Annex 1 Responses to Information Requirements

Federal Indigenous Review Team (FIRT) – Denison's Responses to Information Requirements for the Wheeler River Project Environmental Impact Statement

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
IR-01	English River First Nation (ERFN)	Current use of lands and resources for traditional purposes	General	**Context:** Denison has not gone far enough in terms of learning from and incorporating information from ERFN provided in the *Traditional Knowledge Study and Health and Socio-Economic Study Report*. It appears Denison put a disproportionate amount of reliance on the views and interests of one ERFN land user. While we applaud the efforts of Denison to seek feedback from ERFN land users directly and to work closely with such land users, ERFN's rights and interests in the region of the Project (and the potential of the Project to adversely impact such rights and interests) extend well beyond that of just one land user. **Rationale**: It is important for the proponent and regulators to understand that while the rights and interests of individual ERFN members are important to consider, the Elders and elected leaders of ERFN represent the collective rights and interests of ERFN as a Nation. The results of the scoping study indicated that ERFN holds firmly established rights to the area where the planned project is located. Numerous studies conducted over several decades have examined ERFN's relationship and connection to land use and occupancy of the region where the proposed mine is located from traditional land use, subsistence harvesting, ecological, and sociocultural and economic perspective.	The draft EIS should be revised to reflect the totality of ERFN TK and land use information. Denison and CNSC must continue to work with ERFN to ensure that impacts on ERFN rights are appropriately and fully considered, mitigated, and accommodated.	Denison has met with ERFN regarding the IR and has gained a better understanding of the specific concern raised in the IR. ERFN's relationship and connection to the land is important. Denison will continue to work with ERFN to refine its understanding of this relationship and will work with ERFN to make sure this is accurately reflected in the final EIS. Despite the passing of the late trapper/resource harvester referred to throughout draft EIS, ERFN has communicated to Denison that ERFN considers his use of the area as representative of current and future land users and expects that the relationship to the Project area will be continued and strengthened through generations of future use. Changes will be made throughout the EIS to reflect that the late ERFN land user is but one of many current and future land users, and should be considered as representative of future land uses and expression of rights. For example, statements about the land being inactive at this time or statements that suggest that other land users are limited or have not provided documented use of the area will be removed and repositioned so as to reflect the importance of the area to ERFN. This may result in the inclusion of additional mitigation and enhancement measures. Denison will continue to work with ERFN on the list of Project elements that ERFN feels required additional refinement or that are sources of concern as the EIS review process continues.	As noted in the IR response, the final EIS will be updated. To support review of the response, a few examples of updates to the draft EIS are provided, with new text in **bold**, and deleted text in ~~strikethrough~~: Example 1: *10.1.6.1.4 Human Health Risk Assessment Results* (excerpt only) The ingestion rate for caribou, based on engagement with a local fisher/trapper, was 175 kg/yr of caribou (equivalent to approximately 2 to 3 servings per day). This ingestion rate is conservative compared to an annual caribou ingestion rate of 2.6 kg/yr (1 to 2 servings per month) from the ERFN's Country Food Study (CanNorth 2017) and 54.4 kg/yr for the total game diet for a high traditional foods consumer in the Boreal Shield as per the First Nations Food, Nutrition and Environment Study for Saskatchewan (Chan et al. 2018). Thus, the local fisher/trapper **represents** ~~is relatively extreme~~ **an intensive land user** with respect to local game consumption. **Denison recognizes that ERFN considers the fisher/trapper's use of the area as representative of current and future land users and expects that the relationship to the Project Area will be continued and strengthened through generations of future use.** Example 2: 10.1.6.2 Residual Effects Characterization (excerpt only) For non-carcinogens, the results of the HHRA predicted no exceedances of the HQ benchmark (HQ<0.2) for human receptors for non-carcinogens (cadmium, copper, chromium, cobalt, molybdenum, uranium, and zinc) during all phases of the Project. The one exception was selenium for the fisher/trapper at Russell Lake, where the incremental Project HQ for the fisher/trapper from fish ingestion (northern pike and white sucker) was predicted to be 0.93. ~~The traditional foods diet assumptions for the fisher/trapper are conservative and are based on engagement with a local fisher/trapper which is representative of one person, who consumes a unique composition and quantity of traditional foods. Most~~ **Many** people fishing, hunting, and trapping in the Project Area would consume traditional foods more consistent with the average traditional foods consumer diet, which was developed from the ERFN country foods study (CanNorth 2017). **Denison recognizes that ERFN considers the fisher/trapper's use of the area as representative of current and future land users and expects that the relationship to the Project Area will be continued and strengthened through generations of future use.** Example 3: 11.1.2.1 English River First Nation Indigenous Knowledge (referred to as Traditional Knowledge or TK by the ERFN) was provided by ERFN for consideration in the EIS. This included several reports: • *Wheeler River Project – Summary of Health and Socio-Economic Study Results,* which summarizes results from 16 interviews that were conducted for the health and socio-economic topics (ERFN and SVS 2022a).

[1] Unless otherwise stated, the section noted refers to the draft EIS.
[2] Where IR contents note "See also related IR(s)", responses from Denison may be similar or provided in a single detailed response, but it was preferred to keep original IRs distinct.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
							• *Wheeler River Project - Summary of Traditional Knowledge Study Results*, which analyzed and presented results from 21 land use interviews that provided both IK and LK and included details on ERFN's resource harvesting locations, species harvested, travel routes, cabins and special sites (ERFN and SVS 2022b). • *The English River First Nation Country Foods Study Final Report*, which conducted in 2016 through funding secured from the First Nations Environmental Contaminants Program to complete a country foods study. The study involved three components: a dietary study, a sampling program, and a human health risk evaluation. The overall study objectives were to examine country food usage by ERFN community members and to assess if the country foods are safe to eat. The involvement of ERFN community members was one of the fundamental goals of the study, which relied heavily on TK to identify what and where to sample (CanNorth 2017a). • *The English River First Nation Aboriginal Traditional Knowledge Summary Report*, which was compiled by Environment Canada on behalf of ERFN to summarize information for the purposes of recovery of the Woodland boreal caribou population. Ten individuals (mostly Elders) were selected by ERFN to complete TK interviews to understand boreal Caribou in the English River Traditional Territory (ERFN 2011). Local Knowledge also was provided by an ERFN trapper, fisher, and resource harvester (ERFN Trapper) who resided in and conducted resource use in the Project Area. The ERFN Trapper explained the use of the area by outfitters and cabin lease holders, fish and wildlife abundance and distribution, species harvested for traditional use, and navigation and travel along waterbodies and roads. On October 29, 2019, at Denison's Project exploration camp, the resource user attended a full-day interview. Notes from this interview were finalized on January 2, 2020, with their approval and are used in most ILRU components herein. Unfortunately, prior to the filing of the EIS, the ERFN Trapper passed away. **Despite his passing, ERFN considers the ERFN Trapper's use of the area as representative of current and future land users and expects that the relationship to the Project area will be continued and strengthened through generations of future use.**
IR-02	Canadian Nuclear Safety Commission (CNSC)	Mitigation Measures	General Appendix 16-C	**Context:** Denison's 2019 Wheeler River Terms of Reference states: "The EIA will also discuss the monitoring programs required to demonstrate regulatory compliance and compliance with the commitments Denison has made to its Indigenous and non-Indigenous Stakeholders." The CNSC's Generic Guidelines for the Preparation of an Environmental Impact Statement (EIS), also state: "The EIS will then describe mitigation measures that are specific to each environmental effect identified. Measures will be written as specific commitments that clearly describe how the proponent intends to implement them and the environmental outcome the mitigation is designed to address. **Rationale:** The EIS and the Summary of Monitoring and Follow-up Programs provided in Appendix 16-C contains very high-level information. It is not clear which monitoring programs will be employed to demonstrate regulatory compliance, and compliance with the commitments Denison has made to its Indigenous and non-Indigenous Stakeholders.	CNSC staff expect Denison to provide a comprehensive list of commitments along with the next version of the EIS, including any commitments made to Indigenous Nations and communities and other stakeholders (As committed in the Wheeler River Terms of reference, and as noted in the November 28th, 2022 email from CNSC staff to Denison: *Future Submission of a Commitments Table for Wheeler River EIS*).	A list of commitments, including specific commitment or mitigation measures related to Project effects as an outcome of engagement, made in the draft EIS, throughout the Federal information request period and the Provincial comment response period, will be included with the submission of the revised draft EIS. For clarity, this would not include any private, confidential accommodations made under contractual agreements.	No EIS updates are anticipated to address this IR at this time. Denison acknowledges that a comprehensive list of Project-related commitments will be provided for the record as part of the process of finalizing the EIS.
IR-03	CNSC	Site preparation	Section 1.3.2 Temporal Boundaries	**Context:** The EIS and TSD-ERA provide assessment on the project timeframe, including construction, operation, and decommissioning phases. **Rational**: The site preparation phase is not included in the timeframe	Please provide an assessment of those facility characteristics and activities that may interact with the environment during the site preparation phase, along with an assessment of their potential effects, in order to reflect the entire lifecycle or provide a rationale for its exclusion.	The EIS phase 'Construction' includes site preparation activities and as such these site preparation activities have been assessed within the EIS and the supporting documentation, including Appendix 10-A.	Section 5.3.4 of the final EIS will be modified as follows: Temporal boundaries are based on the different phases of the Project~~,~~**: Construction (including**

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
			Appendix 10-A (ERA)	(EIS and TSD-ERA). As per REGDOC 2.9.1, the sub-section 4.1.1 Complexity of the environmental risk assessment requirements states that "The applicant or licensee shall identify facility characteristics and activities that may interact with the environment during the relevant phase of the facility or activity's lifecycle (for example, site preparation, construction, operation, and decommissioning."		EIS Section 5 Approach and Methodology of the Assessment, Section 5.3.4 outlines the temporal boundaries for the assessment and the Project activity tables used throughout the EIS include elements of site preparation in the Construction phase. The list of key project activities included in the Construction phase are included below; elements related to site preparation are shown in **bold**: Construction Activities • **Development of access roads and air strip** • **Site preparation and earthworks; clearing, levelling, and grading of the Project Area** • Power generation - generators • Installation of main substation and distribution of power around site • Wellfield and freeze hole drilling; ground freezing • Batch plant operation (concrete); crusher at borrow area • Development of surface infrastructure (camp, operations centre, plants, ponds, pads, and support facilities) • Waste management (composting, domestic and industrial landfill operation, recycling) • Water management (including treatment and site runoff) • Groundwater supply • Surface water withdrawal • Fuel management (e.g., propane for comfort heating; vehicle and aircraft fuel) • On-site and off-site operation of vehicles and transport of materials • Air transportation for workers • Regulatory site inspections • Engagement – site visit from Interested Parties	**site preparation), Operation, Decommissioning, and Post-Decommissioning**, as described in Table 5.3-3. Section 1.3.2 of Appendix 10-A will be modified in the final EIS as follows: Consistent with the Wheeler River Project EIS, the temporal boundaries of the assessment include the following Project phases: construction **(which includes site preparation)**, operation, decommissioning, and post-decommissioning (Table 1-1).
