Denison Mines Corp.
Wheeler River Operation

Effluent and Emissions Monitoring Plan

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Approval for Use

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Revision History

Version	Date	Description of Revision
1	January 2024	Draft for CNSC Review
2	April 2025	Responded to CNSC information requests

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Acronyms and Abbreviations

Term	Definition
AAAQO	Alberta Ambient Air Quality Objectives
CAC	Criteria Air Contaminants
CALA	Canadian Association for Laboratory Accreditation
CCME	Canadian Council of Ministers of the Environment
CNSC	Canadian Nuclear Safety Commission
COPC	Constituent of Potential Concern
CSA	Canadian Standards Association
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
EMRP	Effluent Monitoring and Release Pond
ERA	Environmental Risk Assessment
ESL	Effects Screening Levels
FEQG	Federal Environmental Quality Guidelines
GEN	Generator
ISR	In Situ Recovery
IWWTP	Industrial Wastewater Treatment Plant
MDMER	Metal and Diamond Mining Effluent Regulations
NPRI	National Pollutant Release Inventory
OAAQC	Ontario Ambient Air Quality Criteria
QA	Quality Assurance
QC	Quality Control
RST	Recovered Solution Tank
SAAQS	Saskatchewan Ambient Air Quality Standards

SEQG	Saskatchewan Environmental Quality Guidelines
SOP	Standard Operating Procedures
TDS	Total Dissolved Solids
TSP	Total Suspended Particulates

1 Introduction

1.1 Background

This *Effluent and Emissions Monitoring Plan* (Plan) supports the *Environmental Management Program* for the Wheeler River Operation (the Operation). The Plan is intended to meet the expectations of the Canadian Nuclear Safety Commission (CNSC) with respect to effluent and emissions monitoring as described in Regulatory Document 2.9.1 (CNSC, 2021) and to follow guidance from the Canadian Standards Association (CSA) on effluent and emissions monitoring as described in CSA N288.5:22, Effluent and emissions monitoring programs at nuclear facilities (CSA, 2022) and CSA N288.0-2022, Environmental management of nuclear facilities: Common requirements of the CSA N288 series of Standards.

Effluent and emissions monitoring is expected to be risk-based, focusing on both nuclear and hazardous substances released from a licensed facility, and providing a characterization of released constituents of potential concern (COPCs) sufficient to support the ongoing risk assessment, and to demonstrate adequate control of releases for environmental protection.

1.2 Scope

The Plan applies to effluent and emissions monitoring during site preparation and construction, as well as commissioning phases of the Operation. The effluent and emissions monitoring identified in this Plan is intended to apply to future phases of the Operation but may change over the lifecycle of the Operation based on the results of the monitoring and changes in operations.

Consistent with the CNSC definitions, effluent refers to a waterborne release of a nuclear or hazardous substance and emission refers to an atmospheric release of a nuclear or hazardous substance.

The Plan applies to point source effluent and point source emissions. In terms of spatial boundaries, the Plan applies from the point of treatment, if required, to the final point of control for release to the environment before dilution or dispersion occurs.

1.3 Objectives

In accordance with the needs for effluent and emissions monitoring (identified in Section 3), and based on CSA N288.5:22, the monitoring objectives are to:

- To provide information to demonstrate compliance with all regulatory requirements regarding effluents and emissions;
- To provide information on effluents and emissions to support assessment of potential risks to people and the environment as identified in the Environmental Risk Assessment (ERA);
- To provide information on effluents and emissions to support assessment of radiation dose to people and the environment;
- To provide early warning of any unusual or unforeseen releases of nuclear or hazardous substances to the environment; and
- To Confirm the EIS or Environmental review predictions as per CSA N288.5-2022 section 5.1(f)”

2 Wheeler River Operation Effluent and Emissions

2.1 Effluent

An explanation of the site water management and treatment can be found in the *Facility Description Manual;* however, the general effluent release point is described below. The sources feeding into the effluent ponds will be monitored as part of the operational plan and is considered outside of the *Effluent and Emissions Monitoring Plan*.

During construction, no treated effluent is expected to be released to the aquatic environment. Management of runoff water during construction will follow industry best management practice. There may be a need to sample and release precipitation and/or storm water collected in the ponds during the construction phase.

During the operation and decommissioning phases, treated effluent will be released to Whitefish Lake Middle (LA-5) via a discharge line with a diffuser to promote effluent mixing within the lake. Effluent will be released at an average discharge rate of 36.5 m^3/h as the EA case. The maximum upper bound discharge rate is 81 m^3/h. Effluent is not expected to be released during the post-decommissioning phase.

