in this section. Note that the assessment of the potential effects of selenium is not completed using an SSD but is discussed below with a comparison to fish tissue concentrations.

Figures 5.3-1 to 5.3-11 show the developed SSD curves as well as predicted average concentrations during the 2025, 2030, 2040, 2050, and 2100 calendar years for locations where COPCs are predicted to exceed the water quality objectives. These time points represent current (2025), future operation (2030), during decommissioning (2040, 2050), and post-decommissioning (2100). The 95% protection level from the SSD is the value usually used to establish criteria for the protection of integrity of aquatic communities. Concentrations at or below this concentration are not expected to have effects on aquatic biota. This level is used for the assessment within McClean Lake and downstream. For the assessment of the aquatic species

in the S/V TEMS, a higher value is appropriate as these lakes are part of the management system for the McClean Lake Operation and would not be expected to support a fully functioning ecosystem.

Chloride: As shown in Figure 5.3-1, current concentrations of chloride in Sink Reservoir and Vulture Lake are expected to exceed TRVs for several invertebrate species. The peak concentration is expected to increase during future operation but remains below the 80% protection level. This indicates that there may be shifts to the invertebrate community in Sink Reservoir and Vulture Lake during operations, with more salt-tolerant species remaining. During decommissioning, as the WTPs stop releasing, concentrations are predicted to drop and near 2050 the predicted concentrations are close to the 95% protection level, and well below the available TRVs during in the long-term post-decommissioning period. Chloride levels in McClean Lake east basin and downstream locations are expected to remain below the generic WQG, therefore, no effects are expected.

Fluoride: Fluoride is expected to exceed the SEQG only within Sink Reservoir. Figure 5.3-2 shows that all predicted concentrations are below the 95% protection level on the SSD curve. Therefore, no effects on aquatic biota are expected due to the presence of fluoride.

Nitrate (as N) Figure 5.3-3 shows that currently the nitrate concentration is close to the 95% protection level within Sink Reservoir and is expected to increase but remain below the 80% protection level. In Vulture Lake the concentration remains below the 95% protection level. This indicates that there may be effects on aquatic biota in Sink Reservoir. During decommissioning as the WTPs stop releasing; concentrations are predicted to drop below the 95% protection level. Nitrate levels in McClean Lake east basin and downstream locations are expected to remain below the generic WQG, therefore, no effects are expected.

Potassium: There is no WQG for potassium thus the predicted water concentrations were compared to the SSD curves (Figure 5.3-4). Potassium levels are expected to remain below the TRVs for all considered species in Sink Reservoir and Vulture Lake. Therefore, no effects are expected due to the presence of potassium within the S/V TEMS and no effects are anticipated in the downstream waterbodies.

Sulphate: Sulphate levels in Sink Reservoir and Vulture Lake are predicted to exceed TRVs for a number of species during the operational period (Figure 5.3-5). It should be noted that the SSD curve for Sink Reservoir and Vulture Lake is associated with uncertainty as there is a limited number of species and the hardness at these locations is elevated above the range used to develop the SSD. Invertebrates appear to be the most sensitive species, so there may be shifts to the invertebrate community in Sink Reservoir and Vulture Lake during operations. Sulphate levels in Sink Reservoir and Vulture Lake are expected to decrease to below the lowest effects levels during the post-decommissioning period (i.e., by 2100). Predicted sulphate levels in McClean Lake east basin and Keweenaw Lake are expected to remain below the generic WQG, therefore, no effects are expected.

Total Dissolved Solids: It should be noted that TDS is an integrative constituent which is used as a measure of common ions such as sulphate and chloride in water. TDS is not a robust predictor of toxicity for a range of water qualities (Mount et al. 1997) and thus its toxicity is implicitly evaluated in the assessment of other ions (chloride, fluoride, potassium and sulphate) in this assessment.

As discussed in the Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan, water treatment involves an environmental trade-off. The high TDS water, consisting largely of chloride and sulphate salts, can be fatal for some organisms and negatively affect others. The environmental impact of increased salinity was determined to be acceptable as it is less harmful than elevated concentrations of radionuclides and metals and a change in salinity is not permanent and it is expected that concentrations will return to background when water treatment stops and the organisms can become re-established.

Aluminum: Figure 5.3-6 shows the SSD for aluminum. The SSD is based on a robust dataset of 54 endpoints for 14 species (3 fish, 8 invertebrates, 2 aquatic plants/algae, and 1 amphibian). This figure shows that the most sensitive species are fish. As the toxicity is dependent on several factors, the predicted water quality results are compared to guideline values calculated on the expected chemistry of each waterbody (Table 5.3-2). The FEQG is based on the SSD provided in Figure 5.3-1 and the BC guideline is based on this same SSD with an additional factor of 3 applied (see Section 3.4). B.C. applied a factor of 3 in recognition that there is a lack of data on Canadian species (e.g., only 2 of the 3 fish species are relevant, amphibian is non-Canadian, and sensitive EPT invertebrates are not represented) (B.C. WLRS 2023). Table 5.3-2 shows that aluminum exceedances are limited to the S/V TEMS. Although concentrations are currently below guidelines, the aluminum concentrations are expected to rise in future operations and exceed the FEQG (Sink Reservoir and Vulture Lake) and the BC guideline (Sink Reservoir). Once decommissioning starts, the concentrations decline and will recover to background levels over time.

Arsenic: As shown in Figure 5.3-7, arsenic concentrations are below the 95% protection level during operations and into decommissioning within Sink Reservoir and Vulture Lake. Arsenic was below the water quality objective in all downstream locations in the receiving environment. Therefore, it is not expected that exposure to arsenic will result in any adverse effects on aquatic biota.

Cobalt: For cobalt, shown on Figure 5.3-8, all concentrations in Sink Reservoir are expected to be below the 95% protection level at all times. Cobalt was below the water quality objective in Vulture Lake and all downstream locations in the receiving environment. Therefore, it is not expected that exposure to cobalt will result in any adverse effects on aquatic biota.

Iron: Iron is expected to exceed the SEQG only within Sink Reservoir at the 95th percentile. Figure 5.3-9 shows that all predicted concentrations are below the 95% protection level on the SSD curve. Therefore, no effects on aquatic biota are expected due to the presence of iron.

Selenium: Table 5.3-3 provides the results for the comparison of predicted selenium concentrations in water and fish tissue to the applicable benchmarks (see Section 5.2.1.1). For the Base Case, exceedances of the water quality and fish tissue benchmarks are predicted at the mean and 95th percentile in Sink Reservoir and Vulture Lake. In McClean Lake east basin, only the 95th percentile of fish concentrations are predicted to exceed the fish tissue benchmark. As discussed in CNSC's comments, a population level is expected when the mean fish tissue concentration exceeds 13 mg/kg dw (CNSC 2019). Therefore, population level effects are not expected in McClean Lake. In S/V TEMS, the water quality benchmarks are only exceeded during the operation period; the predicted fish concentrations decline over time during the post-decommissioning period but take longer to recover.

Silver The peak silver concentrations in Sink Reservoir may reach approximately the 90% protection level (Figure 5.3-10), which is above the toxicity data for rainbow trout, the most sensitive species. During decommissioning and post-decommissioning, the concentrations decline below the 95% protection level. The results are similar for Vulture Lake. No effects are expected due to the presence of silver in McClean Lake and downstream.

Thallium Peak thallium concentrations in Sink Reservoir and Vulture Lake (Figure 5.3-11) are expected to exceed the toxicological endpoints for sensitive species (primarily invertebrates) but remain below the 80% protection level. During operations the conditions are expected to be similar to current conditions and the concentrations are expected to decline to levels below all effects levels during the post-decommissioning period (i.e., by 2100). Thallium was below the water quality at all downstream locations in the receiving environment

5.3.3 Non-Radionuclides in Sediment

For the assessment of the potential effects on benthic invertebrates from predicted sediment concentrations, a range of benchmarks were considered: available CCME TEL and PEL guidelines, Thompson et al. (2005) LEL and SEL benchmarks, Liber et al. (2011) NOEC and IC25 values, and Burnett-Seidel and Liber (2013) NE2 benchmarks. As seen in Table 3.4-2, where several toxicity benchmarks exist for a particular COPC, there is a range of data representative of potential effects. Given that each methodology discussed in Section 3.3.2 has limitations, it is considered that the use of the various toxicity benchmarks for the assessment is appropriate. The following discussion focuses on the LEL and SEL from Thompson et al. (2005) for comparison (with some exceptions). Benchmark values from Burnett-Seidel and Liber (2013) are also considered, since these benchmarks were determined specifically for Saskatchewan waterbodies and are considered in the EARMP, which was established to monitor long-term changes in the aquatic environment downstream of uranium mines (CanNorth 2014).

Due to the heterogeneous nature of sediment in general, as illustrated in the measured data (Orano 2025c), a greater emphasis has been placed on predicted mean concentrations (compared to the 95th percentiles). Based on the results presented in Section 3.5, it was observed that sediment benchmarks are exceeded by the average concentration in the S/V TEMS and downstream for arsenic (LEL), molybdenum (LEL, NE2), nickel (LEL), and selenium (LEL, SEL).

The results from the predictive modelling for estimated future sediment concentrations were presented in Section 3.5. Arsenic concentrations (Figure 3.5-29) in Sink Reservoir are predicted to increase in the future; however, the average concentrations are predicted to remain below both the NE2 and SEL benchmarks. Average concentrations of arsenic in Vulture Lake and McClean Lake east basin currently exceed the LEL benchmark, although the concentrations will increase, they will remain below the NE2 and SEL benchmarks (and below current measurements in Sink Reservoir). Arsenic concentrations (mean and 95th percentile) in Keweenaw Lake are expected to remain below the LEL.

Based on the results of the predictive modelling for molybdenum in sediment (Figure 3.5-35), concentrations of molybdenum peaked earlier and have declined to current concentrations. Molybdenum concentrations currently in the S/V TEMs are above the LEL and NE2 benchmark, in McClean Lake east basin (segment B),

molybdenum concentrations are currently below the NE2 but above the LEL with the average concentration predicted to be below the LEL in approximately 2070. Average concentrations in Keweenaw Lake are below the LEL.

Nickel concentrations in sediment are expected to increase under the assumed future operating conditions (Figure 3.5-36). For the S/V TEMS and McClean Lake east basin, the LEL benchmark is exceeded at current concentrations, with higher concentrations predicted for the future. However, predicted average concentrations remain well below the NE2 and SEL benchmarks. Concentrations in Keweenaw Lake are expected to remain below the LEL.

Finally, selenium (Figure 3.5-37) was predicted to exceed the LEL guideline, to varying extents, in the S/V TEMS. In the Sink Reservoir the concentrations are expected to exceed the SEL. Currently in the McClean Lake east basin average sediment concentrations are expected to be below the LEL, but will rise above this benchmark with continued operation, before declining in decommissioning. Consideration was also given to ECCC/HC (2017) threshold of 2 µg/g (dw) in sediment to protect benthic-pelagic fish and bird species feeding on benthic organisms. Concentrations in Sink Reservoir and Vulture Lake are expected to exceed this concentration. In McClean Lake east, the concentration will be just above this value. In Keweenaw Lake the sediment concentrations remain below the LEL and FEQG.

5.3.4 Consideration of Species at Risk

No species at risk were identified in the aquatic community.

5.3.5 Summary of Results of Biological Community Sampling

The implications of these results for the benthic community are discussed using a weight of evidence approach in this section. It is noted that some COPCs do not have a benchmark for comparison (cobalt, silver, thallium) and the benthic invertebrate assessment will encompass these COPC.

The McClean Lake Operation EMP includes regular assessments of benthic invertebrate community in the S/V TEMS, McClean Lake east basin, Keweenaw Lake, and Collins Creek (above and below McClean Lake), as well as at reference lakes. The results and conclusions from these assessments are provided in Volume 1 of the 2025 EP TID (Orano 2025c), with key points summarized as follows.

The long-term benthic invertebrate community within lake depositional habitat has demonstrated that there was a reduction in both abundance and richness in Sink Reservoir and Vulture Lake from baseline to the operational period but generally there were no differences over time or from the normal range in McClean Lake east basin. Furthermore, in Collins Creek, depositional benthic invertebrate community data from the exposure area fell within the normal range for the region and temporal variation was small. The composition of community in Keweenaw Lake was determined to be within the normal range of variation during the operational period and was within the normal range of variation of reference conditions as well (Orano 2025c).

The 1991 and 1995 EAs predicted moderate to major impacts on the biological environment in Sink Reservoir and Vulture Lake, implying impacts to benthic invertebrate abundance and richness outside the normal range of variation in baseline conditions. This appears consistent with environmental monitoring data. As concentrations of some COPCs (arsenic, nickel, selenium) are predicted to increase, effects are expected to continue to be observed in the S/V TEMS.

Currently, the benthic invertebrate community in McClean Lake has shown some subtle differences, suggesting little to negligible effect. Although the concentrations of some COPCs may increase, it is not expected that will result in additional effects, with the possible exception of selenium as concentrations in the future will exceed the LEL. No effects have been identified in the benthic community in Kewen Lake and based on the predicted concentrations, this is expected to continue with no effects identified throughout the operating period.

Fish tissue monitoring has shown that some COPCs are present at levels higher in fish tissue from Sink Reservoir and Vulture Lake relative to reference values. In particular, mean concentrations of selenium in northern pike tissue in Vulture Lake and Sink Reservoir have been increasing over time, with the current levels found in ovaries higher than egg-ovary criteria. The 1991 and 1995 Joint Panel EAs predicted the potential incorporation of metals into fish tissue and predicted “moderate to major” effects in Sink Reservoir and Vulture Lake over the lifetime of the operation. Additionally, the selenium concentrations generally agreed with predictions from the 2018 Selenium Review and Assessment Report. In contrast, selenium concentrations in McClean Lake east basin and Kewen Lake remained low and within expected ranges. Notably, McClean Lake demonstrated a decrease in selenium concentrations between 2016 and 2024, while Kewen Lake showed only minor fluctuations.

The trends in catch per unit effort (CPUE) of northern pike and white sucker suggest potential effects. CPUE values for northern pike in Sink Reservoir and Vulture Lake have decreased since their peak, particularly in 2021 and 2024, which could reflect impacts on the fish populations, potentially related to contaminants such as selenium.

The fish population data collected as per Metal and Diamond Mining Effluent Regulations (MDMER) Environmental Effects Monitoring (EEM) monitoring, indicate that burbot and slimy sculpin in the exposure area showed species-specific and, in some cases, divergent responses in 2022. The main conclusions from the 2022 Phase 7 EEM are that burbot in the exposure area continue to show strong growth and condition performance, coupled with improved Young-of-Year (YOY) abundance in 2022. Slimy sculpin show signs of reduced YOY recruitment in the exposure area despite continued adequate growth and condition. These findings, supported by step-change testing, emphasize the importance of ongoing temporal comparisons, and suggest that while conditions for burbot may be improving, slimy sculpin populations could be experiencing subtle stressors affecting reproduction.

5.3.6 Overall Summary for Aquatic Receptors

The overall evaluation of potential effects involves consideration of the multiple-lines of evidence, which are summarized in Table 5.3-4. Overall, it was found that there are effects to aquatic biota within the S/V TEMS. This includes shifts to the species expected to be present and effects on fish populations. Within McClean Lake east basin, there are some subtle compositional differences within the benthic invertebrate community,

but population levels changes are not expected. By Keweenaw Lake, there are not expected to be any effects on aquatic biota.

5.4 Risk Characterization for Terrestrial Receptors/Wildlife

As described in Section 5.3, the risk characterization phase combines the information gathered in the exposure and toxicity assessment phases and characterizes the potential for negative ecological effects. This section of the report evaluates the risks to terrestrial species via comparison of exposure levels to TRVs and reference doses. This section also includes wildlife that frequent the aquatic habitats (e.g., ducks, moose, muskrat).

Various locations are considered as shown in Table 4.4-4. The location depends on the primary habitat of the receptor (aquatic, terrestrial) and the home range of the receptor. For McClean Lake east basin, the concentration is a spatially weighted average of Segment A and Segment B. This area is appropriate for evaluating population-level effects and is consistent with previous assessments.

5.4.1 Terrestrial Plants and Invertebrates

5.4.1.1 Vegetation and Soil Invertebrates Based on Soil Concentrations

The assessment of the potential influence of air emissions on plants and terrestrial invertebrates is completed through the comparison of the soil concentration to the ecological toxicity benchmark from the generic soil guideline, similar to the evaluations for water and sediment quality. Section 5.2.1.2 provided the ecological component of the guidelines that were specifically based on the protection of vegetation and soil invertebrates. Table 5.4-1 presents the comparison of the predicted soil concentration to these component values and shows that the maximum predicted concentrations for the McClean Lake Mill area and the McClean Lake Operation Small Area (Figure 4.4-2) areas are below the ecological toxicity benchmarks for the protection of plants and terrestrial invertebrates and show no discernible change from background concentrations.

5.4.1.2 Predicted Vegetation Concentrations

Tables 5.4-2 presents the maximum predicted mean and 95th percentile foliage concentration for the McClean Mill Area and McClean Lake Operation Area Small over the assessment period. Since phytotoxicity information is not available for all vegetation types, only foliage is presented in the table, but all of the predicted concentrations can be found in Appendix V.1.

There is a lack of available phytotoxicity TRVs for some COPC. For COPCs with available phytotoxicity TRVs, copper, molybdenum and zinc are predicted to exceed at the maximum 95th percentile concentrations at background, McClean Mill Area, and McClean Lake Operation Small Area. There is expected to be little change between the baseline concentrations and the incremental concentrations associated with current and proposed future activities at the McClean Lake Operation at the predicted mean levels. This indicates that no change is expected on vegetation as a result of emissions from the McClean Lake Operation for these COPC.

For lichen (Table 5.4-3), there is the potential for a measurable change in concentration of several COPC. Unfortunately, there are no appropriate benchmarks in which to judge the potential for an effect. Lichens exhibit a range of tolerances to metals. Some species of *Cladonia*, *Peltigera*, and *Stereocaulon* can tolerate high levels of metals, and may even be found growing on mining spoils or other metal-enriched substrates (USFS 2011). A formal evaluation of the health of lichen at the McClean site has not been undertaken but there is a relative abundance of reindeer lichen at exposure sites and field staff have not reported any obvious signs of stress. This confirms that the model is a conservative representation of the uptake by lichen. Therefore, it is not expected that there would be future effects on lichen.

The potential food-chain impacts for animals that consume vegetation was addressed in the pathways assessment for wildlife.

5.4.1.3 Direct Effect from NO_x and SO₂

The maximum incremental concentrations of NO₂ and SO₂ are presented in Table 5.4-4. Also shown in the table are levels associated with effects on vegetation provided by the WHO.

As can be seen in the table all concentrations are well below the applicable criteria. Therefore, no effects on vegetation are expected as a result of exposure to NO₂ or SO₂ from the current and proposed future activities at the McClean Lake Operation.

5.4.2 Wildlife

Two approaches were taken in order to evaluate the potential for negative effects on wildlife. The first is a comparison of predicted water quality to livestock watering guidelines. In addition, a full pathways assessment was undertaken to assess the exposure by wildlife. This includes the exposure from terrestrial pathways (e.g., soil, vegetation) and aquatic pathways (e.g., drinking water, fish, aquatic plants) so that the total exposure by wildlife is represented.

5.4.2.1 Water Quality Guidelines

In order to evaluate the potential for negative effects on wildlife using waterbodies, the predicted surface water concentrations (average and 95th percentile) in the maximum year were compared to water guidelines for livestock watering (Section 5.2.1.3). Table 5.4-5 shows the comparison of the maximum future predicted concentrations for Sink Reservoir, Vulture Lake, McClean Lake east basin and Keweenaw Lake.

As seen in Table 5.4-5, the maximum future predicted concentration exceeds the guideline for sulphate and TDS in Sink Reservoir and Vulture Lake. The maximum occurs during operation and concentrations will decline during decommissioning into closure. It is noted that there is no guideline for ammonia, iron, or potassium but the effect of these COPCs is expected to be encompassed by TDS. In addition, there are no guidelines for radionuclides; however, water is included in the pathways assessment discussed in Section 5.4.2.2 therefore the exposure to these COPCs is included through that assessment.

5.4.2.2 Radionuclides

The potential negative effects of radionuclides on terrestrial ecological receptors were evaluated by comparing the predicted mean and 95th percentile dose estimates, which were derived using an RBE of 10, to the selected reference dose (2.4 mGy/d). SI values are calculated following the same approach as outlined in Section 5.3.1. Appendix V.3 provides an example of the dose calculation. The exposure calculations consider their total exposure and thus include baseline plus McClean Lake Operation effects as well as background exposures to receptors while they are outside of the study area. Therefore, calculated SI values are compared to a benchmark of 1.0.

The SI values for the equivalent dose are provided in Table 5.4-6. All calculated screening index values are well below a benchmark value of 1.0 in the S/V TEMS and the Collins Creek watershed, which indicates that there are no predicted negative effects to terrestrial receptors in these areas from exposure to radiological dose. The largest SI values (0.18 to 0.24) were calculated for the scaup in S/V TEMS and McClean Lake east basin.

5.4.2.3 Non-Radionuclides

As discussed earlier, negative effects from exposure to COPCs were characterized by the value of a simple SI. The SI value was calculated by dividing the predicted exposure dose by the TRV for each ecological receptor, as shown in equation (5.4-1):

$$ScreeningIndex = \frac{Dose}{TRV} \quad (5.4-1)$$

The SI values reported in this section are not estimates of the probability of ecological effect. Rather, the SI values are positively correlated with the potential of an effect, i.e. higher SI values imply a greater potential of an effect. Different magnitudes of the SI have been used in other studies to screen for potential ecological effects. A SI value of 1 has been used in some instances (e.g. Suter 1991) and is used in this study.

Bear, Beaver, Caribou, Eagle, Fox, Hare, Lynx, Lynx, Mallard, Merganser, Mink, Moose, Muskrat, Ptarmigan, Scaup, Shrew, Wolf	For receptors which are not classified as SAR it is reasonable to evaluate the potential for population-level adverse effects using the TRV based on the LOAELs. The mean and the 95% percentile of the exposure are presented to represent the full range of exposure. For the evaluation of population-level effects, more emphasis is placed on the SI based on the mean compared to the LOAEL.

SAR: Little Brown Myotis, Rusty Blackbird, Snowy Owl, Lesser Yellowlegs	Consistent with CSA Standard N288.6 (CSA 2022) guidance, species at risk are assessed at the individual, rather than population level. The NOAEL TRV is used to assess intakes for species at risk and evaluate the protection of individuals, an assessment endpoint. Both the mean and the 95% Upper Confidence Limit of Mean (UCLM) are presented. The 95% UCLM incorporates the uncertainties considered in a probabilistic assessment and represents a conservative exposure case (i.e., above the average case) that is still within the range of possible exposures (U.S. EPA 1989).

Table 5.4-7 presents the results of the SI calculations for wildlife. The locations that the receptor is evaluated depends on the diet (primarily aquatic vs. terrestrial) as well as the home range. This was discussed in Section 4.4.

Little Brown Myotis: As myotis (bats) can consume both terrestrial insects (e.g. beetles, moths) and emergent aquatic insects (e.g., mosquitoes, black flies) the little brown myotis (bat) was evaluated on airsheds (e.g., McClean Lake Mill Area; Figure 4.4-2) and waterbodies (e.g., Sink Reservoir, Vulture Lake, McClean Lake). The results show potential exceedances of the TRVs for molybdenum and selenium in Sink Reservoir (average and UCLM) during operation and through decommissioning, but by 2100 the SI values are below 1. As the bat is a SARA species, the NOAEL is used to assess potential effects on individuals. The exceedances are slightly diminished on Vulture Lake, and, in McClean Lake east basin, the only exceedances indicated are for selenium. There are no exceedances predicted for bats in Kewen Lake. The 2023 USask surveys indicated high bat activity at the mill, Collins Creek downstream, and Kewen Lake, while other areas showed relatively low bat activity (USask 2024).

Bear: The results are presented for a black bear spending time in the McClean Lake Operation Medium Area (Figure 4.4-2). There are no predicted SI values above 1 other than for those indicated at background exposures, as well as very little change in SI values during the operational period. These results indicate that there are no potential negative effects on black bear from the current and proposed future activities at the McClean Lake Operation. The bear is an important indicator of potential effects of atmospheric deposition on the terrestrial environment (and transfer to terrestrial vegetation, berries, and soil) as well as emissions to the aquatic environment (and uptake by fish).

Beaver: The results are shown for beaver for spending 100% of the time in each of Sink Reservoir, Vulture Lake, McClean Lake east basin, and Kewen Lake. Results show that SI values are below 1 for all COPCs at all locations. The SI values for beaver are relatively low, reflecting the dominant role of terrestrial vegetation in the beaver diet and the limited influence of air emissions on terrestrial vegetation. The beaver serves as a representative for other herbivore mammals with aquatic and terrestrial based diets. In the 2024 survey beaver signs and animals were observed at Sink Reservoir, Vulture Lake, McClean Lake east basin, Collins Creek, and Kewen Lake (Orano 2025c).

Blackbird: Similar to the little brown myotis, the rusty blackbird was evaluated on airsheds (e.g., McClean Lake Mill Area) and waterbodies (e.g., Sink Reservoir, Vulture Lake, McClean Lake). The rusty blackbird is a species of special concern in the SARA registry (Government of Canada 2024) and identified in Volume 1 of the 2025 EP TID (Orano 2025c) as potentially occurring within the local assessment boundary. The rusty blackbird serves as a surrogate species for the assessment of potential exposures to other avian insectivores, such as the common nighthawk and olive-sided flycatcher. The rusty blackbird was assessed spending 100% of the time in each of McClean Mill Area, Sink Reservoir, Vulture Lake, McClean Lake east basin, and Kewen Lake (Figure 4.4-2). The results show potential exceedances of the selenium LOAEL and NOAEL for the Base Case scenario. The exceedances are slightly diminished for the rusty blackbird on Vulture Lake, and, in McClean Lake east basin, the exceedances expected to decline such that the SI is below 1 in the post-decommissioning period. There are no exceedances predicted in Kewen Lake.

With respect to predicted selenium concentrations for the various scenarios, it is noted that a study conducted at the Key Lake uranium operation in northern Saskatchewan (Weech et al. 2011) found that eggs of tree swallows (similar invertebrate diet to that assumed for the rusty blackbird) had elevated selenium concentrations in proximity to the exposure area than the reference area; however, the difference in egg selenium concentration did not translate into a reproductive effect, and tree swallows had similar reproductive success at the exposure and reference areas. Also as part of the study, aquatic invertebrates were collected from various locations downstream of the uranium milling facility and at a reference area and the average selenium concentrations in aquatic invertebrates from the exposure areas (6.8-43 µg/g dw) were elevated above the lowest suggested dietary threshold for reproductive impairment in birds (~5 µg/g dw; Ohlendorf 2003). These elevated selenium concentrations in aquatic invertebrates did not result in observable negative impacts to tree swallows breeding downstream of the treated effluent discharge. The predicted benthic invertebrates concentrations outside of the S/V TEMS under the Base Case scenario would be well within the bounds measured at Key Lake (Weech et al. 2011).

Caribou: The results for caribou in the McClean Lake Operation large area (Figure 4.4-2) 100% of the time. All predicted SI values for caribou are below 1. The atmospheric pathway is an important pathway of exposure for caribou since their diet is composed mainly of lichen. Constituent concentrations in lichen are linked directly to constituents in air through direct deposition and nutrient uptake from air. The assessment was conducted using the woodland caribou as a conservative representative of the barren-ground caribou which would spend considerably less time within the local assessment boundary. The woodland caribou is listed as a threatened species on the SARA registry and woodland caribou preferential habitat makes more than half of the local assessment boundary area (Orano 2025c).

Eagle: The eagle is assumed to be present 100% of time in the Collins Creek watershed downstream of McClean Lake (Figure 4.4-2). All SI values are below 1 during the operational period and decommissioning. The eagle was selected as surrogate for exposure for other large piscivore birds such as the osprey, peregrine falcon, and golden eagle; as well, the bald eagle was identified in Volume 1 of the 2025 EP TID (Orano 2025c) as a bird species recorded within the LAB.

Fox: The fox is assumed to be present 100% of time in the McClean Lake Medium Area (Figure 4.4-2). All SI values are below 1 during the operational period, with the exception of selenium. Fox is not a species at risk, thus the best comparison for evaluation of potential effects is to the LOAEL. In this case, the average SI stays below 1, with only the 95th percentile exceeding an SI of 1. Background exposure to selenium is just below an

SI of 1 at the 95th percentile. The exposure to selenium is through the consumption of ducks that spend time at waterbodies in the area. The fox and lynx serve as a surrogate for exposure to other small carnivorous mammals.

Hare: The hare is assumed to be present 100% of the time at the McClean Mill Area and in the McClean Lake Operation Small Area (Figure 4.4-2). There are no predicted SI values above 1 other than for those indicated at background exposures (molybdenum at the 95th percentile), as well as very little change in SI values during the operational period. This reflects the negligible contribution of aerial emissions of constituents of concern to the terrestrial environment, which forms the predominant exposure pathway for this receptor. The hare serves as a surrogate for exposure to other small herbivore mammals such as squirrels and voles.

Lynx: Similar to the fox, the lynx is assumed to be present 100% of the time in the McClean Lake Operation Medium Area (Figure 4.4-2). There are no predicted SI values above 1 other than for those indicated at background exposures, as well as very little change in SI values during the operational period. This reflects the negligible contribution of aerial emissions of constituents of concern to the terrestrial environment. The fox and lynx serves as a surrogate for exposure to other small carnivorous mammals.

Mallard: The mallard is assumed to be present 100% of the time in each of Sink Reservoir, Vulture Lake, McClean Lake east basin, and Kewen Lake. SI values are above 1 for selenium and arsenic at the 95th percentile in Sink Reservoir through the operating period. Further downstream in Vulture Lake, there are not expected to be any exceedances. As it is only at the 95th percentile and within Sink Reservoir, it is unlikely that there would effects on mallard.

Merganser: As mergansers eat fish, higher SI values for selenium are shown. SI values above 1 are predicted in Sink Reservoir at both the mean and 95th percentile throughout the operation period. In Vulture Lake, the SI values are above 1 only at the 95th percentile. SI values stay below 1 in McClean Lake east basin and Kewen Lake. Therefore, any potential effects on merganser would be limited to the S/V TEMS.

Mink: The mink is also assume to reside 100% of the time at each of the exposure waterbodies. The results show that the SI values are above 1 for selenium in the S/V TEMS and McClean Lake east basin. In Kewen Lake only the 95th percentile compared to the NOAEL exceeds, therefore no effects are expected in this waterbody. Fish plays a significant role in the mink diet. Based on these results for the selenium, the potential effects to mink extend beyond the S/V TEMS. The exposure decreases with the cessation of treated effluent discharge, although is still elevated at 2100. In addition to selenium, a potential concern related to molybdenum is identified, but only at the 95th percentile (the LOAEL is the preferred comparison). Based on baseline and recent surveys, mink are present within the local assessment boundary, and generally forage along creeks and rivers, both in the water and in the riparian zone. The general lack of stream channel and riparian habitat within the S/V TEMS suggests that the presence of mink would be low, with Collins Creek providing more suitable habitat. It is also unlikely that a mink would spend all of their time at one of these waterbodies. The recent survey confirmed that mink are present at Kewen Lake, McClean Lake east basin and Collins Creek, while no signs of mink were observed at Sink Reservoir and Vulture Lake (Orano 2025c).

Moose: The results for a moose on the S/V TEMS (approximately 1 month per year) and Collins Creek downstream (12 months per year) are presented. There are no predicted SI values above 1, as well as very

little change in SI values during the operational period. These results indicate that there are no potential negative effects indicated for moose from the current and proposed future activities at the McClean Lake Operation.

Muskrat: The results for the muskrat at Sink Reservoir, Vulture Lake, McClean Lake east basin, and Kewen Lake are presented. In Sink Reservoir, compared to the LOAEL, predicted mean and 95th percentile concentrations of molybdenum exceed the TRVs, with 95th percentile exceedances for selenium. For the NOAEL there are more issues with selenium and for cobalt (95th percentile). In McClean Lake and Kewen Lake there are predicted exceedances for the LOAEL comparison. Muskrat were included in the assessment as it is recognized as a sensitive assessment endpoint with a dietary habit that includes higher consumption of bottom sediments compared to other receptors and organisms present in the area. In the 2024 survey muskrat signs and animals were observed at Collins Creek, but not at Sink Reservoir, Vulture Lake or McClean Lake east basin (CanNorth 2025).

Owl: The snowy owl is a SAR, so the primary comparison is the UCLM to the NOAEL. There are no predicted SI values above 1 in the McClean Lake Operation Medium Area (Figure 4.4-2), as well as very little change in SI values during the operational period. This reflects the negligible contribution of aerial emissions of constituents of concern to the terrestrial environment. The snowy owl also serves as a surrogate for potential exposures to other avian consumers of small mammals such as the boreal owl and northern hawk owl.

Ptarmigan: The results for the ptarmigan in the McClean Mill Area and McClean Lake Operation Small Area (Figure 4.4-2) are presented. There are no predicted SI values above 1, as well as very little change in SI values during the operational period. This reflects the negligible contribution of aerial emissions of constituents of concern to the terrestrial environment.

Scaup: The results for the scaup 100% of the time at each of Sink Reservoir, Vulture Lake, McClean Lake east basin, and Kewen Lake have been summarized. In Sink Reservoir there are predicted exceedances of the selenium compared to the LOAEL at the mean and 95th percentile. In Vulture Lake the exceedances are limited to the 95th percentile and there are no exceedance in McClean Lake east basin and Kewen Lake. A comparison of the SI values for the mallard and the scaup illustrates slightly higher values from the scaup. This is reflective of the greater proportion of benthic invertebrates relative to aquatic vegetation assumed in the scaup diet.

Shrew: The shrew is assumed to be present 100% of the time at the McClean Mill Area and in the McClean Lake Operation Small Area (Figure 4.4-2). There are no predicted SI values above 1 other than the 95th percentile compared to the NOAEL, which are similar to background.

Wolf: The wolf is assumed to be present in the McClean Lake Operation large area (Figure 4.4-2). There are no predicted SI values above 1 other than for those indicated at background exposures, as well as very little change in SI values during the operational period. This reflects the negligible contribution of aerial emissions of constituents of concern to the terrestrial environment.

Yellowlegs: Yellowlegs is evaluated on each of the local waterbodies - Sink Reservoir, Vulture Lake, McClean Lake and Kewen Lake. It is a SAR species and therefore the primary comparison is the UCLM compared to

the NOAEL. The results for Sink Reservoir show potential exceedances of the arsenic, molybdenum and selenium, with a potential concern with nickel identified near the end of the operating period. Yellowlegs consume a lot of benthic invertebrates that are expected to accumulate COPCs through the operating period. After operations cease, the concentrations decline and by 2100, only selenium is identified as a potential concern. The exceedances are slightly diminished Vulture Lake, and, in McClean Lake east basin, only selenium is identified (along with chromium although chromium levels in sediment seem to be naturally higher in McClean Lake compared to upstream (Orano 2025c). There are no exceedances predicted in Keweenaw Lake.

Janz et al. (2010) found that hatchability is the most sensitive endpoint for birds for selenium. Selenium concentrations in water between ~1 and 3 µg/L have been shown in several studies (Lemly and Smith, 1987; DuBow, 1989; Skorupa and Ohlendorf, 1991; BC MOE, 2014) to be suitable for aquatic bird predators, with consideration of food chain transfer (EC/HC 2015). The selenium water concentrations (mean and 95th percentile) at different time periods were provided in Table 5.3-3. From this information it can be seen that selenium concentration in McClean Lake east basin are below this range through the operating period and decommissioning.

Whether the incremental effect from selenium poses an unreasonable risk is not certain. The two lines of evidence in the ecological assessment (calculated SI values and field evidence from other sites) are not in agreement. On-going period biological monitoring, such as fish tissue, should be continued to support the ERA.

5.4.2.4 Consideration of Species at Risk

Consistent with CSA Standard N288.6 (CSA 2022) guidance, species at risk are assessed at the individual, rather than population level. The NOAEL TRV is used to assess intakes for species at risk and evaluate the protection of individuals, an assessment endpoint. Several receptors considered in the assessment were identified as species at risk: little brown myotis, rusty blackbird, woodland caribou, snowy owl, and yellowlegs.

All SI values for radioactive dose are low. As seen in Table 5.4-6, the highest SI for a SARA species is 0.21 for a blackbird at the Sink Reservoir. Even if a lower benchmark was used (e.g., 1 mGy/d) the SI would remain below 1.

The results for species at risk, presented in the detailed tables, is summarized in Table 5.4-8. For non-radioactive COPCs, no potential issues were identified for caribou or snowy owl. Potential issues were indicated for some species that may be present within the S/V TEMS including little brown myotis (selenium, molybdenum), blackbird (selenium), and yellowlegs (arsenic, molybdenum, nickel, selenium). In McClean

Lake east basin, only exposure to selenium remains a potential concern. No SAR are potentially at risk in Keweenaw Lake.

For selenium, data from Key Lake (Wiramanaden et al. 2010) and information presented for a similar insectivore species in Weech et al. (2011) can be used to put the potential for effects from selenium for the rusty blackbird in context, relative to the predicted selenium concentrations in this assessment. The average selenium concentration in water at Wolf Creek (located at the outlet of Wolf Lake) was 18 µg/L in 2006. Wolf Lake is among the locations downstream of treated effluent considered in Weech et al. (2011) and assessed for effects to reproduction for nesting tree swallows. Predicted selenium concentrations in water (mean and 95th percentile) for the Base Case scenario are below 1 µg/L in McClean Lake east basin and downstream locations (and are below 7 µg/L in Sink Reservoir). Based on the observations of Weech et al. (2011), tree swallow hatchability, clutch size, and production were similar among reference and exposure study sites. The results of the Weech et al. (2011) study suggests that there would not be any effects on birds at the concentrations predicted in Sink Reservoir and McClean lake east basin.

5.4.3 Summary of Results of Biological Community Sampling

A survey of semi-aquatic furbearer species found that species density at the S/V TEMS was the lowest among the four locations surveyed (S/V TEMS, McClean Lake east basin, Collins Creek downstream of McClean Lake, and Keweenaw Lake). The highest species density was observed at Collins Creek downstream of McClean Lake. Species density at McClean Lake was similar between the east and west basins (Orano 2025). These differences may be due to several factors, such as natural differences in habitat, human disturbance at the S/V TEMS, natural population cycles and variability, or the presence of COPCs; however, no apparent trends, which could be attributed to COPCs, were observed downstream of the S/V TEMS.

During small mammal sampling, the Mill area (JEB TMF) produced much lower capture rates per 100 trap nights compared to the reference site, which may be attributed to higher levels of disturbance and/or the cyclical nature of small mammal populations (Orano 2025). Tissue chemistry analysis of voles captured at the mill site indicated that most COPC concentrations were within natural ranges, except for arsenic, zinc, radium-226, and uranium.

The 2018 bird survey indicated that Collins Creek downstream of McClean Lake had the highest species richness, likely due to diverse habitats such as sedge meadows and shrubby areas along the creek (Orano 2025). In contrast, the Keweenaw Lake area had the lowest species richness, likely because of its homogeneous habitat dominated by younger jack pine forest. Bird species richness at the S/V TEMS was lower than at Collins Creek but higher than at Keweenaw Lake, which also likely reflects differences in habitat composition.

The 2023–2024 bat survey showed that bat abundance near McClean Lake was similar to levels observed at the S/V TEMS but lower than at other surveyed locations. The highest bat abundance was recorded at the mill, while Collins Creek and Keweenaw Lake also had higher abundance compared to McClean Lake. Overall, bat numbers at McClean Lake exceeded those at the S/V TEMS but remained below those at the mill and other sites, indicating spatial variation in bat activity across the study area, which is also likely attributed to differences in habitat structure rather than the COPC impact.

5.4.4 Overall Summary for Terrestrial Receptors

The overall evaluation of potential effects involves consideration of the multiple-lines of evidence which are summarized in Table 5.4-9. Overall, it was found that there are may be effects on wildlife that use the S/V TEMS due to the presence of sulphate, TDS, arsenic, molybdenum, selenium including for SARA species. Wildlife surveys show low use of the S/V TEMS area by mammals, likely due to poor habitat quality, which reduces the likelihood of animal exposure to COPCs. The only potential issue identified outside of the S/V TEMS is the potential exposure to selenium within the McClean Lake east basin. Further downstream and within the terrestrial locations, there are not expected to be any effects on terrestrial receptors.

5.5 Uncertainties in the Ecological Risk Assessment

Areas of uncertainty attend a risk assessment. This is due to the fact that assumptions are sometimes made in the assessment either due to data gaps, environmental fate complexities, or in the generalization of receptor characteristics. To place a level of confidence in the results, an accounting of the uncertainty, the magnitude and type of which are important in determining the adequacy of the results, must be completed. In recognition of these types of uncertainties, some conservative assumptions are used throughout the assessment to ensure that the potential for an effect would not be underestimated. Several of these assumptions are outlined below.

5.5.1 Assumptions

As discussed, the water and sediment quality predictions are based on best estimates of future conditions, such as source loads and precipitation, which is a theoretical exercise grounded in operational and monitoring experience and engineering design. The future conditions can be subject to external forces that are not related to the McClean Lake Operation and not within the historical experience. The modelling of future conditions has been completed using reasonable estimates.

Transfer factors were used in the pathways assessment to evaluate the transfer of COPCs through the various environmental media considered in the assessment. In some cases, literature values were used in the absence of site-specific data. There is some uncertainty involved in the use of these transfer factors to predict concentrations in environmental media. Where possible, data collected through the monitoring programs were used to develop site-specific transfer factors. Measured concentrations in environmental media (as available) were compared with model predicted concentrations and the comparison is presented in Appendix III.3. Concentrations of fish, benthic invertebrates, and aquatic plants are estimated based on site-specific information, but there is uncertainty in the application of such site-specific transfer factors to future concentrations that are outside of the observed range upon which they were derived.

The ecological exposure profiles are a source of uncertainty, as receptors adjust and vary their diet according to the food sources available. The characteristics (water, food, and sediment/soil consumption) of ecological receptors were obtained from the literature. These values are generally obtained from animals in captivity or are estimated from allometric equations and may not be fully representative of free-range animals in the wild.

An underestimate of exposure might result from this but there are other conservative assumptions that compensate (e.g., time spent in area exposed to COPC). For example, in general it was assumed that receptors spent all their time on and obtain all of their food from discrete locations at the site, which is a very conservative assumption.

Water quality guidelines were used in screening which COPCs require a more detailed examination of potential effects. Water quality guidelines are developed based on the protection of aquatic life and are set at values where no adverse toxic effects are expected (CCME 2007) and are therefore appropriate for this purpose. However, it is acknowledged that there is uncertainty in these values and different jurisdictions have inconsistent values. This can be due to the date the guideline was developed or different approaches being used. One example is selenium; the Canadian water quality guideline is 1 µg/L and the SEQG is 2 µg/L (the basis of these guidelines was discussed in Section 5.2). The results of the selenium assessment would not be significantly affected by the use of the lower guideline. The water quality concerns identified are still limited to the S/V TEMS and the predicted concentrations in McClean Lake east basin are expected to remain below all guidelines. Another example is aluminum; the B.C. guideline is lower than the FEQG by a factor of 3. Similar to selenium, the results of the aluminum assessment would not be significantly affected by the use of the lower guideline. The water quality concerns identified are still limited to the S/V TEMS and the predicted concentrations in McClean Lake east basin are expected to remain below all guidelines.

In the aquatic environment, potential effects were assessed for aquatic biota through the use of SSD curves, which are a statistical representation of the available and acceptable toxicity data. While test species that comprise the SSD may not occur within the geographical area of the McClean Lake Operation, the effects levels are still considered as they may be representative of local biota. For sulphate, the SSD curve applied to Sink Reservoir and Vulture Lake was associated with TRVs for lower hardness levels than the hardness levels in the S/V TEMS.

TRVs are associated with uncertainty due to the extrapolation of testing on lab species to field conditions as well as a range of receptors. Additionally, toxicity information for a COPC was used regardless of its form in the test procedure, even though this may not be the same form used in the assessment (e.g., an oxide form compared to a more soluble form). It can be difficult to determine the influence of these assumptions. In addition, there is uncertainty associated with the methodologies for developing TRVs and the use of NOAEL and LOAEL values as TRVs; however, the TRVs used in the assessment are considered to be protective of the biological populations at the site. It is acknowledged that there is inherent uncertainty associated with the use of NOAEL or LOAEL values as TRVs as these values are not innately related to biologically relevant thresholds and do not provide information about the actual magnitude of effects in the reported studies; however, they have widespread use in the risk assessment community, in part due to policy decisions (Allard et al. 2010). There is also uncertainty in the interpretation of toxicity studies. The LOAEL for uranium from the Paternain et al. (1989) study was used for the assessment; according to the priority substance list assessment report (EC 2006), this value should be considered the NOAEL. Based on the results of the assessment for uranium, a change to the TRV would not affect the conclusions.

In pathways modelling assessments, constituents present in water are usually considered to be 100% bioaccessible for uptake by ecological and human receptors. Constituents present in soil and sediment, which may be inadvertently ingested by wildlife and humans, are often considered to be only partially bioaccessible for uptake across the gut into the body. However, for the purposes of the current assessment, no adjustment

was made to the bioaccessibility of COPCs ingested by receptors; this implies the bioaccessibility is the same as the form used in the toxicity assessment, which is a conservative assumption.

5.5.2 Implication of Climate Change

The effect of climate change on ecological receptors is complex. It is expected that climate change may result in shifts in receptors (flora and fauna) that may use the area and the potential pathways of exposure (Lassiter et al. 2000; Warren et al. 2018). The implication on fate and transport, including water and sediment quality, is discussed in Section 3; however there may also be changes in receptor characteristics and species interactions used in exposure calculations as a result of climate change (Moe et al. 2012, 2024). In terms of toxicity, there may be increases in an organism sensitivity to exposure to contaminants resulting from other stressors. For example, increased temperatures resulted in an increase in the sensitivity of snails to cadmium toxicity (Kimberly and Salice 2013, 2014). Cumulative effects are also important. Noyes and Lema (2015) discuss that many of the environmental changes associated with climate change have the potential to increase organism susceptibility to chemical toxicity, while, chemical exposures may impair the ability of organisms to cope with the changing environmental conditions.

Overall, it is difficult to predict the implication of climate change on the results of the ERA. Some receptors may move out of the area, while new receptors may arrive. As a wide range of receptors were selected for inclusion in the assessment, with a variety of diets and behaviours, this is unlikely to have a significant effect on the conclusions.

5.6 Summary of McClean Lake Operation Ecological Risk Assessment Results

The ecological risk assessment examined the potential for negative effects on a range of biota, from plankton and invertebrates in the aquatic environment to predators, such as the eagle and wolf. The assessment included all current and previously approved projects and activities in conjunction with the currently anticipated mining and milling schedule over the life of the McClean Lake Operation and into the post-decommissioning period. In general, the predicted risks for the current assessment are comparable to risks presented in the previous assessments (AREVA 2012, 2016a).

Since the submission of the 2016 EP TID (AREVA 2016a) various studies have been undertaken to support the ERA. Several of the studies were used to inform the water and sediment quality modelling as discussed in Section 3. In addition, environmental samples were collected and analyzed for COPCs (e.g., soil, benthic invertebrates in McClean Lake, aquatic plants, fish, vegetation, small mammals). This information was used to more accurately reflect the environmental behaviour of COPCs in the model, with a focus on the uptake of selenium in the aquatic environment. Wildlife and vegetation surveys were undertaken to improve knowledge of the species present in the area. The assessment of effects on aquatic organisms relies on the information collected on the health of the benthic invertebrate population and fish. All of this information, along with the pathways modelling of future conditions, has been integrated into the assessment of potential effects on ecological receptors.

Potential effects to aquatic biota present in the S/V TEMS were indicated from exposure to aluminum, chloride, nitrate, sulphate, TDS, selenium, silver and thallium within the S/V TEMS during the operational period. The

effects of these COPCs within the S/V TEMS are of limited duration, and it is expected that concentrations will return to background when water treatment ends, although the metals will take longer to recover. The level of COPCs in sediment suggests a potential impact due to the presence of arsenic, molybdenum, nickel and selenium. It is noted that molybdenum levels continue to decline after treatment was implemented. The potential for an effect was supported by the benthic invertebrate population studies that showed reduced density and richness in the S/V TEMS. The assessment of potential negative effects of radionuclides to aquatic VCs (aquatic plants, phytoplankton, benthic invertebrates, zooplankton, predator fish and forage fish) indicated that all calculated doses were well below dose rate guidelines; these results are consistent with what was presented in the 2016 EP TID.

A comparison of results predicted for the current assessment with results from the 2016 EP TID and 2018 Se RA for aquatic biota are provided in Table 5.6-1. The assessments found the potential for effects on aquatic receptors limited spatially to the S/V TEMS, with the exception of the selenium in the 2016 EP TID (the Base Case scenario is presented). In this case selenium exceedances were potentially extended into McClean Lake east basin. In the 2018 Se RA and in the updated ERA, all water quality in McClean Lake is expected to remain below the guidelines.

Potential effects were identified for ions such as sulphate, chloride and TDS. As discussed in the Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan, water treatment involves an environmental trade-off. The high TDS water, consisting largely of chloride and sulphate salts, can be fatal for some organisms and negatively affect others. However, these changes are not permanent and it is expected that concentrations will return to background when water treatment stops and the organisms can become re-established.

Wildlife that use the area were also included in the assessment. A wide range of receptors were included such as ducks, moose, and semi-aquatic furbearers that use the aquatic environment and those that use the terrestrial environment including shrew, ptarmigan, caribou and wolf. Several species at risk were identified for inclusion in the assessment: rusty blackbird, snowy owl, little brown myotis, lesser yellowlegs and woodland caribou.

Tables 5.6-2 and 5.6-3 summarize comparisons of predicted results from the current and previous ecological risk assessments. Table 5.6-2 compares the 2025 assessment with the 2016 ERA for all select birds and mammals. Table 5.6-3 compares results from the 2025 ERA with the 2016 ERA and the 2018 Se RA results for birds and mammals with potential selenium risks. Potential risks are indicated at the LOAEL for general species and at the NOAEL for species at risk.

The current assessment found the potential for effects on wildlife that may use the S/V TEMS, consistent with the 2016 ERA (the Base Case scenario is presented) and 2018 Se RA. Although some wildlife will be present in the vicinity of the S/V TEMS, limited habitat and on-going industrial activities in this area will minimize the potential effects of COPC. The potential for effects is limited to the S/V TEMS, with the exception of selenium. For wildlife that use McClean Lake east basin, all assessments found that effects are possible due to selenium and similar receptors are identified as a potential concern. It should be noted that the selenium loads are lower in the 2025 ERA compared to the 2016 ERA and thus the spatial extent of the potential issues is more limited. The spatial extent is similar between the 2025 ERA and the 2018 Se RA, although slightly higher SI values are shown in the current assessment. No effects are expected in Keweenaw Lake.

6 McClean Lake Operation ERA - Human Health Risk Assessment

6.1 Exposure Assessment

6.1.1 Overview

Atmospheric and aquatic emissions from the McClean Lake Operation were used to predict doses and intakes to human receptors in the study area. As outlined in Section 3, the aquatic environment was explicitly modeled; water and sediment quality predictions were made for the S/V TEMS and downstream waterbodies. Similarly, atmospheric emissions from dust re-suspension and radon releases from the site were included in the assessment as discussed in Section 2.

The water quality and pathways models are coupled and were run probabilistically to permit uncertainty in the input parameters to be explicitly accounted for in the model predictions. The magnitude of the uncertainties in the model parameters is reflected in the values assigned to the input parameter distributions discussed in prior sections and in the associated appendices. The pathways modelling results presented below are based on 100 trials.

The ADEPT model simultaneously assesses a project and baseline run. In this assessment, the project run was defined as the historical effluent inputs to Sink Reservoir, the future predicted effluent inputs to Sink Reservoir, and the project emissions to air. The baseline run represented the site with no historical or predicted future effluent/emissions; essentially, the site at background conditions. The results of the project and baseline runs are used to calculate a “project increment”, which represents the contributions from the project above baseline (or background) levels.

In this assessment, soil and inhalation exposures of human receptors, as well as water intakes and diet obtained from local sources (meat, fish, berries, and other traditional food consumption) over the year were evaluated, along with the dermal pathway (a relatively insignificant pathway for non-volatile chemicals); Appendix V.1 provides the predicted intakes for the human receptors. Supermarket foods were not considered in the modelling; therefore, typical intakes for general Canadians from exposure to store-bought market foods (e.g., meat, dairy, grains, vegetables) were considered separately in the assessment. These typical intakes are summarized in Table 6.1-1.

For the evaluation of potential effects from gaseous pollutants (SO_x , NO_2) and particulate, the air concentration is compared directly to a toxicity value. Section 2 provides the details on how these concentrations were derived.

To facilitate evaluation of different phases of the McClean Lake Operation several different timesteps were specifically identified including

- **2025 Current conditions.** This year was selected as it represents the current conditions with both JEB WTP and Sue WTP releasing to Sink Reservoir. It uses the results from the air modelling for the Baseline Operations Scenario (2022 to 2025 and 2035 to 2036).
- **2030 Future operations.** This year represents the future operations where JEB WTP and Sue WTP continue to release to Sink Reservoir. It uses the results from the air modelling for the Maximum Future Operations Scenario (2026 to 2034)
- **2040 Decommissioning.** At this time the JEB WTP has decreased to 2000 m³/y and it is the last year of releases from the Sue WTP. It uses the results from the air modelling for the Decommissioning Scenario (2037 to 2050)
- **2050 Decommissioning.** Both JEB WTP and Sue WTP have stopped releasing by this time. It uses the results from the air modelling for the Decommissioning Scenario (2037 to 2050)
- **2100 Post-decommissioning.** This time is over 50 years past when the WTP releases have stopped. It uses the results from the air modelling for the Post-Decommissioning Scenario (2051 to 2100)

6.1.2 Selection of Human Health COPCs

Water quality guidelines are used to screen which of the potential COPCs require an assessment of potential effects on aquatic biota. As water quality guidelines are based on the protection of freshwater aquatic life, all COPCs are considered in the assessment of potential effects on human health. As discussed in Section 5.1.2, ions, aluminum, and iron are only evaluated for water quality. No toxicity information is available for thallium and a recent review of information (ECCC/HC 2024b) concluded that thallium is of low concern to the general public. Therefore, thallium is not considered to be a human health COPC.

6.1.3 Supermarket Food Intakes

The assessment also considered exposure of people to COPCs from eating supermarket foods. Health Canada has been conducting Total Dietary Studies for many years in an effort to capture estimates of dietary exposures for general Canadians, which requires not only measured concentrations in various supermarket foods but also intake rates of these foods.

Health Canada (2023) developed mean intake rates of food composites for typical Canadians of different age ranges (i.e., infant, toddler, child, teen, and adult) based on the 2015 Canadian Community Health Survey-Nutrition Component. These intake rates are combined with concentrations in supermarket foods (Health Canada 2000a) to develop supermarket food intakes for residents of the area as well as general Canadians.

The estimates of exposure are summarized in Table 6.1-1 for the general Canadian – adult, teen, child, and toddler.

6.2 Toxicity Assessment – Humans

Toxicity is the potential of a chemical causing some type of damage, either permanent or temporary, to the structure or functioning of any part of the body. The toxicity depends on the amount of the chemical taken into the body (generally termed the intake or dose) and the length of time a person is exposed. Every chemical has a specific dose and duration of exposure that is necessary to produce a toxic effect in humans. Toxicity assessments generally involve the evaluation of scientific studies, based either on laboratory animal tests or on workplace exposure investigations, by a number of experienced scientists in a wide range of scientific disciplines in order to determine the maximum dose that a human can be exposed to without having a negative health effect. Levels that are likely to result in no appreciable risks or measurable negative effects are known as TRVs or dose limits.

6.2.1 Drinking Water Guidelines

The Health Canada drinking water guidelines (DWG) were considered for the assessment and are provided in Table 6.2-1. The DWG are based a lifetime of exposure from drinking water. Health Canada guidelines were selected as the basis of the value is provided and preference was given to the health-based component. In the absence of a health-based DWG, the SEQG drinking water guideline was selected, which may be based on operational guideline or aesthetic objective. These guidelines are used for the evaluation of predicted surface water concentrations for the consideration of the drinking water pathway for human receptors.

6.2.2 Radionuclides

Assessment of radiation exposures to members of the public is commonly based on estimation of the incremental effects of a project or site. Such assessments consider the radiation dose received from exposure to external radiation as well as the dose received from ingestion of radionuclides. The human receptor model converts radionuclide intake by the human receptors from the various pathways into a dose. Potential effects from radiation are compared to an incremental dose limit of 1,000 microSieverts per year ($\mu\text{Sv/y}$) (1 milliSievert per year [mSv/y]) recommended by the CNSC for the protection of members of the public. Consideration was also given to Health Canada's dose constraint of 300 $\mu\text{Sv/y}$ (0.3 mSv/y) provided in the Canadian Naturally Occurring Radioactive Materials (NORM) Guidelines (Health Canada 2000b). Doses below the Health Canada level are considered as "unrestricted" and no further action is needed to control doses or materials.

Dose coefficient (DC) factors proposed for the current assessment were taken from values provided by the International Commission on Radiological Protection (ICRP 1996). The recommended ingestion and inhalation DCs are summarized on Tables 6.2-2 and 6.2-3, respectively; immersion DCs are provided in Table 6.2-4.

6.2.3 Non-Radionuclides

The TRVs for humans are intended to protect the most sensitive individuals (i.e., the elderly, pregnant women, and children). For COPCs that have non-carcinogenic effects, the TRVs are based on threshold effects concentrations. For COPCs that have carcinogenic effects (i.e., those COPCs that can cause cancer), the TRVs are based on non-threshold effects.

The COPCs selected for this assessment are, for the most part, considered to be non-classifiable with respect to human carcinogenicity (with respect to the oral exposure route), meaning that there are insufficient human or animal data to indicate that they are carcinogens. The exception to this is arsenic, which is considered to have both carcinogenic and non-carcinogenic endpoints.

Table 6.2-5 provides a summary of the TRVs selected for use in the assessment for oral exposure. The TRVs, health effects (toxicological endpoints), and reference sources for each TRV are provided in the table. A discussion of the rationale for selecting the oral TRVs is provided in Appendix V.2.

6.2.4 Health-Based Values for Gaseous Pollutants and Dust

Exposure to gaseous air pollutants can lead to inflammation of the tissues of the eyes, oxidative stress and upper and lower respiratory symptoms, immunosuppression, and mutations to cells in the body, impacting on lungs, heart, brain, and ultimately leading to disease. Although many air pollutants cause adverse impacts on health, particulate matter (PM), NO₂, and SO₂ have the strongest evidence for public health concerns. Fine particulate matter is an especially important source of health risks, as the very small particles can penetrate deep into the lungs, enter the bloodstream, and travel to organs and cause systemic damage to tissues and cells. PM_{2.5}, being smaller particles, can penetrate deeper into the lungs and enter the bloodstream, causing a wider range of health effects, including cardiovascular and systemic issues, whereas PM₁₀ particles are more likely to cause irritation in the upper airways and eyes, nose, and throat. Therefore, PM_{2.5} is generally considered more hazardous due to its deeper reach and inflammatory potential and is evaluated in this assessment.

Some air pollutants, such as PM_{2.5} and NO₂, have no safe levels of exposure, and can cause health effects even at low concentrations. Therefore, both the WHO and the Canadian Federal Government have derived air quality guidelines based on management limits to improve air quality and protect public health. These are not health-based values and are not considered to be TRVs in this assessment.

This assessment uses the best available health-based limits for exposures to SO₂, NO₂, and PM_{2.5} as shown in Table 6.2-6 along with the critical health effects. Volatile organic compounds, acrolein and benzene, are also considered in the air quality assessment and were carried forward to the risk assessment. The health-based values for these COPCs are also shown in Table 6.2-6. The values were adopted from recent reviews of the literature from ATSDR. It is noted that benzene is also carcinogenic and the chronic value selected is similar to that derived for a carcinogenic endpoint (Health Canada 2021b) with a 10⁻⁵ incremental risk level, so the selected value is protective of all endpoints.

It should be noted that workers are subject to Occupational Exposure Limits. The Occupational Health and Safety Regulations, OC 579/2020, provides an 8-h value of 3 ppm for nitrogen dioxide (equivalent to 5.6 mg/m³), 2 ppm for sulphur dioxide (equivalent to 5.7 mg/m³), and 3 mg/m³ for respirable fraction of particles (LWRS 2020). For acrolein a ceiling of 0.1 ppm (0.2 mg/m³) is provided in the Regulation and benzene is included in other groups such as coal tar pitch volatiles as benzene soluble aerosol of 0.2 mg/m³ (8-h average) is provided (LWRS 2020).

6.3 Risk Characterization for Human Receptors

This section presents the predicted risk of negative health effects to individuals (other than those classified as nuclear energy workers) who could potentially be exposed to COPCs released to the environment from the McClean Lake Operation.

6.3.1 Drinking Water

In order to evaluate the potential for negative effects on people drinking water the predicted surface water concentrations (average and 95th percentile) in the maximum year were compared to drinking water guidelines for human health (Section 6.2.1). Table 6.3-1 shows the comparison of the maximum future predicted concentrations in the McClean Lake east basin as it was not reasonable to assume people would drink from the S/V TEMS.

As seen in Table 6.3-1, the maximum future predicted concentration is below the drinking water guideline for all COPC. It is noted that there is no guideline for ammonia or potassium. Health Canada has indicated that a guideline is not required as these COPCs do not represent a health concern. In addition, there are no guidelines for cobalt, molybdenum, or nickel. However, drinking water is included in the pathways assessment discussed for non-radionuclides and therefore the exposure to these COPCs is included through that assessment.

6.3.2 Radiation Dose Effects

Regardless of where people live or work, they are exposed to radiation from natural sources; in Canada, this ranges from about 1,300 to 21,000 µSv/year. People are exposed to radiation from natural sources, such as: cosmic rays; radionuclides in air, water and food; and external radiation from naturally occurring radioactive elements in the soil, rocks, and building materials used in homes. Table 6.3-2 lists exposure to radiation to some of the common sources of naturally occurring radiation for those living in Canada (AECB 1995), which can add up to 1,000 to 2,000 µSv/year. This information is also illustrated in Figure 6.3-1.

The typical radiation dose for people living in the McClean Lake Operation area may be different than that identified in Table 6.3-2 and Figure 6.3-1. For example, ingestion of caribou in northern Canada has been shown to add 1 to 4 mSv/y, primarily due to the natural background levels of Po-210 (Thomas et al. 2001). This exposure would not be related to the operation of any uranium mine but reflects natural conditions in the area.

Annual incremental doses (i.e. doses above baseline) for the McClean Lake Operation were evaluated for exposure to radionuclides. The incremental mean and 95th percentile annual radiation doses resulting from the McClean Lake Operation for the seven receptors are summarized in Figure 6.3-2. All predicted mean and 95th percentile incremental annual doses are well below the CNSC recommended incremental dose limit of 1,000 µSv/year and the Health Canada dose constraint of 300 µSv/year, and are expected to be within the range of variability of radiation dose from natural sources. In most cases the incremental doses are in the order of 5 to 10 µSv/year. For the JEB Camp worker, doses are in the order of 150 µSv/year.

The majority of the dose for the Wollaston Lake Resident (adult, child, and toddler) is due to the ingestion of foliage (backyard garden produce) and exposure to radon. The maximum 95th percentile incremental annual doses are less than 5 µSv/year for these receptors, with an expected maximum mean less than 3 µSv/year.

The Wollaston Lake Trapper (adult, child, and toddler) is predicted to have the highest incremental annual radiological dose, primarily due to eating mallard from Kewen Lake. Radon and fish also add to the dose. The maximum 95th percentile incremental annual dose for the Wollaston Lake Trapper receptors is around 33 µSv/year (for the toddler), with an expected mean dose for the toddler around 10 µSv/year. The expected mean doses for the child and adult are less than 5 µSv/year.

The Wollaston Lake Lodge Operator receptors (adult, child, toddler) are primarily exposed from eating backyard garden produce (foliage). The maximum 95th percentile incremental annual dose for the Wollaston Lake Lodge Operator receptors is around 12 µSv/year, with an expected mean of about less than 5 µSv/year.

Due to their on-site location, the primary pathway of exposure for the JEB Camp Worker is through radon exposure. The maximum 95th percentile incremental annual dose for the JEB Camp Worker is about 200 µSv/year, with an expected mean dose of less than 150 µSv/year. Radon exposure also represents the biggest exposure pathway for the Rabbit Lake Camp Worker and Points North Worker. However, these worker receptors are much less exposed than the JEB Camp Worker, with maximum 95th percentile incremental annual doses less than 5 µSv/year and expected mean doses of less than 3 µSv/year.

Similar to the other non-worker receptors, the Hatchet Lake Lodge Operator is primarily exposed through eating backyard garden produce (foliage). The maximum 95th percentile incremental annual dose for the Hatchet Lake Lodge Operator is less than 10 µSv/year, with an expected maximum mean dose less than 5 µSv/year.

6.3.3 Non-Radionuclide Effects

6.3.3.1 Non cancer causing COPC

Exposures to non-radionuclides were evaluated as daily intakes. For many non-cancer causing COPC, protective biological mechanisms must be overcome before a negative effect is manifested from exposure to the COPC. This is known as a “threshold” concept. The potential for an adverse health effect is evaluated through a comparison to TRVs. However, it should be noted that exposure above a TRV does not mean that a health effect will occur, but instead means that there is an increased risk of a potential negative health effect.

In this assessment, exposures from the McClean Lake Operation are referred to as “incremental” (above background) exposures and include all of the exposure pathways assessed in the model. Exposures as a result of background exposures when the individual is not in the area are referred to as “baseline” exposures. Both incremental and baseline exposure are calculated in this assessment.

Incremental exposures associated with the McClean Lake Operation were calculated and include soil and inhalation exposures as well as water and food obtained from local sources (meat, fish, berries, and other traditional food consumption) over the year. Baseline exposures were calculated and include soil, inhalation, and water exposures while not in McClean Lake Operation area. Store-bought market foods (e.g., meat, dairy, grains, vegetables) were obtained from literature sources (see Table 6.1-1) and added to the incremental and baseline exposures. The dermal pathway (a relatively insignificant pathway) was not considered in the assessment.

As discussed above, the total exposure to non-cancer causing COPCs includes – baseline, project increment and store-bought food exposures. Additionally, the air exposure pathway is insignificant, and any potential air exposures are converted into an intake and added to the total dose. Estimated exposures to non-radionuclides for the adult, child, and toddler human receptors were obtained from the ADEPT model, described in Appendix III.3. The model calculated annual exposures which were then converted to a daily exposure (mg/(kg d)) by dividing by the body weight (70.7 kg for an adult and 32.9 kg for a child and 16.5 kg for a toddler) and the number of days in a year (365 d). These exposures were compared to the toxicity benchmarks, presented in Section 6.2.

A sample calculation is provided in Appendix VI.1. Figure 6.3-3 presents a graphical summary of the maximum predicted intakes. The appropriate TRVs are also indicated in Figure 6.3-3 for comparison. The figure shows that the predicted intakes for all human receptors are below the applicable TRVs for cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, silver, uranium, and zinc. The child receptors are the most exposed individuals. As seen from this figure, store-bought food accounts for the majority of the exposure, with insignificant exposures associated with the McClean Lake Operation. Thus, exposures to non-radionuclides associated with the McClean Lake Operation do not contribute to adverse health effects in humans.

6.3.3.2 Cancer Causing COPC

For carcinogenic COPCs, a risk is calculated by multiplying the estimated intake (in mg/(kg-d)) by the appropriate slope factor (in (mg/(kg-d))⁻¹). This is shown in equation (6.3-1). The estimate corresponds to an incremental risk of an individual developing cancer over a lifetime as a result of exposure. Carcinogenic risk is defined as follows:

$$Risk = (D_o \times SF_o) + (D_i \times SF_i) \tag{6.3-1}$$

where:

D_o = Dose due to oral (ingestion) exposure (mg/(kg-d));

- D_i = Dose due to inhalation (mg/(kg-d));
- SF_o = Slope Factor for oral exposure (mg/(kg-d))⁻¹;
- SF_i = Slope Factor for inhalation (mg/(kg-d))⁻¹.

The calculated risk is then compared to acceptable benchmarks. In this assessment, an incremental risk level of 1×10^{-5} (1 in 100,000) was used to assess the cancer causing effects of arsenic. Health Canada considers this value to represent an “essentially negligible” risk and is consistent with the recommendations of CSA Standard N288.6 (CSA 2022). In this case, four composite receptors (life-time exposure) and three adult workers are assessed. The composite receptors encompass the lifetime exposure of a receptor and encompasses a toddler exposure for 4 years, then as a child for 10 years, and the exposure of this child as an adult for another 60 years. In simple terms, each composite receptor is exposed throughout their lifetime from toddler through to an adult. The workers are assumed to be exposed for 35 years of their adult life. These are conservative assumptions as people may not be present in the McClean Lake Operation for their entire lifetime and workers may not work at the site for 35 years.

Figure 6.3-4 summarizes the predicted mean and 95th percentile lifetime incremental risks from arsenic associated with the McClean Lake Operation over the period from 2016 to 2100. All predicted mean and 95th percentile incremental risks are less than the acceptable incremental cancer risk level of 1×10^{-5} , which, as outlined by Health Canada, represents an “essentially negligible” risk. The highest mean incremental risk is predicted for the Wollaston Lake Trapper lifetime receptor (0.5×10^{-5}). This is due primarily to drinking water from Collins Creek for 6 months of the year.

As shown in Table 6.2-5, several of the COPCs are carcinogenic but only through the inhalation pathway including cadmium, chromium, and nickel. The maximum incremental air concentrations for cadmium, chromium and nickel were used to evaluate the incremental risk for people exposed via the inhalation pathway. Table 6.3-3 shows that the risks from inhalation of cadmium, chromium and nickel at various locations are insignificant (i.e. well below a risk level of 1×10^{-5}).

6.3.3.3 Gaseous Pollutants and Dust

For the assessment of gaseous pollutants and dust, the exposure to off-site receptors is completed by comparing the maximum predicted concentration to a health-based limits discussed in Section 6.2.4. However, the JEB Camp worker is subject to Occupation Health and Safety (OHS) programs. Exposures to hazards like dust or diesel fumes can occur in any area of a mine site and health benchmarks, which are based on sensitive individuals, are not directly applicable. Short-term exposure (e.g., 1 hour) is not evaluated as it will be adequately addressed by OHS. In recognition that workers are present at the camp for an extended duration, beyond those typically addressed in Occupational Exposure Limits (OELs) (LWRS 2020), a 24-h time weighted average (TWA) value was derived and applied to the JEB Camp worker ($280 \mu\text{g}/\text{m}^3$ for NO_2 and SO_2 and $150 \mu\text{g}/\text{m}^3$ for $\text{PM}_{2.5}$).

The maximum incremental concentrations of NO_2 are presented in Table 6.3-4. As can be seen in the table, no exceedances are expected for NO_2 . The maximum incremental concentrations of SO_2 are presented in Table 6.3-5. As can be seen in the table, no exceedances are expected for SO_2 . Therefore, no health effects

are predicted as a result of SO₂ emissions at the McClean Lake Operation. The predicted incremental concentrations for fine particulate matter (PM_{2.5}) are presented in Table 6.3-6. No exceedances are shown in the table, therefore, no health effects are predicted as a result of exposure to PM_{2.5} at the McClean Lake Operation. As discussed in Section 2, the particulate matter and NO₂ emissions estimates from the assessment scenarios are considered conservative.