IR-04	Environment and Climate Change Canada (ECCC)	Fish and fish habitat	Section 2, Project Description Section: Glossary	**Context:** The Proponent defines 'clean waste rock' as "Waste rock generated as sandstone cuttings and core from drilling activities associated with well and freeze hole development that does not have uranium containing materials". ECCC notes that the use of the term "Clean Waste Rock" could be misunderstood to mean that the waste rock is devoid of any contaminant. Even when the waste rock referred to as "clean waste rock" does not contain uranium materials, it could contain other metals or contaminants that could have adverse environmental effects. It is also not clear whether the "clean waste rock" is characterized for Acid Rock Drainage/Metal Leaching (ARD/ML) given that some portion of the basement rock is to be drilled out to anchor the freeze walls and may have ARD/ML potential. **Rationale:** The current definition of 'clean waste rock' in the draft EIS could lead to inappropriate handling and disposal if it is assumed to be devoid of any metals or other contaminants that might negatively affect the environment.	Provide a clear and more detailed definition of the term 'clean waste rock'.	Clean waste rock is defined as non-mineralized and non-potentially acid generating (PAG) rock. Clean waste rock will be sent to a storage pad (clean waste rock pad) that is proposed to be lined with an impermeable geomembrane collecting precipitation that will be monitored for quality and would allow for treatment if necessary. The clean waste rock pad is expected to hold approximately 7,800 m^3 of clean waste rock. Further characterization and test work are ongoing to confirm the ARD/ML characteristics of this waste rock. From the historically completed testing it is recognized that the non-mineralized mine rock is expected to include both non-PAG and PAG mine rock. The clean waste rock pile is being evaluated for potential segregation of the PAG mine rock. However, it is noted that, as observed in the six field barrel tests on Phoenix mine rock, including four bins that were identified as containing PAG mine rock, no net-acidity was observed over at least the first two years of the field barrel testing. In all barrel tests the pH values were greater than 7 and were producing substantial alkalinity (SRK, 2020). This indicates that the potential lag-time to net-acid generation would be on the scale of years and monitoring/collection/potential treatment could be pursued as conditions at the clean rock pile develop. It is noted that the non-mineralized mine rock is expected to have central tendency (i.e., median) solids contents that are generally similar to the average upper continental crustal abundance contents (Rudnick and Gao, 2014). The field barrel tests have all maintained neutral pH conditions and metals concentrations and their respective loading rates have generally either been stable or decreasing over the test duration (SRK 2020). However, further testing is required to confirm the expected behaviour at field-scale over operational-timescales. It is noted that comparing field barrel leachate concentrations are not directly representative of expected contact water within an at-scale storage pad; however, it is recognized that the clean waste rock pad is of a modest size and that loadings to contact water are expected to be directly correlated with the quantity of rock held within a catchment. Further, the barrel tests were performed on materials that were crushed to less than 1mm, field-scale mine rock of larger grain sizes would be expected to have appreciably lower mass loading rates than the unit rates observed in the field cells. Confirmatory sampling of both the waste rock and drainage at the clean waste rock is planned during both construction and operations. References: Rudnick, R.L. and S. Gao. 2014. Composition of the Continental Crust. Treatise on Geochemistry (Second Edition) Volume 4, 2014, Pages 1-51 SRK Consulting Inc. (SRK).2020. Wheeler River On-site Kinetic Leach Tests, Progress Update – Draft. Prepared for Denison Mines Corp. January 2020.	Section 2.2.4.8 of the final EIS will be updated as follows: Clean waste rock **(non-mineralized and non-potentially acid generating [PAG] rock)** will be generated as sandstone cuttings and core from drilling activities. Based on the current wellfield and freeze wall design, approximately 7,800 m^3 of clean waste rock will be generated. Clean waste rock will be stored on a 2,500 m2 single geomembrane liner (Figure 2.2-26) and can be used for road construction and/or concrete production. **The clean waste rock will be assayed and tested for PAG during Operations to ensure the material can be reused when required.**
IR-05	CNSC	Change to an environmental component due to hazardous contaminants	Section 2.2.1.2	**Context:** Water volumes for mud/diamond drilling is listed as minimal as the mud will be re-used. The mud is identified as a mixture of water, clay, and environmentally friendly polymers that clean out the cuttings and help to keep the drilling bit cool. **Rationale:** Although the mud for drilling will be re-used, there could be environmental impacts should there be an accident while drilling.	Please identify the components of the environmentally friendly polymers for the drilling mud and potential environmental impacts should the mud not be recovered.	Two primary drilling methodologies are planned for the development of the wellfield that will be comprised of monitor, injection, recovery and freeze wells. The two primary forms of drilling are diamond and mud rotary drilling. Diamond drilling will be used for freeze, monitor and small diameter injection wells. Mud rotary drilling will be used for recovery and larger diameter injection wells. Both methodologies employ similar mud management programs as part of the drilling process in that they both use a combination of light polymer and bentonite products to stabilize the subsurface formation during drilling and well installation.	No EIS updates are anticipated to address this IR at this time.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						Various products are used at specific depths to stabilize the formation and include Ultra PAC, Sawdust, Prima Seal, Premium Gel, Prairie Drill, KCl, Hyper drill, Hydrated lime, Envirofloc, Caustic Soda, Calcium Chloride, Purevis and bentonite. All products used on the Wheeler River Project are considered environmentally friendly and safe for use for workers as indicated by their respective safety data sheet (SDS) and product data sheet (PDS. The use of drilling muds was addressed within the A&M hazards screening (Table 3-2; in Appendix A of Appendix 14-A) and characterized it as a low risk event. Potential worker safety risks primarily include slipping hazards at the worksite as the products generally create non-adhesive bonds in surfaces that are contacted. All of the products used are routinely landspread on farmer's fields in the Oil and Gas industry in both Saskatchewan and Alberta at the same quantities or greater proposed for use on the Wheeler River Project. As a vast array and combination of products are used, the specific compositions are not presented herein but are available upon request.	
IR-06	CNSC	Geology and groundwater	Section 2.2.1.4, Wellfield for In Situ Recovery Mining	**Context:** This Section of the EIS indicates that a tracer test was completed in 2021 and a feasibility field test was initiated in 2022. No information from these tests is included in the EIS and no reporting timelines are provided. **Rationale:** Guidance from the IAEA (2001) and best practices highlighted by regulatory regimes in other countries such as the United States (IAEA, 2016) and Australia (Geoscience Australia, 2010) indicates that single and multi-well trial (feasibility) testing for mining and remediation techniques should be carried out before a licence for full-scale operations can be granted. This is part of the requirement for proponents to demonstrate to government authorities that all potential risks have been considered during the life of operation and post-remediation of the mine. Additionally, Section 8.5.2 of the Generic EIS Guidelines states: "Units may be characterized as aquifers or aquitards, and unit descriptions should include their geochemical characteristics, vertical and lateral permeabilities, transport mechanism (diffusion versus advection) and the directions of groundwater flow", And that "The applicant or licensee should present a conceptual and numerical hydrogeological model that discusses the hydrostratigraphy and groundwater flow systems". Outcomes from the tracer test inform model parameters such as effective porosity (see IR-78), dispersion, and dispersivity (see IR-96). The wellfield leach tests and remediation trails ultimately inform environmental monitoring during site activities, and the source term for the groundwater model. This source term represents the contaminants which flow through the desilicified zone into Whitefish Lake, which represents a source of contamination considered in the ERA. **References**: [1] International Atomic Energy Agency (IAEA). 2001. Manual of Acid in Site Leach Uranium Mining Technology. IAEA-TECDOC-1239. Vienna. 283 p. [2] International Atomic Energy Agency (IAEA). 2016. In Situ Leach Uranium Mining: An Overview of Operations. IAEA Nuclear Energy Series No. NF-T-1.4. Vienna. 76 p. [3] Commonwealth of Australia (Geoscience Australia). 2010. Australia's in situ recovery uranium mining best practice guide. ISBN 978-1-921672-95-8. Canberra. 33 p.	1. Please provide a summary of the results of field tests (i.e., tracer tests, wellfield leach tests, and remediation trials) in the EIS, or provide a technical supporting document with this information, and ensure the documentation is appropriately referenced in the EIS. 2. Please indicate how outcomes from these field tests inform the design of In Situ Recovery. This information should include: • feasibility of meeting remediation targets. • groundwater flow conditions and validation of flow models. • mobilization of contaminants (e.g., Al, Se or V). • potential for free gas evolution/two-phase flow. • identifying composition of lixiviant and production solutions. • success despite presence of >2% carbonate minerals (siderite, $FeCO_3$) in the ore zone (see Table 4-3 of Appendix 7-A). • site-specific data to parameterize, validate, and refine solute transport models (hydraulic conductivity, effective porosity, dispersivity, diffusion, etc.). 3. Please provide further information of proposed operations including % recovery, uranium concentrations, optimal liquid/solid ratios, anticipated reagent consumption, etc.	Please see Attachment IR-06.	The following text will be added to the final EIS, under a new heading, Section 2.2.1.6 ISR Mining-Related Inputs for the EIS: It is important to note that Denison is completing a sequential EA and licensing process for the Project (see Section 1). Detailed ISR mining-related information needed to support licensing and permitting has not been included in the EIS; it will be provided to regulators as part of permitting and licensing. For the EIS, an understanding of ISR design is needed to describe potential effects related to Project activities within the biophysical environment (EIS Part II, Section 6 to 9), human environment (EIS Part III Sections 10 to 13), and accidents and malfunction (Section 14) assessments. Denison used the ISR mine design and the 3D hydrogeology and contaminant transport numerical modelling of the injection and extraction wells to determine the potential interactions between mining activities and the environment. Two key outputs from the ISR mine design and 3D hydrogeology modelling work were used as inputs for the groundwater assessment (Section 7): 1) The extent of mining solution migration away from the injection and recovery well screens, as defined by the mining area (50m above the ore zone and within the freeze wall) and 2) groundwater quality of the mining area following remediation. Monitoring will be completed during operations and decommissioning to confirm these inputs. Importantly, since the mine design includes the freeze wall, movement of mining solution is restricted and contained horizontally during operations. Wellfield pumping provides the hydraulic containment to keep mining solution within the 50 m mining area (see Section 2.2.1.4.2). During the operation phase, and under normal operational conditions there is no interaction between the mining zone and surface water or down gradient groundwater environments, and the groundwater assessment (Section 7) focuses on the post-decommissioning period following removal of the freeze wall, once the groundwater flow paths return to pre-mining conditions. During mining area remediation (see Section 2.3.3.1.1), the freeze wall will remain in place until decommissioning objectives are achieved. Refinement of the mining area decommissioning objectives and associated modelling will be done through updates to the Decommissioning Plan, and will be bounded by the objectives evaluated in the EIS.