In the ERA, COPCs for effluent were identified by first identifying those constituents that:

- Are known to be present in the treated effluent; and
- Have existing water quality guidelines; or
- Are identified in the Metal and Diamond Mining Effluent Regulations (MDMER), SOR/2002-222, with the exception of cyanide which is considered not applicable.

This list was then reduced to the constituents expected to potentially be operational issues or result in changes to water quality in Whitefish Lake (LA-5) and the downstream environment.

In the ERA screening values were identified for surface water. The most restrictive federal or provincial guideline for surface water quality, based on the Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life, the Federal Environmental Quality Guidelines (FEQG), and the Saskatchewan Environmental Quality Guidelines (SEQG), was selected as the screening value for most surface water COPCs. Guidelines were adjusted for pre-operational hardness and pH, where applicable.

In the ERA the screening involved a conservative process of comparing the reasonable upper bound treated effluent quality against the selected water quality guidelines protective of human and ecological health. The reasonable upper bound treated effluent was derived using a combination of information available from lab tests as well as derived effluent quality based on not exceeding water and sediment quality guidelines in the middle part of Whitefish Lake.

No formal screening was conducted for radionuclides. However, since radiation dose to human and ecological receptors is of public and regulatory interest, the radionuclides in the U-238 decay series (U-238, U-234, thorium-230 [Th-230], radium-226 [Ra-226], Pb-210, polonium-210 [Po-210]) were considered COPCs for effluent and surface water.

Based on the screening of effluent quality vs. water quality guidelines conducted in the ERA, the following COPCs were identified:

- General Chemistry: chloride, sulphate, and total dissolved solids;
- Metals and metalloids: arsenic, cadmium, chromium, cobalt, copper, molybdenum, selenium, uranium, zinc; and
- Radionuclides: uranium-238, uranium-234, thorium-230, radium-226, lead-210, polonium-210.

2.2 Emissions

For emissions to the atmosphere, the ERA focused on the construction, operation, and decommissioning phases when effects on air quality are expected to be the greatest due to the intensity and number of activities.

The atmospheric releases are identified in the air emissions inventory detailed in the Air Quality Impact Assessment (Environmental Impact Statement (EIS) Section 6). The emissions will vary over time based on the schedule of Operation activities. The major air emission sources are:

- Fossil fuel combustion emissions from mobile equipment and stationary equipment (e.g., generators, heaters, vehicle and equipment movements);
- Fugitive dust emissions from drilling and blasting, material handling, crushing, vehicle generated road dust, and wind erosion from waste piles;
- Air emissions released from processing (e.g., dryer and hygiene scrubber stacks); and
- Removal of site infrastructure and reclamation of waste piles and other storage areas/ponds during the decommissioning phase.

Operation-related atmospheric releases would include criteria air contaminants (CACs; nitrogen oxides [assessed as nitrogen dioxide], sulphur dioxide, hydrogen sulphide, ozone, carbon monoxide, total suspended particulates [TSP], and fine particulate matter [PM10 and PM2.5]), and metals including uranium in dust, and radon.

Criteria air contaminants have either federal or provincial ambient air quality criteria or both. Nitrogen oxides, sulphur dioxide, carbon monoxide, and particulates (TSP, PM10, and PM2.5) would be CACs directly emitted by the Operation from stationary and mobile sources. Sources of hydrogen sulphide and ozone are expected to be negligible and therefore were not retained for further assessment of impacts to air quality. Particulates would be associated with sources such as road dust from unpaved roads; wind erosion; materials handling; dozing at the wellfield and waste pads; the in-situ recovery (ISR) dryer and hygiene scrubber stacks (dusts emitted in the form of yellowcake); and construction activities. Particulates would be measured in terms of TSP, PM10, and PM2.5. Metals would be emitted as a portion of dust. Dust emissions would be potentially associated with wellfield drilling in mineralized waste, wind erosion from the mineralized waste pad, material handling at the wellfield and mineralized waste pad, and stack emissions from the ISR Plant (the dryer, and hygiene scrubber stacks).

Long-lived radioactive dust is of primary concern at the back end of the ISR process since the process is wet until the yellowcake product (uranium oxide) is precipitated out of solution and dried. The long-lived species of concern at that point are uraniuim-238 and uranium-234. The uranium mass is almost entirely uraniuim-238; on an activity basis, uranium-238 and uranium-234 contribute equal activity. It

was assumed that other radionuclides in the uranium-238 decay chain would not be present at the point of release, but decay and ingrowth is accounted for over time at the point of exposure.