The maximum incremental concentrations acrolein and benzene are presented in Table 6.3-7 for different averaging times. Also shown in the table are health-based criteria discussed in Section 6.2.4. As an 8-h occupational limit is not available for these COPCs, the health-based limit was used for the 24-h exposure for the worker. As can be seen in the table, no exceedances are expected for either acrolein or benzene and the incremental concentrations are a small fraction of the health based benchmark (maximum of 3% of the 24-hr value for acrolein). Therefore, no health effects are predicted as a result of acrolein or benzene emissions at the McClean Lake Operation.

In summary, exposure to gaseous pollutants and fine particulate matter associated with the McClean Lake Operation is not expected to result in negative health effects in humans.

6.4 Uncertainties in the Human Health Risk Assessment

There is always inherent uncertainty in risk assessments due to the fact that assumptions are made either due to data gaps, environmental fate complexities, or in the generalization of receptor characteristics. To place a level of confidence in the results, an accounting of the uncertainty, the magnitude and type of which are important in determining the adequacy of the results, must be completed. In recognition of these types of uncertainties, some conservative assumptions are used throughout the assessment to ensure that the potential for an effect would not be underestimated. Several of these major assumptions are outlined below.

6.4.1 Assumptions

As discussed, the water and sediment quality predictions are based on best estimates of future conditions, such as source loads and precipitation, which is a theoretical exercise, grounded in operational and monitoring experience and engineering design. The future conditions can be subject to external forces that are not related to the McClean Lake Operation and not within the historical experience. The modelling of future conditions has been completed using reasonable estimates.

Transfer factors were used in the pathways assessment to evaluate the transfer of COPCs through the various environmental media considered. In some cases, literature values were used in the absence of site-specific data. There is some uncertainty involved in the use of these transfer factors to predict concentrations in environmental media. Where possible, data collected through the monitoring programs were used to develop site-specific transfer factors. Additionally, during the calibration phase, measured concentrations in environmental media (water, sediment, fish, vegetation - as available) were compared with model predicted concentrations to ensure that the predicted concentrations represented the measured concentrations to the extent possible. This helps in reducing the uncertainty in the assessment. The comparisons are presented in Appendix III.3. The fish tissue concentrations are estimated based on site-specific information; however, there

is uncertainty in the application of this site-specific information to future concentrations that are outside of the observed range.

Human receptor characteristics were based on components of the Hatchet Lake survey dietary characteristics and the interactions with the McClean Lake Operation were assumed based on cautious but plausible scenarios of people utilizing the site and surrounding area. The human receptors selected do not represent actual individuals, and it is possible that an individual could have behaviours that do not match with the assumptions of the risk assessment. However, the use of ranges on dietary intakes should capture uncertainty associated with the behavior of individuals. There were some assumptions made in the development of the consumption rates, such as only adults consume Labrador tea. The assessment showed that consumption of foods from the local environment does not add a significant amount of exposure for COPCs. thus these assumptions are not expected to affect the overall conclusions.

6.4.2 Implication of Climate Change

Changes in food-chain structure will likely lead to alterations in the diet, particularly for Indigenous peoples. This may include the gradual replacement of traditional food items by imported foods from other regions, driven by a multitude of factors, including climate change. The FNFNES study for Saskatchewan (Chan et al. 2018) reported that Indigenous people anticipate climate change will decrease the availability of traditional foods and decrease the accessibility to traditional foods. Over half of the participants identified that they could already see the effects of climate change in their territory.

Water quality may also be affected by climate change and this was discussed in Section 3.6.2**Error! Reference source not found..** Climate change is expected to increase the frequency and intensity of wildfires (Hanes et al. 2019). This can cause an increase in COPCs in air, particularly particulate matter, which would impact human health.

Stahl et al. (2013) summarized conclusions from a workshop on climate change and indicated that human actions (including mitigation of and adaptation to impacts of climate change) may have as much influence on the fate and distribution of chemical contaminants as does climate change.

Cumulative risk assessment frameworks that consider multiple stressors have been proposed as a method to fully address the effect of climate change. However, there are none available currently. The lifespan of this project is relatively short (25 years) and the use of conservative assumptions within the risk assessment should account for some climate change effects. Additionally, climate change effects are already being experienced in the McClean Lake Operation area (more extreme events, fires etc.) and while these changes will continue, it is not anticipated that there will be significant climate change effects that would affect the results of the human health assessment.

6.5 Summary of the McClean Lake Operation ERA Human Health Risk Assessment Results

The human health risk assessment evaluated the potential health effects associated with exposures to gaseous pollutants such as NO_x, SO₂ and PM_{2.5}; non-radionuclide COPCs (including arsenic, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, silver, uranium, and zinc); and radioactivity associated with the McClean Lake Operation. The findings are as follows:

- Maximum concentrations of NO₂, SO₂ and, PM_{2.5} are within the health-based values. JEB camp workers are subject to Occupational Exposure Limits as exposures to hazards like dust or diesel fumes can occur in any area of a mine site, therefore the health-based values used in this assessment are not applicable. Based on these comparisons, JEB camp workers are not predicted to experience any adverse health effects.
- The predicted intakes of non-radionuclides (including baseline exposures and supermarket foods) are below levels identified by regulatory agencies such as Health Canada and the U.S. EPA as being safe for individuals. Therefore, negative health effects are not expected.
- The incremental cancer risk from exposure to arsenic by people that reside in the Wollaston Lake community and may trap or work near the site is expected to be negligible.
- The maximum mean incremental dose to people from radiation released from the McClean Lake Operation is below the Health Canada dose constraint as well as the CNSC allowable incremental dose limit for members of the public. This indicates that negative health effects are not predicted.

Based on the overall assessment, no negative effects are expected on human health.

7 Bena and Candy Lakes Ecological Risk Assessment

7.1 Introduction

Surface water samples are collected from Candy Lake and Bena Lake semi-annually (in January and July) as per the approved Environmental Monitoring Program. The 2022 EP TID indicated increasing trends in nitrate measured in Bena Lake. An assessment was conducted in 2024 (Orano 2024b) that reviewed the available information and conducted a preliminary ecological risk evaluation looking at increasing nitrate in Candy and Bena lakes. This included the potential risks to the aquatic ecosystems using an SSD (species sensitivity distribution) as well as the potential for eutrophication due to recent measured nitrate levels. This assessment has been included in Appendix VII.1 and has been summarized in this section, along with other investigations into the impact at Bena Lake.

It should be noted that the measured data has historically been reported as nitrate + nitrite. In well aerated surface waters, such as Candy and Bena lakes, it is expected that nitrate + nitrite will be present as nitrate. That was recently confirmed by collecting additional samples where nitrite values were consistently below detection. Therefore, nitrate + nitrite is taken to be exclusively nitrate in the discussion.

7.2 Bena and Candy Lakes Environmental Modelling

Volume 1 of the 2025 EP TID identified increasing surface water concentrations of most major ions, barium and strontium at Bena and Candy Lakes since completion of the Sue E mining. Increasing concentrations of ammonia (as N), inorganic carbon, nitrate (as N), total nitrogen, pH, fluoride, and nickel were also observed in Bena Lake after the Sue E mining completion. However, concentrations of these parameters generally remained well within available water quality guidelines. The only exception was nitrate (as N) concentrations in Bena Lake which exceeded the SEQG in 2016-2022 but decreased and stayed below the guideline in 2023-2024. No SEQG exceedances were observed in Candy Lake.

7.2.1 Source Term Investigation

A potential source for the elevated nitrate was identified as groundwater flows from the Sue E CWRP (CWRP; Orano 2022a). The pore water from the Sue E CWRP was noted to contain a significant amount of nitrate + nitrite, which is attributed to residues of blasting agents used during mining.

7.2.1.1 Groundwater Modelling

Appendix VII.2 provides an overview of groundwater modelling of the loads from the Sue E CWRP completed in 2025. Peak loads were estimated from peak concentrations and flushing times. The most appropriate flushing time was taken to be 25 years; however, an upper bound flushing time of 50 years was also examined. Figure 7.2-1 shows the estimated groundwater flux of nitrate (as N) to Bena Lake over time under the 50 year flushing scenario. The modelling starts in 2008 and it can be seen that the maximum load is expected to be approximately 35 years from the start of the modelling timeframe (i.e., between 2040 and 2045).

7.2.1.2 Estimated Concentration in Bena Lake

Waterbody attributes for Bena Lake are presented in Table 7.2-1. As seen in the table, the total annual Bena Lake discharge is much higher than the volume, indicating that the residence time is quite short, i.e., the total lake volume is replaced multiple times a year.

As a screening level assessment, the peak groundwater loads were used to estimate the concentrations in Bena Lake. Since the water has shown a change in major ions, that was the focus of this simple dilution calculation. The peak load was assumed to be released into the volume of the annual discharge of Bena Lake (Table 7.2-2). There is no need to account for accumulation of these ions in the surface water of Bena Lake due to the short residence time. It should be noted that this is a conservative assessment as the peak load from the upper bound (50 year flushing) was used; as noted earlier, this peak load is not predicted to reach Bena Lake for at least another decade.

This dilution calculation would be expected to provide a maximum potential upper bound concentration in the future. As seen in Table 7.2-2 even under this conservative approach, the maximum future groundwater loading is not sufficient to result in the concentrations currently seen in Bena Lake or exceed the SEQG. For example, using this approach the maximum nitrate concentration in Bena Lake due to groundwater loadings would be expected to be approximately 0.8 mg/L, but measured concentrations in recent years have been higher than this value and exceeded the SEQG in 2022. Other ions, such as magnesium and potassium, which have shown an increase over time, are not predicted to substantially change due to the groundwater loading. This leads to the conclusion that there must be another source of these parameters to Bena Lake.

7.2.2 Summary of Predicted Water and Sediment Quality

The loading from groundwater affected by the Sue E CWRP was determined to be insufficient to result in increase of nitrate or other parameters in 2016-2024; therefore, additional follow-up work has to be conducted to further investigate this source (Section 8).

7.3 Bena and Candy Lakes Ecological Risk Assessment

7.3.1 Site Characterization

As discussed in Appendix VII.1 phytoplankton and zooplankton were similar between Bena Lake and reference areas. No rare plants were identified. Fish species present included both northern pike and burbot. In Candy Lake, Chlorophyta, Chrysophyta Cyanophyta, Copepoda and Monogonota were the dominant plankton communities. The fish captured from Candy Lake during baseline studies included burbot, northern pike, and white sucker.

7.3.2 Summary of Results of Preliminary ERA

The risk evaluation (Appendix VII.1) looked at current conditions (2016-2023). The 95% UCLM was compared to water quality guidelines. For the protection of aquatic life, nitrate levels were compared to the SSD curve

to evaluate potential effects on aquatic communities. The assessment found that recent nitrate levels presented no risk to the aquatic community in Candy Lake and represented a potentially low risk to sensitive fish species in Bena Lake. The potential for eutrophication was evaluated and as the system has low phosphorus, the nitrate level was not expected to affect trophic status of Bena or Candy lakes.

Overall nitrate was not expected to affect the trophic status of Bena or Candy lakes and was not a concern for ecological receptors.

7.4 Development of a Site-Specific Nitrate Objective for Bena Lake

A site-specific objective (SSO) for nitrate for Bena Lake was developed based on the available information.

As discussed in Appendix VII.1, to investigate the implication of elevated nitrate levels in Bena Lake, an SSD approach was taken. An SSD curve is derived by considering all of the available applicable chronic toxicity data and can therefore be used to investigate potential effects on an aquatic community. The developed nitrate SSD, shown in Figure 7.3-1, has information on 13 species, including endpoints related to invertebrates, fish, and amphibians; therefore, the SSD can be used to directly evaluate toxicity to the aquatic community. It should be noted that the nitrate SSD curve was developed using all reasonable end points regardless of whether the species has been observed in the McClean Lake Operation area. Six of 13 species included in the nitrate SSD curve have been noted in the greater McClean Lake Operation area; however, none of the species were observed in Bena or Candy lakes or Candy Creek.

Table 7.3-1 shows the protection levels based on the SSD for nitrate (as N). As seen in Table 7.3-1, fish are sensitive to nitrate. At both the 95% protection level and 90% protection level, only lake trout are shown to be potentially affected. The lowest toxicity data is the maximum acceptable toxicant concentration (MATC) for the lake trout swim-up fry (*Salvelinus namaycush*) based on a 146-d study on developmental delay to swim-up stage and growth as wet weight (McGurk et al. 2006). The study derived a lowest observable effect concentration of 6.3 mg/L NO₃-N (28 mg/L NO₃) and identified mortality at 200 mg/L NO₃-N (886 mg/L NO₃).

Out of the 5 fish species in the nitrate SSD curve, 3 belong to the order Salmoniformes and the other two are Cypriniformes. Northern pike belongs to Salmoniformes and burbot belongs to Gadiformes. White sucker belongs to the Cypriniformes order and, while it was not found in Bena Lake, the species has been present in Candy Lake.

Consideration was also given to other factors that could affect toxicity (CCME 2012). There is some evidence that increasing hardness would have an ameliorating effect on toxicity, but the effect was not strong enough to be included as a toxicity modifying factor in the guideline derivation. Higher chloride concentrations tended to reduce nitrite toxicity to fishes, as the chloride ion will bind competitively with gill chloride cells thereby limiting the amount of nitrate entering the blood stream; however, this interaction does not appear to reduce the toxicity of nitrate to salmonids. Therefore, no toxicity modifying factors were explicitly included.

In terms of protection levels for aquatic SSDs, the 95% is frequently used to establish criteria for the protection of integrity of aquatic communities. Theoretically, this protection level would ensure that 95% aquatic species would not be affected. However, this does not mean that 5% of the species in natural environments would be

affected. In fact, in natural environments, the 95% protection level has been found to correspond to the no observed adverse effect concentration (NOAEC) based on multispecies, microcosm studies (Giesy et al. 1999) and is generally a factor of 2 to 5 below the values established in field tests (van Straalen and van Leeuwen 2002). Solomon and Giddings (2000) argued that significant effects rarely occur at the 90% protection level because of factors such as variance in exposure and recolonization.

For the SSO for Bena Lake a value of 6.5 mg/L NO₃-N is selected. This is the upper limit of the 95% protection limit. Although the central tendency is typically selected, the upper bound was used in this case in consideration that the most sensitive species, lake trout, are not expected to inhabit Bena Lake. It is noted that this concentration is approximately equal to the lowest observed effects concentration and is still below even the lowest prediction interval of the 90% protection level.

Nitrate adds nitrogen to a system, which can result in eutrophication due to nutrient enrichment. While the SSD approach evaluated direct toxicity to invertebrate, fish, and amphibians, eutrophication is not evaluated through the SSD. Eutrophication of an aquatic system requires excess nitrogen and phosphorus; phosphorus is usually the limiting factor in freshwater systems (CCME 2012). This appears to be the case for Bena and Candy lakes as measured total phosphorus has been <0.01 mg/L for all surface water samples collected over the 2016 to 2024 period. As an additional line of evidence turbidity can be used as an indirect indicator as eutrophication of a system can result in increased turbidity (e.g., due to algal growth). There is no increase in turbidity in Bena Lake. Therefore, it is not expected that the SSO will result a change to the trophic status of Bena Lake.

7.5 Summary

Surface water monitoring at Bena and Candy Lakes has shown historical increases in nitrate concentrations at Bena Lake, with exceedances of SEQG between 2016 and 2022, followed by a decline below guideline levels in 2023–2024. Groundwater from the Sue E CWRP was investigated as a potential nitrate source, due to its potential contamination with the blasting agent residues. The groundwater modelling performed under a conservative 50-year flushing scenario indicated that this loading alone could not account for past elevated concentrations, suggesting additional sources.

A preliminary ecological risk assessment concluded that current nitrate levels pose no risk to Candy Lake and only a low potential risk to sensitive fish species in Bena Lake, with no expected eutrophication due to consistently low phosphorus levels. A site-specific nitrate objective of 6.5 mg/L NO₃-N was established for Bena Lake using a species sensitivity distribution approach, considering local conditions and absence of the most sensitive species. Overall, nitrate concentrations are not anticipated to adversely affect aquatic communities or trophic status, though further investigation into other contributing sources is recommended as described in Section 8.

8 Environmental Monitoring and Study Recommendations

The next section provides a review of the current McClean Lake Operaiton Environmental Monitoring Program (EMP) and outline recommendations for monitoring enhancements and supplementary studies derived from the report findings.

8.1 Environmental Monitoring Program

8.1.1 Meteorological Monitoring

The on-site meteorological station measures hourly temperature, pressure, relative humidity, wind speed, wind direction, and total precipitation suitable for use in air dispersion modelling. No changes to the program are recommended at this time.

8.1.2 Air Quality Monitoring

The current ambient air quality monitoring program includes HVAS measurements of TSP (and adsorbed metals and radionuclides) as well as monitoring of SO₂ and radon. An evaluation of the ambient air monitoring program under the current EMP requires confidence in the air model predictions. As such, this assessment included an evaluation of the model performance by comparing predictions of TSP (and absorbed metals), SO₂, and radon for the baseline operations scenario to available monitoring data for the period 2020 to 2024. Details of the model evaluation can be found in Appendix II.3, which showed that in general, the model had good agreement with measured TSP, SO₂, and radon values. This means that the model predictions for these COPCs were within an acceptable factor of two of monitored values. Similarly, model predictions of cadmium, copper, manganese, molybdenum, nickel, and zinc were within a factor of two of monitored values, also demonstrating good performance. In contrast, the model predictions for arsenic, cobalt, lead, selenium, thallium, uranium, and vanadium, were overestimated by more than a factor of two, illustrating that the results for these COPCs are likely conservative.

Additionally, stack emission testing is completed to collect data that can be used to assess risks to the environment, inform the inputs to the air dispersion model, demonstrate compliance with release limits and objectives, and confirm the effectiveness of control systems.

Overall, the model evaluation lends confidence to the model results presented in Section 2.3, including the isopleths of predicted concentrations shown in Figures 2.3-1 to 2.3-80. These results are used below to evaluate the components of the ambient air monitoring program and provide recommendations for improvements to the EMP.

8.1.2.1 Total Suspended Particulate

Currently, there are four exposure HVAS and one reference HVAS located at the McClean Lake Operation that measure 24-hour TSP concentration on a weekly basis (Table 2.2-6; Figure 2.2-4). Figures 2.3-1, 2.3-2,

2.3-28 and 2.3-29 present isopleths of 24-hour and annual TSP concentrations for the baseline and maximum future operations scenarios, while annual uranium concentrations are presented in Figure 2.3-9 (baseline) and Figure 2.3-36 (maximum future). Uranium is used as a surrogate for all adsorbed metals/radionuclides since this is the metal with the highest predicted concentration relative to its ambient air quality criteria (Sections 2.3.1 and 2.3.2). Due to greater uncertainty in the predictions for the decommissioning scenario, the results are not used to make recommendations for the monitoring program.

In the TSP figures noted above, it can be seen that concentrations are elevated around the JEB area, particularly near the JEB TMF and JEB CWRP due to construction-related activities for TMF expansion. Additionally, TSP concentrations are elevated around the McClean Mining site and Sue F Mining site (in future), as well as the Sue ore transfer pad. There is also influence from unpaved road dust, which is most evident in the annual contour plots where contours are parallel to the roads.

Similar to TSP, the plots of annual uranium concentrations in Figures 2.3-9 and 2.3-36 show the influence of the McClean and Sue F Mining sites and the Sue ore transfer pad. In the JEB area, uranium concentrations are most concentrated around the mill, which is to be expected since the mill is one of the most significant sources of uranium emissions (Section 2.2.6.2).

The exposure HVAS should be situated to capture the influences of TSP and its adsorbed constituents. As shown in the aforementioned figures, HVJ1A is well situated to capture influences from the JEB TMF construction activities, while HVJ2 is well situated to capture influences from the mill. While HVJ3 is not as influenced by these sources, this HVAS unit is important for understanding exposures to workers at the permanent camp. Similarly, HVS1A appears well positioned to capture the potential influences of the Sue F Mining site and Sue ore transfer pad as it is located downwind of these areas. However, the current HVAS network does not appear to capture the potential influences from the McClean Mining site. In all, the locations of the current exposure stations do not need to change. However, it is recommended that one additional exposure HVAS be considered downwind (i.e., southeast) of the McClean Mining site. A potential location for a HVAS may be near the gatehouse; however, siting would need to be confirmed through evaluation against the applicable technical criteria (e.g., mandatory setbacks from roads and trees).

The reference HVAS (HVJ4) should be located upwind of the McClean Lake Operation and in an area where concentrations return to baseline levels. As evidenced by Figures 2.3-2 and 2.3-29 (annual TSP) and Figures 2.3-9 and 2.3-36 (annual uranium), HVJ4 lies outside of the area of influence from McClean mining activities and is in a location where concentrations are approaching near-background levels of annual TSP and uranium concentrations. While 24-hour concentrations of TSP at HVJ4 are predicted to be slightly above background levels, it is noted that the monitor is still outside of the area of influence from the McClean Mining site. Furthermore, the model predictions, particularly for the maximum future operations scenario, are considered conservative and so, it is likely that actual concentrations will be less and closer to background levels. In all, the location of the current reference station HVJ4 does not need to change. However, trends should continue to be monitored to understand whether McClean Mining site activities are influencing HVJ4 measurements.

8.1.2.1.1 Sulphur Dioxide

Currently, SO₂ is monitored continuously at station JM02 downwind of the acid plant (Figure 2.2-4). Isopleths of 1-hour, 24-hour, and annual SO₂ concentrations for the baseline and maximum future operations scenarios are presented in Figures 2.3-18 to 2.3-20 and Figures 2.3-45 to 2.3-47, respectively. Because the acid plant does not operate during decommissioning, results for this scenario are not used to provide recommendations to the monitoring program.

The SO₂ monitor should be situated to capture the influence of SO₂ emissions from the acid plant. As evidenced by the model validation presented in Appendix II.3 and the above-noted Figures, the JM02 station is well situated to capture influences from the acid plant both now and in the future. As such, no changes to the ambient SO₂ monitoring program are recommended at this time.

8.1.2.1.2 Radon

Currently, radon is monitored semi-annually at six exposure stations near the JEB site and 12 exposure stations near the McClean Mining site and Sue area (Table 2.2-6; Figure 2.2-4). One reference station is located near Mallen Lake. Field duplicates and blanks are also included in the program. Isopleths of annual radon concentrations for each of the assessment scenarios are presented in Figures 2.3-27, 2.3-54, 2.3-79, and 2.3-80 and show the current locations of the radon monitors.

Based on a comparison of predicted concentrations near the JEB site relative to the existing monitoring network, it can be seen that the existing monitoring locations provide good coverage. However, the model shows potential influences north of the TMF which is not covered by the existing network. As a result, one additional monitor location north of the JEB TMF should be considered to help understand the influences of this source on radon concentrations.

The monitoring network in the McClean mining and Sue areas were established for mining activities that are no longer planned, such as the McClean underground mine and the Caribou pit. Despite the switch to the SABRE mining method, the model results show that the existing monitoring network still provides good coverage in these areas with consideration to current and future operations (Figure 2.3-27 and Figure 2.3-54), as well as the decommissioning and post-decommissioning phases (Figure 2.3-79 and Figure 2.3-80). For instance, while TE-S6, TE-S8, and TE-S9 do not appear to be currently influenced by the McClean Lake Operation, there is potential for future operations and decommissioning activities in the Sue area to influence these stations later on. As a result, it is recommended that they stay in the program. While TE-M4 does not appear to be influenced by operational or decommissioning activities, it is recommended to keep this station in the program to verify the model predictions. Redundancies have been identified between TE-M3 and TE-M6 due to their close proximity. It is therefore recommended that TE-M6 be removed from the program to optimize monitoring efficiency.

Based on the model predictions in Section 2.3, two areas that do not currently have good coverage by the monitoring network are north of the McClean Mining site and the Sue F Mining site (Figure 2.3-54). To better understand the influences of future Sue F activities, it is recommended that two stations (one to the north and

one to the north east) be installed at least one year ahead of mining. In addition, one additional monitor north of the McClean Mining site is recommended.

Figure 8.1-1 shows locations of the proposed adjustments to the radon monitoring program as follows:

- one additional monitor north of the JEB TMF,
- removing TE-M6 to reduce redundancies,
- one additional monitor north of the McClean Mining site,
- installing two additional monitoring stations to the north and northeast of the Sue F Mining site at least one year before start-up of mining activities so that changes in concentration before and after mining can be better understood.

8.1.2.2 Stack Emissions

The current stack sampling campaign includes the elements summarized in Table 2.4-1. At this time, the current stack sampling campaign is considered sufficient to support the air dispersion modelling assessment.

8.1.3 Aquatic Ecosystem Monitoring

The aquatic components of the EMP that are used in the ERA include monitoring of surface water, sediment, benthos communities, and fish chemistry.

- Surface water samples are collected at reference areas and key exposure locations including Sink Reservoir, Vulture Lake, McClean Lake east basin, McClean Lake outlet, Collins Creek downstream, Kewen Lake, Candy Lake, and Bena Lake. A range of parameters including general chemistry (e.g., pH, hardness), ions (e.g., chloride, sulphate), nutrients (e.g., ammonia, nitrate), metals (e.g., arsenic, selenium, uranium) and radionuclides are included. The sampling frequency varies from weekly to semi-annual depending on a location and monitoring parameters.
- Benthic and sediment samples are collected at reference areas and key exposure lakes including Sink Reservoir, Vulture Lake, McClean Lake East Basin, and Kewen Lake. Sediment monitoring is completed on a three-year sampling cycle.
- Fish chemistry samples (on a three year cycle) are collected at reference locations and Sink Reservoir, Vulture Lake, McClean Lake East Basin, and Kewen Lake.

The routine EMP has also been complemented with Environmental effects monitoring (EEM), as required under the MDMER. The EEM program collects information on fish populations and health and fish habitat, including benthic invertebrate communities, sediment characterization, water quality, limnology and general

habitat descriptions. Sampling areas are located in Collins Creek upstream of McClean Lake and at the McClean Lake outlet. The EEM program data is collected on a three-year cycle and provides complementary environmental monitoring data, which, when combined with the EMP benthic invertebrate, sediment and fish monitoring data provides comprehensive environmental monitoring for the Operation as outlined in Volume 1 of the 2025 EP TID (Orano 2025).

The information from these programs is directly used in the ERA. The water and sediment concentrations are used in the model calibration and validation to provide confidence in the conclusions of the assessment. Appendix III.3 shows that the model has generally good agreement between the predicted and observed values. The information from the fish chemistry program is used to confirm the predictions of fish concentrations and can be used to modify the empirical model. This is particularly important for selenium. The community information from the benthic invertebrate program and fish population is used in a weight-of-evidence in the ERA.

Overall, the EMP and EEM programs provide a strong foundation for the McClean Lake Operation ERA. However, water monitoring in Bena and Candy Lakes is currently insufficient to capture seasonal variability in COPC concentrations, which may undermine assessment of effects related to the observed COPC increase (Section 7). Therefore, it is recommended to increase water monitoring frequency in Bena and Candy Lakes from semi-annual to quarterly.

8.1.4 Terrestrial Ecosystem Monitoring

The terrestrial components of the EMP that are used in the ERA include monitoring of air, soil, and vegetation.

- Air: The ambient air quality program is discussed in Section 8.1.2
- Soil: Soil samples are collected from reference areas and key exposure including the JEB mill and TMF area, McClean Lake area, and the Sue mine area. Soil sampling is completed on a six-year sampling cycle.
- Vegetation: Lichen, blueberry (stems with leaves and berries) and Labrador Tea (stems with leaves) are monitored along with soil.

Overall, the EMP is providing a solid foundation for the ERA and it is recommended to continue with the implementation of the program in the current form.

8.2 Supplementary Studies

Supplementary studies are conducted to achieve specific, well-defined objectives. They complement environmental monitoring by enhancing site-specific understanding of contaminant transfer and addressing emerging, immediate, or time-limited issues. Because these studies must remain flexible in timing and application, they are carried out outside the EMP. Based on findings presented in Sections 2 to 7, several supplementary studies have been recommended.

8.2.1 Air Dispersion Modelling

As discussed in Section 2.2.6, the air emissions inventory often assumed that emission rates of TSP, PM₁₀, and PM_{2.5} were equivalent which can result in conservative predictions for fine particulate matter. Since these predictions are an important input to the human health risk assessment (Section 6), a supplementary study including stack tests for particle size distribution is recommended before the next air modelling update. The data are to be used to refine emission estimates of PM₁₀ and PM_{2.5} from the mill and incinerator stacks.

As described in Section 2.2.6.1.1, default material properties such as silt and moisture content were applied in the emissions calculations for fugitive dust releases in the absence of site-specific data. A lack of site-specific data can lead to uncertainty in predictions of TSP (and adsorbed constituents). As such, it is recommended that where feasible, site-specific investigations of silt and moisture content be completed for the ore pads (coarse and fines), waste rock, and roadbed material.

In addition, the air dispersion modelling results showed elevated concentrations of NO₂ around the McClean Mining site and Sue F Mining site (in future) that exceeded the 1- and 24-hour SAAQS (Section 2.3). While no exceedances were predicted to occur outside of the lease boundary, it is recommended that a monthly passive NO₂ monitoring program be completed to understand the influences of SABRE mining activities on ambient NO₂ concentrations. Passive monitors are a cost-effective sampler type that are recommended over continuous sampling due to the uncertainty with the air model predictions.

Results of the above studies will be used to inform future air dispersion modelling updates.

8.2.2 Bena and Candy Lake Ecological Risk Assessment

As discussed in Section 7, surface water concentrations of most major ions have increased in Bena Lake, along with elevated levels of barium and strontium in both Bena and Candy Lakes. Additional increases in ammonia (as N), inorganic carbon, nitrate (as N), total nitrogen, pH, fluoride, and nickel were also observed in Bena Lake. These trends might be attributed to the nearby Sue E CWRP, but available data are insufficient to determine the pathways and assess potential ecological effects; therefore, the following studies are proposed:

- **Source Investigation:** To evaluate the potential impact of COPC loadings to Bena Lake, the source must be clearly identified. As noted in Section 7, groundwater loading alone does not account for the observed changes; therefore, additional follow-up work is required to investigate potential COPC pathways from the Sue E CWRP to Bena Lake.
- **Environmental Data:** In addition to the proposed increase in water monitoring frequency (Section 8.1.3), sediment, benthos, and fish sampling should be conducted in Bena Lake and compared to the 2003 baseline dataset. This will provide insight into whether observed concentration changes have had any effect on the aquatic biota.

Once COPC pathways to Bena Lake are better understood and additional ecological data are collected, a follow-up ecological risk assessment can be implemented to support risk-based decisions for this area management.

9 Summary and Path Forward

9.1 Background

To provide a comprehensive understanding of the McClean Lake Operation performance and its interaction with the surrounding environment, Orano undertook the initiative to compile and summarize the relevant environmental studies into the 2025 Environmental Performance Technical Information Document (EP TID) as follows:

- Volume 1 of the 2025 EP TID contains a repository of environmental information, the evaluation provides a basis to understand current project-environment interactions.
- Volume 2 of the 2025 EP TID (this document) characterizes current and potential future risks over the remaining lifecycle of the project using the environmental risk assessment (ERA) methodology in line with CSA Standard N288.6 *Environmental Risk Assessments at Nuclear Facilities and Uranium Mines and Mills* (CSA 2022) and based on past and anticipated future activities.

This document (2025 EP TID Volume 2) provides an update of the air dispersion modelling assessment, the water and sediment quality assessment, and the ERA to evaluate the potential effects of the McClean Lake Operation on the environment, which benefited from the use of a variety of site-specific environmental data that has been collected at the site and presented in Volume 1 of the EP TID. The 2025 ERA predictions have been compared to predictions made in the original environmental assessments (EAs) for the McClean Lake Operation reviewed by the Joint Panel (COGEMA 1995; Minatco 1991). Table 9.1-1 provides a summary of the approved predictions. The 2025 ERA predictions were also compared to complementary EAs performed for different projects on the McClean Lake Operation and Midwest leases (AREVA 2004, AREVA 2009; AREVA 2011), and the past ERA iterations (AREVA 2012; AREVA 2016; Orano 2018).

The key future activities of the current mine plan considered in the 2025 ERA include:

- the JEB Tailings Management Facility (TMF) expansion,
- mining of McClean North, Sue F, and Midwest deposits with SABRE,
- hauling and continued milling of ore from the following deposits: Cigar Lake, McClean North, Sue F, Sue B, and Midwest to the year 2036,
- water management and treatment at the JEB Water Treatment Plant (WTP) to 2038 and at the Sue WTP to 2040, and
- demolition and reclamation at the end of the operation life.

As outlined in the 2016 EP TID Volume 2, with milling of Cigar Lake ore, an increasing trend in selenium concentration reporting from the JEB WTP has been identified. Since 2016, Orano has significantly improved its understanding of selenium sources and fate within the McClean Lake Mill and water treatment plant processes, implemented a number of adaptive management initiatives for enhancement of selenium control in the mill, JEB TMF, and Sink/Vulture Treated Effluent Management System (S/V TEMS), developed the administrative level, action level, and exposure based release limit (EBRL) for selenium concentrations in the JEB WTP effluent, and upgraded the JEB WTP with the ferrous sulphate treatment system to enhance selenium removal. The Base Case scenario presented in Sections 3 to 6 of this document is based on the current mine plan with active selenium treatment, applied to keep the average selenium load in the JEB WTP effluent below the EBRL. The Base Case scenario without selenium treatment has also been considered as presented in Appendix III.4.

Additionally, the potential environmental effects on Bena and Candy Lake due to nitrate transfer from the Sue E Clean Waste Rock Pile (CWRP) are discussed in Section 7.

An overall summary of the conclusions of each of the ERA components is provided in the following sections.

9.2 Noise and Vibration

The noise and vibration assessment conducted in the 2012 EP TID was considered appropriate for future McClean Lake Operation activities, except for the Surface Access Borehole Resource Extraction (SABRE) mining method, which was not included in previous ERAs. To address this gap, a noise and vibration assessment for SABRE mining was completed in 2025. The results showed that SABRE noise levels are marginally higher (less than 1%) than those anticipated in the 2012 EP TID for the McClean Mining project, and SABRE vibration attenuates to background levels within 90 meters of the mining pad. Together, the 2012 and 2025 assessments are deemed sufficient for all future McClean Lake Operation activities; therefore, no further updates are required.

9.3 Air Dispersion Modelling

Air dispersion modelling of atmospheric emissions from the McClean Lake Operation was undertaken to evaluate the potential short- and long-term effects to ambient air quality from mining and milling operations. The CALMET/CALPUFF air dispersion modeling package was used to predict the potential effects of the McClean Lake Operation on local and regional air quality at gridded receptor locations and at the discrete ERA receptors and ERA airsheds. Where applicable, background concentrations were added to model predicted Constituent of Potential Concern (COPC) concentrations and compared to applicable air quality criteria.

Overall, the air quality assessment showed that the potential effects of the McClean Lake Operation on ambient air quality in the air modelling local and regional study areas are minimal and limited to occasional exceedances of 24-hour TSP and particulate matter (PM₁₀) standards in areas to the north of the JEB site and within 1 km of the lease boundary. For all other COPCs and averaging periods, concentrations were predicted to be less than the applicable standards, criteria or guidelines at all locations beyond the property boundary.

In addition, radon concentrations were predicted to be at or less than the background level of 15 to 25 Bq/m³ at locations beyond the property boundary. These findings are consistent with the findings presented in the 1991 and 1995 Environmental Impact Statements (EISs) and 2016 TID. Results from the air dispersion modelling were also subsequently used as inputs to the pathways model for the assessment of potential effects on ecological and human health.

9.4 Water and Sediment Quality from Wastewater Release

An assessment was undertaken of the potential effects of effluent discharge at the McClean Lake Operation. The assessment focused on the prediction of water and sediment quality within and downstream of the S/V TEMS. The potential effects of the current and proposed future activities at the McClean Lake Operation within the Collins Creek watershed depend on the quantity and quality of WTP flows and Collins Creek flow conditions.

At the McClean Lake Operation, the S/V TEMS has been in operation since 1996 and an extensive record of monitoring information has been acquired during this time. This information provides a comprehensive basis from which to derive model inputs to facilitate the accurate prediction of water and sediment quality expected within continued operation.

The enhanced probabilistic watershed model ADEPT was used to assess the fate of COPCs in the surface waters and sediments within the S/V TEMS and the lake and river segments of the Collins Creek watershed. The ADEPT program was designed to simulate the effects of contaminant input on surface water and sediment quality in the downstream environment. The important processes incorporated into the model include horizontal (lateral) and vertical transport of dissolved species, chemical and biochemical reactions, settling of particulate matter, and sediment exchange. The movement of various chemical species into and out of the sediment exchange zone is particularly important. The ADEPT model is constructed within a probabilistic framework, incorporating natural variability and uncertainty of model parameters into the calculations.

The model reflects the effluent quality, expected source flows (discharge rates), receiving environment flow conditions (Collins Creek flow), and baseline surface water and sediment quality data. Important components identified previously (e.g., wetland feature in the upper end of Sink Reservoir, exchangeable portion of the sediment) were incorporated in the current assessment. In addition, the modelling approach was modified for the current assessment compared to previous assessments particularly with respect to improving the incorporation of geochemical processes. Significant removal of several COPCs is taking place within the S/V TEMS, likely facilitated by the presence of other elements, such as iron and barium, which can form precipitates and additional adsorption sites for other metals. The ADEPT model incorporated geochemical considerations for several key constituents. The solubility and surface complexation calculations were based upon detailed geochemical modelling performed by Orano and applied to arsenic, sulphate, and uranium. Precipitation and redissolution of calcium and sulphate as gypsum was considered, as well as surface sorption for uranium and arsenic (associated with ferrihydrite [iron] formation).

For this application, the model was run using monthly time steps to assess the effects of variations in watershed flows on receiving water quality. The model simulation begins in 1996, commensurate with the

actual initiation of wastewater management activities at the McClean Lake Operation. For the period from March 1996 to December 2024, actual measured flows and measured effluent quality from each of the three effluent sources (JEB WTP, Sue WTP, JEB Dewatering Well System [DWS, discontinued in 2014]) which reported to the S/V TEMS were used directly in the model.

Calibration of the ADEPT model showed that it provides a reasonable approximation of the dispersion within the environment. The calibration was updated to include information from studies on the removal within Sink Upper Compartment (SUC), effluent plume delineation, and to reflect operational changes (e.g., increase to the volume in Sink Reservoir to encourage more removal at this location). In general, predicted concentrations in Sink Reservoir and Vulture Lake are slightly over-estimated compared with observed values. Overall, ADEPT was able to capture the general time and load dependent trends in concentrations.

The future Base Case scenario accounts for flows from anticipated performance of the JEB and Sue WTPs. The future quantity and quality of effluent from each of the sources were derived from a combination of operational monitoring information and anticipated operations. As the model is run probabilistically, lognormal distributions were used to describe predicted future water quality for constituents of concern.

A comparative framework is provided to evaluate predicted water and sediment concentrations downstream of effluent release to several established benchmarks. The modelled concentrations of COPCs are compared to predictions that were previously reviewed by the Joint Panel (COGEMA 1995; Minatco 1991) as well as applicable water and sediment quality objectives from Provincial or Federal agencies. All simulations were based on 100 probabilistic model runs over an approximately 75-year modeling duration. The output results from the 100 trials were then analyzed to calculate lower 5th percentile values, mean values, and upper 95th percentile values.

Water concentrations decrease in each progressive downstream water body due to the substantial increase in watershed drainage area, and the corresponding increased influence of runoff. There are short-term fluctuations that reflect the change in flows during applicable years. Months with higher flows provide the most dilution, resulting in correspondingly lower predicted concentrations of constituents of concern. As with the water column predictions, the concentrations of COPCs in the sediment decrease progressively downstream of effluent release.

Predicted concentrations of COPCs are generally lower in the 2025 ERA than in the previous assessments. Selenium concentrations are much lower than that included in the 2016 ERA Base Case scenario but slightly higher than in the 2018 Selenium Review and Assessment Report. Although the Water Quality Guidelines (WQGs) are exceeded for several COPCs within the S/V TEMS (aluminum, chloride, fluoride, nitrate, sulphate, Total Dissolved Solids (TDS), arsenic, cobalt, selenium, silver, and thallium), there are no predicted concentrations in water that are expected to exceed the applicable guideline downstream of S/V TEMS.

Predicted sediment concentrations of chromium, lead, uranium, and zinc are below applicable sediment toxicity benchmarks. Predicted concentrations of radionuclides are similar to, or less than, values predicted in previous assessments, and below available sediment toxicity benchmarks. The maximum mean predicted sediment arsenic, molybdenum, and nickel concentrations in the S/V TEMS and McClean Lakeeast basin

exceed the Lowest Effect Level (LEL) toxicity benchmark, but not the Severe Effect Level (SEL) or the IC₂₅ benchmarks. For selenium, the predicted concentrations are above the SEL, but not within McClean Lake east basin, although levels do exceed the LEL at this location.

As expected, predicted surface water and sediment concentrations are higher for the Base Case without Selenium Treatment than those predicted under the Base Case scenario. Despite this, the predictions under the Base Case without Selenium Treatment are within the range of other historical assessments, remaining well below the 2016 EP TID Base Case predictions but above the 2018 Revised Selenium Forecast.

The 1991 EIS (Minatco 1991) concluded that discharge of treated effluent to Sink Reservoir would have a moderate to major impact on water quality in the S/V TEMS during the operating life of the McClean Lake Operation (Table 9.1-1). Impact on water quality in McClean Lake and downstream was assessed to be minor to moderate during the operating life of the Project. In the EIS conducted in support of the Midwest Project (COGEMA 1995), the discharge of treated effluent to Sink Reservoir was determined to result in a moderate to major impact on water quality within the S/V TEMS during the operating life of the Project. The overall impact on water quality in McClean Lake and Collins Creek was assessed to be minor to moderate during the operating life of the Project. The overall impact of the sediments on surface water quality was assessed to be moderate in the short term and minor in the long term. The 2025 modelling outcome for the Base Case scenario is consistent with the determinations made in the previous EIS and ERA reports.

9.5 Effects on the Environment

The assessment of spatial and temporal project-environment interactions during the operational and near-term post-decommissioning periods of the McClean Lake Operation required a comprehensive and integrated assessment framework. The pathways framework in this assessment involves consideration of various pathways by which humans, animals, and plants may be exposed to emissions from the McClean Lake Operation. Thus, the pathways model or framework assesses the integrated contribution of emissions to the atmospheric and aquatic environments from all sources to determine environmental concentrations of COPCs and estimates exposure and dose levels for aquatic and terrestrial biota as well as humans.

The ADEPT model, which uses the results of the air dispersion modelling and water and sediment quality modelling, was used to model the fate and transport of COPCs in the environment. This model was used to estimate exposure to both human and ecological receptors that could potentially be affected by the McClean Lake Operation. The pathways analysis is based on the annual average exposure as the measurement endpoints (toxicological benchmarks) for plants, animals, and people are typically based on chronic exposures. The predicted exposures were then combined with toxicological benchmarks to evaluate the potential negative effects on humans and Valued Components (VCs).

In the selection of inputs for use in the model, site-specific information was used where possible. Exposure estimates were based on transfer factors developed from site-specific measured data, where available, to determine the concentrations of the various constituents in sediments, benthic invertebrates, aquatic plants, fish and terrestrial vegetation. If site-specific information was not available, then regional (Saskatchewan) information was used. This information was augmented from information published in the scientific literature.

Inputs needed to characterize the diets and other attributes of the ecological receptors (and/or VCs) selected for the assessment were obtained from literature sources. Information gathered on a regional basis on the dietary habits of people who live in northern Saskatchewan was used in the assessment of exposures and doses to human receptors in the study area.

There are some differences in the modelling conducted for the current assessment compared to previous assessments. ADEPT completes the pathways calculations following general guidance provided in CSA N288.1 (CSA 2020), with the incorporation of site-specific information where available. ADEPT completes the exposure assessment for ecological and human receptors following the approach outlined in CSA N288.6 (CSA 2022). Some notable differences from previous assessments include additional COPCs (aluminum, iron, nitrate, cadmium, chromium, silver, thallium), updates to the water and sediment quality model to account for the data collected from environmental studies (e.g., Sink Upper Compartment investigation, plume delineation in McClean Lake east basin, University of Saskatchewan selenium research, etc.), additional ecological receptors (e.g., fox, little brown myotis, lesser yellowlegs) as well updates to some toxicity reference values.

9.5.1 McClean Lake Operation ERA

9.5.1.1 Ecological Receptors

Valued Components provide the common basis that underlies environmental baseline and monitoring studies, and the assessment of potential effects. Valued Components support ecosystem structure, and provide significant cultural, social, and economic values. The VCs included in the assessment are largely consistent with previous EISs; however additional VCs were included to address the potential presence of Species at Risk (SAR) in the area. The following endpoints and their corresponding VCs were assessed (each endpoint represents a key ecological category, with associated species or groups that serve as indicators for evaluation):

- Terrestrial Plants: blueberry, labrador tea, lichen
- Soil Invertebrates: terrestrial insects
- Macrophytes: Aquatic plants (pondweed)
- Benthic Invertebrates: chironomids
- Phytoplankton: green algae
- Zooplankton: daphnids
- Predatory Fish: northern pike and lake trout
- Bottom Feeding Fish: white sucker and lake whitefish
- Amphibian: boreal chorus frog
- Terrestrial Birds: bald eagle, ptarmigan, rusty blackbird (species at risk), snowy owl (species at risk)
- Aquatic Birds: mallard, merganser, scaup, lesser yellowlegs (species at risk)

- Terrestrial Mammals: woodland caribou (species at risk), little brown myotis (species at risk), snowshoe hare, moose, fox, wolf, black bear, lynx
- Aquatic Mammals: muskrat, beaver, mink

The ecological risk assessment examined the potential for negative effects on populations of a range of biota, from plankton, in the aquatic environment, to a predator, like the wolf, in the terrestrial environment. Risks to ecological receptors were generally examined through the calculation of a Screening Index (SI) value which is the ratio of the exposure to a Toxicity Reference Value (TRV) or benchmark level associated with an effect. To evaluate the potential for population-level effects, it is important to consider the SI value along with spatial and temporal considerations. Additional lines of evidence can be used in the overall evaluation, such as surveys that show that there is a limited habitat for mammals at the S/V TEMS.

The assessment indicates negligible potential for effects expected for plants, soil invertebrates, bear, beaver, caribou, eagle, fox, hare, lynx, moose, owl, ptarmigan, shrew, and wolf. There is however a potential for effects on:

- Aquatic biota (plankton, benthic invertebrates, aquatic plants, amphibians, and fish) due to exposure to general chemistry parameters including aluminum, chloride, sulphate, TDS, within the S/V TEMS during operation. As discussed in the Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan (Joint Panel, 1997), the potential for effects associated with the elevated TDS were acknowledged; water treatment involves an environmental trade-off. The high TDS water, consisting largely of chloride and sulphate salts, can be fatal for some organisms and negatively affect others. The Joint Panel considered that these changes are not permanent and it was anticipated that concentrations would return to background when water treatment stops and the organisms can become re-established.
- In terms of wildlife (birds and mammals), potential effects were identified for sulphate, TDS, arsenic, molybdenum, and nickel. These effects are limited to the S/V TEMS.
- For selenium, the Base Case scenario, which included use of selenium treatment technology for keeping selenium concentrations in the JEB WTP effluent under the EBRL, conclusions are consistent with the 2018 Selenium Review and Risk Assessment Report:
 - There is the potential for effects to aquatic biota limited to the S/V TEMS.
 - Several species that depend on the aquatic environment (mallard, merganser, yellowlegs, mink, muskrat) as well as terrestrial species that eat emergent aquatic insects (blackbird and little brown myotis) were identified as a concern from exposure to selenium. The corresponding potential effects were primarily related to the S/V TEMS during the operation and decommissioning, while at the McClean Lake east basin, potential effects were limited to four species (blackbird, yellowlegs, mink, and little brown myotis) and only during the operating period. No selenium-related effects are expected downstream of McClean Lake.

The pathways assessment for the Base Case without selenium treatment indicated a greater potential for wildlife risks, including broader temporal and spatial impacts, compared to the Base Case scenario with the treatment. However, these risks remain much lower than those identified in the 2016 ERA.

In the EIS conducted in support of the Midwest Project (COGEMA 1995), the discharge of treated effluent to Sink Reservoir was determined to result in a moderate to major impact on aquatic resources within the S/V TEMS during the operating life of the Project (Table 9.1-1). The overall ecological impact in McClean Lake and Collins Creek was assessed to be negligible. Similar conclusions were determined in the 1991 EIS (Minatco 1991). The conclusions of the current assessment are consistent with the determination made in the 1991 and 1995 EIS.

9.5.1.2 People

Human receptor groups/locations were selected based on plausible scenarios of people working and/or living nearby, although there may not be measurable changes to the environment at these locations. The components of the Hatchet Lake survey dietary characteristics (CanNorth 2000) were linked to different watersheds in the assessment area depending on the human receptor location and expected period of occupancy at these locations. An updated traditional foods study was completed for Wollaston Lake as part of a community-based environmental monitoring program (CanNorth 2021). Generally, the rates of traditional food consumption from the CanNorth (2000) survey, are similar to or greater than the rates presented in the more recent survey (CanNorth 2021) and therefore the use of this study represents a conservative approach.

The representative people evaluated include:

- **Wollaston Lake residents:** These individuals (adult, child and toddler) are expected to obtain their dietary components year-round from the local area, with the exception of barren-ground caribou that come from an area not impacted by the McClean Lake Operation, and supermarket foods.
- **Wollaston Lake trapper:** A resident of Wollaston Lake (adult and accompanying child and toddler) that spends three months of the year trapping an area closer to the McClean Lake Operation.
- **Lodge operator:** The operators of the fishing lodges located on Hidden Bay, (Wollaston Lake Lodge) and Hatchet Lake Lodge) were included. The lodge operators and families (child and toddler) may spend three months at the lodges during which time they obtain food and water from the local area.
- **Camp workers:** Non-Nuclear Energy Workers (non-NEW) are assumed to be present at mine camps 50% of the year during which time they are exposed to the local environmental conditions. Workers at the on-site JEB camp were included as well as near-by Rabbit Lake and Points North camps.

The estimated intakes of non-radioactive COPCs are compared to benchmarks that are protective of human health, including sensitive sub-populations. The total intake is estimated which includes the baseline levels in all environmental media. For estimating radionuclide dose, dose coefficients are used that relate the intake rate in Becquerel (Bq) to an effective dose rate (in μSv). For dose, the comparison benchmark is for a McClean Lake Operation increment (i.e. above baseline) thus the dose estimates provided are those attributable only to the project emissions.

The human health risk assessment addressed Criteria Air Contaminants such as NO_x , SO_2 and PM; non-radionuclide COPCs (including arsenic, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, silver, uranium, zinc); and radioactivity. The findings are as follows:

- Maximum concentrations of NO₂, SO₂ and fine PM_{2.5}, are below the health-based limits at off-site locations where people are located and are below occupational exposure levels at the JEB camp.
- Exposures to non-radionuclides were evaluated. The predicted intakes from the project are below levels identified by regulatory agencies such as Health Canada and the US Environmental Protecting Agency (EPA) as being safe for individuals. Consideration was also given to baseline exposure and supermarket foods.
- The estimated incremental cancer risk for people that reside at the Wollaston Lake community and may trap or work near the site is expected to be negligible.
- The maximum mean incremental dose to people from radiation released from the McClean Lake Operation is expected to remain below the Health Canada dose constraint as well as the Canadian Nuclear Safety Commission (CNSC) allowable incremental dose limit for members of the public.

Based on the overall assessment, no negative effects are expected on human health. The EIS conducted in support of the Midwest Project (COGEMA 1995) concluded that the impact on radiological doses to people would be negligible; this is consistent with the current assessment.

9.5.2 Bena and Candy Lakes ERA

Increasing concentrations of major ions have been identified in Bena and Candy Lakes surface water in recent years, which generally remained within available water quality guidelines, except for nitrates in Bena Lake. A potential source for elevated nitrate was previously anticipated as groundwater flows from the Sue E CWRP (Orano 2024b). The pore water from the Sue E CWRP was noted to contain a significant amount of nitrate + nitrite, which is attributed to residues of blasting agents used during mining. Groundwater modelling of the loads from the Sue E CWRP was conducted. It was found that this pathway was not sufficient to explain the pattern in Bena Lake. Additional follow-up work is needed to further investigate this source.

A risk evaluation was conducted for Bena Lake based on the current conditions. The assessment found that recent nitrate levels presented no risk to the aquatic community in downstream Candy Lake and represented a potentially low risk to sensitive fish species in Bena Lake. The potential for eutrophication was evaluated and, as the system has low phosphorus, the nitrate level was not expected to affect trophic status of Bena or Candy lakes. This information was used to develop the site specific objective for nitrate of 6.5 mg/L-N. This value is based on an understanding of receptors and environment of Bena Lake in combination with the toxicity information for nitrate.

9.6 Path Forward

As required by CSA N288.6, Orano uses the ERA outcome to ensure proper management of corresponding environmental risks. The following actions have been identified based on the 2025 ERA:

- Orano will continue to manage selenium risks under its Selenium Adaptive Management Plan accepted by CNSC and Saskatchewan Ministry of Environment (SMOE).

- The air dispersion modelling outcome will be used to update the McClean Lake Operation Industrial Source Air Quality (ISAQ) Environmental Protection Plan (EPP) in 2026.
- While the McClean Lake Operation Environmental Monitoring Program (EMP) provides a solid basis for the ERA updates, the following adjustments to the radon monitoring program are proposed:
 - addition of two radon monitors, one to the north of the JEB TMF and one to the north of the McClean Mining site,
 - removing radon monitor TE-M6 to reduce redundancies in the Sue area, and
 - initiation of radon monitoring at two additional monitoring stations at least one year prior to mining of Sue F.
 - The proposed adjustments will be incorporated into the EMP upon regulatory review of this document.
- In addition to the above EMP adjustments, Orano plans to implement the following supplementary studies to reduce uncertainties related to the air dispersion modelling before the next ERA update:
 - stack testing for particle size distribution to refine emission estimates of PM₁₀ and PM_{2.5} from the mill and incinerator stacks,
 - measurement of nitrogen oxide and total suspended particulate levels in vicinity of active mining sites to understand the potential effects of SABRE mining operations on ambient air concentrations, and
 - site-specific investigations of silt and moisture content for ore (coarse and fines), waste rock, and roadbed material as feasible.
- In relation to observed surface water quality effects in Bena Lake, Orano will implement the following actions:
 - increase the surface water monitoring frequency in Bena and Candy Lakes from semi-annual to quarterly to assess potential seasonal effects on COPC concentration fluctuations in lake water,
 - investigate potential COPC pathways from the Sue E CWRP to Bena Lake to determine the corresponding COPC loads,

- sample sediment, benthos, and fish in Bena and Candy Lakes to determine if observed COPC increases in surface water are having an effect on aquatic biota, and
- implement Ecological Risk Assessment for Bena and Candy Lakes based on results from the above studies.

The next EP TID update is scheduled for 2030; however, experience has shown that completing and follow-up on regulatory review of EP TID Volumes 1 and 2 simultaneously requires significant resources. Additionally, the ERA update presented in Volume 2 relies on data processing, findings, and conclusions from the Environmental Performance Assessment presented in Volume 1, making it impractical to prepare both documents at the same time. To address these issues, Orano proposes the following approach for the next EP TID update:

- Volume 1 will be prepared in 2030 and will include an ERA review implemented in line with Section 11 of CSA N288.6, similar to Section 8 in the 2022 EP TID (Orano 2023).
- The ERA review findings and regulatory feedback on Volume 1 will be used to complete Volume 2 with the full ERA update in 2031.

This approach ensures compliance with CSA N288.6 requirements for regular ERA reviews and updates while maintaining efficiency, data integrity, and the effective use of resources. Additionally, this timeline provides an opportunity for regulatory input following the ERA review, ensuring that the ERA update reflects current expectations.

9.7 Conclusion

In conclusion, the 2025 ERA confirms that environmental risks associated with the McClean Lake Operation remain well-controlled and consistent with the findings presented in the previous environmental assessments. Continued monitoring and targeted studies will ensure environmental protection and regulatory compliance throughout the operational lifecycle.

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Table 1.2-1 McClean Lake Operation – Environmental Assessment History

Project	Environmental Assessment	Subsequent Approval/Licensing Actions	Key Aspects
McClean Lake Operation	McClean Lake EIS: 1991 Joint Panel Approved: 1993 Subsequent assessment to confirm acceptability of JEB TMF (Cigar Lake Project 1995)	Construction Licence: Atomic Energy Control Board (AECB) Ministerial Approval: Saskatchewan Ministry of Environment Provincial Approval to Construct and Operate the McClean Lake Mine and Mill	Initial approval for the overall McClean Lake Project, which included one underground mine (McClean), four open pit mines (JEB and Sue), and the JEB mill, as well as the waste management system for the entire project. Subsequent approval for the JEB TMF facility Production Limit: 6 million lbs U ₃ O ₈ (licence)
McClean Lake Operation – Change in Mill	Change in Stripping Process in Mill Solvent Extraction Circuit: July 1994	Ministerial Approval change: Saskatchewan Ministry of Environment Construction Licence Amendment	Change the strong acid stripping process in the mill solvent extraction circuit to an ammonium sulphate stripping process. This change in the mill design based to reduce reagent consumption, reduce chemical loading on the environment and allow ammonium sulphate to be recovered and marketed as a byproduct: ammonium sulphate fertilizer.
McClean Lake Operation – Change in JEB pit	Change in Dewatering Procedures at JEB Pit: April 1995	Ministerial Approval change: Saskatchewan Ministry of Environment Construction Licence Amendment	Changed the JEB pit dewatering method from pumping and treating groundwater inflows from in-pit sumps with treatment of all waters prior to release into Sink Lake to dewatering the groundwater with a ring of dewatering wells around the JEB pit which would intercept groundwater prior to entry into the pit, separation of any groundwater which requires treatment and discharge to Sink Lake.
Midwest Project	Midwest EIS: 1995 Addenda submitted: 1996 (March, May, October) and May 1997 Joint Panel Approved: 1997	Have not proceeded with project yet	Adopted new underground mining method, jet-boring in frozen ground.
Cigar Lake Project	Cigar Lake EIS: 1995 Addenda submitted: 1996 (April, July, December) and May 1997 Joint Panel Approved: 1997	Canadian Nuclear Safety Commission (CNSC) and Provincial Approval to <i>Construct</i> Cigar Lake Mine (December 2004) CNSC and Provincial Approval to Expand the JEB Mill to Process Cigar Lake Ore (2005)	Assessment and approval to process up to 24 million lbs (10.9 million kg) of U ₃ O ₈ annually and of that, process 18 million pounds (8.2 million kg) U ₃ O ₈ from Cigar Lake high grade ore slurry through the mill expansion (including deposition of tails to the JEB TMF) Assessment and approval of the activity of transporting high grade ore slurry to McClean Lake Operation

Table 1.2-1 McClean Lake Operation – Environmental Assessment History

Project	Environmental Assessment	Subsequent Approval/Licensing Actions	Key Aspects
Disposal of Cigar Lake Waste Rock	Disposal of Cigar Lake Waste Rock in the Mined-out Sue C Pit EIS: 2001 Addendum submitted: 2002 Joint Screening Report Approved: Province: September 2003 CNSC: August 2003	Have not proceeded with the project yet; project on indefinite hold	Transport and disposal of Cigar Lake waste rock in the McClean Lake Operation's mined out Sue C/A pit.
Sue E Project	Sue E EIS: 2004 Addendum submitted: 2005 Federal Screening Report Approved: Province: 2005 CNSC: 2005	CNSC and Provincial Approval to Construct and Operate the Sue E Project (2005)	Development of an open pit and the construction of a new clean waste stockpile and a temporary till stockpile. Use of existing facilities for the milling, tailings disposal and water treatment. Expected production of 8.3 million pounds U_3O_8 . Subsequent assessments demonstrate that the past, current and planned future activities at the McClean Lake Operation continue to fall within the environmental effects envelope originally reviewed by the Joint Panel. These effects considered production levels from McClean Lake Operation to be up to 24 million lbs (10.9 million kg) U_3O_8 through the mill, based on the processing of high grade ore.
Mining Equipment Development Program	Change in Mining Method at McClean Mining Site: December 2004	CNSC and Provincial Approval to proceed with Mining Equipment Development Program at McClean Mining Site (2005) Provincial Approval to construct facilities for Mining Equipment Development Program (2005)	A change from previously approved underground mining to a small-scale research program at Pod 1 East of McClean Mining Site. The program was designed to develop and test the mining of ore bodies from the surface using jet boring.
Ferric Sulphate Production at McClean Lake	Federal Screening Report Approved: CNSC: October 2006	CNSC and Provincial Approval to Construct and Operate a Ferric Sulphate Production Circuit (2006)	Addition of a ferric sulphate production circuit to JEB Mill.
Rabbit Lake Solution Processing Plant	Federal Screening Report Approved: Province: August 2008 CNSC: June 2008	Did not proceed with the project	Receipt of 18 Mlbs U_3O_8 from Cigar Lake Mine, sending equivalent of 10 Mlbs U_3O_8 to Rabbit Lake Operation as Uranium Solution and processing 8 Mlbs U_3O_8 of Cigar Lake ore through McClean Lake Mill with remaining capacity for McClean Lake source ores

Table 1.2-1 McClean Lake Operation – Environmental Assessment History

Project	Environmental Assessment	Subsequent Approval/Licensing Actions	Key Aspects
Midwest Project	Midwest EIS: 2011 Comprehensive Study Level EA Approved: Provincial and Federal August 2012	Have not proceeded with project yet	Open pit mining method Includes a mill expansion: 27/16 million lbs – base case 27/27 million lbs – cumulative case
Caribou Project	Federal and Provincial Screening Approved: Province of Saskatchewan 2009 Canadian Nuclear Safety Commission 2010	CNSC Approval to Construct and Operate the Caribou Project (future) Provincial Approval to Construct and Operate the Caribou Project (future)	Development of an open pit and the construction of a new clean waste stockpile. Use of existing facilities for the milling, tailings disposal and water treatment. Expected production of 2.6 million pounds U ₃ O ₈ . Subsequent assessments demonstrate that the past, current and planned future activities at the McClean Lake Operation continue to fall within the environmental effects envelope originally reviewed by the Joint Panel. These effects considered production levels from McClean Lake to be up to 24 million lbs (10.9 million kg) U ₃ O ₈ through the McClean Lake Mill, based on the processing of high- grade ore.
Receipt and Processing of McArthur River Ore at the McClean Lake Operation	Proposal submitted: November 2009 DEIS submitted: January 2011 FEIS submitted: May 2011 Provincial approval: January 2012 Federal approval (CNSC): April 2012 Screening Level EA	Did not proceed with project	To transport ore slurry on existing public roads, from McArthur River Mine to the McClean Lake Mill for a three-year period.
McClean Mining Project	Change in Mining Method at McClean Mining Site: April 2025	Provincial Approval to proceed with McClean Mining Project (scheduled for 2025)	Change from test mining of Pod 1 East to production mining at McClean North deposit using Surface Access Borehole Resource Extraction (SABRE) mining method.

Table 1.2-2 Licences Issued by the Canadian Nuclear Safety Commission (CNSC), and its Predecessor, the Atomic Energy Control Board (AECB)

CNSC (AECB) Licences	Licenced Activities	Date Issued	Licence Basis EAs
AECB-MFRL-148-2	Site Preparation	April 1, 1994	McClean Lake Project EIS (1991)
AECB-MFEL-167-0-2	Mining Facility Excavation	June 1, 1994	Midwest Project EIS (1991)
AECB-MFCL-169-0	Mine facility construction of all necessary surface support facilities in preparation to mine and operate mill and waste treatment systems	June 29, 1994	McClean Lake Project EIS (1991)
AECB-MFCL-169-0.1	Mill process change from Strong acid to ammonium sulphate stripping	December 19, 1994	McClean Lake Project EIS (1991)
AECB-MFCL-169-0.2	Surface stripping JEB and operation of associated dewatering and water treatment facilities	September 18, 1995	McClean Lake Project EIS (1991)
AECB-MFOL-170-0	Operation of JEB open pit mine and associated water management systems	March 12, 1996	McClean Lake Project EIS (1991)
AECB-MFEL-167-0.2	Mining Facility Excavation	December 16, 1996	Midwest Project EIS (1991)
AECB-MFOL-170-0.1	Sue C site preparation and operation of associated water management systems	March 9, 1998	McClean Lake Project EIS (1991)
AECB-MFOL-170-0.3	Preparatory work to Construct JEB TMF	August 14, 1998	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
AECB-MFOL-170-0.4	Approval to construct JEB TMF and associated tailings and water systems	March 26, 1999	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
AECB-MFOL-170-0.5	Approval to operate JEB Mill, TMF and associated facilities	June 21, 1999	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
AECB-MFOL-170-0.6	Approval to mine Sue C ore;	November 9, 1999	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
AECB-MFOL-170-0.7	Approval to possess, import and use radioactive prescribed substances;	May 29, 2000	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)

Table 1.2-2 Licences Issued by the Canadian Nuclear Safety Commission (CNSC), and its Predecessor, the Atomic Energy Control Board (AECB)

CNSC (AECB) Licences	Licensed Activities	Date Issued	Licence Basis EAs
AECB-MFRL-167-0.4	Mining Facility Excavation	May 29, 2000	McClean Lake Project EIS (1991), Midwest Project EIS (1995)
UMOL-MINEMILL-McCLEAN.08/2001	Licence extension of AECB-MFOL-170.7	June 21, 2001	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
UMOL-MINEMILL-McCLEAN.09/2005	Mine Sue C, A and B, produce up to 8 million lbs/year	August 21, 2001	2001 Screening Report (CNSC) (No Provincial EA Required)
UMSL-Excavate-Midwest.05/Indf	Site Preparation Licence	May 31, 2002	McClean Lake Project EIS (1991), Midwest Project EIS (1995)
UMOL-MINEMILL-McCLEAN.00/2009	Licence renewal with amendments to modify the JEB mill to receive and process Cigar Lake ore	May 19, 2005	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
UMOL-MINEMILL-McCLEAN.02/2009	Amendment to allow preparatory work at Sue E mine site	July 21, 2005	Sue E Project EIS (2004)
UMOL-MINEMILL-McCLEAN.03/2009	Amendment to allow open pit mining of Sue E orebody	December 9, 2005	Sue E Project EIS (2004)
UMOL-MINEMILL-McCLEAN.04/2009	Amendment to allow Phase II of the Mining Equipment Development Program	March 30, 2006	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
UMOL-MINEMILL-McCLEAN.04/2009	Approval to construct and operate ferric sulphate circuit under condition 3.1 of operating licence	December 5, 2006	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995), Ferric Sulphate Production at the McClean Lake Operation Screening Report (2006)
UMOL-MINEMILL-McCLEAN.05/2009	Licence extension	May 25, 2009	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
UMOL-MINEMILL-McCLEAN.00/2017	Licence renewal	July 1, 2009	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995)
UMOL-MINEMILL-McCLEAN.01/2017	Licence amendment; adopt the Licence Condition Handbook framework	December 19, 2012	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); McArthur River (2011); Midwest (2011)

Table 1.2-2 Licences Issued by the Canadian Nuclear Safety Commission (CNSC), and its Predecessor, the Atomic Energy Control Board (AECB)

CNSC (AECB) Licences	Licensed Activities	Date Issued	Licence Basis EAs
UMOL-MINEMILL-McCLEAN.01/2017 - Licence Condition Handbook Revision 0	Original document; Increase annual production to 13 mlbs; operate high grade ore slurry receiving circuit and high-grade ore milling circuits; process high grade ore from the McArthur River Mine	March 7, 2013	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UMOL-MINEMILL-McCLEAN.01/2017 - Licence Condition Handbook Revision 01	Construct the Mill Upgrade Project to increase annual production capacity to 24 Mlbs	July 9, 2013	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UMOL-MINEMILL-McCLEAN.01/2017 - Licence Condition Handbook Revision 02	Administrative and editorial changes	April 23, 2014	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UMOL-MINEMILL-McCLEAN.01/2017 - Licence Conditions Handbook Revision 03	Added JEB Ore Pad as contingency measure; changed annual U3O8 production to 24,000,000 lbs; added documents to licensing basis; administrative and editorial changes.	June 23, 2016	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UMOL-MINEMILL-McCLEAN.00/2027	Licence renewal	July 1, 2017	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UMOL-MINEMILL-McCLEAN.00/2027 - Licence Conditions Handbook Revision 04	Allow placement of tailings up to 448 mASL	October 6, 2017	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UMOL-MINEMILL-McCLEAN.01/2027	Licence update to reflect name change from AREVA Resources Canada Inc. to Orano Canada Inc.	July 12, 2018	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UML-MINEMILL-McCLEAN.02/2027	Amendment to allow JEB TMF Expansion (468.8 mASL)	January 17, 2022	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)

Table 1.2-2 Licences Issued by the Canadian Nuclear Safety Commission (CNSC), and its Predecessor, the Atomic Energy Control Board (AECB)

CNSC (AECB) Licences	Licensed Activities	Date Issued	Licence Basis EAs
UML-MINEMILL-McCLEAN.02/2027 - Licence Conditions Handbook Revision 05	Reflects Licence amendment, UML-MINEMILL-McCLEAN.02/2027, includes revised financial guarantee value and introduces references to most recent CNSC regulatory documents and Canadian Standard Association documents.	April 14, 2022	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)
UML-MINEMILL-McCLEAN.02/2027 - Licence Conditions Handbook Revision 06	The LCH was updated to include CNSC regulatory documents and Canadian Standard Association documents, which were published after the last update of the LCH Rev 5 dated April 14, 2022.	May 1, 2024	McClean Lake Project EIS (1991), Midwest Project EIS (1995), Cigar Lake Project EIS (1995); Caribou EIS (2009); McArthur River (2011); Midwest (2011)

Table 1.3-1 Key Events That Have Occurred at the McClean Lake Operation Since 1995

Year	Event
1995	Construction begins
	JEB pit mining begins
1996	JEB water treatment plant begins operation
	JEB pit dewatering system begins operation, discharge to Sink Reservoir
1997	JEB pit mining ends
	Sue C pit mining begins
	Sue water treatment plant begins operation
1999	Mill begins operation (JEB WTP influence) and JEB TMF begins operation
2002	Sue C pit mining ends
	Back hauling of Sue C and JEB special waste to Sue C pit begins
	Back hauling of Sue C and JEB special waste to Sue C pit ends
	Sue WTP ceases operating - Sue C pit allowed to flood naturally with groundwater and surface runoff
2003	Molybdenum optimization WTP scale trials begin
2004	Optimized molybdenum WTP removal process implemented at JEB
	Sue WTP resumes operation to draw down water level in Sue C pit in anticipation of initiation of Sue A mining
2005	Sue A mining begins
	Mine equipment development (MED) program initiated
	Sue E pit mining begins
	Commence Mill Expansion Project for receipt and processing of high-grade ore and expand capacity to 13 Mlbs/year
2006	Sue A mining ends
	Start of placement of Sue E special waste in Sue C/A pit
	Mill Optimization Project (to process low grade ore and increase volume of ore feed)
2007	Ferric sulphate and oxygen plants commissioned and turned over to McClean Lake Operation
	Sue B overburden removal
	MED program mined and backfilled one hole; 81 tonnes of ore produced

Table 1.3-1 Key Events That Have Occurred at the McClean Lake Operation Since 1995

Year	Event
2008	Sue E mining ends
	Sue B mining begins, disposal of all waste rock in Sue E pit
	Initial push down of Sue E special waste in Sue C/A pit
	Sue E overburden backhauled into Sue E pit to cover Sue B waste material
	Sue B mining ends
	Till covers completed over pit bottom in Sue B and wastes in Sue E; pits allowed to flood
2009	Sue WTP operation ceases temporarily - Sue C/A pit allowed to flood naturally with groundwater and surface runoff
	Relocation of Sue E special waste deposited in Sue C/A pit
	MED program mined and backfilled four holes; 759 tonnes of ore produced
	Sue WTP testwork performed with 3-stage configuration; after test, operation ceases and Sue C/A pit allowed to flood naturally with groundwater and surface runoff
2010	MED program completed mining and backfilled one hole; 361 tonnes of ore produced
	Relocation of Sue E special waste deposited in Sue C/A pit occurred
	Temporary cessation of milling
	Tailings Preparation Circuit adapted to treat and place JEB WTP sludges
2011	Sue WTP testwork with 3-stage process and RO unit occurred. Water pumped from the Sue C/A and Sue B pits and treated.
	Enter agreement to process 100% of Cigar Lake ore slurry at the McClean Lake Mill
2012	SABRE program (formerly MED) mined and backfilled two holes; 1022 tonnes of ore produced
2012-2013	JEB TMF Optimization Project, Stage 1 - sloping improvements and liner placement to 439 mASL
2012-2017	Sue WTP testwork with 3-stage process and optimization occurred seasonally. Water was pumped from Sue C/A pit each year, and also from Sue B in 2012. When the plant ceases operating Sue C/A pit is allowed to flood naturally.
2013	Installation of the new Yellowcake Packaging System

Table 1.3-1 Key Events That Have Occurred at the McClean Lake Operation Since 1995

Year	Event
2013-2016	McClean Lake Mill Upgrade Project
2014	JEB TMF Dewatering Wells ceased operation
	Re-design and construct the Leaching Circuit to effectively mitigate in-circuit hydrogen evolution
	Cigar Lake mine starts shipping ore to McClean Lake Operation
	Restart of Milling Operations
2016	Production Level Increase to 18,000,000 lbs U ₃ O ₈
2016	Calcliner Stack Extension (to improve SO ₂ dispersion)
	Target elevation level for Sink Reservoir increased to 441 mASL from 440 mASL (to improve effluent mixing)
2016-2017	Construction of the Ore Pad Runoff Pond at JEB site (to manage the stormwater)
2016	SABRE Project renewed
2017	Relocation of Temporary Contaminated Landfill to the Permanent Location in Sue C/A pit
2017-2019	Decommissioning of the JEB Dewatering Wells
2018	JEB TMF Optimization Project Stage 2 (resloping & placement of liner to 443 mASL)
	56,000-liter Hydrogen Peroxide Tank Added to the Hydrogen Peroxide Bay
	Implementation of the Sub-Aqueous Tailings Deposition as an Alternative to the Tremie Deposition
	Drilling and preparation of four pilot holes at SABRE site
2019	JEB TMF Expansion (placement of liner to 448 mASL)
	Construction and commissioning of additional SABRE infrastructure
2020	Covid Care and Maintenance Period (April-November)
	Implementation of the Selenium Mitigation Measures at the JEB TMF (increased distance between the tailings thickener overflow discharge and the reclaim intake, silt curtain installation at the reclaim intake)
2021	Covid Care and Maintenance Period (January-April)
	JEB TMF Expansion (embankment increase to 457.5 mASL)
	Extension of Sub Aqueous Deposition Lines at JEB TMF
	SABRE project completed test mining of four cavities; 1500 tonnes of ore produced
2022	The tailings deposition system was modified with sub-aqueous piping extended and supported by a buoy and anchor technique to improve accessibility to tailings capacity.