IR-07	ECCC	Fish and fish habitat	Section 2.2.1.4.2, Wellfield Operation Section 2.2.1.4.2.2, Secondary Containment of Mining Solution – Pumping	**Context:** The description in Sections 2.2.1.4.2 and 2.2.1.4.2.2 refer to the differential rates of injection and withdrawal, which implies that more solution will be withdrawn through the recovery well than volume of mining solution injected. According to the description of the site, a freeze wall will create a barrier between the uranium deposit to be mined and outside the isolated area to prevent inflow of groundwater from the sandstone outside the freeze wall. Secondly, it was indicated that the basement rock below the uranium deposit will prevent infusion of groundwater from below. The Proponent stated that inward hydraulic gradient will be created	Clarify where the extra groundwater will come from to sustain this differential rate of injection and withdrawals during operation and if this extra water has been accounted for in the model and the amount of water that ends up in the receiving environment.	The freeze wall will provide hydraulic containment between the internal wellfield and the external regional groundwater system with each well pattern maintaining a minimum 1% 'bleed' to maintain hydraulic gradients towards recovery wells. The "extra" water pumped (i.e., the water pumped in excess of injection) will be derived from stored groundwater within the sandstone units above the ore zone, and from the underlying paleoweathered zone, within each phase of Operation that is surrounded by freeze walls. The volume of stored water was estimated using the calibrated groundwater flow model, which contains 3D volumes for the saturated soil and rock within each of the walled phases, including appropriate porosity values. These volumes of stored water were compared to the volume pumped within each phase of operation, over the expected period of extraction	No EIS updates are anticipated to address this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				by recovering more solution than is being injected. In general, the wellfield will operate to draw a minimum of 1% more solution out of the wellfield compared to solutions injected in. This will help avoid increased subsurface pressures from injection pressure build up within the deposit. **Rationale:** It is not clear where the extra groundwater will come from that will sustain this differential rate of injection and withdrawals as the freeze wall and bedrock basement will isolate the injection well from groundwater. If it is assumed that there is limited amount of groundwater present in the sandstone layer above the uranium deposit, that amount of groundwater in the sandstone layer is finite and will be exhausted at some point. Therefore, it is not clear where the extra groundwater will come from. If the extra volume of water is not accounted for in the modelling, that would ultimately affect the volume of water that ends up in the receiving environment and likewise the amount of contaminants contained.		based on the mining plan. The stored volume of water was calculated to be 3.4 (Phase 1) to 9.7 (Phase 4) times the estimated excess pumped volume. In other words, there is ample stored water within each walled phase to supply the excess pumped volume. The excess pumping creates a hydraulic gradient toward the ore zone within each walled phase, which will help to avoid vertical spreading of the UBS during operations. If monitoring during operations indicates water levels are falling quicker than anticipated, additional water could be added within the walled phase, within the Upper Sandstone Aquifer. The volume of water reduction within each phase of operations was evaluated within model simulations presented in Appendix 7C, Section 2.7. The volume reduction within mined phases was found to be minor compared to the volume of water pumped from the Upper Sandstone Aquifer located outside the freeze wall confines and within the regional groundwater system during decommissioning (i.e., pumping at 35.5 m^3/hr). The pumping of groundwater for process water results in an order of magnitude more water volume extraction than the estimated volume required to replenish stored water when the freeze walls are thawed.	
IR-08	ECCC	Change to an environmental component due to radiological contaminants	Section 2.2.1.4.2.2 Project Description	**Context:** This section describes how an inward hydraulic gradient will be created within the mining area as a secondary containment method for control of mining solution. While the process is described, there is no information on contingency measures in place for pump failure or system maintenance solutions. There is also no information on how quickly the hydraulic gradient, and therefore secondary containment, would be compromised if any pumps stopped working. It is also unclear how primary containment (i.e., well design) failure, such as physical/mechanical issues compromising casings, would affect the creation of the hydraulic gradient and secondary containment as well. **Rationale:** It is important to have contingency planning in place in the event that there are any issues with the hydraulic gradient and secondary containment system for control of the acidic mining solution. There is no information in this section on how the hydraulic gradient (i.e., secondary containment) would be maintained if a well or pump (i.e., Primary containment) experienced problems.	Provide further information regarding how the inward hydraulic gradient system functions, with particular focus on how the hydraulic gradient and secondary containment will be maintained if any wells or pumps were compromised.	The following highlights the three levels of containment that will be in place to mitigate the potential for loss of containment of the mining solution. Mining solution containment was discussed in the draft EIS, Section 2.2.1.4.2 Wellfield Operation. As noted in the IR, the hydraulic gradient created in the mining zone between injection and recovery wells provides for secondary containment. i. Primary Containment (Well Design) The well configuration is designed to make sure fluids, whether injected or extracted, are confined to set depth locations. In the case of most injection and extraction wells, this would refer to the surface injection point and the screened location at the ore zone depth. The cased and sealed well in all other portions of the well design ensure no interaction with groundwater from other formations from surface to the deposit depth, thus preventing dilution from inward fluid flow of formation waters or outward migration from the well. Well integrity is monitored through live pressure monitoring systems in the annulus of the wells for leak detection and scheduled compliance checks via wireline tools of well integrity. ii. Secondary Containment (Hydraulic Gradient) Hydraulic gradients within the wellfield are maintained initially on a per pattern basis comprising of a single extraction well with four injection wells. In this initial stage of wellfield operations, all solutions from the four injection wells are drawn towards the single extraction well. As wellfield development progresses subsequent adjacent patterns are constructed. In these subsequent stages, the fluid from the injection wells is now drawn toward multiple extraction wells, essentially dividing the recovered solution between the number of operating extraction wells. As subsequent progression of wellfield development evolves, the inward hydraulic gradient of fluids injected will be further divided by adjacent extraction wells. In upset conditions, such as pump failure, or during scheduled pump maintenance when a given extraction well would be shut down purposefully, the fluids that would normally be recovered by a particular extraction well would then temporarily be recovered by one of the adjacent extraction wells within the larger extraction well network. This is a standard approach used in ISR mining. When the upset conditions or scheduled maintenance have been completed, the "normal" mining solution recovery pattern would be restored to the original flow path. In this way, and by design, hydraulic containment is maintained at all times. iii. Tertiary Containment (Freeze Wall) The freeze wall provides two main benefits: a. A defined area for the mining process to occur with the establishment of clear 'no flow' boundaries being the freeze wall itself. b. Essentially removes the effects of the regional groundwater system and regional hydraulic gradient within the confines of the freeze wall. In the event of an upset condition, groundwater velocity is essentially null preventing any migration of fluids up or down gradient. This allows time to recover any fluids in a controlled manner while re-establishing operating conditions in what would otherwise be considered a 'stagnant' system.	The following text will be added to the final EIS in section 2.2.1.4.2.2 Secondary Containment of Mining Solutions. "In the case of an upset condition, such as pump failure, or scheduled pump maintenance when a given extraction well would be shut down purposefully, the fluids that would normally be recovered by a particular extraction well would then temporarily be recovered by one of the adjacent extraction wells within the larger extraction well network. When the upset conditions or scheduled maintenance have been completed, the "normal" mining solution recovery pattern would be restored to the original flow path. In this way, and by design, hydraulic containment is maintained at all times."
IR-09	CNSC	Geology and Groundwater	Section 2.2.1.4.2.2	**Context:** This section indicates that mining solution within the mining area can primarily be controlled by maintaining an inward hydraulic gradient. The inward hydraulic gradient will be created by recovering more solution than is being injected. **Rationale**: If, for some reason, the recovered solution is much more than that being injected, an excessive drawdown could be created. If, by accident, mining solution is leaking into the upper sandstone aquifer through crack in injection/recovery well casing at the same time, it would be challenging to remediate the upper sandstone aquifer in dry conditions (due to excessive drawdown).	Please clarify if any measure will be implemented to avoid excessive drawdown and develop contingency measures to address such accident.	The measures that will be implemented to avoid excessive drawdown are as follows: Continuous (real-time) water level monitoring will be implemented for hydraulic head measurements in individual wells as well as the surrounding open aquifer system contained within the boundaries of the freeze wall. These monitor wells will be installed at various depths throughout the mining area (i.e., within the freeze wall) ranging from the shallow groundwater system to the deposit depth and further, through the paleoweathered zone, into basement rock below the deposit and mining horizon. The mining methods operational success and efficiencies are benefitted by maintaining a shallow depth to water to reduce the magnitude of hydrostatic head needed to be applied to pump within each recovery well. In the event that excessive drawdown was identified through the monitoring system, it could be mitigated. Water would be pumped into the overburden aquifer to offset such injection and pumping imbalance. Water sources would include those from both groundwater and surface sources previously assessed. It is noted that leakage of "mining solution" into the upper aquifer is a hypothetical accident	No EIS updates are anticipated to address this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						or malfunction that would not be allowed to persist as it would be identified by monitoring. Individual wells will be monitored for integrity and well operation would stop if a leak were detected to prevent or limit migration of fluid outside of the mining zone. Further, all monitor, injection and recovery wells can be retrofitted with down hole pumps to recover solution that may have leaked or migrated in an upset condition. Additional recovery wells can be installed at select depth to further increase recovery if the need should arise.	
IR-10	ECCC	Fish and fish habitat	Section 2.2.1.4.2.3, Tertiary Containment of Mining Solution - Freeze Wall	**Context:** The Proponent stated that as a tertiary means of containment for the mining area, the uranium deposit is proposed to be surrounded by a freeze wall that extends from the surface to the basement rock, isolating the mining area from regional groundwater. Current plans are for the freeze wall to be a minimum of 10 m thick, be installed 25 m away from the uranium deposit, and extend 30 m into the basement rock (Figure 2.2-6). As explained in Section 2.2.1.4.2.2, mining solution will be injected into the ore zone under pressure and will likely react, not just with the uranium in the ore zone, but also the binding or cementing material in the sandstone. This means that some portion of the sandstone above the uranium layer and perhaps some portions of the freeze wall will dissolve, thereby creating more void than just the thickness of the uranium layer or horizon. The void may affect the integrity of the freeze wall as containment. **Rationale:** It is not clear how the Proponent will monitor the freeze wall to verify whether portions of the freeze wall are being dissolved in the mining process and how it plans to verify the integrity of the freeze wall as a containment for the mining solution. In addition, if the dissolution reaction of the uranium ore is exothermic, then the heat generated may also affect the integrity of the freeze wall.	1. Explain how the integrity of the freeze wall will be maintained as a means of containment that prevents migration of the mining solution out of the ore zone into the receiving environment. 2. Demonstrate that the mining solution injected under pressure will not compromise the integrity of the freeze wall as a containment. 3. Demonstrate how both exothermic and chemical reactions of the mining solution used to dissolve the uranium ore will not compromise the integrity of the freeze wall as a containment. **Technical Discussion Required**: Yes. ECCC would like to better understand the chemical constituents that compose the mining solution and the chemical reactions that it will cause.	Denison met with the FIRT reviewers on April 19, 2023 to discuss the response to IR-10. Greg Newman, from Newmans Geotechnique Incorporated, attended the meeting to provide information on the freeze wall integrity and basis for the design, which relies on site field data and lived experience from several exiting Saskatchewan mining operations. A written response to IR-10, summarizing the material presented by Greg Newman, is included here as Attachment IR-10.	No EIS updates are anticipated to address this IR.