Radon emissions are expected to arise from a number of sources: wellfield drilling, groundwater exposure to the atmosphere, mining solution venting from wellheads and leaking transport piping, recovered solution tank venting, recovered solution pond, ISR plant ventilation, and the mineralized waste and stage 1 precipitates storage pads.

The screening of air quality constituents was based on maximum predicted concentrations of CACs, metals including uranium, radon, and maximum dust deposition, at air quality model locations that correspond with receptor locations.

In the ERA ambient air quality criteria were selected from the following sources (listed in order of preference): Saskatchewan Ambient Air Quality Standards (SAAQS), Alberta Ambient Air Quality Objectives (AAAQO), Ontario Ambient Air Quality Criteria (OAAQC), Texas effects screening levels (ESLs). Screening values for radionuclide concentrations in ambient air were not available. All relevant radionuclides were assessed in the ERA in terms of their contribution to the total radiological dose to human and ecological receptors.

Air quality constituents that exceeded a screening value were nitrogen dioxide, particulate matter (TSP, PM10), and uranium. These are the COPCs for air emissions, along with radionuclides (uranium-238, uranium-234, thorium-230, radium-226, radon-222, lead-210, polonium-210).

3 Need for Effluent and Emissions Monitoring

3.1 Monitoring Required by a Regulator

The *Effluent and Emissions Monitoring Plan* follows guidance in the CSA *N288.5 Effluent and Emissions Monitoring Programs at Nuclear Facilities*, and regulatory requirements in the *Metal and Diamond Mining Effluent Regulations*, as well as any applicable requirements in licenses, approvals, and permits.

Monitoring of effluent (and receiving water quality, which is detailed in the *Environmental Monitoring Plan*) is required to evaluate whether the effluent (and receiving water) meet applicable criteria (i.e., effluent quality criteria, surface water quality guidelines).

Monitoring of effluent is required to demonstrate compliance with conditions of effluent discharge permitting and approvals.

3.2 Monitoring Based on Potential Risk to People or Environment

Monitoring of water quality in the effluent monitoring ponds and other catchment ponds prior to discharge to the environment will be needed to support further evaluation of Operation-related effects on fish and fish habitat, fish health, sediment, and benthic invertebrate communities in the receiving water environment (i.e., Whitefish Lake).

The ERA evaluated human use of local surface water for drinking and bathing. Monitoring of effluent will support ongoing assessment of risks to human receptors via the direct contact and ingestion of water pathways. The use of effluent data to support the ERA is stipulated in CSA N288.6 *Environmental risk assessments at nuclear facilities and uranium mines and mills*.

3.3 Monitoring to Support Radiation Dose Assessment

Monitoring of effluent and emissions will support ongoing assessment of radiation doses to human receptors. A comprehensive suite of radionuclides is included in the monitoring plans in order to evaluate total dose. The monitoring also supports assessment as described in the *Radiation Protection Plan*.

3.4 Monitoring based on Other Operational Needs

Monitoring of uncontrolled discharges that may trigger emergency response is not within the scope of this Plan and is described in the *Emergency Preparedness and Response Program*. Monitoring of waste is not within the scope of the Plan and is described in the *Waste Management Program*.

Monitoring of influent to the industrial wastewater treatment plant (IWWTP) will provide information to support operation of the IWWTP by allowing operators to adjust the treatment process according to influent chemistry.

4 Design of Effluent and Emissions Monitoring

4.1 Specific Objectives

In order to satisfy the general objectives stated in Section 3 above, the following specific objectives of monitoring are identified by effluent or emissions stream, indicating classes of parameters to be monitored in each stream:

a) To determine concentrations of major ions, suspended solids, dissolved solids, ammonia (total, free), relevant metals and radionuclides in effluent from the Industrial Wastewater Treatment Plant, as well as loadings from the effluent to Whitefish Lake, effluent pH and acute lethality.

b) To determine the concentrations of suspended particulate (TSP, PM_{10}, $PM_{2.5}$), relevant metals, and radionuclides in emissions to air from the ISR Process Plant stacks (dryer and hygiene stacks), as well as loadings to air from these stacks.

c) To determine the concentrations of nitrogen oxides (NO_X) and radon in emissions to the air in the immediate vicinity of the Operation site.

d) Estimation of greenhouse gas emissions from combustion sources and the loss of a carbon sink associated with the development of the Project Area during the first year of construction.