Table 1.3-1 Key Events That Have Occurred at the McClean Lake Operation Since 1995

Year	Event
	Upgrade of the JEB WTP with the integrated ferrous sulphate treatment system to enhance selenium removal from the mill effluent
	Upgrades to Solvent Extraction (SX) Circuit (installation of anhydrous ammonia isolation valves to mitigate large releases of ammonia)
	A third ferric reactor installed, commissioned and in operation
	Hydroseeding of the south and west slopes of Sue C Waste Rock Pile as part of progressive decommissioning initiatives
	Decommissioned of some outbuildings around site
	Initiated dismantling the Cigar Lake Ore Slurry Contingency Storage Cell on the JEB Ore Pad
2023	JEB TMF liner expansion was completed to increase the crest elevation from 448.0 mASL to 452.5 mASL. The previous deposition pipeline extensions were removed, new pipeline extensions were installed, the walkway between the header barge and tremie barge was removed, and the tremie barge was removed.
	Arsenic flotation pilot trial
	Initiation of mill automation in areas that were previously highly manual processes.
	Shredded waste from progressive decommissioning activities
	Completed dismantling the Cigar Lake Ore Slurry Contingency Storage Cell on the JEB Ore Pad
	Continued decommissioning of outbuildings around the site
2024	Graded and hydroseeded the west, north and east slopes of Sue C Waste Rock Pile
	New deposition lines were installed at two new locations in the TMF, with removal of the lines installed in 2023
	TMF level was increased from January 1 to March 31 to aid in proper hydration of the new liner installed in 2023
	Second arsenic flotation pilot trial
	Replacement of the JEB WTP effluent discharge pipeline to Sink Reservoir
	Major overhaul of the dry side of the Ammonium Sulphate Crystallization (CX) Plant including installation of a new centrifuge, fluid bed dryer and screw conveyor
	1 st stage of gypsum mitigation system implemented (temporary mitigation, while the long-term chemical treatment is being developed)
	McClean Mining Pad (formerly known as SABRE Test Pad) extension
	McClean Mining (formerly known as SABRE Project): four pilot holes drilled and cased

Table 1.6-1 McClean Lake Operation – Anticipated Mill Product Schedule (Mlb U₃O₈)

Year	McClean Lake Operation - Mill Product Schedule (Mlb U ₃ O ₈)				
	Cigar Lake	McClean & Sue F	Midwest	Sue B	Total Mill Production
2025	18.0	0.6	0.0	0.0	18.6
2026	18.0	0.7	0.0	0.0	18.7
2027	18.3	0.6	0.0	0.0	18.9
2028	18.3	0.5	0.0	0.0	18.8
2029	18.2	0.7	0.0	0.0	18.9
2030	18.1	0.6	4.1	0.0	22.8
2031	18.0	0.1	5.0	0.0	23.1
2032	18.0	0.0	4.9	0.0	22.9
2033	18.0	0.0	5.0	0.0	23.0
2034	18.0	0.0	3.0	0.0	21.0
2035	6.4	0.0	2.7	0.0	9.1
2036	3.3	0.0	1.0	0.0	4.3

Table 2.2-1 COPC Selection for the Air Dispersion Modelling Assessment

Parameter	Available Predictions in 2016 ERA ⁽¹⁾	Identified as COPC for 2025 ERA ⁽²⁾	Existing SAAQS ⁽³⁾	2025 Draft SAAQS ⁽⁴⁾	Reportable Air Release to NPRI ⁽⁵⁾	Significant Screening Result ⁽⁶⁾	Selected as COPC
TSP	Y	n/a	Y	n/a	Y	n/a	Y
PM ₁₀	Y	n/a	Y	n/a	Y	n/a	Y
PM _{2.5}	Y	n/a	Y	n/a	Y	n/a	Y
CO	N	n/a	Y	n/a	N	n/a	Y
NO ₂	Y	n/a	Y	n/a	Y	n/a	Y
SO ₂	Y	n/a	Y	n/a	Y	n/a	Y
Arsenic (As)	Y	Y	N	N	Y	n/a	Y
Cadmium (Cd)	N	Y	N	N	Y	n/a	Y
Chromium (Cr)	N	Y	N	N	N	n/a	Y
Cobalt (Co)	Y	Y	N	N	Y	n/a	Y
Copper (Cu)	Y	Y	N	N	Y	n/a	Y
Lead (Pb)	Y	Y	N	N	Y	n/a	Y
Manganese (Mn)	N	N	N	N	Y	Y	Y
Molybdenum (Mo)	Y	Y	N	N	N	n/a	Y
Nickel (Ni)	Y	Y	N	N	Y	n/a	Y
Selenium (Se)	Y	Y	N	N	N	n/a	Y
Silver (Ag)	N	Y	N	N	N	n/a	Y
Thallium (Tl)	N	Y	N	N	Y	n/a	Y
Uranium (U)	Y	Y	N	N	N	n/a	Y
Vanadium (Vn)	N	N	N	N	Y	Y	Y
Zinc (Zn)	Y	Y	N	N	Y	n/a	Y
Ammonia	N	n/a	N	Y	Y	Y	Y
Acrolein	Y	n/a	N	N	N	n/a	Y
Benzene	N	n/a	N	Y	N	Y	Y
Ethylbenzene	N	n/a	N	Y	N	N	N
Toluene	N	n/a	N	Y	N	N	N
Xylenes	N	n/a	N	Y	N	N	N
Dioxins & Furans	N	n/a	N	N	Y	N	N
Radon	Y	n/a	N	N	n/a	n/a	Y

Notes: n/a – not applicable

⁽¹⁾ If the parameter was included in the 2016 ERA with an available prediction, it was selected as a COPC.

⁽²⁾ If a metal was identified as a COPC for the ERA (Section 3), it was selected as a COPC.

⁽³⁾ If the parameter was not included in the 2016 ERA but has a current Saskatchewan Ambient Air Quality Standard (SAAQS), it was selected as a COPC.

⁽⁴⁾ If the parameter has a 2025 draft SAAQS, it was screened as a potential COPC.

⁽⁵⁾ If the parameter was a reportable air release to the National Pollutant Release Inventory over the 2020 to 2024 period, it was screened as a potential COPC.

⁽⁶⁾ Potential COPC identified based on items 4 and 5 above were screened for significance following the method described in Section 2.2.2 and detailed in Appendix II.1.

Table 2.2-2 Saskatchewan Ambient Air Quality Standards

COPC	Saskatchewan Ambient Air Quality Standard (µg/m³)			
	1-hour	8-hour	24-hour	Annual
Total Suspended Particulates (TSP)	-	-	100	60 ⁽¹⁾
Particulate Matter (PM₁₀)	-	-	50	-
Particulate Matter (PM_{2.5})	-	-	28	10
Carbon Monoxide (CO)	15,000 (13,000 ppb)	6,000 (5,000 ppb)	-	-
Nitrogen Dioxide (NO₂)	300 (159 ppb)	-	200 (106 ppb)	45 ⁽²⁾ (24 ppb)
Sulphur Dioxide (SO₂)	450 (172 ppb)	-	125 (48 ppb)	20 ⁽²⁾ (8 ppb)
Ammonia (NH ₃) ⁽³⁾⁽⁴⁾	1,400 (2,000 ppb)	-	500 (350 ppb)	-
Benzene (C ₆ H ₆) ⁽³⁾⁽⁵⁾	30 (9 ppb)	-	-	3 (0.9 ppb)
Ethylbenzene (C ₆ H ₅ CH ₂ CH ₃) ⁽³⁾⁽⁵⁾	2,000 (460 ppb)	-	-	-
Toluene (C ₅ H ₅ CH ₃) ⁽³⁾⁽⁵⁾	1,880 (499 ppb)	-	400 (106 ppb)	-
Xylenes ((CH ₃) ₂ C ₆ H ₄) ⁽³⁾⁽⁵⁾	2,300 (530 ppb)	-	700 (161 ppb)	-

Notes: Bold font indicates the current SAAQS (SMOE 2025a)

⁽¹⁾ Geometric mean.

⁽²⁾ Arithmetic mean.

⁽³⁾ 2025 draft SAAQS Table 20 (SMOE 2025b)

⁽⁴⁾ Adopted from Alberta (1-hour standard) and U.S. EPA (24-hour standard).

⁽⁵⁾ Adopted from Alberta.

Table 2.2-3 Ontario Ambient Air Quality Criteria

COPC	Ontario AAQC or JSL ⁽¹⁾ (µg/m ³)			
	1-hour	24-hour	30-day	Annual
Arsenic (As)	-	0.3	-	-
Cadmium (Cd)	-	0.025	-	0.005
Chromium (Cr)	-	0.5	-	-
Cobalt (Co)	-	0.1	-	-
Copper (Cu)	-	50	-	-
Lead (Pb)	-	0.5	0.2	-
Manganese (Mn, as PM ₁₀)	-	0.2	-	-
Molybdenum (Mo)	-	120	-	-
Nickel (Ni, as PM ₁₀)	-	0.1	-	0.02
Selenium (Se)	-	10	-	-
Silver (Ag)	-	1	-	-
Thallium (Tl)	-	0.5 ⁽¹⁾	-	-
Uranium (U, as PM ₁₀)	-	0.15	-	0.03
Vanadium (V)	-	2	-	-
Zinc (Zn)	-	120	-	-
Acrolein	4.5	0.4	-	-
Dioxins & Furans (D&F)	-	0.1 pg TEQ/m ³	-	-

Note: ⁽¹⁾ Ontario Jurisdictional Screening Level (JSL) (MECP 2023).

Table 2.2-4 Background Ambient Air Concentrations of COPCs

COPC	Background Concentrations (µg/m³)				
	1-hour	8-hour	24-hour	30-day	Annual
TSP	-	-	76.7	-	7.4
PM ₁₀ ⁽¹⁾⁽²⁾	-	-	31.0	-	-
PM _{2.5} ⁽¹⁾	-	-	12.1	-	4.0
CO ⁽¹⁾	380	290	-	-	-
NO ₂ ⁽¹⁾	6.2	-	6.2	-	2.0
SO ₂ ⁽¹⁾	0.8	-	1.0	-	0.2
Arsenic (As)	-	-	0.0000109	-	0.0000632 ⁽⁵⁾
Cadmium (Cd)	-	-	0.0000554	-	0.0000391
Chromium (Cr)	-	-	0.000554	-	0.000149 ⁽⁵⁾
Cobalt (Co)	-	-	0.0000708	-	0.0000456 ⁽⁵⁾
Copper (Cu)	-	-	0.151	-	0.0734 ⁽⁵⁾
Lead (Pb)	-	-	0.000444	0.000267	0.000267 ⁽⁵⁾
Manganese (Mn)	-	-	0.00254	-	-
Molybdenum (Mo)	-	-	0.00736	-	0.00373 ⁽⁵⁾
Nickel (Ni)	-	-	0.000544	-	0.000325
Selenium (Se)	-	-	0.0000426	-	0.0000251 ⁽⁵⁾
Silver (Ag)	-	-	0.000156	-	0.0000299 ⁽⁵⁾
Thallium (Tl)	-	-	0.0000210	-	0.0000157 ⁽⁵⁾
Uranium (U)	-	-	0.000593	-	0.000341
Vanadium (V)	-	-	0.0000757	-	-
Zinc (Zn)	-	-	0.00532	-	0.00287 ⁽⁵⁾
Ammonia ⁽³⁾	0	-	0	-	-
Acrolein ⁽³⁾	0	-	0	-	-
Benzene ⁽³⁾	0	-	-	-	0
Radon ⁽⁴⁾	-	-	-	-	15 to 25 Bq/m³

Notes: ⁽¹⁾ Regional background concentrations for rural areas specified in the Saskatchewan Air Dispersion Modelling Guideline (GS 2025).

⁽²⁾ PM₁₀ = PM_{2.5} x 2.56, as specified in the Saskatchewan Air Dispersion Modelling Guideline (GS 2025).

⁽³⁾ Assumed negligible.

⁽⁴⁾ Based on data collected during the pre-development baseline program (Minatco 1991).

⁽⁵⁾ Majority of metals do not have applicable ambient quality standards or criteria, however for the purposes of the model evaluation in Appendix II.3 and the ERA, annual concentrations for all metals were derived.

Table 2.2-5 Discrete Receptors Used for the Environmental Risk Assessment

Receptor Name	UTM Coordinates (NAD 83, Zone 13)	
	Easting (m)	Northing (m)
Sink Reservoir	568,828	6,461,934
Vulture Lake	567,453	6,460,607
McClean Lake East Basin	566,465	6,458,536
Keweenaw Lake	567,053	6,449,706
S/V TEMS ⁽¹⁾	-	-
JEB Camp	567,890	6,466,521
Rabbit Lake Camp	576,860	6,451,050
Points North Airport	554,239	6,458,760
Hatchet Lake ⁽²⁾	582,834 (582,928)	6,500,671 (6,482,605)
Wollaston Lake Community Area ⁽²⁾	608,455 (589,928)	6,442,712 (6,442,605)
Wollaston Lake Lodge (Hidden Bay) ⁽²⁾	572,360 (571,928)	6,440,650 (6,442,605)

Notes: ⁽¹⁾ Average of Sink Reservoir and Vulture Lake.

⁽²⁾ Receptor located outside of the air dispersion modelling domain. Model results for the closest gridded receptor were conservatively used as a surrogate. Surrogate receptor coordinates provided in brackets.

Table 2.2-6 Monitoring Station Locations

Sampler Type	Sampler ID	UTM Coordinates (NAD 83, Zone 13)	
		Easting (m)	Northing (m)
Hi-Volume Air Sampler	HVJ1	567,990	6,467,418
Hi-Volume Air Sampler	HVJ2	568,499	6,466,917
Hi-Volume Air Sampler	HVJ3	567,827	6,466,314
Hi-Volume Air Sampler	HVJ4	566,649	6,459,495
Hi-Volume Air Sampler	HVS1	570,459	6,458,278
Sulphur Dioxide Monitor	JM02	568,519	6,466,774
Radon track-etch	TE-J1	567,119	6,467,651
Radon track-etch	TE-J2	566,766	6,465,713
Radon track-etch	TE-J3	569,705	6,469,174
Radon track-etch	TE-J4	568,247	6,466,370
Radon track-etch	TE-J6	570,091	6,467,350
Radon track-etch	TE-J7	569,374	6,465,744
Radon track-etch	TE-M1	567,120	6,460,160
Radon track-etch	TE-M2	567,365	6,458,058
Radon track-etch	TE-M3	568,570	6,459,063
Radon track-etch	TE-M4	567,857	6,457,277
Radon track-etch	TE-M6	568,916	6,458,693
Radon track-etch	TE-M8	569,825	6,458,210
Radon track-etch	TE-S1	570,589	6,458,365
Radon track-etch	TE-S2	569,937	6,458,690
Radon track-etch	TE-S3	571,286	6,458,809
Radon track-etch	TE-S6	571,175	6,457,291
Radon track-etch	TE-S8	569,620	6,456,527
Radon track-etch	TE-S9	569,100	6,457,386
Radon track-etch	TE-C1	566,019	6,474,415

Table 2.2-7 Summary of Calculation Methods used in the Air Emissions Inventory

Emission Source	Emission Factor or Equation	References and Notes
Bulldozing	$E = k \cdot s^a / M^b$ Where: E = emission factor (kg dust/hr) k = particle size multiplier (2.6 for TSP) s = silt content (%) M = moisture content (%) a, b = constants	(U.S. EPA 1998)
Crushing and Screening	Various. Table 2 and 4 of NPRI pits and quarries reporting guide.	(GC 2022a)
Drilling	TSP = 0.59 kg/hole PM ₁₀ = PM _{2.5} = 0.31 kg/hole	(GC 2022a)
Grading	$TSP = 0.0034 \times S^{2.5}$ $PM_{10} = 0.60 \times 0.0056 \times S^{2.0}$ $PM_{2.5} = 0.031 \times 0.0034 \times S^{2.5}$ Where: EF = emission factor (kg/VKT) S = grader speed (km/hr) VKT = vehicle kilometer travelled	(U.S. EPA 1998)
Construction – Disturbed Areas	TSP = 1.2 (0.7) Mg/ha/month PM ₁₀ = 0.42 (0.25) Mg/ha/month PM _{2.5} = 0.04 (0.02) Mg/ha/month	(U.S. EPA 1995) and (Countess Environmental 2006) for worst-case conditions (i.e., cut/fill volumes unknown) Values in brackets are average emission factors that were used when cut/fill volumes were available.
Construction – Cut/Fill	TSP = 0.0002 Mg/m ³ /month PM ₁₀ = 0.00007 Mg/m ³ /month PM _{2.5} = 0.00001 Mg/m ³ /month	(U.S. EPA 1995) and (Countess Environmental 2006) TSP factor not available for average conditions. Calculated using ratio of TSP/PM ₁₀ for worst-case conditions (1.2 ton/ha/month / 0.42 ton/ha/month).

Emission Source	Emission Factor or Equation	References and Notes
Generators	TSP, PM ₁₀ , PM _{2.5} = 0.093 g/hp-hr NO _x = 7.52 g/hp-hr	Caterpillar 3516B Technical Specifications (AREVA 2016) (U.S. EPA 2023a) for speciation of VOCs
	CO = 0.76 g/hp-hr HC = 0.03 g/hp-hr	
	SO ₂ = Fuel consumption (L/h) * %S/100 * fuel density (g/L) * 64 (g/mol) / 32 (g/mol) / 3600 (s/h) Where: ER = emission rate (g/s) %S = percent sulphur in diesel fuel (0.0015%)	(GC 2017) for fuel sulphur content
Grout Plant (excluding cement silo)	TSP = 0.286 kg/Mg PM ₁₀ = 0.078 kg/Mg PM _{2.5} = 0.0184 kg/Mg	(U.S. EPA 2006a)
Material handling (e.g., loading and unloading material to trucks)	$E = k \times (0.0016) \times (U/2.2)^{1.3} / (M/2)^{1.4}$ Where: E = emission factor in kg/tonne of material k = particle size multiplier for TSP, PM ₁₀ and PM _{2.5} U = mean wind speed (m/s) M = moisture content (%)	(U.S. EPA 2006b)
Off-road diesel engines (except generators)	ER = EF x Engine Rating (kW) x Equipment Quantity x Engine Load (%) x 1000 (g/kg) / 3600 (s/h) Where: ER = emission rate (g/s) EF = emission factor (varies by equipment type) (kg/kW-h)	(AG 2008) (U.S. EPA 2023a) for speciation of VOCs
On-road vehicle tailpipe (diesel and gasoline)	Particulate and gases (except SO ₂): ER = EF x fuel consumption (m ³ /h) x 1000 (g/kg) / 3600 (s/h) Where: ER = emission rate (g/s) EF = emission factor (kg/m ³) (varies by vehicle and fuel type)	(AG 2008) (U.S. EPA 2020) (U.S. EPA 2023b) for speciation of VOCs

Emission Source		Emission Factor or Equation	References and Notes
		SO ₂ = Fuel Consumption (L/h) * %S/100 * fuel density (g/L) * 64 (g/mol) / 32 (g/mol) / 3600 (s/h) Where: ER = emission rate (g/s) %S = percent sulphur in fuel	(GC 2017) (GC 2020)
Propane combustion		TSP = PM ₁₀ = PM _{2.5} = 0.024 kg/m ³ NOx = 1.558 kg/m ³ CO = 0.899 kg/m ³	(U.S. EPA 2008) (GC 2022b)
Stacks	Grinding Stack	Maximum results from stack testing data. Future emission rates scaled based on expected production.	(SRC 2022d)
	Packaging Stack	Maximum results from 2019 to 2024 stack testing data. Future emission rates scaled based on expected production.	(SRC 2019a) (SRC 2019b) (SRC 2020a) (SRC 2020b) (SRC 2021a) (SRC 2021b) (SRC 2022a) (SRC 2022b) (SRC 2022c) (SRC 2022e) (SRC 2022f) (SRC 2022g) (SRC 2023a) (SRC 2023b) (SRC 2023c) (SRC 2023d) (SRC 2023e) (SRC 2023f) (SRC 2023g) (SRC 2024a) (SRC 2024b) (SRC2025)
	Calcliner Stack		
	Crystallizer Stack		
	Acid Plant Stack	Max. SO ₂ equals 3.4 g/s and scaled based on production rates.	(SRC 2020b) (SRC 2021b) (SRC 2022b) (SRC 2023f)
		CO, NOx: Scaling factors relative to SO ₂ developed from 2015 and 2016 stack test reports and applied to current SO ₂ rates.	Engineering calculation (AREVA 2016)
Silo Baghouse (Cement)		TSP = PM ₁₀ = PM _{2.5} = 10 mg/m ³ As = 0.0005% x TSP Cd and Cr = 0.00007% x TSP Mn = 0.0561% x TSP Ni = 0.0049% x TSP Pb = 0.0002% x TSP	(MECP 2018) (U.S. EPA 2006a) for metals content, where available.

Emission Source	Emission Factor or Equation	References and Notes
Unpaved road dust (industrial roads)	$E = k \times (s/12)^a \times (W/3)^b$ Where: E = emission factor in g/VKT k = particle size multiplier for TSP, PM ₁₀ and PM _{2.5} s = silt content (%) W = vehicle weight (tons) a, b = constants 1 lb/VMT = 281.9 g/VKT VKT = vehicle kilometers travelled	(U.S. EPA 2006c)
Waste Incinerator	TSP 361 mg/Nm ³ PM ₁₀ 285 mg/Nm ³ PM _{2.5} 162 mg/Nm ³	(SRC 2019a) (AREVA 2016) (U.S. EPA 1996) for metals content
	CO 7 mg/Nm ³ SO ₂ 50 mg/Nm ³ NOx 94 mg/Nm ³	Eco Waste Solutions Incinerator Model No. ECO 1.75TN 1P MS 60L Technical Specification sheet.
	Dioxins and furans 80 pg/Nm ³	(CCME 2001)
Wind Erosion	$E = k \times 1.9 \times (s/1.5) \times (F/15)$ Where: E = emission factor (kg dust/ha/day) k = particle size multiplier (1 for TSP) s = silt content (%) f = % of time wind speed is >5.4 m/s at mean pile height	(Countess Environmental 2006)

Table 2.2-8 Summary of Geochemical Data

Material	U (%)	Ag (%)	As (%)	Cd (%)	Co (%)	Cr (%)	Cu (%)	Mo (%)
McClean Ore	3.43%	0.00052%	1.0%	0.00014%	0.057%	0.0099%	0.0073%	0.18%
Midwest Ore	7.16%	0.0081%	8.88%	0.0023%	0.13%	0.010%	0.20%	0.091%
Sue B Ore	0.3%	0.0036%	0.65%	0.0002%	0.022%	0.0092%	0.01%	0.17%
Sue F Ore ⁽¹⁾	0.3%	0.0036%	0.65%	0.0002%	0.022%	0.0092%	0.01%	0.17%
Cigar Waste Rock	0.0012%	0.00004%	0.031%	0.015%	0.015%	0.015%	0.0059%	0.0025%
JEB Clean Waste Rock ⁽²⁾	0.0016%	0.00001%	0.0015%	0.00001%	0.0009%	0.00079%	0.003%	0.0015%
Sue C Clean Waste Rock	0.0015%	0.00001%	0.0015%	0.00001%	0.0005%	0.00079%	0.0013%	0.0015%
Sue E Clean Waste Rock	0.0016%	0.00001%	0.001%	0.00001%	0.0009%	0.00079%	0.003%	0.00007%
Overburden	0.0015%	0.00001%	0.001%	0.00001%	0.0005%	0.00079%	0.0013%	0.00007%
Road material ⁽³⁾	0.0015%	0.00001%	0.001%	0.00001%	0.0005%	0.00079%	0.0013%	0.00007%

Material	Mn (%)	Ni (%)	Pb (%)	Se (%)	Tl (%)	V (%)	Zn (%)
McClean Ore	0.000004%	0.014%	0.18%	0.39%	0.0079%	0.085%	0.012%
Midwest Ore	0.00001%	0.97%	0.23%	0.00081%	0.017%	0.32%	0.096%
Sue B Ore	0.00001%	0.32%	0.092%	0.18%	0.020%	0.33%	0.011%
Sue F Ore ⁽¹⁾	0.00001%	0.32%	0.092%	0.18%	0.020%	0.33%	0.011%
Cigar Waste Rock	0.014%	0.0034%	0.002%	0.015%	0.00004%	0.0089%	0.00044%
JEB Clean Waste Rock ⁽²⁾	0.0051%	0.0015%	0.0038%	0.0001%	0.00003%	0.0082%	0.0022%
Sue C Clean Waste Rock	0.0051%	0.0015%	0.002%	0.0001%	0.00003%	0.0082%	0.0022%
Sue E Clean Waste Rock	0.0051%	0.0004%	0.0038%	0.00005%	0.00003%	0.0082%	0.0013%
Overburden	0.0051%	0.0004%	0.002%	0.00005%	0.00003%	0.0082%	0.0013%
Road material ⁽³⁾	0.0051%	0.0004%	0.002%	0.00005%	0.00003%	0.0082%	0.0013%

Notes: ⁽¹⁾ Assumed equal to Sue B ore.
⁽²⁾ Maximum of Sue C and E clean waste rock.
⁽³⁾ Assumed equal to overburden material.

Scenario	TSP (g/s)	PM ₁₀ (g/s)	PM _{2.5} (g/s)	U (g/s)	Ag (g/s)	As (g/s)	Co (g/s)	Cd (g/s)	Cr (g/s)	Cu (g/s)	Mo (g/s)	Mn (g/s)	Ni (g/s)	Pb (g/s)	Se (g/s)	Tl (g/s)	V (g/s)	Zn (g/s)
Baseline Operations (2022 – 2025 and 2035 to 2036)	1.13E+01	4.98E+00	2.75E+00	1.55E-02	9.99E-06	1.33E-03	1.07E-04	1.50E-04	1.72E-04	2.13E-04	1.60E-03	8.58E-04	5.35E-04	1.06E-03	4.20E-04	2.24E-05	9.58E-04	3.62E-04
Max. Future Operations (2026 – 2034)	1.74E+01	7.17E+00	3.57E+00	2.31E-02	1.98E-05	1.01E-02	2.43E-04	1.68E-04	2.17E-04	5.10E-04	1.89E-03	1.53E-03	1.63E-03	1.34E-03	4.59E-04	4.03E-05	1.65E-03	5.61E-04
Decommissioning (2037 – 2050)	9.69E+00	3.19E+00	8.49E-01	1.39E-04	1.10E-06	3.09E-04	1.52E-04	1.47E-04	2.37E-04	2.07E-04	7.14E-05	5.18E-04	2.23E-04	8.99E-04	9.93E-05	2.80E-06	7.53E-04	1.45E-04
Post-Decommissioning (2051+)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes: ⁽¹⁾ Emissions represent the site-wide total of maximum short-term emission rates for summer.

Scenario	CO (g/s)	SO ₂ (g/s)	NO _x (g/s)	Acrolein (g/s)	Benzene (g/s)	NH ₃ (g/s)	Radon (Bq/s)
Baseline Operations (2022 – 2025 and 2035 to 2036)	6.02E+00	2.76E+00	3.15E+01	1.09E-02	3.35E-02	2.13E+00	4.54E+06
Max. Future Operations (2026 – 2034)	8.21E+00	3.70E+00	3.62E+01	1.86E-02	5.66E-02	2.45E+00	6.98E+06
Decommissioning (2037 – 2050)	3.87E+00	2.98E-02	2.74E+01	5.58E-03	1.81E-02	0	1.23E+05
Post-Decommissioning (2051+)	0	0	0	0	0	0	3.06E+05

Notes: ⁽¹⁾ Except radon, emissions represent the site-wide total of maximum short-term emission rates for summer. Only long-term (i.e., annual) concentrations of radon were evaluated in the ERA; therefore, emissions represent average annual rates.

Table 2.2-11 Summary of Maximum Air Emission Rates by Source for the Baseline Operations Scenario (Particulate and Metals)

Model ID	Description	TSP (g/s)	PM ₁₀ (g/s)	PM _{2.5} (g/s)	U (g/s)	Ag (g/s)	As (g/s)	Co (g/s)	Cd (g/s)	Cr (g/s)	Cu (g/s)	Mo (g/s)	Mn (g/s)	Ni (g/s)	Pb (g/s)	Se (g/s)	Tl (g/s)	V (g/s)	Zn (g/s)
ACID	Acid plant tail gas stack	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AB1E	Air buster tank - McClean mining Pad 1E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AB1W	Air buster tank - McClean mining Pad 1W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ABSUEF	Air buster tank - Sue F mining area	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CALC	Calcliner scrubber stack	1.22E+00	1.22E+00	1.22E+00	1.28E-02	1.72E-06	9.72E-05	1.42E-06	8.33E-05	9.17E-06	3.06E-05	1.29E-03	8.33E-06	3.06E-05	3.89E-06	3.61E-05	3.06E-07	3.06E-07	1.31E-04
CX	Crystallizer stack	2.53E-01	2.53E-01	2.53E-01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DROP1	Drop to grinding grizzly	2.92E-06	1.38E-06	2.09E-07	2.09E-07	2.37E-10	2.59E-07	3.79E-09	6.62E-11	3.00E-10	5.70E-09	5.37E-09	2.95E-13	2.84E-08	6.82E-09	1.14E-08	5.75E-10	9.58E-09	2.80E-09
DROP2	Waste rock drop to Sue C pit	3.81E-05	1.80E-05	2.73E-06	6.09E-10	3.81E-12	5.71E-10	3.42E-10	3.81E-12	3.01E-10	1.14E-09	5.71E-10	1.94E-09	5.71E-10	1.45E-09	3.81E-11	1.14E-11	3.12E-09	8.45E-10
GEN1	Backup generator 1	6.24E-02	6.24E-02	6.24E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEN2	Backup generator 2	6.24E-02	6.24E-02	6.24E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEN3	Backup generator 3	6.24E-02	6.24E-02	6.24E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEN4	Backup generator 4	6.24E-02	6.24E-02	6.24E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEN5	Backup generator 5	6.24E-02	6.24E-02	6.24E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRIND	Grinding stack	1.11E-02	1.11E-02	1.11E-02	3.81E-04	5.79E-08	1.11E-04	6.32E-06	1.51E-08	1.10E-06	8.11E-07	2.04E-05	4.22E-10	1.56E-06	2.03E-05	4.34E-05	8.78E-07	9.40E-06	1.34E-06
HEAT1	Propane heating - support services area	2.52E-04	2.52E-04	2.52E-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAT2	Propane heating - site services area	2.65E-04	2.65E-04	2.65E-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAT3	Propane heating - gatehouse area	3.24E-05	3.24E-05	3.24E-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAT4	Camp propane use	7.38E-04	7.38E-04	7.38E-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAT5	Sue WTP area propane use	7.38E-04	7.38E-04	7.38E-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
INC	Incinerator stack	8.06E-02	6.37E-02	3.63E-02	0	0	1.57E-05	0	5.62E-05	7.73E-05	0	0	0	1.29E-04	6.53E-04	0	0	0	0
JEBOB1_s	JEB north overburden pile (summer)	3.36E-03	1.68E-03	2.52E-04	5.04E-08	3.36E-10	3.36E-08	1.68E-08	3.36E-10	2.66E-08	4.40E-08	2.35E-09	1.71E-07	1.34E-08	6.72E-08	1.68E-09	1.01E-09	2.76E-07	4.37E-08
JEBOB1_w	JEB north overburden pile (winter)	6.72E-04	3.36E-04	5.04E-05	1.01E-08	6.72E-11	6.72E-09	3.36E-09	6.72E-11	5.31E-09	8.81E-09	4.71E-10	3.43E-08	2.69E-09	1.34E-08	3.36E-10	2.02E-10	5.51E-08	8.74E-09
JEBWST_s	JEB CWRP (summer)	2.25E+00	6.98E-01	1.65E-01	3.57E-05	2.23E-07	3.34E-05	2.01E-05	2.23E-07	1.76E-05	6.69E-05	3.34E-05	1.14E-04	3.34E-05	8.47E-05	2.23E-06	6.69E-07	1.83E-04	4.95E-05
JEBWST_w	JEB CWRP (winter)	2.79E-02	2.19E-02	1.54E-02	1.93E-07	1.21E-09	1.81E-07	1.09E-07	1.21E-09	9.55E-08	3.62E-07	1.81E-07	6.16E-07	1.81E-07	4.59E-07	1.21E-08	3.62E-09	9.91E-07	2.68E-07

Model ID	Description	TSP (g/s)	PM ₁₀ (g/s)	PM _{2.5} (g/s)	U (g/s)	Ag (g/s)	As (g/s)	Co (g/s)	Cd (g/s)	Cr (g/s)	Cu (g/s)	Mo (g/s)	Mn (g/s)	Ni (g/s)	Pb (g/s)	Se (g/s)	Tl (g/s)	V (g/s)	Zn (g/s)
JTMF1	TMF radon release (baseline)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JTMF2	TMF radon release (future)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MILL	Mill general ventilation	7.48E-03	7.48E-03	7.16E-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MOFFAT_s	Moffat borrow area (summer)	2.52E-01	9.13E-02	1.48E-02	4.04E-06	2.52E-08	3.78E-06	2.27E-06	2.52E-08	1.99E-06	7.57E-06	3.78E-06	1.29E-05	3.78E-06	9.58E-06	2.52E-07	7.57E-08	2.07E-05	5.60E-06
MOFFAT_w	Moffat borrow area (winter)	9.98E-05	4.99E-05	7.49E-06	1.60E-09	9.98E-12	1.50E-09	8.98E-10	9.98E-12	7.89E-10	2.99E-09	1.50E-09	5.09E-09	1.50E-09	3.79E-09	9.98E-11	2.99E-11	8.18E-09	2.22E-09
PACK	Packaging stack	9.17E-02	9.17E-02	9.17E-02	2.42E-04	4.44E-06	9.44E-07	1.08E-06	9.17E-06	7.78E-06	1.31E-05	5.56E-06	9.17E-06	1.33E-05	1.53E-06	8.89E-08	1.81E-07	3.61E-07	7.22E-05
PAD1E	McClean Pad 1E mining	9.67E-01	4.01E-01	2.24E-01	2.63E-04	4.12E-08	8.03E-05	4.47E-06	5.09E-07	1.40E-06	9.68E-07	1.43E-05	4.30E-04	3.87E-05	1.61E-05	2.99E-05	6.09E-07	7.60E-06	1.23E-06
PAD1W	McClean Pad 1W mining	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PAD1W_c	McClean Pad 1W construction	4.74E-01	2.56E-01	1.39E-01	5.03E-06	3.35E-08	5.03E-06	1.68E-06	3.35E-08	2.65E-06	4.39E-06	5.03E-06	1.71E-05	5.03E-06	6.70E-06	3.35E-07	1.01E-07	2.75E-05	7.44E-06
PAD2	McClean Pad 2 construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROAD1_s	Road 1 (summer)	7.46E-01	2.06E-01	2.40E-02	1.11E-05	7.41E-08	7.41E-06	3.71E-06	7.41E-08	5.86E-06	9.71E-06	5.19E-07	3.78E-05	2.97E-06	1.48E-05	3.71E-07	2.22E-07	6.08E-05	9.64E-06
ROAD1_w	Road 1 (winter)	3.16E-01	8.21E-02	9.30E-03	4.72E-06	3.14E-08	3.14E-06	1.57E-06	3.14E-08	2.48E-06	4.12E-06	2.20E-07	1.60E-05	1.26E-06	6.29E-06	1.57E-07	9.43E-08	2.58E-05	4.09E-06
ROAD2_s	Road 2 (summer)	4.71E-01	1.23E-01	1.35E-02	7.04E-06	4.69E-08	4.69E-06	2.35E-06	4.69E-08	3.71E-06	6.15E-06	3.28E-07	2.39E-05	1.88E-06	9.38E-06	2.35E-07	1.41E-07	3.85E-05	6.10E-06
ROAD2_w	Road 2 (winter)	2.29E-01	5.96E-02	6.85E-03	3.41E-06	2.28E-08	2.28E-06	1.14E-06	2.28E-08	1.80E-06	2.98E-06	1.59E-07	1.16E-05	9.11E-07	4.55E-06	1.14E-07	6.83E-08	1.87E-05	2.96E-06
ROAD3_s	Road 3 (summer)	1.82E-01	4.91E-02	6.37E-03	2.70E-06	1.80E-08	1.80E-06	9.00E-07	1.80E-08	1.42E-06	2.36E-06	1.26E-07	9.18E-06	7.20E-07	3.60E-06	9.00E-08	5.40E-08	1.48E-05	2.34E-06
ROAD3_w	Road 3 (winter)	8.59E-02	2.32E-02	3.55E-03	1.27E-06	8.44E-09	8.44E-07	4.22E-07	8.44E-09	6.67E-07	1.11E-06	5.91E-08	4.30E-06	3.38E-07	1.69E-06	4.22E-08	2.53E-08	6.92E-06	1.10E-06
ROAD4_s	Road 4 (summer)	4.29E-01	1.16E-01	1.50E-02	6.37E-06	4.24E-08	4.24E-06	2.12E-06	4.24E-08	3.35E-06	5.56E-06	2.97E-07	2.16E-05	1.70E-06	8.49E-06	2.12E-07	1.27E-07	3.48E-05	5.52E-06
ROAD4_w	Road 4 (winter)	2.02E-01	5.45E-02	8.29E-03	2.98E-06	1.99E-08	1.99E-06	9.94E-07	1.99E-08	1.57E-06	2.60E-06	1.39E-07	1.01E-05	7.95E-07	3.97E-06	9.94E-08	5.96E-08	1.63E-05	2.58E-06
ROAD5_s	Road 5 (summer)	1.50E+00	4.04E-01	4.65E-02	2.24E-05	1.49E-07	1.49E-05	7.47E-06	1.49E-07	1.18E-05	1.96E-05	1.05E-06	7.62E-05	5.97E-06	2.99E-05	7.47E-07	4.48E-07	1.22E-04	1.94E-05
ROAD5_w	Road 5 (winter)	6.81E-01	1.78E-01	2.09E-02	1.02E-05	6.78E-08	6.78E-06	3.39E-06	6.78E-08	5.35E-06	8.88E-06	4.74E-07	3.46E-05	2.71E-06	1.36E-05	3.39E-07	2.03E-07	5.56E-05	8.81E-06
ROAD6_s	Road 6 (summer)	2.57E-02	7.93E-03	1.25E-03	3.76E-07	2.51E-09	2.51E-07	1.25E-07	2.51E-09	1.98E-07	3.29E-07	1.76E-08	1.28E-06	1.00E-07	5.02E-07	1.25E-08	7.53E-09	2.06E-06	3.26E-07
ROAD6_w	Road 6 (winter)	8.00E-03	2.28E-03	4.86E-04	1.16E-07	7.70E-10	7.70E-08	3.85E-08	7.70E-10	6.09E-08	1.01E-07	5.39E-09	3.93E-07	3.08E-08	1.54E-07	3.85E-09	2.31E-09	6.32E-07	1.00E-07
ROAD7_s	Road 7 (summer)	2.32E-01	6.18E-02	7.89E-03	3.44E-06	2.30E-08	2.30E-06	1.15E-06	2.30E-08	1.81E-06	3.01E-06	1.61E-07	1.17E-05	9.18E-07	4.59E-06	1.15E-07	6.89E-08	1.88E-05	2.98E-06
ROAD7_w	Road 7 (winter)	1.12E-01	3.03E-02	4.56E-03	1.66E-06	1.11E-08	1.11E-06	5.53E-07	1.11E-08	8.74E-07	1.45E-06	7.74E-08	5.64E-06	4.43E-07	2.21E-06	5.53E-08	3.32E-08	9.07E-06	1.44E-06
ROAD8_s	Road 8 (summer)	2.47E-01	9.09E-02	1.41E-02	3.59E-06	2.39E-08	2.39E-06	1.20E-06	2.39E-08	1.89E-06	3.14E-06	1.68E-07	1.22E-05	9.57E-07	4.79E-06	1.20E-07	7.18E-08	1.96E-05	3.11E-06
ROAD8_w	Road 8 (winter)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SBORE_J_s	JEB Ore Pad Sue B Ore (summer)	2.22E-02	1.11E-02	1.66E-03	6.66E-05	8.08E-07	1.44E-04	4.93E-06	4.42E-08	2.05E-06	2.22E-06	3.86E-05	2.13E-09	7.10E-05	2.04E-05	3.98E-05	4.37E-06	7.28E-05	2.54E-06
SBORE_J_w	JEB Ore Pad Sue B Ore (winter)	4.44E-03	2.22E-03	3.33E-04	1.33E-05	1.62E-07	2.88E-05	9.85E-07	8.83E-09	4.11E-07	4.44E-07	7.72E-06	4.26E-10	1.42E-05	4.08E-06	7.96E-06	8.73E-07	1.46E-05	5.08E-07
SBORE_S_s	Sue Ore Pad Sue B Ore (summer)	5.18E-02	2.59E-02	3.88E-03	1.55E-04	1.89E-06	3.37E-04	1.15E-05	1.03E-07	4.79E-06	5.18E-06	9.01E-05	4.97E-09	1.66E-04	4.76E-05	9.29E-05	1.02E-05	1.70E-04	5.92E-06
SBORE_S_w	Sue Ore Pad Sue B Ore (winter)	1.04E-02	5.18E-03	7.77E-04	3.11E-05	3.77E-07	6.73E-05	2.30E-06	2.06E-08	9.58E-07	1.04E-06	1.80E-05	9.94E-10	3.31E-05	9.53E-06	1.86E-05	2.04E-06	3.40E-05	1.18E-06

Model ID	Description	TSP (g/s)	PM ₁₀ (g/s)	PM _{2.5} (g/s)	U (g/s)	Ag (g/s)	As (g/s)	Co (g/s)	Cd (g/s)	Cr (g/s)	Cu (g/s)	Mo (g/s)	Mn (g/s)	Ni (g/s)	Pb (g/s)	Se (g/s)	Tl (g/s)	V (g/s)	Zn (g/s)
SBREC_J_s	JEB Ore Pad SABRE Coarse Ore (summer)	1.71E-02	8.56E-03	1.28E-03	5.88E-04	8.92E-08	1.71E-04	9.74E-06	2.32E-08	1.70E-06	1.25E-06	3.15E-05	6.51E-10	2.40E-06	3.13E-05	6.69E-05	1.35E-06	1.45E-05	2.06E-06
SBREC_J_w	JEB Ore Pad SABRE Coarse Ore (winter)	3.45E-03	1.72E-03	2.58E-04	1.18E-04	1.79E-08	3.45E-05	1.96E-06	4.67E-09	3.42E-07	2.52E-07	6.34E-06	1.31E-10	4.82E-07	6.31E-06	1.35E-05	2.72E-07	2.92E-06	4.15E-07
SBREF_J_s	JEB Ore Pad SABRE Fines (summer)	1.34E-02	6.70E-03	1.01E-03	4.60E-04	6.98E-08	1.34E-04	7.62E-06	1.82E-08	1.33E-06	9.79E-07	2.47E-05	5.10E-10	1.88E-06	2.45E-05	5.23E-05	1.06E-06	1.13E-05	1.62E-06
SBREF_J_w	JEB Ore Pad SABRE Fines (winter)	2.68E-03	1.34E-03	2.01E-04	9.20E-05	1.40E-08	2.68E-05	1.53E-06	3.64E-09	2.66E-07	1.96E-07	4.94E-06	1.02E-10	3.76E-07	4.91E-06	1.05E-05	2.12E-07	2.27E-06	3.23E-07
SBREF_S_s	Sue Ore Pad SABRE Fines (summer)	1.34E-02	6.70E-03	1.01E-03	4.60E-04	6.98E-08	1.34E-04	7.62E-06	1.82E-08	1.33E-06	9.79E-07	2.47E-05	5.10E-10	1.88E-06	2.45E-05	5.24E-05	1.06E-06	1.13E-05	1.62E-06
SBREF_S_w	Sue Ore Pad SABRE Fines (winter)	2.68E-03	1.34E-03	2.01E-04	9.21E-05	1.40E-08	2.68E-05	1.53E-06	3.64E-09	2.66E-07	1.96E-07	4.94E-06	1.02E-10	3.76E-07	4.91E-06	1.05E-05	2.12E-07	2.27E-06	3.23E-07
SUE	Sue area off-road combustion	3.29E-03	3.29E-03	3.02E-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUECOB_s	Sue C overburden pile (summer)	2.10E-03	1.05E-03	1.58E-04	3.15E-08	2.10E-10	2.10E-08	1.05E-08	2.10E-10	1.66E-08	2.75E-08	1.47E-09	1.07E-07	8.41E-09	4.20E-08	1.05E-09	6.30E-10	1.72E-07	2.73E-08
SUECOB_w	Sue C overburden pile (winter)	4.20E-04	2.10E-04	3.15E-05	6.30E-09	4.20E-11	4.20E-09	2.10E-09	4.20E-11	3.32E-09	5.51E-09	2.94E-10	2.14E-08	1.68E-09	8.41E-09	2.10E-10	1.26E-10	3.45E-08	5.46E-09
SUECPIT	Sue C Pit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUECWST_s	Sue C CWRP (summer)	8.39E-01	1.99E-01	8.17E-02	1.24E-05	8.29E-08	1.24E-05	4.14E-06	8.29E-08	6.55E-06	1.09E-05	1.24E-05	4.23E-05	1.24E-05	1.66E-05	8.29E-07	2.49E-07	6.79E-05	1.84E-05
SUECWST_w	Sue C CWRP (winter)	2.30E-02	1.65E-02	1.01E-02	1.97E-07	1.31E-09	1.97E-07	6.57E-08	1.31E-09	1.04E-07	1.72E-07	1.97E-07	6.70E-07	1.97E-07	2.63E-07	1.31E-08	3.94E-09	1.08E-06	2.92E-07
SUEEOB_s	Sue E overburden pile (summer)	2.10E-03	1.05E-03	1.58E-04	3.15E-08	2.10E-10	2.10E-08	1.05E-08	2.10E-10	1.66E-08	2.75E-08	1.47E-09	1.07E-07	8.41E-09	4.20E-08	1.05E-09	6.30E-10	1.72E-07	2.73E-08
SUEEOB_w	Sue E overburden pile (winter)	4.20E-04	2.10E-04	3.15E-05	6.30E-09	4.20E-11	4.20E-09	2.10E-09	4.20E-11	3.32E-09	5.51E-09	2.94E-10	2.14E-08	1.68E-09	8.41E-09	2.10E-10	1.26E-10	3.45E-08	5.46E-09
SUEEWST_s	Sue E CWRP (summer)	4.69E-02	2.04E-02	2.93E-03	7.50E-07	4.69E-09	4.69E-07	4.22E-07	4.69E-09	3.70E-07	1.41E-06	3.28E-08	2.39E-06	1.88E-07	1.78E-06	2.34E-08	1.41E-08	3.85E-06	6.10E-07
SUEEWST_w	Sue E CWRP (winter)	6.83E-03	3.41E-03	5.12E-04	1.09E-07	6.83E-10	6.83E-08	6.15E-08	6.83E-10	5.40E-08	2.05E-07	4.78E-09	3.48E-07	2.73E-08	2.60E-07	3.41E-09	2.05E-09	5.60E-07	8.88E-08
SUEF	Sue F mining	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TMFC	TMF expansion	5.89E-01	2.32E-01	5.52E-02	8.80E-06	5.50E-08	8.25E-06	4.95E-06	5.50E-08	4.34E-06	1.65E-05	8.25E-06	2.80E-05	8.25E-06	2.09E-05	5.50E-07	1.65E-07	4.51E-05	1.22E-05
TMFD	TMF closure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	Summer	1.13E+01	4.98E+00	2.75E+00	1.55E-02	9.99E-06	1.33E-03	1.07E-04	1.50E-04	1.72E-04	2.13E-04	1.60E-03	8.58E-04	5.35E-04	1.06E-03	4.20E-04	2.24E-05	9.58E-04	3.62E-04
	Winter	4.66E+00	2.85E+00	2.24E+00	1.40E-02	7.02E-06	5.06E-04	2.99E-05	1.49E-04	1.12E-04	6.95E-05	1.37E-03	5.32E-04	2.69E-04	7.58E-04	1.71E-04	6.08E-06	2.09E-04	2.30E-04

Table 2.2-12 Summary of Maximum Air Emission Rates by Source for the Baseline Operations Scenario (Gases)

Model ID	Description	CO (g/s)	SO ₂ (g/s)	NO _x (g/s)	Acrolein (g/s)	Benzene (g/s)	NH ₃ (g/s)	Radon ⁽¹⁾ (Bq/s)
ACID	Acid plant tail gas stack	3.11E-02	2.49E+00	3.38E-02	0	0	0	0
AB1E	Air buster tank -McClean mining Pad 1E	0	0	0	0	0	0	2.49E+04
AB1W	Air buster tank -McClean mining Pad 1W	0	0	0	0	0	0	0
ABSUEF	Air buster tank -Sue F mining area	0	0	0	0	0	0	0
CALC	Calcliner scrubber stack	5.89E-01	1.85E-01	6.58E-01	0	0	2.13E+00	0
CX	Crystallizer stack	1.00E-01	0	2.94E-02	0	0	0	0
DROP1	Drop to grinding grizzly	0	0	0	0	0	0	0
DROP2	Waste rock drop to Sue C pit	0	0	0	0	0	0	0
GEN1	Backup generator 1	5.10E-01	3.35E-03	5.04E+00	4.64E-04	1.34E-03	0	0
GEN2	Backup generator 2	5.10E-01	3.35E-03	5.04E+00	4.64E-04	1.34E-03	0	0
GEN3	Backup generator 3	5.10E-01	3.35E-03	5.04E+00	4.64E-04	1.34E-03	0	0
GEN4	Backup generator 4	5.10E-01	3.35E-03	5.04E+00	4.64E-04	1.34E-03	0	0
GEN5	Backup generator 5	5.10E-01	3.35E-03	5.04E+00	4.64E-04	1.34E-03	0	0
GRIND	Grinding stack	0	0	0	0	0	0	9.13E+03
HEAT1	Propane heating -support services area	9.45E-03	0	1.64E-02	0	0	0	0
HEAT2	Propane heating -site services area	9.93E-03	0	1.72E-02	0	0	0	0
HEAT3	Propane heating -gatehouse area	1.22E-03	0	2.11E-03	0	0	0	0
HEAT4	Camp propane use	2.77E-02	0	4.80E-02	0	0	0	0
HEAT5	Sue WTP area propane use	2.77E-02	0	4.80E-02	0	0	0	0
INC	Incinerator stack	1.56E-03	1.12E-02	2.10E-02	0	0	0	0
JEBOB1_s	JEB north overburden pile (summer)	0	0	0	0	0	0	0
JEBOB1_w	JEB north overburden pile (winter)	0	0	0	0	0	0	0
JEBWST_s	JEB CWRP (summer)	8.67E-02	1.67E-04	2.08E-01	3.42E-04	9.90E-04	0	0
JEBWST_w	JEB CWRP (winter)	8.05E-02	1.56E-04	1.93E-01	3.30E-04	9.55E-04	0	0
JTMF1	TMF radon release (baseline)	0	0	0	0	0	0	1.77E+04
JTMF2	TMF radon release (future)	0	0	0	0	0	0	0
MILL	Mill general ventilation	1.52E-01	3.91E-05	2.78E-01	8.25E-05	2.39E-04	0	1.94E+06
MOFFAT_s	Moffat borrow area (summer)	0	0	0	0	0	0	0
MOFFAT_w	Moffat borrow area (winter)	0	0	0	0	0	0	0
PACK	Packaging stack	1.33E-02	4.42E-02	1.94E-02	0	0	0	0
PAD1E	McClean Pad 1E mining	9.24E-01	1.79E-03	2.22E+00	3.78E-03	1.09E-02	0	1.80E+05
PAD1W	McClean Pad 1W mining	0	0	0	0	0	0	0
PAD1W_c	McClean Pad 1W construction	7.07E-01	1.37E-03	1.70E+00	2.90E-03	8.38E-03	0	0
PAD2	McClean Pad 2 construction	0	0	0	0	0	0	0
ROAD1_s	Road 1 (summer)	1.32E-02	6.35E-05	5.53E-02	4.93E-05	1.22E-04	0	0
ROAD1_w	Road 1 (winter)	4.82E-03	1.80E-05	1.65E-02	1.29E-05	1.66E-05	0	0
ROAD2_s	Road 2 (summer)	1.35E-01	3.28E-05	3.58E-02	2.37E-05	6.30E-04	0	0
ROAD2_w	Road 2 (winter)	1.34E-01	2.72E-05	3.10E-02	1.92E-05	6.17E-04	0	0
ROAD3_s	Road 3 (summer)	6.69E-02	2.86E-05	3.37E-02	2.46E-05	3.20E-04	0	0

Model ID	Description	CO (g/s)	SO ₂ (g/s)	NOx (g/s)	Acrolein (g/s)	Benzene (g/s)	NH ₃ (g/s)	Radon ⁽¹⁾ (Bq/s)
ROAD3_w	Road 3 (winter)	6.60E-02	2.41E-05	2.98E-02	2.10E-05	3.09E-04	0	0
ROAD4_s	Road 4 (summer)	8.05E-02	5.86E-05	6.99E-02	5.33E-05	3.99E-04	0	0
ROAD4_w	Road 4 (winter)	7.85E-02	4.76E-05	6.05E-02	4.45E-05	3.74E-04	0	0
ROAD5_s	Road 5 (summer)	1.53E-01	1.17E-04	1.12E-01	8.07E-05	7.58E-04	0	0
ROAD5_w	Road 5 (winter)	1.43E-01	6.06E-05	6.48E-02	3.60E-05	6.29E-04	0	0
ROAD6_s	Road 6 (summer)	5.86E-02	1.36E-05	1.41E-02	8.03E-06	2.72E-04	0	0
ROAD6_w	Road 6 (winter)	5.79E-02	9.72E-06	1.08E-02	4.90E-06	2.63E-04	0	0
ROAD7_s	Road 7 (summer)	6.86E-02	3.22E-05	3.79E-02	2.80E-05	3.27E-04	0	0
ROAD7_w	Road 7 (winter)	6.80E-02	2.88E-05	3.51E-02	2.53E-05	3.19E-04	0	0
ROAD8_s	Road 8 (summer)	1.78E-02	9.69E-05	8.26E-02	7.74E-05	2.24E-04	0	0
ROAD8_w	Road 8 (winter)	0	0	0	0	0	0	0
SBORE_J_s	JEB Ore Pad Sue B Ore (summer)	0	0	0	0	0	0	8.78E+04
SBORE_J_w	JEB Ore Pad Sue B Ore (winter)	0	0	0	0	0	0	8.78E+04
SBORE_S_s	Sue Ore Pad Sue B Ore (summer)	0	0	0	0	0	0	2.05E+05
SBORE_S_w	Sue Ore Pad Sue B Ore (winter)	0	0	0	0	0	0	2.05E+05
SBREC_J_s	JEB Ore Pad SABRE Coarse Ore (summer)	0	0	0	0	0	0	7.77E+05
SBREC_J_w	JEB Ore Pad SABRE Coarse Ore (winter)	0	0	0	0	0	0	7.77E+05
SBREF_J_s	JEB Ore Pad SABRE Fines (summer)	0	0	0	0	0	0	6.07E+05
SBREF_J_w	JEB Ore Pad SABRE Fines (winter)	0	0	0	0	0	0	6.07E+05
SBREF_S_s	Sue Ore Pad SABRE Fines (summer)	0	0	0	0	0	0	6.08E+05
SBREF_S_w	Sue Ore Pad SABRE Fines (winter)	0	0	0	0	0	0	6.08E+05
SUE	Sue area off-road combustion	1.68E-02	3.26E-05	4.03E-02	6.87E-05	1.99E-04	0	0
SUECOB_s	Sue C overburden pile (summer)	0	0	0	0	0	0	0
SUECOB_w	Sue C overburden pile (winter)	0	0	0	0	0	0	0
SUECPIT	Sue C Pit	0	0	0	0	0	0	0
SUECWST_s	Sue C CWRP (summer)	5.37E-02	1.04E-04	1.29E-01	2.13E-04	6.16E-04	0	5.74E+04
SUECWST_w	Sue C CWRP (winter)	5.03E-02	9.78E-05	1.21E-01	2.06E-04	5.97E-04	0	5.74E+04
SUEEOB_s	Sue E overburden pile (summer)	0	0	0	0	0	0	0
SUEEOB_w	Sue E overburden pile (winter)	0	0	0	0	0	0	0
SUEEWST_s	Sue E CWRP (summer)	2.64E-04	4.60E-07	6.12E-04	5.25E-07	1.52E-06	0	3.17E+04
SUEEWST_w	Sue E CWRP (winter)	0	0	0	0	0	0	3.17E+04
SUEF	Sue F mining	0	0	0	0	0	0	0
TMFC	TMF expansion	2.00E-01	3.88E-04	4.80E-01	8.18E-04	2.37E-03	0	0
TMFD	TMF closure	0	0	0	0	0	0	0
Total	Summer	6.02E+00	2.76E+00	3.15E+01	1.09E-02	3.35E-02	2.13E+00	4.54E+06
	Winter	5.13E+00	2.75E+00	2.92E+01	6.95E-03	2.22E-02	2.13E+00	4.54E+06

Notes: ⁽¹⁾ Only long-term (i.e., annual) concentrations of radon were evaluated in the ERA. Therefore, emissions represent average annual rates and summer/winter rates are the same.