IR-11	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.2.3 Project Description	**Context:** It is unclear how much contact water may be produced during the drilling of the mine well field during the construction phase of the proposed Project. Figure 2.2-14 indicates that no water will be produced during the drilling process in the construction phase. In Section 2.2.1.2 both mud rotary drilling and diamond drilling are proposed for the creation of wells. Both processes require water, however only mud rotary drilling produces liquid mud that is then reused in the drilling process. **Rationale:** It is unclear if the liquid mud produced during drilling can be reused indefinitely with further water additions, or if this eventually becomes the clean sand grain cutting and how it will be disposed of (i.e., liquid or solid waste). If the mud produced from drilling is classified as liquid waste and disposed of as contact water, it is not clear if this is accounted for in the site water management plan and water balance during the construction phase. Contact water from well drilling during the construction phase has not been quantified or accounted for in Figure 2.2-1, and therefore it is unclear if proposed infrastructure during the construction phase has the capacity to contain this waste stream in addition to the waste streams currently outlined in Figure 2.2-1.	Provide further information on potential wastewater produced during the construction phase from drilling processes, and if proposed infrastructure can contain any water produced.	A centrifuge will be used for separating out solids during both diamond and mud rotary drilling to recycle fluids. Only solid drill cuttings, not wastewater, will be produced and all muds and waters will be recycled as part of the drilling process. Upon completion of a drilling campaign, all remaining mud and water will be stripped of remaining solids, treated with mud zymes to break down polymers, and injected back down into the mineralized horizon. During active drill campaigns clean water will be held in approved tanks as part of the drill program between well drilling.	No EIS updates are anticipated to address this IR.
IR-12	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.2.3, Project Description	**Context:** There is not enough information provided within the draft EIS and site water infrastructure designs to determine if the infrastructure will sufficiently contain mine site contact and non-contact water runoff. It is unclear how water management will occur during all proposed Project stages at the Project airstrip, which is located away from the main Project site. No information has been provided regarding water that may come into contact with fuels and oils from machinery on the air strip, how and where that contaminated water will be treated, and how surface runoff around the airstrip will be managed. Additionally, it is unclear if contaminants from heavy machinery on roads have been considered during runoff collection plans throughout the mine Project site. Water management at the airstrip and roads can have impacts on surface water quality and sediment quality and contaminants (e.g., Hydrocarbons) from these sources should be considered in overall site water management plans. In Section 2.2.3.1 a site drainage plan for contact and non-contact water has been provided in Figure 2.2-17, and water balances have been provided for the different Project phases in Figures 2.2-14 to 2.2-16. In Section 2.2.3.4 a volume of 30,000m3 for the process water pond is provided, and it is stated that the process water pond has the capacity to contain Probable Maximum Precipitation (PMP) event estimated to be 483.3mm while allowing for 1.0m of freeboard. However, there are no estimates on the total volume of water that may be drained from the overall site infrastructure (i.e., the well field, processing areas, etc.) during a 24-hr PMP event. Additionally, in Figure 2.2.17 culvert locations are provided, however there is no further information on culvert designs, flow ratings and capacity for PMP events.	1. Provide information on how contact and non-contact water from the site airstrip will be managed. Include information on potential contaminant characterization and loadings and an assessment of risk to the environment. 2. Provide further information on how potential contaminants in runoff from roads have been considered in the site water management. Include information on potential contaminant characterization and loadings and an assessment of risk to the environment. 3. Provide estimated volumes of water to be drained from overall site infrastructure (such as the mine terrace, airstrip, camp area etc.), during a 24-hr PMP event. 4. Provide additional information on culvert designs and conveyance capacity for PMP events.	1. and 2. Denison's approach to site water management is keep non-contact water "clean" – that is, the management approach provides that non-contact water does not come into contact with site aspects that may impart constituents/contaminants of concern and that non-contact water mingles with contact water. Contact water is water expected at the wellfield and processing plant terrace (refer to runoff collection arrows shown in draft EIS Figure 2.2-17), and also includes leachate collected from landfills. As such, runoff from the airstrip and site roads is considered non-contact water and will not be actively managed. However, should a spill occur, the spill response plan will be followed. Details of Denison's response plans will be developed to support licensing as part of the Waste Management and Emergency Management and Fire Protection programs. By following best practice and mitigation measures outlined in the EIS, Denison does not anticipate a need to continually manage water at the airstrip or along site roads as the water here will be clean, non-contact runoff. Examples of relevant mitigation measures include: • Project components including equipment and machinery will be regularly maintained and inspected to make sure they are in good working order. • Fuel storage and distribution infrastructure will be constructed in accordance with applicable legislation requirements. • Fuels will be stored in approved, above-ground, double-walled storage tank(s) equipped with secondary containment in accordance with provincial regulations and standards. • A wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants. Refer to Section 14 of the draft EIS for the screening and evaluation of various accident and malfunction scenarios. Should unplanned events or conditions occur, it will be important for Denison to address and respond in an appropriate manner. Details of Denison's response plans will be developed to support licensing as part of the Waste Management and Emergency Management and Fire Protection programs. Additionally, should unexpected water pooling be observed at the airstrip or site roads during Operation, temporary water	No EIS updates are anticipated to address this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				Rationale: In order to be able to understand site water management and flood risk potential, more information needs to be provided regarding the site water infrastructure designs and capture volumes during PMP events. This information will aid ECCC in understanding how contact and non-contact water will be conveyed throughout the site. Runoff from roads and the site airstrip will contain contaminants from vehicles, heavy machinery, aircrafts and de-icing practices. Additional information on the runoff collection systems and expected contaminant concentrations for the site airstrip and roads is needed to determine if the receiving environment and aquatic and terrestrial receptors are protected.		removal means such as vac trucks or sump pumps could be employed and the areas would be re-graded to minimize water accumulation. 3. As indicated in the response to IR-12, points 1 and 2 above, Denison expects contact water requiring management is at the wellfield and processing plant terrace (refer to runoff collection arrows shown in draft EIS Figure 2.2-17). For this area, the volume of water expected during a 24-hour PMP of 493 mm is approximately 37,240 m^3. The wellfield runoff pond has been sized appropriately (38,200 m^3 with 1 m of freeboard) to contain this volume of water. 4. Details related to culvert design and conveyance capacity are being developed as part of ongoing engineering activities. Culverts will be a designed with a sufficient size and length to convey water around the site during a PMP event.	
IR-13	ECCC CNSC	Fish and fish habitat	Section 2.2.4, Waste Management Section 2.2.7.7, Borrow Area Section 2.3.1.3 Site Preparation and Earthworks	**Context:** The Proponent indicates that a borrow area is planned for an area northeast of the processing plant. The borrow material or overburden will be used during construction for roads, airstrip, pads, and in the batch plant for concrete production needs, during Operation for ongoing maintenance of various Project components and during decommissioning for fill and cover material. Suitable construction fill material will be sourced from the proposed borrow area and any suitable clean sandstone generated during freeze wall and well drilling (Section 2.2.7.7). It was also noted in Sections 2.2.1.3 and 2.2.14 that the freeze wall will be established by drilling over 300 vertical holes from surface to the basement rock. The freeze holes will extend 30 m into the basement rock and will produce waste rock from basement rock (Figure 2.2-6). However, there is no information whether the waste rock from basement rock would potentially be acid generating and/or metal leaching. This means that all the extra 30 m of basement rock should also be characterized for potential ARD/ML to determine use or appropriate disposal. **Rationale:** ECCC notes that the Proponent did not indicate whether the borrow material and the drill out part of the sandstone layers and basement rock will be tested for Acid rock drainage/metal leaching (ARD/ML) potential before they will be used during construction, operation and decommissioning. ARD/ML is an environmental hazard that will have an adverse effect on waterbodies frequented by fish. Potential acid generating and metal leaching waste rock could pose negative impacts on the environment if they are not managed adequately.	Please provide: 1. Information on whether the waste rock from the basement rock is potentially acid generating and metal leaching; a. Confirm that any borrow material to be used for construction will be characterized for potential ARD/ML. b. Confirm that the part of waste rock recovered from the basement rock, will also be tested for potential ARD/ML. 2. Criteria for segregating the potential acid generating and metal leaching waste rock, if it exists, from clean waste rock; and, 3. A plan to manage the potential acid generating and metal leaching waste rock, if it exists.	1. The waste rock from the basement is potentially acid generating due to localized pyrite mineralization. Select and systematic assays are conducted to characterize pyrite distribution throughout the deposit and adjacent geological units. Rock recovered from basement during drilling will be further characterized prior to or during drilling activities. 1a. Borrow pit area selection was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further explorative works are ongoing part of ongoing Engineering activities and with confirmation of characterization through assays of representative samples. 1b. Basement rock will be tested for potential for acid generation. It is expected that a portion will be potentially acid generating. Select and systematic assays are conducted to characterize pyrite distribution throughout the deposit and adjacent geological units. 2. All basement rock will be stored on the special waste pad. Waste rock from the sandstone will also be characterized primarily based on geological and geochemical characteristics, and if a portion of the waste rock is potentially acid generating, it will also be stored on the special waste pad. See also response to IR-04 3. Clean waste rock will be generated as sandstone cuttings from drilling activities. Clean waste rock will be stored on the clean waste rock pad. The clean waste pile will be assayed and tested for Potential Acid Generation (PAG) during operations to ensure the material can be reused when required. Potentially acid generating waste rock will be stored on the special waste pad. Special waste is defined as mineralized materials that cannot be disposed of in the clean waste pile. It is primarily made of drill cores and cuttings from wellfield construction. A double-lined process water pond with leak detection has been designed to capture water from various areas, including the process precipitates storage pad and special waste pad. The pond will be designed to hold up to 30,000 m^3 of water and will be located next to the processing plant. The pond has been designed to hold a probable maximum precipitation event. The pond will be able to receive water from all site ponds and monitoring wells. The ponds that are designed to receive materials recovered during drilling activities are all lined with a leachate collection pond that will be monitored for water quality. The environmental monitoring program that will be presented during licensing will cover characterization of materials placed in the clean and special waste ponds to ensure environmental protection.	