4.2 Stormwater Monitoring

Stormwater monitoring will take place during construction only, as described in Table 4-1.

Table 4-1: Stormwater Monitoring for the Construction Phase

Station Identifier	Constituents/Parameter(s)	Rationale for Monitoring	Sample Type	Sampling Frequency	Samples /Year
TBD	Major ions	COPC or part of TDS	Grab	As Needed[1]	TBD
TBD	Total dissolved solids (TDS)	COPC in EIS/ERA	Grab	As Needed[1]	TBD
TBD	Total suspended solids	MDMER-sch4	Grab	As Needed[1]	TBD
TBD	Total ammonia nitrogen	MDMER-sch4	Grab	As Needed[1]	TBD
TBD	pH, temperature	MDMER-sch4	Grab	As Needed[1]	TBD
TBD	Metals	COPC or MDMER-sch4	Grab	As Needed[1]	TBD

1 Monitoring to occur following stormwater events.

4.3 Effluent and Emissions Monitoring

Source monitoring of effluent and emissions is completed to verify the environmental performance of the Operation's effluent and air emissions control systems. Monitoring data provides the information that is required to verify predicted effects (or their absence), to evaluate the effectiveness of mitigation measures, and to confirm compliance with statutory requirements.

The effluent and emissions monitoring are described in Table 4-2 and Table 4-3.

4.3.1 Effluent Monitoring and Release Pond

Industrial wastewater treatment is completed through an engineered IWWTP. Treated effluent is managed through a batch release system which allows the operation to verify compliance of effluent constituents to meet acceptable release criteria prior to discharge to the environment.

Following treatment, the treated effluent is discharged to the effluent monitoring pond. While filling, a pond fill composite (PFC) sample of the treated waters is collected, the PFC sample is analyzed to verify compliance prior to approval for release to the environment. As the treated effluent from a monitoring pond is released a pond release composite (PRC) sample is collected to represent the treated effluent quality released to the environment. Should a PFC sample not meet acceptable release criteria the pond

would be recycled to the process water pond for retreatment through the IWWTP. Compliance checks on effluent quality is completed as outlined in Table 4-2 below.

Table 4-2: Effluent Monitoring for the Final Discharge Point

Station Identifier	Constituents/Parameter(s)	Rationale for Monitoring	Sample Type	Sampling Frequency	Samples /Year
EMRP	Major ions [1]	COPC or part of TDS	Composite	Weekly[7]	52
EMRP	Total dissolved solids (TDS) [1]	COPC in EIS/ERA	Composite	Weekly[7]	52
EMRP	Total suspended solids	MDMER-sch4	Composite	Weekly[7]	52
EMRP	Total ammonia nitrogen[2]	MDMER-sch4	Grab	Weekly[8]	52
EMRP	pH, temperature[2]	MDMER-sch4	Grab	Weekly[8]	52
EMRP	Acute lethality[3]	MDMER-sch4	Grab	Monthly[9]	12
EMRP	Metals[4]	COPC or MDMER-sch4	Composite	Weekly	52
EMRP	Radionuclides[5]	COPC or MDMER-sch4	Composite	Weekly	52
EMRP	Flow volume[6]	MDMER-sch4	Continuous	Daily[6]	365
EMRP	EEM chemistry[10]	MDMER-sch5	Grab	1/Quarter	4
EMRP	Sublethal toxicity[11]	MDMER-sch5	Grab	2/Year[12]	2

1 Including at least Cl^-, SO_4^{2-}, HCO_3^-, NO_3^-, Na^+, Ca^{2+}, Mg^{2+}, K^+. TDS is calculated as the sum of major ions.
2 Total ammonia nitrogen is used with pH and temperature to calculate unionized ammonia.
3 Acute lethality is tested on Rainbow Trout and *Daphnia magna.*
4 Metals of interest in the ERA are As, Cd, Cr, Co, Cu, Mo, Se, U, Zn. MDMER schedule 4 also requires As, Cu, Pb, Ni, Zn.
5 Radionuclides of interest in the ERA are U-238, U-234, Th-230, Ra-226, Pb-210, Po-210. MDMER schedule 4 requires Ra-226.
6 Flow is measured continuously and results are recorded daily in m^3/day. Flow is used to calculate monthly loadings for schedule 4 parameters.
7 Weekly sample is a 24-h composite collected once per week.
8 Weekly sample is a grab coincident with collection of the 24-h composite.
9 Monthly sample is a grab coincident with collection of a 24-h composite.
10 EEM chemistry includes hardness, alkalinity, conductivity, temperature, Cl^-, SO_4^2, NO_3^-, phosphorus, Al, Cd, Hg, Mo, Se, Cr, Co, Tl, U. The Hg may be discontinued if <0.1 ug/L for 12 consecutive samples.
11 Sublethal toxicity is tested on fathead minnow (or early life stage salmonid), *Ceriodaphnia dubia*, *Lemna minor*, and freshwater alga, on samples concurrent with those used for EEM chemistry.
12 After 3 years, sublethal testing is 1/Quarter using the most sensitive test species based on geometric mean of IC25.
EMRP = Effluent Monitoring and Release Pond