Table 2.2-13 Summary of Maximum Air Emission Rates by Source for the Maximum Future Operations Scenario (Particulate and Metals)

Model ID	Description	TSP (g/s)	PM ₁₀ (g/s)	PM _{2.5} (g/s)	U (g/s)	Ag (g/s)	As (g/s)	Co (g/s)	Cd (g/s)	Cr (g/s)	Cu (g/s)	Mo (g/s)	Mn (g/s)	Ni (g/s)	Pb (g/s)	Se (g/s)	Tl (g/s)	V (g/s)	Zn (g/s)
ACID	Acid plant tail gas stack	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AB1E	Air buster tank - McClean mining Pad 1E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AB1W	Air buster tank - McClean mining Pad 1W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ABSUEF	Air buster tank - Sue F mining area	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CALC	Calcliner scrubber stack	1.40E+00	1.40E+00	1.40E+00	1.48E-02	1.99E-06	1.12E-04	1.64E-06	9.62E-05	1.06E-05	3.53E-05	1.49E-03	9.62E-06	3.53E-05	4.49E-06	4.17E-05	3.53E-07	3.53E-07	1.51E-04
CX	Crystallizer stack	2.93E-01	2.93E-01	2.93E-01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DROP1	Drop to grinding grizzly	1.55E-05	7.35E-06	1.11E-06	1.11E-06	1.26E-09	1.38E-06	2.02E-08	3.52E-10	1.59E-09	3.03E-08	2.86E-08	1.57E-12	1.51E-07	3.63E-08	6.07E-08	3.06E-09	5.10E-08	1.49E-08
DROP2	Waste rock drop to Sue C pit	1.07E-04	5.05E-05	7.65E-06	1.71E-09	1.07E-11	1.60E-09	9.61E-10	1.07E-11	8.44E-10	3.20E-09	1.60E-09	5.45E-09	1.60E-09	4.06E-09	1.07E-10	3.20E-11	8.76E-09	2.37E-09
GEN1	Backup generator 1	6.24E-02	6.24E-02	6.24E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEN2	Backup generator 2	6.24E-02	6.24E-02	6.24E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEN3	Backup generator 3	6.24E-02	6.24E-02	6.24E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEN4	Backup generator 4	6.24E-02	6.24E-02	6.24E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEN5	Backup generator 5	6.24E-02	6.24E-02	6.24E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRIND	Grinding stack	5.91E-02	5.91E-02	5.91E-02	4.23E-03	4.80E-06	5.25E-03	7.68E-05	1.34E-06	6.07E-06	1.15E-04	1.09E-04	5.97E-09	5.74E-04	1.38E-04	2.31E-04	1.16E-05	1.94E-04	5.67E-05
HEAT1	Propane heating - support services area	2.44E-04	2.44E-04	2.44E-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAT2	Propane heating - site services area	2.57E-04	2.57E-04	2.57E-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAT3	Propane heating - gatehouse area	3.14E-05	3.14E-05	3.14E-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAT4	Camp propane use	7.38E-04	7.38E-04	7.38E-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAT5	Sue WTP area propane use	7.39E-04	7.39E-04	7.39E-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
INC	Incinerator stack	8.06E-02	6.37E-02	3.63E-02	0	0	1.57E-05	0	5.62E-05	7.73E-05	0	0	0	1.29E-04	6.53E-04	0	0	0	0
JEBOB1_s	JEB north overburden pile (summer)	3.36E-03	1.68E-03	2.52E-04	5.04E-08	3.36E-10	3.36E-08	1.68E-08	3.36E-10	2.66E-08	4.40E-08	2.35E-09	1.71E-07	1.34E-08	6.72E-08	1.68E-09	1.01E-09	2.76E-07	4.37E-08
JEBOB1_w	JEB north overburden pile (winter)	6.72E-04	3.36E-04	5.04E-05	1.01E-08	6.72E-11	6.72E-09	3.36E-09	6.72E-11	5.31E-09	8.81E-09	4.71E-10	3.43E-08	2.69E-09	1.34E-08	3.36E-10	2.02E-10	5.51E-08	8.74E-09

Model ID	Description	TSP (g/s)	PM ₁₀ (g/s)	PM _{2.5} (g/s)	U (g/s)	Ag (g/s)	As (g/s)	Co (g/s)	Cd (g/s)	Cr (g/s)	Cu (g/s)	Mo (g/s)	Mn (g/s)	Ni (g/s)	Pb (g/s)	Se (g/s)	Tl (g/s)	V (g/s)	Zn (g/s)
JEBWST_s	JEB CWRP (summer)	2.61E+00	7.97E-01	1.80E-01	4.14E-05	2.59E-07	3.88E-05	2.33E-05	2.59E-07	2.04E-05	7.76E-05	3.88E-05	1.32E-04	3.88E-05	9.83E-05	2.59E-06	7.76E-07	2.12E-04	5.75E-05
JEBWST_w	JEB CWRP (winter)	3.31E-02	2.71E-02	2.02E-02	1.93E-07	1.21E-09	1.81E-07	1.09E-07	1.21E-09	9.55E-08	3.62E-07	1.81E-07	6.16E-07	1.81E-07	4.59E-07	1.21E-08	3.62E-09	9.91E-07	2.68E-07
JTMF1	TMF radon release (baseline)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JTMF2	TMF radon release (future)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MILL	Mill general ventilation	8.69E-03	8.69E-03	8.25E-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MOFFAT_s	Moffat borrow area (summer)	4.99E-04	2.50E-04	3.74E-05	7.99E-09	4.99E-11	7.49E-09	4.49E-09	4.99E-11	3.94E-09	1.50E-08	7.49E-09	2.55E-08	7.49E-09	1.90E-08	4.99E-10	1.50E-10	4.09E-08	1.11E-08
MOFFAT_w	Moffat borrow area (winter)	9.98E-05	4.99E-05	7.49E-06	1.60E-09	9.98E-12	1.50E-09	8.98E-10	9.98E-12	7.89E-10	2.99E-09	1.50E-09	5.09E-09	1.50E-09	3.79E-09	9.98E-11	2.99E-11	8.18E-09	2.22E-09
PACK	Packaging stack	1.06E-01	1.06E-01	1.06E-01	2.79E-04	5.13E-06	1.09E-06	1.25E-06	1.06E-05	8.98E-06	1.51E-05	6.42E-06	1.06E-05	1.54E-05	1.76E-06	1.03E-07	2.08E-07	4.17E-07	8.34E-05
PAD1E	McClean Pad 1E mining	6.10E-05	6.10E-05	6.10E-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PAD1W	McClean Pad 1W mining	9.38E-01	3.72E-01	1.97E-01	2.55E-04	4.01E-08	7.81E-05	4.35E-06	5.09E-07	1.38E-06	9.52E-07	1.39E-05	4.30E-04	3.86E-05	1.57E-05	2.90E-05	5.91E-07	7.41E-06	1.20E-06
PAD1W_c	McClean Pad 1W construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PAD2	McClean Pad 2 construction	2.60E-01	1.81E-01	1.32E-01	1.81E-06	1.21E-08	1.81E-06	6.05E-07	1.21E-08	9.56E-07	1.58E-06	1.81E-06	6.17E-06	1.81E-06	2.42E-06	1.21E-07	3.63E-08	9.92E-06	2.69E-06
ROAD1_s	Road 1 (summer)	1.14E+00	3.07E-01	3.48E-02	1.70E-05	1.13E-07	1.13E-05	5.66E-06	1.13E-07	8.95E-06	1.48E-05	7.93E-07	5.78E-05	4.53E-06	2.27E-05	5.66E-07	3.40E-07	9.29E-05	1.47E-05
ROAD1_w	Road 1 (winter)	5.12E-01	1.33E-01	1.51E-02	7.65E-06	5.10E-08	5.10E-06	2.55E-06	5.10E-08	4.03E-06	6.68E-06	3.57E-07	2.60E-05	2.04E-06	1.02E-05	2.55E-07	1.53E-07	4.18E-05	6.63E-06
ROAD2_s	Road 2 (summer)	2.89E-01	7.65E-02	8.57E-03	4.32E-06	2.88E-08	2.88E-06	1.44E-06	2.88E-08	2.28E-06	3.77E-06	2.02E-07	1.47E-05	1.15E-06	5.76E-06	1.44E-07	8.64E-08	2.36E-05	3.75E-06
ROAD2_w	Road 2 (winter)	1.38E-01	3.60E-02	4.23E-03	2.06E-06	1.37E-08	1.37E-06	6.85E-07	1.37E-08	1.08E-06	1.80E-06	9.60E-08	6.99E-06	5.48E-07	2.74E-06	6.85E-08	4.11E-08	1.12E-05	1.78E-06
ROAD3_s	Road 3 (summer)	8.52E-02	2.42E-02	3.79E-03	1.25E-06	8.35E-09	8.35E-07	4.17E-07	8.35E-09	6.60E-07	1.09E-06	5.84E-08	4.26E-06	3.34E-07	1.67E-06	4.17E-08	2.50E-08	6.85E-06	1.09E-06
ROAD3_w	Road 3 (winter)	3.75E-02	1.06E-02	2.20E-03	5.42E-07	3.61E-09	3.61E-07	1.81E-07	3.61E-09	2.85E-07	4.73E-07	2.53E-08	1.84E-06	1.44E-07	7.22E-07	1.81E-08	1.08E-08	2.96E-06	4.70E-07
ROAD4_s	Road 4 (summer)	1.75E-01	4.95E-02	7.10E-03	2.59E-06	1.72E-08	1.72E-06	8.62E-07	1.72E-08	1.36E-06	2.26E-06	1.21E-07	8.79E-06	6.89E-07	3.45E-06	8.62E-08	5.17E-08	1.41E-05	2.24E-06
ROAD4_w	Road 4 (winter)	7.45E-02	2.05E-02	3.64E-03	1.09E-06	7.26E-09	7.26E-07	3.63E-07	7.26E-09	5.74E-07	9.52E-07	5.08E-08	3.70E-06	2.91E-07	1.45E-06	3.63E-08	2.18E-08	5.96E-06	9.44E-07
ROAD5_s	Road 5 (summer)	2.58E+00	6.84E-01	7.67E-02	3.86E-05	2.57E-07	2.57E-05	1.29E-05	2.57E-07	2.03E-05	3.37E-05	1.80E-06	1.31E-04	1.03E-05	5.14E-05	1.29E-06	7.71E-07	2.11E-04	3.34E-05
ROAD5_w	Road 5 (winter)	1.22E+00	3.19E-01	3.73E-02	1.82E-05	1.22E-07	1.22E-05	6.08E-06	1.22E-07	9.61E-06	1.59E-05	8.51E-07	6.20E-05	4.86E-06	2.43E-05	6.08E-07	3.65E-07	9.97E-05	1.58E-05
ROAD6_s	Road 6 (summer)	3.31E-02	9.92E-03	1.54E-03	4.86E-07	3.24E-09	3.24E-07	1.62E-07	3.24E-09	2.56E-07	4.25E-07	2.27E-08	1.65E-06	1.30E-07	6.48E-07	1.62E-08	9.73E-09	2.66E-06	4.21E-07
ROAD6_w	Road 6 (winter)	1.18E-02	3.32E-03	6.78E-04	1.70E-07	1.14E-09	1.14E-07	5.68E-08	1.14E-09	8.98E-08	1.49E-07	7.96E-09	5.80E-07	4.55E-08	2.27E-07	5.68E-09	3.41E-09	9.32E-07	1.48E-07
ROAD7_s	Road 7 (summer)	4.68E-01	1.24E-01	1.56E-02	6.96E-06	4.64E-08	4.64E-06	2.32E-06	4.64E-08	3.67E-06	6.08E-06	3.25E-07	2.37E-05	1.86E-06	9.28E-06	2.32E-07	1.39E-07	3.81E-05	6.03E-06
ROAD7_w	Road 7 (winter)	2.32E-01	6.22E-02	9.27E-03	3.42E-06	2.28E-08	2.28E-06	1.14E-06	2.28E-08	1.80E-06	2.99E-06	1.60E-07	1.16E-05	9.12E-07	4.56E-06	1.14E-07	6.84E-08	1.87E-05	2.96E-06
ROAD8_s	Road 8 (summer)	2.23E+00	6.04E-01	6.94E-02	3.33E-05	2.22E-07	2.22E-05	1.11E-05	2.22E-07	1.75E-05	2.91E-05	1.55E-06	1.13E-04	8.87E-06	4.44E-05	1.11E-06	6.66E-07	1.82E-04	2.88E-05
ROAD8_w	Road 8 (winter)	9.94E-01	2.59E-01	2.99E-02	1.48E-05	9.89E-08	9.89E-06	4.95E-06	9.89E-08	7.82E-06	1.30E-05	6.93E-07	5.05E-05	3.96E-06	1.98E-05	4.95E-07	2.97E-07	8.11E-05	1.29E-05
SBORE_J_s	JEB Ore Pad Sue B Ore (summer)	2.22E-02	1.11E-02	1.66E-03	6.66E-05	8.08E-07	1.44E-04	4.93E-06	4.42E-08	2.05E-06	2.22E-06	3.86E-05	2.13E-09	7.10E-05	2.04E-05	3.98E-05	4.37E-06	7.28E-05	2.54E-06
SBORE_J_w	JEB Ore Pad Sue B Ore (winter)	4.44E-03	2.22E-03	3.33E-04	1.33E-05	1.62E-07	2.88E-05	9.85E-07	8.83E-09	4.11E-07	4.44E-07	7.72E-06	4.26E-10	1.42E-05	4.08E-06	7.96E-06	8.73E-07	1.46E-05	5.08E-07
SBORE_S_s	Sue Ore Pad Sue B Ore (summer)	5.18E-02	2.59E-02	3.88E-03	1.55E-04	1.89E-06	3.37E-04	1.15E-05	1.03E-07	4.79E-06	5.18E-06	9.01E-05	4.97E-09	1.66E-04	4.76E-05	9.29E-05	1.02E-05	1.70E-04	5.92E-06

Model ID	Description	TSP (g/s)	PM ₁₀ (g/s)	PM _{2.5} (g/s)	U (g/s)	Ag (g/s)	As (g/s)	Co (g/s)	Cd (g/s)	Cr (g/s)	Cu (g/s)	Mo (g/s)	Mn (g/s)	Ni (g/s)	Pb (g/s)	Se (g/s)	Tl (g/s)	V (g/s)	Zn (g/s)
SBORE_S_w	Sue Ore Pad Sue B Ore (winter)	1.04E-02	5.18E-03	7.77E-04	3.11E-05	3.77E-07	6.73E-05	2.30E-06	2.06E-08	9.58E-07	1.04E-06	1.80E-05	9.94E-10	3.31E-05	9.53E-06	1.86E-05	2.04E-06	3.40E-05	1.18E-06
SBREC_J_s	JEB Ore Pad SABRE Coarse Ore (summer)	1.72E-02	8.62E-03	1.29E-03	1.23E-03	1.40E-06	1.53E-03	2.23E-05	3.89E-07	1.77E-06	3.35E-05	1.57E-05	1.74E-09	1.67E-04	4.02E-05	3.05E-07	2.98E-06	5.44E-05	1.65E-05
SBREC_J_w	JEB Ore Pad SABRE Coarse Ore (winter)	3.50E-03	1.75E-03	2.62E-04	2.50E-04	2.83E-07	3.10E-04	4.54E-06	7.90E-08	3.59E-07	6.81E-06	3.20E-06	3.53E-10	3.39E-05	8.17E-06	9.37E-08	6.04E-07	1.10E-05	3.35E-06
SBREF_J_s	JEB Ore Pad SABRE Fines (summer)	1.34E-02	6.70E-03	1.01E-03	9.60E-04	1.09E-06	1.19E-03	1.74E-05	3.04E-07	1.38E-06	2.62E-05	1.22E-05	1.35E-09	1.30E-04	3.13E-05	1.11E-07	2.32E-06	4.23E-05	1.29E-05
SBREF_J_w	JEB Ore Pad SABRE Fines (winter)	2.68E-03	1.34E-03	2.01E-04	9.21E-05	1.41E-08	2.69E-05	1.53E-06	3.67E-09	2.66E-07	1.99E-07	4.94E-06	1.02E-10	3.90E-07	4.91E-06	1.05E-05	2.12E-07	2.27E-06	3.25E-07
SBREF_S_s	Sue Ore Pad SABRE Fines (summer)	1.34E-02	6.70E-03	1.01E-03	9.60E-04	1.09E-06	1.19E-03	1.74E-05	3.04E-07	1.38E-06	2.62E-05	1.22E-05	1.35E-09	1.30E-04	3.13E-05	1.12E-07	2.32E-06	4.23E-05	1.29E-05
SBREF_S_w	Sue Ore Pad SABRE Fines (winter)	2.68E-03	1.34E-03	2.01E-04	9.21E-05	1.41E-08	2.70E-05	1.53E-06	3.67E-09	2.66E-07	1.99E-07	4.94E-06	1.02E-10	3.91E-07	4.91E-06	1.05E-05	2.12E-07	2.28E-06	3.25E-07
SUE	Sue area off-road combustion	4.39E-03	4.39E-03	4.03E-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUECOB_s	Sue C overburden pile (summer)	2.10E-03	1.05E-03	1.58E-04	3.15E-08	2.10E-10	2.10E-08	1.05E-08	2.10E-10	1.66E-08	2.75E-08	1.47E-09	1.07E-07	8.41E-09	4.20E-08	1.05E-09	6.30E-10	1.72E-07	2.73E-08
SUECOB_w	Sue C overburden pile (winter)	4.20E-04	2.10E-04	3.15E-05	6.30E-09	4.20E-11	4.20E-09	2.10E-09	4.20E-11	3.32E-09	5.51E-09	2.94E-10	2.14E-08	1.68E-09	8.41E-09	2.10E-10	1.26E-10	3.45E-08	5.46E-09
SUECPIT	Sue C Pit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUECWST_s	Sue C CWRP (summer)	7.29E-01	1.73E-01	8.13E-02	1.07E-05	7.15E-08	1.07E-05	3.58E-06	7.15E-08	5.65E-06	9.37E-06	1.07E-05	3.65E-05	1.07E-05	1.43E-05	7.15E-07	2.15E-07	5.87E-05	1.59E-05
SUECWST_w	Sue C CWRP (winter)	2.63E-02	1.97E-02	1.31E-02	1.97E-07	1.31E-09	1.97E-07	6.57E-08	1.31E-09	1.04E-07	1.72E-07	1.97E-07	6.70E-07	1.97E-07	2.63E-07	1.31E-08	3.94E-09	1.08E-06	2.92E-07
SUEEOB_s	Sue E overburden pile (summer)	2.10E-03	1.05E-03	1.58E-04	3.15E-08	2.10E-10	2.10E-08	1.05E-08	2.10E-10	1.66E-08	2.75E-08	1.47E-09	1.07E-07	8.41E-09	4.20E-08	1.05E-09	6.30E-10	1.72E-07	2.73E-08
SUEEOB_w	Sue E overburden pile (winter)	4.20E-04	2.10E-04	3.15E-05	6.30E-09	4.20E-11	4.20E-09	2.10E-09	4.20E-11	3.32E-09	5.51E-09	2.94E-10	2.14E-08	1.68E-09	8.41E-09	2.10E-10	1.26E-10	3.45E-08	5.46E-09
SUEEWST_s	Sue E CWRP (summer)	3.41E-02	1.71E-02	2.56E-03	5.46E-07	3.41E-09	3.41E-07	3.07E-07	3.41E-09	2.70E-07	1.02E-06	2.39E-08	1.74E-06	1.37E-07	1.30E-06	1.71E-08	1.02E-08	2.80E-06	4.44E-07
SUEEWST_w	Sue E CWRP (winter)	6.83E-03	3.41E-03	5.12E-04	1.09E-07	6.83E-10	6.83E-08	6.15E-08	6.83E-10	5.40E-08	2.05E-07	4.78E-09	3.48E-07	2.73E-08	2.60E-07	3.41E-09	2.05E-09	5.60E-07	8.88E-08
SUEF	Sue F mining	1.16E+00	5.93E-01	4.00E-01	2.76E-05	2.88E-07	5.60E-05	1.93E-06	5.14E-07	1.38E-06	1.20E-06	1.41E-05	4.30E-04	6.28E-05	9.52E-06	1.46E-05	1.56E-06	2.70E-05	1.22E-06
TMFC	TMF expansion	2.32E+00	8.45E-01	1.27E-01	3.62E-05	2.26E-07	3.40E-05	2.04E-05	2.26E-07	1.79E-05	6.79E-05	3.40E-05	1.16E-04	3.40E-05	8.61E-05	2.26E-06	6.79E-07	1.86E-04	5.03E-05
TMFD	TMF closure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	Summer	1.74E+01	7.17E+00	3.57E+00	2.31E-02	1.98E-05	1.01E-02	2.43E-04	1.68E-04	2.17E-04	5.10E-04	1.89E-03	1.53E-03	1.63E-03	1.34E-03	4.59E-04	4.03E-05	1.65E-03	5.61E-04
	Winter	7.94E+00	4.31E+00	3.09E+00	2.01E-02	1.34E-05	6.01E-03	1.14E-04	1.66E-04	1.35E-04	2.21E-04	1.67E-03	1.05E-03	9.53E-04	9.22E-04	3.66E-04	1.93E-05	5.68E-04	3.44E-04

Table 2.2-14 Summary of Maximum Air Emission Rates by Source for the Maximum Future Operations Scenario (Gases)

Model ID	Description	CO (g/s)	SO ₂ (g/s)	NO _x (g/s)	Acrolein (g/s)	Benzene (g/s)	NH ₃ (g/s)	Radon ⁽¹⁾ (Bq/s)
ACID	Acid plant tail gas stack	4.24E-02	3.40E+00	4.61E-02	0	0	0	0
AB1E	Air buster tank -McClean mining Pad 1E	0	0	0	0	0	0	0
AB1W	Air buster tank -McClean mining Pad 1W	0	0	0	0	0	0	2.88E+04
ABSUEF	Air buster tank -Sue F mining area	0	0	0	0	0	0	9.19E+03
CALC	Calcliner scrubber stack	6.80E-01	2.14E-01	7.60E-01	0	0	2.45E+00	0
CX	Crystallizer stack	1.15E-01	0	3.40E-02	0	0	0	0
DROP1	Drop to grinding grizzly	0	0	0	0	0	0	0
DROP2	Waste rock drop to Sue C pit	0	0	0	0	0	0	0
GEN1	Backup generator 1	5.10E-01	3.35E-03	5.04E+00	4.64E-04	1.34E-03	0	0
GEN2	Backup generator 2	5.10E-01	3.35E-03	5.04E+00	4.64E-04	1.34E-03	0	0
GEN3	Backup generator 3	5.10E-01	3.35E-03	5.04E+00	4.64E-04	1.34E-03	0	0
GEN4	Backup generator 4	5.10E-01	3.35E-03	5.04E+00	4.64E-04	1.34E-03	0	0
GEN5	Backup generator 5	5.10E-01	3.35E-03	5.04E+00	4.64E-04	1.34E-03	0	0
GRIND	Grinding stack	0	0	0	0	0	0	1.13E+05
HEAT1	Propane heating -support services area	9.16E-03	0	1.59E-02	0	0	0	0
HEAT2	Propane heating -site services area	9.62E-03	0	1.67E-02	0	0	0	0
HEAT3	Propane heating -gatehouse area	1.18E-03	0	2.04E-03	0	0	0	0
HEAT4	Camp propane use	2.77E-02	0	4.80E-02	0	0	0	0
HEAT5	Sue WTP area propane use	2.77E-02	0	4.80E-02	0	0	0	0
INC	Incinerator stack	1.56E-03	1.12E-02	2.10E-02	0	0	0	0
JEBOB1_s	JEB north overburden pile (summer)	0	0	0	0	0	0	0
JEBOB1_w	JEB north overburden pile (winter)	0	0	0	0	0	0	0
JEBWST_s	JEB CWRP (summer)	1.21E-01	2.32E-04	2.90E-01	4.67E-04	1.35E-03	0	0
JEBWST_w	JEB CWRP (winter)	1.07E-01	2.08E-04	2.58E-01	4.39E-04	1.27E-03	0	0
JTMF1	TMF radon release (baseline)	0	0	0	0	0	0	0
JTMF2	TMF radon release (future)	0	0	0	0	0	0	2.82E+04
MILL	Mill general ventilation	1.55E-01	5.21E-05	2.87E-01	1.10E-04	3.18E-04	0	2.00E+06
MOFFAT_s	Moffat borrow area (summer)	0	0	0	0	0	0	0
MOFFAT_w	Moffat borrow area (winter)	0	0	0	0	0	0	0
PACK	Packaging stack	1.53E-02	5.10E-02	2.25E-02	0	0	0	0
PAD1E	McClean Pad 1E mining	2.29E-03	0	3.96E-03	0	0	0	0
PAD1W	McClean Pad 1W mining	7.77E-01	1.50E-03	1.86E+00	3.17E-03	9.18E-03	0	1.85E+05
PAD1W_c	McClean Pad 1W construction	0	0	0	0	0	0	0
PAD2	McClean Pad 2 construction	7.07E-01	1.37E-03	1.70E+00	2.90E-03	8.38E-03	0	0
ROAD1_s	Road 1 (summer)	1.60E-02	7.42E-05	6.51E-02	5.69E-05	1.32E-04	0	0
ROAD1_w	Road 1 (winter)	7.68E-03	2.86E-05	2.63E-02	2.05E-05	2.65E-05	0	0
ROAD2_s	Road 2 (summer)	1.32E-01	2.90E-05	3.02E-02	1.88E-05	6.14E-04	0	0
ROAD2_w	Road 2 (winter)	1.31E-01	2.33E-05	2.54E-02	1.43E-05	6.01E-04	0	0
ROAD3_s	Road 3 (summer)	6.48E-02	2.68E-05	3.07E-02	1.92E-05	3.01E-04	0	0

Model ID	Description	CO (g/s)	SO ₂ (g/s)	NO _x (g/s)	Acrolein (g/s)	Benzene (g/s)	NH ₃ (g/s)	Radon ⁽¹⁾ (Bq/s)
ROAD3_w	Road 3 (winter)	6.39E-02	2.23E-05	2.68E-02	1.56E-05	2.90E-04	0	0
ROAD4_s	Road 4 (summer)	6.98E-02	3.99E-05	4.50E-02	3.20E-05	3.38E-04	0	0
ROAD4_w	Road 4 (winter)	6.78E-02	2.90E-05	3.57E-02	2.32E-05	3.12E-04	0	0
ROAD5_s	Road 5 (summer)	1.69E-01	1.51E-04	1.53E-01	1.15E-04	8.42E-04	0	0
ROAD5_w	Road 5 (winter)	1.59E-01	9.55E-05	1.06E-01	7.02E-05	7.12E-04	0	0
ROAD6_s	Road 6 (summer)	5.94E-02	1.49E-05	1.59E-02	9.51E-06	2.77E-04	0	0
ROAD6_w	Road 6 (winter)	5.86E-02	1.10E-05	1.25E-02	6.38E-06	2.68E-04	0	0
ROAD7_s	Road 7 (summer)	8.11E-02	5.46E-05	6.74E-02	5.28E-05	3.97E-04	0	0
ROAD7_w	Road 7 (winter)	8.05E-02	5.12E-05	6.46E-02	5.01E-05	3.89E-04	0	0
ROAD8_s	Road 8 (summer)	1.96E-01	1.73E-04	1.72E-01	1.39E-04	1.05E-03	0	0
ROAD8_w	Road 8 (winter)	1.78E-01	7.63E-05	8.94E-02	6.17E-05	8.23E-04	0	0
SBORE_J_s	JEB Ore Pad Sue B Ore (summer)	0	0	0	0	0	0	8.78E+04
SBORE_J_w	JEB Ore Pad Sue B Ore (winter)	0	0	0	0	0	0	8.78E+04
SBORE_S_s	Sue Ore Pad Sue B Ore (summer)	0	0	0	0	0	0	2.05E+05
SBORE_S_w	Sue Ore Pad Sue B Ore (winter)	0	0	0	0	0	0	2.05E+05
SBREC_J_s	JEB Ore Pad SABRE Coarse Ore (summer)	0	0	0	0	0	0	1.66E+06
SBREC_J_w	JEB Ore Pad SABRE Coarse Ore (winter)	0	0	0	0	0	0	1.66E+06
SBREF_J_s	JEB Ore Pad SABRE Fines (summer)	0	0	0	0	0	0	1.27E+06
SBREF_J_w	JEB Ore Pad SABRE Fines (winter)	0	0	0	0	0	0	1.27E+06
SBREF_S_s	Sue Ore Pad SABRE Fines (summer)	0	0	0	0	0	0	1.27E+06
SBREF_S_w	Sue Ore Pad SABRE Fines (winter)	0	0	0	0	0	0	1.27E+06
SUE	Sue area off-road combustion	2.23E-02	4.34E-05	5.37E-02	9.16E-05	2.65E-04	0	0
SUECOB_s	Sue C overburden pile (summer)	0	0	0	0	0	0	0
SUECOB_w	Sue C overburden pile (winter)	0	0	0	0	0	0	0
SUECPIT	Sue C Pit	0	0	0	0	0	0	0
SUECWST_s	Sue C CWRP (summer)	6.81E-02	1.32E-04	1.64E-01	2.77E-04	8.01E-04	0	5.73E+04
SUECWST_w	Sue C CWRP (winter)	6.70E-02	1.30E-04	1.61E-01	2.75E-04	7.95E-04	0	5.73E+04
SUEEOB_s	Sue E overburden pile (summer)	0	0	0	0	0	0	0
SUEEOB_w	Sue E overburden pile (winter)	0	0	0	0	0	0	0
SUEEWST_s	Sue E CWRP (summer)	0	0	0	0	0	0	3.17E+04
SUEEWST_w	Sue E CWRP (winter)	0	0	0	0	0	0	3.17E+04
SUEF	Sue F mining	1.90E+00	3.69E-03	4.56E+00	7.78E-03	2.25E-02	0	3.15E+04
TMFC	TMF expansion	2.66E-01	5.17E-04	6.39E-01	1.09E-03	3.15E-03	0	0
TMFD	TMF closure	0	0	0	0	0	0	0
Total	Summer	8.21E+00	3.70E+00	3.62E+01	1.86E-02	5.66E-02	2.45E+00	6.98E+06
	Winter	7.96E+00	3.70E+00	3.55E+01	1.73E-02	5.28E-02	2.45E+00	6.98E+06

Notes: ⁽¹⁾ Only long-term (i.e., annual) concentrations of radon were evaluated in the ERA. Therefore, emissions represent average annual rates and summer/winter rates are the same.

Table 2.2-15 Summary of Maximum Air Emission Rates by Source for the Decommissioning Scenario (Particulate and Metals)

Model ID	Description	TSP (g/s)	PM ₁₀ (g/s)	PM _{2.5} (g/s)	U (g/s)	Ag (g/s)	As (g/s)	Co (g/s)	Cd (g/s)	Cr (g/s)	Cu (g/s)	Mo (g/s)	Mn (g/s)	Ni (g/s)	Pb (g/s)	Se (g/s)	Tl (g/s)	V (g/s)	Zn (g/s)
ACID	Acid plant tail gas stack	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AB1E	Air buster tank - McClean mining Pad 1E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AB1W	Air buster tank - McClean mining Pad 1W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ABSUEF	Air buster tank -Sue F mining area	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CALC	Calciner scrubber stack	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CX	Crystallizer stack	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DROP1	Drop to grinding grizzly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DROP2	Waste rock drop to Sue C pit	1.49E-03	7.06E-04	1.07E-04	1.79E-08	5.97E-10	4.60E-07	2.31E-07	2.18E-07	2.24E-07	8.78E-08	3.75E-08	2.01E-07	5.02E-08	3.03E-08	2.25E-07	5.97E-10	1.33E-07	6.53E-09
GEN1	Backup generator 1	6.24E-02	6.24E-02	6.24E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEN2	Backup generator 2	6.24E-02	6.24E-02	6.24E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEN3	Backup generator 3	6.24E-02	6.24E-02	6.24E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEN4	Backup generator 4	6.24E-02	6.24E-02	6.24E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEN5	Backup generator 5	6.24E-02	6.24E-02	6.24E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRIND	Grinding stack	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAT1	Propane heating - support services area	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAT2	Propane heating - site services area	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAT3	Propane heating - gatehouse area	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAT4	Camp propane use	7.38E-04	7.38E-04	7.38E-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAT5	Sue WTP area propane use	7.39E-04	7.39E-04	7.39E-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
INC	Incinerator stack	8.06E-02	6.37E-02	3.63E-02	0	0	1.57E-05	0	5.62E-05	7.73E-05	0	0	0	1.29E-04	6.53E-04	0	0	0	0
JEBOB1_s	JEB north overburden pile (summer)	3.07E-02	1.45E-02	2.20E-03	4.61E-07	3.07E-09	3.07E-07	1.54E-07	3.07E-09	2.43E-07	4.02E-07	2.15E-08	1.57E-06	1.23E-07	6.14E-07	1.54E-08	9.21E-09	2.52E-06	3.99E-07
JEBOB1_w	JEB north overburden pile (winter)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JEBWST_s	JEB CWRP (summer)	2.39E+00	8.12E-01	1.60E-01	3.73E-05	2.33E-07	3.49E-05	2.10E-05	2.33E-07	1.84E-05	6.99E-05	3.49E-05	1.19E-04	3.49E-05	8.85E-05	2.33E-06	6.99E-07	1.91E-04	5.17E-05
JEBWST_w	JEB CWRP (winter)	1.21E-02	6.04E-03	9.06E-04	1.93E-07	1.21E-09	1.81E-07	1.09E-07	1.21E-09	9.55E-08	3.62E-07	1.81E-07	6.16E-07	1.81E-07	4.59E-07	1.21E-08	3.62E-09	9.91E-07	2.68E-07
JTMF1	TMF radon release (baseline)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Model ID	Description	TSP (g/s)	PM ₁₀ (g/s)	PM _{2.5} (g/s)	U (g/s)	Ag (g/s)	As (g/s)	Co (g/s)	Cd (g/s)	Cr (g/s)	Cu (g/s)	Mo (g/s)	Mn (g/s)	Ni (g/s)	Pb (g/s)	Se (g/s)	Tl (g/s)	V (g/s)	Zn (g/s)
JTMF2	TMF radon release (future)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MILL	Mill general ventilation	7.99E-01	2.98E-01	5.26E-02	1.23E-05	7.72E-08	1.16E-05	6.94E-06	7.72E-08	6.10E-06	2.31E-05	1.16E-05	3.94E-05	1.16E-05	2.93E-05	7.72E-07	2.31E-07	6.33E-05	1.71E-05
MOFFAT_s	Moffat borrow area (summer)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MOFFAT_w	Moffat borrow area (winter)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PACK	Packaging stack	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PAD1E	McClellan Pad 1E mining	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PAD1W	McClellan Pad 1W mining	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PAD1W_c	McClellan Pad 1W construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PAD2	McClellan Pad 2 construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROAD1_s	Road 1 (summer)	2.82E+00	7.41E-01	8.13E-02	4.21E-05	2.81E-07	2.81E-05	1.40E-05	2.81E-07	2.22E-05	3.68E-05	1.97E-06	1.43E-04	1.12E-05	5.62E-05	1.40E-06	8.43E-07	2.30E-04	3.65E-05
ROAD1_w	Road 1 (winter)	1.35E+00	3.52E-01	4.01E-02	2.02E-05	1.35E-07	1.35E-05	6.74E-06	1.35E-07	1.07E-05	1.77E-05	9.44E-07	6.88E-05	5.39E-06	2.70E-05	6.74E-07	4.05E-07	1.11E-04	1.75E-05
ROAD2_s	Road 2 (summer)	4.03E-01	1.06E-01	1.17E-02	6.03E-06	4.02E-08	4.02E-06	2.01E-06	4.02E-08	3.18E-06	5.27E-06	2.81E-07	2.05E-05	1.61E-06	8.04E-06	2.01E-07	1.21E-07	3.30E-05	5.23E-06
ROAD2_w	Road 2 (winter)	1.95E-01	5.09E-02	5.93E-03	2.91E-06	1.94E-08	1.94E-06	9.70E-07	1.94E-08	1.53E-06	2.54E-06	1.36E-07	9.89E-06	7.76E-07	3.88E-06	9.70E-08	5.82E-08	1.59E-05	2.52E-06
ROAD3_s	Road 3 (summer)	1.88E-01	5.07E-02	6.57E-03	2.79E-06	1.86E-08	1.86E-06	9.31E-07	1.86E-08	1.47E-06	2.44E-06	1.30E-07	9.49E-06	7.44E-07	3.72E-06	9.31E-08	5.58E-08	1.53E-05	2.42E-06
ROAD3_w	Road 3 (winter)	8.89E-02	2.40E-02	3.66E-03	1.31E-06	8.74E-09	8.74E-07	4.37E-07	8.74E-09	6.91E-07	1.15E-06	6.12E-08	4.46E-06	3.50E-07	1.75E-06	4.37E-08	2.62E-08	7.17E-06	1.14E-06
ROAD4_s	Road 4 (summer)	4.52E-01	1.22E-01	1.57E-02	6.71E-06	4.48E-08	4.48E-06	2.24E-06	4.48E-08	3.54E-06	5.86E-06	3.13E-07	2.28E-05	1.79E-06	8.95E-06	2.24E-07	1.34E-07	3.67E-05	5.82E-06
ROAD4_w	Road 4 (winter)	2.14E-01	5.75E-02	8.74E-03	3.15E-06	2.10E-08	2.10E-06	1.05E-06	2.10E-08	1.66E-06	2.75E-06	1.47E-07	1.07E-05	8.41E-07	4.21E-06	1.05E-07	6.31E-08	1.72E-05	2.73E-06
ROAD5_s	Road 5 (summer)	5.47E-01	1.58E-01	2.03E-02	8.11E-06	5.41E-08	5.41E-06	2.70E-06	5.41E-08	4.27E-06	7.08E-06	3.78E-07	2.76E-05	2.16E-06	1.08E-05	2.70E-07	1.62E-07	4.43E-05	7.03E-06
ROAD5_w	Road 5 (winter)	2.03E-01	5.36E-02	7.02E-03	3.02E-06	2.01E-08	2.01E-06	1.01E-06	2.01E-08	1.59E-06	2.64E-06	1.41E-07	1.03E-05	8.05E-07	4.03E-06	1.01E-07	6.04E-08	1.65E-05	2.62E-06
ROAD6_s	Road 6 (summer)	1.60E-02	4.55E-03	9.53E-04	2.31E-07	1.54E-09	1.54E-07	7.70E-08	1.54E-09	1.22E-07	2.02E-07	1.08E-08	7.86E-07	6.16E-08	3.08E-07	7.70E-09	4.62E-09	1.26E-06	2.00E-07
ROAD6_w	Road 6 (winter)	8.00E-03	2.28E-03	4.86E-04	1.16E-07	7.70E-10	7.70E-08	3.85E-08	7.70E-10	6.09E-08	1.01E-07	5.39E-09	3.93E-07	3.08E-08	1.54E-07	3.85E-09	2.31E-09	6.32E-07	1.00E-07
ROAD7_s	Road 7 (summer)	5.94E-01	1.57E-01	1.96E-02	8.83E-06	5.89E-08	5.89E-06	2.94E-06	5.89E-08	4.65E-06	7.71E-06	4.12E-07	3.00E-05	2.36E-06	1.18E-05	2.94E-07	1.77E-07	4.83E-05	7.65E-06
ROAD7_w	Road 7 (winter)	2.95E-01	7.91E-02	1.17E-02	4.35E-06	2.90E-08	2.90E-06	1.45E-06	2.90E-08	2.29E-06	3.80E-06	2.03E-07	1.48E-05	1.16E-06	5.81E-06	1.45E-07	8.71E-08	2.38E-05	3.77E-06
ROAD8_s	Road 8 (summer)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROAD8_w	Road 8 (winter)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SBORE_J_s	JEB Ore Pad Sue B Ore (summer)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SBORE_J_w	JEB Ore Pad Sue B Ore (winter)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SBORE_S_s	Sue Ore Pad Sue B Ore (summer)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SBORE_S_w	Sue Ore Pad Sue B Ore (winter)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SBREC_J_s	JEB Ore Pad SABRE Coarse Ore (summer)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Model ID	Description	TSP (g/s)	PM ₁₀ (g/s)	PM _{2.5} (g/s)	U (g/s)	Ag (g/s)	As (g/s)	Co (g/s)	Cd (g/s)	Cr (g/s)	Cu (g/s)	Mo (g/s)	Mn (g/s)	Ni (g/s)	Pb (g/s)	Se (g/s)	Tl (g/s)	V (g/s)	Zn (g/s)
SBREC_J_w	JEB Ore Pad SABRE Coarse Ore (winter)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SBREF_J_s	JEB Ore Pad SABRE Fines (summer)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SBREF_J_w	JEB Ore Pad SABRE Fines (winter)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SBREF_S_s	Sue Ore Pad SABRE Fines (summer)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SBREF_S_w	Sue Ore Pad SABRE Fines (winter)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUE	Sue area off-road combustion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUECOB_s	Sue C overburden pile (summer)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUECOB_w	Sue C overburden pile (winter)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUECPIT	Sue C Pit	6.17E-01	1.57E-01	6.48E-02	7.41E-06	2.47E-07	1.90E-04	9.56E-05	9.01E-05	9.26E-05	3.63E-05	1.55E-05	8.33E-05	2.08E-05	1.25E-05	9.31E-05	2.47E-07	5.49E-05	2.70E-06
SUECWST_s	Sue C CWRP (summer)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUECWST_w	Sue C CWRP (winter)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUEEOB_s	Sue E overburden pile (summer)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUEEOB_w	Sue E overburden pile (winter)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUEEWST_s	Sue E CWRP (summer)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUEEWST_w	Sue E CWRP (winter)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUEF	Sue F mining	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TMFC	TMF expansion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TMFD	TMF closure	4.46E-01	1.92E-01	6.48E-02	6.25E-06	3.91E-08	5.86E-06	3.52E-06	3.91E-08	3.09E-06	1.17E-05	5.86E-06	1.99E-05	5.86E-06	1.48E-05	3.91E-07	1.17E-07	3.20E-05	8.67E-06
Total	Summer	9.69E+00	3.19E+00	8.49E-01	1.39E-04	1.10E-06	3.09E-04	1.52E-04	1.47E-04	2.37E-04	2.07E-04	7.14E-05	5.18E-04	2.23E-04	8.99E-04	9.93E-05	2.80E-06	7.53E-04	1.45E-04
	Winter	4.18E+00	1.46E+00	5.46E-01	5.51E-05	5.60E-07	2.41E-04	1.15E-04	1.47E-04	1.95E-04	9.06E-05	2.90E-05	2.43E-04	1.71E-04	7.42E-04	9.53E-05	1.18E-06	3.11E-04	5.05E-05

Table 2.2-16 Summary of Maximum Air Emission Rates by Source for the Decommissioning Scenario (Gases)

Model ID	Model Source	CO (g/s)	SO ₂ (g/s)	NO _x (g/s)	Acrolein (g/s)	Xylenes (g/s)	NH ₃ (g/s)	Radon ⁽¹⁾ (Bq/s)
ACID	Acid plant tail gas stack	0	0	0	0	0	0	0
AB1E	Air buster tank -McClean mining Pad 1E	0	0	0	0	0	0	0
AB1W	Air buster tank -McClean mining Pad 1W	0	0	0	0	0	0	0
ABSUEF	Air buster tank -Sue F mining area	0	0	0	0	0	0	0
CALC	Calciner scrubber stack	0	0	0	0	0	0	0
CX	Crystallizer stack	0	0	0	0	0	0	0
DROP1	Drop to grinding grizzly	0	0	0	0	0	0	0
DROP2	Waste rock drop to Sue C pit	0	0	0	0	0	0	3.40E+02
GEN1	Backup generator 1	5.10E-01	3.35E-03	5.04E+00	4.64E-04	2.88E-04	0	0
GEN2	Backup generator 2	5.10E-01	3.35E-03	5.04E+00	4.64E-04	2.88E-04	0	0
GEN3	Backup generator 3	5.10E-01	3.35E-03	5.04E+00	4.64E-04	2.88E-04	0	0
GEN4	Backup generator 4	5.10E-01	3.35E-03	5.04E+00	4.64E-04	2.88E-04	0	0
GEN5	Backup generator 5	5.10E-01	3.35E-03	5.04E+00	4.64E-04	2.88E-04	0	0
GRIND	Grinding stack	0	0	0	0	0	0	0
HEAT1	Propane heating -support services area	0	0	0	0	0	0	0
HEAT2	Propane heating -site services area	0	0	0	0	0	0	0
HEAT3	Propane heating -gatehouse area	0	0	0	0	0	0	0
HEAT4	Camp propane use	2.77E-02	0	4.80E-02	0	0	0	0
HEAT5	Sue WTP area propane use	2.77E-02	0	4.80E-02	0	0	0	0
INC	Incinerator stack	1.56E-03	1.12E-02	2.10E-02	0	0	0	0
JEBOB1_s	JEB north overburden pile (summer)	0	0	0	0	0	0	0
JEBOB1_w	JEB north overburden pile (winter)	0	0	0	0	0	0	0
JEBWST_s	JEB CWRP (summer)	3.04E-01	5.87E-04	7.29E-01	1.20E-03	7.46E-04	0	0
JEBWST_w	JEB CWRP (winter)	0	0	0	0	0	0	0
JTMF1	TMF radon release (baseline)	0	0	0	0	0	0	0
JTMF2	TMF radon release (future)	0	0	0	0	0	0	2.82E+04
MILL	Mill general ventilation	1.42E-01	2.76E-04	3.41E-01	5.81E-04	3.61E-04	0	0
MOFFAT_s	Moffat borrow area (summer)	0	0	0	0	0	0	0
MOFFAT_w	Moffat borrow area (winter)	0	0	0	0	0	0	0
PACK	Packaging stack	0	0	0	0	0	0	0
PAD1E	McClean Pad 1E mining	0	0	0	0	0	0	0
PAD1W	McClean Pad 1W mining	0	0	0	0	0	0	0
PAD1W_c	McClean Pad 1W construction	0	0	0	0	0	0	0
PAD2	McClean Pad 2 construction	0	0	0	0	0	0	0
ROAD1_s	Road 1 (summer)	2.97E-02	1.25E-04	1.12E-01	9.36E-05	2.40E-04	0	0
ROAD1_w	Road 1 (winter)	2.14E-02	7.97E-05	7.32E-02	5.72E-05	2.17E-04	0	0
ROAD2_s	Road 2 (summer)	1.32E-01	3.28E-05	3.27E-02	2.05E-05	1.01E-03	0	0
ROAD2_w	Road 2 (winter)	1.31E-01	2.72E-05	2.79E-02	1.60E-05	1.01E-03	0	0
ROAD3_s	Road 3 (summer)	6.32E-02	3.07E-05	2.99E-02	2.02E-05	4.86E-04	0	0

Model ID	Model Source	CO (g/s)	SO ₂ (g/s)	NO _x (g/s)	Acrolein (g/s)	Xylenes (g/s)	NH ₃ (g/s)	Radon ⁽¹⁾ (Bq/s)
ROAD3_w	Road 3 (winter)	6.23E-02	2.61E-05	2.60E-02	1.65E-05	4.83E-04	0	0
ROAD4_s	Road 4 (summer)	7.21E-02	6.43E-05	6.17E-02	4.36E-05	5.58E-04	0	0
ROAD4_w	Road 4 (winter)	7.01E-02	5.34E-05	5.24E-02	3.48E-05	5.53E-04	0	0
ROAD5_s	Road 5 (summer)	1.46E-01	9.26E-05	8.96E-02	6.27E-05	1.04E-03	0	0
ROAD5_w	Road 5 (winter)	1.36E-01	3.67E-05	4.20E-02	1.79E-05	1.01E-03	0	0
ROAD6_s	Road 6 (summer)	5.86E-02	1.36E-05	1.41E-02	8.03E-06	4.41E-04	0	0
ROAD6_w	Road 6 (winter)	5.79E-02	9.72E-06	1.08E-02	4.90E-06	4.39E-04	0	0
ROAD7_s	Road 7 (summer)	8.82E-02	6.50E-05	8.28E-02	6.66E-05	4.78E-04	0	0
ROAD7_w	Road 7 (winter)	8.76E-02	6.17E-05	7.99E-02	6.39E-05	4.77E-04	0	0
ROAD8_s	Road 8 (summer)	0	0	0	0	0	0	0
ROAD8_w	Road 8 (winter)	0	0	0	0	0	0	0
SBORE_J_s	JEB Ore Pad Sue B Ore (summer)	0	0	0	0	0	0	0
SBORE_J_w	JEB Ore Pad Sue B Ore (winter)	0	0	0	0	0	0	0
SBORE_S_s	Sue Ore Pad Sue B Ore (summer)	0	0	0	0	0	0	0
SBORE_S_w	Sue Ore Pad Sue B Ore (winter)	0	0	0	0	0	0	0
SBREC_J_s	JEB Ore Pad SABRE Coarse Ore (summer)	0	0	0	0	0	0	0
SBREC_J_w	JEB Ore Pad SABRE Coarse Ore (winter)	0	0	0	0	0	0	0
SBREF_J_s	JEB Ore Pad SABRE Fines (summer)	0	0	0	0	0	0	0
SBREF_J_w	JEB Ore Pad SABRE Fines (winter)	0	0	0	0	0	0	0
SBREF_S_s	Sue Ore Pad SABRE Fines (summer)	0	0	0	0	0	0	0
SBREF_S_w	Sue Ore Pad SABRE Fines (winter)	0	0	0	0	0	0	0
SUE	Sue area off-road combustion	0	0	0	0	0	0	0
SUECOB_s	Sue C overburden pile (summer)	0	0	0	0	0	0	0
SUECOB_w	Sue C overburden pile (winter)	0	0	0	0	0	0	0
SUECPIT	Sue C Pit	0	0	0	0	0	0	5.59E+03
SUECWST_s	Sue C CWRP (summer)	0	0	0	0	0	0	5.72E+04
SUECWST_w	Sue C CWRP (winter)	0	0	0	0	0	0	5.72E+04
SUEEOB_s	Sue E overburden pile (summer)	0	0	0	0	0	0	0
SUEEOB_w	Sue E overburden pile (winter)	0	0	0	0	0	0	0
SUEEWST_s	Sue E CWRP (summer)	0	0	0	0	0	0	3.17E+04
SUEEWST_w	Sue E CWRP (winter)	0	0	0	0	0	0	3.17E+04
SUEF	Sue F mining	0	0	0	0	0	0	0
TMFC	TMF expansion	0	0	0	0	0	0	0
TMFD	TMF closure	2.84E-01	5.51E-04	6.81E-01	1.16E-03	7.21E-04	0	0
Total	Summer	3.87E+00	2.98E-02	2.74E+01	5.58E-03	7.52E-03	0	1.23E+05
	Winter	3.31E+00	2.85E-02	2.60E+01	3.11E-03	5.99E-03	0	1.23E+05

Notes: ⁽¹⁾ Only long-term (i.e., annual) concentrations of radon were evaluated in the ERA. Therefore, emissions represent average annual rates and summer/winter rates are the same.

Table 2.3-1 Maximum Predicted Concentrations of COPCs for the Baseline Operations Scenario (Particulate Matter)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		TSP (µg/m³) ⁽¹⁾					PM ₁₀ (µg/m³) ⁽¹⁾			PM _{2.5} (µg/m³) ⁽¹⁾			
	Easting (m)	Northing (m)	24h Conc.	24h Conc.	24h Exceed. (days/yr)	Annual Conc.	Annual Conc.	24h Conc.	24h Conc.	24h Exceed. (days/yr)	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.
			Incr.	Total	Total	Inc.	Total	Incr.	Total	Total	Incr.	Total	Inc.	Total
Maximum Off-Property	Various		67.5	144.2	57	4.5	12.0	32.6	63.6	20	9.4	21.5	0.9	4.9
Sink Reservoir	568828	6461934	13.1	89.7	0	1.1	8.5	6.8	37.7	0	2.2	14.3	0.1	4.1
Vulture Lake	567453	6460607	8.2	84.8	0	0.6	8.0	5.3	36.3	0	2.8	14.9	0.1	4.1
McClean Lake East Basin	566465	6458536	19.5	96.2	0	0.6	8.0	14.0	45.0	0	7.0	19.1	0.2	4.2
Kewen Lake	567053	6449706	1.4	78.0	0	0.1	7.5	1.1	32.0	0	0.6	12.7	0.02	4.0
S/V TEMS	n/a	n/a	10.6	87.3	0	0.9	8.3	6.0	37.0	0	2.5	14.6	0.1	4.1
JEB Camp	567890	6466521	19.7	96.3	0	2.6	10.1	12.6	43.5	0	8.8	20.9	0.4	4.4
Rabbit Lake Camp	576860	6451050	1.1	77.8	0	0.1	7.5	1.0	32.0	0	0.7	12.8	0.03	4.0
Points North Airport	554239	6458760	0.6	77.2	0	<0.1	7.4	0.5	31.5	0	0.3	12.4	0.02	4.0
Hatchet Lake	582928	6482605	0.3	76.9	0	<0.1	7.4	0.3	31.2	0	0.2	12.3	0.01	4.0
Wollaston Lake Community Area	589928	6442605	0.2	76.8	0	<0.1	7.4	0.1	31.1	0	0.1	12.2	0.01	4.0
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	0.3	77.0	0	<0.1	7.4	0.3	31.2	0	0.1	12.2	0.01	4.0
Background			-	76.7	-	-	7.4	-	31.0	-	-	12.1	-	4.0
Criteria			-	100	-	-	60	-	50	-	-	28	-	10

Notes: ⁽¹⁾ Criteria exceedances (if any) are shown as bold values in grey highlighting.

Table 2.3-2 Maximum Predicted Concentrations of COPCs for the Baseline Operations Scenario (Uranium and Metals, Part 1 of 2)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		Uranium (U) (µg/m³)				Silver (Ag) (µg/m³)		Arsenic (As) (µg/m³)		Cadmium (Cd) (µg/m³)				Cobalt (Co) (µg/m³)		Chromium (Cr) (µg/m³)		Copper (Cu) (µg/m³)		Manganese (Mn) (µg/m³)	
	Easting (m)	Northing (m)	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.
			Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total
Maximum Off-Property	Various		6.98E-02	7.04E-02	7.53E-03	7.87E-03	7.10E-05	2.27E-04	1.10E-02	1.11E-02	5.74E-04	6.29E-04	1.24E-05	5.15E-05	1.31E-03	1.38E-03	9.07E-04	1.46E-03	2.97E-03	1.54E-01	6.27E-03	8.81E-03
Sink Reservoir	568828	6461934	7.88E-03	8.47E-03	4.35E-04	7.76E-04	9.94E-06	1.66E-04	2.31E-03	2.42E-03	6.46E-05	1.20E-04	1.81E-06	4.09E-05	1.43E-04	2.14E-04	1.28E-04	6.82E-04	2.36E-04	1.51E-01	2.72E-03	5.27E-03
Vulture Lake	567453	6460607	4.47E-03	5.06E-03	3.49E-04	6.90E-04	5.85E-06	1.62E-04	1.40E-03	1.50E-03	5.39E-05	1.09E-04	9.80E-07	4.01E-05	8.19E-05	1.53E-04	8.14E-05	6.35E-04	1.81E-04	1.51E-01	5.18E-03	7.73E-03
McClean Lake East Basin	566465	6458536	6.03E-03	6.62E-03	4.28E-04	7.69E-04	6.73E-06	1.63E-04	2.61E-03	2.72E-03	2.47E-05	8.02E-05	7.00E-07	3.98E-05	1.98E-04	2.69E-04	1.62E-04	7.16E-04	2.42E-04	1.51E-01	8.00E-03	1.05E-02
Kewen Lake	567053	6449706	2.76E-03	3.35E-03	7.15E-05	4.12E-04	1.61E-06	1.58E-04	3.64E-04	4.73E-04	2.40E-05	7.94E-05	3.42E-07	3.94E-05	3.05E-05	1.01E-04	2.68E-05	5.81E-04	4.87E-05	1.51E-01	5.51E-04	3.10E-03
S/V TEMS	n/a	n/a	6.17E-03	6.77E-03	3.92E-04	7.33E-04	7.89E-06	1.64E-04	1.86E-03	1.96E-03	5.92E-05	1.15E-04	1.40E-06	4.05E-05	1.13E-04	1.83E-04	1.04E-04	6.58E-04	2.08E-04	1.51E-01	3.95E-03	6.50E-03
JEB Camp	567890	6466521	5.21E-02	5.27E-02	2.47E-03	2.81E-03	4.22E-05	1.98E-04	7.87E-03	7.98E-03	5.02E-04	5.57E-04	1.24E-05	5.15E-05	5.18E-04	5.88E-04	6.91E-04	1.24E-03	6.35E-04	1.52E-01	1.33E-03	3.88E-03
Rabbit Lake Camp	576860	6451050	3.77E-03	4.36E-03	1.54E-04	4.95E-04	2.44E-06	1.58E-04	3.24E-04	4.33E-04	3.15E-05	8.70E-05	9.06E-07	4.00E-05	2.53E-05	9.61E-05	2.71E-05	5.81E-04	3.97E-05	1.51E-01	3.58E-04	2.90E-03
Points North Airport	554239	6458760	2.25E-03	2.84E-03	9.18E-05	4.33E-04	1.79E-06	1.58E-04	1.91E-04	3.00E-04	1.85E-05	7.39E-05	5.58E-07	3.96E-05	1.56E-05	8.64E-05	1.30E-05	5.67E-04	2.48E-05	1.51E-01	2.09E-04	2.75E-03
Hatchet Lake	582928	6482605	1.01E-03	1.60E-03	5.08E-05	3.92E-04	6.07E-07	1.57E-04	9.14E-05	2.01E-04	9.64E-06	6.51E-05	3.15E-07	3.94E-05	8.17E-06	7.90E-05	7.83E-06	5.62E-04	1.54E-05	1.51E-01	4.96E-05	2.59E-03
Wollaston Lake Community Area	589928	6442605	7.00E-04	1.29E-03	3.60E-05	3.77E-04	4.63E-07	1.56E-04	4.57E-05	1.55E-04	8.55E-06	6.40E-05	2.22E-07	3.93E-05	3.83E-06	7.46E-05	6.98E-06	5.61E-04	6.43E-06	1.51E-01	6.70E-05	2.61E-03
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	8.42E-04	1.43E-03	3.83E-05	3.79E-04	5.64E-07	1.57E-04	9.11E-05	2.00E-04	7.48E-06	6.29E-05	2.12E-07	3.93E-05	7.04E-06	7.79E-05	8.45E-06	5.62E-04	1.18E-05	1.51E-01	1.25E-04	2.67E-03
Background			-	5.93E-04	-	3.41E-04	-	1.56E-04	-	1.09E-04	-	5.54E-05	-	3.91E-05	-	7.08E-05	-	5.54E-04	-	1.51E-01	-	2.54E-03
Criteria			-	1.50E-01	-	3.00E-02	-	1.00E+00	-	3.00E-01	-	2.50E-02	-	5.00E-03	-	1.00E-01	-	5.00E-01	-	5.00E+01	-	2.00E-01

Notes: ⁽¹⁾ Criteria exceedances (if any) are shown as bold values in grey highlighting.

Table 2.3-3 Maximum Predicted Concentrations of COPCs for the Baseline Operations Scenario (Uranium and Metals, Part 2 of 2)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		Molybdenum (Mo) (µg/m³)		Nickel (Ni) (µg/m³)				Lead (Pb) (µg/m³)				Selenium (Se) (µg/m³)		Thallium (Tl) (µg/m³)		Vanadium (V) (µg/m³)		Zinc (Zn) (µg/m³)	
	Easting (m)	Northing (m)	24h Conc.	24h Conc.	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.	24h Conc.	24h Conc.	30-day Conc.	30-day Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.
			Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total
Maximum Off-Property	Various		6.65E-03	1.40E-02	3.67E-03	4.21E-03	2.13E-04	5.38E-04	6.68E-03	7.12E-03	1.52E-03	1.79E-03	3.84E-03	3.88E-03	2.40E-04	2.61E-04	9.78E-03	9.85E-03	2.40E-03	7.72E-03
Sink Reservoir	568828	6461934	7.68E-04	8.13E-03	8.41E-04	1.38E-03	3.89E-05	3.64E-04	5.54E-04	9.98E-04	1.46E-04	4.13E-04	6.91E-04	7.33E-04	5.47E-05	7.57E-05	1.62E-03	1.69E-03	2.35E-04	5.55E-03
Vulture Lake	567453	6460607	4.34E-04	7.79E-03	4.97E-04	1.04E-03	3.02E-05	3.55E-04	3.14E-04	7.59E-04	8.56E-05	3.53E-04	4.20E-04	4.63E-04	3.25E-05	5.35E-05	9.02E-04	9.78E-04	1.60E-04	5.48E-03
McClean Lake East Basin	566465	6458536	6.17E-04	7.98E-03	1.17E-03	1.72E-03	2.44E-05	3.50E-04	7.54E-04	1.20E-03	8.78E-05	3.55E-04	8.41E-04	8.84E-04	4.05E-05	6.15E-05	1.84E-03	1.91E-03	3.12E-04	5.63E-03
Kewen Lake	567053	6449706	2.58E-04	7.62E-03	1.32E-04	6.76E-04	3.92E-06	3.29E-04	1.26E-04	5.70E-04	1.45E-05	2.82E-04	1.10E-04	1.53E-04	8.19E-06	2.91E-05	3.31E-04	4.06E-04	5.47E-05	5.37E-03
S/V TEMS	n/a	n/a	6.01E-04	7.96E-03	6.69E-04	1.21E-03	3.45E-05	3.60E-04	4.34E-04	8.79E-04	1.16E-04	3.83E-04	5.56E-04	5.98E-04	4.36E-05	6.46E-05	1.26E-03	1.34E-03	1.97E-04	5.52E-03
JEB Camp	567890	6466521	4.98E-03	1.23E-02	1.57E-03	2.11E-03	1.24E-04	4.50E-04	5.83E-03	6.28E-03	1.49E-03	1.76E-03	2.72E-03	2.76E-03	1.26E-04	1.47E-04	3.19E-03	3.26E-03	1.01E-03	6.33E-03
Rabbit Lake Camp	576860	6451050	3.69E-04	7.73E-03	1.13E-04	6.56E-04	5.42E-06	3.31E-04	1.68E-04	6.13E-04	2.02E-05	2.87E-04	1.00E-04	1.43E-04	6.46E-06	2.74E-05	2.54E-04	3.30E-04	7.30E-05	5.39E-03
Points North Airport	554239	6458760	2.18E-04	7.58E-03	6.89E-05	6.13E-04	2.61E-06	3.28E-04	7.25E-05	5.17E-04	9.87E-06	2.77E-04	5.85E-05	1.01E-04	3.77E-06	2.47E-05	1.59E-04	2.35E-04	4.10E-05	5.36E-03
Hatchet Lake	582928	6482605	9.83E-05	7.46E-03	2.71E-05	5.71E-04	1.30E-06	3.26E-04	5.10E-05	4.95E-04	6.75E-06	2.74E-04	2.95E-05	7.21E-05	1.51E-06	2.25E-05	6.67E-05	1.42E-04	2.02E-05	5.34E-03
Wollaston Lake Community Area	589928	6442605	6.94E-05	7.43E-03	1.75E-05	5.61E-04	1.04E-06	3.26E-04	4.99E-05	4.94E-04	8.20E-06	2.75E-04	1.43E-05	5.69E-05	8.63E-07	2.18E-05	3.63E-05	1.12E-04	1.16E-05	5.33E-03
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	8.28E-05	7.44E-03	3.37E-05	5.78E-04	1.56E-06	3.27E-04	4.90E-05	4.93E-04	7.92E-06	2.75E-04	2.82E-05	7.08E-05	1.79E-06	2.28E-05	7.11E-05	1.47E-04	1.83E-05	5.34E-03
Background			-	7.36E-03	-	5.44E-04	-	3.25E-04	-	4.44E-04	-	2.67E-04	-	4.26E-05	-	2.10E-05	-	7.57E-05	-	5.32E-03
Criteria			-	1.20E+02	-	1.00E-01	-	2.00E-02	-	5.00E-01	-	2.00E-01	-	1.00E+01	-	5.00E-01	-	2.00E+00	-	1.20E+02

Notes: ⁽¹⁾ Criteria exceedances (if any) are shown as bold values in grey highlighting.

Table 2.3-4 Maximum Predicted Concentrations of COPCs for the Baseline Operations Scenario (CO, NO₂ and SO₂)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		CO (µg/m³)				NO ₂ (µg/m³)						SO ₂ (µg/m³)					
	Easting (m)	Northing (m)	1h Conc.	1h Conc.	8h Conc.	8h Conc.	1h Conc.	1h Conc.	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.	1h Conc.	1h Conc.	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.
			Inc.	Total	Inc.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total
Maximum Off-Property	Various		58.6	438.6	30.6	320.6	254.2	260.4	163.1	169.3	3.3	5.3	53.7	54.5	30.9	31.9	2.4	2.6
Sink Reservoir	568828	6461934	20.9	400.9	12.4	302.4	48.4	54.6	17.2	23.4	0.6	2.6	5.7	6.5	1.6	2.6	0.1	0.3
Vulture Lake	567453	6460607	31.5	411.5	17.3	307.3	69.5	75.7	24.3	30.5	0.9	2.9	4.0	4.8	1.0	2.0	0.03	0.2
McClean Lake East Basin	566465	6458536	95.5	475.5	49.5	339.5	174.4	180.6	65.0	71.2	2.0	4.0	2.6	3.4	0.8	1.8	0.02	0.2
Kewen Lake	567053	6449706	4.9	384.9	2.9	292.9	12.5	18.7	6.5	12.7	0.1	2.1	1.2	2.0	0.5	1.5	0.01	0.2
S/V TEMS	n/a	n/a	26.2	406.2	14.8	304.8	58.9	65.1	20.7	26.9	0.7	2.7	4.8	5.6	1.3	2.3	0.04	0.2
JEB Camp	567890	6466521	39.5	419.5	32.3	322.3	242.5	248.7	173.2	179.4	4.1	6.1	30.1	30.9	10.8	11.8	0.4	0.6
Rabbit Lake Camp	576860	6451050	3.3	383.3	1.9	291.9	14.0	20.2	4.4	10.6	0.1	2.1	2.1	2.9	0.8	1.8	0.03	0.2
Points North Airport	554239	6458760	2.4	382.4	1.2	291.2	11.7	17.9	2.9	9.1	0.1	2.1	2.0	2.8	0.5	1.5	0.02	0.2
Hatchet Lake	582928	6482605	1.1	381.1	0.6	290.6	7.6	13.8	1.8	8.0	0.02	2.0	0.8	1.6	0.2	1.2	0.01	0.2
Wollaston Lake Community Area	589928	6442605	0.6	380.6	0.4	290.4	3.3	9.5	1.6	7.8	0.02	2.0	0.4	1.2	0.2	1.2	0.01	0.2
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	1.5	381.5	0.9	290.9	5.7	11.9	1.2	7.4	0.03	2.0	0.6	1.4	0.2	1.2	0.01	0.2
Background			-	380	-	290	-	6.2	-	6.2	-	2.0	-	0.8	-	1.0	-	0.2
Criteria			-	15,000	-	6,000	-	300	-	200	-	45	-	450	-	125	-	20

Notes: ⁽¹⁾ Criteria exceedances (if any) are shown as bold values in grey highlighting.

Table 2.3-5 Maximum Predicted Concentrations of COPCs for the Baseline Operations Scenario (Ammonia, Acrolein, and Benzene)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		Ammonia (µg/m³)		Acrolein (µg/m³)		Benzene (µg/m³)	
	Easting (m)	Northing (m)	1h Conc.	24h Conc.	1h Conc.	24h Conc.	1h Conc.	Ann Conc.
			Total	Total	Total	Total	Total	Total
Maximum Off-Property	Various		28.4	10.7	0.2	0.05	0.6	0.01
Sink Reservoir	568828	6461934	4.1	1.2	0.09	0.03	0.3	0.003
Vulture Lake	567453	6460607	2.6	0.7	0.1	0.04	0.4	0.005
McClellan Lake East Basin	566465	6458536	1.7	0.5	0.4	0.1	1.3	0.01
Keweenaw Lake	567053	6449706	0.8	0.4	0.02	0.004	0.1	0.0004
S/V TEMS	n/a	n/a	3.4	0.9	0.1	0.03	0.4	0.004
JEB Camp	567890	6466521	16.2	6.4	0.06	0.02	0.2	0.01
Rabbit Lake Camp	576860	6451050	1.6	0.5	0.01	0.003	0.03	0.0004
Points North Airport	554239	6458760	1.4	0.3	0.01	0.002	0.03	0.0002
Hatchet Lake	582928	6482605	0.6	0.1	0.002	0.0005	0.01	0.0001
Wollaston Lake Community Area	589928	6442605	0.3	0.1	0.002	0.001	0.01	0.0001
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	0.4	0.1	0.005	0.001	0.02	0.0001
Background			0	0	0	0	0	0
Criteria			1,400	500	4.5	0.4	30	3

Notes: (1) Criteria exceedances (if any) are shown as bold values in grey highlighting.

Table 2.3-6 Maximum Predicted Concentrations of COPCs for the Baseline Operations Scenario (Radon)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		Radon (Bq/m³)
	Easting (m)	Northing (m)	Annual Conc.
			Inc.
Maximum Off-Property	568952	6468159	11.9
Sink Reservoir	568828	6461934	0.5
Vulture Lake	567453	6460607	0.4
McClellan Lake East Basin	566465	6458536	0.4
Keweenaw Lake	567053	6449706	0.1
S/V TEMS	n/a	n/a	0.5
JEB Camp	567890	6466521	9.2
Rabbit Lake Camp	576860	6451050	0.1
Points North Airport	554239	6458760	0.1
Hatchet Lake	582928	6482605	0.03
Wollaston Lake Community Area	589928	6442605	0.02
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	0.03
Background			15 to 25

Notes: (1) Criteria exceedances (if any) are shown as bold values in grey highlighting.

Table 2.3-7 Maximum Predicted Concentrations of COPCs for the Maximum Future Operations Scenario (Particulate Matter)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		TSP (µg/m³) ⁽¹⁾					PM ₁₀ (µg/m³) ⁽¹⁾			PM _{2.5} (µg/m³) ⁽¹⁾			
	Easting (m)	Northing (m)	24h Conc.	24h Conc.	24h Exceed. (days/yr)	Annual Conc.	Annual Conc.	24h Conc.	24h Conc.	24h Exceed. (days/yr)	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.
			Incr.	Total	Total	Inc.	Total	Incr.	Total	Total	Incr.	Total	Inc.	Total
Maximum Off-Property	Various		98.1	174.8	46	7.5	14.9	51.7	82.7	20	10.8	22.9	1.2	5.2
Sink Reservoir	568828	6461934	16.6	93.3	0	1.6	9.0	9.6	40.6	0	5.0	17.1	0.2	4.2
Vulture Lake	567453	6460607	11.5	88.1	0	0.8	8.2	7.4	38.4	0	4.6	16.7	0.2	4.2
McClean Lake East Basin	566465	6458536	19.7	96.4	0	0.7	8.1	14.6	45.6	0	8.4	20.5	0.3	4.3
Kewen Lake	567053	6449706	2.2	78.9	0	0.1	7.5	1.7	32.7	0	0.9	13.0	0.02	4.0
S/V TEMS	n/a	n/a	14.0	90.7	0	1.2	8.6	8.5	39.5	0	4.8	16.9	0.2	4.2
JEB Camp	567890	6466521	35.5	112.2	6	4.5	11.9	19.8	50.7	1	10.4	22.5	0.6	4.6
Rabbit Lake Camp	576860	6451050	1.9	78.5	0	0.1	7.5	1.7	32.7	0	1.1	13.2	0.04	4.0
Points North Airport	554239	6458760	1.2	77.8	0	0.03	7.5	0.9	31.8	0	0.5	12.6	0.02	4.0
Hatchet Lake	582928	6482605	0.5	77.1	0	0.01	7.4	0.4	31.4	0	0.2	12.3	0.01	4.0
Wollaston Lake Community Area	589928	6442605	0.3	76.9	0	0.01	7.4	0.2	31.2	0	0.2	12.3	0.01	4.0
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	0.5	77.1	0	0.02	7.4	0.4	31.4	0	0.2	12.3	0.01	4.0
Background			-	76.7	-	-	7.4	-	31.0	-	-	12.1	-	4.0
Criteria			-	100	-	-	60	-	50	-	-	28	-	10

Notes: ⁽¹⁾ Exceedances (if any) are shown as bold values in grey highlighting.