Section 2 of the final EIS will be updated per below: 2.2.4.7 Special Waste and Special Waste Pad During Operation, the special waste pad is expected to contain special waste that is primarily mineralized core, ~~and~~ cuttings from wellfield development**, basement rock, and any waste rock determined to be potentially acid generating (PAG)**. Special waste from drilling activities is defined as uranium containing materials that cannot be disposed of in the clean waste pile, **including PAG waste rock**. Special waste will be determined by Denison geologists based on ore zone intersection expectations**,** ~~and~~ probe reading taken during wellfield drilling activities**, and results of systematic assays to characterize the acid generating potential of the waste rock**. Based on the current wellfield and freeze wall design, approximately ~~150~~ **2,000** m^3 of special waste rock will be generated. Denison will examine opportunities to reprocess the mineralized core and cuttings generated during wellfield development to recover uranium. This reprocessing may be done by placing the material in tanks with mining solution or placing the material underground into the mining area at the end of a well's production. The special waste pad may be used to temporarily store other materials that may be radioactive (e.g., contaminated soil) prior to final disposal in the industrial landfill or a licensed off-site facility. The special waste pad is estimated to be 2,500 m2 in size and will be constructed with a double composite liner system with leak detection capabilities (Figure 2.2-25). Any contact water coming off the special waste pad will be directed to the wellfield runoff pond (Section 2.2.3.5). 2.9.1.3.3 Waste Management Program The Waste Management Program would include requirements and processes to ensure that Denison's activities that involve planning for, handling, transporting, processing, storage, and disposal of wastes are performed in a manner that complies with applicable regulatory and licence requirements and protects workers, the public, and the environment. The Waste Management Program would include identification of waste inventory and the characteristics of the waste (radiological and hazardous non-radiological), waste segregation, waste packaging and transfer requirements, and the plan for storage or disposal of the wastes. **The Waste Management Program will detail the plans for waste rock segregation based on mineralized content and acid generating potential**.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
IR-14	CNSC	Wastes and Decommissioning	Section 2.3.3.1.3 Decontamination, Demolition, and Disposal (p. 2-82) Table 4.3-2: Key Issues and Concerns from English River First Nation (p. 4-33)	**Context:** The EIS states "Concrete foundations will be left in place. Any portions of concrete foundations remaining above grade will be levelled and rebar will be cut-off at grade. Large slabs will be perforated on a 2-m grid to permit drainage. Concrete slabs will be covered with 0.5 m of development rock or locally stockpiled till." (p. 2-82) Further, Denison notes that "Concern about responsible authority for restoring the environment, including contaminants when mining concludes. How long will it take to have the environment fully restored and, if Denison is no longer the operator, how will this be completed?" (p. 4-33). This comment status is noted as *Complete*. **Rationale:** Permanent structures will remain following decommissioning, according to the excerpt above. It's unclear how engagement activities influenced Denison's planned decommissioning approach, or how the comment above has been addressed or received.	How has the proposal to leave these foundations in place been received by the Indigenous Nations and communities during engagement sessions? Have engagement activities influenced Denison's planned decommissioning approach? Describe in additional detail how the comment from p. 4-33 has been addressed and how this has been received by those who expressed this concern?	Denison understands the importance of demonstrating to the CNSC how issues and concerns raised by Indigenous nations and communities have been resolved, or where this has not been achieved, how Denison can demonstrate its efforts towards doing so and/or rationale for where agreement has not been reached. Please see response to IR-28 for information on how Denison will provide this information as the EA process advances. The option to leave concrete foundations in place will be discussed with Indigenous Nations and communities as decommissioning plans become more defined. The conceptual decommissioning plan (CDP) included in the draft EIS contains the appropriate level of detail for this stage of the Project. As described in Section 2.3.3, the details of the decommissioning plan will evolve and become more specific as the Project advances. The subsequent iteration of the plan is the preliminary decommissioning plan (PDP). The PDP will be submitted to regulators as part of Project licensing and permitting and will provide additional detailed information with respect to site decommissioning. The PDP would reflect input that will be solicited from Indigenous Nations and communities and others prior to its submission. Prior to executing decommissioning activities, Denison shall prepare and submit a detailed decommissioning plan (DDP) to regulators for acceptance, which builds on the PDP. In this case the DDP would reflect input that will be solicited from Indigenous Nations and communities and others prior to its submission and would also be informed by conditions on the ground at the site at that time, operational experience that has been gained and the regulatory landscape at that time. As is highlighted above, the decommissioning plan will evolve over time and the plan will become more refined as the Project advances. Denison is committed to continue to engage with Indigenous Nations and communities to solicit input. The comment in Section 4 on page 4-33: "Concern about responsible authority for restoring the environment, including contaminants when mining concludes. How long will it take to have the environment fully restored and, if Denison is no longer the operator, how will this be completed?" was addressed in the draft EIS in the following manner: - Concern about responsible authority for restoring the environment, including contaminants when mining concludes: Denison is responsible for decommissioning. Denison's decommissioning commitment is to return the land back to the Province of Saskatchewan for unrestricted surface land use post-closure. - How long will it take to have the environment fully restored: Based on best practice and technical studies completed for the Project, the active decommissioning phase is anticipated to be 5 years. The Post-Decommissioning phase extends from the end of physical decommissioning until transfer of the site into the provincial Institutional Control Program (Government of Saskatchewan 2009) or direct release of the land back to the Crown. Post-Decommissioning is expected to last 15 years and during this phase, monitoring will be conducted until the site-specific decommissioning and reclamation objectives for the Project are met. - if Denison is no longer the operator, how will this be completed?: The financial assurance process provides certainty that the Project can be decommissioned as planned. The Project will not be issued an approval to operate until the decommissioning plan and associated cost estimate are accepted by the Minister of Environment and the financial assurance is in place. If Denison is unable to complete the decommissioning for any reason (e.g., bankruptcy), the finances are available for the Province of Saskatchewan to complete the activities as planned. The PDP will include an associated estimate for the decommissioning costs and Denison will provide financial assurance to confirm the identified decommissioning activities can be completed as planned. Updates to the financial assurance are done in conjunction with updates to the decommissioning plan, on a frequency of every five years during operations. References: Government of Saskatchewan. 2009. *Institutional Control Program: Post Closure Management of Decommissioned Mine/Mill Properties Located on Crown Land in Saskatchewan*. Ministry of Energy and Resources. December 2009.	Refer to IR-28 for information on EIS updates related to issues and concerns.
IR-15	ECCC	Fish and fish habitat	Section 2.2.3.4 Project Description Section 8.1.3.4.2, Aquatic Environment	**Context:** In Section 2.2.3.4 it is stated that the estimated PMP event for Project infrastructure planning is 483.3mm. In Section 8.1.3.4.2 it is stated that the PMP is 489.3 mm. **Rationale:** It is unclear which value is the correct PMP value and if Project infrastructure has been planned correctly.	Provide the correct PMP value and verify that Project infrastructure has been designed utilizing the correct value.	The PMP event used for feasibility engineering designs is 493 mm. The PMP value has been extrapolated from Key Lake data presented in the Canadian Climate Program (1994). Denison reviewed the update to the Canadian Climate Program (1994) report provided in Atmospheric Environment Branch (1999) which shows PMP at the approximate Wheeler River Project location at 489.3 mm. Denison retained the higher of the two PMP values, i.e., 493 mm, for design purposes. The PMP value in Section 2 will be updated from 483.3 mm to 493 mm in the final EIS. The PMP value used in Section 8 (489.3 mm) will not be updated because it is less than the design PMP and, as such, was conservative. References: Canadian Climate Program. 1994. Point Probable Maximum Precipitation in Northern Saskatchewan. R.F. Hopkinson Scientific Services Regina Operations Building, Regina Airport. Regina, Saskatchewan. Report No. CSS – R94 – 01. Atmospheric Environment Branch. 1999. Environment Canada Prairie and Northern Region – Point Probable Maximum Precipitation for the Prairie Provinces. Atmospheric Environment Branch, Atmospheric and Hydrologic Sciences Division. Regina, Saskatchewan. Report No. AHSD – R99 – 01.	Section 2.2.3.4 of the final EIS will be updated as follows: "The pond will be surrounded by a 2.0 m berm, have capacity for 0.5 m storage from a probable maximum precipitation (PMP) event estimated to be ~~483.3 mm~~ 493 mm, and allow for maintenance of 1.0 m of free board."

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
IR-16	CNSC	Human health with respect to hazardous contaminants	Section 2.2.3.8	**Context:** The EIS and technical supporting documents do not provide sufficient justification for the selection of the proposed wastewater treatment systems for the industrial wastewater treatment plant or the domestic wastewater treatment plant. In addition, it is not clear how the upper bound of the industrial wastewater treatment plant effluent quality was obtained. **Rationale:** Draft REGDOC-2.9.2 formally documents the CNSC's expectations to licensees for controlling releases to the environment. For proposed new facilities, these expectations include conducting a best available technology and techniques, economically achievable (BATEA) Assessment, and determining key parameters necessary to support the EIS. These include identifying: • environmental release targets to inform the design of wastewater treatment systems to constrain the quantity and concentration of contaminants and physical stressors released into the environment, • the best available technology and techniques through an options analysis; and • the anticipated influent characteristics, overall treatment efficiencies, and maximum predicted design release as the output of the assessment. Consideration of the principle of pollution prevention and BATEA is also a requirement of REGDOC-2.9.1. CNSC staff have met with Denison to discuss the expectations in draft REGDOC-2.9.2.	Please provide a summary of the BATEA assessment to justify the selection of the wastewater treatment plant system. As part of the summary, please identify the anticipated environmental release targets used to inform the design, as well as the maximum predicted design release concentrations and loadings to the receiving environment. The maximum predicted design releases should be used in the ERA to demonstrate protection of people and the environment.	Denison is undertaking a sequential EA and licensing process under the NSCA. For context, the EA process for a Project under CEAA 2012 and the Saskatchewan Environmental Assessment Act is long and complex. As such, the inputs and outputs (e.g., effluent quality) needed for the EIS were developed by Denison's Project engineers early in the EA process to allow for the biophysical and human assessments to advance. An example of one of these outputs is the IWWTP effluent quality. The effluent quality predictions in the EIS provide a bounding scenario of the basis of the assessment of Project effects. As stated in the Draft REGDOC 2.9.2 Denison understands that a BATEA assessment be conducted to determine the predicted design release characteristics as part of the licence application for a new facility or activity. Outside of the EIS process, the Project detailed engineering is progressing, including the design of the IWWTP and associated refinement of effluent quality predictions. Denison is following Draft REGDOC 2.9.2 to arrive at a treatment option that remains within the bounds of the EA, which ultimately predicts no significant impacts to the receiving environment. The maximum design release characteristics for the IWWTP will be provided as part of Denison's licence application to the CNSC. Denison met with the CNSC specialist from the Health Sciences and Environmental Compliance Division on December 7, 2022 to discuss the approach associated with a sequential EA and Licensing, and it was agreed that the above approach is acceptable. Denison is committed to completing the BATEA and providing the details to the CNSC.	No EIS updates are anticipated to address this IR.