4.3.2 Emissions

Emissions monitoring will occur at the ISR Process Plant stacks. The monitoring is outlined inTable 4-3.

Greenhouse gas emissions will be calculated using emission factors according to the *Greenhouse Gas Reporting Procedure*.

Table 4-3: Emissions Monitoring for the Dryer and Hygiene Stacks near point sources

Station Identifier(s)	Constituents/Parameter(s)	Rationale for Monitoring	Sample Type	Sampling Frequency	Samples /Year
PP1, PP2, PP3	Particulate [1]	Recommended in ERA	Composite	Semi-annual	2
PP1, PP2, PP3	Metals in TSP [2]	Recommended in ERA	Composite	Semi-annual	2
PP1, PP2, PP3	Nickel and Uranium in PM_{10} [3]	Recommended in ERA	Composite	Semi-annual	2
PP1, PP2, PP3	Uranium in $PM_{2.5}$ [3]	Recommended in ERA	Composite	Semi-annual	2mdmer
PP1, PP2, PP3	Radionuclides in TSP [4]	Recommended in ERA	Composite	Semi-annual	2
PP1, PP2, PP3	Flow volume [5]	-	Continuous	Semi-annual	365
GEN1, GEN2	Nitrogen oxides [6]	Recommended in EIS/ERA	Continuous	Semi-annual	1
RST	Radon [7]	COPC in EIS/ERA	Continuous	Semi-annual	1

1 Particulate includes total suspended particulate (TSP), and finer fractions (PM_{10} and $PM_{2.5}$).
2 Metals of interest in the ERA are As, Cd, Cr, Co, Cu, Pb, Mo, Ni, Se, U, V, Zn.
3 Both Ni and U have air quality criteria based on PM_{10}, but U is the main constituent of respiratory concern.
4 The particulate radionuclides of main concern are U-238 and U-234. Other U-238 series particulates are of minor concern.
5 Flow is measured continuously and results are recorded daily in m^3/day.
6 Passive samplers for NOX deployed around the source at point of impingement in four compass directions.
7 Passive samplers for radon deployed around the source at point of impingement in four compass directions.

5 Monitoring Performance and Data Acceptance Criteria

5.1 Monitoring Performance Criteria

Monitoring performance will be evaluated annually for each effluent and emission stream in terms of the percentage of planned samples over the year that were successfully obtained and analyzed. It is expected that a small proportion of samples may not be successfully collected and analyzed, due to equipment malfunction or other logistical reasons. The performance objective is 90% of planned samples successfully obtained and analyzed where weekly or monthly samples were planned, and 75% where quarterly samples were planned. For continuous measurements, the target is to have the system on-line 90% of the time. A weekly or monthly composite will be considered complete if 75% of its grab samples are collected.

5.2 Data Acceptance Criteria

Data acceptance criteria are defined for chemical and radiochemical analyses and are analyte specific. The criteria pertain to results of quality control (QC) samples that are associated with each batch of samples analyzed. Types of QC samples are described in Sections 8.2 and 8.3. If the QC samples do not meet these criteria for any analyte, an unusual laboratory situation is indicated and results for the associated samples are flagged as suspect. If the QC data indicate a laboratory problem, the sample may be re-analyzed. Any flagged sample result will be carefully reviewed before data use to determine if it should be included or excluded for that data use.

The data acceptance criteria will be developed by Denison's Environmental Manager, considering the data quality needs of the EMP, as well as laboratory capabilities, and any regulatory requirements. Data acceptance criteria for effluent samples are listed by analyte in Table 5-1. Data acceptance criteria for air emissions samples are listed by analyte in Table 5-2.