Table 2.3-8 Maximum Predicted Concentrations of COPCs for the Maximum Future Operations Scenario (Uranium and Metals, Part 1 of 2)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		Uranium (U) (µg/m³)				Silver (Ag) (µg/m³)		Arsenic (As) (µg/m³)		Cadmium (Cd) (µg/m³)				Cobalt (Co) (µg/m³)		Chromium (Cr) (µg/m³)		Copper (Cu) (µg/m³)		Manganese (Mn) (µg/m³)	
	Easting (m)	Northing (m)	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.
			Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total
Maximum Off-Property	Various		1.09E-01	1.09E-01	1.45E-02	1.48E-02	1.41E-04	2.97E-04	9.78E-02	9.79E-02	5.82E-04	6.37E-04	5.71E-05	9.62E-05	2.26E-03	2.33E-03	1.23E-03	1.79E-03	5.44E-03	1.57E-01	8.85E-03	1.14E-02
Sink Reservoir	568828	6461934	1.13E-02	1.19E-02	7.61E-04	1.10E-03	1.58E-05	1.72E-04	7.66E-03	7.77E-03	7.40E-05	1.29E-04	2.44E-06	4.15E-05	1.95E-04	2.66E-04	1.46E-04	7.00E-04	3.03E-04	1.51E-01	5.74E-03	8.29E-03
Vulture Lake	567453	6460607	7.55E-03	8.14E-03	5.80E-04	9.21E-04	1.07E-05	1.67E-04	5.31E-03	5.42E-03	5.92E-05	1.15E-04	1.34E-06	4.04E-05	1.30E-04	2.00E-04	7.69E-05	6.31E-04	2.71E-04	1.51E-01	5.05E-03	7.59E-03
McClean Lake East Basin	566465	6458536	7.69E-03	8.28E-03	6.62E-04	1.00E-03	9.50E-06	1.66E-04	5.30E-03	5.40E-03	2.90E-05	8.44E-05	9.52E-07	4.00E-05	2.04E-04	2.75E-04	1.20E-04	6.74E-04	2.23E-04	1.51E-01	1.04E-02	1.30E-02
Kewen Lake	567053	6449706	4.02E-03	4.61E-03	1.26E-04	4.67E-04	3.03E-06	1.59E-04	1.57E-03	1.67E-03	2.72E-05	8.26E-05	4.56E-07	3.95E-05	4.71E-05	1.18E-04	3.24E-05	5.86E-04	8.65E-05	1.51E-01	1.00E-03	3.55E-03
S/V TEMS	n/a	n/a	9.44E-03	1.00E-02	6.71E-04	1.01E-03	1.33E-05	1.69E-04	6.48E-03	6.59E-03	6.66E-05	1.22E-04	1.89E-06	4.10E-05	1.62E-04	2.33E-04	1.11E-04	6.65E-04	2.87E-04	1.51E-01	5.39E-03	7.94E-03
JEB Camp	567890	6466521	9.11E-02	9.17E-02	6.01E-03	6.35E-03	9.72E-05	2.53E-04	7.37E-02	7.38E-02	5.02E-04	5.57E-04	1.68E-05	5.59E-05	1.42E-03	1.49E-03	6.91E-04	1.24E-03	2.66E-03	1.54E-01	2.62E-03	5.16E-03
Rabbit Lake Camp	576860	6451050	5.61E-03	6.20E-03	2.59E-04	6.00E-04	4.65E-06	1.61E-04	2.17E-03	2.28E-03	3.53E-05	9.08E-05	1.19E-06	4.03E-05	4.98E-05	1.21E-04	3.20E-05	5.86E-04	9.50E-05	1.51E-01	7.29E-04	3.27E-03
Points North Airport	554239	6458760	3.32E-03	3.91E-03	1.70E-04	5.11E-04	3.87E-06	1.60E-04	1.92E-03	2.03E-03	2.12E-05	7.66E-05	7.45E-07	3.98E-05	3.68E-05	1.08E-04	2.38E-05	5.78E-04	6.53E-05	1.51E-01	3.62E-04	2.91E-03
Hatchet Lake	582928	6482605	1.49E-03	2.08E-03	9.15E-05	4.32E-04	1.38E-06	1.57E-04	8.03E-04	9.12E-04	1.08E-05	6.62E-05	4.15E-07	3.95E-05	1.94E-05	9.02E-05	1.12E-05	5.65E-04	4.08E-05	1.51E-01	1.00E-04	2.65E-03
Wollaston Lake Community Area	589928	6442605	9.60E-04	1.55E-03	5.99E-05	4.01E-04	1.02E-06	1.57E-04	5.44E-04	6.53E-04	9.35E-06	6.48E-05	2.89E-07	3.94E-05	9.11E-06	7.99E-05	7.76E-06	5.62E-04	1.61E-05	1.51E-01	1.22E-04	2.67E-03
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	1.29E-03	1.88E-03	6.62E-05	4.07E-04	1.08E-06	1.57E-04	5.54E-04	6.64E-04	8.51E-06	6.39E-05	2.78E-07	3.94E-05	1.36E-05	8.44E-05	1.01E-05	5.64E-04	2.59E-05	1.51E-01	2.42E-04	2.79E-03
Background			-	5.93E-04	-	3.41E-04	-	1.56E-04	-	1.09E-04	-	5.54E-05	-	3.91E-05	-	7.08E-05	-	5.54E-04	-	1.51E-01	-	2.54E-03
Criteria			-	1.50E-01	-	3.00E-02	-	1.00E+00	-	3.00E-01	-	2.50E-02	-	5.00E-03	-	1.00E-01	-	5.00E-01	-	5.00E+01	-	2.00E-01

Table 2.3-9 Maximum Predicted Concentrations of COPCs for the Maximum Future Operations Scenario (Uranium and Metals, Part 2 of 2)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		Molybdenum (Mo) (µg/m³)		Nickel (Ni) (µg/m³)				Lead (Pb) (µg/m³)				Selenium (Se) (µg/m³)		Thallium (Tl) (µg/m³)		Vanadium (V) (µg/m³)		Zinc (Zn) (µg/m³)	
	Easting (m)	Northing (m)	24h Conc.	24h Conc.	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.	24h Conc.	24h Conc.	30-day Conc.	30-day Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.
			Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total
Maximum Off-Property	Various		8.05E-03	1.54E-02	1.18E-02	1.23E-02	1.49E-03	1.82E-03	7.20E-03	7.65E-03	2.01E-03	2.28E-03	3.60E-03	3.65E-03	2.93E-04	3.13E-04	1.49E-02	1.50E-02	3.87E-03	9.19E-03
Sink Reservoir	568828	6461934	9.34E-04	8.29E-03	1.63E-03	2.18E-03	1.01E-04	4.26E-04	6.05E-04	1.05E-03	1.69E-04	4.36E-04	4.74E-04	5.16E-04	6.55E-05	8.65E-05	1.90E-03	1.98E-03	2.44E-04	5.56E-03
Vulture Lake	567453	6460607	5.28E-04	7.89E-03	1.26E-03	1.80E-03	8.14E-05	4.07E-04	3.80E-04	8.24E-04	1.02E-04	3.69E-04	3.41E-04	3.83E-04	4.55E-05	6.65E-05	1.15E-03	1.22E-03	2.23E-04	5.54E-03
McClean Lake East Basin	566465	6458536	6.02E-04	7.96E-03	1.70E-03	2.24E-03	5.64E-05	3.82E-04	7.06E-04	1.15E-03	9.76E-05	3.65E-04	8.29E-04	8.72E-04	4.82E-05	6.91E-05	1.49E-03	1.57E-03	2.22E-04	5.54E-03
Kewen Lake	567053	6449706	3.18E-04	7.68E-03	3.03E-04	8.47E-04	1.22E-05	3.37E-04	1.65E-04	6.10E-04	1.99E-05	2.87E-04	1.06E-04	1.49E-04	1.01E-05	3.11E-05	4.29E-04	5.04E-04	7.99E-05	5.40E-03
S/V TEMS	n/a	n/a	7.31E-04	8.09E-03	1.45E-03	1.99E-03	9.13E-05	4.16E-04	4.92E-04	9.37E-04	1.35E-04	4.03E-04	4.07E-04	4.50E-04	5.55E-05	7.65E-05	1.53E-03	1.60E-03	2.34E-04	5.55E-03
JEB Camp	567890	6466521	5.94E-03	1.33E-02	9.06E-03	9.61E-03	7.38E-04	1.06E-03	5.83E-03	6.28E-03	1.70E-03	1.96E-03	1.95E-03	1.99E-03	2.08E-04	2.29E-04	7.31E-03	7.39E-03	2.11E-03	7.43E-03
Rabbit Lake Camp	576860	6451050	4.60E-04	7.82E-03	3.43E-04	8.87E-04	1.88E-05	3.44E-04	2.01E-04	6.46E-04	2.75E-05	2.95E-04	1.53E-04	1.95E-04	1.00E-05	3.10E-05	3.68E-04	4.44E-04	1.07E-04	5.43E-03
Points North Airport	554239	6458760	2.68E-04	7.63E-03	2.55E-04	7.99E-04	1.29E-05	3.38E-04	1.05E-04	5.50E-04	1.45E-05	2.82E-04	1.05E-04	1.47E-04	5.84E-06	2.68E-05	2.46E-04	3.22E-04	7.64E-05	5.40E-03
Hatchet Lake	582928	6482605	1.19E-04	7.48E-03	1.15E-04	6.59E-04	6.57E-06	3.32E-04	6.48E-05	5.09E-04	1.00E-05	2.77E-04	3.03E-05	7.30E-05	2.89E-06	2.39E-05	1.24E-04	1.99E-04	3.62E-05	5.36E-03
Wollaston Lake Community Area	589928	6442605	8.35E-05	7.44E-03	6.96E-05	6.14E-04	3.95E-06	3.29E-04	5.57E-05	5.00E-04	9.76E-06	2.77E-04	2.68E-05	6.94E-05	1.46E-06	2.24E-05	5.53E-05	1.31E-04	1.97E-05	5.34E-03
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	1.04E-04	7.46E-03	9.44E-05	6.38E-04	5.42E-06	3.31E-04	6.11E-05	5.06E-04	1.05E-05	2.78E-04	3.45E-05	7.72E-05	2.73E-06	2.37E-05	1.01E-04	1.77E-04	2.69E-05	5.35E-03
Background			-	7.36E-03	-	5.44E-04	-	3.25E-04	-	4.44E-04	-	2.67E-04	-	4.26E-05	-	2.10E-05	-	7.57E-05	-	5.32E-03
Criteria			-	1.20E+02	-	1.00E-01	-	2.00E-02	-	5.00E-01	-	2.00E-01	-	1.00E+01	-	5.00E-01	-	2.00E+00	-	1.20E+02

Table 2.3-10 Maximum Predicted Concentrations of COPCs for the Maximum Future Operations Scenario (CO, NO₂ and SO₂)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		CO (µg/m³)				NO ₂ (µg/m³)						SO ₂ (µg/m³)					
	Easting (m)	Northing (m)	1h Conc.	1h Conc.	8h Conc.	8h Conc.	1h Conc.	1h Conc.	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.	1h Conc.	1h Conc.	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.
			Inc.	Total	Inc.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total
Maximum Off-Property	Various		75.3	455.3	48.6	338.6	254.2	260.4	163.1	169.3	4.3	6.3	73.3	74.1	42.0	43.0	3.3	3.5
Sink Reservoir	568828	6461934	45.2	425.2	32.6	322.6	93.3	99.5	48.2	54.4	1.0	3.0	7.6	8.4	2.2	3.2	0.1	0.3
Vulture Lake	567453	6460607	63.5	443.5	37.4	327.4	126.8	133.0	46.9	53.1	1.4	3.4	5.4	6.2	1.3	2.3	0.04	0.2
McClean Lake East Basin	566465	6458536	106.5	486.5	50.3	340.3	186.2	192.4	77.3	83.5	3.0	5.0	3.5	4.3	1.1	2.1	0.03	0.2
Kewen Lake	567053	6449706	9.1	389.1	5.0	295.0	17.7	23.9	8.0	14.2	0.1	2.1	1.6	2.4	0.7	1.7	0.02	0.2
S/V TEMS	n/a	n/a	54.3	434.3	35.0	325.0	110.1	116.3	47.5	53.7	1.2	3.2	6.5	7.3	1.8	2.8	0.1	0.3
JEB Camp	567890	6466521	43.0	423.0	34.6	324.6	242.9	249.1	174.1	180.3	4.5	6.5	40.7	41.5	14.6	15.6	0.5	0.7
Rabbit Lake Camp	576860	6451050	6.5	386.5	3.9	293.9	14.9	21.1	7.4	13.6	0.1	2.1	2.9	3.7	1.1	2.1	0.04	0.2
Points North Airport	554239	6458760	4.0	384.0	2.4	292.4	12.0	18.2	3.0	9.2	0.1	2.1	2.7	3.5	0.7	1.7	0.03	0.2
Hatchet Lake	582928	6482605	1.4	381.4	0.9	290.9	8.1	14.3	1.8	8.0	0.03	2.0	1.1	1.9	0.3	1.3	0.02	0.2
Wollaston Lake Community Area	589928	6442605	1.0	381.0	0.6	290.6	3.6	9.8	1.9	8.1	0.03	2.0	0.5	1.3	0.3	1.3	0.01	0.2
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	2.6	382.6	1.4	291.4	7.1	13.3	1.9	8.1	0.05	2.0	0.7	1.5	0.2	1.2	0.01	0.2
Background			-	380	-	290	-	6.2	-	6.2	-	2.0	-	0.8	-	1.0	-	0.2
Criteria			-	15,000	-	6,000	-	300	-	200	-	45	-	450	-	125	-	20

Table 2.3-11 Maximum Predicted Concentrations of COPCs for the Maximum Future Operations Scenario (Ammonia, Acrolein, and Benzene)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		Ammonia (µg/m³)		Acrolein (µg/m³)		Benzene (µg/m³)	
	Easting (m)	Northing (m)	1h Conc.	24h Conc.	1h Conc.	24h Conc.	1h Conc.	Ann Conc.
			Total	Total	Total	Total	Total	Total
Maximum Off-Property	Various		32.7	12.3	0.3	0.10	0.7	0.02
Sink Reservoir	568828	6461934	4.7	1.4	0.2	0.08	0.6	0.005
Vulture Lake	567453	6460607	3.0	0.8	0.3	0.08	0.9	0.007
McClean Lake East Basin	566465	6458536	2.0	0.6	0.5	0.1	1.5	0.02
Kewen Lake	567053	6449706	0.9	0.4	0.04	0.01	0.1	0.0006
S/V TEMS	n/a	n/a	3.9	1.1	0.3	0.08	0.8	0.006
JEB Camp	567890	6466521	18.6	7.3	0.08	0.03	0.3	0.01
Rabbit Lake Camp	576860	6451050	1.8	0.6	0.02	0.008	0.06	0.0007
Points North Airport	554239	6458760	1.7	0.4	0.02	0.003	0.05	0.0004
Hatchet Lake	582928	6482605	0.7	0.2	0.004	0.001	0.01	0.0001
Wollaston Lake Community Area	589928	6442605	0.3	0.1	0.003	0.001	0.01	0.0001
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	0.4	0.1	0.009	0.002	0.03	0.0002
Background			0	0	0	0	0	0
Criteria			1,400	500	4.5	0.4	30	3

Table 2.3-12 Maximum Predicted Concentrations of COPCs for the Maximum Future Operations Scenario (Radon)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		Radon (Bq/m³)
	Easting (m)	Northing (m)	Annual Conc.
			Inc.
Maximum Off-Property	568952	6468465	16.8
Sink Reservoir	568828	6461934	0.7
Vulture Lake	567453	6460607	0.6
McClean Lake East Basin	566465	6458536	0.6
Kewen Lake	567053	6449706	0.1
S/V TEMS	n/a	n/a	0.6
JEB Camp	567890	6466521	12.2
Rabbit Lake Camp	576860	6451050	0.1
Points North Airport	554239	6458760	0.1
Hatchet Lake	582928	6482605	0.04
Wollaston Lake Community Area	589928	6442605	0.03
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	0.04
Background			15 to 25

Table 2.3-13 Maximum Predicted Concentrations of COPCs for the Decommissioning Scenario (Particulate Matter)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		TSP (µg/m³) ⁽¹⁾					PM ₁₀ (µg/m³) ⁽¹⁾			PM _{2.5} (µg/m³) ⁽¹⁾			
	Easting (m)	Northing (m)	24h Conc.	24h Conc.	24h Exceed. (days/yr)	Annual Conc.	Annual Conc.	24h Conc.	24h Conc.	24h Exceed. (days/yr)	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.
			Incr.	Total	Total	Inc.	Total	Incr.	Total	Total	Incr.	Total	Inc.	Total
Maximum Off-Property	Various		78.6	155.3	62	11.1	18.5	40.0	70.9	28	8.1	20.2	0.6	4.6
Sink Reservoir	568828	6461934	5.4	82.1	0	0.5	7.9	2.6	33.6	0	0.4	12.5	0.04	4.0
Vulture Lake	567453	6460607	5.4	82.0	0	0.5	7.9	2.8	33.7	0	0.4	12.5	0.04	4.0
McClean Lake East Basin	566465	6458536	4.3	80.9	0	0.5	8.0	2.6	33.6	0	0.4	12.5	0.04	4.0
Kewen Lake	567053	6449706	1.9	78.5	0	0.1	7.5	1.3	32.3	0	0.2	12.3	0.01	4.0
S/V TEMS	n/a	n/a	5.4	82.1	0	0.5	7.9	2.7	33.7	0	0.4	12.5	0.04	4.0
JEB Camp	567890	6466521	29.6	106.2	5	2.2	9.6	14.1	45.1	0	4.1	16.2	0.2	4.2
Rabbit Lake Camp	576860	6451050	0.9	77.5	0	0.1	7.5	0.7	31.7	0	0.2	12.3	0.01	4.0
Points North Airport	554239	6458760	0.4	77.1	0	<0.1	7.4	0.4	31.3	0	0.1	12.2	0.004	4.0
Hatchet Lake	582928	6482605	0.2	76.9	0	<0.1	7.4	0.2	31.2	0	0.1	12.2	0.002	4.0
Wollaston Lake Community Area	589928	6442605	0.1	76.8	0	<0.1	7.4	0.1	31.1	0	0.03	12.1	0.002	4.0
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	0.3	77.0	0	<0.1	7.4	0.2	31.2	0	0.1	12.2	0.003	4.0
Background			-	76.7	-	-	7.4	-	31.0	-	-	12.1	-	4.0
Criteria			-	100	-	-	60	-	50	-	-	28	-	10

Notes: ⁽¹⁾ Exceedances (if any) are shown as bold values in grey highlighting.

Table 2.3-14 Maximum Predicted Concentrations of COPCs for the Decommissioning Scenario (Uranium and Metals, Part 1 of 2)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		Uranium (U) (µg/m³)				Silver (Ag) (µg/m³)		Arsenic (As) (µg/m³)		Cadmium (Cd) (µg/m³)				Cobalt (Co) (µg/m³)		Chromium (Cr) (µg/m³)		Copper (Cu) (µg/m³)		Manganese (Mn) (µg/m³)	
	Easting (m)	Northing (m)	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.
			Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total
Maximum Off-Property	Various		1.86E-03	2.45E-03	1.91E-04	5.32E-04	1.17E-05	1.68E-04	4.51E-03	4.62E-03	2.13E-03	2.19E-03	6.93E-05	1.08E-04	2.27E-03	2.34E-03	2.20E-03	2.75E-03	3.29E-03	1.54E-01	5.99E-03	8.53E-03
Sink Reservoir	568828	6461934	1.45E-04	7.38E-04	1.40E-05	3.55E-04	1.38E-06	1.57E-04	7.77E-04	8.87E-04	3.49E-04	4.04E-04	1.00E-05	4.91E-05	3.91E-04	4.62E-04	3.92E-04	9.46E-04	1.96E-04	1.51E-01	5.38E-04	3.08E-03
Vulture Lake	567453	6460607	1.60E-04	7.53E-04	1.38E-05	3.55E-04	1.36E-06	1.57E-04	8.52E-04	9.61E-04	3.90E-04	4.46E-04	9.75E-06	4.88E-05	4.29E-04	5.00E-04	4.24E-04	9.78E-04	1.96E-04	1.51E-01	5.79E-04	3.12E-03
McClean Lake East Basin	566465	6458536	1.52E-04	7.45E-04	1.51E-05	3.56E-04	1.35E-06	1.57E-04	7.61E-04	8.70E-04	3.44E-04	3.99E-04	7.77E-06	4.69E-05	3.83E-04	4.54E-04	3.82E-04	9.36E-04	1.86E-04	1.51E-01	6.14E-04	3.16E-03
Kewen Lake	567053	6449706	7.39E-05	6.67E-04	3.85E-06	3.45E-04	5.86E-07	1.57E-04	1.87E-04	2.96E-04	7.58E-05	1.31E-04	1.78E-06	4.09E-05	9.41E-05	1.65E-04	1.01E-04	6.55E-04	8.56E-05	1.51E-01	2.78E-04	2.82E-03
S/V TEMS	n/a	n/a	1.53E-04	7.46E-04	1.39E-05	3.55E-04	1.37E-06	1.57E-04	8.15E-04	9.24E-04	3.70E-04	4.25E-04	9.89E-06	4.90E-05	4.10E-04	4.81E-04	4.08E-04	9.62E-04	1.96E-04	1.51E-01	5.58E-04	3.10E-03
JEB Camp	567890	6466521	6.37E-04	1.23E-03	4.89E-05	3.90E-04	4.07E-06	1.60E-04	5.73E-04	6.83E-04	5.02E-04	5.57E-04	5.38E-06	4.45E-05	3.21E-04	3.92E-04	6.90E-04	1.24E-03	1.01E-03	1.52E-01	2.08E-03	4.62E-03
Rabbit Lake Camp	576860	6451050	4.09E-05	6.34E-04	3.17E-06	3.44E-04	4.81E-07	1.56E-04	2.42E-04	3.51E-04	1.09E-04	1.64E-04	2.37E-06	4.15E-05	1.21E-04	1.92E-04	1.29E-04	6.83E-04	7.00E-05	1.51E-01	1.96E-04	2.74E-03
Points North Airport	554239	6458760	2.11E-05	6.14E-04	1.18E-06	3.42E-04	1.76E-07	1.56E-04	7.04E-05	1.80E-04	2.96E-05	8.51E-05	7.61E-07	3.98E-05	3.54E-05	1.06E-04	3.67E-05	5.91E-04	2.90E-05	1.51E-01	8.18E-05	2.63E-03
Hatchet Lake	582928	6482605	1.01E-05	6.03E-04	4.84E-07	3.41E-04	7.33E-08	1.56E-04	1.95E-05	1.29E-04	9.08E-06	6.45E-05	3.13E-07	3.94E-05	9.68E-06	8.05E-05	1.16E-05	5.66E-04	1.62E-05	1.51E-01	3.55E-05	2.58E-03
Wollaston Lake Community Area	589928	6442605	5.28E-06	5.98E-04	4.68E-07	3.41E-04	6.31E-08	1.56E-04	3.22E-05	1.41E-04	1.53E-05	7.08E-05	4.03E-07	3.95E-05	1.61E-05	8.69E-05	1.89E-05	5.73E-04	9.08E-06	1.51E-01	2.61E-05	2.57E-03
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	1.39E-05	6.07E-04	9.17E-07	3.42E-04	1.55E-07	1.56E-04	6.89E-05	1.78E-04	2.91E-05	8.45E-05	6.25E-07	3.97E-05	3.47E-05	1.06E-04	3.59E-05	5.90E-04	2.30E-05	1.51E-01	6.55E-05	2.61E-03
Background			-	5.93E-04	-	3.41E-04	-	1.56E-04	-	1.09E-04	-	5.54E-05	-	3.91E-05	-	7.08E-05	-	5.54E-04	-	1.51E-01	-	2.54E-03
Criteria			-	1.50E-01	-	3.00E-02	-	1.00E+00	-	3.00E-01	-	2.50E-02	-	5.00E-03	-	1.00E-01	-	5.00E-01	-	5.00E+01	-	2.00E-01

Notes: ⁽¹⁾ Exceedances (if any) are shown as bold values in grey highlighting.

Table 2.3-15 Maximum Predicted Concentrations of COPCs for the Decommissioning Scenario (Uranium and Metals, Part 2 of 2)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		Molybdenum (Mo) (µg/m³)		Nickel (Ni) (µg/m³)				Lead (Pb) (µg/m³)				Selenium (Se) (µg/m³)		Thallium (Tl) (µg/m³)		Vanadium (V) (µg/m³)		Zinc (Zn) (µg/m³)	
	Easting (m)	Northing (m)	24h Conc.	24h Conc.	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.	24h Conc.	24h Conc.	30-day Conc.	30-day Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.	24h Conc.
			Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total
Maximum Off-Property	Various		1.57E-03	8.93E-03	1.64E-03	2.18E-03	1.44E-04	4.69E-04	6.67E-03	7.12E-03	1.36E-03	1.63E-03	2.21E-03	2.25E-03	3.51E-05	5.61E-05	9.60E-03	9.68E-03	2.47E-03	7.79E-03
Sink Reservoir	568828	6461934	6.29E-05	7.42E-03	9.99E-05	6.44E-04	6.84E-06	3.32E-04	4.16E-04	8.60E-04	7.16E-05	3.39E-04	3.62E-04	4.05E-04	2.93E-06	2.39E-05	7.97E-04	8.73E-04	1.26E-04	5.45E-03
Vulture Lake	567453	6460607	6.92E-05	7.43E-03	1.02E-04	6.46E-04	6.37E-06	3.32E-04	2.99E-04	7.44E-04	4.55E-05	3.13E-04	4.05E-04	4.47E-04	3.27E-06	2.42E-05	8.86E-04	9.61E-04	1.37E-04	5.46E-03
McClean Lake East Basin	566465	6458536	6.18E-05	7.42E-03	9.39E-05	6.38E-04	6.03E-06	3.31E-04	2.09E-04	6.53E-04	3.97E-05	3.07E-04	3.57E-04	4.00E-04	3.21E-06	2.42E-05	8.56E-04	9.32E-04	1.26E-04	5.45E-03
Kewen Lake	567053	6449706	1.68E-05	7.38E-03	3.32E-05	5.77E-04	1.55E-06	3.27E-04	1.36E-04	5.80E-04	1.40E-05	2.81E-04	7.85E-05	1.21E-04	1.52E-06	2.25E-05	4.08E-04	4.84E-04	6.56E-05	5.39E-03
S/V TEMS	n/a	n/a	6.61E-05	7.43E-03	1.01E-04	6.45E-04	6.61E-06	3.32E-04	3.58E-04	8.02E-04	5.85E-05	3.26E-04	3.83E-04	4.26E-04	3.10E-06	2.41E-05	8.42E-04	9.17E-04	1.31E-04	5.45E-03
JEB Camp	567890	6466521	4.36E-04	7.80E-03	1.15E-03	1.70E-03	3.65E-05	3.62E-04	5.83E-03	6.28E-03	1.38E-03	1.65E-03	9.68E-05	1.39E-04	1.22E-05	3.31E-05	3.34E-03	3.41E-03	7.89E-04	6.11E-03
Rabbit Lake Camp	576860	6451050	2.14E-05	7.38E-03	5.21E-05	5.96E-04	1.65E-06	3.27E-04	1.62E-04	6.07E-04	1.79E-05	2.85E-04	1.09E-04	1.52E-04	8.69E-07	2.18E-05	2.25E-04	3.01E-04	3.51E-05	5.36E-03
Points North Airport	554239	6458760	9.11E-06	7.37E-03	1.52E-05	5.59E-04	6.60E-07	3.26E-04	6.55E-05	5.10E-04	6.80E-06	2.74E-04	3.10E-05	7.36E-05	4.35E-07	2.14E-05	1.16E-04	1.92E-04	2.01E-05	5.34E-03
Hatchet Lake	582928	6482605	6.55E-06	7.37E-03	1.05E-05	5.54E-04	3.43E-07	3.26E-04	4.59E-05	4.90E-04	5.46E-06	2.73E-04	8.25E-06	5.09E-05	1.98E-07	2.12E-05	5.37E-05	1.29E-04	1.17E-05	5.33E-03
Wollaston Lake Community Area	589928	6442605	3.00E-06	7.36E-03	1.08E-05	5.55E-04	2.90E-07	3.25E-04	4.83E-05	4.93E-04	8.03E-06	2.75E-04	1.46E-05	5.72E-05	1.19E-07	2.11E-05	3.09E-05	1.07E-04	5.23E-06	5.33E-03
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	6.65E-06	7.37E-03	1.21E-05	5.56E-04	4.64E-07	3.26E-04	3.99E-05	4.84E-04	6.31E-06	2.74E-04	3.02E-05	7.28E-05	3.08E-07	2.13E-05	8.02E-05	1.56E-04	1.25E-05	5.33E-03
Background			-	7.36E-03	-	5.44E-04	-	3.25E-04	-	4.44E-04	-	2.67E-04	-	4.26E-05	-	2.10E-05	-	7.57E-05	-	5.32E-03
Criteria			-	1.20E+02	-	1.00E-01	-	2.00E-02	-	5.00E-01	-	2.00E-01	-	1.00E+01	-	5.00E-01	-	2.00E+00	-	1.20E+02

Notes: ⁽¹⁾ Exceedances (if any) are shown as bold values in grey highlighting.

Table 2.3-16 Maximum Predicted Concentrations of COPCs for the Decommissioning Scenario (CO, NO₂ and SO₂)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		CO (µg/m³)				NO ₂ (µg/m³)						SO ₂ (µg/m³)					
	Easting (m)	Northing (m)	1h Conc.	1h Conc.	8h Conc.	8h Conc.	1h Conc.	1h Conc.	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.	1h Conc.	1h Conc.	24h Conc.	24h Conc.	Annual Conc.	Annual Conc.
			Inc.	Total	Inc.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total
Maximum Off-Property	Various		56.7	436.7	38.9	328.9	253.8	260.0	162.9	169.1	2.7	4.7	0.2	1.0	0.1	1.1	0.002	0.20
Sink Reservoir	568828	6461934	5.8	385.8	3.1	293.1	44.2	50.4	8.1	14.3	0.2	0.04	0.8	0.01	1.0	0.0001	0.20	0.20
Vulture Lake	567453	6460607	7.9	387.9	4.1	294.1	30.2	36.4	10.6	16.8	0.1	0.03	0.8	0.01	1.0	0.0001	0.20	0.20
McClean Lake East Basin	566465	6458536	8.2	388.2	5.1	295.1	20.9	27.1	3.8	10.0	0.1	0.02	0.8	0.004	1.0	0.0001	0.20	0.20
Kewen Lake	567053	6449706	1.7	381.7	0.9	290.9	8.9	15.1	4.3	10.5	0.02	0.03	0.8	0.006	1.0	0.0002	0.20	0.20
S/V TEMS	n/a	n/a	6.9	386.9	3.6	293.6	37.2	43.4	9.3	15.5	0.1	0.03	0.8	0.007	1.0	0.0004	0.20	0.20
JEB Camp	567890	6466521	38.2	418.2	27.0	317.0	241.3	247.5	173.6	179.8	3.4	0.01	0.8	0.004	1.0	0.00002	0.20	0.20
Rabbit Lake Camp	576860	6451050	1.7	381.7	0.9	290.9	13.8	20.0	3.8	10.0	0.03	0.03	0.8	0.01	1.0	0.0001	0.20	0.20
Points North Airport	554239	6458760	1.4	381.4	0.7	290.7	11.4	17.6	2.9	9.1	0.01	0.3	1.1	0.1	1.1	0.0014	0.20	0.20
Hatchet Lake	582928	6482605	0.9	380.9	0.4	290.4	7.1	13.3	1.7	7.9	0.009	0.02	0.8	0.005	1.0	0.00003	0.20	0.20
Wollaston Lake Community Area	589928	6442605	0.4	380.4	0.3	290.3	3.2	9.4	1.5	7.7	0.007	0.01	0.8	0.003	1.0	0.00001	0.20	0.20
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	0.7	380.7	0.4	290.4	4.3	10.5	0.9	7.1	0.008	0.01	0.8	0.002	1.0	0.00001	0.20	0.20
Background			-	380	-	290	-	6.2	-	6.2	-	2.0	-	0.8	-	1.0	-	0.2
Criteria			-	15,000	-	6,000	-	300	-	200	-	45	-	450	-	125	-	20

Notes: ⁽¹⁾ Exceedances (if any) are shown as bold values in grey highlighting.

Table 2.3-17 Maximum Predicted Concentrations of COPCs for the Decommissioning Scenario (Ammonia, Acrolein, and Benzene)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		Ammonia (µg/m³)		Acrolein (µg/m³)		Benzene (µg/m³)	
	Easting (m)	Northing (m)	1h Conc.	24h Conc.	1h Conc.	24h Conc.	1h Conc.	Ann Conc.
			Total	Total	Total	Total	Total	Total
Maximum Off-Property	Various		0	0	0.2	0.08	0.6	0.01
Sink Reservoir	568828	6461934	0	0	0.01	0.002	0.04	0.001
Vulture Lake	567453	6460607	0	0	0.01	0.002	0.05	0.001
McClean Lake East Basin	566465	6458536	0	0	0.01	0.001	0.04	0.001
Kewen Lake	567053	6449706	0	0	0.002	0.001	0.01	0.0001
S/V TEMS	n/a	n/a	0	0	0.01	0.002	0.04	0.001
JEB Camp	567890	6466521	0	0	0.11	0.03	0.4	0.01
Rabbit Lake Camp	576860	6451050	0	0	0.004	0.001	0.01	0.0001
Points North Airport	554239	6458760	0	0	0.003	0.001	0.01	0.0001
Hatchet Lake	582928	6482605	0	0	0.001	0.0003	0.004	0.00003
Wollaston Lake Community Area	589928	6442605	0	0	0.001	0.0002	0.002	0.00002
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	0	0	0.001	0.0002	0.005	0.00003
Background			0	0	0	0	0	0
Criteria			1,400	500	4.5	0.4	30	3

Notes: ⁽¹⁾ Exceedances (if any) are shown as bold values in grey highlighting.

Table 2.3-18 Maximum Predicted Concentrations of COPCs for the Decommissioning Scenario (Radon)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		Radon (Bq/m³)
	Easting (m)	Northing (m)	Annual Conc.
			Inc.
Maximum Off-Property	571279	6468159	0.3
Sink Reservoir	568828	6461934	0.02
Vulture Lake	567453	6460607	0.02
McClean Lake East Basin	566465	6458536	0.01
Kewen Lake	567053	6449706	0.003
S/V TEMS	n/a	n/a	0.02
JEB Camp	567890	6466521	0.04
Rabbit Lake Camp	576860	6451050	0.005
Points North Airport	554239	6458760	0.002
Hatchet Lake	582928	6482605	0.001
Wollaston Lake Community Area	589928	6442605	0.001
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	0.001
Background			15 to 25

Notes: ⁽¹⁾ Exceedances (if any) are shown as bold values in grey highlighting.

Table 2.3-19 Maximum Predicted Concentrations of COPCs for the Post-Decommissioning Scenario (Radon)

Receptor ID	UTM Coordinates (NAD 1983, UTM Zone 13N)		Radon (Bq/m³)
	Easting (m)	Northing (m)	Annual Conc.
			Inc.
Maximum Off-Property	567837	6482605	1.6
Sink Reservoir	568828	6461934	0.03
Vulture Lake	567453	6460607	0.02
McClellan Lake East Basin	566465	6458536	0.02
Keweenaw Lake	567053	6449706	0.004
S/V TEMS	n/a	n/a	0.03
JEB Camp	567890	6466521	0.3
Rabbit Lake Camp	576860	6451050	0.01
Points North Airport	554239	6458760	0.004
Hatchet Lake	582928	6482605	0.002
Wollaston Lake Community Area	589928	6442605	0.001
Wollaston Lake Lodge (Hidden Bay)	571928	6442605	0.002
Background			15 to 25

Notes: ⁽¹⁾ Exceedances (if any) are shown as bold values in grey highlighting.

Table 3.1-1 Summary of Selected COPCs for 2025 McClean Lake Operation ERA

Constituent	COPCs in 2016 ERA	COPCs for 2025 ERA	
		COPC	Comment
General Chemistry			
Ammonia (as N) - Total	Y	Y	Water quality only
Calcium	Y*	Y*	Water quality only
Chloride	Y	Y	Water quality only
Fluoride	Y	Y	Water quality only
Nitrate (as N)	-	Y	Water quality only
Potassium	Y	Y*	To inform TDS. Water quality only.
Sulphate	Y	Y	Water quality only
Total Dissolved Solids	Y	Y	Water quality only
Metals			
Aluminum	-	Y	Water quality only, not bioaccumulative (fate in environment driven by chemistry)
Arsenic	Y	Y	
Cadmium	-	Y	
Chromium	-	Y	
Cobalt	Y	Y	
Copper	Y	Y	
Iron	Y*	Y	Water quality only, fate in environment driven by chemistry
Lead	Y	Y	
Molybdenum	Y	Y	
Nickel	Y	Y	
Selenium	Y	Y	
Silver	-	Y	
Thallium	-	Y	
Uranium	Y	Y	
Zinc	Y	Y	
Radionuclides			
Lead-210	Y	Y	
Polonium-210	Y	Y	
Radium-226	Y	Y	
Thorium-230	Y	Y	
Air Quality			
Acrolein	-	Y	Air quality only
Benzene	-	Y	Air quality only
Nitrogen dioxide, NO2	Y	Y	Air quality only
Particulate matter, PM2.5	Y	Y	Air quality only
Radon	Y	Y	Include in dose estimate
Sulphur dioxide, SO2	Y	Y	Air quality only

Note:

Y* Not a COPC but a modelling parameter used to estimate hardness or total dissolved solids.

TDS is a composite parameter that includes dissolved ions in water, such as calcium, magnesium, potassium, and sodium, as well as carbonates, bicarbonates, chlorides, and sulphate.

Table 3.3-1 Future JEB WTP Flows

Timeframe	Assumed flow (m³/d)
2025 – 2036	4,203
2037 – 2049	2,000

Table 3.3-2 Future Sue WTP Flows

Timeframe	Assumed flow (m³/d)
2025 – 2027 (June-Oct only)	4,880
2028 – 2034 (June-Oct only)	4,950
2035 – 2036	7,150
2037 – 2038	6,000
2039 – 2040	3,500

Table 3.3-3 McClean Lake Operation JEB WTP Effluent Quality Summary of Operational Data

Parameter	Units ^a	N	Start Date	End Date	Maximum	Minimum	Mean	Standard Deviation
General Chemistry								
Ammonia (as N)	mg/L	2,348	1-Jan-16	31-Dec-24	20.2	0.8	7.01	2.40
Calcium	mg/L	97	1-Jan-16	31-Dec-24	793	384	616	70
Chloride	mg/L	2,832	1-Jan-16	31-Dec-24	336	9	121	25
Fluoride	mg/L	97	1-Jan-16	31-Dec-24	1.4	0.23	0.85	0.26
Nitrate (as N)	mg/L	98	1-Jan-16	31-Dec-24	1.9	0.01	0.37	0.31
Potassium	mg/L	97	1-Jan-16	31-Dec-24	36	16	26	4
Sulphate	mg/L	2,836	1-Jan-16	31-Dec-24	3,367	234	2,001	385
Total Dissolved Solids	mg/L	97	1-Jan-16	31-Dec-24	3,950	2,250	3,091	379
Metals								
Aluminum	mg/L	98	1-Jan-16	31-Dec-24	0.2	0.029	0.10	0.03
Arsenic	mg/L	2,838	1-Jan-16	31-Dec-24	0.127	0.008	0.037	0.020
Cadmium	mg/L	98	1-Jan-16	31-Dec-24	0.00011	0.00001	0.00001	0.00001
Chromium	mg/L	98	1-Jan-16	31-Dec-24	0.010	0.0005	0.001	0.001
Cobalt	mg/L	98	1-Jan-16	31-Dec-24	0.010	0.002	0.006	0.001
Copper	mg/L	2,838	1-Jan-16	31-Dec-24	0.054	0.001	0.003	0.002
Iron	mg/L	2,837	1-Jan-16	31-Dec-24	3.75	0.005	0.36	0.36
Lead	mg/L	2,838	1-Jan-16	31-Dec-24	0.007	0.0005	0.001	0.001
Molybdenum	mg/L	2,838	1-Jan-16	31-Dec-24	0.256	0.001	0.005	0.01
Nickel	mg/L	2,838	1-Jan-16	31-Dec-24	0.192	0.004	0.02	0.01
Selenium	mg/L	2,838	1-Jan-16	31-Dec-24	0.085	0.0005	0.02	0.014
Silver	mg/L	98	1-Jan-16	31-Dec-24	0.00005	0.00005	0.0001	0.0000
Thallium	mg/L	98	1-Jan-16	31-Dec-24	0.0034	0.0002	0.001	0.001
Uranium	mg/L	2,838	1-Jan-16	31-Dec-24	0.043	0.001	0.005	0.004
Zinc	mg/L	2,838	1-Jan-16	31-Dec-24	0.029	0.001	0.003	0.002
Radionuclides								
Lead-210	Bq/L	98	1-Jan-16	31-Dec-24	0.08	0.02	0.03	0.02
Polonium-210	Bq/L	98	1-Jan-16	31-Dec-24	0.12	0.005	0.02	0.02
Radium-226	Bq/L	2,838	1-Jan-16	31-Dec-24	0.108	0.004833	0.01	0.01
Thorium-230	Bq/L	98	1-Jan-16	31-Dec-24	0.02	0.01	0.01	0.00

Note: Based on Appendix III.2

a – Definition of units: mg/L = milligrams per litre; Bq/L = Becquerels per litre. TDS is a composite parameter that includes dissolved ions in water, such as calcium, magnesium, potassium, and sodium, as well as carbonates, bicarbonates, chlorides, and sulphate.

Table 3.3-4 Assumed Probabilistic Distributions of Discharge Waters – JEB WTP

COPCs	Units ^a	Average	Lognormal Distribution Descriptors – for Predicted Quality			
			Geometric Mean	Geometric Standard Deviation (GSD)	Minimum (-3 GSD)	Maximum (+3 GSD)
General Chemistry						
Ammonia (as N)	mg/L	12	11	1.4	4.2	31
Calcium	mg/L	716	711	1.1	506	999
Chloride	mg/L	336	329	1.2	178	608
Fluoride	mg/L	1.2	1.1	1.3	0.5	2.8
Nitrate (as N)	mg/L	1.9	1.5	2.1	0.2	13
Potassium	mg/L	36	36	1.2	22	56
Sulphate ^b	mg/L	2,279	2,238	1.2	1,263	3,965
Total Dissolved Solids ^b	mg/L	4,331	4,299	1.1	2,980	6,202
Metals						
Aluminum ^b	mg/L	2	1.9	1.3	0.8	4.6
Arsenic ^b	mg/L	0.074	0.065	1.7	0.014	0.30
Cadmium	mg/L	0.00002	0.000014	2.3	0.000001	0.00017
Chromium	mg/L	0.003	0.002	2.3	0.0002	0.03
Cobalt	mg/L	0.01	0.010	1.2	0.006	0.02
Copper	mg/L	0.01	0.008	1.8	0.001	0.05
Iron	mg/L	1	0.7	2.3	0.1	8.6
Lead	mg/L	0.002	0.001	2.3	0.00001	0.02
Molybdenum	mg/L	0.2	0.089	3.6	0.002	4.02
Nickel	mg/L	0.05	0.045	1.6	0.011	0.18
Selenium ^b	mg/L	0.021	0.017	1.9	0.003	0.11
Silver	mg/L	0.00005	Constant Distribution (0.0005)			
Thallium	mg/L	0.003	0.002	2.3	0.0002	0.03
Uranium	mg/L	0.01	0.008	2.0	0.001	0.06
Zinc	mg/L	0.007	0.006	1.8	0.001	0.04
Radionuclides						
Lead-210	Bq/L	0.064	0.053	1.8	0.009	0.33
Polonium-210	Bq/L	0.047	0.033	2.3	0.003	0.40
Radium-226	Bq/L	0.02	0.014	2.3	0.001	0.17
Thorium-230	Bq/L	0.03	Constant Distribution (0.03)			

Note: Average values based on Appendix III.2. Geometric standard deviations based on JEB WTP operational data from 2016-2024 as presented in Appendix III.2. Geometric means were calculated using the average and geometric standard deviation. Constant distribution selected for COPCs where all 2016-2024 data were <MDL.

a – Definition of units: mg/L = milligrams per litre; Bq/L = Becquerels per litre

b – Varies with time, maximum monthly average and geometric mean presented.

TDS is a composite parameter that includes dissolved ions in water, such as calcium, magnesium, potassium, and sodium, as well as carbonates, bicarbonates, chlorides, and sulphate.

Table 3.3-5 Assumed Probabilistic Distributions of Discharge Waters – JEB WTP – Time Variable

COPCs	Aluminum	Sulphate	Total Dissolved Solids	Arsenic	Selenium
2025	0.2	2,198	3,708	0.052	0.0089
2026	0.2	2,237	3,748	0.052	0.0068
2027	0.2	2,268	3,778	0.052	0.0070
2028	2.0	2,138	4,285	0.052	0.0087
2029	2.0	2,158	4,304	0.052	0.0077
2030	2.0	2,176	4,323	0.074	0.013
2031	2.0	2,176	4,323	0.074	0.016
2032	2.0	2,158	4,304	0.074	0.017
2033	2.0	2,138	4,285	0.074	0.018
2034	2.0	2,117	4,264	0.074	0.016
2035	2.0	2,094	4,241	0.074	0.0094
2036	2.0	2,070	4,216	0.074	0.0070
2037	0.2	2,176	3,686	0.052	0.0043
2038	0.2	2,176	3,686	0.052	0.0043
2039	0.2	2,176	3,686	0.052	0.0043
2040	0.2	2,176	3,686	0.052	0.0043
2041	0.2	2,176	3,686	0.052	0.0043
2042	0.2	2,176	3,686	0.052	0.0043
2043	0.2	2,176	3,686	0.052	0.0043
2044	0.2	2,176	3,686	0.052	0.0043
2045	0.2	2,176	3,686	0.052	0.0043
2046	0.2	2,176	3,686	0.052	0.0043
2047	0.2	2,176	3,686	0.052	0.0043
2048	0.2	2,176	3,686	0.052	0.0043
2049	0.2	2,176	3,686	0.052	0.0043

Note: all concentrations expressed in mg/L. Predicted concentrations presented as annual averages, but effluent predictions applied within model on a monthly basis.

TDS is a composite parameter that includes dissolved ions in water, such as calcium, magnesium, potassium, and sodium, as well as carbonates, bicarbonates, chlorides, and sulphate.

Table 3.3-6 McClean Lake Operation Sue WTP Effluent Quality Summary of Operational Data

Parameter	Units ^a	N	Start Date	End Date	Maximum	Minimum	Mean	Standard Deviation
General Chemistry								
Ammonia (as N)	mg/L	2,304	6-Jul-16	23-Oct-24	2.20	0.05	0.20	0.20
Calcium	mg/L	46	6-Jul-16	23-Oct-24	202	40	65	28
Chloride	mg/L	2,304	6-Jul-16	23-Oct-24	70.0	1.0	9.9	3.5
Fluoride	mg/L	46	6-Jul-16	23-Oct-24	0.330	0.040	0.089	0.039
Nitrate (as N) ^b	mg/L	46	6-Jul-16	23-Oct-24	29.0	3.6	6.6	3.8
Potassium	mg/L	46	6-Jul-16	23-Oct-24	12.0	3.7	5.7	1.3
Sulphate	mg/L	2,304	6-Jul-16	23-Oct-24	900	31	131	47
Total Dissolved Solids	mg/L	46	6-Jul-16	23-Oct-24	915	185	288	120
Metals								
Aluminum	mg/L	46	6-Jul-16	23-Oct-24	0.016	0.002	0.008	0.004
Arsenic	mg/L	2,304	6-Jul-16	23-Oct-24	0.100	0.001	0.007	0.006
Cadmium	mg/L	46	6-Jul-16	23-Oct-24	0.00002	0.00001	0.00001	0.000001
Chromium	mg/L	46	6-Jul-16	23-Oct-24	0.0005	0.0005	0.0005	0.00000
Cobalt	mg/L	46	6-Jul-16	23-Oct-24	0.0039	0.0006	0.0018	0.0008
Copper	mg/L	2,304	6-Jul-16	23-Oct-24	0.015	0.001	0.001	0.001
Iron	mg/L	46	6-Jul-16	23-Oct-24	0.40	0.05	0.20	0.10
Lead	mg/L	2,304	6-Jul-16	23-Oct-24	0.0080	0.0005	0.0007	0.0005
Molybdenum	mg/L	2,304	6-Jul-16	23-Oct-24	0.140	0.002	0.018	0.009
Nickel	mg/L	2,304	6-Jul-16	23-Oct-24	0.180	0.004	0.056	0.029
Selenium	mg/L	2,304	6-Jul-16	23-Oct-24	0.0080	0.0005	0.0011	0.0006
Silver	mg/L	46	6-Jul-16	23-Oct-24	0.0008	0.0001	0.0001	0.0001
Thallium	mg/L	46	6-Jul-16	23-Oct-24	0.0008	0.0002	0.0002	0.0001
Uranium	mg/L	2,304	6-Jul-16	23-Oct-24	0.007	0.001	0.001	0.001
Zinc	mg/L	46	6-Jul-16	23-Oct-24	0.0058	0.0005	0.0013	0.0011
Radionuclides								
Lead-210	Bq/L	46	6-Jul-16	23-Oct-24	0.050	0.020	0.028	0.010
Polonium-210	Bq/L	46	6-Jul-16	23-Oct-24	0.010	0.005	0.007	0.002
Radium-226	Bq/L	2,304	6-Jul-16	23-Oct-24	0.043	0.001	0.008	0.003
Thorium-230	Bq/L	46	6-Jul-16	23-Oct-24	0.01	0.01	0.01	0.00

Note: Based on Appendix III.2.

a – Definition of units: mg/L = milligrams per litre; Bq/L = Becquerels per litre

b – Nitrate and nitrite (as N)

TDS is a composite parameter that includes dissolved ions in water, such as calcium, magnesium, potassium, and sodium, as well as carbonates, bicarbonates, chlorides, and sulphate.

Table 3.3-7 Assumed Probabilistic Distributions of Discharge Waters – Sue WTP

COPCs	Units ^a	Average	Lognormal Distribution Descriptors – for Predicted Quality			
			Geometric Mean	Geometric Standard Deviation (GSD)	Minimum (-3 GSD)	Maximum (+3 GSD)
General Chemistry						
Ammonia (as N)	mg/L	2.6	1.8	2.3	0.2	22
Calcium ^b	mg/L	202	186	1.5	54	640
Chloride	mg/L	100	94	1.4	34	264
Fluoride	mg/L	0.12	0.11	1.5	0.03	0.4
Nitrate (as N) ^c	mg/L	10	8.7	1.7	1.7	43
Potassium ^b	mg/L	12	12	1.3	6.0	23
Sulphate ^b	mg/L	223	210	1.4	74	596
Total Dissolved Solids ^b	mg/L	619	571	1.5	172	1,898
Metals						
Aluminum	mg/L	0.016	0.01	1.6	0.003	0.1
Arsenic	mg/L	0.014	0.011	2.1	0.001	0.10
Cadmium	mg/L	0.00002	0.00002	1.1	0.000015	0.00003
Chromium	mg/L	0.0005	Constant Distribution (0.0005)			
Cobalt	mg/L	0.004	0.004	1.5	0.001	0.01
Copper ^b	mg/L	0.015	0.011	2.3	0.001	0.13
Iron	mg/L	0.4	0.4	1.6	0.1	1.5
Lead	mg/L	0.001	0.001	1.9	0.0001	0.01
Molybdenum ^b	mg/L	0.14	0.13	1.6	0.03	0.52
Nickel	mg/L	0.12	0.11	1.6	0.02	0.46
Selenium	mg/L	0.002	0.002	1.7	0.0004	0.01
Silver	mg/L	0.0004	0.0003	2.3	0.00002	0.0034
Thallium	mg/L	0.0002	0.0002	1.6	0.00004	0.001
Uranium	mg/L	0.001	0.0007	2.3	0.0001	0.009
Zinc	mg/L	0.004	0.003	2.1	0.0003	0.03
Radionuclides						
Lead-210	Bq/L	0.04	0.038	1.4	0.013	0.11
Polonium-210	Bq/L	0.012	0.012	1.3	0.005	0.03
Radium-226 ^b	Bq/L	0.043	0.040	1.4	0.014	0.12
Thorium-230	Bq/L	0.01	Constant Distribution (0.01)			

Note: Average values as per Appendix III.2. Geometric standard deviations based on Sue WTP operational data from 2016-2024. Geometric means were calculated using the average and geometric standard deviation. Constant distribution selected for COPCs where all 2016-2024 data were <MDL.

a – Definition of units: mg/L = milligrams per litre; Bq/L = Becquerels per litre

b –Varies with scenario, maximum average and geometric mean presented.

c –Nitrate and nitrite (as N).

TDS is a composite parameter that includes dissolved ions in water, such as calcium, magnesium, potassium, and sodium, as well as carbonates, bicarbonates, chlorides, and sulphate.

Table 3.3-8 McClean Lake Operation Dewatering Well System Effluent Quality Summary

Constituent	Units ^a	Number of Observations	Start Year	End Year	Summary Statistics of Original Observations					
					Minimum	Maximum	Mean	Standard Deviation	Geometric Mean	Geometric Standard Deviation
General Chemistry										
Ammonia (as N)	mg/L	149	2001	2014	0.01	0.97	0.1	0.1	0.1	2.6
Calcium	mg/L	418	1996	2014	2.7	11	3.9	1.0	3.7	1.3
Chloride	mg/L	1,278	1998	2014	0.2	12	0.7	0.6	0.5	2.1
Fluoride	mg/L	56	2009	2014	0.04	0.17	0.13	0.02	0.13	1.2
Nitrate (as N) ^b	mg/L	32	2009	2014	0.04	1.3	0.15	0.25	0.08	3.2
Potassium	mg/L	257	1996	2014	0.1	2.2	1.1	0.2	1.1	1.2
Sulphate	mg/L	1,278	1998	2014	1	29	5.2	3.7	4.3	1.9
Total Dissolved Solids	mg/L	1,452	1996	2014	8	134	44.7	7.8	44.1	1.2
Metals										
Aluminum	mg/L	132	2001	2014	0.002	0.042	0.01	0.004	0.004	1.9
Arsenic	µg/L	11,677	1996	2014	0.1	103	1.6	1.3	1.2	2.1
Cadmium	mg/L	145	2001	2014	0.00001	0.001	0.0006	0.0005	0.0005	2.1
Chromium	mg/L	132	2001	2014	0.0005	0.002	0.0008	0.0003	0.001	1.4
Cobalt	mg/L	132	2001	2014	0.0005	0.002	0.001	0.000	0.001	1.2
Copper	mg/L	11,676	1996	2014	0.0001	0.038	0.001	0.003	0.001	3.7
Iron	mg/L	8,238	1996	2014	0.037	19.8	1.00	0.50	0.90	1.6
Lead	mg/L	11,676	1996	2014	0.0001	0.032	0.001	0.001	0.000	3.0
Molybdenum	mg/L	145	2001	2014	0.0005	0.11	0.003	0.011	0.001	4.6
Nickel	mg/L	11,676	1996	2014	0.0004	0.057	0.001	0.000	0.001	1.6
Selenium	mg/L	3,551	1996	2014	0.0001	0.005	0.0005	0.0005	0.0003	2.2
Silver	mg/L	63	2001	2014	0.00001	0.001	0.0001	0.0003	0.0001	3.6
Thallium	mg/L	56	2009	2014	0.0002	0.0002	0.0002	0	0.0002	1.0
Uranium	µg/L	11,675	1996	2014	0.1	24	0.7	0.7	0.5	2.3
Zinc	mg/L	11,676	1996	2014	0.0005	0.043	0.003	0.002	0.002	2.1
Radionuclides										
Lead-210	Bq/L	146	2001	2014	0.02	0.06	0.021	0.013	0.018	1.8
Polonium-210	Bq/L	146	2001	2014	0.0025	0.09	0.014	0.010	0.011	1.9
Radium-226	Bq/L	11,672	1996	2014	0.0025	2.1	0.025	0.009	0.023	1.4
Thorium-230	Bq/L	146	2001	2014	0.005	0.06	0.006	0.005	0.004	2.1

Note: Data summary of JP01. The DWW has not operated since June 2014.

a - Definition of units: mg/L = milligrams per litre; Bq/L = Becquerels per litre. µg/L = micrograms per litre

b - Nitrate and nitrite (as N).

TDS is a composite parameter that includes dissolved ions in water, such as calcium, magnesium, potassium, and sodium, as well as carbonates, bicarbonates, chlorides, and sulphate.

Table 3.4-1 Selected water quality guidelines

Constituent	WQG	Units	Note
General Chemistry			
Ammonia, Total	1.46	mg/L (as N)	SEQG, depends on pH and temperature. Example shown is based on pH=7.6 and Temperature= 15°C
Ammonia (un-ionized)	16	µg/L (as N)	SEQG for surface water – aquatic life
Chloride	120	mg/L	SEQG for surface water – aquatic life
Fluoride	1.0	mg/L	SEQG for livestock watering
Nitrate (as N)	3.0	mg/L	SEQG for surface water – aquatic life
Potassium	-	-	No guideline available
Sulphate	128-429	mg/L	SEQG for surface water – aquatic life: 128 mg/L for hardness 0 – 30 mg/L; 218 mg/L for hardness 31 – 75 mg/L; 309 mg/L for hardness 76 – 180 mg/L; 429 mg/L for hardness 181 – 250 mg/L; Site specific for hardness >250 mg/L
Total dissolved solids	500	mg/L	SEQG for drinking water
Metals			
Aluminum	0.002-0.8	mg/L	$BC: 0.001 * \left(\frac{\exp([0.645 \times \ln(DOC)] + [2.255 \times \ln(hardness)]) + [1.995 \times pH] + [-0.284 \times (\ln(hardness) \times pH)] - 9.898}{3} \right)$
Arsenic	5	µg/L	SEQG for surface water – aquatic life
Cadmium	0.04-0.37	µg/L	SEQG for surface water – aquatic life: $10^{(1.016(\log_{10}(hardness)-1.71))}$ where hardness ≥5.3 mg/L and ≤360 mg/L;
Chromium	8.9	µg/L	SEQG for surface water – aquatic life based on trivalent chromium
Cobalt	0.78-1.8	µg/L	FEQG: $e^{(0.414 \times (\ln(Hardness)) - 1.887)}$
Copper	7	µg/L	SEQG for surface water – aquatic life
Iron	300	µg/L	SEQG for surface water – aquatic life
Lead	1-7	µg/L	SEQG: 1 µg/L where hardness is 0 – 60 mg/L; equation: $e^{(1.273[\ln(hardness)] - 4.705)}$ where hardness is >65 and ≤ 180 mg/L; 7 µg/L where hardness is > 180 – 400 mg/L
Molybdenum	500	µg/L	SEQG for livestock watering
Nickel	4-170	µg/L	SEQG for surface water – aquatic life: $e^{(0.846[\ln(hardness)] + 0.0584)}$
Selenium	2	µg/L	SEQG for surface water – aquatic life
Silver	0.1	µg/L	SEQG for surface water – aquatic life
Thallium	0.80	µg/L	Alberta PAL
Uranium	15	µg/L	SEQG for surface water – aquatic life
Zinc	30	µg/L	SEQG for surface water – aquatic life
Radionuclides			
Lead-210	0.2	Bq/L	Health Canada for drinking water
Polonium-210	0.1	Bq/L	Health Canada for drinking water
Radium-226	0.11	Bq/L	SEQG for drinking water
Thorium-230	0.6	Bq/L	Health Canada for drinking water

Note:

Alberta PAL – Alberta surface water guidelines for the protection freshwater of aquatic life (ESRD 2014)

BC - British Columbia Environmental Quality Guideline (B.C. EQG) (B.C. WLRs 2025).

HC – Health Canada drinking water guideline (HC 2024)

SEQG – Saskatchewan Environmental Quality Guidelines (ENV 2025)

FEQG – Federal Environmental Quality Guidelines (GC 2024)

TDS is a composite parameter that includes dissolved ions in water, such as calcium, magnesium, potassium, and sodium, as well as carbonates, bicarbonates, chlorides, and sulphate.

Table 3.4-2 Sediment Quality Toxicity Benchmarks

Constituent	CCME 1999		Thompson et al. 2005		Liber et al. 2011		Burnett-Seidel and Liber 2013	
	TEL	PEL	LEL	SEL	NOEC	IC ₂₅	REF	NE2
µg/g dry weight								
Arsenic	5.9	17	9.8	346	-	174	20.8	522
Cadmium	0.6	3.5	-	-	-	-		
Chromium	37.3	90	47.6	115.4	-	-	29.9 ^a	26.0
Cobalt	-	-	-	-	-	-	-	-
Copper	35.7	197	22	269	-	-	-	-
Lead	35	91.3	37	412	-	-	-	-
Molybdenum	-	-	13.8	1,238	3,589	-	22.6	245
Nickel	-	-	23	484	-	189	21.4	326
Selenium	-	-	1.9	16.1	-	-	3.6	29.7
Silver	-	-	-	-	-	-	-	-
Thallium	-	-	-	-	-	-	-	-
Uranium	-	-	104	5,874	-	964	96.7	2,296
Zinc	123	315	-	-	-	-	-	-
Bq/g dry weight								
Lead-210	-	-	0.9	21	-	-	-	-
Polonium-210	-	-	0.8	12	-	-	-	-
Radium-226	-	-	0.6	14.4	-	-	-	-
Thorium-230	-	-	-	-	-	-	-	-

Note: All concentrations in dry weight. TEL= threshold effects level; PEL = probable effect level; LEL = lowest effect level; SEL = severe effect level; NOEC = no observed effect concentration; REF = reference sediment; IC₂₅ = Inhibitory concentration that effects growth in 25% of the population; NE2 = no effect 2 value; - = no data available.

^a Note that REF is slightly higher than NE2

Table 3.5-1 Predicted Maximum Mean and Maximum 95th Percentile Values Water Quality

Constituent	Water Quality Guideline ^a	Sink Reservoir															
		1991 EIS		1995 EIS		Caribou 24/24		Midwest 2011		2012 McClean TID		2016 McClean TID Base Case		2018 Se RA		2025 McClean TID Base Case	
		Max Mean	95 th *	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Mean	95 th	Max Mean	95 th	Max Mean	95 th
General Chemistry																	
Ammonia Total (mg/L- N)	1.46 ^b	5.3	6.7	7.3	8.5	8.8	14.9	9.24	15.6	10.4	15.8	7.5 ^d	10.9 ^d	-	-	6.9 ^d	9.6 ^d
Chloride (mg/L)	120	-	-	-	-	37.5	43.9	39.4	46.0	71.6	107	1,209	1,421	-	-	338	412
Fluoride (mg/L)	1.0	-	-	-	-	-	-	-	-	-	-	0.67	0.75	-	-	1.0	1.3
Nitrate (mg/L- N)	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	16
Potassium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	181	230	-	-	34	40
Sulphate (mg/L)	429 ^b	1,590	1,828	1,440	1,665	835	1,020	877	1,070	1,120	1,430	3,098	3,753	-	-	1,771	2,161
TDS (mg/L)	500	2,250	2,614	2,005	2,395	964	1,540	1,010	1,670	1,660	2,140	6,446	8,062	-	-	3,601	4,377
Metals																	
Aluminum (mg/L)	0.12 ^b	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.76	1.0
Arsenic (µg/L)	5	88	158	81	132	12.1	31.5	12.4	30.9	12.3	21.3	12.4	20.4	-	-	18.0	34.0
Cadmium (µg/L)	0.37 ^b	6.5	9.3	7	9	-	-	-	-	-	-	-	-	-	-	0.035	0.053
Chromium (µg/L)	8.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0	3.9
Cobalt (µg/L)	2.0 ^b	-	-	-	-	2.0	3.9	2.1	4.2	1.6	2.2	4.8	9.6	-	-	5.8	8.6
Copper (µg/L)	7	55	75	51	71	2.5	4.4	2.4	4.4	1.7	2.6	5.1	10.2	-	-	3.9	6.8
Iron (µg/L)	300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	122	300
Lead (µg/L)	7 ^b	14	26	15	25	1.6	3.3	1.56	3.2	1.3	1.6	1.0	2.8	-	-	1.2	2.0
Molybdenum (µg/L)	500	3,570	4,730	3,360	4,462	188	407	182	390	125	191	143	260	-	-	106	272
Nickel (µg/L)	170 ^b	121	161	123	160	19.1	37.5	19.7	37.5	21.3	56.9	37.6	68.3	-	-	83	126
Selenium (µg/L)	2	19	31.6	19	30	2.2	4.4	2.32	4.75	2.3	5.0	53.0	90.7	5.3	6.4	10	19
Silver (µg/L)	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.34	0.61
Thallium (µg/L)	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.4	3.1
Uranium (µg/L)	15	542	792	582	887	15.7	49.2	17.0	53.6	8.7	22.2	25.3	91.7	-	-	3.4	7.9
Zinc (µg/L)	30	84	108	88	112	5.6	7.5	6.1	8.7	6.8	9.1	7.6	20.4	-	-	5.5	8.5
Radionuclides																	
Lead-210 (Bq/L)	0.2	0.33	0.6	0.11	0.21	0.03	0.05	0.04	0.05	0.02	0.03	0.03	0.05	-	-	0.06	0.08
Polonium-210 (Bq/L)	0.1	-	-	-	-	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.04	-	-	0.02	0.05
Radium-226 (Bq/L)	0.11	0.09	0.2	0.09	0.13	0.01	0.02	0.01	0.02	0.02	0.04	0.02	0.04	-	-	0.03	0.04
Thorium-230 (Bq/L)	0.6	0.04	0.1	0.03	0.62	0.01	0.02	0.02	0.03	0.02	0.03	0.02	0.04	-	-	0.03	0.03

Note: Mean/95th Percentile. Shaded cells denote highest maximum mean value (except for new parameters). Predictions that exceed the guideline are shown in bold.

^aUpper 95th = Mean +2x Standard Deviation

^b See Table 3.4-1

^c Guideline depends on water chemistry. In Sink Reservoir and Vulture Lake the hardness is taken to be greater than 180 mg/L; in McClean Lake the hardness is taken to be 80 mg/L and downstream the hardness is less than 60 mg/L. Assumed pH of 7.6 and temperature of 15°C.

^d Guideline not available or predicted concentration not available.

^e Assessed as un-ionized ammonia, totals presented for comparison.

TDS is a composite parameter that includes dissolved ions in water, such as calcium, magnesium, potassium, and sodium, as well as carbonates, bicarbonates, chlorides, and sulphate.

Constituent	Water Quality Guideline ^a	Vulture Lake															
		1991 EIS		1995 EIS		Caribou 24/24		Midwest 2011		2012 McClean TID		2016 McClean TID Base Case		2018 Se RA		2025 McClean TID Base Case	
		Max Mean	95 th *	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th
General Chemistry																	
Total Ammonia (mg/L- N)	1.46 ^b	4.8	5.7	6.0	6.5	6.3	8.4	6.8	9.1	7.5	9.7	2.8 ^d	4.1 ^d	-	-	1.9 ^d	2.5 ^d
Chloride (mg/L)	120	-	-	-	-	27.4	31	29.6	33.1	63.7	79.7	834	934	-	-	182	209
Fluoride (mg/L)	1.0	-	-	-	-	-	-	-	-	-	-	0.44	0.49	-	-	0.61	0.72
Nitrate (mg/L- N)	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.1	8.1
Potassium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	126	151	-	-	19	21
Sulphate (mg/L)	429 ^b	1,156	1,306	1,244	1,342	607	699	656	755	812	934	2,200	2,495	-	-	1,102	1,260
TDS (mg/L)	500	1,695	1,955	1,770	1,977	678	855	733	932	1,200	1,410	4,593	5,357	-	-	2,169	2,411
Metals																	
Aluminum (mg/L)	0.2 ^b	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.46	0.55
Arsenic (µg/L)	5	51	103	42	81	6.3	12.7	6.4	12.5	7.2	12.8	6.4	10.4	-	-	7.8	14
Cadmium (µg/L)	0.37	4.5	7.5	4	6	-	-	-	-	-	-	-	-	-	-	0.023	0.034
Chromium (µg/L)	8.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.85	1.3
Cobalt (µg/L)	2.0 ^b	-	-	-	-	1.4	1.9	1.5	1.9	1.4	1.8	1.2	2.1	-	-	1.1	1.8
Copper (µg/L)	7	36	58	29	43	2.2	2.7	2.2	2.5	1.3	1.9	3.2	4.3	-	-	1.6	2.5
Iron (µg/L)	300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	61	126
Lead (µg/L)	7 ^b	7.4	15.4	8	16	1.3	1.6	1.2	1.5	1.1	1.3	0.44	0.80	-	-	0.41	0.61
Molybdenum (µg/L)	500	2,620	3,900	1,990	2,770	163	330	163	330	77	110	71.9	103	-	-	37	72
Nickel (µg/L)	170 ^b	94	134	76	97	12.5	19.3	13	19.9	13.4	28.2	19.8	28.6	-	-	27	41
Selenium (µg/L)	2	12.4	25	10	18	1.6	2.2	1.7	2.3	1.2	2.4	23.7	33.5	2.9	3.4	4.1	5.8
Silver	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.20	0.28
Thallium	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.39	0.76
Uranium (µg/L)	15	332	564	316	519	6.4	18.7	7.0	20.2	4.5	9.8	8.4	25.7	-	-	0.64	1.3
Zinc (µg/L)	30	58	86	55	69	5.1	5.4	5.5	6.4	5.8	7.4	6.2	11.2	-	-	2.1	3.1
Radionuclides																	
Lead-210 (Bq/L)	0.2	0.18	0.4	0.06	0.14	0.029	0.034	0.03	0.04	0.02	0.03	0.02	0.03	-	-	0.02	0.03
Polonium-210 (Bq/L)	0.1	-	-	-	-	0.006	0.007	0.006	0.01	0.01	0.01	0.02	0.02	-	-	0.010	0.016
Radium-226 (Bq/L)	0.11	0.06	0.1	0.05	0.08	0.006	0.01	0.006	0.01	0.01	0.02	0.02	0.02	-	-	0.01	0.02
Thorium-230 (Bq/L)	0.6	0.02	0.03	0.02	0.03	0.01	0.012	0.01	0.01	0.01	0.02	0.01	0.02	-	-	0.01	0.02

Note: Mean/95th Percentile. Shaded cells denote highest maximum mean value (except for new parameters). Predictions that exceed the stated guideline are shown in bold.

^aUpper 95th = Mean +2x Standard Deviation

^a See Table 3.4-1

^b Guideline depends on water chemistry. In Sink Reservoir and Vulture Lake the hardness is taken to be greater than 180 mg/L; in McClean Lake the hardness is taken to be 80 mg/L and downstream the hardness is less than 60 mg/L. Assumed pH of 7.6 and temperature of 15°C.

^c - = guideline not available or predicted concentration not available.

^d Assessed as un-ionized ammonia, totals presented for comparison.

TDS is a composite parameter that includes dissolved ions in water, such as calcium, magnesium, potassium, and sodium, as well as carbonates, bicarbonates, chlorides, and sulphate.

Constituent	Water Quality Guideline ^a	McClellan Lake East Basin – Segment B															
		1991 EIS		1995 EIS		Caribou 24/24		Midwest 2011		2012 McClellan TID		2016 McClellan TID Base Case		2018 Se RA		2025 McClellan TID Base Case	
		Max Mean	95 th *	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th
General Chemistry																	
Total Ammonia (mg/L- N)	1.54 ^b	0.91	1.1	0.94	1.1	0.73	1.1	0.94	1.4	0.84	1.2	0.56 ^d	0.83 ^d	-	-	0.35 ^d	0.47 ^d
Chloride (mg/L)	120	-	-	-	-	3.8	4.6	4.7	5.7	11.3	14.6	73.9	103	-	-	27	45
Fluoride (mg/L)	1.0	-	-	-	-	-	-	-	-	-	-	0.11	0.13	-	-	0.12	0.18
Nitrate (mg/L- N)	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.84	1.4
Potassium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	11.4	15.7	-	-	3.1	4.7
Sulphate (mg/L)	218 ^b	177	195.6	170	197	59.4	80	74.6	94.0	83.5	112	195	271	-	-	142	256
TDS (mg/L)	500	282	326	264	305	80	110	99.6	139	136	181	408	563	-	-	317	544
Metals																	
Aluminum (mg/L)	0.12 ^b	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.070	0.11
Arsenic (µg/L)	5	6	14	5	11	1.4	2.5	2.2	3.6	1.2	1.8	1.6	2.3	-	-	1.3	2.5
Cadmium (µg/L)	0.13	1	1.5	0.9	1.2	-	-	-	-	-	-	-	-	-	-	0.011	0.012
Chromium (µg/L)	8.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.54	0.59
Cobalt (µg/L)	0.93 ^b	-	-	-	-	1.1	1.2	1.1	1.2	1.1	1.1	0.39	0.62	-	-	0.22	0.39
Copper (µg/L)	7	7.7	11.7	0.6	10	2.0	2.1	2.0	2.1	0.68	0.76	0.58	0.90	-	-	0.33	0.49
Iron (µg/L)	300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	227	275
Lead (µg/L)	2.4 ^b	3.5	11.5	3	12	1.0	1.1	1.0	1.1	1.0	1.0	0.16	0.23	-	-	0.10	0.13
Molybdenum (µg/L)	500	390	610	270	423	30.9	64.1	38.2	69.2	16.6	22.1	14.8	22.5	-	-	5.6	10
Nickel (µg/L)	43 ^b	15	21	12	16	2.7	3.8	3.5	5.2	3.4	5.5	2.8	4.2	-	-	3.5	5.7
Selenium (µg/L)	2	1.9	4.1	2.0	3	0.42	0.53	0.5	0.7	0.23	0.36	3.2	5.5	0.28	0.35	0.49	0.79
Silver	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.046	0.063
Thallium	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.099	0.15
Uranium (µg/L)	15	43.5	83.7	40.2	72.2	1.2	3.1	1.9	4.4	1.1	1.9	1.5	3.6	-	-	0.13	0.26
Zinc (µg/L)	30	12	18	12	17	5.0	5.1	5.1	5.4	5.1	5.3	2.5	3.8	-	-	1.1	1.2
Radionuclides																	
Lead-210 (Bq/L)	0.2	0.05	0.1	0.04	0.13	0.027	0.028	0.03	0.03	0.013	0.015	0.012	0.014	-	-	0.011	0.012
Polonium-210 (Bq/L)	0.1	-	-	-	-	0.005	0.005	0.005	0.006	0.005	0.006	0.006	0.008	-	-	0.004	0.005
Radium-226 (Bq/L)	0.11	0.01	0.02	0.009	0.014	0.003	0.004	0.004	0.005	0.004	0.005	0.004	0.005	-	-	0.006	0.006
Thorium-230 (Bq/L)	0.6	0.01	0.02	0.011	0.024	0.006	0.006	0.007	0.008	0.007	0.008	0.003	0.005	-	-	0.003	0.003

Note: Mean/95th Percentile. Shaded cells denote highest maximum mean value (except for new parameters). Predictions that exceed the stated guideline are shown in bold.

^aUpper 95th = Mean +2x Standard Deviation

^a See Table 3.4-1

^b Guideline depends on water chemistry. In Sink Reservoir and Vulture Lake the hardness is taken to be greater than 180 mg/L; in McClellan Lake the hardness is taken to be 80 mg/L and downstream the hardness is less than 60 mg/L. Assumed pH of 7.4 and temperature of 20°C.

^c - = guideline not available or predicted concentration not available.

^d Assessed as un-ionized ammonia, totals presented for comparison.

TDS is a composite parameter that includes dissolved ions in water, such as calcium, magnesium, potassium, and sodium, as well as carbonates, bicarbonates, chlorides, and sulphate.

Constituent	Water Quality Guideline ^a	Collins Creek at Kewen Lake															
		1991 EIS		1995 EIS		Caribou 24/24		Midwest 2011		2012 McClean TID		2016 McClean TID Base Case		2018 Se RA		2025 McClean TID Base Case	
		Max Mean	95 th *	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th
General Chemistry																	
Total Ammonia (mg/L- N)	1.54 ^b	0.47	0.6	0.20	-	0.41	0.62	0.56	0.84	0.51	0.73	0.34 ^d	0.51 ^d	-	-	0.20 ^d	0.27 ^d
Chloride (mg/L)	120	-	-	1.1	-	2.2	2.6	2.9	3.5	6.7	8.7	36.9	52.1	-	-	15	24
Fluoride (mg/L)	1.0	-	-	-	-	-	-	-	-	-	-	0.09	0.10	-	-	0.080	0.12
Nitrate (mg/L- N)	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.46	0.76
Potassium (mg/L)	-	-	-	-	-	-	-	-	-	-	-	5.9	8.2	-	-	1.8	2.7
Sulphate (mg/L)	218 ^b	72	81	14.3	-	31.9	42.8	43.5	55.9	48.5	64.3	97.0	137.4	-	-	76	138
TDS (mg/L)	500	129	149	25.8	-	43.9	60.3	59.1	82.8	80.1	108	204	286	-	-	182	305
Metals																	
Aluminum (mg/L)	0.05 ^b	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.042	0.064
Arsenic (µg/L)	5	3.0	7.0	0.87	-	0.97	1.6	1.5	2.4	0.89	1.2	1.2	1.6	-	-	0.80	1.5
Cadmium (µg/L)	0.06	0.7	0.9	-	-	-	-	-	-	-	-	-	-	-	-	0.010	0.011
Chromium (µg/L)	8.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.52	0.55
Cobalt (µg/L)	0.78 ^b	-	-	1.0	-	1.0	1.1	1.1	1.2	1.0	1.1	0.27	0.40	-	-	0.14	0.24
Copper (µg/L)	7	5.0	8.4	2.0	-	2.0	2.1	2.02	2.05	0.60	0.65	0.38	0.58	-	-	0.22	0.31
Iron (µg/L)	300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	264	287
Lead (µg/L)	1 ^b	3.5	11.5	1.0	-	1.02	1.04	1.02	1.06	1.0	1.1	0.13	0.17	-	-	0.076	0.097
Molybdenum (µg/L)	500	180	300	39.7	-	16.7	34.3	22.5	40.8	9.9	13.1	8.9	13.7	-	-	3.0	5.8
Nickel (µg/L)	19 ^b	8.0	11.2	1.3	-	1.9	2.5	2.47	3.49	2.3	3.5	1.6	2.6	-	-	1.9	3.2
Selenium (µg/L)	2	1.0	1.8	0.26	-	0.31	0.37	0.38	0.47	0.15	0.22	1.8	3.3	0.15	0.2	0.26	0.43
Silver	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.036	0.047
Thallium	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.076	0.11
Uranium (µg/L)	15	19	37.4	0.46	-	0.74	1.75	1.20	2.70	0.70	1.1	0.87	2.1	-	-	0.093	0.17
Zinc (µg/L)	30	8.0	14.0	5.0	-	5.01	5.03	5.1	5.3	5.1	5.2	1.8	2.6	-	-	1.1	1.1
Radionuclides																	
Lead-210 (Bq/L)	0.2	0.037	-	0.027	-	0.027	0.028	0.03	0.03	0.012	0.013	0.011	0.013	-	-	0.011	0.011
Polonium-210 (Bq/L)	0.1	-	-	0.005	-	0.005	0.005	0.005	0.006	0.004	0.005	0.005	0.006	-	-	0.003	0.004
Radium-226 (Bq/L)	0.11	0.006	0.01	0.004	-	0.003	0.004	0.004	0.004	0.003	0.004	0.003	0.004	-	-	0.005	0.006
Thorium-230 (Bq/L)	0.6	0.011	0.02	0.005	-	0.005	0.006	0.006	0.007	0.006	0.007	0.002	0.003	-	-	0.002	0.002

Note: Mean/95th Percentile. Shaded cells denote highest maximum mean value (except for new parameters). Predictions that exceed the stated guideline are shown in bold.

*Upper 95th = Mean +2x Standard Deviation

^a See Table 3.4-1

^b Guideline depends on water chemistry. In Sink Reservoir and Vulture Lake the hardness is taken to be greater than 180 mg/L; in McClean Lake the hardness is taken to be 80 mg/L and downstream the hardness is less than 60 mg/L. Assumed pH of 7.4 and temperature of 20°C.

^c - = guideline not available or predicted concentration not available.

^d Assessed as un-ionized ammonia, totals presented for comparison.

TDS is a composite parameter that includes dissolved ions in water, such as calcium, magnesium, potassium, and sodium, as well as carbonates, bicarbonates, chlorides, and sulphate.