IR-17	CNSC	Human health with respect to hazardous contaminants	Section 2.2.3.8	**Context:** It is also acknowledged that Denison stated in meetings with CNSC staff that Denison intends to propose final release targets to the CNSC as part of the licence application submission. **Rationale:** It is not clear in the submission whether Denison has considered whether any applicable technology-based performance standards exist in Canada or internationally, and would be relevant as effluent discharge targets, in order to ensure principles of pollution prevention are applied. Consideration of this would help ensure that the proposed effluent discharge targets harmonize with existing federal, provincial/territorial, and/or municipal requirements. For example, there are release limits for radium-226, TSS, and pH outlined in the federal Metal and Diamond Mining Effluent Regulations, which have been demonstrated to be achievable in the uranium mine and mill industry. In addition, countries like the United States, where in-situ recovery has been conducted in the past, have specific technology-based limits. These are known as New Source Performance Standards and are identified in US Code of Federal Regulations (US CFR) 40, Chapter 1, Subchapter N, Part 440 - Ore Mining and Dressing Point Source Category. It is not clear whether these have been considered in Denison's assessment. These should be considered when identifying suitable achievable technologies.	Denison should harmonize their proposed Effluent Release Targets with the technology-based performance standards that exist in the Metal and Diamond Mining Effluent Regulations where applicable, or other suitable international regulations.	Denison appreciates the comment and is committed to meeting all MDMER release targets. The effluent quality predictions in the EIS provide a bounding scenario of the basis of the assessment of Project effects. Denison is undertaking a sequential EA and licensing process under the NSCA. For context, the EA process for a Project under CEAA 2012 and the Saskatchewan Environmental Assessment Act is long and complex. As such, the inputs and outputs (effluent quality) developed for the IWWTP were necessary and determined by Denison's Project engineers early in the process to allow for the EIS biophysical and human assessments to advance. Proposed effluent release to the environment starts at Operation phase and BATEA information will come with the application for the license to operate. Please also see response to IR-117. The anticipated effluent quality of constituents of potential concern during normal operations presented in the EIS is based primarily on lab tests conducted by Denison with a safety factor of three added. Section 3.1.1.2 of the ERA (Appendix 10-A) states: "The reasonable upper bound treated effluent was derived using a combination of information available from lab tests conducted by Denison as well as derived effluent quality based on not exceeding water and sediment quality guidelines in Whitefish Lake. Effluent treatment feed solution was prepared by leaching drill core material from the Phoenix deposit, and further processing that solution through two steps (process precipitate removal and yellowcake precipitation) prior to effluent treatment testing. Effluent treatment tests incorporated three stages: low pH, high pH, and neutralization. A combination of reagents (iron sulphate, barium chloride, lime, and sulphuric acid) was used to facilitate precipitation of constituents. After each stage, solid-liquid separation was conducted by mixing flocculant with solution to settle solids to the bottom of the test vessel. The supernatant liquid was used for the following stage. The solids were washed, filtered, and dried to determine solids mass generation for mass balance purposes. For each stage, the liquids and solids were assayed for various COPCs. The reasonable upper bound effluent was usually an expected effluent quality from Denison multiplied by a safety factor of three." Denison intends to continue to refine effluent quality predictions as part of the BATEA assessment and licensing phase of the Project (see IR-16). The effluent quality predictions provided in the EIS will continue to bound the assessment, and provide a conservative representation of risk to human health and the environment.	No EIS updates are anticipated to address this IR.
IR-18	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.2.3.9, Project Description Appendix 8-E	**Context:** In Table 2.2-1 the upper bound Industrial Wastewater Treatment Plant (IWWTP) effluent quality final discharge targets for Constituents of Potential Concern (COPCs) are provided. General parameters (e.g., temperature, pH, etc.), and several Schedule 4 Substances with maximum authorized concentrations (lead, nickel, suspended solids, and un-ionized ammonia) under the Metal and Diamond Mining Effluent Regulations (MDMER) have not been provided in this table. There are several COPCs (aluminum, mercury, iron, nitrate, thallium, phosphorus and manganese) for effluent characterization under Schedule 5 Section 4 of the MDMER that have not been provided in this table. Additionally, no information on water quality guidelines has been provided in this table. Furthermore, it is stated that the final effluent quality discharge target for uranium is 0.057 mg/L. However, the Canadian Council of Ministers of the Environment (CCME) water short term (acute) water quality guidelines for the protection of aquatic life is 0.033 mg/L. The	1. Update Table 2.2-1 and Appendix 8-E to include all general parameters required for environmental effects monitoring: pH, temperature, hardness, alkalinity, and conductivity. 2. Update Table 2.2-1 and Appendix 8-E to include missing Schedule 4 Substances under the MDMER with maximum authorized concentrations: lead, nickel, suspended solids, and un-ionized ammonia. 3. Update Table 2.2-1 and Appendix 8-E to include missing Schedule 5 Section 4 parameters required for effluent characterization under the MDMER: aluminum, mercury, iron, nitrate, thallium, phosphorus and manganese. 4. Include all acute and chronic water quality thresholds for each parameter in Table 2.2-1 and Appendix 8-E.	Denison fully understands its obligations with respect to the MDMER and will comply with the MDMER end of pipe effluent discharge criteria and other requirements of the regulations. The lack of the MDMER general parameters and Schedule 4 substances in the draft EIS table 2.2-1 should not be misconstrued to mean Denison was not intending to meet these requirements. Rather these tables were developed based on rigorous screening to identify COPCs and then model these in the receiving environment. Table 2.2-1 in the draft EIS is not reflective of the proposed monitoring parameters during effluent release. Regardless, Denison will update the table; please see the response below. 1) Please see attachment IR-18 for updated Table 2.2-1 which is consistent with the updated Table 8.2-10 (as updated for IR-114). Parameters specific to Schedule 4 have been assessed and predicted. Schedule 5 parameters are included where available. As Schedule 5 parameters do no have screening criteria, they will be monitored by Denison consistent with the MDMER upon falling under this regulation.	Table 2.2-1 and Appendix 8-E will be updated in the final EIS; the updated version of the table is provided in attachment IR-18.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				proposed effluent discharge target for uranium exceeds the acute water quality guidelines, indicating effluent may pose the risk of being acutely lethal to aquatic biota at end-of-pipe. **Rationale:** ECCC requests the Proponent include the general water quality parameters that influence water quality thresholds, parameters in Schedule 4 and Schedule 5 Section 4 of the MDMER, and their respective water quality guidelines for consideration and transparency. Discharges from the proposed Project will alter water quality in the immediate receiving area, and this may include some sublethal effects on aquatic biota, which must be minimized. It remains the Proponent's responsibility to adhere to the MDMER to ensure that effluent at the end-of-pipe from all final discharge points be non-acutely lethal and meet requirements for prescribed deleterious substances under Schedule 4 of the regulations.	5. Describe additional mitigation measures that can be considered to minimize impacts to aquatic biota from uranium concentrations in effluent.	2) Please see attachment IR-18 for updated Table 2.2-1 which is consistent with the updated Table 8.2-10 (as updated for IR-114). Parameters specific to Schedule 4 have been assessed and predicted. 3) Please see attachment IR-18 for updated Table 2.2-1 which is consistent with the updated Table 8.2-10 (as updated for IR-114). Parameters specific to Schedule 4 have been assessed and predicted. Schedule 5 parameters are included where available. As Schedule 5 parameters do no have screening criteria, they will be monitored by Denison consistent with the MDMER upon falling under this regulation. 4) Please see attachment IR-18 for updated Table 2.2-1 which is consistent with the updated Table 8.2-10 (as updated for IR-114). Applicable screening criteria have been updated to identify most applicable acute or chronic thresholds for the protection of aquatic life. 5) As noted in response to IR-16 and IR-17 effluent discharge criteria as depicted in the draft EIS provide a bounding scenario of the basis of the assessment of Project effects and final effluent quality will meet prescribe limits developed through licensing and permitting, as informed by the BATEA evaluation process. In that context, it is expected that the uranium concentration in effluent would be lower then assumed for the purpose of the evaluation in the draft EIS and it is understood that uranium concentrations (or concentrations of other constituents) that resulted in acute toxicity would be not be permitted. Accordingly, the need for and types of mitigation measures as might be needed for uranium (or other constituents) would be developed as part of the process of developing final effluent quality limits in the permitting and licensing processes.	
IR-19	ECCC	Change to an environmental component due to radiological contaminants	Section 2.2.4 Project Description	**Context:** In this section, it is proposed that the IWWTP precipitate pond will have a single geosynthetic composite liner system, which is used for ponds/pads that only store non-radioactive materials. However, from Section 2.2.3.9 on industrial wastewater treatment, it is unclear if the precipitates from the stage three neutralization process that are pumped to the IWWTP precipitates pond will have any residual radioactivity. **Rationale:** For the protection of the surrounding environment, it is important that any ponds/pads that are expected to store radiological contaminants be designed to have proper controls (i.e., liners with monitoring systems) in place.	1. Confirm the characterization of the precipitates that are to be stored in the IWWTP precipitate pond. 2. If radiological constituents are expected within those precipitates, update the draft EIS to ensure the proposed geosynthetic liner system for the IWWTP precipitate pond will be adequate to ensure the protection of the surrounding environment.	1. The IWWTP precipitate pond will contain non-radiological, gypsum-like material. As outlined in Section 2.2.4.5 and 2.2.4.6, any radioactive precipitates generated during the first stage of the IWWTP will be directed to the process precipitate pond, not the IWWTP precipitate pond. Waste segregation and management will be important for Denison during Operation. The Waste Management Program will be established and approved by the CNSC as part of licencing. Denison will conduct regular assays of slurry sent to the IWWTP precipitate pond during Operation to confirm the quality of these precipitates. 2. In consideration of the above, radiological constituents are not expected within the IWWTP precipitate pond.	No EIS updates are anticipated to address this IR.
IR-20	NRCan	Fish and fish habitat	Section 2.3.3.1.1 Appendix 7-C	**Context**: The proponent's objective for mining area remediation is to restore the groundwater within the confines of the freeze wall to an acceptable remediation target (EIS, sec. 2.3.3.1.1). The proponent's acceptable decommissioning objectives for groundwater quality are provided in EIS Table 2.3-3 and in Table 3-5 of Appendix 7-C. These objectives were based on laboratory core flood tests performed by flushing samples of ore with groundwater and groundwater amended with sodium hydroxide or sodium bicarbonate. The composition of the remediated groundwater observed in the core flood tests serves as the source term for the post-decommissioning reactive transport modeling presented in section 4 of Appendix 7-C. **Rationale**: In NRCan's opinion, it is important for reviewers to be able to assess the level of remediation achieved in order to reach the proponent's decommissioning groundwater quality objectives. Therefore, the proponent should provide complete water quality data for the pregnant lixiviant that remains in the ore zone after the end of mining and prior to any remediation.	NRCan requests that the proponent revise Table 3-5 of Appendix 7-C to show the water quality in lixiviant remaining in the ore zone at the end of mining, prior to remediation activities.	Please see response to Attachment IR-20, IR-67, IR-69.	In the final EIS, Table 3-5 in Appendix 7-C will be updated. The updated table is provided here as Appendix B to Attachment IR-20, IR-67, IR-69.