Table 5-1: Data Acceptance Criteria for Monitored Substances in Liquid Effluents

Substance(s)	Units	MDMER Criteria[1]	Maximum L_D or L_C [2]	Blank Criterion[3]	Precision (±%)[4]	Accuracy (±%)[5]
Major ions	mg/L	-	0.6	< L_D	10	10
TDS	mg/L	-				
TSS	mg/L	15/22.5/30	2	< L_D	15	15
Ammonia-N	mg/L	-	0.05	< L_D	10	10
pH	pH units	-	-	-	0.1 units	0.1 units
Temperature	°C	-	-	-	10	0.5°C
Arsenic	mg/L	0.1/0.15/0.2	0.0025	< L_D	10	10
Copper	mg/L	0.1/0.15/0.2	0.001	< L_D	10	10
Lead	mg/L	0.08/0.12/0.16	0.0005	< L_D	10	10
Nickel	mg/L	0.25/0.38/0.5	0.0125	< L_D	10	10
Zinc	mg/L	0.4/0.6/0.8	0.01	< L_D	10	10
Cadmium	mg/L	-	0.000045	< L_D	10	10
Chromium	mg/L	-	0.00445	< L_D	10	10
Cobalt	mg/L	-	0.00125	< L_D	10	10
Molybdenum	mg/L	-	0.0365	< L_D	10	10
Selenium	mg/L	-	0.0005	< L_D	10	10
Uranium	mg/L	-	0.0075	< L_D	10	10
Ra-226	Bq/L	0.37/0.74/1.11	0.01	< L_D	10	10
Th-230	Bq/L	-				
Pb-210	Bq/L	-				
Po-210	Bq/L	-				

1 Metal and Diamond Mining Effluent Regulations – monthly mean/composite/grab.
2 Limit below which a quantitative result is not reported (L_D or L_C according to lab practice).
3 Lab and field blanks will be evaluated according to the same criteria.
4 Relative standard deviation for low level QC samples (10 x L_D).
5 Percent difference from expected for low level QC samples (10 x L_D).

Table 5-2: Data Acceptance Criteria for Monitored Substances in Emissions to Air

Substance	Units	Maximum L_D or L_C [1,2]	Blank Criterion[3]	Precision (±%)[4]	Accuracy (±%)[5]
TSP	mg/m^3	0.003	< L_D	15	15
PM_{10} & $PM_{2.5}$	mg/m^3	0.003	< L_D	15	15
Arsenic	$\mu g/m^3$	0.000001	< L_D	30	30
Cadmium	$\mu g/m^3$	0.000001	< L_D	30	30
Chromium	$\mu g/m^3$	0.000001	< L_D	30	30
Cobalt	$\mu g/m^3$	0.000001	< L_D	30	30
Copper	$\mu g/m^3$	0.000002	< L_D	30	30
Lead	$\mu g/m^3$	0.000001	< L_D	30	30
Molybdenum	$\mu g/m^3$	0.000001	< L_D	30	30
Nickel	$\mu g/m^3$	0.000001	< L_D	30	30
Selenium	$\mu g/m^3$	0.000001	< L_D	30	30
Zinc	$\mu g/m^3$	0.000005	< L_D	30	30
Uranium	$\mu g/m^3$	0.000001	< L_D	30	30
Th-230	Bq/m^3	0.000007	< L_C	30	30
Ra-226	Bq/m^3	0.000003	< L_C	30	30
Pb-210	Bq/m^3	0.000001	< L_C	30	30
Po-210	Bq/m^3	0.000003	< L_C	30	30

1 L_D or L_C for radionuclides and metals based on an air volume of 30,000 to 36,000 m^3. Same limit for Ni and U on fractions.
2 Limit below which a quantitative result is not reported (L_D or L_C according to lab practice).
3 Lab and field blanks will be evaluated according to the same criteria.
4 Relative standard deviation for low level QC samples (10 x L_D).
5 Percent difference from expected for low level QC samples (10 x L_D).

6 Sampling and Analysis Procedures

6.1 Sampling Procedures

Effluent and emissions sampling will be conducted in accordance with standard operating procedures (SOPs) as described by Denison (2024). These SOPs encompass sampling of liquid effluents and of air emissions, and any continuous monitoring, as appropriate to the effluent and emission streams and analytes as described in Section 4.2 above, as well as sample submission and field measurement procedures. The SOPs follow accepted sampling practice.