Table 3.5-2 Predicted Maximum Mean and Maximum 95th Percentile Values Sediment Quality

Constituent	LEL or TEL	SEL or PEL	Sink Reservoir													
			1991 EIS	1995 EIS	Caribou 24/24		Midwest 2011		2012 McClean TID		2016 McClean TID Base Case		2018 Se RA		2025 McClean TID Base Case	
			Max Mean	Max Mean	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th
Metals																
Arsenic (µg/g)	9.8	346	700	410	307	637	317	679	93	123	78	126	-	-	168	219
Cadmium (µg/g)	0.6	3.5	-	17	-	-	-	-	-	-	-	-	-	-	0.50	1.1
Chromium (µg/g)	37.3	90	-	-	-	-	-	-	-	-	-	-	-	-	13	17
Cobalt (µg/g)	-	-	-	-	29.9	55.8	32.1	61.5	17.3	30.9	20	37	-	-	34	61
Copper (µg/g)	22	269	-	172	18.3	39.7	17	36.3	11.2	17.2	34	62	-	-	22	33
Lead (µg/g)	37	412	-	139	23	37.5	20.7	32.8	11.6	15.1	14	22	-	-	12	17
Molybdenum (µg/g)	13.8	1,238	-	-	4,890	13,300	4,890	13,300	619	878	377	790	-	-	912	1,727
Nickel (µg/g)	23	484	250	148	216	418	220	428	74	113	94	156	-	-	270	427
Selenium (µg/g)	1.9	16.1	-	-	19.9	53.6	21	56.3	9.5	14.6	124	197	11.4	17.0	20	28
Silver (µg/g)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.11	0.23
Thallium (µg/g)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	7.1
Uranium (µg/g)	104	5,874	-	-	516	1,048	560	1,208	80	94	75	132	-	-	28	43
Zinc (µg/g)	123	315	260	140	119	256	137	295	93	115	27	42	-	-	69	117
Radionuclides																
Lead-210 (Bq/g)	0.9	21	-	-	1.0	1.33	1.1	2.1	0.69	0.94	0.30	0.48	-	-	0.45	0.81
Polonium-210 (Bq/g)	0.8	12	-	-	1.2	1.80	1.4	2.1	0.50	0.65	0.59	1.4	-	-	0.59	1.1
Radium-226 (Bq/g)	0.6	14.4	0.80	0.49	0.98	1.33	0.9	1.3	0.08	0.16	0.12	0.20	-	-	0.23	0.42
Thorium-230 (Bq/q)	-	-	-	-	0.20	0.30	0.21	0.32	0.06	0.12	0.06	0.10	-	-	0.06	0.11

Note – Mean/95th Percentile predictions. Numbers in bold exceed the LEL or TEL. Numbers in bold and underlined exceed the SEL or PEL. Shaded cells denote the highest maximum mean values (except for new parameters).

Definition of units: µg/g = micrograms per gram dry weight; Bq/g = Becquerels per gram dry weight.

Sediment quality benchmarks based on Thompson et al. (2005) except for cadmium, chromium, and zinc which is based on CCME (1999 and updates)).

LEL = Lowest Effect Level;

SEL = Severe Effect Level; (Thompson et al. 2005)

TEL = Threshold Effect Level ;

PEL = Probable Effect Level; (CCME 1999 and updates)

Constituent	LEL or TEL	SEL or PEL	Vulture Lake													
			1991 EIS	1995 EIS	Caribou 24/24		Midwest 2011		2012 McClean TID		2016 McClean TID Base Case		2018 Se RA		2025 McClean TID Base Case	
			Max Mean	Max Mean	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th
Metals																
Arsenic (µg/g)	9.8	346	300	184	85.5	171	88.4	193	51	56	31	55	-	-	54	119
Cadmium (µg/g)	0.6	3.5		10	-	-	-	-	-	-	-	-	-	-	0.6	1.3
Chromium (µg/g)	37.3	90	-	-	-	-	-	-	-	-	-	-	-	-	8.9	9.9
Cobalt (µg/g)	-	-	-	-	11.8	24.3	12.6	25.5	8.6	10.6	19	26	-	-	28	40
Copper (µg/g)	22	269	-	91	12.9	29.7	12.5	29.3	7.63	10.1	8	11	-	-	14	27
Lead (µg/g)	37	412	-	67	10.9	18	10	16.8	8.9	9.6	8	11	-	-	6.8	9.7
Molybdenum (µg/g)	13.8	1,238	-	-	1,240	3,300	1,240	3,230	629	691	444	780	-	-	414	766
Nickel (µg/g)	23	484	150	96	90.6	131	93.2	135	52	65	93	160	-	-	213	396
Selenium (µg/g)	1.9	16.1	-	-	2.8	7	3.0	7.4	5.4	6.4	54	86	5.8	8.6	10	16
Silver (µg/g)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.082	0.16
Thallium (µg/g)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.1	3.8
Uranium (µg/g)	104	5,874	-	-	110	252	124.8	284	33	46	45	69	-	-	12	17
Zinc (µg/g)	123	315	155	92	84.5	224	91.4	228	46	55	27	46	-	-	73	138
Radionuclides																
Lead-210 (Bq/g)	0.9	21	-	-	0.53	1.6	0.55	1.60	0.42	0.46	0.22	0.34	-	-	0.36	0.65
Polonium-210 (Bq/g)	0.8	12	-	-	0.30	0.80	0.34	0.90	0.29	0.31	0.32	0.62	-	-	0.51	0.99
Radium-226 (Bq/g)	0.6	14.4	0.35	0.21	0.13	0.24	0.14	0.26	0.06	0.08	0.09	0.17	-	-	0.16	0.29
Thorium-230 (Bq/g)	-	-	-	-	0.08	0.10	0.08	0.12	0.04	0.07	0.04	0.06	-	-	0.04	0.06

Note – Mean/95th Percentile predictions. Numbers in bold exceed the LEL or TEL Numbers in bold and underlined exceed the SEL or PEL. Shaded cells denote the highest maximum mean values (except for new parameters).

Definition of units: µg/g = micrograms per gram dry weight; Bq/g = Becquerels per gram dry weight.

Sediment quality benchmarks based on Thompson et al. (2005) expect for cadmium, chromium, and zinc which is based on CCME (1999 and updates).

LEL = Lowest Effect Level;

SEL = Severe Effect Level; (Thompson et al. 2005)

TEL = Threshold Effect Level ;

PEL = Probable Effect Level; (CCME 1999 and updates)

Constituent	LEL or TEL	SEL or PEL	McClellan Lake East Basin – Segment B													
			1991 EIS	1995 EIS	Caribou 24/24		Midwest 2011		2012 McClellan TID		2016 McClellan TID Base Case		2018 Se RA		2025 McClellan TID Base Case	
			Max Mean	Max Mean	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th
Metals																
Arsenic (µg/g)	9.8	346	32	22	6.5	15.7	8.3	17.9	43.8	70.8	15	36	-		20	52
Cadmium (µg/g)	0.6	3.5	-	4	-	-	-	-	-	-	-	-	-		0.3	0.4
Chromium (µg/g)	37.3	90	-	-	-	-	-	-	-	-	-	-	-		21	23
Cobalt (µg/g)	-	-	-	-	6.7	18.6	6.8	18.7	4.3	7.2	3.7	6.8	-		7.7	12.0
Copper (µg/g)	22	269	-	25	10.7	26.7	10.7	26.7	5.8	6.7	5	6	-		5.3	10.0
Lead (µg/g)	37	412	-	47	6.8	13.3	6.8	13.3	7.5	7.9	7	11	-		5.7	8.5
Molybdenum (µg/g)	13.8	1,238	-	-	57.3	117	64.7	140	175	308	100	240	-		57	154
Nickel (µg/g)	23	484	15	23	20.8	44.7	22.8	33	33	63.7	62	118	-		43	80
Selenium (µg/g)	1.9	16.1	-	-	0.5	1.3	0.5	1.4	5.2	11.5	18.3	42	2.4	4.2	2.4	4.2
Silver (µg/g)	-	-	-	-	-	-	-	-	-	-	-	-	-		0.15	0.20
Thallium (µg/g)	-	-	-	-	-	-	-	-	-	-	-	-	-		0.54	1.1
Uranium (µg/g)	104	5,874	-	-	10.2	35.7	12.4	37	9.7	20.8	12.2	24	-		3.4	6.2
Zinc (µg/g)	123	315	30	19	80.8	219	81.3	220	34.9	42.3	12	17	-		65	133
Radionuclides																
Lead-210 (Bq/g)	0.9	21	-	-	0.46	1.52	0.46	1.52	0.34	0.38	0.16	0.28	-		0.53	1.0
Polonium-210 (Bq/g)	0.8	12	-	-	0.24	0.75	0.24	0.75	0.23	0.25	0.24	0.48	-		0.63	1.1
Radium-226 (Bq/g)	0.6	14.4	0.05	0.04	0.04	0.12	0.04	0.12	0.04	0.05	0.03	0.05	-		0.07	0.15
Thorium-230 (Bq/g)	-	-	-	-	0.02	0.04	0.03	0.04	0.03	0.04	0.03	0.03	-		0.02	0.03

Note – Mean/95th Percentile predictions. Numbers in bold exceed the LEL or TEL. Numbers in bold and underlined exceed the SEL or PEL. Shaded cells denote the highest maximum mean values (except for new parameters).

Definition of units: µg/g = micrograms per gram dry weight; Bq/g = Becquerels per gram dry weight.

Sediment quality benchmarks based on Thompson et al. (2005) expect for cadmium, chromium, and zinc which is based on CCME (1999 and updates).

LEL = Lowest Effect Level;

SEL = Severe Effect Level; (Thompson et al. 2005)

TEL = Threshold Effect Level ;

PEL = Probable Effect Level; (CCME 1999 and updates)

Constituent	LEL or TEL	SEL or PEL	Kewen Lane													
			1991 EIS	1995 EIS	Caribou 24/24		Midwest 2011		2012 McClean TID		2016 McClean TID Base Case		2018 Se RA		2025 McClean TID Base Case	
			Max Mean	Max Mean	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th	Max Mean	95 th
Metals																
Arsenic (µg/g)	9.8	346	-	-	4.9	13.7	5.6	15	7.9	13.9	4.4	7.7	-	-	2.7	4.8
Cadmium (µg/g)	0.6	3.5	-	-	-	-	-	-	-	-	-	-	-	-	0.28	0.38
Chromium (µg/g)	37.3	90	-	-	-	-	-	-	-	-	-	-	-	-	13	17
Cobalt (µg/g)	-	-	-	-	6.6	18.5	6.7	18.6	3.0	3.7	2.1	3.1	-	-	3.7	4.6
Copper (µg/g)	22	269	-	-	10.7	26.7	10.7	26.7	5.7	6.5	5.0	5.3	-	-	1.3	1.8
Lead (µg/g)	37	412	-	-	6.7	13.2	6.7	13.2	6.6	6.7	6.6	8.6	-	-	2.8	4.7
Molybdenum (µg/g)	13.8	1,238	-	-	27.2	61.4	30.8	74.9	156	209	17.4	37.8	-	-	8.5	22
Nickel (µg/g)	23	484	-	-	13.7	29.5	14.4	28.1	14	21.5	13.1	19.7	-	-	7.0	11
Selenium (µg/g)	1.9	16.1	-	-	0.38	1.1	0.41	1.2	1.5	2.0	3.1	5.0	0.85	1.1	0.61	0.80
Silver (µg/g)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.15	0.19
Thallium (µg/g)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.51	1.0
Uranium (µg/g)	104	5,874	-	-	8.6	35.2	9.4	35.6	4.6	8.2	3.4	7.1	-	-	1.5	2.9
Zinc (µg/g)	123	315	-	-	80.8	219	80.9	219	31.8	32.8	19.4	29.2	-	-	38	66
Radionuclides																
Lead-210 (Bq/g)	0.9	21	-	-	0.46	1.52	0.46	1.52	0.32	0.34	0.14	0.23	-	-	0.14	0.27
Polonium-210 (Bq/g)	0.8	12	-	-	0.24	0.75	0.24	0.75	0.23	0.23	0.18	0.36	-	-	0.16	0.32
Radium-226 (Bq/g)	0.6	14.4	-	-	0.04	0.12	0.04	0.12	0.04	0.04	0.02	0.03	-	-	0.052	0.10
Thorium-230 (Bq/g)	-	-	-	-	0.02	0.04	0.02	0.04	0.03	0.04	0.02	0.03	-	-	0.021	0.024

Note – Mean/95th Percentile predictions. Numbers in bold exceed the LEL or TEL. Numbers in bold and underlined exceed the SEL or PEL. Shaded cells denote the highest maximum mean values (except for new parameters).

Definition of units: µg/g = micrograms per gram dry weight; Bq/g = Becquerels per gram dry weight.

Sediment quality benchmarks based on Thompson et al. (2005) expect for cadmium, chromium, and zinc which is based on CCME (1999 and updates).

LEL = Lowest Effect Level;

SEL = Severe Effect Level; (Thompson et al. 2005)

TEL = Threshold Effect Level ;

PEL = Probable Effect Level; (CCME 1999 and updates)

Table 3.7-1 Spatial Trends of Maximum Mean Water Quality Predictions to Guidelines

Constituent	Water Quality Guidelines ^a	Sink Reservoir	Vulture Lake	McClellan Lake East Basin - B	Collins Creek at Keweenaw Lake
General Chemistry					
Un-ionized Ammonia (mg/L-N)	16				
Chloride (mg/L)	120				
Fluoride (mg/L)	1.0 ^c				
Nitrate (mg/L as N)	3.0				
Potassium (mg/L)	-				
Sulphate (mg/L)	128-429 ^d				
TDS (mg/L)	500				
Metals					
Aluminum (mg/L)	0.009-1.8 ^b				
Arsenic (µg/L)	5				
Cadmium (µg/L)	0.04-0.37 ^d				
Chromium (µg/L) ^e	8.9				
Cobalt (µg/L)	0.78-1.8 ^d				
Copper (µg/L)	7				
Iron (µg/L)	300				
Lead (µg/L)	1 - 7 ^d				
Molybdenum (µg/L)	500 ^c				
Nickel (µg/L)	25 - 150 ^d				
Selenium (µg/L)	2				
Silver (µg/L)	0.1				
Thallium (µg/L)	0.8 ^f				
Uranium (µg/L)	15				
Zinc (µg/L)	30				
Radionuclides					
Lead-210 (Bq/L)	0.2				
Polonium-210 (Bq/L)	0.1				
Radium-226 (Bq/L)	0.11				
Thorium-230 (Bq/L)	0.6				

Note:  indicates future mean exceedance of WQG.  indicates no prolonged future mean exceedance of WQG.

 = Guideline not available.

Definition of units: mg/L = milligrams per litre; µg/L = micrograms per litre; Bq/L = Becquerels per litre.

^a See Table 3.4-1

TDS is a composite parameter that includes dissolved ions in water, such as calcium, magnesium, potassium, and sodium, as well as carbonates, bicarbonates, chlorides, and sulphate.

Table 3.7-2 Spatial Trends of Maximum Mean Sediment Quality Predictions to Guidelines

Constituent	LEL or TEL ^a	SEL or PEL ^a	Sink Reservoir	Vulture Lake	McClean Lake East Basin - B	Keweenaw Lake
Metals						
Arsenic (µg/g)	10	346				
Cadmium (µg/g)	0.6	3.5				
Chromium (µg/g)	37.3	90				
Cobalt (µg/g)	-	-				
Copper (µg/g)	22	269				
Lead (µg/g)	37	412				
Molybdenum (µg/g)	13.8	1,238				
Nickel (µg/g)	23	484				
Selenium (µg/g)	1.9	16.1				
Silver (µg/g)	-	-				
Thallium (µg/g)	-	-				
Uranium (µg/g)	104	5,874				
Zinc (µg/g)	123	315				
Radionuclides						
Lead-210 (Bq/g)	0.9	21				
Polonium-210 (Bq/g)	0.8	12				
Radium-226 (Bq/g)	0.6	14.4				
Thorium-230 (Bq/g)	-	-				

Note: indicates future mean exceedance of SEL/PEL . Indicates future mean exceedance of LEL/TEL only
 indicates no future mean exceedance of SQG. = Guideline not available.

^a See Table 3.4-2. Sediment quality benchmarks

LEL = Lowest Effect Level;

TEL = Threshold Effect Level ;

SEL = Severe Effect Level; (Thompson *et al.* 2005)

PEL = Probable Effect Level; (CCME 1999 and updates)

Table 4.2-1 List of Selected Valued Components

Environmental Components	Sub-Components	Relevant VCs	Rationale
Radiation and Radioactivity	Humans	Non-NEW workers Members of the Wollaston Lake Community Lodge Operators Trappers around Collins Creek	• Potentially exposed through ingestion and immersion pathways, as well as groundshine and radon
	Biological (Non-Human)	Populations of non-human biota	• Non-human biota present in the McClean Lake Operation area could potentially receive radiation doses
Surface Water Quality	S/V TEMS, McClean Lake, and Collins Creek to Wollaston Lake	Water and Sediment Quality	• Effluent discharges to the S/V TEMS has the potential to affect water quality in the receiving environment
Atmosphere	Terrestrial Vegetation	Terrestrial Vegetation	• Component of terrestrial food web • Consumed by other receptors • May be affected by project emissions
	Terrestrial Invertebrates	Terrestrial Invertebrates	• Component of terrestrial food web • Consumed by other receptors • May be affected by project emissions (through changes in soil quality)
	Humans	Non-NEW workers Members of the Wollaston Lake Community Lodge Operators Trappers around Collins Creek	• Potentially exposed through inhalation of particulate containing COPC, inhalation of radon, immersion in air, and exposure to NO_x, SO₂, and particulate matter
Aquatic Environment	Aquatic Biota	Forage Fish	• Component of aquatic food web (bottom feeder) • Consumed by other receptors • Sensitive to changes in aquatic environment • Biota may be affected by project effluent
		Predator Fish	• Component of aquatic food web (open water feeder) • Consumed by other receptors • Sensitive to changes in aquatic environment • Biota may be affected by project effluent
		Benthic Invertebrates	• Component of aquatic food web • Consumed by other receptors • Sensitive to changes in aquatic environment • Biota may be affected by project effluent
		Aquatic Plants	
		Amphibians	
		Phytoplankton and Zooplankton	• Sensitive to changes in aquatic environment • Biota may be affected by project effluent
	Wildlife	Aquatic Birds (mallard, scaup, merganser, yellowlegs)	• Rely on aquatic food web • Consumed by other receptors • Sensitive to changes in water and sediment quality • Biota may be affected by project effluent
		Aquatic-Based Mammals (beaver, muskrat, mink)	
Terrestrial Environment	Wildlife	Terrestrial Birds (blackbird, eagle, owl, ptarmigan)	• Sensitive to changes in air and water quality • Consumed by other receptors • Biota may be affected by project releases
		Terrestrial-Based Mammals (myotis, bear, caribou, fox, hare, lynx, moose, shrew, wolf)	• Sensitive to changes in air and water quality • Consumed by other receptors • Biota may be affected by project releases
	Humans	Non-NEW workers Members of the Wollaston Lake Community Lodge Operators Trappers around Collins Creek	• Potentially exposed through food, water, and air pathways

Table 4.4-1 Species at Risk for Consideration

Common Name	Scientific Name	COSEWIC Designation	Selected for Inclusion?	Comment
Birds				
Barn swallow	<i>Hirundo riparia</i>	Special Concern	N	Forage in open areas and over open water. Consume flies (majority of the diet), along with beetles, bees, wasps, ants, butterflies, moths, and other flying insects ^[1] . Represented by the rusty blackbird
Common nighthawk	<i>Chordeiles minor</i>	Special Concern	N	Almost exclusively consume flying insects ^[1] . Represented by the rusty blackbird
Lesser yellowlegs	<i>Tringa flavipes</i>	Threatened	Y	A shorebird. Eats primarily invertebrates gleaned from water or land, especially snails and flies, beetles, dragonflies of all life stages. Small fish and seeds are occasionally taken ^[1] .
Olive-sided flycatcher	<i>Contopus cooperi</i>	Special Concern	N	Breed in boreal forests. Prefer openings or edges in the forest. Consume flying insects including flying ants, wasps, bees, dragonflies, grasshoppers, beetles, moths and flies ^[1] . Represented by the rusty blackbird
Rusty Blackbird	<i>Euphagus carolinus</i>	Special Concern	Y	Breeds in wet forest environments. In summer consumed mostly insects ^[1] . The rusty blackbird has been observed within the local assessment boundary negative (Volume 1 of 2025 EP TID).
Snowy Owl	<i>Bubo scandiacus</i>	Threatened		Breeds in tundra habitats, irruptive medium- to long-distance migrant. Prefers wide-open spaces to hunt. Eats mainly small mammals. ^[1]
Mammals				
Barren-ground caribou	<i>Rangifer tarandus groenlandicus</i>	Threatened	N	Barren ground caribou spend most of their time in the tundra, but can seasonally migrate into northern Saskatchewan. Their main source of food is lichen. Represented by the woodland caribou
Eastern red bat	<i>Lasiurus borealis</i>	Endangered	N	Migrator. Hunt most often in open habitats or along habitat edges and within canopy gaps in forested landscapes. Obligate insectivores that prey on aerial insects. ^[2] Represented by the little brown myotis.
Hoary bat	<i>Lasiurus cinereus</i>	Endangered	N	Migrator. Hunt most often in open habitats or along habitat edges and within canopy gaps in forested landscapes. Obligate insectivores that prey on aerial insects. ^[2] Represented by the little brown myotis.
Silver-haired bat	<i>Lasionycteris noctivagans</i>	Endangered	N	Migrator. Hunt most often in open habitats or along habitat edges and within canopy gaps in forested landscapes. Obligate insectivores that prey on aerial insects. ^[2] Represented by the little brown myotis.
Little brown myotis (bat)	<i>Myotis lucifugus</i>	Endangered	Y	Hybernator. Consumes a variety of arthropod species including beetles, flies, mayflies, true bugs, ants, moths, lacewings, stoneflies, caddisflies and mosquitoes. Little brown myotis is selected as a representative for bat species as it is endangered at both national and international levels.
Northern myotis	<i>Myotis septentrionalis</i>	Endangered	N	Hybernator. Consumes a variety of insects and spiders, including diptera, coleoptera, homoptera, hymenoptera, tricoptera, and lepidoptera. ³
Woodland caribou (boreal population)	<i>Rangifer tarandus caribou</i>	Threatened	Y	Woodland caribou consume lichen as well as grasses and shrubs, depending on availability. They require large areas of mature to old-growth coniferous forest and peatlands. They have the potential to occur in the local assessment boundary. SMOE mapping shows that are primarily found southwest of Collins Creek (SMOE 2025).

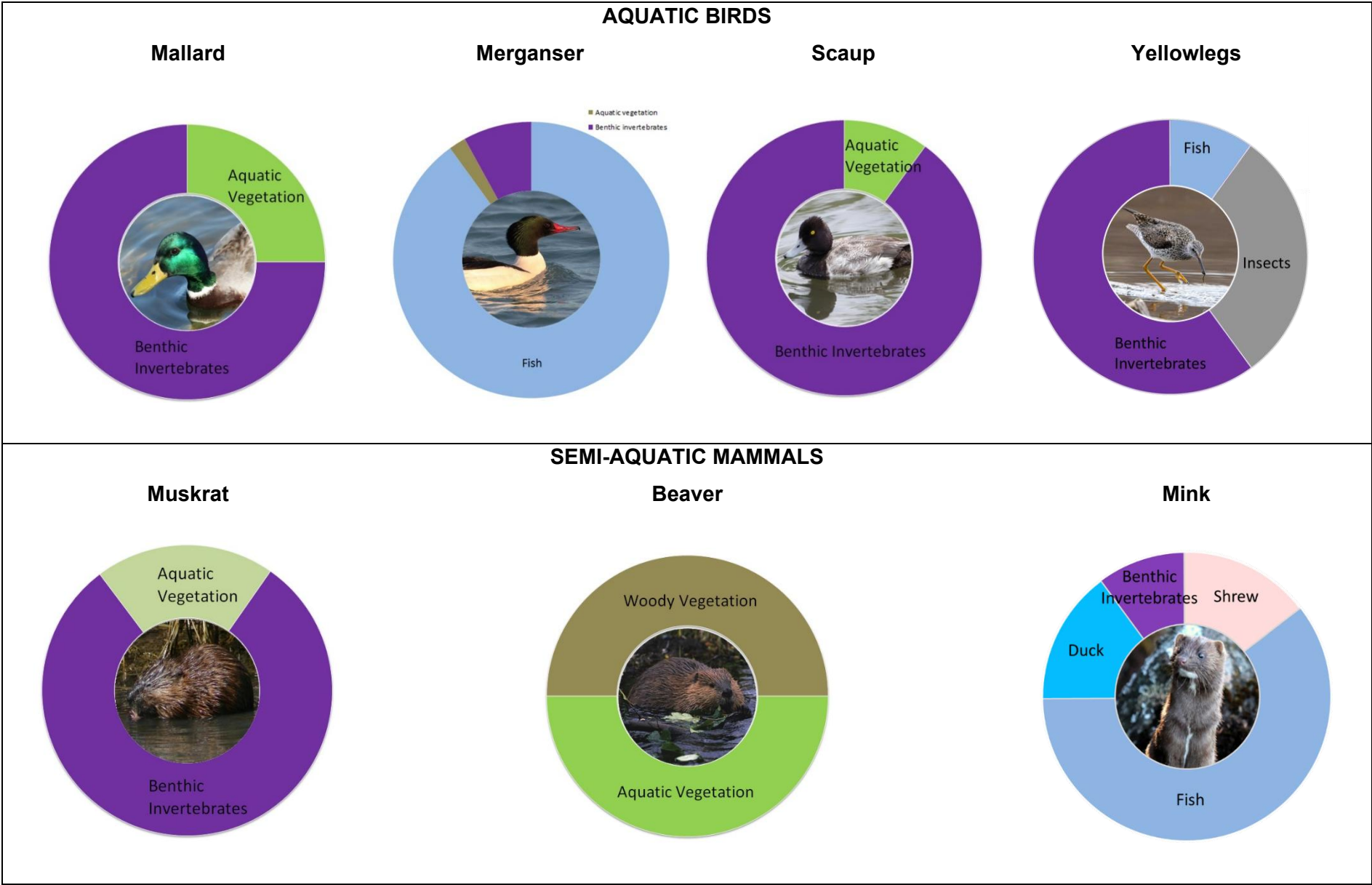
Note: species at risk identified under COSEWIC as special concern, threatened, or endangered and potentially occurring within the local assessment boundary.in Table 5.3-3 of Volume 1 of 2025 EP TID.

¹ All About Birds (Cornell 2025).

² COSEWIC Assessment (2023).

³ COSEWIC Assessment (2013).

Table 4.4-2 Summary of Selected Aquatic Bird and Mammal Receptors: Dietary Representation

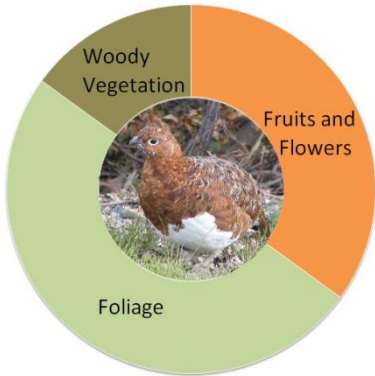


Note: These receptors also assumed to consume water and sediment.

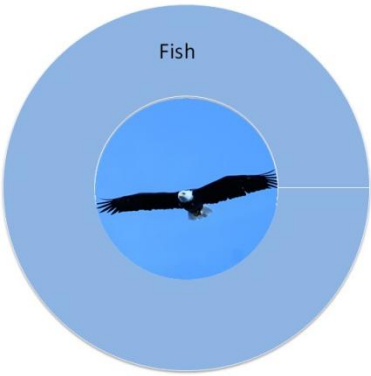
Table 4.4-3 Summary of Selected Terrestrial Bird and Mammal Receptors: Dietary Representation

TERRESTRIAL BIRDS

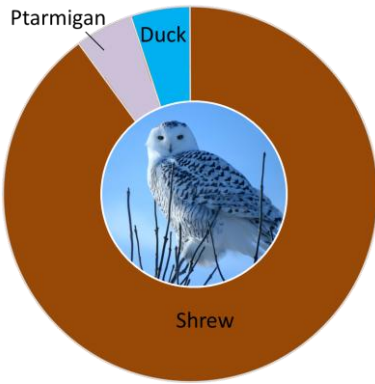
Willow Ptarmigan



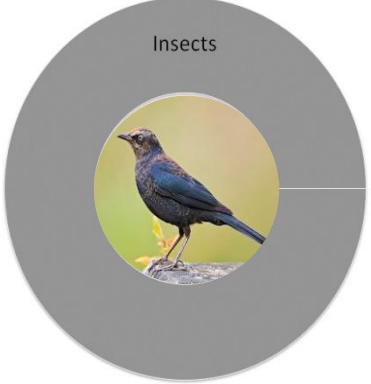
Bald Eagle^b



Snowy Owl

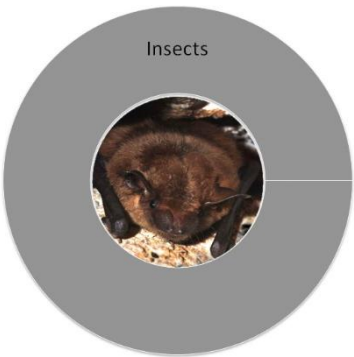


Rusty Blackbird

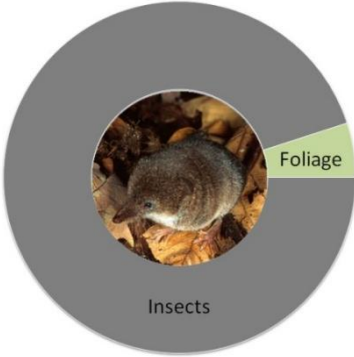


TERRESTRIAL MAMMALS

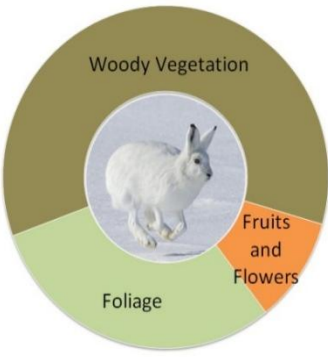
Little Brown Myotis



Masked Shrew



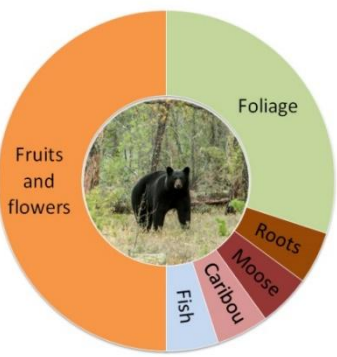
Snowshoe Hare



Moose



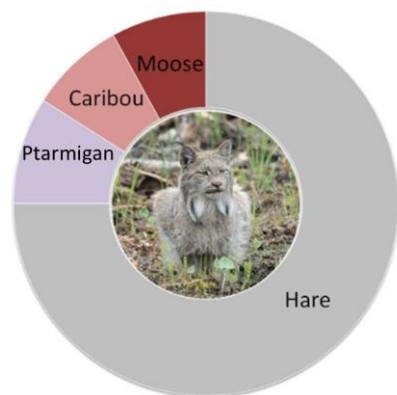
Black Bear



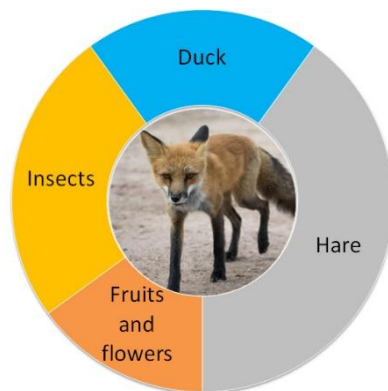
Note: These receptors also assumed to consume water and soil (blackbird, ptarmigan, owl) or water and sediment (eagle).

TERRESTRIAL MAMMALS

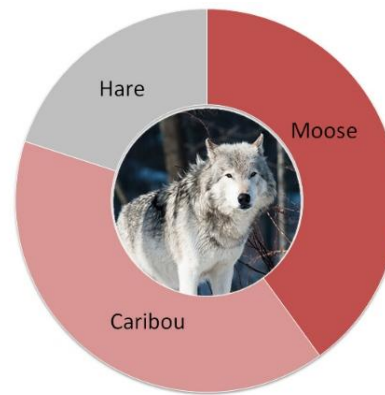
Canada Lynx



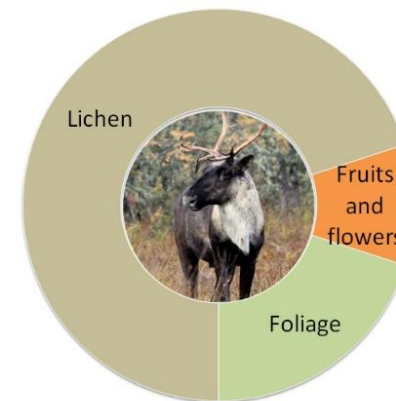
Fox



Grey Wolf



Woodland Caribou



Note: These receptors also assumed to consume water and soil.

Table 4.4-4 Summary of Ecological Receptors and Locations

Ecological Receptor		Terrestrial				Water-Based	
		McClean Lake Mill Area	McClean Lake Operation Small Area	McClean Lake Operation Medium Area	McClean Lake Operation Large Area	Collins Creek Downstream	S/V TEMS, McClean Lake East Basin, Keweenaw Lake
Aquatic Plants	Pondweed	-	-	-	-	-	✓
Benthic Invertebrates	Chironomids	-	-	-	-	-	✓
Phytoplankton	Green Algae	-	-	-	-	-	✓
Zooplankton	Daphnids	-	-	-	-	-	✓
Predatory Fish	Northern Pike	-	-	-	-	-	✓
	Lake Trout	-	-	-	-	-	✓
Bottom-feeding Fish	White Sucker	-	-	-	-	-	✓
	Lake Whitefish	-	-	-	-	-	✓
Amphibian	Boreal Chorus Frog	-	-	-	-	-	✓
Aquatic Birds	Mallard	-	-	-	-	-	✓
	Common Merganser	-	-	-	-	-	✓
	Lesser Scaup	-	-	-	-	-	✓
	Lesser Yellowlegs	-	-	-	-	-	✓
Semi-aquatic Mammals	Muskrat	-	-	-	-	-	✓
	Beaver	-	-	-	-	-	✓
	Mink	-	-	-	-	-	✓
Terrestrial Plants	Blueberry	✓	✓	-	-	-	-
	Labrador tea	✓	✓	-	-	-	-
	Lichen	✓	✓	-	-	-	-
Terrestrial invertebrates	Soil-dwelling & terrestrial-based insects	✓	✓	-	-	-	-
Terrestrial Birds	Bald Eagle	-	-	-	-	✓	-
	Willow Ptarmigan	✓	✓	-	-	-	-
	Rusty Blackbird	✓	-	-	-	-	✓
	Snowy Owl	-	-	✓	-	-	-
Terrestrial Mammals	Caribou (woodland)	-	-	-	✓	-	-
	Snowshoe Hare	✓	✓	-	-	-	-
	Moose	-	-	-	-	✓	✓ (SV TEMS only)
	Wolf	-	-	-	✓	-	-
	Black Bear	-	-	✓	-	-	-
	Red Fox	-	-	✓	-	-	-
	Lynx	-	-	✓	-	-	-
	Masked Shrew	✓	✓	-	-	-	-
	Little Brown Myotis (Bat)	✓	✓	-	-	-	✓

Note:

- receptor not assessed at this location

✓ receptor assessed at this location

Locations shown in Figure 4.4-2.

Table 4.5-1 Pathways Considered in the Human Health Assessment

Receptors	Wollaston Lake Resident	Wollaston Lake Trapper	Wollaston Lake Lodge Operator	Rabbit Lake Worker	JEB Worker	Points North Worker	Hatchet Lake Operator
Water	Wollaston Lake (1.0)	Wollaston Lake (0.75) Collins Bay (0.25)	Wollaston Lake (0.25) Background (0.75)	Collins Creek, near Collins Bay (0.5) Background (0.5)	Wollaston Lake (0.5) Background ¹ (0.5)	--	Wollaston Lake ¹ (0.25) Background (0.75)
Dust, Radon, Groundshine	Wollaston Lake community area (1.0)	Wollaston Lake community area (0.75) Collins Creek downstream airshed (0.25)	Wollaston Lake Lodge (0.25) Background (0.75)	Rabbit Lake Camp (0.5) Background (0.5)	JEB Camp (0.5) Wollaston Lake community area (0.5)	Points North (0.5) Background (0.5)	Hatchet Lake (0.25) Background (0.75)
Moose	Wollaston Lake community area (1.0)	Collins Creek downstream watershed (1.0)	Collins Creek downstream watershed (0.25) Background (0.75)	--	Wollaston Lake community area (1.0)	--	Hatchet Lake (0.25) Background (0.75)
Beaver	Wollaston Lake (1.0)	Kewen Lake (1.0)	Wollaston Lake (0.25) Background (0.75)	--	Wollaston Lake (1.0)	--	Hatchet Lake (0.25) Background (0.75)
Hare	Wollaston Lake community area (1.0)	Collins Creek downstream airshed (1.0)	Wollaston Lake Lodge (0.25) Background (0.75)	--	Wollaston Lake community area (1.0)	--	Hatchet Lake (0.25) Background (0.75)
Ptarmigan	Wollaston Lake community area (1.0)	Collins Creek downstream airshed (1.0)	Wollaston Lake Lodge (0.25) Background (0.75)	--	Wollaston Lake community area (1.0)	--	Hatchet Lake (0.25) Background (0.75)
Mallard	Wollaston Lake (1.0)	Kewen Lake (1.0)	Wollaston Lake (0.25) Background (0.75)	--	Wollaston Lake (1.0)	--	Hatchet Lake (0.25) Background (0.75)
Fish	Wollaston Lake (1.0)	Wollaston Lake (0.75) Kewen Lake (0.25)	Wollaston Lake (0.25) Background (0.75)	Collins Bay (0.1) Kewen Lake (0.1) Background (0.8)	Wollaston Lake (1.0)	Kewen Lake (0.2) Background (0.8)	--
Berries	Wollaston Lake community area (1.0)	Wollaston Lake community area (0.75) Collins Creek downstream airshed (0.25)	Wollaston Lake Lodge (0.25) Background (0.75)	Rabbit Lake Camp (0.5) Background (0.5)	JEB Camp (0.5) Wollaston Lake community area (0.5)	Points North (0.5) Background (0.5)	Hatchet Lake (0.25) Background (0.75)
Soil	Wollaston Lake community area (1.0)	Wollaston Lake community area (0.75) Collins Creek downstream airshed (0.25)	Wollaston Lake Lodge (0.25) Background (0.75)	Rabbit Lake Camp (0.5) Background (0.5)	JEB Camp (0.5) Wollaston Lake community area (0.5)	Points North (0.5) Background (0.5)	Hatchet Lake (1.0)
Labrador Tea	Wollaston Lake community area (1.0)	Wollaston Lake community area (0.75) Collins Creek downstream airshed (0.25)	Wollaston Lake Lodge (0.25) Background (0.75)	Rabbit Lake Camp (0.5) Background (0.5)	JEB Camp (0.5) Wollaston Lake community area (0.5)	Points North (0.5) Background (0.5)	Hatchet Lake (0.25) Background (0.75)
Vegetables	Wollaston Lake community area (0.05)	Wollaston Lake community area (0.05)	Wollaston Lake Lodge (0.05)	--	Wollaston Lake community area (0.05)	--	Hatchet Lake (0.05)
Fraction of year spent at location	1.0	1.0	0.25	0.5	JEB Camp (0.5) Wollaston Lake community area (0.5)	0.5	0.25

Note: Fraction of diet obtained from the identified sources shown in brackets.

¹ Drinking water source is Pat Lake, which is unaffected and taken to be background.

While survey of the nearby Hatchet Lake community found that barren-ground caribou are hunted and form a part of their diet, the survey indicated that the Hatchet Lake community largely hunts caribou in the area to the north and northeast of Wollaston Lake, an area not within the potential influence of the McClean Lake Operation (CanNorth 2000); for this reason the barren-ground caribou are not explicitly evaluated in the current assessment

Table 4.5-2 Summary of Pooled Intakes (g/d) of Traditional Food from Hatchet Lake Band Survey

Food Item	Child (2 to 10 years)		Adult (21+ years)	
	Mean	Maximum	Mean	Maximum
Meat				
Caribou	240	1,020	359	1,330
Moose	1.6	27.1	2.5	19.8
Beaver	0.1	2.6	0.9	5.9
Other small animals	0.2	1.5	1.8	11.6
Poultry				
Ground birds	0.2	4.1	1.5	9.4
Water birds	2.0	20.3	2.7	12.1
Other				
Fish	43.8	313	70	218
Berries	8.5	30.4	1.8	16.3
Total Meat, Fish and Poultry	288	1,388	438	1,607

Note: From CanNorth (2000).

Table 4.5-3 Estimated Total Intakes of Above and Below Ground Vegetables

Food Item and Receptor	Default (g/a)	Distribution ^a
Above Ground Vegetables		
Toddler	16,425	LN(16,425, 2.4, 2,852, 94,608)
Child	23,725	LN(23,725, 2.5, 3,796, 148,190)
Adult	36,135	LN(36,135, 2.2, 7,483, 174,835)
Below Ground Vegetables		
Toddler	28,835	LN(28,835, 2.1, 6,540, 127,162)
Child	43,435	LN(43,435, 2.2, 8,979, 210,240)
Adult	53,655	LN(53,655, 2.0, 13,432, 214,620)

a – LN = Lognormal Distribution (geometric mean, geometric standard deviation, minimum, maximum).

The values presented in the table are representative of the total annual intake of vegetables. For this assessment, the only human receptors ingesting vegetables from the regional study area were assumed to be the Wollaston Lake community receptors (resident and trapper), who could obtain 5% of the annual intake of local vegetables .

Table 4.5-4 Dietary Characteristics Assumed for Adult Receptors Related to Local Food Consumption

Description	Units	Nominal Value	Probability Distribution ^a	Reference
average annual intake of vegetables: above ground leafy vegetables (foliage) below ground vegetables (roots) berries (fruits and flowers)	g(wet wt)/y	4.9 x 10 ⁴ 6.9 x 10 ⁴ 1.2 x 10 ³	LN (3.6 x 10 ⁴ , 2.2, 7.5 x 10 ³ , 1.7 x 10 ⁵) LN (5.4 x 10 ⁴ , 2.0, 1.3 x 10 ⁴ , 2.1 x 10 ⁵) LN (6.5 x 10 ² , 3.0, 7.3 x 10 ¹ , 5.9 x 10 ³)	Richardson 1997 Richardson 1997 CanNorth 2000
average annual intake of medicinal tea (foliage)	g(wet wt)/y	0.018	T (0.0084, 0.0157, 0.031)	Assumed from Receveur et al. 1998
average annual intake of water	m ³ /y	0.54	LN (0.48, 1.65, 0.18, 1.3)	Richardson 1997
annual inhalation rate	m ³ /y	6,060	LN (5.9 x 10 ³ , 1.3, 3.5 x 10 ³ , 9.9 x 10 ³)	Richardson and Stantec (2013)
annual intake of soil	g/y	0.58	LN (0.3, 3.2, 0.03, 3.1)	Wilson et al (2013)
annual intake of meat, fish and poultry	g/y	1.6 x 10 ⁵	β (4.5 x 10 ³ , 5.9 x 10 ⁵ , 7.43, 20.39)	CanNorth 2000
fraction of meat, fish, and poultry – moose	-	0.00835	C (0.00835)	Based on CanNorth 2000
fraction of meat, fish, and poultry – fish	-	0.145	C (0.145)	Based on CanNorth 2000
fraction of meat, fish, and poultry – ptarmigan	-	0.002	C (0.002)	Based on CanNorth 2000
fraction of meat, fish, and poultry – hare	-	0.005	C (0.005)	Based on CanNorth 2000
fraction of meat, fish, and poultry – beaver	-	0.004	C (0.004)	Based on CanNorth 2000
fraction of meat, fish, and poultry – mallard	-	0.006	C (0.006)	Based on CanNorth 2000

^a Distribution type: C = constant (value); T = triangular (minimum, mode, maximum); β = Beta (minimum, maximum, alpha, beta); LN = lognormal distribution (geometric mean, geometric standard deviation, minimum, maximum).

Body weight = 70.7 kg.

Table 4.5-5 Dietary Characteristics Assumed for Child Receptors Related to Local Food Consumption

Description	Units	Nominal Value	Probability Distribution ^a	Reference
average annual intake of vegetables: above ground leafy vegetables (foliage)	g(wet wt)/y	3.7×10^4	LN (2.4×10^4 , 2.5, 3.8×10^3 , 1.5×10^5)	Richardson 1997
below ground vegetables (roots)		5.9×10^4	LN (4.3×10^4 , 2.2, 9.0×10^3 , 2.1×10^5)	Richardson 1997
berries (fruits and flowers)		5.7×10^3	LN (3.1×10^3 , 3.0, 3.3×10^2 , 2.8×10^4)	CanNorth 2000
average annual intake of medicinal tea (foliage)	g(wet wt)/y	0	C (0)	Assumed
average annual intake of water	m ³ /y	0.28	LN (0.26, 1.49, 0.12, 0.58)	Richardson 1997
annual inhalation rate	m ³ /y	5,200	LN (5.0×10^3 , 1.3, 3.0×10^3 , 8.5×10^3)	Richardson and Stantec (2013)
annual intake of soil	g/y	8.4	LN (4.9, 2.8, 0.63, 38)	Wilson et al (2013)
annual intake of meat, fish and poultry	g/y	8.3×10^4	LN(5.5×10^4 , 2.5, 8.8×10^3 , 3.4×10^5)	CanNorth 2000
fraction of meat, fish, and poultry – moose	-	0.025	C (0.025)	Based on CanNorth 2000
fraction of meat, fish, and poultry – fish	-	0.17	C (0.17)	Based on CanNorth 2000
fraction of meat, fish, and poultry – ptarmigan	-	0.0012	C (0.0012)	Based on CanNorth 2000
fraction of meat, fish, and poultry – hare	-	0.0009	C (0.0009)	Based on CanNorth 2000
fraction of meat, fish, and poultry – beaver	-	0.0017	C (0.0017)	Based on CanNorth 2000
fraction of meat, fish, and poultry – mallard	-	0.011	C (0.0011)	Based on CanNorth 2000

^a Distribution type: C = constant (value); T = triangular (minimum, mode, maximum); $\square\square$ = Beta (minimum, maximum, alpha, beta); LN = lognormal distribution (geometric mean, geometric standard deviation, minimum, maximum).

Body weight = 32.9 kg.

Table 4.5-6 Dietary Characteristics Assumed for Toddler Receptors Related to Local Food Consumption

Description	Units	Nominal Value	Probability Distribution ^a	Reference
average annual intake of vegetables: above ground leafy vegetables (foliage) below ground vegetables (roots) berries (fruits and flowers)	g(wet wt)/y	2.4 x 10 ⁴ 3.8 x 10 ⁴ 4.3 x 10 ³	LN (1.6 x 10 ⁴ , 2.4, 2.9 x 10 ³ , 9.5 x 10 ⁴) LN (2.9 x 10 ⁴ , 2.1, 6.5 x 10 ³ , 1.3 x 10 ⁵) LN (2.3 x 10 ³ , 3.0, 2.6 x 10 ² , 2.1 x 10 ⁴)	Richardson 1997 Richardson 1997 Assumed from Child
average annual intake of medicinal tea (foliage)	g(wet wt)/y	0	C (0)	Assumed
average annual intake of water	m ³ /y	0.22	LN (0.18, 1.84, 0.05, 0.62)	Richardson 1997
annual inhalation rate	m ³ /y	2,880	LN (2.8 x 10 ³ , 1.3, 1.6 x 10 ³ , 4.7 x 10 ³)	Richardson and Stantec (2013)
annual intake of soil	g/y	7.3	LN (4.5, 2.7, 0.6, 33)	Wilson et al (2013)
annual intake of meat, fish and poultry	g/y	7.95 x 10 ⁴	□ (2.25 x 10 ³ , 2.95 x 10 ⁵ , 3.71, 10.2)	Calculated based on 50% of adult annual intake
fraction of meat, fish, and poultry – moose	-	0.025	C (0.025)	Assumed same as child
fraction of meat, fish, and poultry – fish	-	0.17	C (0.17)	Assumed same as child
fraction of meat, fish, and poultry – ptarmigan	-	0.0012	C (0.0012)	Assumed same as child
fraction of meat, fish, and poultry – hare	-	0.0009	C (0.0009)	Assumed same as child
fraction of meat, fish, and poultry – beaver	-	0.0017	C (0.0017)	Assumed same as child
fraction of meat, fish, and poultry – mallard	-	0.011	C (0.011)	Assumed same as child

^a Distribution type: C = constant (value); T = triangular (minimum, mode, maximum); □ = Beta (minimum, maximum, alpha, beta); LN = lognormal distribution (geometric mean, geometric standard deviation, minimum, maximum)

Body weight = 16.5 kg.

Table 4.8-1 Problem Formulation Checklist – Ecological Risk Assessment

Land Use	Receptor Group	Exposure Pathways – Contact/Ingestion			
		Soil	Surface Water	Sediment	Food*
Natural Wildlands	Soil invertebrates	✓	NR	NR	NR
	Terrestrial plants	✓	NR	NR	NR
	Aquatic birds	NR	✓	✓	✓
	Terrestrial birds	✓	✓	NR	✓
	Semi-Aquatic mammals	NR	✓	✓	✓
	Terrestrial mammals	✓	✓	NR	✓
	Amphibians ^a	NR	✓	✓	NR
	Reptiles ^b	NA	NA	NA	NA
	Fish	NR	✓	✓	NR
	Aquatic plants	NR	✓	✓	NR
	Aquatic invertebrates	NR	✓	✓	NR

Note: NA – not assessed

NR – not relevant.

✓ – assessed.

* Identifies when food is explicitly included, otherwise implicitly included in transfer factors when needed.

a – assessed as fish if no information available.

b – reptiles are not common in the area and there is a lack of available information on toxicity effects for the assessment of reptiles.

Table 4.8-2 Problem Formulation Checklist – Human Health Risk Assessment

Potential Pathway of Exposure	Members of the Public/Non-NEW Workers	Comment
Incidental Soil Ingestion	Yes/Yes	Emissions to air and subsequent deposition to soil were considered in the assessment. Incidental soil ingestion was assessed for human receptors.
Dermal Contact with Soil	Yes/Yes	Emissions to air and subsequent deposition to soil were considered in the assessment. Dermal contact with soil was assessed for human receptors.
Inhalation	Yes/Yes	Emissions to air considered in the assessment. Inhalation of air was assessed for human receptors.
Immersion in air	Yes/Yes	Emissions to air considered in the assessment. Immersion in air was assessed for human receptors
Immersion in water	Yes/Yes	Emissions to water were considered in the assessment. Immersion in water (bathing) was assessed for human receptors.
Drinking water	Yes/Yes ^a	Emissions to water were considered in the assessment. The drinking water pathway was assessed for most human receptors.
Harvest local foods (berry)	Yes/Yes	Emissions to air and subsequent deposition to soil and fruit and uptake from soil were considered in the assessment. Ingestion of berries was assessed for human receptors.
Harvest local produce (garden produce)	Yes/No ^a	Emissions to air and subsequent deposition to soil and foliage and uptake from soil were considered in the assessment. Ingestion of foliage as backyard garden produce was assessed for member of the public human receptors.
Hunting/trapping	Yes/Yes ^a	Emissions to air and water and subsequent food chain transfer were considered in the assessment. Ingestion of birds and mammals was assessed for most human receptors.
Fishing	Yes/Yes ^a	Emissions to water and transfer to fish were considered in the assessment. Ingestion of fish was assessed for most human receptors.
Irrigation of vegetation	Min	There are no backyard gardens on or near the site; backyard gardens considered in the assessment are at a sufficient distance that this would be an insignificant pathway.
Livestock	No	No domestic livestock in the area.
External dose from soil	Yes/Yes	Emissions to air and subsequent deposition to soil were considered in the assessment. External dose from soil (as groundshine) was assessed for human receptors.
Recreational use of surface water	Yes/Yes	Emissions to water were considered in the assessment. Immersion in water (swimming) was assessed for human receptors.

Note: a – pathway not considered for non-NEW workers while at the site. Min – minimal, not quantitatively assessed as insignificant route of exposure

Table 5.2-1 Selected Toxicity Reference Values for Aquatic Receptors – Selenium

Environmental Component	Benchmark	Reference
Water Quality	1.5 µg/L	U.S.EPA (2016)water quality criterion for the protection of aquatic life – lentic aquatic systems
Fish Tissue	13 µg/g (dw)	Site-specific fish flesh/muscle benchmark

Note: The U.S. EPA guideline was selected as the primary comparison point. Other guidelines available including the SEQG of 2 µg/L and the CCME guideline of 1 µg/L.

Table 5.2-2 Selected Soil Quality Guidelines – Ecological Protection

Constituent	Tier 1 Natural Area	Ecological Contact	Livestock Soil and Food Ingestion	Note
Metals (mg/kg)				
Arsenic	17	17	380	
Cadmium	3.8	10	3.8	
Chromium	64	64	-	
Cobalt	20	20	-	
Copper	63	63	300	
Lead	70	300	70	
Molybdenum	4	4	-	
Nickel	45	45	530	
Selenium	1	1	4.5	
Silver	20	20	-	
Uranium	33	500	33	
Zinc	250	250	980	
Radionuclides (Bq/g)				
Lead-210	0.3	-	-	No SEQG, Alberta guideline used (AEPA 2024) .
Polonium-210	Included with Lead-210	-	-	No SEQG, Alberta guideline used (AEPA 2024) .
Radium-226	0.3	-	-	No SEQG, Alberta guideline used (AEPA 2024) .
Thorium-230	10	-	-	No SEQG, Alberta guideline used (AEPA 2024) .

Note:
SEQG – Saskatchewan Environmental Quality Guidelines (ENV 2025)

Table 5.2-3 Summary of Phytotoxicity Levels

Constituent	Units	Phytotoxic Leaf Conc. ^a	Phytotoxic foliage Conc. ^b	Upper Critical Level in leaves and shoots ^c
Arsenic	mg/kg dw	5-20	3-10	11-26
Cadmium	mg/kg dw	5-30	5-700	14-16
Chromium	mg/kg dw	5-30	20	5-20
Cobalt	mg/kg dw	15-50	25-100	3-9
Copper	mg/kg dw		25-40	
Lead	mg/kg dw	30-300		20-35
Molybdenum	mg/kg dw	10-50	100	130-140
Nickel	mg/kg dw		50-100	
Selenium	mg/kg dw	5-30	100	7-90
Silver	mg/kg dw	5-10	-	4-5
Uranium	mg/kg dw			
Zinc	mg/kg dw	100-400	500-1,500	160-320

Note:

a - Leaf tissue concentration in plants that are neither sensitive or tolerant (McBride 1994).

b - Phytotoxic conc. In plant foilage (Langmuir et al. 2004).

c - Upper Critical Level in leaves and shoots of spring barley associated with reduced yield (Davis et al. 1978).

; dw = dry weight

Table 5.2-4 Selected Water Quality Guidelines – Livestock Water

Constituent	WQG	Units	Note
General Chemistry			
Ammonia (un-ionized)	-	µg/L (as N)	No guideline available
Chloride	600	mg/L	BC guideline
Fluoride	1	mg/L	SEQG
Nitrate (as N)	100	mg/L	SEQG for nitrate + nitrite (applied to nitrate)
Potassium	-	-	No guideline available
Sulphate	1,000	mg/L	SEQG
Total dissolved solids	3,000	mg/L	SEQG
Metals			
Aluminum	5,000	µg/L	SEQG
Arsenic	25	µg/L	SEQG
Cadmium	80	µg/L	SEQG
Chromium	50	µg/L	SEQG
Cobalt	1,000	µg/L	CEQG
Copper	500	µg/L	SEQG
Iron	-	µg/L	No guideline available
Lead	100	µg/L	SEQG
Molybdenum	500	µg/L	CEQG
Nickel	1,000	µg/L	SEQG
Selenium	50	µg/L	SEQG
Silver	50	µg/L	SEQG
Uranium	200	µg/L	SEQG
Zinc	50,000	µg/L	SEQG
Radionuclides			
Lead-210	-	Bq/L	No guideline available
Polonium-210	-	Bq/L	No guideline available
Radium-226	-	Bq/L	No guideline available
Thorium-230	-	Bq/L	No guideline available

Note:

SEQG – Saskatchewan Environmental Quality Guidelines for surface water – livestock water (ENV 2025)

CEQG (CCME 2024) Protection of Agriculture (livestock)

Table 5.2-5 Selected Toxicity Reference Values for Avian Species

Constituent	LOAEL (mg/kg-d)	NOAEL (mg/kg-d)	Test Species	Surrogate for:
Arsenic	3.6	2.2	Chicken	Blackbird, eagle, owl, ptarmigan, yellowlegs
	5.1	NA	Duck (mallard)	Mallard, merganser, scaup
Cadmium	4.38	0.97	Chicken	Blackbird, eagle, owl, ptarmigan, yellowlegs
	25.6	3.08	Duck (mallard)	Mallard, merganser, scaup
Chromium (trivalent)	27.8	NA	Chicken	Blackbird, eagle, owl, ptarmigan
	2.78	0.57	Duck (black)	Mallard, merganser, scaup, yellowlegs
Cobalt	14.1	4.1	Chicken	Blackbird, eagle, owl, ptarmigan, yellowlegs
	148	14.8	Duck	Mallard, merganser, scaup
Copper	27	15.3	Turkey	Blackbird, eagle, owl, ptarmigan, yellowlegs
	75.2	24.1	Duck (mallard)	Mallard, merganser, scaup
Lead	27.7	6.83	Japanese quail	Blackbird, eagle, mallard, merganser, owl, ptarmigan, scaup, yellowlegs
Molybdenum	20.8	NA	Turkey	Blackbird, eagle, mallard, merganser, owl, ptarmigan, scaup, yellowlegs
Nickel	10.7	NA	Duck (mallard)	Mallard, merganser, scaup, yellowlegs
	19.9	14.6	Chicken	Blackbird, eagle, owl, ptarmigan
Selenium	0.59	0.36	Chicken	Blackbird, eagle, owl, ptarmigan, yellowlegs
	1.37	1.18	Duck (mallard)	Mallard, merganser, scaup
Silver	45.4	NA	Turkey	Blackbird, eagle, mallard, merganser, owl, ptarmigan, scaup, yellowlegs
Uranium	NA	16	Duck (black)	Blackbird, eagle, mallard, merganser, owl, ptarmigan, scaup, yellowlegs
Zinc	62.7	NA	Duck (mallard)	Mallard, merganser, scaup
	179	90.1	Chicken	Blackbird, eagle, owl, ptarmigan, yellowlegs

Note: mg/(kg-d) - milligrams per kilogram per day

LOAEL = lowest observable adverse effect level; NOAEL = no observable adverse effect level

NA: Not value available (the LOAEL is used in lieu of a NOAEL for the evaluation of species at risk);

Table 5.2-6 Selected Toxicity Reference Values for Mammalian Species

Constituent	LOAEL (mg/kg-d)	NOAEL (mg/kg-d)	Test Species	Surrogate for:
Arsenic	3.1	1.5	Dog	Bear, fox, lynx, mink, wolf
	14.2	8.1	Rat	Myotis, beaver, caribou, moose, muskrat, shrew
	3	0.8	Rabbit	Hare
Cadmium	5.51	0.33	Mouse	All
Chromium	29.9	23.7	Rat	All
Cobalt	13.4	5.2	Rat	All
Copper	8.8	5.6	Pig	Bear, caribou, fox, lynx, moose, wolf
	11.5	5.9	Mink	Mink
	45.7	27.7	Rabbit	Hare
	119	63	Rat	Myotis, beaver, and muskrat, shrew
Lead	50.4	10.7	Rabbit	All
Molybdenum	2.6	0.26	Mouse	Myotis, bear, beaver, fox, hare, lynx, mink, muskrat, shrew, wolf
	4.1	NA	Holstein calf	Caribou, moose
Nickel	9.8	3.4	Cow	Caribou, moose
	11.6	6.2	Rat	Myotis, beaver, hare, muskrat, shrew
	112	45	Dog	Bear, fox, lynx, mink, wolf
Selenium	0.21	NA	Dog	Bear, fox, lynx, mink, wolf
	0.33	0.17	Cow	Caribou, moose
	0.63	0.33	Rat	Myotis, beaver, hare, muskrat, shrew
Silver	138	NA	Rat	All
Uranium	5.6	2.8	Mouse	All
Zinc	75.9	37.9	Cow	Caribou, moose
	249	215	Rat	Myotis, bear, beaver, fox, hare, lynx, mink, muskrat, shrew, wolf

Note: mg/(kg-d) = milligrams per kilogram per day

NA: Not value available (the LOAEL is used in lieu of a NOAEL for the evaluation of species at risk);

LOAEL = lowest observable adverse effect level; NOAEL = no observable adverse effect level

Table 5.2-7 Dose Coefficients Used for Ecological Receptors

Constituent	DC (in mGy/d per Bq/g)			
	Internal	External – Water	External – Sediment	External – Soil
U-238+	1.52×10^{-1}	1.50×10^{-3}	2.01×10^{-2}	8.99×10^{-4}
Th-230	6.60×10^{-2}	1.06×10^{-5}	3.40×10^{-5}	1.29×10^{-5}
Ra-226+	3.52×10^{-1}	2.13×10^{-2}	3.33×10^{-2}	3.80×10^{-2}
Pb-210+	4.53×10^{-2}	9.54×10^{-5}	3.90×10^{-3}	1.87×10^{-5}
Po-210	7.49×10^{-2}	1.18×10^{-7}	1.36×10^{-7}	1.83×10^{-7}

Reference: (ERICA 2021)

Dose (mGy/d) per Bq/g tissue concentration for internal dose and per Bq/g of environmental concentration for external dose

U-238+ = U-238+Th-234+U-234+0.046xU-235 (Internal or external)

Ra-226=Ra-226 + 0.3*Rn-222 (internal)

Ra-226=Ra-226 + Rn-222 (external)

Pb-210+=Pb-210+Bi-210

Table 5.3-1 Results of Radiological Assessment for Aquatic Receptors

Location	Receptor	Screening Index Values											
		Background		2025		2030		2040		2050		2100	
		Mean	95th	Mean	95th	Mean	95th	Mean	95th	Mean	95th	Mean	95th
Sink Reservoir	BI	0.011	0.019	0.059	0.12	0.071	0.14	0.097	0.20	0.087	0.18	0.031	0.011
	AV	<0.0001	0.0020	0.0030	0.0070	0.0040	0.0080	0.0030	0.0090	0.0020	0.0030	<0.0001	<0.0001
	BF	<0.0001	<0.0001	<0.0001	0.0010	<0.0001	0.0020	<0.0001	0.0020	<0.0001	<0.0001	<0.0001	<0.0001
	PF	<0.0001	<0.0001	<0.0001	0.0010	<0.0001	0.0020	<0.0001	0.0010	<0.0001	<0.0001	<0.0001	<0.0001
	PP	0.0030	0.0040	0.018	0.034	0.021	0.044	0.018	0.035	0.010	0.022	0.0010	0.0030
	ZP	0.0060	0.010	0.047	0.078	0.053	0.090	0.042	0.064	0.023	0.038	0.0030	0.0060
Vulture Lake	BI	0.011	0.019	0.045	0.099	0.055	0.12	0.075	0.17	0.055	0.13	0.020	0.011
	AV	<0.0001	0.0020	0.0010	0.0030	0.0020	0.0040	0.0020	0.0050	<0.0001	0.0020	<0.0001	<0.0001
	BF	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0010	<0.0001	0.0010	<0.0001	<0.0001	<0.0001	<0.0001
	PF	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	PP	0.0030	0.0040	0.0080	0.015	0.013	0.027	0.012	0.024	0.0070	0.016	0.0010	0.0030
	ZP	0.0060	0.010	0.018	0.030	0.027	0.048	0.025	0.042	0.015	0.027	0.0030	0.0060
McClean Lake east basin ^a	BI	0.011	0.019	0.024	0.047	0.024	0.048	0.026	0.052	0.026	0.052	0.021	0.011
	AV	<0.0001	0.0020	0.0010	0.0030	0.0020	0.0040	0.0020	0.0040	<0.0001	0.0020	<0.0001	<0.0001
	BF	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	PF	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	PP	0.0030	0.0040	0.0080	0.015	0.013	0.027	0.012	0.024	0.0070	0.016	0.0010	0.0030
	ZP	0.0060	0.010	0.018	0.030	0.027	0.047	0.025	0.041	0.015	0.026	0.0030	0.0060
Keweenaw Lake	BI	0.011	0.019	0.017	0.035	0.018	0.038	0.019	0.042	0.020	0.046	0.023	0.011
	AV	<0.0001	0.0020	<0.0001	0.0020	<0.0001	0.0020	<0.0001	0.0020	<0.0001	0.0020	<0.0001	<0.0001
	BF	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	PF	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	PP	0.0030	0.0040	0.0030	0.0040	0.0030	0.0050	0.0030	0.0050	0.0030	0.0040	0.0020	0.0030
	ZP	0.0060	0.010	0.0070	0.011	0.0070	0.011	0.0070	0.011	0.0070	0.010	0.0060	0.0060

Note: Mean = predicted mean for indicated year; 95th = 95th percentile for indicated year; BI = benthic invertebrates; AV = aquatic vegetation; BF = benthic fish; PF = pelagic fish; PP = phytoplankton; ZP = zooplankton.
 Calculated using a dose benchmark of 9.6 mGy/d.

Table 5.3-2 Comparison of Predicted Aluminum Water Concentrations to Various Guidelines

Location	CEQG	BC Guideline	Predicted Concentrations									
			2025		2030		2040		2050		2100 ^e	
			Mean	95 th	Mean	95 th	Mean	95 th	Mean	95 th	Mean	95 th
Sink Reservoir ^a	0.37	0.12	0.11	0.12	0.56	0.70	0.068	0.077	0.069	0.094	0.01	0.01
Vulture Lake ^b	0.60	0.20	0.06	0.069	0.42	0.49	0.055	0.061	0.07	0.085	0.01	0.01
McClellan Lake east basin, Segment B ^c	0.32	0.11	0.013	0.015	0.039	0.054	0.013	0.014	0.011	0.012	0.01	0.01
Keweenaw Lake ^d	0.22	0.07	0.011	0.012	0.023	0.029	0.011	0.012	0.011	0.011	0.01	0.01

Note: Mean = predicted mean for indicated year; 95th = 95th percentile for indicated year.

All concentrations in mg/L

Guidelines are discussed in Section 3.4

a Based on a pH of 6.3, hardness of 430 mg/L (maximum for equation) and DOC of 2 mg/L

b Based on a pH of 6.9, hardness of 430 mg/L (maximum for equation) and DOC of 3.2 mg/L

c Based on a pH of 6.5, hardness of 68 mg/L and DOC of 4.5 mg/L

d Based on a pH of 6.5, hardness of 33 mg/L and DOC of 4.2 mg/L

e By 2100 the water quality has recovered and the guideline would be 0.15 mg/L (FEQG) and 0.05 mg/L (BC) at all locations (based on an assumed pH of 6.5, hardness of 15 mg/L and DOC of 4 mg/L)

shaded values exceed the BC guideline

Bold and italic values exceed the FEQG and BC guideline

Table 5.3-3 Assessment of Potential Effects on Aquatic Receptors – Selenium (Base Case)

Environmental Component	Result	Year	Predicted Concentrations					Measurement Endpoint
			Sink Reservoir	Vulture Lake	McClellan Lake East Basin	Collins Creek at Keweenaw Lake	Keweenaw Lake	
Water Quality	Mean	2025	3.8	1.8	0.16	0.067	0.059	1.5 µg/L ^a
		2030	5.3	2.5	0.23	0.093	0.081	
		2040	1.8	1.2	0.11	0.050	0.047	
		2050	0.67	0.53	0.029	0.017	0.019	
		2100	0.069	0.020	0.010	0.010	0.010	
	95 th Percentile	2025	5.5	2.4	0.21	0.087	0.076	
		2030	7.0	3.2	0.31	0.13	0.11	
		2040	2.3	1.5	0.15	0.066	0.060	
		2050	1.2	0.72	0.035	0.020	0.022	
		2100	0.11	0.032	0.010	0.010	0.010	
Fish Tissue	45 th Percentile ^c	2025	35	19	5.3	1.6	1.9	13 µg/g (dw) ^b
		2030	38	19	5.8	1.7	1.9	
		2040	43	20	6.7	1.9	2.1	
		2050	34	12	4.9	1.9	1.9	
		2100	5.9	1.7	1.9	1.8	1.6	
	95 th Percentile	2025	101	53	19	3.5	4.1	
		2030	110	55	21	3.7	4.4	
		2040	126	58	26	4.2	4.9	
		2050	99	35	18	4.2	4.3	
		2100	17	3.6	4.9	3.9	3.4	

Note: **bold shading** indicates predicted concentration of selenium exceeding water quality criterion or fish tissue benchmark. Mean = predicted mean for indicated year; 95th = 95th percentile for indicated year.

a – U.S. EPA (2016) water quality criterion for the protection of aquatic life – lentic aquatic systems.

b – Site-specific benchmark.

c – The 45th percentile is presented as it was previously demonstrated that it is a better representation of the measured fish concentrations.

Table 5.3-4 Overall Summary for Aquatic Receptors

Location	Lines of Evidence
S/V TEMS	• All radiological SI values are less than 1 • SSD indicates ○ potential effects on invertebrates (chloride, sulphate, thallium) ○ potential effects on fish (aluminum, nitrate, selenium, silver) • Elevated concentrations in fish tissue (selenium, nickel, thallium, and uranium). Selenium level above site-specific benchmark. • Data suggest decrease in fish population • Comparison to sediment benchmarks indicated potential effects on benthic invertebrates (arsenic, molybdenum, nickel, and selenium) • Reduced density and richness in the benthic invertebrate community
McClellan Lake east basin	• All radiological SI values are less than 1 • Water quality expected to remain below guidelines • Fish tissue selenium elevated but below site-specific fish benchmark • Comparison to sediment benchmarks indicated potential effects on benthic invertebrates (arsenic, molybdenum, nickel, and selenium) • Maintenance of core characteristics and subtle compositional differences within the benthic invertebrate community • In Collins Creek at the McClellan Lake outlet: ○ benthic invertebrate community within normal range ○ selenium concentrations in fish well below the site specific criteria ○ burbot shows strong growth and condition performance, coupled with improved young-of-the-year fish abundance, slimy sculpin populations could be experiencing subtle stressors affecting reproduction
Keweenaw Lake	• All radiological SI values are less than 1 • Water quality expected to remain below guidelines • Fish tissue predicted to be in the range of background • Sediment quality expected to remain below benchmarks • Benthic invertebrate community within normal range

Table 5.4-1 Comparison of Predicted Soil Concentrations to Soil Guidelines

Constituent	Ecological Component of Soil Guideline ^a	Maximum Predicted Concentrations				
		Background	McClean Mill Area		McClean Lake Operation Small Area	
			Mean	Mean	95 th Percentile	Mean
Metals (mg/kg)						
Arsenic	17	0.47	0.52	0.52	0.47	0.47
Cadmium	3.8	0.10	0.10	0.10	0.10	0.10
Chromium	64	8.5	8.5	8.5	8.5	8.5
Cobalt	20	0.89	0.89	0.89	0.89	0.89
Copper	63	1.6	1.6	1.6	1.6	1.6
Lead	70	3.0	3.1	3.1	3.0	3.0
Molybdenum	4	0.13	0.19	0.19	0.14	0.14
Nickel	45	2.8	2.9	2.9	2.8	2.8
Selenium	1	0.10	0.11	0.11	0.10	0.10
Silver	20	0.050	0.050	0.050	0.050	0.050
Uranium	33	0.44	2.4	2.4	0.68	0.68
Zinc	250	10	10	10	10	10
Radionuclides (Bq/g)						
Lead-210	0.3 ^b	0.056	0.078	0.078	0.059	0.059
Polonium-210	0.3	0.039	0.049	0.049	0.040	0.040
Radium-226	0.3	0.016	0.038	0.038	0.019	0.019
Thorium-230	10	0.021	0.043	0.043	0.024	0.024

Note:

a The lowest ecological component value was selected

b The guideline for lead-210 includes consideration of polonium-210.