IR-21	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.3.3.1.3, Project Description	**Context:** The decommissioning process for the wellfield and associated infrastructure is discussed, however there is no information provided on the potential risk for subsidence of the ground above the depleted uranium deposit. After the uranium has been dissolved and pumped to the surface, a cavity will be formed in the area where the uranium used to exist. This could destabilize the overlying substrates, causing the ground at the surface to sink in the future. There is currently no information regarding this risk, and how it may alter the overlying environment, surface water features, runoff, or existing nearby waterbodies. **Rationale:** From a surface water and sediment quality perspective, it is important to understand how potential subsidence in the future post-decommissioning may affect the existing environment. It is currently unclear if there is any risk to the aquatic environment if subsidence were to occur and alter existing waterbodies, create new surface water features, or if there will be any risk to the decommissioned onsite industrial landfill and industrial wastewater treatment plant precipitate pond.	Provide further information on the potential risks from subsidence including the probability of occurrence, how it may affect surface water features, and if there exists any risk to the planned decommissioning of waste management infrastructure.	To clarify, the portion of the deposit being mined is never truly a void and what remains after mining will be a honeycomb texture with water-filled interstices. The mined area is filled with a fluid at all times, whether it be a mining solution, groundwater, or the neutralizing solution. This is different from a more traditional underground operation such as Cigar Lake, where there is physical excavation of the orebody, leaving a temporary air-filled space. Although the uranium ore is high-grade by global standards it is not entirely massive in nature. As such, the uranium will be leached in a 'honeycomb' texture leaving behind a structure of partial intact rock mass with the remaining area being filled by fluid. This retains the pressure balance of the mining zone with the adjacent water-saturated rock masses. Although the above provides context on the absence of true, air-filled voids remaining post-mining, the risk of subsidence has been assessed appropriately (included in the draft EIS as Appendix K to Appendix 7-C; see also draft EIS Section 7 Geology Valued Component - Terrain Morphology and Stability Key Indicator and draft EIS Section 9 Terrain Valued Component - Terrain Morphology Key Indicator and Terrain Stability Key Indicator). The analysis shows there is negligible risk of subsidence and the magnitude of subsistence, if it were to occur, is the range of 7.5 cm at surface. Subsequent to the filing of the draft EIS, Denison undertook additional modelling with refined, more granular inputs including consideration of subunits within the altered zone (RESPEC 2023). With this more refined analysis, the potential surface subsidence has been reduced from 7.5 cm to 2.4 to 2.8 mm (RESPEC 2023 is included here as Attachment: IR-21). Further, this potential subsidence, if it were to occur, would be limited to the footprint directly above the deposit which will not contain any decommissioned waste management infrastructure. Two main Project components containing waste in the Post-Decommissioning	No EIS updates are anticipated to address this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						period will be the IWWTP precipitate pond (which will contain non-radioactive gypsum-like material) and the Industrial Landfill. All other wastes will be disposed of off-site. Spatially, the mining area is about 500 m from the IWWTP precipitate pond and about 800 m from industrial landfill. Given the negligible risk and magnitude of surface subsidence (2.4 to 2.8 mm) which would be limited to the footprint directly above the deposit, along with the distance from this area to on-site decommissioning wastes, there is negligible risk for effects of subsidence to the planned decommissioning of waste management infrastructure.	
IR-22	NRCan	Fish and fish habitat	Section 2.10 Appendix 2-C, section 1.1.1.4	**Context**: With respect to the choice of In-Situ Recovery (ISR) mining solution, two alternatives were assessed: alkaline and acidic lixiviants (Appendix 2-C, sec. 1.1.1.4). In the consideration of technical and economic feasibility of the alternatives (Table 2, Appendix 2-C), the proponent concludes that: Option 1 (alkaline) is not technically feasible based on the uranium deposit geochemistry. Option 2 (acidic) is technically and economically feasible based on the uranium deposit geochemistry and ability to dissolve uranium. Accordingly, the alkaline alternative was not carried forward into the Environmental Assessment (EIS, Table 2.10-1; Appendix 2-C, Table 3). While acidic ISR solutions are widely used internationally (e.g., Kazakhstan), in the United States, where the environmental regulatory regime is more strict, alkaline solutions have been used exclusively since 1970. **Rationale**: In NRCan's opinion, the proponent should provide a more thorough technical justification for adopting an acidic ISR lixiviant.	In the Alternative Means Assessment (Appendix 2-C), NRCan requests that the proponent provides a more thorough technical justification for selecting an acidic ISR lixiviant rather than a less environmentally problematic alkaline leach used exclusively in the USA.	The following additional information will be added to Appendix 2-C Alternative Means Assessment, Section 1.1.1.4 Mining solution: In 2017, Denison completed core testing at a laboratory in the United States that was familiar with in situ recovery (ISR) mining and processing methods. The two lixiviant or leach solutions were 1) an alkaline solution and 2) an acidic solution. The alkaline solution was comprised of 2,000 ppm sodium bicarbonate and 500 ppm hydrogen peroxide. The sodium bicarbonate is a complexing agent and the hydrogen peroxide is an oxidant. This alkaline leach solution used in the laboratory is similar to lixiviant solutions used for ISR mining in the US. The acidic solution was prepared with sulfuric acid and hydrogen peroxide, in varying concentrations as the testing proceeded. After 30 pore volumes, the alkaline leach had recovered less than 1% of the uranium in the core. For comparison, the acidic leach recovered around 30% of the uranium in the core after 30 pore volumes and just under 90% of uranium was recovered after 120 pore volumes. At the Phoenix deposit, carbonate and organic concentrations are quite low, which makes acid leach for uranium much more amenable at reasonable concentrations. Moreover, the ISR test work completed in 2017 highlighted alkaline leach would be ineffective and uneconomical. An excerpt below from the 2017 ISR laboratory report highlights the challenges with alkaline leach, pointing to the deposit specifics (depth, grade, location) which inhibit the ability to leach via alkaline methods: • "Bicarbonate is limited in practice by the chemical cost and physical ability (chemical addition rates) to increase wellfield concentrations appreciably above 2-3 g/L as HCO_3." • "Field oxygen additions are limited by injection well depths (i.e., depth to ore) which, along with injection pressures, determines the maximum concentration of O_2(g) which could be successfully introduced to the wellfield." • "pH control is critical to prevent potential calcium carbonate (Calcite, $CaCO_3$) precipitation within the wellbore and/or ore-body." In 2018, Denison contracted a third-party consultant with expertise in Australia's ISR industry to complete a desktop review of various ISR test work completed for the Phoenix deposit, including the 2017 study described above. The third-party review of the alkaline and acid leach test work noted that for the alkaline bottle roll leach, it was unsurprising that the uranium extraction, 0.8%, was so low. Assuming the formation of the $UO_2(CO_3)_2^{2-}$ complex, the sodium bicarbonate consumption by the uranium would be ~188 kg/t, not including any potential bicarbonate consumption by any other phases present in the ore. The amount of sodium bicarbonate added in the test is calculated to be 7.2 kg/t, which was grossly inadequate. It is likely that given sufficient carbonate/bicarbonate and oxidant, alkaline leaching of the ore would technically be feasible, but it is likely in practice that the carbonate consumption would be excessively high. The rate of carbonate leaching is also much slower than acid, and the introduction of oxidant is also more difficult in an alkaline system. Alkaline leach is commonly used in the United States due to the primary components that make up their ore bodies. They are rich in carbonates and organics, which makes uranium quite difficult and costly to mine via acid leach as the acid is consumed by these constituents prior to any uranium being liberated and leached itself. These issues are not of concern with alkaline leach. There is currently one operation in the United States (Lance Uranium Project – Eastern Wyoming) that uses acid leach. The company had switched to acid leach after a failed trial of alkaline leach/mining due to high carbonates in the ore body that were not previous examined in detail. As noted in Table 2 of Appendix 2-C, the alkaline leach option for mining solution was determined to not be technically and economically feasible based on the uranium deposit geochemistry and ability to dissolve uranium.	Appendix 2-C Alternative Means Assessment, Section 1.1.1.4 Mining solution will be updated as follow (additions in **bold**, deletions in ~~strikethrough~~): **Two options were considered for mining solution: Option 1: alkaline solution and 2. acidic solution.** Factors determining the choice between acid or alkaline ISR technology are: composition of the host rock and ores, reagent cost and consumption, the degree of uranium recovery, and the intensity of the process (IAEA 2001). The leach intensity is determined as the sum of the leach duration, solution ratio (liquid/solid), and average uranium concentration in the recovery solution. ~~1. Alkaline solution~~ Alkaline or high-pH mining solutions are used at a number of uranium ISR operations. The mining solution is typically made with carbonate or bicarbonate. The single most important factor in the process is the rock composition within the productive aquifer, and in particular, the concentration of calcium carbonate. Ores with a higher carbonate content normally require alkaline (bicarbonate) leaching. ~~2. Acidic solution~~ Acidic or low-pH mining solutions are used at a number of uranium ISR operations. The acidic mining solution is typically made with dilute sulfuric acid. The single most important factor in the process is the rock composition within the productive aquifer, and in particular, the concentration of calcium carbonate. For economic sulphuric acid leaching, the carbonate content should not exceed 2% CO_2. **In 2017, Denison completed core testing at a laboratory in the United States that was familiar with in situ recovery (ISR) mining and processing methods. The two lixiviant or leach solutions were 1) an alkaline solution and 2) an acidic solution. The alkaline solution was comprised of 2,000 ppm sodium bicarbonate and 500 ppm hydrogen peroxide. The sodium bicarbonate is a complexing agent and the hydrogen peroxide is an oxidant. This alkaline leach solution used in the laboratory is similar to lixiviant solutions used for ISR mining in the US. The acidic solution was prepared with sulfuric acid and hydrogen peroxide, in varying concentrations as the testing proceeded. After 30 pore volumes, the alkaline leach had recovered less than 1% of the uranium in the core. For comparison, the acidic leach recovered around 30% of the uranium in the core after 30 pore volumes and just under 90% of uranium was recovered after 120 pore volumes.** **At the Phoenix deposit, carbonate and organic concentrations are quite low, which makes acid leach for uranium much more amenable at reasonable concentrations. Moreover, the ISR test work completed in 2017 highlighted alkaline leach would be ineffective and uneconomical. An excerpt below from the 2017 ISR laboratory report highlights the challenges with alkaline leach, pointing to the deposit specifics (depth,**

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