6.2 Analysis Procedures

The chemical and radiochemical analyses to be performed on effluent and emissions samples will be performed in accordance with the SOPs of the qualified analytical laboratories. The SOPs follow accepted analytical practice. Third party laboratories are accredited by the Canadian Association for Laboratory Accreditation (CALA) as conforming to international standard ISO/IEC 17025 for the analyses required.

7 Interpretation of Monitoring Data

7.1 Recording and Reporting of Data

Measured values from laboratories are recorded in an uncensored form, along with detection limits. In reports, measurements below detection limits should be flagged, and may be reported as “less than” values, or at face value, to be decided in consultation with regulatory authorities.

Analytical uncertainties associated with each measurement will be reported. Uncertainties in estimated values, such as means, will be quantified.

7.2 Comparing to Licensed Release Limits and Action Levels

Effluent release data will be compared to action levels, licensed release limits and MDMER limits.

Action levels are identified in the *Environmental Code of Practice*. Action levels correspond to effluent monitoring results that, if met or exceeded during routine conditions, might indicate a loss of control of the Environmental Protection Program. Action levels are derived according to CSA N288.8 *Establishing and Implementing Action Levels for Releases to the Environment from Nuclear Facilities* and are lower than licensed release limits so that action may be taken prior to licensed release limits being exceeded.

Licensed release limits are based on the expected maximum release (including a margin for operational flexibility) and any exceedance of this limit represents a release outside of the licensing basis and demonstrates a lack of compliance with the license. The design quantities (emissions and effluent releases) provided in the EIS are the basis for the licensed release limits.

Effluent concentrations must be compared to MDMER limits which specify maximum authorized concentrations of prescribed deleterious substances, as well as limits on pH, and acute lethality.

7.3 Loadings to Support Dispersion Modelling

One reason for monitoring effluents and emissions is to support the estimation of environmental concentrations (where they are not measured) and the estimation of resulting risks or doses to people and the environment (Section 3). Models used to estimate environmental concentrations require loading rates as input. Loading rates to receiving water or air will be calculated from the weekly or monthly concentrations of measured constituents (Section 4) multiplied by corresponding weekly or monthly flow rates. Annual loadings will be calculated as a sum of the weekly or monthly values.

All estimated loadings will be accompanied by an estimate of uncertainty, based on the observed variance in the measured concentrations and flows.

8 Quality Assurance and Quality Control

8.1 Quality Assurance

Quality Assurance (QA) is the system used to verify that the process is operating within acceptable limits and QC is the mechanisms established to measure non-conforming method performance. The QA/QC processes incorporate the requirements of CSA N286 and ISO 9001.

8.2 Quality Control Samples

As per CSA N288.5, 10% of total samples analyzed should be field and laboratory QA/QC samples. There should be QA/QC samples for both emissions and effluent samples. The types of QA/QC samples to be collected in the field are listed below:

- Duplicate Samples
    - A separate sample collected at the same time or in rapid succession from the same station as a Plan sample; and
    - Used to assess field (sampling) plus laboratory variability.
- Field and laboratory parallel analyses
    - Variables such as pH and conductivity measured in the laboratory and in the field using different instruments;
    - Provides an indication of whether conditions have changed between field sampling and laboratory analysis; and
    - May also identify systematic errors in field instruments.
- Field Blank
    - Empty sample containers filled in the field with pure water that was provided by the laboratory and transported to the field;
    - Handled identically to Plan samples except for the water used to fill containers; and
    - A test of whether sampling conditions, reagents, instruments, or containers may contaminate samples.

8.3 Laboratory Quality Control

Accredited laboratories have their own quality control programs, with their own criteria for flagging suspect data. For laboratories performing analysis under the effluent and emissions monitoring program, the criteria in Tables 5.1 and 5.2 were reviewed by program staff and were deemed compatible with monitoring program objectives. Specifically, if the laboratory detection limits, blank criteria, precision criteria, and accuracy criteria are met, it is anticipated that effluent and emissions data will be mostly quantitative (not "less than"), not appreciably affected by contamination, not appreciably affected by laboratory sources of variability (relative to variability in the effluent or emissions), and not biased to an extent that would compromise monitoring program objectives.

Laboratory QA/QC analysis properties are described below:

- Precision
    - Defined as the reproducibility and reliability of the test method; and
    - Determined by analyzing replicate samples (i.e., multiple containers that each contain subsets of a homogenized sample).
- Accuracy
    - Defined as the degree of closeness of measurements to the analyte's true value; and
    - Determined by analyzing reference standards (i.e., solutions derived from accurately known commercial formulations).
- Sample contamination
    - Determined by analyzing laboratory blank samples (i.e., distilled or deionized water).
- Detection limits or sensitivity
    - Defined as the lowest concentration at which individual measurement results for a specific analyte are statistically different from a blank sample with a specified confidence level for a given method and representative media; and
    - Detection limits vary among methods for most analytes and are an important consideration when concentrations are likely to be very low (i.e., near detection limits).