Bold shaded values exceed the guideline

Table 5.4-2 Maximum Predicted Mean and 95th Percentile Vegetation Concentrations

Constituent	Units	Phytotoxic Concentration ^a		Maximum Predicted Concentrations ^b					
				Background		McClean Mill Area		McClean Lake Operation Small Area	
		dw	ww ^c	Mean	95th	Mean	95th	Mean	95th
Arsenic	µg/g ww	3	1.3	0.18	0.45	0.19	0.47	0.18	0.45
Cadmium	µg/g ww	5	2.1	0.021	0.074	0.021	0.074	0.021	0.074
Chromium	µg/g ww	5	2.1	0.59	0.96	0.59	0.96	0.59	0.96
Cobalt	µg/g ww	3	1.3	0.19	0.91	0.19	0.91	0.19	0.91
Copper	µg/g ww	25	10.6	7.4	22	7.4	22	7.4	22
Lead	µg/g ww	20	8.4	0.15	0.52	0.16	0.52	0.15	0.52
Molybdenum	µg/g ww	10	4.2	1.8	7.2	1.9	7.6	1.9	7.3
Nickel	µg/g ww	50	21.1	1.2	3.6	1.2	3.6	1.2	3.6
Selenium	µg/g ww	5	2.1	0.090	0.14	0.091	0.15	0.090	0.14
Silver	µg/g ww	4	1.7	0.012	0.029	0.012	0.029	0.012	0.029
Uranium	µg/g ww	-	-	0.083	0.31	0.15	0.46	0.093	0.33
Zinc	µg/g ww	100	42.2	41	128	41	128	41	128
Thorium-230	Bq/g ww	-	-	0.0024	0.0076	0.0031	0.0088	0.0025	0.0078
Radium-226	Bq/g ww	-	-	0.019	0.050	0.022	0.057	0.019	0.051
Lead-210	Bq/g ww	-	-	0.34	1.1	0.35	1.1	0.34	1.1
Polonium-210	Bq/g ww	-	-	0.25	0.95	0.25	0.98	0.25	0.95

Note: **Bold Shaded** values exceed the phytotoxic levels.

a - Lowest value from Table 5.2-2.

b – Foliage concentrations presented for comparison to the benchmark.

c – dry weight (dw) concentrations converted to wet weight (ww) concentrations using an assumed moisture content of 58%.

Table 5.4-3 Maximum Predicted Mean and 95th Percentile Lichen Concentrations

Constituent	Units	Phytotoxic Concentration ^a		Maximum Predicted Lichen Concentrations				
				Background	McClellan Mill Area		McClellan Lake Operation Small Area	
		dw	ww		Mean	95th	Mean	95th
Arsenic	µg/g ww	-	-	0.92	2.0	2.7	1.3	1.8
Cadmium	µg/g ww	-	-	0.090	0.18	0.25	0.22	0.30
Chromium	µg/g ww	-	-	1.4	1.4	1.5	1.4	2.0
Cobalt	µg/g ww	-	-	0.092	0.14	0.20	0.13	0.17
Copper	µg/g ww	-	-	0.55	1.4	2.0	1.00	1.4
Lead	µg/g ww	-	-	0.28	0.80	1.0	0.48	0.65
Molybdenum	µg/g ww	-	-	0.092	0.41	0.55	0.25	0.34
Nickel	µg/g ww	-	-	0.55	1.2	1.7	0.69	0.95
Selenium	µg/g ww	-	-	0.046	0.13	0.17	0.070	0.097
Silver	µg/g ww	-	-	0.027	0.027	0.034	0.034	0.047
Uranium	µg/g ww	-	-	0.46	2.7	3.3	1.3	1.8
Zinc	µg/g ww	-	-	5.1	15	20	10	14
Thorium-230	Bq/g ww	-	-	0.0057	0.034	0.041	0.017	0.022
Radium-226	Bq/g ww	-	-	0.0057	0.034	0.041	0.017	0.022
Lead-210	Bq/g ww	-	-	0.11	0.41	0.56	0.29	0.39
Polonium-210	Bq/g ww	-	-	0.10	0.37	0.51	0.26	0.36

Note: a = no applicable phytotoxic concentrations available for lichen.

Table 5.4-4 Assessment of Potential Effects on Vegetation Due to NO₂ and SO₂

Location	NO ₂ (µg/m ³)		SO ₂ (µg/m ³)	
	Annual		Annual	
	Maximum Incremental	Maximum Total	Maximum Incremental	Maximum Total
McClellan Lake Mill Area	5.1	7.1	2.6	2.8
McClellan Lake Operation Small Area	0.9	2.9	0.14	0.34
McClellan Lake Operation Medium Area	1.3	3.3	0.23	0.43
McClellan Lake Operation Large Area	0.7	2.7	0.02	0.22
Phytotoxicity Benchmark (µg/m ³)	19 ^a		20 ^b 10	

Note:

- a The phytotoxicity values for NO_x (annual average of 30 µg/m³) have been converted to a NO₂ concentration (assuming NO₂ represents 63% of NO_x) for comparison to model results.
- b 20 µg/m³ is selected for forests and natural vegetation; 10 µg/m³ is selected for lichen

Table 5.4-5 Comparison to Water Quality Guidelines for Wildlife Receptors

Constituent	WQG	Units	Maximum Predicted Concentrations							
			Sink Reservoir		Vulture Lake		McClean Lake east basin		Kewen Lake	
			Mean	95th	Mean	95th	Mean	95th	Mean	95th
Ammonia	-	µg/L-N	3.9	4.6	1.0	1.3	0.11	0.14	0.06	0.07
Chloride	600	mg/L	219	252	170	191	13	19	6	8
Fluoride	1	mg/L	0.73	0.88	0.57	0.67	0.078	0.096	0.057	0.065
Nitrate (as N)	100	mg/L	7.3	10	5.4	6.5	0.45	0.59	0.22	0.28
Potassium	-	-	23	25	18	20	1.7	2.2	0.99	1.2
Sulphate	1,000	mg/L	1,353	1,544	1,026	1,161	73	109	34	47
Total dissolved solids	3,000	mg/L	2,634	3,018	2,023	2,250	171	239	93	120
Aluminum	5	mg/L	0.56	0.70	0.43	0.50	0.04	0.054	0.023	0.029
Arsenic	25	µg/L	15	25	7.5	13	0.77	1.2	0.48	0.67
Cadmium	80	µg/L	0.032	0.046	0.023	0.033	0.011	0.011	0.01	0.01
Chromium	50	µg/L	1.5	2.1	0.82	1.2	0.50	0.53	0.49	0.50
Cobalt	1,000	µg/L	4.4	6.1	0.92	1.7	0.12	0.17	0.08	0.11
Copper	500	µg/L	2.9	4.4	1.5	2.1	0.22	0.27	0.16	0.18
Iron	-	mg/L	0.11	0.24	0.051	0.11	0.20	0.26	0.25	0.29
Lead	100	µg/L	0.90	1.2	0.37	0.48	0.07	0.08	0.06	0.06
Molybdenum	500	µg/L	80	129	35	57	3.0	4.9	1.4	2.4
Nickel	1,000	µg/L	62	84	26	38	1.7	2.4	0.83	1.2
Selenium	50	µg/L	7.7	10	3.9	4.7	0.27	0.36	0.12	0.15
Silver	50	µg/L	0.26	0.39	0.19	0.26	0.038	0.044	0.031	0.034
Uranium	200	µg/L	2.7	4.5	0.55	1.2	0.074	0.12	0.058	0.078
Zinc	50,000	µg/L	3.9	5.2	2.0	2.6	1.0	1.1	1.0	1.0
Lead-210	-	Bq/L	0.023	0.031	0.011	0.013	0.005	0.006	0.005	0.005
Polonium-210	-	Bq/L	0.017	0.026	0.01	0.015	0.003	0.004	0.003	0.004
Thorium-230	-	Bq/L	0.017	0.021	0.011	0.013	0.002	0.002	0.001	0.001
Radium-226	-	Bq/L	0.039	0.051	0.02	0.025	0.01	0.011	0.01	0.01

Note:

bold/shaded indicates concentration above the WQG

Max – Maximum future concentration. 95th – 95th percentile, annual average concentrations

Table 5.4-6 Results of Radiological Assessment for Terrestrial Receptors

Location	Receptor	Screening Index Value											
		Background		2025		2030		2040		2050		2100	
		Mean	95th	Mean	95th	Mean	95th	Mean	95th	Mean	95th	Mean	95th
Sink Reservoir	Beaver	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Mallard	0.0090	0.030	0.033	0.098	0.038	0.12	0.044	0.13	0.040	0.12	0.013	0.037
	Merganser	0.0020	0.0070	0.0090	0.022	0.010	0.025	0.010	0.026	0.0080	0.022	0.0030	0.0080
	Mink	<0.001	<0.001	<0.001	0.0020	<0.001	0.0030	0.0010	0.0040	0.0010	0.0040	<0.001	0.0010
	Muskrat	<0.001	0.0020	0.0040	0.012	0.0040	0.014	0.0060	0.019	0.0050	0.017	0.0020	0.0070
	Scaup	0.015	0.048	0.050	0.15	0.057	0.18	0.067	0.20	0.060	0.18	0.019	0.060
	Yellowlegs	0.015	0.041	0.056	0.14	0.064	0.17	0.075	0.20	0.068	0.18	0.021	0.051
	Blackbird	0.012	0.039	0.037	0.16	0.043	0.18	0.050	0.21	0.046	0.18	0.016	0.055
	Myotis	<0.001	<0.001	0.0010	0.0020	0.0010	0.0030	0.0020	0.0040	0.0010	0.0030	<0.001	0.0010
Vulture Lake	Beaver	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Mallard	0.0090	0.030	0.027	0.083	0.032	0.097	0.038	0.11	0.028	0.084	0.011	0.034
	Merganser	0.0020	0.0070	0.0060	0.016	0.0070	0.019	0.0080	0.023	0.0060	0.017	0.0030	0.0080
	Mink	<0.001	<0.001	<0.001	0.0010	<0.001	0.0020	<0.001	0.0020	<0.001	0.0020	<0.001	<0.001
	Muskrat	<0.001	0.0020	0.0030	0.0090	0.0030	0.011	0.0040	0.015	0.0030	0.011	0.0010	0.0040
	Scaup	0.015	0.048	0.040	0.13	0.048	0.16	0.056	0.18	0.043	0.14	0.018	0.060
	Yellowlegs	0.015	0.041	0.043	0.11	0.052	0.14	0.061	0.17	0.046	0.12	0.018	0.048
	Blackbird	0.012	0.039	0.031	0.11	0.037	0.13	0.043	0.15	0.033	0.11	0.015	0.048
	Myotis	<0.001	<0.001	<0.001	0.0020	0.0010	0.0020	0.0010	0.0020	0.0010	0.0020	<0.001	0.0010
S/V TEMS	Moose	0.0020	0.0090	0.0030	0.010	0.0030	0.010	0.0030	0.010	0.0030	0.010	0.0030	0.0090
	Shrew	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Blackbird	0.012	0.039	0.033	0.12	0.039	0.14	0.045	0.17	0.038	0.13	0.015	0.047
	Myotis	<0.001	<0.001	0.0010	0.0020	0.0010	0.0020	0.0010	0.0030	0.0010	0.0020	<0.001	0.0010
McClean Mill Area	Hare	0.0010	0.0030	0.0020	0.0050	0.0020	0.0050	0.0020	0.0040	0.0020	0.0040	0.0020	0.0040
	Ptarmigan	0.053	0.19	0.055	0.20	0.055	0.20	0.055	0.20	0.055	0.20	0.055	0.20
	Shrew	<0.001	<0.001	0.0010	0.0020	0.0010	0.0020	0.0010	0.0020	0.0010	0.0020	0.0010	0.0020
	Blackbird	0.012	0.039	0.013	0.040	0.013	0.040	0.013	0.040	0.013	0.040	0.013	0.040
	Myotis	<0.001	<0.001	0.0010	0.0020	0.0010	0.0020	0.0010	0.0020	0.0010	0.0020	0.0010	0.0020
	Hare	0.0010	0.0030	0.0010	0.0030	0.0010	0.0030	0.0010	0.0030	0.0010	0.0030	0.0010	0.0030
	Ptarmigan	0.053	0.19	0.054	0.19	0.054	0.19	0.054	0.19	0.054	0.19	0.054	0.19

Location	Receptor	Screening Index Value											
		Background		2025		2030		2040		2050		2100	
		Mean	95th	Mean	95th	Mean	95th	Mean	95th	Mean	95th	Mean	95th
McClean Lake Operation Small Area	Shrew	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
McClean Lake Average	Beaver	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Mallard	0.0090	0.030	0.041	0.13	0.042	0.13	0.042	0.13	0.041	0.13	0.040	0.12
	Merganser	0.0020	0.0070	0.0080	0.022	0.0080	0.022	0.0080	0.022	0.0080	0.022	0.0080	0.021
	Mink	<0.001	<0.001	<0.001	0.0010	<0.001	0.0010	<0.001	0.0020	<0.001	0.0020	<0.001	0.0020
	Muskrat	<0.001	0.0020	0.0020	0.0070	0.0020	0.0070	0.0020	0.0080	0.0020	0.0080	0.0020	0.0080
	Scaup	0.015	0.048	0.067	0.23	0.068	0.23	0.069	0.24	0.067	0.23	0.065	0.22
	Yellowlegs	0.015	0.041	0.063	0.17	0.063	0.17	0.064	0.17	0.062	0.17	0.060	0.16
McClean Lake Operation Medium Area	Bear	0.0010	0.0020	0.0010	0.0020	0.0010	0.0020	0.0010	0.0020	0.0010	0.0020	0.0010	0.0020
	Lynx	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Owl	0.0040	0.013	0.0060	0.016	0.0060	0.016	0.0060	0.016	0.0060	0.016	0.0060	0.016
	Fox	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
McClean Lake Operation Large Area	Caribou	<0.001	0.0010	<0.001	0.0010	<0.001	0.0010	<0.001	0.0010	<0.001	0.0010	<0.001	0.0010
	Wolf	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Keweenaw Lake	Beaver	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Mallard	0.0090	0.030	0.011	0.035	0.011	0.036	0.012	0.038	0.012	0.038	0.012	0.040
	Merganser	0.0020	0.0070	0.0030	0.0070	0.0030	0.0070	0.0030	0.0070	0.0030	0.0070	0.0030	0.0070
	Mink	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0010
	Muskrat	<0.001	0.0020	0.0010	0.0040	0.0010	0.0040	0.0010	0.0040	0.0010	0.0040	0.0010	0.0050
	Scaup	0.015	0.048	0.016	0.048	0.016	0.048	0.016	0.049	0.016	0.049	0.017	0.051
	Yellowlegs	0.015	0.041	0.016	0.042	0.016	0.042	0.016	0.043	0.017	0.043	0.017	0.045
	Blackbird	0.012	0.039	0.013	0.043	0.013	0.044	0.014	0.045	0.014	0.045	0.014	0.046
	Myotis	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0010	<0.001	0.0010
Collins Creek Downstream	Eagle	<0.001	0.0030	0.0010	0.0030	0.0010	0.0030	0.0010	0.0030	0.0010	0.0030	0.0010	0.0030
	Moose	0.0020	0.0090	0.0030	0.010	0.0030	0.010	0.0030	0.010	0.0030	0.010	0.0030	0.010

Note: calculated using a dose benchmark of 2.4 mGy/d and a RBE of 10. Mean = predicted mean for indicated year; 95th = 95th percentile for indicated year.

Table 5.4-7 Screening Index Values for Non-Radionuclide Intakes for Wildlife

Little Brown Myotis (Bat) – McClean Lake Mill Area

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	0.14	0.16	<0.01	<0.01	0.14	0.16	<0.01	<0.01	0.15	0.16
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	119	63	0.02	0.03	0.04	0.05	0.02	0.03	0.04	0.05	0.02	0.03	0.04	0.05
Lead	50.4	10.7	0.03	0.03	0.12	0.14	0.03	0.03	0.13	0.15	0.03	0.03	0.13	0.15
Molybdenum	2.6	0.26	<0.01	<0.01	0.06	0.07	<0.01	<0.01	0.08	0.09	<0.01	<0.01	0.09	0.09
Nickel	11.6	6.2	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02
Selenium	0.63	0.33	0.25	0.28	0.48	0.53	0.25	0.28	0.49	0.53	0.26	0.28	0.49	0.54
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.02	0.03	0.01	0.01	0.02	0.03
Zinc	249	215	0.04	0.05	0.05	0.05	0.04	0.05	0.05	0.05	0.04	0.05	0.05	0.05

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	0.15	0.17	<0.01	<0.01	0.15	0.17	<0.01	<0.01	0.15	0.17
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	119	63	0.02	0.03	0.04	0.05	0.02	0.03	0.04	0.05	0.02	0.03	0.04	0.05
Lead	50.4	10.7	0.03	0.03	0.13	0.15	0.03	0.03	0.13	0.15	0.03	0.03	0.13	0.15
Molybdenum	2.6	0.26	<0.01	<0.01	0.09	0.10	<0.01	<0.01	0.09	0.10	<0.01	<0.01	0.09	0.10
Nickel	11.6	6.2	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02
Selenium	0.63	0.33	0.26	0.28	0.50	0.54	0.26	0.28	0.50	0.54	0.26	0.28	0.50	0.54
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	0.01	0.01	0.03	0.03	0.01	0.01	0.03	0.03	0.01	0.01	0.03	0.03
Zinc	249	215	0.04	0.05	0.05	0.05	0.04	0.05	0.05	0.05	0.04	0.05	0.05	0.05

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Little Brown Myotis (Bat) – Sink Reservoir

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	0.02	0.02	0.03	0.04	0.02	0.03	0.04	0.05
Cadmium	5.51	0.33	<0.01	<0.01	0.14	0.16	<0.01	0.01	0.17	0.19	<0.01	0.01	0.16	0.18
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Copper	119	63	0.02	0.03	0.04	0.05	0.03	0.03	0.05	0.06	0.03	0.03	0.05	0.06
Lead	50.4	10.7	0.03	0.03	0.12	0.14	0.03	0.03	0.12	0.14	0.03	0.03	0.12	0.15
Molybdenum	2.6	0.26	<0.01	<0.01	0.06	0.07	0.37	0.45	3.7	4.4	0.37	0.44	3.7	4.3
Nickel	11.6	6.2	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.02	0.02	0.01	0.01	0.02	0.02
Selenium	0.63	0.33	0.25	0.28	0.48	0.53	8.7	9.9	16.6	18.9	9.3	10.6	17.8	20.2
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.01	0.01	0.02	0.02
Zinc	249	215	0.04	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.05	0.06	0.06	0.07

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	14.2	8.1	0.03	0.04	0.06	0.07	0.03	0.04	0.05	0.06	<0.01	<0.01	0.01	0.01
Cadmium	5.51	0.33	<0.01	<0.01	0.15	0.17	<0.01	<0.01	0.14	0.16	<0.01	<0.01	0.13	0.15
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	0.01	0.03	0.03	0.01	0.01	0.03	0.03	<0.01	<0.01	0.01	0.01
Copper	119	63	0.03	0.04	0.06	0.07	0.03	0.04	0.06	0.07	0.02	0.03	0.05	0.05
Lead	50.4	10.7	0.03	0.03	0.13	0.15	0.03	0.03	0.13	0.14	0.03	0.03	0.12	0.14
Molybdenum	2.6	0.26	0.34	0.40	3.4	4.0	0.31	0.37	3.1	3.6	0.06	0.08	0.63	0.76
Nickel	11.6	6.2	0.01	0.02	0.03	0.03	0.01	0.01	0.02	0.03	<0.01	<0.01	0.02	0.02
Selenium	0.63	0.33	10.7	12.3	20.4	23.5	8.5	9.8	16.3	18.8	1.6	1.8	3.0	3.4
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	0.05	0.06	0.06	0.07	0.05	0.06	0.06	0.07	0.04	0.05	0.05	0.06

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Little Brown Myotis (Bat) – Vulture Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.02	0.02
Cadmium	5.51	0.33	<0.01	<0.01	0.14	0.16	0.01	0.01	0.18	0.20	<0.01	0.01	0.17	0.19
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Copper	119	63	0.02	0.03	0.04	0.05	0.02	0.03	0.05	0.05	0.03	0.03	0.05	0.06
Lead	50.4	10.7	0.03	0.03	0.12	0.14	0.03	0.03	0.12	0.14	0.03	0.03	0.12	0.14
Molybdenum	2.6	0.26	<0.01	<0.01	0.06	0.07	0.18	0.21	1.8	2.1	0.16	0.20	1.6	1.9
Nickel	11.6	6.2	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.02	0.02	<0.01	0.01	0.02	0.02
Selenium	0.63	0.33	0.25	0.28	0.48	0.53	4.3	4.9	8.2	9.4	4.4	5.0	8.4	9.6
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Zinc	249	215	0.04	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.05	0.06	0.06	0.07

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	14.2	8.1	0.01	0.01	0.02	0.03	<0.01	0.01	0.02	0.02	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	0.01	0.16	0.18	<0.01	<0.01	0.15	0.17	<0.01	<0.01	0.14	0.16
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	0.02	0.03	<0.01	<0.01	0.02	0.02	<0.01	<0.01	<0.01	<0.01
Copper	119	63	0.03	0.03	0.05	0.06	0.03	0.03	0.05	0.06	0.02	0.03	0.04	0.05
Lead	50.4	10.7	0.03	0.03	0.12	0.14	0.03	0.03	0.12	0.14	0.03	0.03	0.12	0.14
Molybdenum	2.6	0.26	0.14	0.17	1.4	1.7	0.10	0.12	1.0	1.2	0.01	0.01	0.11	0.13
Nickel	11.6	6.2	0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02	<0.01	<0.01	0.01	0.02
Selenium	0.63	0.33	4.7	5.4	8.9	10.3	2.7	3.1	5.2	6.0	0.32	0.35	0.61	0.68
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	0.05	0.06	0.06	0.07	0.05	0.06	0.06	0.07	0.04	0.05	0.05	0.06

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Little Brown Myotis (Bat) – McClean Lake East Basin

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Cadmium	5.51	0.33	<0.01	<0.01	0.14	0.16	<0.01	<0.01	0.15	0.17	<0.01	<0.01	0.15	0.17
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Copper	119	63	0.02	0.03	0.04	0.05	0.02	0.03	0.05	0.05	0.02	0.03	0.05	0.05
Lead	50.4	10.7	0.03	0.03	0.12	0.14	0.03	0.03	0.12	0.14	0.03	0.03	0.12	0.14
Molybdenum	2.6	0.26	<0.01	<0.01	0.06	0.07	0.04	0.05	0.42	0.51	0.04	0.05	0.38	0.47
Nickel	11.6	6.2	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.02	0.02
Selenium	0.63	0.33	0.25	0.28	0.48	0.53	1.6	1.9	3.0	3.7	1.7	2.2	3.3	4.1
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	0.04	0.05	0.05	0.05	0.05	0.06	0.06	0.07	0.05	0.06	0.06	0.07

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	14.2	8.1	<0.01	<0.01	0.01	0.02	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	0.15	0.17	<0.01	<0.01	0.15	0.17	<0.01	<0.01	0.15	0.17
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01
Copper	119	63	0.02	0.03	0.05	0.05	0.02	0.03	0.05	0.05	0.02	0.03	0.04	0.05
Lead	50.4	10.7	0.03	0.03	0.12	0.14	0.03	0.03	0.12	0.14	0.03	0.03	0.12	0.14
Molybdenum	2.6	0.26	0.03	0.04	0.34	0.41	0.03	0.03	0.25	0.29	<0.01	<0.01	0.08	0.09
Nickel	11.6	6.2	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.01	0.02
Selenium	0.63	0.33	2.1	2.6	4.1	5.0	1.5	1.8	2.8	3.5	0.42	0.48	0.80	0.92
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	0.05	0.06	0.06	0.07	0.05	0.06	0.06	0.07	0.05	0.06	0.06	0.07

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Little Brown Myotis (Bat) – Kewen Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	0.14	0.16	<0.01	<0.01	0.15	0.17	<0.01	<0.01	0.15	0.17
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	119	63	0.02	0.03	0.04	0.05	0.02	0.03	0.04	0.05	0.02	0.03	0.04	0.05
Lead	50.4	10.7	0.03	0.03	0.12	0.14	0.03	0.03	0.12	0.14	0.03	0.03	0.12	0.14
Molybdenum	2.6	0.26	<0.01	<0.01	0.06	0.07	<0.01	<0.01	0.09	0.10	<0.01	<0.01	0.08	0.09
Nickel	11.6	6.2	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Selenium	0.63	0.33	0.25	0.28	0.48	0.53	0.37	0.41	0.71	0.78	0.39	0.43	0.74	0.82
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	0.04	0.05	0.05	0.05	0.04	0.05	0.05	0.06	0.04	0.05	0.05	0.06

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	0.15	0.17	<0.01	<0.01	0.15	0.17	<0.01	<0.01	0.15	0.17
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	119	63	0.02	0.03	0.04	0.05	0.02	0.03	0.04	0.05	0.02	0.03	0.04	0.05
Lead	50.4	10.7	0.03	0.03	0.12	0.14	0.03	0.03	0.12	0.14	0.03	0.03	0.12	0.14
Molybdenum	2.6	0.26	<0.01	<0.01	0.08	0.09	<0.01	<0.01	0.07	0.08	<0.01	<0.01	0.06	0.06
Nickel	11.6	6.2	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Selenium	0.63	0.33	0.43	0.48	0.82	0.91	0.39	0.44	0.74	0.83	0.30	0.33	0.57	0.64
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	0.04	0.05	0.05	0.06	0.04	0.05	0.05	0.06	0.05	0.05	0.05	0.06

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Bear - McClean Lake Operation Medium Area

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	<0.01	0.02	0.02	0.03	0.04	0.09	0.08	0.19	0.04	0.11	0.09	0.22
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.02	0.04	0.12	0.18	0.03	0.05	0.16	0.24	0.03	0.05	0.15	0.23
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	0.01	0.03	0.03	0.07	0.01	0.03	0.02	0.06
Nickel	10.7	5.35	<0.01	<0.01	<0.01	0.01	0.01	0.03	0.03	0.05	0.02	0.03	0.03	0.07
Selenium	1.37	1.18	0.01	0.03	0.01	0.03	0.09	0.25	0.10	0.30	0.10	0.28	0.12	0.33
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.01	0.02	0.03	0.05	0.05	0.12	0.10	0.24	0.05	0.12	0.10	0.24

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Chromium	2.78	0.57	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	0.06	0.12	0.09	0.19	0.06	0.12	0.09	0.19	0.06	0.12	0.09	0.19
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	0.03	0.10	0.27	0.97	0.03	0.10	0.27	0.97	0.03	0.10	0.27	0.97
Nickel	10.7	5.35	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	1.37	1.18	0.09	0.17	0.18	0.33	0.08	0.13	0.15	0.26	0.05	0.08	0.11	0.15
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.02	0.05	0.02	0.06	0.02	0.05	0.02	0.06	0.02	0.05	0.02	0.06

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Beaver – Sink Reservoir

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	0.06	<0.01	0.03	0.02	0.07
Copper	119	63	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	<0.01	<0.01	0.01	0.03	0.07	0.11	0.65	1.1	0.06	0.11	0.63	1.1
Nickel	11.6	6.2	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Selenium	0.63	0.33	<0.01	<0.01	<0.01	0.01	<0.01	0.01	0.01	0.02	<0.01	0.02	0.02	0.04
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	0.03	0.02	0.07	<0.01	0.02	0.01	0.04	<0.01	<0.01	<0.01	<0.01
Copper	119	63	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.06	0.10	0.57	0.96	0.05	0.08	0.49	0.81	<0.01	0.02	0.09	0.16
Nickel	11.6	6.2	<0.01	<0.01	0.01	0.02	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Selenium	0.63	0.33	<0.01	<0.01	0.01	0.02	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Beaver – Vulture Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Copper	119	63	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	<0.01	<0.01	0.01	0.03	0.03	0.05	0.29	0.49	0.03	0.05	0.27	0.47
Nickel	11.6	6.2	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Selenium	0.63	0.33	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.02
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	119	63	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.02	0.04	0.23	0.40	0.02	0.03	0.16	0.28	<0.01	<0.01	0.01	0.03
Nickel	11.6	6.2	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Selenium	0.63	0.33	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Beaver – McClean Lake East Basin

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	119	63	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	<0.01	<0.01	0.01	0.03	<0.01	0.01	0.05	0.11	<0.01	<0.01	0.04	0.10
Nickel	11.6	6.2	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Selenium	0.63	0.33	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	119	63	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	<0.01	<0.01	0.04	0.09	<0.01	<0.01	0.02	0.06	<0.01	<0.01	0.01	0.03
Nickel	11.6	6.2	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Selenium	0.63	0.33	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Beaver – Kewen Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	119	63	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	<0.01	<0.01	0.01	0.03	<0.01	<0.01	0.01	0.03	<0.01	<0.01	0.01	0.03
Nickel	11.6	6.2	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Selenium	0.63	0.33	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	119	63	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	<0.01	<0.01	0.01	0.03	<0.01	<0.01	0.01	0.03	<0.01	<0.01	0.01	0.03
Nickel	11.6	6.2	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Selenium	0.63	0.33	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Rusty Blackbird – McClean Lake Mill Area

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02
Cadmium	4.38	0.97	0.01	0.01	0.05	0.06	0.01	0.01	0.05	0.06	0.01	0.01	0.05	0.06
Chromium	27.8	13.9	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Cobalt	14.1	4.1	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Copper	27	15.3	0.10	0.11	0.18	0.20	0.10	0.11	0.18	0.20	0.10	0.11	0.18	0.20
Lead	27.7	6.83	0.05	0.05	0.19	0.22	0.05	0.06	0.20	0.23	0.05	0.06	0.20	0.23
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	19.9	14.6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.59	0.36	0.29	0.32	0.47	0.52	0.29	0.32	0.47	0.52	0.29	0.32	0.47	0.52
Silver	45.4	22.7	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.06	0.07	0.12	0.13	0.06	0.07	0.12	0.13	0.06	0.07	0.12	0.13

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02
Cadmium	4.38	0.97	0.01	0.01	0.05	0.06	0.01	0.01	0.05	0.06	0.01	0.01	0.05	0.06
Chromium	27.8	13.9	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Cobalt	14.1	4.1	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Copper	27	15.3	0.10	0.11	0.18	0.20	0.10	0.11	0.18	0.20	0.10	0.11	0.18	0.20
Lead	27.7	6.83	0.05	0.06	0.20	0.23	0.05	0.06	0.20	0.23	0.05	0.06	0.20	0.23
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	19.9	14.6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.59	0.36	0.29	0.32	0.48	0.53	0.29	0.32	0.48	0.53	0.29	0.32	0.48	0.53
Silver	45.4	22.7	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.06	0.07	0.12	0.13	0.06	0.07	0.12	0.13	0.06	0.07	0.12	0.13

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Rusty Blackbird – Sink Reservoir

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	<0.01	<0.01	0.01	0.01	0.07	0.08	0.12	0.14	0.10	0.11	0.16	0.18
Cadmium	4.38	0.97	0.01	0.01	0.05	0.06	0.01	0.02	0.06	0.07	0.01	0.01	0.06	0.06
Chromium	27.8	13.9	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Cobalt	14.1	4.1	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.02	0.03	<0.01	<0.01	0.03	0.03
Copper	27	15.3	0.10	0.11	0.18	0.20	0.12	0.13	0.20	0.23	0.13	0.14	0.23	0.25
Lead	27.7	6.83	0.05	0.05	0.19	0.22	0.05	0.06	0.20	0.22	0.05	0.06	0.20	0.22
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	0.05	0.06	0.10	0.12	0.05	0.06	0.10	0.11
Nickel	19.9	14.6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Selenium	0.59	0.36	0.29	0.32	0.47	0.52	9.7	11.2	16.0	18.3	10.4	11.9	17.1	19.6
Silver	45.4	22.7	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.06	0.07	0.12	0.13	0.07	0.08	0.14	0.15	0.07	0.08	0.15	0.16

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	0.14	0.16	0.23	0.26	0.13	0.14	0.21	0.23	0.03	0.03	0.04	0.05
Cadmium	4.38	0.97	0.01	0.01	0.05	0.06	0.01	0.01	0.05	0.06	<0.01	0.01	0.04	0.05
Chromium	27.8	13.9	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Cobalt	14.1	4.1	<0.01	0.01	0.04	0.04	0.01	0.01	0.04	0.04	<0.01	<0.01	0.02	0.02
Copper	27	15.3	0.14	0.16	0.25	0.28	0.15	0.16	0.26	0.28	0.11	0.12	0.19	0.21
Lead	27.7	6.83	0.05	0.06	0.20	0.23	0.05	0.06	0.20	0.22	0.05	0.05	0.20	0.22
Molybdenum	20.8	10.4	0.04	0.05	0.09	0.10	0.04	0.05	0.08	0.09	<0.01	<0.01	0.02	0.02
Nickel	19.9	14.6	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.59	0.36	11.9	13.7	19.6	22.4	9.5	10.9	15.6	17.9	1.7	2.0	2.9	3.3
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.08	0.09	0.15	0.17	0.08	0.09	0.15	0.17	0.06	0.07	0.13	0.14

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Rusty Blackbird – Vulture Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	<0.01	<0.01	0.01	0.01	0.03	0.03	0.05	0.06	0.04	0.04	0.06	0.07
Cadmium	4.38	0.97	0.01	0.01	0.05	0.06	0.01	0.02	0.06	0.07	0.01	0.02	0.06	0.07
Chromium	27.8	13.9	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Cobalt	14.1	4.1	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.03	0.03
Copper	27	15.3	0.10	0.11	0.18	0.20	0.11	0.12	0.19	0.22	0.12	0.13	0.21	0.23
Lead	27.7	6.83	0.05	0.05	0.19	0.22	0.05	0.06	0.20	0.22	0.05	0.06	0.20	0.22
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	0.02	0.03	0.05	0.05	0.02	0.03	0.04	0.05
Nickel	19.9	14.6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.59	0.36	0.29	0.32	0.47	0.52	4.9	5.7	8.0	9.3	5.0	5.8	8.3	9.6
Silver	45.4	22.7	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.06	0.07	0.12	0.13	0.07	0.08	0.14	0.16	0.07	0.08	0.15	0.16

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	0.05	0.06	0.08	0.10	0.04	0.05	0.07	0.08	<0.01	0.01	0.02	0.02
Cadmium	4.38	0.97	0.01	0.01	0.06	0.06	0.01	0.01	0.05	0.06	0.01	0.01	0.05	0.06
Chromium	27.8	13.9	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Cobalt	14.1	4.1	<0.01	0.01	0.03	0.04	<0.01	<0.01	0.03	0.03	<0.01	<0.01	0.01	0.01
Copper	27	15.3	0.13	0.14	0.22	0.25	0.12	0.13	0.21	0.24	0.10	0.11	0.18	0.20
Lead	27.7	6.83	0.05	0.06	0.20	0.22	0.05	0.06	0.20	0.22	0.05	0.05	0.19	0.22
Molybdenum	20.8	10.4	0.02	0.02	0.04	0.04	0.01	0.02	0.03	0.03	<0.01	<0.01	<0.01	<0.01
Nickel	19.9	14.6	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.59	0.36	5.3	6.2	8.7	10.1	3.1	3.6	5.1	6.0	0.36	0.41	0.60	0.67
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.08	0.09	0.16	0.17	0.08	0.08	0.15	0.16	0.06	0.07	0.12	0.14

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Rusty Blackbird – McClean Lake East

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	<0.01	<0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.02	0.03	0.04	0.04
Cadmium	4.38	0.97	0.01	0.01	0.05	0.06	0.01	0.01	0.05	0.06	0.01	0.01	0.05	0.06
Chromium	27.8	13.9	<0.01	<0.01	0.02	0.02	<0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02
Cobalt	14.1	4.1	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Copper	27	15.3	0.10	0.11	0.18	0.20	0.11	0.12	0.19	0.21	0.11	0.12	0.19	0.21
Lead	27.7	6.83	0.05	0.05	0.19	0.22	0.05	0.06	0.20	0.22	0.05	0.06	0.20	0.22
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	0.01
Nickel	19.9	14.6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.59	0.36	0.29	0.32	0.47	0.52	1.7	2.1	2.9	3.5	1.9	2.3	3.2	3.8
Silver	45.4	22.7	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.06	0.07	0.12	0.13	0.08	0.08	0.15	0.17	0.08	0.08	0.15	0.17

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	0.03	0.03	0.05	0.06	0.02	0.03	0.04	0.05	0.02	0.02	0.02	0.03
Cadmium	4.38	0.97	0.01	0.01	0.05	0.06	0.01	0.01	0.05	0.06	0.01	0.01	0.05	0.06
Chromium	27.8	13.9	<0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Cobalt	14.1	4.1	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.01	0.02
Copper	27	15.3	0.11	0.12	0.19	0.21	0.11	0.12	0.19	0.21	0.10	0.12	0.18	0.21
Lead	27.7	6.83	0.05	0.05	0.20	0.22	0.05	0.06	0.20	0.22	0.05	0.06	0.20	0.22
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	19.9	14.6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.59	0.36	2.4	2.9	3.9	4.7	1.7	2.0	2.7	3.3	0.47	0.54	0.76	0.88
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.08	0.08	0.15	0.17	0.08	0.08	0.15	0.17	0.08	0.08	0.15	0.16

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Rusty Blackbird – Keweenaw Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Cadmium	4.38	0.97	0.01	0.01	0.05	0.06	0.01	0.01	0.05	0.06	0.01	0.01	0.05	0.06
Chromium	27.8	13.9	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Cobalt	14.1	4.1	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Copper	27	15.3	0.10	0.11	0.18	0.20	0.10	0.11	0.17	0.20	0.10	0.11	0.17	0.20
Lead	27.7	6.83	0.05	0.05	0.19	0.22	0.05	0.05	0.19	0.22	0.05	0.05	0.19	0.22
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	19.9	14.6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.59	0.36	0.29	0.32	0.47	0.52	0.42	0.47	0.68	0.77	0.44	0.49	0.71	0.80
Silver	45.4	22.7	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.06	0.07	0.12	0.13	0.06	0.07	0.12	0.14	0.06	0.07	0.12	0.14

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Cadmium	4.38	0.97	0.01	0.01	0.05	0.06	0.01	0.01	0.05	0.06	0.01	0.01	0.05	0.06
Chromium	27.8	13.9	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Cobalt	14.1	4.1	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Copper	27	15.3	0.10	0.11	0.17	0.20	0.10	0.11	0.17	0.20	0.10	0.11	0.17	0.20
Lead	27.7	6.83	0.05	0.05	0.19	0.22	0.05	0.05	0.19	0.22	0.05	0.05	0.19	0.22
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	19.9	14.6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.59	0.36	0.48	0.55	0.79	0.90	0.44	0.49	0.71	0.81	0.34	0.38	0.55	0.62
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.06	0.07	0.13	0.14	0.06	0.07	0.13	0.14	0.07	0.07	0.13	0.15

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Caribou – McClean Lake Operation Large Area

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	8.8	5.6	<0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	4.1	2.05	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Nickel	9.8	3.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.33	0.17	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	75.9	37.9	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	8.8	5.6	<0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	4.1	2.05	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Nickel	9.8	3.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.33	0.17	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	75.9	37.9	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Eagle – Collins Creek Downstream

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.6	2.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	4.38	0.97	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	27.8	13.9	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	14.1	4.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	27	15.3	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	19.9	14.6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.59	0.36	0.07	0.11	0.11	0.19	0.11	0.21	0.18	0.34	0.12	0.22	0.19	0.37
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.6	2.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	4.38	0.97	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	27.8	13.9	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	14.1	4.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	27	15.3	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	19.9	14.6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.59	0.36	0.13	0.26	0.21	0.43	0.12	0.23	0.19	0.37	0.09	0.16	0.14	0.26
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Fox – McClean Lake Operation Medium Area

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.1	1.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Cadmium	5.51	0.33	<0.01	<0.01	0.02	0.04	<0.01	<0.01	0.02	0.04	<0.01	<0.01	0.02	0.04
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	8.8	5.6	0.08	0.15	0.12	0.24	0.08	0.15	0.12	0.24	0.08	0.15	0.12	0.24
Lead	50.4	10.7	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Molybdenum	2.6	0.26	0.01	0.03	0.11	0.34	0.01	0.04	0.12	0.36	0.01	0.04	0.12	0.36
Nickel	112	45	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.21	0.105	0.22	0.48	0.45	0.96	0.59	1.6	1.2	3.2	0.63	1.7	1.3	3.4
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	0.03	0.09	0.04	0.10	0.03	0.09	0.04	0.10	0.03	0.09	0.04	0.10

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.1	1.5	<0.01	0.01	0.01	0.03	<0.01	0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.01
Cadmium	5.51	0.33	<0.01	<0.01	0.02	0.04	<0.01	<0.01	0.02	0.04	<0.01	<0.01	0.02	0.04
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	8.8	5.6	0.08	0.15	0.12	0.24	0.08	0.15	0.12	0.24	0.08	0.15	0.12	0.24
Lead	50.4	10.7	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Molybdenum	2.6	0.26	0.01	0.04	0.12	0.36	0.01	0.04	0.11	0.35	0.01	0.04	0.11	0.35
Nickel	112	45	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.21	0.105	0.74	2.0	1.5	4.1	0.57	1.5	1.1	3.0	0.28	0.58	0.55	1.2
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	0.03	0.09	0.04	0.10	0.03	0.09	0.04	0.10	0.03	0.09	0.04	0.10

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Hare – McClean Mill Area

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3	0.8	0.02	0.05	0.06	0.20	0.02	0.05	0.07	0.20	0.02	0.06	0.07	0.21
Cadmium	5.51	0.33	<0.01	<0.01	0.04	0.15	<0.01	<0.01	0.04	0.15	<0.01	<0.01	0.04	0.15
Chromium	29.9	23.7	<0.01	0.02	0.01	0.03	<0.01	0.02	0.01	0.03	<0.01	0.02	0.01	0.03
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Copper	45.7	27.7	0.04	0.12	0.07	0.20	0.04	0.12	0.07	0.20	0.04	0.12	0.07	0.20
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.06	0.19	0.56	1.9	0.06	0.20	0.59	2.0	0.06	0.20	0.59	2.0
Nickel	11.6	6.2	0.04	0.08	0.07	0.16	0.04	0.08	0.07	0.16	0.04	0.08	0.07	0.16
Selenium	0.63	0.33	0.04	0.07	0.07	0.14	0.04	0.07	0.07	0.14	0.04	0.07	0.07	0.14
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	0.02	0.01	0.03	<0.01	0.02	0.02	0.05	0.01	0.03	0.02	0.05
Zinc	249	215	0.04	0.11	0.05	0.13	0.04	0.11	0.05	0.13	0.04	0.11	0.05	0.13

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3	0.8	0.02	0.05	0.07	0.20	0.02	0.05	0.07	0.20	0.02	0.05	0.07	0.20
Cadmium	5.51	0.33	<0.01	<0.01	0.04	0.15	<0.01	<0.01	0.04	0.15	<0.01	<0.01	0.04	0.15
Chromium	29.9	23.7	<0.01	0.02	0.01	0.03	<0.01	0.02	0.01	0.03	<0.01	0.02	0.01	0.03
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Copper	45.7	27.7	0.04	0.12	0.07	0.20	0.04	0.12	0.07	0.20	0.04	0.12	0.07	0.20
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.06	0.20	0.59	2.0	0.06	0.20	0.59	2.0	0.06	0.20	0.59	2.0
Nickel	11.6	6.2	0.04	0.08	0.07	0.16	0.04	0.08	0.07	0.16	0.04	0.08	0.07	0.16
Selenium	0.63	0.33	0.04	0.07	0.07	0.14	0.04	0.07	0.07	0.14	0.04	0.07	0.07	0.14
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	0.02	0.02	0.05	<0.01	0.02	0.02	0.05	<0.01	0.02	0.02	0.05
Zinc	249	215	0.04	0.11	0.05	0.13	0.04	0.11	0.05	0.13	0.04	0.11	0.05	0.13

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Hare – McClean Lake Operation Small Area

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3	0.8	0.02	0.05	0.06	0.20	0.02	0.05	0.06	0.20	0.02	0.05	0.06	0.20
Cadmium	5.51	0.33	<0.01	<0.01	0.04	0.15	<0.01	<0.01	0.04	0.15	<0.01	<0.01	0.04	0.15
Chromium	29.9	23.7	<0.01	0.02	0.01	0.03	<0.01	0.02	0.01	0.03	<0.01	0.02	0.01	0.03
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Copper	45.7	27.7	0.04	0.12	0.07	0.20	0.04	0.12	0.07	0.20	0.04	0.12	0.07	0.20
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.06	0.19	0.56	1.9	0.06	0.19	0.56	1.9	0.06	0.19	0.56	1.9
Nickel	11.6	6.2	0.04	0.08	0.07	0.16	0.04	0.08	0.07	0.16	0.04	0.08	0.07	0.16
Selenium	0.63	0.33	0.04	0.07	0.07	0.14	0.04	0.07	0.07	0.14	0.04	0.07	0.07	0.14
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	0.02	0.01	0.03	<0.01	0.02	0.01	0.03	<0.01	0.02	0.01	0.03
Zinc	249	215	0.04	0.11	0.05	0.13	0.04	0.11	0.05	0.13	0.04	0.11	0.05	0.13

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3	0.8	0.02	0.05	0.06	0.20	0.02	0.05	0.06	0.20	0.02	0.05	0.06	0.20
Cadmium	5.51	0.33	<0.01	<0.01	0.04	0.15	<0.01	<0.01	0.04	0.15	<0.01	<0.01	0.04	0.15
Chromium	29.9	23.7	<0.01	0.02	0.01	0.03	<0.01	0.02	0.01	0.03	<0.01	0.02	0.01	0.03
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Copper	45.7	27.7	0.04	0.12	0.07	0.20	0.04	0.12	0.07	0.20	0.04	0.12	0.07	0.20
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.06	0.19	0.56	1.9	0.06	0.19	0.56	1.9	0.06	0.19	0.56	1.9
Nickel	11.6	6.2	0.04	0.08	0.07	0.16	0.04	0.08	0.07	0.16	0.04	0.08	0.07	0.16
Selenium	0.63	0.33	0.04	0.07	0.07	0.14	0.04	0.07	0.07	0.14	0.04	0.07	0.07	0.14
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	0.02	0.01	0.03	<0.01	0.02	0.01	0.03	<0.01	0.02	0.01	0.03
Zinc	249	215	0.04	0.11	0.05	0.13	0.04	0.11	0.05	0.13	0.04	0.11	0.05	0.13

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Lynx – McClean Lake Operation Medium Area

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.1	1.5	<0.01	0.01	<0.01	0.03	<0.01	0.01	<0.01	0.03	<0.01	0.01	0.01	0.03
Cadmium	5.51	0.33	<0.01	<0.01	0.03	0.11	<0.01	<0.01	0.03	0.11	<0.01	<0.01	0.03	0.11
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	8.8	5.6	0.24	0.82	0.38	1.3	0.24	0.82	0.38	1.3	0.24	0.82	0.38	1.3
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.06	0.19	0.55	1.9	0.06	0.19	0.56	1.9	0.06	0.19	0.56	1.9
Nickel	112	45	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Selenium	0.21	0.105	0.49	2.1	0.97	4.1	0.49	2.1	0.98	4.1	0.49	2.1	0.98	4.1
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uranium	5.6	2.8	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Zinc	249	215	0.17	0.56	0.20	0.65	0.17	0.56	0.20	0.65	0.17	0.56	0.20	0.65

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.1	1.5	<0.01	0.01	<0.01	0.03	<0.01	0.01	<0.01	0.03	<0.01	0.01	<0.01	0.03
Cadmium	5.51	0.33	<0.01	<0.01	0.03	0.11	<0.01	<0.01	0.03	0.11	<0.01	<0.01	0.03	0.11
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	8.8	5.6	0.24	0.82	0.38	1.3	0.24	0.82	0.38	1.3	0.24	0.82	0.38	1.3
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.06	0.19	0.56	1.9	0.06	0.19	0.56	1.9	0.06	0.19	0.56	1.9
Nickel	112	45	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Selenium	0.21	0.105	0.49	2.1	0.98	4.1	0.49	2.1	0.97	4.1	0.49	2.1	0.97	4.1
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uranium	5.6	2.8	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Zinc	249	215	0.17	0.56	0.20	0.65	0.17	0.56	0.20	0.65	0.17	0.56	0.20	0.65

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Mallard – Sink Reservoir

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	<0.01	0.02	0.02	0.03	0.21	0.42	0.41	0.83	0.28	0.55	0.55	1.1
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.01
Chromium	2.78	0.57	0.02	0.04	0.12	0.18	0.03	0.05	0.13	0.23	0.03	0.05	0.13	0.23
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	0.10	<0.01	0.01	0.05	0.12
Copper	75.2	24.1	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	0.05	0.01	0.03	0.03	0.08
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	0.17	0.33	0.33	0.65	0.16	0.31	0.33	0.63
Nickel	10.7	5.35	<0.01	<0.01	<0.01	0.01	0.06	0.12	0.12	0.23	0.09	0.17	0.17	0.34
Selenium	1.37	1.18	0.01	0.03	0.01	0.03	0.63	1.5	0.73	1.7	0.67	1.6	0.78	1.8
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	<0.01	0.02	<0.01	0.02
Zinc	62.7	31.35	0.01	0.02	0.03	0.05	0.04	0.09	0.08	0.17	0.04	0.10	0.09	0.20

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	0.40	0.80	0.79	1.6	0.35	0.71	0.70	1.4	0.06	0.12	0.12	0.24
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.02	0.04	0.12	0.19	0.02	0.04	0.12	0.18	0.02	0.04	0.12	0.18
Cobalt	148	14.8	<0.01	0.01	0.05	0.12	<0.01	<0.01	0.04	0.08	<0.01	<0.01	<0.01	0.01
Copper	75.2	24.1	0.02	0.04	0.05	0.11	0.02	0.04	0.05	0.11	<0.01	<0.01	<0.01	0.02
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	0.15	0.29	0.30	0.58	0.13	0.25	0.27	0.50	0.03	0.05	0.05	0.10
Nickel	10.7	5.35	0.15	0.30	0.30	0.60	0.12	0.25	0.24	0.49	0.02	0.04	0.04	0.09
Selenium	1.37	1.18	0.76	1.8	0.89	2.1	0.60	1.4	0.70	1.7	0.10	0.23	0.11	0.27
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Uranium	16	16	<0.01	0.02	<0.01	0.02	<0.01	0.02	<0.01	0.02	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.05	0.12	0.11	0.24	0.05	0.12	0.10	0.24	0.02	0.05	0.05	0.11

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Mallard – Vulture Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	<0.01	0.02	0.02	0.03	0.07	0.19	0.14	0.39	0.09	0.25	0.18	0.50
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Chromium	2.78	0.57	0.02	0.04	0.12	0.18	0.02	0.04	0.12	0.18	0.02	0.04	0.12	0.18
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.02	0.03
Copper	75.2	24.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.03	<0.01	0.02	0.02	0.05
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	0.08	0.18	0.15	0.35	0.07	0.15	0.14	0.30
Nickel	10.7	5.35	<0.01	<0.01	<0.01	0.01	0.04	0.08	0.09	0.15	0.06	0.12	0.13	0.24
Selenium	1.37	1.18	0.01	0.03	0.01	0.03	0.31	0.68	0.36	0.79	0.32	0.69	0.37	0.80
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.01	0.02	0.03	0.05	0.04	0.09	0.08	0.18	0.05	0.10	0.09	0.21

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	0.13	0.38	0.27	0.75	0.11	0.30	0.21	0.60	0.01	0.03	0.03	0.06
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.02	0.04	0.12	0.18	0.02	0.04	0.12	0.18	0.02	0.04	0.12	0.18
Cobalt	148	14.8	<0.01	<0.01	0.02	0.04	<0.01	<0.01	0.01	0.02	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	<0.01	0.02	0.03	0.08	<0.01	0.02	0.03	0.07	<0.01	<0.01	<0.01	0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	0.06	0.12	0.12	0.25	0.04	0.09	0.08	0.17	<0.01	<0.01	<0.01	<0.01
Nickel	10.7	5.35	0.11	0.21	0.23	0.41	0.08	0.14	0.15	0.29	<0.01	0.01	0.01	0.02
Selenium	1.37	1.18	0.33	0.74	0.39	0.85	0.19	0.43	0.22	0.50	0.02	0.04	0.02	0.04
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.05	0.13	0.11	0.25	0.05	0.11	0.09	0.22	0.02	0.04	0.04	0.09

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Mallard – McClean Lake East

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	<0.01	0.02	0.02	0.03	0.04	0.09	0.08	0.19	0.04	0.11	5.1	2.55
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	25.6	3.08
Chromium	2.78	0.57	0.02	0.04	0.12	0.18	0.03	0.05	0.16	0.24	0.03	0.05	2.78	0.57
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	148	14.8
Copper	75.2	24.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	75.2	24.1
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	27.7	6.83
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	0.01	0.03	0.03	0.07	0.01	0.03	20.8	10.4
Nickel	10.7	5.35	<0.01	<0.01	<0.01	0.01	0.01	0.03	0.03	0.05	0.02	0.03	10.7	5.35
Selenium	1.37	1.18	0.01	0.03	0.01	0.03	0.09	0.25	0.10	0.30	0.10	0.28	1.37	1.18
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	45.4	22.7
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	16	16
Zinc	62.7	31.35	0.01	0.02	0.03	0.05	0.05	0.12	0.10	0.24	0.05	0.12	62.7	31.35

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	0.09	0.22	0.06	0.16	0.12	0.31	0.05	0.13	0.10	0.26	0.03	0.06
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.15	0.23	0.03	0.04	0.14	0.21	0.03	0.04	0.13	0.20	0.03	0.04
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	<0.01	0.02	<0.01	<0.01	0.01	0.03	<0.01	<0.01	0.01	0.02	<0.01	<0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	0.02	0.06	<0.01	0.03	0.02	0.05	<0.01	0.02	0.01	0.03	<0.01	<0.01
Nickel	10.7	5.35	0.03	0.07	0.03	0.06	0.06	0.11	0.02	0.04	0.04	0.09	<0.01	<0.01
Selenium	1.37	1.18	0.12	0.33	0.12	0.36	0.14	0.42	0.08	0.25	0.10	0.29	0.02	0.06
Silver	45.4	22.7	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.10	0.24	0.05	0.12	0.10	0.25	0.05	0.12	0.10	0.24	0.05	0.12

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Mallard – Kewen Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	<0.01	0.02	0.02	0.03	<0.01	0.02	0.02	0.03	<0.01	0.02	0.02	0.03
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.02	0.04	0.12	0.18	0.02	0.04	0.12	0.18	0.02	0.04	0.12	0.18
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	10.7	5.35	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Selenium	1.37	1.18	0.01	0.03	0.01	0.03	0.02	0.04	0.02	0.05	0.02	0.05	0.03	0.05
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.01	0.02	0.03	0.05	0.02	0.04	0.04	0.08	0.02	0.04	0.04	0.09

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	<0.01	0.02	0.02	0.04	<0.01	0.02	0.02	0.03	<0.01	0.02	0.02	0.03
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.02	0.04	0.12	0.18	0.02	0.04	0.12	0.18	0.02	0.04	0.12	0.18
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	10.7	5.35	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Selenium	1.37	1.18	0.03	0.05	0.03	0.06	0.02	0.05	0.03	0.05	0.02	0.03	0.02	0.04
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.02	0.05	0.05	0.09	0.02	0.05	0.05	0.10	0.03	0.06	0.06	0.11

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Merganser – Sink Reservoir

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	<0.01	<0.01	<0.01	<0.01	0.05	0.07	0.10	0.14	0.07	0.10	0.13	0.20
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.01	0.03	0.07	0.13	0.03	0.06	0.12	0.27	0.03	0.06	0.13	0.28
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Copper	75.2	24.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	0.05	0.10	0.11	0.19	0.05	0.09	0.11	0.19
Nickel	10.7	5.35	<0.01	<0.01	<0.01	<0.01	0.02	0.03	0.04	0.05	0.02	0.04	0.05	0.08
Selenium	1.37	1.18	0.06	0.10	0.06	0.11	1.6	3.5	1.9	4.1	1.7	3.8	2.0	4.4
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.02	0.03	0.03	0.07	0.02	0.04	0.04	0.08	0.02	0.04	0.04	0.08

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	0.08	0.12	0.16	0.23	0.07	0.10	0.14	0.20	0.01	0.02	0.02	0.04
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.02	0.05	0.10	0.22	0.02	0.03	0.08	0.16	0.01	0.03	0.07	0.13
Cobalt	148	14.8	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	0.05	0.09	0.10	0.17	0.04	0.08	0.09	0.16	<0.01	0.02	0.02	0.03
Nickel	10.7	5.35	0.04	0.07	0.08	0.14	0.03	0.06	0.06	0.11	<0.01	0.01	0.01	0.02
Selenium	1.37	1.18	2.0	4.3	2.3	5.0	1.6	3.4	1.8	4.0	0.27	0.57	0.31	0.66
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.02	0.04	0.04	0.08	0.02	0.04	0.04	0.08	0.02	0.04	0.04	0.07

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Merganser – Vulture Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	<0.01	<0.01	<0.01	<0.01	0.02	0.04	0.03	0.07	0.02	0.05	0.05	0.09
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.01	0.03	0.07	0.13	0.01	0.03	0.07	0.13	0.02	0.03	0.08	0.15
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	0.02	0.05	0.05	0.09	0.02	0.04	0.05	0.08
Nickel	10.7	5.35	<0.01	<0.01	<0.01	<0.01	0.01	0.02	0.02	0.04	0.02	0.03	0.04	0.06
Selenium	1.37	1.18	0.06	0.10	0.06	0.11	0.80	1.8	0.92	2.1	0.82	1.9	0.95	2.2
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.02	0.03	0.03	0.07	0.02	0.04	0.04	0.08	0.02	0.04	0.04	0.08

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	0.03	0.06	0.06	0.13	0.02	0.05	0.04	0.09	<0.01	<0.01	<0.01	0.01
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.01	0.03	0.07	0.13	0.01	0.03	0.07	0.13	0.01	0.03	0.07	0.13
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	0.02	0.03	0.04	0.07	0.01	0.02	0.03	0.05	<0.01	<0.01	<0.01	<0.01
Nickel	10.7	5.35	0.03	0.05	0.06	0.10	0.02	0.04	0.04	0.08	<0.01	<0.01	<0.01	<0.01
Selenium	1.37	1.18	0.86	2.0	1.0	2.3	0.51	1.2	0.59	1.4	0.07	0.13	0.08	0.15
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.02	0.04	0.04	0.08	0.02	0.04	0.04	0.08	0.02	0.04	0.04	0.07

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Merganser – McClean Lake East

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	0.04	<0.01	0.02	0.02	0.04
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.01	0.03	0.07	0.13	0.02	0.03	0.08	0.15	0.02	0.03	0.08	0.14
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Nickel	10.7	5.35	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.02
Selenium	1.37	1.18	0.06	0.10	0.06	0.11	0.25	0.63	0.29	0.73	0.27	0.70	0.32	0.81
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.02	0.03	0.03	0.07	0.02	0.04	0.04	0.08	0.02	0.04	0.04	0.08

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	0.01	0.03	0.02	0.06	<0.01	0.03	0.02	0.05	<0.01	0.01	0.01	0.03
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.02	0.03	0.08	0.14	0.02	0.03	0.08	0.13	0.02	0.03	0.07	0.13
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Nickel	10.7	5.35	<0.01	0.01	0.02	0.03	<0.01	0.01	0.01	0.02	<0.01	<0.01	<0.01	<0.01
Selenium	1.37	1.18	0.33	0.90	0.38	1.0	0.24	0.63	0.28	0.74	0.08	0.17	0.10	0.19
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.02	0.04	0.04	0.08	0.02	0.04	0.04	0.08	0.02	0.04	0.04	0.08

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Merganser – Kewen Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.01	0.03	0.07	0.13	0.01	0.03	0.07	0.13	0.01	0.03	0.07	0.13
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	10.7	5.35	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	1.37	1.18	0.06	0.10	0.06	0.11	0.08	0.14	0.09	0.16	0.08	0.15	0.09	0.17
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.02	0.03	0.03	0.07	0.02	0.04	0.04	0.07	0.02	0.04	0.04	0.07

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.01	0.03	0.07	0.13	0.01	0.03	0.07	0.13	0.01	0.03	0.07	0.13
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	10.7	5.35	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	1.37	1.18	0.09	0.16	0.10	0.19	0.08	0.14	0.09	0.17	0.06	0.11	0.07	0.13
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.02	0.04	0.04	0.07	0.02	0.04	0.04	0.07	0.02	0.04	0.04	0.07

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Mink – Sink Reservoir

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.1	1.5	<0.01	<0.01	0.01	0.02	0.11	0.16	0.23	0.34	0.15	0.22	0.31	0.46
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.02	0.03
Copper	11.5	5.9	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	<0.01	<0.01	0.04	0.08	0.88	1.7	8.8	16.5	0.86	1.6	8.6	16.0
Nickel	112	45	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.02
Selenium	0.21	0.105	0.30	0.58	0.61	1.2	8.0	20.2	15.9	40.5	8.5	21.6	17.0	43.3
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	0.01	0.02	0.02	0.04	0.01	0.02	0.03	0.04
Zinc	249	215	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.1	1.5	0.21	0.31	0.43	0.63	0.18	0.27	0.38	0.56	0.03	0.05	0.07	0.10
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	0.02	0.02	0.04	<0.01	0.02	0.02	0.04	<0.01	<0.01	<0.01	0.01
Copper	11.5	5.9	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.79	1.5	7.9	14.9	0.71	1.3	7.1	12.7	0.13	0.26	1.3	2.6
Nickel	112	45	<0.01	0.01	0.02	0.03	<0.01	<0.01	0.01	0.02	<0.01	<0.01	<0.01	<0.01
Selenium	0.21	0.105	9.7	24.7	19.4	49.4	7.7	19.6	15.4	39.1	1.3	3.3	2.6	6.6
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	0.01	0.02	0.03	0.04	0.01	0.02	0.03	0.04	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Mink – Vulture Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.1	1.5	<0.01	<0.01	0.01	0.02	0.04	0.08	0.08	0.17	0.05	0.11	0.10	0.23
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.01	0.03	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	0.01	0.02
Copper	11.5	5.9	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	<0.01	<0.01	0.04	0.08	0.39	0.75	3.9	7.5	0.36	0.65	3.6	6.5
Nickel	112	45	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Selenium	0.21	0.105	0.30	0.58	0.61	1.2	4.0	10.2	8.0	20.4	4.1	10.5	8.2	21.0
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.01	0.02
Zinc	249	215	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.1	1.5	0.07	0.17	0.15	0.34	0.06	0.14	0.11	0.28	<0.01	0.02	0.02	0.03
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	0.02	0.03	<0.01	<0.01	0.01	0.02	<0.01	<0.01	<0.01	<0.01
Copper	11.5	5.9	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.31	0.53	3.0	5.3	0.22	0.36	2.2	3.6	0.01	0.02	0.13	0.24
Nickel	112	45	<0.01	<0.01	0.01	0.03	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01
Selenium	0.21	0.105	4.3	11.3	8.6	22.6	2.5	6.6	5.0	13.2	0.31	0.66	0.62	1.3
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	0.01	0.02	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Mink – McClean Lake East

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.1	1.5	<0.01	<0.01	0.01	0.02	0.02	0.05	0.04	0.10	0.02	0.05	0.05	0.11
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	11.5	5.9	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	<0.01	<0.01	0.04	0.08	0.07	0.21	0.69	2.1	0.06	0.19	0.62	1.8
Nickel	112	45	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.21	0.105	0.30	0.58	0.61	1.2	1.2	2.9	2.4	5.8	1.3	3.2	2.6	6.5
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.1	1.5	0.03	0.07	0.06	0.15	0.03	0.06	0.05	0.13	0.02	0.03	0.03	0.07
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	11.5	5.9	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.05	0.15	0.54	1.5	0.04	0.11	0.36	1.0	<0.01	0.01	0.06	0.13
Nickel	112	45	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.21	0.105	1.6	3.9	3.2	7.9	1.1	2.8	2.3	5.6	0.38	0.83	0.75	1.7
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Mink – Kewen Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.1	1.5	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	11.5	5.9	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	<0.01	<0.01	0.04	0.08	<0.01	0.02	0.09	0.21	<0.01	0.02	0.08	0.18
Nickel	112	45	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.21	0.105	0.30	0.58	0.61	1.2	0.35	0.74	0.71	1.5	0.37	0.78	0.73	1.6
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.1	1.5	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	11.5	5.9	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08	0.02	0.04	0.03	0.08
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	<0.01	0.02	0.07	0.16	<0.01	0.01	0.05	0.12	<0.01	<0.01	0.04	0.08
Nickel	112	45	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.21	0.105	0.40	0.85	0.81	1.7	0.37	0.78	0.73	1.6	0.30	0.59	0.61	1.2
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03	<0.01	0.02	<0.01	0.03

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Moose – S/V TEMS

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	0.02	0.06	<0.01	<0.01	0.02	0.06	<0.01	<0.01	0.02	0.06
Chromium	29.9	23.7	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	8.8	5.6	0.07	0.26	0.10	0.41	0.07	0.26	0.10	0.41	0.07	0.26	0.10	0.41
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	4.1	2.05	<0.01	<0.01	<0.01	0.01	<0.01	0.01	0.02	0.03	<0.01	0.01	0.02	0.03
Nickel	9.8	3.4	0.02	0.03	0.04	0.10	0.02	0.03	0.04	0.10	0.02	0.03	0.04	0.10
Selenium	0.33	0.17	0.02	0.05	0.04	0.09	0.02	0.05	0.04	0.09	0.02	0.05	0.04	0.09
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Zinc	75.9	37.9	0.04	0.13	0.09	0.27	0.04	0.13	0.09	0.27	0.04	0.13	0.09	0.27

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	0.02	0.06	<0.01	<0.01	0.02	0.06	<0.01	<0.01	0.02	0.06
Chromium	29.9	23.7	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	8.8	5.6	0.07	0.26	0.10	0.41	0.07	0.26	0.10	0.41	0.07	0.26	0.10	0.41
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	4.1	2.05	<0.01	0.01	0.02	0.03	<0.01	0.01	0.01	0.02	<0.01	<0.01	<0.01	0.02
Nickel	9.8	3.4	0.02	0.04	0.05	0.10	0.02	0.03	0.04	0.10	0.02	0.03	0.04	0.10
Selenium	0.33	0.17	0.02	0.05	0.04	0.09	0.02	0.05	0.04	0.09	0.02	0.05	0.04	0.09
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Zinc	75.9	37.9	0.04	0.13	0.09	0.27	0.04	0.13	0.09	0.27	0.04	0.13	0.09	0.27

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Moose – Collins Creek Downstream

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	0.02	0.06	<0.01	<0.01	0.02	0.06	<0.01	<0.01	0.02	0.06
Chromium	29.9	23.7	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	8.8	5.6	0.07	0.26	0.10	0.41	0.07	0.26	0.10	0.41	0.07	0.26	0.10	0.41
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	4.1	2.05	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Nickel	9.8	3.4	0.02	0.03	0.04	0.10	0.02	0.03	0.04	0.10	0.02	0.03	0.04	0.10
Selenium	0.33	0.17	0.02	0.05	0.04	0.09	0.02	0.05	0.04	0.09	0.02	0.05	0.04	0.09
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Zinc	75.9	37.9	0.04	0.13	0.09	0.27	0.04	0.13	0.09	0.27	0.04	0.13	0.09	0.27

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	<0.01	0.02	0.06	<0.01	<0.01	0.02	0.06	<0.01	<0.01	0.02	0.06
Chromium	29.9	23.7	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	8.8	5.6	0.07	0.26	0.10	0.41	0.07	0.26	0.10	0.41	0.07	0.26	0.10	0.41
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	4.1	2.05	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.01
Nickel	9.8	3.4	0.02	0.03	0.04	0.10	0.02	0.03	0.04	0.10	0.02	0.03	0.04	0.10
Selenium	0.33	0.17	0.02	0.05	0.04	0.09	0.02	0.05	0.04	0.09	0.02	0.05	0.04	0.09
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Zinc	75.9	37.9	0.04	0.13	0.09	0.27	0.04	0.13	0.09	0.27	0.04	0.13	0.09	0.27

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Muskrat – Sink Reservoir

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	0.05	0.08	0.08	0.13	0.06	0.10	0.11	0.18
Cadmium	5.51	0.33	<0.01	0.01	0.06	0.19	0.01	0.03	0.18	0.52	<0.01	0.03	0.15	0.43
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.02
Cobalt	13.4	5.2	<0.01	0.01	0.01	0.03	0.19	0.62	0.49	1.6	0.23	0.72	0.59	1.9
Copper	119	63	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	<0.01	<0.01	0.03	0.05	1.4	2.5	14.0	25.5	1.4	2.3	13.8	23.1
Nickel	11.6	6.2	<0.01	<0.01	<0.01	<0.01	0.07	0.14	0.13	0.25	0.09	0.16	0.17	0.30
Selenium	0.63	0.33	0.01	0.03	0.02	0.05	0.65	1.4	1.2	2.7	0.71	1.5	1.4	2.9
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	0.03	0.05	0.06	0.10	0.03	0.05	0.06	0.10
Zinc	249	215	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	<0.01	0.02	<0.01	0.02