9 Reporting, Review and Audit

9.1 Reporting of Results

The required results of monitoring under this Plan will be reported annually to the CNSC and the Saskatchewan Ministry of the Environment (Sask ENV). The annual report will include monitoring data for the year, for all effluent and emissions streams, as outlined in Section 4.2 above. It will also include comparison of the monitoring results to action levels and release limits, as described in Section 7.1 above, and a summary interpretation of results in terms of effluent and emissions control, and regulatory compliance. Where action levels are exceeded, causes will be investigated, and possible corrective actions to improve control will be considered.

The following specific documents/data will be reported to the relevant regulators (Table 9-1).

Table 9-1: Reporting Requirements for the Effluent and Emissions Monitoring Plan

Type of Report	Regulator
Annual report – harmonized report to meet CNSC REGDOC-3.1.2, Reporting Requirements, Volume I: Non-Power Reactor Class I Facilities and Uranium Mines and Mills, Version 1.1, and CSA N288.0, Environmental management of nuclear facilities: Common requirements of the CSA N288 series of Standards	CNSC, ENV
MDMER regulatory data reporting (quarterly and annual) through the Mine Effluent Reporting System	Environment and Climate Change Canada (ECCC)
MDMER EEM reporting through the Environmental Effects Monitoring Electronic Reporting System based on biological monitoring frequency	ECCC
National Pollutant Release Inventory (NPRI) of pollutants released to air, water, and land (annual by June 1st)	ECCC
Greenhouse Gas Emissions (annual by June 1st Federal and October 31st Provincial)	ECCC, ENV
Halocarbon release report on the release of halocarbons of an amount greater than 10 kg but less than 100 kg from any system, container, or equipment (semi-annual)	
Environmental Performance Report (submitted to the Province of Saskatchewan every 5 years, or as agreed to by Saskatchewan Ministry of Environment (SK MOE))	SK MOE

9.2 Program Review

The performance of monitoring under the *Effluent and Emissions Monitoring Plan* will be evaluated annually against program performance criteria, as outlined in Section 5.1 above. If performance criteria are not met, causes will be investigated, and possible corrective actions to improve program performance will be considered.

In addition, the effectiveness of the effluent and emissions monitoring in accomplishing its objectives will be reviewed annually, and recommendations may be made for improved design of the monitoring or other corrective actions.

9.3 Program Audits

An internal audit of monitoring under the *Effluent and Emissions Monitoring Plan* will be conducted every five years, or more frequently if indicated by substantive facility changes, in concert with the ERA review/update. The audit will be conducted by staff not involved in the effluent and emissions monitoring program. It will include reconsideration of the need for effluent and emissions monitoring and of the monitoring objectives, and of the design to meet objectives. The audit results will be documented and will be considered in a review/update of the *Effluent and Emissions Monitoring Plan.*

The internal audits will follow the process and procedures outlined in the *Management System Program.*

10 Staff Qualifications and Training

10.1 Qualifications

The necessary qualifications for staff involved in effluent and emissions monitoring are as described in the *Training Management Program* and supporting Plans and Procedures.

10.2 Training

The necessary training for staff involved in effluent and emissions monitoring are as described in the *Training Management Program* and supporting Plans and Procedures.

11 References

11.1 Internal

Document Number	Document Name
36	Environmental Code of Practice
33	Environmental Monitoring Plan
09	Environmental Management Program
13	Emergency Preparedness and Response Program
02	Facility Description Manual
TBD	Greenhouse Gas Reporting Procedure
06	Management System Program
23	Radiation Protection Plan
08	Training Management Program
10	Waste Management Program

11.2 External

Canadian Nuclear Safety Commission (CNSC). 2021. Regulatory Document 2.9.2. Environmental Protection – Controlling Releases to the Environment. March 2021. Draft.

Canadian Standards Association (CSA). 2022. CSA N288.5:22. Effluent and emissions monitoring programs at nuclear facilities. February.

Canadian Standards Association (CSA). 2022. CSA N288.0:22. Environmental management of nuclear facilities: Common requirements of the CSA N288 series of Standards. January.