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	0.08	0.14	0.15	0.25	0.07	0.12	0.13	0.21	0.01	0.02	0.02	0.04
Cadmium	5.51	0.33	<0.01	0.02	0.11	0.33	<0.01	0.01	0.08	0.22	<0.01	0.01	0.06	0.19
Chromium	29.9	23.7	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	0.21	0.64	0.55	1.6	0.15	0.36	0.38	0.93	0.01	0.04	0.03	0.09
Copper	119	63	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	1.2	2.3	12.3	22.8	1.1	1.9	10.6	18.9	0.19	0.36	1.9	3.6
Nickel	11.6	6.2	0.14	0.26	0.27	0.48	0.09	0.16	0.17	0.30	0.02	0.03	0.03	0.05
Selenium	0.63	0.33	0.75	1.7	1.4	3.2	0.58	1.3	1.1	2.5	0.09	0.22	0.18	0.41
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	0.03	0.04	0.06	0.09	0.02	0.03	0.04	0.06	<0.01	<0.01	<0.01	0.01
Zinc	249	215	<0.01	0.02	<0.01	0.02	<0.01	0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Muskrat – Vulture Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	0.02	0.04	0.03	0.07	0.02	0.05	0.04	0.09
Cadmium	5.51	0.33	<0.01	0.01	0.06	0.19	<0.01	0.02	0.14	0.39	<0.01	0.02	0.11	0.31
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	0.01	0.01	0.03	0.04	0.10	0.09	0.25	0.05	0.13	0.12	0.33
Copper	119	63	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	<0.01	<0.01	0.03	0.05	0.62	1.2	6.2	11.9	0.58	1.1	5.8	11.0
Nickel	11.6	6.2	<0.01	<0.01	<0.01	<0.01	0.04	0.08	0.08	0.15	0.06	0.12	0.11	0.22
Selenium	0.63	0.33	0.01	0.03	0.02	0.05	0.32	0.73	0.60	1.4	0.33	0.76	0.64	1.5
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	0.03	<0.01	0.02	0.02	0.03
Zinc	249	215	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	0.03	0.07	0.05	0.13	0.02	0.06	0.04	0.10	<0.01	<0.01	<0.01	0.01
Cadmium	5.51	0.33	<0.01	0.01	0.08	0.23	<0.01	0.01	0.06	0.19	<0.01	0.01	0.06	0.19
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	0.05	0.13	0.12	0.34	0.02	0.04	0.05	0.11	<0.01	0.01	0.01	0.03
Copper	119	63	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.50	0.92	5.0	9.2	0.34	0.68	3.4	6.8	0.02	0.03	0.19	0.34
Nickel	11.6	6.2	0.10	0.19	0.18	0.35	0.06	0.12	0.11	0.23	<0.01	<0.01	<0.01	0.02
Selenium	0.63	0.33	0.33	0.78	0.63	1.5	0.19	0.46	0.36	0.87	0.02	0.04	0.03	0.08
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	0.02	0.02	0.03	<0.01	<0.01	0.01	0.02	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	0.01	<0.01	0.02	<0.01	0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Muskrat – McClean Lake East

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	0.04	<0.01	0.02	0.02	0.04
Cadmium	5.51	0.33	<0.01	0.01	0.06	0.19	<0.01	0.01	0.07	0.20	<0.01	0.01	0.07	0.19
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	0.01	0.01	0.03	<0.01	0.02	0.02	0.05	<0.01	0.02	0.02	0.06
Copper	119	63	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	<0.01	<0.01	0.03	0.05	0.10	0.26	1.0	2.6	0.09	0.23	0.90	2.3
Nickel	11.6	6.2	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	0.04	0.01	0.02	0.02	0.05
Selenium	0.63	0.33	0.01	0.03	0.02	0.05	0.09	0.23	0.17	0.44	0.10	0.26	0.19	0.50
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.02

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	0.01	0.03	0.02	0.06	<0.01	0.03	0.02	0.05	<0.01	0.01	<0.01	0.02
Cadmium	5.51	0.33	<0.01	0.01	0.06	0.19	<0.01	0.01	0.06	0.19	<0.01	0.01	0.06	0.19
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	0.02	0.02	0.06	<0.01	0.01	0.02	0.04	<0.01	0.01	0.01	0.03
Copper	119	63	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.08	0.19	0.78	1.9	0.05	0.13	0.50	1.3	<0.01	0.02	0.07	0.16
Nickel	11.6	6.2	0.02	0.04	0.04	0.08	0.02	0.03	0.03	0.06	<0.01	<0.01	<0.01	0.01
Selenium	0.63	0.33	0.12	0.32	0.22	0.62	0.08	0.22	0.15	0.43	0.02	0.06	0.04	0.11
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	0.01	<0.01	0.02	<0.01	0.01	<0.01	0.02	<0.01	0.01	<0.01	0.02

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Muskrat – Keweenaw Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	0.01	0.06	0.19	<0.01	0.01	0.06	0.19	<0.01	0.01	0.06	0.19
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	0.01	0.01	0.03	<0.01	0.02	0.01	0.04	<0.01	0.02	0.01	0.04
Copper	119	63	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	<0.01	<0.01	0.03	0.05	0.01	0.04	0.14	0.35	0.01	0.03	0.13	0.32
Nickel	11.6	6.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.63	0.33	0.01	0.03	0.02	0.05	0.02	0.05	0.04	0.09	0.02	0.05	0.04	0.10
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	0.01	0.06	0.19	<0.01	0.01	0.06	0.19	<0.01	0.01	0.06	0.19
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	0.02	0.01	0.04	<0.01	0.01	0.01	0.03	<0.01	0.01	0.01	0.03
Copper	119	63	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.01	0.03	0.11	0.29	<0.01	0.02	0.07	0.17	<0.01	<0.01	0.03	0.05
Nickel	11.6	6.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.63	0.33	0.02	0.06	0.05	0.11	0.02	0.05	0.04	0.09	0.02	0.04	0.03	0.07
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Snowy Owl – McClean Lake Operation Medium Area

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	4.38	0.97	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02
Chromium	27.8	13.9	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	14.1	4.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	27	15.3	0.04	0.04	0.07	0.08	0.04	0.05	0.07	0.08	0.04	0.04	0.07	0.08
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	19.9	14.6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.59	0.36	0.14	0.17	0.23	0.28	0.20	0.22	0.32	0.37	0.20	0.23	0.33	0.38
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.06	0.07	0.12	0.14	0.06	0.07	0.12	0.15	0.06	0.07	0.12	0.14

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	4.38	0.97	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02
Chromium	27.8	13.9	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	14.1	4.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	27	15.3	0.04	0.04	0.07	0.08	0.04	0.05	0.07	0.08	0.04	0.05	0.07	0.08
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	19.9	14.6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	0.59	0.36	0.22	0.25	0.36	0.41	0.19	0.22	0.32	0.36	0.15	0.18	0.25	0.29
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.06	0.07	0.12	0.14	0.06	0.07	0.12	0.15	0.06	0.07	0.12	0.15

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Ptarmigan – McClean Lake Mill Area

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.6	2.2	<0.01	0.02	0.02	0.03	<0.01	0.02	0.02	0.04	0.01	0.02	0.02	0.04
Cadmium	4.38	0.97	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	27.8	13.9	<0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02
Cobalt	14.1	4.1	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	0.03
Copper	27	15.3	0.05	0.11	0.10	0.20	0.05	0.11	0.10	0.20	0.05	0.11	0.10	0.20
Lead	27.7	6.83	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Molybdenum	20.8	10.4	0.01	0.04	0.02	0.08	0.01	0.04	0.02	0.08	0.01	0.04	0.02	0.08
Nickel	19.9	14.6	0.02	0.03	0.02	0.04	0.02	0.03	0.02	0.04	0.02	0.03	0.02	0.04
Selenium	0.59	0.36	0.03	0.05	0.06	0.08	0.03	0.05	0.06	0.08	0.03	0.05	0.06	0.08
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.04	0.09	0.09	0.18	0.04	0.09	0.09	0.18	0.04	0.09	0.09	0.18

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.6	2.2	<0.01	0.02	0.02	0.04	<0.01	0.02	0.02	0.04	<0.01	0.02	0.02	0.04
Cadmium	4.38	0.97	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	27.8	13.9	<0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02
Cobalt	14.1	4.1	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	0.03
Copper	27	15.3	0.05	0.11	0.10	0.20	0.05	0.11	0.10	0.20	0.05	0.11	0.10	0.20
Lead	27.7	6.83	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Molybdenum	20.8	10.4	0.01	0.04	0.02	0.08	0.01	0.04	0.02	0.08	0.01	0.04	0.02	0.08
Nickel	19.9	14.6	0.02	0.03	0.02	0.04	0.02	0.03	0.02	0.04	0.02	0.03	0.02	0.04
Selenium	0.59	0.36	0.03	0.05	0.06	0.08	0.03	0.05	0.06	0.08	0.03	0.05	0.06	0.08
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.04	0.09	0.09	0.18	0.04	0.09	0.09	0.18	0.04	0.09	0.09	0.18

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Ptarmigan – McClean Lake Operation Small Area

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.6	2.2	<0.01	0.02	0.02	0.03	<0.01	0.02	0.02	0.03	<0.01	0.02	0.02	0.03
Cadmium	4.38	0.97	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	27.8	13.9	<0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02
Cobalt	14.1	4.1	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	0.03
Copper	27	15.3	0.05	0.11	0.10	0.20	0.05	0.11	0.10	0.20	0.05	0.11	0.10	0.20
Lead	27.7	6.83	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Molybdenum	20.8	10.4	0.01	0.04	0.02	0.08	0.01	0.04	0.02	0.08	0.01	0.04	0.02	0.08
Nickel	19.9	14.6	0.02	0.03	0.02	0.04	0.02	0.03	0.02	0.04	0.02	0.03	0.02	0.04
Selenium	0.59	0.36	0.03	0.05	0.06	0.08	0.03	0.05	0.06	0.08	0.03	0.05	0.06	0.08
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.04	0.09	0.09	0.18	0.04	0.09	0.09	0.18	0.04	0.09	0.09	0.18

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.6	2.2	<0.01	0.02	0.02	0.03	<0.01	0.02	0.02	0.03	<0.01	0.02	0.02	0.03
Cadmium	4.38	0.97	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Chromium	27.8	13.9	<0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02	<0.01	0.01	0.02	0.02
Cobalt	14.1	4.1	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	0.03
Copper	27	15.3	0.05	0.11	0.10	0.20	0.05	0.11	0.10	0.20	0.05	0.11	0.10	0.20
Lead	27.7	6.83	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Molybdenum	20.8	10.4	0.01	0.04	0.02	0.08	0.01	0.04	0.02	0.08	0.01	0.04	0.02	0.08
Nickel	19.9	14.6	0.02	0.03	0.02	0.04	0.02	0.03	0.02	0.04	0.02	0.03	0.02	0.04
Selenium	0.59	0.36	0.03	0.05	0.06	0.08	0.03	0.05	0.06	0.08	0.03	0.05	0.06	0.08
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.04	0.09	0.09	0.18	0.04	0.09	0.09	0.18	0.04	0.09	0.09	0.18

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Scaup – Sink Reservoir

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	0.01	0.03	0.03	0.05	0.32	0.60	0.63	1.2	0.43	0.81	0.85	1.6
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.01
Chromium	2.78	0.57	0.04	0.06	0.17	0.27	0.04	0.06	0.17	0.28	0.04	0.06	0.17	0.28
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	0.06	<0.01	<0.01	0.04	0.08
Copper	75.2	24.1	<0.01	<0.01	<0.01	0.01	<0.01	0.02	0.03	0.07	0.02	0.04	0.05	0.11
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	0.26	0.52	0.53	1.0	0.26	0.52	0.52	1.0
Nickel	10.7	5.35	<0.01	<0.01	0.01	0.02	0.09	0.18	0.18	0.35	0.13	0.26	0.26	0.52
Selenium	1.37	1.18	0.02	0.04	0.02	0.05	0.97	2.1	1.1	2.4	1.0	2.3	1.2	2.7
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.02
Zinc	62.7	31.35	0.02	0.04	0.04	0.07	0.06	0.13	0.12	0.26	0.07	0.15	0.13	0.30

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	0.61	1.2	1.2	2.3	0.55	1.0	1.1	2.0	0.09	0.17	0.18	0.34
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.04	0.06	0.17	0.27	0.04	0.06	0.17	0.27	0.04	0.06	0.17	0.27
Cobalt	148	14.8	<0.01	<0.01	0.05	0.08	<0.01	<0.01	0.04	0.07	<0.01	<0.01	<0.01	0.02
Copper	75.2	24.1	0.02	0.05	0.07	0.16	0.02	0.05	0.07	0.16	<0.01	<0.01	0.01	0.03
Lead	27.7	6.83	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	0.24	0.46	0.47	0.91	0.21	0.41	0.42	0.83	0.04	0.08	0.08	0.17
Nickel	10.7	5.35	0.23	0.47	0.45	0.93	0.19	0.38	0.37	0.77	0.03	0.07	0.07	0.14
Selenium	1.37	1.18	1.2	2.6	1.4	3.0	0.94	2.1	1.1	2.4	0.15	0.36	0.18	0.41
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Uranium	16	16	0.02	0.03	0.02	0.03	0.01	0.02	0.01	0.02	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.08	0.18	0.16	0.36	0.08	0.18	0.16	0.36	0.04	0.08	0.07	0.16

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Scaup – Vulture Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	0.01	0.03	0.03	0.05	0.11	0.27	0.21	0.55	0.14	0.35	0.28	0.71
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.01
Chromium	2.78	0.57	0.04	0.06	0.17	0.27	0.04	0.06	0.17	0.27	0.04	0.06	0.17	0.27
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.03	<0.01	<0.01	0.02	0.03
Copper	75.2	24.1	<0.01	<0.01	<0.01	0.01	<0.01	0.01	0.02	0.04	0.01	0.02	0.03	0.07
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	0.12	0.27	0.24	0.54	0.11	0.23	0.22	0.46
Nickel	10.7	5.35	<0.01	<0.01	0.01	0.02	0.07	0.12	0.13	0.24	0.10	0.18	0.20	0.35
Selenium	1.37	1.18	0.02	0.04	0.02	0.05	0.48	1.1	0.55	1.3	0.49	1.1	0.57	1.3
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01
Zinc	62.7	31.35	0.02	0.04	0.04	0.07	0.06	0.15	0.12	0.30	0.07	0.17	0.14	0.35

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	0.21	0.53	0.41	1.1	0.16	0.43	0.32	0.86	0.02	0.05	0.04	0.09
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.04	0.06	0.17	0.27	0.04	0.06	0.17	0.27	0.04	0.06	0.17	0.27
Cobalt	148	14.8	<0.01	<0.01	0.03	0.05	<0.01	<0.01	0.02	0.03	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	0.02	0.04	0.05	0.11	0.01	0.03	0.04	0.10	<0.01	<0.01	<0.01	0.02
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	0.09	0.19	0.19	0.38	0.07	0.14	0.13	0.27	<0.01	<0.01	<0.01	0.02
Nickel	10.7	5.35	0.18	0.31	0.35	0.62	0.12	0.24	0.25	0.47	<0.01	0.02	0.02	0.03
Selenium	1.37	1.18	0.52	1.2	0.60	1.4	0.30	0.74	0.35	0.86	0.03	0.06	0.03	0.07
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Uranium	16	16	<0.01	0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.08	0.21	0.17	0.42	0.07	0.17	0.14	0.35	0.03	0.07	0.06	0.14

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Scaup – McClean Lake East

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	0.01	0.03	0.03	0.05	0.06	0.16	0.12	0.31	0.07	0.17	0.14	0.34
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.04	0.06	0.17	0.27	0.05	0.08	0.24	0.38	0.05	0.07	0.22	0.36
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Copper	75.2	24.1	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	0.02	0.03	<0.01	<0.01	0.02	0.03
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	0.02	0.05	0.04	0.10	0.02	0.05	0.04	0.09
Nickel	10.7	5.35	<0.01	<0.01	0.01	0.02	0.02	0.04	0.04	0.08	0.03	0.05	0.05	0.10
Selenium	1.37	1.18	0.02	0.04	0.02	0.05	0.14	0.38	0.16	0.44	0.15	0.42	0.18	0.49
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.02	0.04	0.04	0.07	0.07	0.18	0.15	0.36	0.07	0.18	0.15	0.37

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	0.09	0.22	0.18	0.44	0.08	0.20	0.15	0.39	0.04	0.11	0.09	0.21
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.04	0.07	0.21	0.33	0.04	0.06	0.20	0.31	0.04	0.06	0.19	0.29
Cobalt	148	14.8	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	<0.01	0.01	0.02	0.03	<0.01	<0.01	0.02	0.03	<0.01	<0.01	0.01	0.02
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	0.02	0.04	0.03	0.08	0.01	0.03	0.02	0.05	<0.01	<0.01	<0.01	<0.01
Nickel	10.7	5.35	0.05	0.09	0.09	0.18	0.03	0.07	0.07	0.14	<0.01	0.01	0.02	0.03
Selenium	1.37	1.18	0.19	0.53	0.22	0.62	0.13	0.37	0.15	0.43	0.04	0.09	0.04	0.10
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.08	0.19	0.15	0.37	0.07	0.18	0.15	0.37	0.07	0.18	0.14	0.36

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Scaup – Kewen Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	0.01	0.03	0.03	0.05	0.01	0.03	0.03	0.05	0.01	0.03	0.03	0.05
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.04	0.06	0.17	0.27	0.04	0.06	0.17	0.27	0.04	0.06	0.17	0.27
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Nickel	10.7	5.35	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02
Selenium	1.37	1.18	0.02	0.04	0.02	0.05	0.03	0.07	0.04	0.09	0.03	0.08	0.04	0.09
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.02	0.04	0.04	0.07	0.03	0.06	0.06	0.12	0.03	0.06	0.07	0.13

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	5.1	2.55	0.01	0.03	0.03	0.05	0.01	0.03	0.03	0.05	0.01	0.03	0.03	0.05
Cadmium	25.6	3.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.04	0.06	0.17	0.27	0.04	0.06	0.17	0.27	0.04	0.06	0.17	0.27
Cobalt	148	14.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	75.2	24.1	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Lead	27.7	6.83	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	10.7	5.35	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02	<0.01	<0.01	0.01	0.02
Selenium	1.37	1.18	0.04	0.09	0.05	0.10	0.03	0.08	0.04	0.09	0.02	0.06	0.03	0.07
Silver	45.4	22.7	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	62.7	31.35	0.04	0.07	0.07	0.14	0.04	0.08	0.07	0.15	0.04	0.09	0.09	0.18

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Shrew – McClean Lake Mill Area

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	0.02	0.17	0.39	<0.01	0.02	0.17	0.40	<0.01	0.02	0.17	0.40
Chromium	29.9	23.7	<0.01	0.02	0.01	0.02	<0.01	0.02	0.01	0.02	<0.01	0.02	0.01	0.02
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Copper	119	63	0.03	0.07	0.06	0.13	0.03	0.07	0.06	0.13	0.03	0.07	0.06	0.13
Lead	50.4	10.7	0.03	0.08	0.16	0.39	0.04	0.09	0.16	0.41	0.04	0.09	0.16	0.41
Molybdenum	2.6	0.26	0.05	0.16	0.46	1.6	0.05	0.17	0.50	1.7	0.05	0.17	0.51	1.7
Nickel	11.6	6.2	0.01	0.02	0.03	0.05	0.01	0.03	0.03	0.05	0.01	0.03	0.03	0.05
Selenium	0.63	0.33	0.12	0.25	0.22	0.47	0.12	0.25	0.23	0.48	0.12	0.26	0.24	0.49
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	0.01	0.01	0.03	0.03	0.06	0.02	0.03	0.03	0.06
Zinc	249	215	0.06	0.13	0.07	0.15	0.06	0.13	0.07	0.15	0.06	0.13	0.07	0.15

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	0.02	0.17	0.40	<0.01	0.02	0.17	0.40	<0.01	0.02	0.17	0.40
Chromium	29.9	23.7	<0.01	0.02	0.01	0.02	<0.01	0.02	0.01	0.02	<0.01	0.02	0.01	0.02
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Copper	119	63	0.03	0.07	0.06	0.13	0.03	0.07	0.06	0.13	0.03	0.07	0.06	0.13
Lead	50.4	10.7	0.04	0.09	0.16	0.41	0.04	0.09	0.16	0.41	0.04	0.09	0.16	0.41
Molybdenum	2.6	0.26	0.05	0.17	0.52	1.7	0.05	0.17	0.52	1.7	0.05	0.17	0.52	1.7
Nickel	11.6	6.2	0.01	0.03	0.03	0.05	0.01	0.03	0.03	0.05	0.01	0.03	0.03	0.05
Selenium	0.63	0.33	0.13	0.27	0.24	0.51	0.13	0.27	0.24	0.51	0.13	0.27	0.24	0.51
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	0.02	0.03	0.03	0.06	0.02	0.03	0.03	0.06	0.02	0.03	0.03	0.06
Zinc	249	215	0.06	0.13	0.07	0.15	0.06	0.13	0.07	0.15	0.06	0.13	0.07	0.15

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Shrew – McClean Lake Operation Small Area

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	0.02	0.17	0.39	<0.01	0.02	0.17	0.39	<0.01	0.02	0.17	0.39
Chromium	29.9	23.7	<0.01	0.02	0.01	0.02	<0.01	0.02	0.01	0.02	<0.01	0.02	0.01	0.02
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Copper	119	63	0.03	0.07	0.06	0.13	0.03	0.07	0.06	0.13	0.03	0.07	0.06	0.13
Lead	50.4	10.7	0.03	0.08	0.16	0.39	0.03	0.08	0.16	0.39	0.03	0.08	0.16	0.39
Molybdenum	2.6	0.26	0.05	0.16	0.46	1.6	0.05	0.16	0.47	1.6	0.05	0.16	0.47	1.6
Nickel	11.6	6.2	0.01	0.02	0.03	0.05	0.01	0.02	0.03	0.05	0.01	0.02	0.03	0.05
Selenium	0.63	0.33	0.12	0.25	0.22	0.47	0.12	0.25	0.22	0.47	0.12	0.25	0.22	0.47
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Zinc	249	215	0.06	0.13	0.07	0.15	0.06	0.13	0.07	0.15	0.06	0.13	0.07	0.15

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	14.2	8.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	5.51	0.33	<0.01	0.02	0.17	0.39	<0.01	0.02	0.17	0.39	<0.01	0.02	0.17	0.39
Chromium	29.9	23.7	<0.01	0.02	0.01	0.02	<0.01	0.02	0.01	0.02	<0.01	0.02	0.01	0.02
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Copper	119	63	0.03	0.07	0.06	0.13	0.03	0.07	0.06	0.13	0.03	0.07	0.06	0.13
Lead	50.4	10.7	0.03	0.08	0.16	0.39	0.03	0.08	0.16	0.39	0.03	0.08	0.16	0.39
Molybdenum	2.6	0.26	0.05	0.16	0.47	1.6	0.05	0.16	0.47	1.6	0.05	0.16	0.47	1.6
Nickel	11.6	6.2	0.01	0.02	0.03	0.05	0.01	0.02	0.03	0.05	0.01	0.02	0.03	0.05
Selenium	0.63	0.33	0.12	0.25	0.23	0.47	0.12	0.25	0.23	0.47	0.12	0.25	0.23	0.47
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02
Zinc	249	215	0.06	0.13	0.07	0.15	0.06	0.13	0.07	0.15	0.06	0.13	0.07	0.15

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Wolf – McClean Lake Operation Large Area

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.1	1.5	<0.01	0.02	0.01	0.04	<0.01	0.02	0.01	0.04	<0.01	0.02	0.01	0.04
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.04	<0.01	<0.01	<0.01	0.04	<0.01	<0.01	<0.01	0.04
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	8.8	5.6	0.08	0.27	0.13	0.42	0.08	0.27	0.13	0.42	0.08	0.27	0.13	0.42
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.01	0.04	0.13	0.43	0.01	0.04	0.13	0.43	0.01	0.04	0.13	0.43
Nickel	112	45	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Selenium	0.21	0.105	0.19	0.65	0.38	1.3	0.19	0.65	0.38	1.3	0.19	0.65	0.38	1.3
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	0.13	0.49	0.16	0.57	0.13	0.49	0.16	0.57	0.13	0.49	0.16	0.57

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th	Avg	95th
Arsenic	3.1	1.5	<0.01	0.02	0.01	0.04	<0.01	0.02	0.01	0.04	<0.01	0.02	0.01	0.04
Cadmium	5.51	0.33	<0.01	<0.01	<0.01	0.04	<0.01	<0.01	<0.01	0.04	<0.01	<0.01	<0.01	0.04
Chromium	29.9	23.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	13.4	5.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	8.8	5.6	0.08	0.27	0.13	0.42	0.08	0.27	0.13	0.42	0.08	0.27	0.13	0.42
Lead	50.4	10.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	2.6	0.26	0.01	0.04	0.13	0.43	0.01	0.04	0.13	0.43	0.01	0.04	0.13	0.43
Nickel	112	45	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Selenium	0.21	0.105	0.19	0.65	0.38	1.3	0.19	0.65	0.38	1.3	0.19	0.65	0.38	1.3
Silver	138	69	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	5.6	2.8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	249	215	0.13	0.49	0.16	0.57	0.13	0.49	0.16	0.57	0.13	0.49	0.16	0.57

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; 95th = 95th percentile for indicated year.

Yellowlegs – Sink Reservoir

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	0.05	0.05	0.08	0.09	1.1	1.2	1.8	2.0	1.5	1.6	2.5	2.6
Cadmium	4.38	0.97	<0.01	<0.01	0.04	0.04	<0.01	<0.01	0.04	0.04	<0.01	<0.01	0.03	0.03
Chromium	2.78	0.57	0.19	0.19	0.92	0.94	0.14	0.15	0.67	0.71	0.14	0.15	0.69	0.72
Cobalt	14.1	4.1	0.01	0.01	0.04	0.04	0.05	0.05	0.15	0.17	0.06	0.07	0.22	0.24
Copper	27	15.3	0.06	0.07	0.11	0.12	0.05	0.05	0.08	0.09	0.07	0.08	0.13	0.15
Lead	27.7	6.83	0.03	0.03	0.11	0.13	<0.01	<0.01	0.03	0.04	<0.01	<0.01	0.04	0.04
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	1.3	1.4	2.6	2.8	1.3	1.4	2.5	2.8
Nickel	10.7	5.35	0.02	0.02	0.05	0.05	0.32	0.34	0.64	0.69	0.47	0.50	0.94	1.0
Selenium	0.59	0.36	0.16	0.17	0.26	0.28	4.8	5.4	7.8	8.8	5.1	5.7	8.4	9.4
Silver	45.4	22.7	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.06
Zinc	179	90.1	0.04	0.05	0.08	0.09	0.04	0.04	0.07	0.08	0.04	0.05	0.08	0.09

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	2.2	2.3	3.6	3.8	2.0	2.1	3.2	3.4	0.33	0.35	0.54	0.57
Cadmium	4.38	0.97	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.01	0.02	<0.01	<0.01	<0.01	<0.01
Chromium	2.78	0.57	0.14	0.14	0.67	0.69	0.13	0.14	0.65	0.67	0.10	0.10	0.48	0.49
Cobalt	14.1	4.1	0.09	0.10	0.31	0.33	0.09	0.10	0.32	0.34	0.02	0.03	0.08	0.09
Copper	27	15.3	0.11	0.12	0.19	0.22	0.11	0.12	0.19	0.21	0.02	0.02	0.04	0.04
Lead	27.7	6.83	0.01	0.01	0.05	0.05	0.01	0.01	0.04	0.05	<0.01	<0.01	0.02	0.02
Molybdenum	20.8	10.4	1.2	1.3	2.3	2.5	1.0	1.1	2.1	2.3	0.20	0.22	0.39	0.44
Nickel	10.7	5.35	0.84	0.89	1.7	1.8	0.70	0.75	1.4	1.5	0.13	0.14	0.25	0.27
Selenium	0.59	0.36	5.9	6.6	9.6	10.8	4.6	5.2	7.6	8.6	0.76	0.85	1.2	1.4
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	0.06	0.06	0.06	0.06	0.05	0.06	0.05	0.06	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.05	0.06	0.10	0.11	0.05	0.06	0.10	0.11	0.02	0.03	0.05	0.05

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Yellowlegs – Vulture Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	0.05	0.05	0.08	0.09	0.38	0.45	0.62	0.73	0.50	0.58	0.81	0.94
Cadmium	4.38	0.97	<0.01	<0.01	0.04	0.04	<0.01	0.01	0.05	0.05	<0.01	<0.01	0.04	0.04
Chromium	2.78	0.57	0.19	0.19	0.92	0.94	0.09	0.09	0.44	0.45	0.10	0.10	0.46	0.48
Cobalt	14.1	4.1	0.01	0.01	0.04	0.04	0.04	0.04	0.13	0.14	0.05	0.06	0.18	0.19
Copper	27	15.3	0.06	0.07	0.11	0.12	0.03	0.04	0.06	0.06	0.05	0.06	0.09	0.10
Lead	27.7	6.83	0.03	0.03	0.11	0.13	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	0.58	0.64	1.2	1.3	0.53	0.58	1.1	1.2
Nickel	10.7	5.35	0.02	0.02	0.05	0.05	0.25	0.27	0.50	0.55	0.37	0.40	0.74	0.81
Selenium	0.59	0.36	0.16	0.17	0.26	0.28	2.4	2.6	3.9	4.3	2.4	2.7	4.0	4.5
Silver	45.4	22.7	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Zinc	179	90.1	0.04	0.05	0.08	0.09	0.04	0.04	0.07	0.09	0.04	0.05	0.09	0.10

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	0.73	0.85	1.2	1.4	0.57	0.68	0.94	1.1	0.08	0.09	0.13	0.15
Cadmium	4.38	0.97	<0.01	<0.01	0.03	0.03	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Chromium	2.78	0.57	0.10	0.10	0.47	0.48	0.09	0.09	0.45	0.46	0.08	0.08	0.38	0.38
Cobalt	14.1	4.1	0.08	0.08	0.26	0.28	0.06	0.06	0.20	0.21	<0.01	<0.01	0.03	0.03
Copper	27	15.3	0.07	0.08	0.12	0.14	0.06	0.07	0.10	0.12	0.01	0.02	0.02	0.03
Lead	27.7	6.83	<0.01	<0.01	0.03	0.03	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.01	0.01
Molybdenum	20.8	10.4	0.45	0.49	0.90	0.98	0.32	0.35	0.65	0.71	0.02	0.02	0.04	0.04
Nickel	10.7	5.35	0.66	0.72	1.3	1.4	0.47	0.52	0.94	1.0	0.04	0.04	0.07	0.08
Selenium	0.59	0.36	2.6	2.9	4.2	4.7	1.5	1.7	2.4	2.7	0.15	0.16	0.24	0.27
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.05	0.06	0.10	0.12	0.05	0.05	0.09	0.10	0.02	0.02	0.04	0.05

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Yellowlegs – McClean Lake East Basin

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	0.05	0.05	0.08	0.09	0.22	0.26	0.36	0.42	0.24	0.29	0.40	0.47
Cadmium	4.38	0.97	<0.01	<0.01	0.04	0.04	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Chromium	2.78	0.57	0.19	0.19	0.92	0.94	0.23	0.23	1.1	1.1	0.22	0.22	1.1	1.1
Cobalt	14.1	4.1	0.01	0.01	0.04	0.04	0.02	0.02	0.07	0.07	0.02	0.02	0.07	0.08
Copper	27	15.3	0.06	0.07	0.11	0.12	0.02	0.03	0.04	0.04	0.02	0.03	0.04	0.05
Lead	27.7	6.83	0.03	0.03	0.11	0.13	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	0.10	0.12	0.20	0.23	0.09	0.10	0.18	0.21
Nickel	10.7	5.35	0.02	0.02	0.05	0.05	0.08	0.08	0.15	0.17	0.10	0.11	0.20	0.22
Selenium	0.59	0.36	0.16	0.17	0.26	0.28	0.69	0.82	1.1	1.3	0.77	0.91	1.3	1.5
Silver	45.4	22.7	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.04	0.05	0.08	0.09	0.05	0.05	0.09	0.10	0.05	0.05	0.09	0.11

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	0.32	0.38	0.52	0.62	0.27	0.33	0.44	0.54	0.15	0.18	0.25	0.29
Cadmium	4.38	0.97	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Chromium	2.78	0.57	0.20	0.21	0.98	1.0	0.19	0.20	0.93	0.95	0.18	0.18	0.87	0.89
Cobalt	14.1	4.1	0.02	0.02	0.08	0.08	0.02	0.02	0.07	0.08	0.02	0.02	0.06	0.06
Copper	27	15.3	0.03	0.03	0.05	0.05	0.03	0.03	0.04	0.05	0.02	0.02	0.03	0.04
Lead	27.7	6.83	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Molybdenum	20.8	10.4	0.08	0.09	0.16	0.18	0.05	0.06	0.11	0.12	<0.01	<0.01	0.02	0.02
Nickel	10.7	5.35	0.17	0.19	0.34	0.38	0.13	0.14	0.26	0.28	0.03	0.03	0.06	0.07
Selenium	0.59	0.36	0.94	1.1	1.5	1.8	0.66	0.80	1.1	1.3	0.19	0.22	0.31	0.36
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.05	0.05	0.09	0.11	0.05	0.05	0.09	0.11	0.04	0.05	0.09	0.10

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Yellowlegs – Keweenaw Lake

Constituent	Toxicity Benchmarks		Background				Year 2025				Year 2030			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	0.05	0.05	0.08	0.09	0.03	0.04	0.06	0.06	0.04	0.04	0.06	0.07
Cadmium	4.38	0.97	<0.01	<0.01	0.04	0.04	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Chromium	2.78	0.57	0.19	0.19	0.92	0.94	0.14	0.15	0.70	0.73	0.14	0.15	0.70	0.73
Cobalt	14.1	4.1	0.01	0.01	0.04	0.04	<0.01	<0.01	0.03	0.03	<0.01	<0.01	0.03	0.03
Copper	27	15.3	0.06	0.07	0.11	0.12	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Lead	27.7	6.83	0.03	0.03	0.11	0.13	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Molybdenum	20.8	10.4	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.02	0.03	0.01	0.01	0.02	0.03
Nickel	10.7	5.35	0.02	0.02	0.05	0.05	0.02	0.02	0.04	0.04	0.02	0.02	0.04	0.04
Selenium	0.59	0.36	0.16	0.17	0.26	0.28	0.18	0.19	0.29	0.32	0.19	0.20	0.30	0.33
Silver	45.4	22.7	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.04	0.05	0.08	0.09	0.02	0.02	0.04	0.05	0.02	0.02	0.04	0.05

Constituent	Toxicity Benchmarks		Year 2040				Year 2050				Year 2100			
	mg/kg-d		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL		SI-LOAEL		SI-NOAEL	
	LOAEL	NOAEL	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM	Avg	UCLM
Arsenic	3.6	2.2	0.04	0.04	0.06	0.07	0.04	0.04	0.06	0.06	0.03	0.03	0.05	0.05
Cadmium	4.38	0.97	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02	<0.01	<0.01	0.02	0.02
Chromium	2.78	0.57	0.14	0.15	0.69	0.72	0.14	0.15	0.69	0.71	0.14	0.14	0.69	0.70
Cobalt	14.1	4.1	<0.01	<0.01	0.03	0.04	<0.01	<0.01	0.03	0.04	<0.01	<0.01	0.03	0.04
Copper	27	15.3	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01
Lead	27.7	6.83	<0.01	<0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	0.01
Molybdenum	20.8	10.4	<0.01	0.01	0.02	0.02	<0.01	<0.01	0.01	0.02	<0.01	<0.01	<0.01	<0.01
Nickel	10.7	5.35	0.02	0.02	0.04	0.05	0.02	0.02	0.04	0.04	0.02	0.02	0.03	0.04
Selenium	0.59	0.36	0.21	0.23	0.34	0.38	0.18	0.20	0.30	0.33	0.14	0.15	0.23	0.25
Silver	45.4	22.7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	16	16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	179	90.1	0.02	0.03	0.04	0.05	0.02	0.03	0.05	0.05	0.03	0.03	0.05	0.06

Note: **bold/shaded** indicates SI values above 1. Avg = predicted average for indicated year; UCLM = upper confidence limit of the mean for indicated year.

Table 5.4-8 Summary of Results for Species at Risk

Little Brown Myotis	S/V TEMS		McClellan Lake E		Keweenaw Lake	
	Maximum year during operation	Year 2100 (post-decommissioning)	Maximum year during operation	Year 2100 (post-decommissioning)	Maximum year during operation	Year 2100 (post-decommissioning)
Arsenic						
Cadmium						
Chromium						
Cobalt						
Copper						
Iron						
Lead						
Molybdenum						
Nickel						
Selenium						
Silver						
Thallium						
Uranium						
Zinc						

Notes: Green – all intakes lower than NOAELs; Orange – UCLM above NOAEL

Rusty Blackbird	S/V TEMS		McClean Lake E		Keweenaw Lake	
	Maximum year during operation	Year 2100 (post-decommissioning)	Maximum year during operation	Year 2100 (post-decommissioning)	Maximum year during operation	Year 2100 (post-decommissioning)
Arsenic						
Cadmium						
Chromium						
Cobalt						
Copper						
Iron						
Lead						
Molybdenum						
Nickel						
Selenium						
Silver						
Thallium						
Uranium						
Zinc						

Notes: Green – all intakes lower than NOAELs; Orange – UCLM above NOAEL

Woodland Caribou	McClean Lake Operation Large Area	
	Maximum year during operation	Year 2100 (post-decommissioning)
Arsenic		
Cadmium		
Chromium		
Cobalt		
Copper		
Iron		
Lead		
Molybdenum		
Nickel		
Selenium		
Silver		
Thallium		
Uranium		
Zinc		

Snowy Owl	McClean Lake Operation Medium Area	
	Maximum year during operation	Year 2100 (post-decommissioning)
Arsenic		
Cadmium		
Chromium		
Cobalt		
Copper		
Iron		
Lead		
Molybdenum		
Nickel		
Selenium		
Silver		
Thallium		
Uranium		
Zinc		

Notes: Green – all intakes lower than NOAELs; Orange – UCLM above NOAEL

Yellowlegs	S/V TEMS		McClellan Lake E		Keweenaw Lake	
	Maximum year during operation	Year 2100 (post-decommissioning)	Maximum year during operation	Year 2100 (post-decommissioning)	Maximum year during operation	Year 2100 (post-decommissioning)
Arsenic						
Cadmium						
Chromium **						
Cobalt						
Copper						
Iron						
Lead						
Molybdenum						
Nickel						
Selenium						
Silver						
Thallium						
Uranium						
Zinc						

Notes: Green – all intakes lower than NOAELs; Orange – UCLM above NOAEL

** Result slightly above 1, however, similar SI values noted for background exposure.

Table 5.4-9 Overall Summary for Terrestrial Receptors

Location	Lines of Evidence
Plants	• Soil concentrations below ecological component of guideline • Only small changes in soil concentrations from background • Little change in vegetation concentrations, below phytotoxicity levels unless due to background • COPC concentrations in lichen can be expected to change • Below toxicity levels for NO_x and SO₂
Soil invertebrates	• Soil concentrations below ecological component of guideline • Only small changes in soil concentrations from background
Wildlife – S/V TEMS	• All radiological SI values are less than 1 • Sulphate and TDS in S/V TEMS could be an issue as a source of drinking water • Potential issues identified for*: ○ Arsenic (yellowlegs) ○ Molybdenum (myotis, muskrat, yellowlegs) ○ Selenium (myotis, blackbird, merganser, mink, scaup, yellowlegs) • Potential issues identified for SARA species (myotis, blackbird, yellowlegs) • Studies of selenium at other sites did not show effects on birds at similar (or higher) concentrations in the aquatic environment • Semi-aquatic furbearer density lower than at other areas • Bird species richness lower than at Collins Creek but higher than at Kewen Lake • Bat abundance close to bat abundance at McClean Lake, but lower than at the mill, Kewen, and Collins Creek
Wildlife – McClean Lake East Basin	• All radiological SI values are less than 1 • Water quality below drinking water guidelines • Potential issues identified for*: ○ Selenium (myotis, blackbird, mink, yellowlegs) • Potential issues identified for SARA species (myotis, blackbird, yellowlegs) • Studies of selenium at other sites did not show effects on birds at similar (or higher) concentrations in the aquatic environment • Semi-aquatic furbearer density at McClean Lake east basin close to semi-aquatic furbearer abundance at McClean Lake west basin and higher than semi-aquatic furbearer abundance at Kewen Lake, but lower than at Collins Creek downstream • Bat abundance close to abundance at S/V TEMS and lower than at other locations
Wildlife – Terrestrial locations (Small Area, Medium Area, Large Area)	• Soil concentrations below ecological component of guideline • Only small changes in soil concentrations from background • All radiological SI values are less than 1 • All SI values for non-radiological COPCs are below 1 • Abundance of small mammals at the mill is lower than at reference locations • Small mammal tissue concentrations mostly within the natural range with exception of arsenic, zinc, radium-226, and uranium • Bat abundance highest at the mill
Wildlife – Downstream	• All radiological SI values are less than 1 • Water quality below drinking water guidelines

Location	Lines of Evidence
	• All SI values for non-radiological COPCs are below 1 • Semi-aquatic furbearer abundance at Keweenaw is lower than at McClean Lake and Collins Creek downstream • Semi-aquatic furbearer density at Collins Creek downstream is highest among water bodies considered in the ERA • Bird species richness highest at Collins Creek downstream and lowest at Keweenaw Lake • Bat abundance higher than at SV TEMS, but lower than at the mill

* Species listed had an SI above 1 for the mean compared to the LOAEL (or UCLM compared to the NOAEL for species at risk)

Table 5.6-1

Comparison of Ecological Results with 2016 EP TID and 2018 Se RA – Aquatic Biota

Constituent	2016 ERA			2025 ERA		
	S/V TEMS	McClean Lake E	Keweenaw Lake	S/V TEMS	McClean Lake E	Keweenaw Lake
Aluminum						
Ammonia						
Chloride						
Fluoride						
Nitrate						
Potassium						
Sulphate						
TDS						
Arsenic						
Cadmium						
Chromium						
Cobalt						
Copper						
Iron						
Lead						
Molybdenum						
Nickel						
Selenium						
Selenium – 2018 RA						
Silver						
Thallium						
Uranium						
Zinc						
Radioactivity						

Note

	Mean exceeds guideline		95th exceeds guideline		Predictions below guideline
	Not Evaluated				

Table 5.6-2 Comparison of 2025 Ecological Assessment Results with 2016 ERA – Birds and Mammals

Constituent	Birds																Terrestrial Birds																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
	Aquatic Birds						Terrestrial Birds																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
	Mallard			Merganser			Scaup			Yellowlegs*				Bald Eagle	Willow Ptarmigan		Rusty Blackbird *				Snowy Owl *																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
	2016 ERA		2025 ERA		2016 ERA		2025 ERA		2016 ERA		2025 ERA		2016 ERA	2025 ERA	2016 ERA		2025 ERA		2016 ERA		2025 ERA																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake	SV TEMS	McClean Lake East Basin	Kewen Lake</

Note:
Plants and invertebrates have no SI values above 1 thus are not summarized.

* Species at risk (comparison based on NOAEL instead of LOAEL)

SI at mean above 1 SI at 95th above 1 No SI above 1 Not Evaluated

Constituent	Semi-aquatic mammals												Terrestrial Mammals																																
	Muskrat			Beaver			Mink			Caribou (woodland) *	Snowshoe Hare		Moose		Wolf		Black Bear	Red Fox	Lynx		Masked Shrew		Little Brown Myotis (Bat) *																						
	2016 ERA		2025 ERA	2016 ERA		2025 ERA	2016 ERA		2025 ERA	2016 ERA	2025 ERA	2016 ERA		2025 ERA	2016 ERA	2025 ERA	2016 ERA	2025 ERA	2016 ERA	2025 ERA	2016 ERA	2025 ERA	2016 ERA		2025 ERA																				
	S/V TEMS	McClean Lake East Basin	Kewen Lake	S/V TEMS	McClean Lake East Basin	Kewen Lake	S/V TEMS	McClean Lake East Basin	Kewen Lake	S/V TEMS	McClean Lake East Basin	Kewen Lake	S/V TEMS	McClean Lake East Basin	Kewen Lake	McClean Lake Operation Area	McClean Lake Operation Area	McClean Lake Mill Area	McClean Lake Operation Small Area	McClean Lake Mill Area	McClean Lake Operation Small Area	S/V TEMS	Collins Creek Watershed	S/V TEMS	Collins Creek Downstream	McClean Lake Operation Area	McClean Lake Operation Large Area	Collins Creek Watershed	McClean Lake Operation Medium Area	McClean Lake Operation Medium Area	McClean Lake Operation Medium Area	McClean Lake Operation Area	McClean Lake Operation Medium Area	McClean Lake Mill Area	McClean Lake Operation Small Area	S/V TEMS	McClean Lake Mill Area	McClean Lake East Basin	Kewen Lake	S/V TEMS	McClean Lake Mill Area	McClean Lake East Basin	Kewen Lake		
Radioactivity																																													
Arsenic																																													
Cadmium																																													
Chromium																																													
Cobalt																																													
Copper																																													
Lead																																													
Molybdenum																																													
Nickel																																													
Selenium																																													
Silver																																													
Uranium																																													
Zinc																																													

Note
* Species at risk (comparison based on NOAEL instead of LOAEL)

SI at mean above 1SI at 95th above 1No SI above 1Not Evaluated

Table 5.6-3 Comparison of 2025 Ecological Assessment Results with 2016 EP TID and 2018 Se RA – Species with Potential Selenium-Related Risks

Receptor	2016 ERA						2018 Se RA						2025 ERA					
	S/V TEMS		McClellan Lake east basin		Keweenaw Lake		S/V TEMS		McClellan Lake east basin		Keweenaw Lake		S/V TEMS		McClellan Lake east basin		Keweenaw Lake	
	Oper	Post-Decom	Oper	Post-Decom	Oper	Post-Decom	Oper	Post-Decom	Oper	Post-Decom	Oper	Post-Decom	Oper	Post-Decom	Oper	Post-Decom	Oper	Post-Decom
Myotis*																		
Rusty Blackbird*																		
Mallard																		
Merganser																		
Mink																		
Muskrat																		
Scaup																		
Yellowlegs*																		

Note

* Species at risk (comparison based on NOAEL instead of LOAEL)

Oper. – Peak during operation

Post-Decomm – Results at 2100 (post-decommissioning period)

SI at mean above 1

SI at 95th above 1

No SI above 1

Not Evaluated

Table 6.1-1 Summary of General Canadian Supermarket Food Dietary Intakes of COPC

Constituent	Intake from Supermarket Foods (mg/kg-d)			
	Adult	Teen	Child	Toddler
Arsenic	1.3×10^{-4}	1.5×10^{-4}	5.0×10^{-4}	3.2×10^{-4}
Cadmium	3.2×10^{-4}	4.2×10^{-4}	1.6×10^{-3}	9.0×10^{-4}
Chromium	1.1×10^{-4}	1.2×10^{-4}	4.4×10^{-4}	3.1×10^{-4}
Cobalt	1.0×10^{-2}	1.1×10^{-2}	4.1×10^{-2}	3.0×10^{-2}
Copper	7.5×10^{-5}	7.3×10^{-5}	2.6×10^{-4}	1.8×10^{-4}
Lead	1.3×10^{-4}	1.5×10^{-4}	5.0×10^{-4}	3.2×10^{-4}
Molybdenum	1.2×10^{-3}	1.5×10^{-3}	6.0×10^{-3}	5.1×10^{-3}
Nickel	1.9×10^{-3}	1.8×10^{-3}	6.7×10^{-3}	5.4×10^{-3}
Selenium	9.4×10^{-4}	1.3×10^{-3}	4.8×10^{-3}	3.6×10^{-3}
Silver	7.7×10^{-6}	8.8×10^{-6}	2.7×10^{-5}	1.8×10^{-5}
Uranium	6.1×10^{-5}	5.6×10^{-5}	1.7×10^{-4}	1.2×10^{-4}
Zinc	6.7×10^{-2}	8.9×10^{-2}	3.4×10^{-1}	2.9×10^{-1}

Table 6.2-1 Drinking Water Guidelines

Constituent	Value	Units	Comment
General Chemistry			
Ammonia	-		Health Canada indicates no guideline required.
Chloride	250	mg/L	SEQG value (ENV 2025) as Health Canada only has an aesthetic objective
Fluoride	1.5	mg/L	Health Canada health-based value
Nitrate (as N)	10	mg/L	Health Canada health-based value
Potassium	-		Health Canada indicates no guideline required.
Sulphate	500	mg/L	SEQG value (ENV 2025) as Health Canada only has an aesthetic objective
Total dissolved solids	500	mg/L	SEQG value (ENV 2025) as Health Canada only has an aesthetic objective
Metals			
Aluminum	2.9	mg/L	Health Canada health-based value
Arsenic	10	µg/L	Health Canada as low as reasonably achievable
Cadmium	7	µg/L	Health Canada health-based value
Chromium	50	µg/L	Health Canada health-based value
Cobalt	-		
Copper	2,000	µg/L	Health Canada health-based value
Iron	0.3	mg/L	SEQG value (ENV 2025) as Health Canada only has an aesthetic objective
Lead	5	µg/L	Health Canada as low as reasonably achievable
Molybdenum	-		
Nickel	-		
Selenium	50	µg/L	Health Canada health-based value
Silver	-		
Uranium	20	µg/L	Health Canada health-based value
Zinc	5,000	µg/L	SEQG value (ENV 2025) as Health Canada only has an aesthetic objective
Radionuclides			
Lead-210	0.2	Bq/L	Health Canada drinking water guideline
Polonium-210	0.1	Bq/L	Health Canada (2009)
Thorium-230	0.6	Bq/L	Health Canada (2009)
Radium-226	0.11	Bq/L	SEQG value (ENV 2025) as it is lower than the Health Canada drinking water guideline (0.5 Bq/L)

Note: From Health Canada (2025) unless otherwise noted.

- No value provided

Table 6.2-2 ICRP Ingestion Dose Conversion Factors for Members of the Public

Radionuclide	ICRP 119 (2012)			
	f ₁	Adult ^a	Child ^b	Toddler ^c
		DCF (Sv/Bq)	DCF (Sv/Bq)	DCF (Sv/Bq)
Uranium-238	0.02	4.5 x 10 ⁻⁸	8.0 x 10 ⁻⁸	1.2 x 10 ⁻⁷
Thorium-230	5.0 x 10 ⁻⁴	2.1 x 10 ⁻⁷	3.1 x 10 ⁻⁷	4.1 x 10 ⁻⁷
Radium-226	0.2	2.8 x 10 ⁻⁷	6.2 x 10 ⁻⁷	9.6 x 10 ⁻⁷
Lead-210	0.2	6.9 x 10 ⁻⁷	2.2 x 10 ⁻⁶	3.6 x 10 ⁻⁶
Polonium-210	0.5	1.2 x 10 ⁻⁶	4.4 x 10 ⁻⁶	8.8 x 10 ⁻⁶

Notes:

a Values shown are ICRP Publication 119 (2012) default values recommended for adult members of the public.

b Values shown are for a 5-year old child.

c Values shown are for a 1-year old child.

Table 6.2-3 ICRP Inhalation Dose Conversion Factors for Members of the Public

Radionuclide	ICRP 119 (2012)			
	type ^b	Adult ^a	Child ^c	Toddler ^d
		DCF (Sv/Bq)	DCF (Sv/Bq)	DCF (Sv/Bq)
Uranium-238	S	8.0 x 10 ⁻⁶	1.6 x 10 ⁻⁵	2.5 x 10 ⁻⁵
Thorium-230	S	1.4 x 10 ⁻⁵	2.4 x 10 ⁻⁵	3.5 x 10 ⁻⁵
Radium-226	S	9.5 x 10 ⁻⁶	1.9 x 10 ⁻⁵	2.9 x 10 ⁻⁵
Lead-210	S	5.6 x 10 ⁻⁶	1.1 x 10 ⁻⁵	1.8 x 10 ⁻⁵
Polonium-210	S	4.3 x 10 ⁻⁶	8.6 x 10 ⁻⁶	1.4 x 10 ⁻⁵

Notes:

a DCFs for adults and 1 µm AMAD (activity median aerodynamic diameter) particles are from ICRP Publication 119 (2012).

b Type S - slow rate at which radionuclides are cleared from the lungs.

c Values shown are for a 5-year old child.

d Values shown are for a 1-year old child.

Table 6.2-4 Immersion Dose Conversion Factors for Members of the Public

Radionuclide	Immersion DC ^a		
	Air (Sv/y per Bq/m ³)	Water (Sv/y per Bq/m ³)	Groundshine (Sv/y per Bq/m ²)
Uranium-238	1.1 x 10 ⁻¹⁰	2.5 x 10 ⁻¹³	1.7 x 10 ⁻¹¹
Thorium-230	5.5 x 10 ⁻¹⁰	1.2 x 10 ⁻¹²	2.4 x 10 ⁻¹¹
Radium-226	9.9 x 10 ⁻⁹	4.1 x 10 ⁻¹²	7.8 x 10 ⁻¹¹
Lead-210	1.8 x 10 ⁻⁹	2.2 x 10 ⁻¹¹	2.0 x 10 ⁻¹⁰
Polonium-210	1.3 x 10 ⁻¹¹	2.8 x 10 ⁻¹⁴	2.6 x 10 ⁻¹³

Notes:

a Effective Dose Coefficients from Eckerman and Ryman (1993).

Table 6.2-5 Selected Toxicity Reference Values for Human Receptors

Constituent	Effect Type ^(a)	Value	Health Effect	Reference ^(b)
Arsenic	C - ingestion	1.8	Internal cancers (liver, lung, bladder, kidney) (oral, human)	Health Canada (2021)
	C – inhalation	6.4	Lung cancer	Health Canada (2021)
Cadmium	NC - ingestion	0.0008	Nephrotoxicity	Health Canada (2021)
	C – inhalation	4.2	Lung cancer	Health Canada (2021)
Chromium ^b	NC - ingestion	1.5	No observed effects	Health Canada (2021)
	C – inhalation	19	Lung cancer	Health Canada (2021)
Cobalt	NC - ingestion	0.02	Haematological effects (elevated red blood cells)	ATSDR (2024a)
Copper	NC - ingestion	0.426	Hepatotoxicity and GI effects	Health Canada (2021)
Lead	NC - ingestion	0.00025	Decrease in IQ	CCME (2025)
Molybdenum	NC - ingestion	0.023 (toddler) 0.023 (child) 0.027 (teen) 0.028 (adult)	Reproductive effects	Health Canada (2010)
Nickel	NC	0.012	Dermal toxicity	Health Canada (2021)
	C – inhalation	1.3	Cancer (lung, nasal, kidney, prostate, mouth)	Health Canada (2021)
Selenium	NC - ingestion	0.006 (toddler) 0.0063 (child) 0.0062 (teen) 0.0057 (adult)	Clinical selenosis	Health Canada (2021)
Silver	NC - ingestion	0.005	Dermal	U.S. EPA (2024), last updated 1991
Uranium	NC	0.0006	Nephrotoxicity, hepatotoxic effects	Health Canada (2021)
Zinc	NC - ingestion	0.48 (toddler) 0.51 (child) 0.54 (teen) 0.57 (adult)	Subclinical change in copper and iron status	Health Canada (2021)

Note: ATSDR = Agency for Toxic Substances and Disease Registry; CCME = Canadian Council of Ministers of the Environment; WHO = World Health Organization

^a C – Carcinogenic (non-threshold) effect; NC - non-carcinogenic (threshold) effect

^b Oral TRV is for trivalent chromium, expected to represent 90% of the chromium present in food (Health Canada Cr TSD) (Health Canada 2016a). For the inhalation slope factor, it is assumed that 25% of the chromium is present in the carcinogenic hexavalent form (Health Canada Cr TSD) therefore, the unit risk of 76(mg/m³)⁻¹ was reduced and applied to total chromium.

Units: mg/(kg-d) for NC-ingestion; (mg/(kg-d))⁻¹ for C-ingestion; (mg/m³)⁻¹ for C-inhalation

Table 6.2-6 Health-Based Values for Particulate and Gaseous Air Pollutants

Gaseous Air Pollutants		Health-Based Concentration ($\mu\text{g}/\text{m}^3$)	Critical Effect	Reference
NO ₂	1 hour	50	Effects in asthmatics in short-term controlled exposure studies	Health Canada (2015)
	24 hour	25	All-cause non-accidental mortality and asthma, hospital admissions and emergency room visits	WHO (2021)
	Annual	10	All non-accidental mortality and cause-specific, respiratory mortality	WHO (2021)
SO ₂	1 hour	100	No effects on asthmatics based on a 5 to 10 minute human exposure studies which derived a value of 67ppb (180 $\mu\text{g}/\text{m}^3$) converted to a 1 hour exposure	Health Canada (2016b)
	24 hour	40	Asthma hospital admissions and emergency room visits, daily non-accidental mortality and respiratory mortality	WHO (2021)
PM _{2.5}	24 hour	15	All-cause non-accidental mortality and cause specific mortality (cardiovascular, non-malignant respiratory, cerebrovascular)	WHO (2021)
	Annual	5	All non-accidental mortality and cause-specific mortality (circulatory, non-malignant respiratory mortality, lung cancer)	WHO (2021)
Acrolein	1 hour	7	Nose and throat irritation and decreased respiratory rate in human subjects	ATSDR (2025)
	24 hour	0.9	Nasal respiratory gland metaplasia in rats	ATSDR (2025)
Benzene	1 hour	30	Decreased number of peripheral lymphocytes and impaired function of marrow lymphocytes	ATSDR (2024b)
	24 hour	0.6	Decreased number of peripheral lymphocytes	ATSDR (2024b)

Table 6.3-1 Comparison of Predicted Concentrations to Drinking Water Guidelines

COPC	Value	Units	Maximum Future Concentration – McClean Lake East Basin	
			Mean	95 th Percentile
General Chemistry				
Ammonia	-		0.11	0.14
Chloride	250	mg/L	13	19
Fluoride	1.5	mg/L	0.078	0.10
Nitrate (as N)	10	mg/L	0.45	0.59
Potassium	-		1.7	2.2
Sulphate	500	mg/L	73	109
Total dissolved solids	500	mg/L	171	239
Metals				
Aluminum	2.9	mg/L	0.040	0.054
Arsenic	10	µg/L	0.77	1.2
Cadmium	7	µg/L	0.011	0.011
Chromium	50	µg/L	0.50	0.53
Cobalt	-		0.12	0.17
Copper	2,000	µg/L	0.22	0.27
Iron	0.3	mg/L	0.20	0.26
Lead	5	µg/L	0.073	0.083
Molybdenum	-		3.0	4.9
Nickel	-		1.7	2.4
Selenium	50	µg/L	0.27	0.36
Silver	-		0.038	0.044
Uranium	20	µg/L	0.074	0.12
Zinc	5,000	µg/L	1.0	1.1
Radionuclides				
Lead-210	0.2	Bq/L	0.01	0.01
Polonium-210	0.1	Bq/L	0.003	0.004
Thorium-230	0.6	Bq/L	0.002	0.002
Radium-226	0.11	Bq/L	0.005	0.006

Note: Annual average concentrations

Table 6.3-2 Typical Natural Sources of Radiation for Canadian Population

Natural Sources of Radiation	Average Annual Dose
Dose from cosmic radiation	300 µSv/year
Naturally-occurring radionuclides (uranium and thorium series and K-40) found in soil, rocks, sediments that transfer naturally to human food, water and air	350 µSv/year
Naturally-occurring radionuclides in soils, rocks, and building materials contributing to external radiation	350 µSv/year
Naturally-occurring radon gas and its radioactive decay products	1,000 µSv/year

Table 6.3-3 Summary of Carcinogenic Risk Estimates for Inhalation of Metals

	JEB Camp	Rabbit Lake Camp	Points North Worker	Wollaston Lake Community	Wollaston Lake Trapper	Wollaston Lake Lodge Operator	Hatchet Lake
Cadmium	2.1×10^{-11}	2.9×10^{-12}	9.3×10^{-13}	1.7×10^{-12}	4.2×10^{-11}	6.6×10^{-13}	4.4×10^{-13}
Chromium	3.6×10^{-10}	2.2×10^{-11}	8.0×10^{-12}	1.2×10^{-11}	3.4×10^{-11}	5.2×10^{-12}	2.7×10^{-12}
Nickel	2.8×10^{-10}	7.1×10^{-12}	4.9×10^{-12}	5.1×10^{-12}	9.5×10^{-12}	1.8×10^{-12}	2.1×10^{-12}

Note: Calculated from the incremental air concentration.

Table 6.3-4 Maximum Concentrations of NO₂ at Discrete Receptor Locations

	1-hr Maximum		24-hr Maximum		Annual Maximum	
	Inc	Tot	Inc	Tot	Inc	Tot
JEB Camp	- ^a	- ^a	174	180	4.5	6.5
Rabbit Lake Camp	15	21	7.4	14	0.1	2.1
Points North Worker	12	18	3.0	9.2	0.1	2.1
Wollaston Lake Community	3.6	9.8	1.9	8.1	<0.1	2.0
Wollaston Lake Trapper ^b	18	24	8.0	14	0.1	2.1
Wollaston Lake Lodge Operator	7.1	13	1.9	8.1	<0.1	2.0
Hatchet Lake	8.1	14	1.8	8.0	<0.1	2.0
Health-Based Criteria	50 (NA^a)		25 (280^c)		10 (10^d)	

Note: All concentrations in µg/m³. Inc.= Incremental; Tot. = Total (including background); NA = Not Applicable

^a Short-term (1-hour) exposure is directly addressed with the Occupational Health and Safety program for workers

^b Kewen Lake used as the location for the trapper

^c Adjusted Occupational Exposure Value for 24 hr exposure. (Occupational value is 5.6 mg/m³ for an 8-hr shift (LWRS 2020).

^d Although workers would not be present at this location on an annual basis, the value is provided for information and is compared to the health-based criteria for members of the public

Table 6.3-5 Maximum Concentrations of SO₂ at Discrete Receptor Locations

	1-hr Maximum		24-hr Maximum	
	Inc	Tot	Inc	Tot
JEB Camp	- ^a	- ^a	15	16
Rabbit Lake Camp	2.9	3.7	1.1	2.1
Points North Worker	2.7	3.5	0.7	1.7
Wollaston Lake Community	0.5	1.3	0.3	1.3
Wollaston Lake Trapper ^b	1.6	2.4	0.7	1.7
Wollaston Lake Lodge Operator	0.7	1.5	0.2	1.2
Hatchet Lake	1.1	1.9	0.3	1.3
Health-Based Criteria	100 (NA^a)		40 (280^c)	

Note: All concentrations in µg/m³. Inc.= Incremental; Tot. = Total (including background); NA = Not Applicable

^a Short-term (1-hour) exposure is directly through Occupational Health and Safety program for workers

^b Kewen Lake used as the location for the trapper.

^c Adjusted Occupational Exposure Value for 24 hr exposure. (Occupational value is 5.7 mg/m³ for an 8-hr shift (LWRS 2020).

Table 6.3-6 Maximum Concentrations of PM2.5 at Discrete Receptor Locations

	24-hr Maximum		Annual Maximum	
	Inc	Tot	Inc	Tot
JEB Camp	10 ^a	23 ^a	0.6	4.6
Rabbit Lake Camp	1.1	13	0.04	4.0
Points North Worker	0.5	13	0.02	4.0
Wollaston Lake Community	0.2	12	0.01	4.0
Wollaston Lake Trapper ^b	0.9	13	0.02	4.0
Wollaston Lake Lodge Operator	0.2	12	0.01	4.0
Hatchet Lake	0.2	12	0.01	4.0
Health-Based Criteria	15 (150^a)		5 (5^c)	

Note: All concentrations in µg/m³. Inc.= Incremental; Tot. = Total (including background); NA = Not Applicable

^a Adjusted Occupational Exposure Value for 24 hr exposure. (Occupational value is 3 mg/m³ for an 8-hr shift (LWRS 2020))

^b Kewen Lake used as the location for the trapper.

^c Although workers would not be present at this location on an annual basis, the value is provided for information and is compared to the health-based criteria for members of the public.

Table 6.3-7 Comparison of Acrolein and Benzene at Discrete Receptor Locations

	Acrolein		Benzene	
	1-hr Maximum	24-hr Maximum	1-hr Maximum	24-hr Maximum
JEB Camp	– ^a	0.026	– ^a	0.007
Rabbit Lake Camp	0.019	0.008	0.06	0.001
Points North Worker	0.015	0.003	0.05	<0.001
Wollaston Lake Community	<0.01	0.001	0.01	<0.001
Wollaston Lake Trapper ^b	0.037	0.010	0.11	0.001
Wollaston Lake Lodge Operator	<0.01	0.002	0.03	<0.001
Hatchet Lake	<0.01	0.001	0.01	<0.001
Health-Based Criteria	7 (NA^a)	0.9 (0.9^c)	30 (NA^a)	0.6 (0.6^c)

Note: All concentrations in µg/m³.

^a Short-term (1-hour) exposure is directly addressed through Occupational Health and Safety program for workers.

^b Kewen Lake used as the location for the trapper.

^c As there is no directly applicable 8-hr Occupational Exposure Value (LWRS 2020), the health-based limit for members of the public was applied for workers

Table 6.5-1 Comparison of Human Health Risk Assessment Results with 2016 EP TID

2016

	Radioactivity Dose	Non-Carcinogenic Effects	Non-Radioactivity Cancer Risk	Gaseous Pollutants and Dust
Wollaston Lake Trapper				
Wollaston Lake Lodge Operator				
Rabbit Lake Worker (non-NEW)				
JEB Worker (non-NEW)				PM ₁₀
Points North Worker				
Hatchet Lake Lodge Operator				

2025

	Radioactivity Dose	Non-Carcinogenic Effects	Non-Radioactivity Cancer Risk	Gaseous Pollutants and Dust
Wollaston Lake Trapper				
Wollaston Lake Lodge Operator				
Rabbit Lake Worker (non-NEW)				
JEB Worker (non-NEW)				
Points North Worker				
Hatchet Lake Lodge Operator				

Table 7.2-1 Waterbody Attributes for Bena Lake

	Surface Area (ha) ^a	Volume (m ³ x 10 ⁶) ^a	Mean Total Annual Discharge (m ³ x 10 ⁶) ^b	Average Depth (m) ^c
Bena Lake	15.6	0.16	0.45	1.0

Notes:

^a value taken from Table 4.2-3 of the Sue E EIS (COGEMA 2004)

^b value taken from Table 2.4-7 of the 2016 McClean EP TID Vol.1 (AREVA 2016)

^c average depth calculated

Table 7.2-2 Estimated Water Concentration in Bena Lake from Groundwater Loading

Parameter	WQG ^e	Units	Peak Groundwater Loading (kg/y) ^a	Estimated Concentration (mg/L) Including Groundwater Load			Mean Measured Concentration (mg/L) ^d		
				Baseline ^b	Incremental ^c	Total	2022	2023	2024
Ammonia (as N)	0.51	mg/L (as N)	36.5	0.05	0.074	0.12	0.12	0.15	0.30
Nitrate (as N)	3	mg/L (as N)	294.8	0.2	0.60	0.8	4.0	2.4	1.0
Bicarbonate	-	-	196.5	12	0.4	12	29	34	18
Calcium	-	-	224.6	2.3	0.45	2.7	7.4	9.1	4.3
Chloride	120	mg/L	21.1	0.4	0.04	0.5	1.2	1.1	0.75
Fluoride	1.0	mg/L	1.1	0.03	0.002	0.04	0.09	0.10	0.05
Magnesium	-	-	53.4	0.8	0.11	0.9	2.1	2.4	1.3
Potassium	-	-	31.6	0.5	0.06	0.5	1.4	1.5	0.8
Sodium	200 ^f	mg/L	32.3	1.2	0.07	1.2	1.6	1.9	1.0
Sulphate	128	mg/L	11.9	0.8	0.02	0.8	0.4	0.5	0.5
Total Dissolved Solids	500	mg/L	2050.0	37	4.1	41	59	63	39

Notes:

^a values taken from Appendix VII.2

^b values taken from Table IV.4-3 of the 2016 McClean EP TID Vol.1 (AREVA 2016)

^c estimated as the peak loading diluted in the annual discharge volume (0.45×10⁶ m³) as shown in Table 7.2-1

^d as provided in Table 4.3-15 of 2025 EP TID Vol.1 (Orano 2025)

^e Refer to Table 3.4-1.

^f Total and dissolved. SEQG (ENV 2025)

Table 7.3-1 Protection Levels Based on Species Sensitivity Distribution - Nitrate as N

Protection Levels	Concentration (mg NO ₃ -N / L)			Species Affected at Central Tendency
	Central Tendency	Lower Prediction Interval	Upper Prediction Interval	
95%	4.5	3.4	6.5	Lake trout (<i>Salvelinus namaycush</i>)
90%	9.5	7.2	13	Lake trout (<i>Salvelinus namaycush</i>)
80%	21	17	26	Lake trout (<i>Salvelinus namaycush</i>), rainbow trout (<i>Oncorhynchus mykiss</i>), water flea (<i>Ceriodaphnia dubia</i>)

Note: SSD is presented in Appendix VII.1.

Table 8.1-1 Stack Testing Program Summary

Stack ID	Location	Sample Type	Measured COPC	Frequency
SE01	Sulphuric Acid Plant	Continuous	SO ₂	Daily Average
SE02	Ammonium Sulphate Crystallization Plant after scrubber stack	Grab	Particulate	Semi Annual
SE03	Ore Grinding Circuit after scrubber stack	Grab	Particulate	Semi Annual
SE04	Yellowcake Calciner after scrubber stack	Grab	Particulate	Semi Annual
		Grab	Ra-226, Pb-210, Th-230, U, As, Ni Particulates, SO ₂ , NH ₃	Annual
SE05	Yellowcake Packaging after scrubber stack	Grab	Particulates	Semi Annual
		Grab	Ra-226, Pb-210, Th-230, U, As, Ni; Particulates	Annual
SE07	Incinerator Stack	Grab	Particulate	Once every 5 years

Table 9.1-1 Summary of 1991 and 1995 EIS Determinations

Constituent	1991	1995
S/V TEMS		
Water Quality*	Moderate to Major	Moderate to Major
Sediment*	Moderate in short term Minor in long term	Moderate in short term Minor in long term
Ecological Impact**	Moderate	Minor to Moderate
McClean		
Water Quality*	Minor to Moderate	Minor to Moderate
Sediment*	Negligible	Moderate in short term Minor in long term
Ecological Impact**	Negligible	Negligible
Collins Creek		
Water Quality*	Minor	Minor to Moderate
Sediment*	--	--
Ecological Impact**	Negligible	Negligible
Overall		
Air Quality*	Negligible to Minor	Negligible to Minor
Human health		

Note: According to Minatco (1991), Cogema (1995):

*** Physical Environment:**

Major Impact was defined as deterioration in air, water or land (soil) quality where environmental standards or objectives would be exceeded most of the time or a permanent loss or alteration of a lake or stream through drainage, infilling, diversion or excessive flooding.

Moderate Impact is defined as a temporary deterioration in air, water or land (soil) quality with occasional (a small proportion of the time) violation of environmental standards or objectives or a temporary drainage or occasional flooding of a lake or stream.

Minor Impact is defined as one temporary deterioration in air, water or land (soil) quality where no environmental standards or objectives would be exceeded or a temporary fluctuation in lake levels or stream flows outside normal yearly variations.

Negligible Impact is defined as a temporary deterioration in air, water or land (soil) quality indistinguishable from normal fluctuations in natural background conditions or a temporary fluctuation in lake levels or stream flows occurring within normal yearly variations.

**** Biological Environment:**

Major Impact was defined as one affecting a whole population or species in sufficient magnitude to cause a decline in abundance and/or change in distribution beyond which natural recruitment (reproduction, immigration to affected areas) would not return that population or species, or any population or species dependent on it, to its former level within several generations.

Moderate Impact is defined as one affecting a portion of a population which may result in a change in abundance and/or distribution over one or more generations of that portion of the population or any population dependent on it, but which does not change the integrity of any population as a whole. It may be localized.

Minor Impact is defined as one affecting a specific group of individuals in a population at a localized area and/or over a short period (one generation or less), but not affecting other trophic levels or the integrity of the population itself.

Negligible Impact is defined as one affecting the population or specific group of individuals at a localized area and/or over a short period in such a way as to be similar in effect to small random changes in the population due to environmental vagaries, but having no measurable effect on the population as a whole.