							grade, location) which inhibit the ability to leach via alkaline methods: **• "Bicarbonate is limited in practice by the chemical cost and physical ability (chemical addition rates) to increase wellfield concentrations appreciably above 2-3 g/L as HCO3."** **• "Field oxygen additions are limited by injection well depths (i.e., depth to ore) which, along with injection pressures, determines the maximum concentration of O2(g) which could be successfully introduced to the wellfield."** **• "pH control is critical to prevent potential calcium carbonate (Calcite, CaCO3) precipitation within the wellbore and/or ore-body."** **In 2018, Denison contracted a third-party consultant with expertise in Australia's ISR industry to complete a desktop review of various ISR test work completed for the Phoenix deposit, including the 2017 study described above. The third-party review of the alkaline and acid leach test work noted that for the alkaline bottle roll leach, it was unsurprising that the uranium extraction, 0.8%, was so low. Assuming the formation of the UO2(CO3)22- complex, the sodium bicarbonate consumption by the uranium would be ~188 kg/t, not including any potential bicarbonate consumption by any other phases present in the ore. The amount of sodium bicarbonate added in the test is calculated to be 7.2 kg/t, which was grossly inadequate. It is likely that given sufficient carbonate/bicarbonate and oxidant, alkaline leaching of the ore would technically be feasible, but it is likely in practice that the carbonate consumption would be excessively high. The rate of carbonate leaching is also much slower than acid, and the introduction of oxidant is also more difficult in an alkaline system.** **Alkaline leach is commonly used in the United States due to the primary components that make up their ore bodies. They are rich in carbonates and organics, which makes uranium quite difficult and costly to mine via acid leach as the acid is consumed by these constituents prior to any uranium being liberated and leached itself. These issues are not of concern with alkaline leach. There is currently one operation in the United States (Lance Uranium Project – Eastern Wyoming) that uses acid leach. The company had switched to acid leach after a failed trial of alkaline leach/mining due to high carbonates in the ore body that were not previous examined in detail.**

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
IR-23	CNSC	Alternative Means	Section 2.10.2 Alternative Means Appendix 2-A PD Engagement Tables Appendix 2-C Alternative Means Assessment (p. 3)	**Context:** There are multiple rows in the Indigenous Tables for Appendix 2-A where comments and concerns raised by Indigenous Nations and communities and other members of the public were taken into consideration in the Alternative Means Assessment. However, it is unclear how these were considered. A few examples: • 16-EN-DesNd-101.1: Interested in any future business opportunities that may be available as Denison advances their Wheeler River Project. • 16-EN-ERFN-100.15: In that territory near the Wheeler River there are a lot of spawning and calving areas for moose, caribou; those creeks are for whitefish spawning. There's lots of heavy muskeg there. A lot of us have been there, and we'd like to know there'll still be access to the area. • 6-EN-ERFN-100.17: Today because of climate change, things are starting to happen that normally didn't happen. Even the permafrost is now further down. In the Wheeler River area, where there's some permafrost, have your environment guys seen a change? Will there be a change? These are some of the questions that need to be answered in order to come out with a positive spin. **Rationale**: Appendix 2-C, Alternative Means assessment, states (p.3): "Engagement with Interested Parties naturally included alternatives means and the engagement input was included in the evaluation of alternative means. Refer to the references list below and *Appendix 2-A Engagement Database Summary – Project Description* for details of engagement information referenced in this alternative means assessment." It is unclear in section 2.10.2 of the EIS, Appendix 2-A or Appendix 2C how the comments documented by Denison have been considered or influenced the alternative means assessment.	Please explain how comments and concerns collected during Denison's engagement sessions were considered or influenced the alternative means assessment. Please include this information in the EIS and/or it's appendices.	Denison's specific engagement initiatives on Project alternatives are outlined in Appendix 2-C for the 1) mining method, 2) freeze design for tertiary containment of mining solution, 3) treated effluent discharge location to surface water, and 4) access road alignment. In addition to these targeted engagement topics, information gathered more broadly during engagement was also considered in Project alternatives through the consideration of general concerns or statements. Two main areas where comments and concerns fed into and informed the Alternatives Assessment are: 1) Appendix 2-C, Section 1.2 Consideration of Technical and Economic Feasibility along with Land Use Screening, and 2) Appendix 2-C, Section 1.4 Evaluation of Alternative Means. The comparative evaluation of alternative means is presented in Appendix 2-C, Table 6 to Table 22. The evaluation considered the relative residual effects of each of the technical and economically feasible alternatives for each of the evaluation criteria identified in Appendix 2-C, Table 5, following the application of mitigation measures described in Appendix 2-C, Table 4. In each case, the preferred alternative and rationale for its selection were identified. In addition, specific input received from Indigenous groups and other Interested Parties that contributed to the selection of the preferred option was highlighted, when applicable. The alternative means assessment provided in the tables in this section was conducted at a screening level, appropriate for the stage of the Project when the alternatives were considered. The assessment considered both quantitative (where possible) and qualitative information as available. The comparative evaluation identified more preferred versus less preferred alternatives. To follow-up on one of the examples listed in the context and rationale section of this IR, 16-EN-DesNd-101.1 was a comment related to interest in business opportunities. As noted in Appendix 2-A, this comment factored into the comparative evaluation of alternative means for waste management, domestic waste disposal in the section outlining input received from Interested Parties. For additional background, two options were under evaluation: Option 1 was collection and disposal off-site by a third-party contractor and Option 2 was collection and disposal in an on-site domestic landfill. The following text is available in Appendix 2-C, Table 17: Waste Management – Domestic Waste Disposal - Alternative Means Assessment: During seven years of engagement activities for the Project, Denison has understood the importance of designing a project that minimizes interactions with the biophysical environment and the importance of continued land use by Indigenous groups. Looking at domestic waste disposal options, the option to transport domestic waste off site to a nearby licensed facility may generate a local economic opportunity (16-EN-DesNd-101.1, 19-EN-VB-132.5, 21-ENSUR-446.48). However, the transport of material off site would increase traffic, which may have a negative effect on traditional land use, infrastructure and services, and wildlife (16-EN-ERFN-100.15) (21-EN-SUR-446.68). Increased traffic would also increase greenhouse gas emissions. Concerns related to climate change were raised during engagement and consultation activities completed by Denison (e.g., 22-EN-ERFN-621.15, 22-EN-SUR-652.57). It should be noted that these concerns pertain to climate change rather than GHG emissions specifically. The concerns included observations of climate-related changes that have been noticed by the English River First Nation (e.g., depth of permafrost; 16-EN-ERFN-100.17) and observations by the English River First Nation Trapper who provided local knowledge in support of the EIS (19-LK-ERFNTrap-134.232). While no specific feedback was received on the domestic waste disposal options, the above provides context on how Denison's fulsome engagement activities have influenced the selection of a preferred alternative for domestic waste disposal. Based on the evaluation of alternative means, a preferred alternative means for each respective Project component or activity was selected. Rationale for the selection based on the comparative evaluation of alternatives is provided and input received by Interested Parties is presented. As shown in the above example, the input received from Interested Parties was an important part of the multifaceted evaluation.	See attachment IR-24 for proposed content for final EIS Section 2.10, which, relative to the draft EIS, includes the addition of Section 2.10.3 Summary of Influence of Indigenous Knowledge, Local Knowledge, and Engagement on the Alternative Means Assessment.
IR-24	CNSC	Alternative Means	Section 2.10.2 Alternative Means	**Context:** While Appendix 2-C (Alternative Means Assessment) is detailed and includes all aspects of the Alternative means assessment that are required, the summary of the analysis and conclusions in Section 2.10.2 of the EIS lacks the level of detail required to understand the methodology used, and how Denison arrived at these conclusions. **Rationale**: As noted in the Agency's Operational Policy Statement on Addressing "Purpose of" and "Alternative Means" under the CEAA 2012: "If a preferred means is selected, the analysis and the rationale for the choice should be explained from the perspective of the proponent, and be documented in the EIS in sufficient detail to provide context for public and technical comment periods during the project EA, and ultimately to allow the decision maker to understand the choice."	Please summarize the analysis of the alternative means assessment within the body of the EIS, in sufficient detail that a reader of the EIS has adequate information to understand the methodology used, and how Denison arrived at these conclusions. *Note: In addition to the adding text to summarize, Table 6 in Appendix 2-C could be useful to understanding table 2.10.1 in the EIS.	Additional details from Appendix 2-C will be provided in Section 2.10 of the final EIS. Also, an example of alternative means evaluated for mining method will be added into Section 2.10.2 in the final EIS. It is noted that no new information would be presented in the final EIS Section 2.10.2 beyond that which was presented in the draft EIS Appendix 2-C.	See Attachment IR-24 for proposed updates to Section 2.10.2.
IR-25	CNSC	Current use of lands and resources for traditional purposes	Section 3, Sections 4, Section 5, Section 11 (and all other applicable once Métis Knowledge Use Study is completed)	**Context:** The EIS states that Denison is currently negotiating an agreement with MN-S and no traditional land use information is included throughout the EIS given no agreement was signed or Traditional land use information was shared at the time the EIS was being drafted. As noted in the EIS Denison has committed that: "As information becomes available from the agreed-upon process between the Métis Nation – Saskatchewan and Denison, it will be incorporated into the final EIS." (p. 11-36)	Please update the revised Draft EIS to reflect the integration of the Métis Use and Knowledge Study in the Draft EIS where applicable, when this study is completed and provided to Denison. In addition, please include an updated Issues and Concerns table that includes relevant information from the MN-S as a result of engagement activities and relevant MN-S studies in the next version of the EIS, as appropriate.	A study agreement was signed with the MN-S to complete a Metis Knowledge Study by the end of October 2023. Denison has met with the MN-S to discuss the next steps and anticipated timeline, however no information has been provided to Denison, to date. When the study is completed within the agreed upon timeframe, Denison will update the final EIS to include relevant information in the assessment. It is important to note that Denison has incorporated Metis land use information and perspectives into the draft EIS, through the funding of the Kineepik Metis Land and Occupancy information along with the KML VEC statement, of which relevant information has been incorporated directly into the draft EIS to determine effects to the human environment.	The final EIS will be updated with applicable information pertaining to the effects assessment from the Metis Knowledge Study when provided within the agreed upon timeframe (end of October 2023).

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				Rationale: More information is required to better understand the issues and concerns, valued components, and current use of lands and resources for traditional purposes by MN-S near the project area. Requirements are detailed in CNSC's Generic EIS Guidelines, section 8.9: Indigenous land and resource use.	Should this information not be made available to Denison at the time of revising the draft EIS, the next version of the EIS and the response to this IR should provide a status update on discussions and engagement with MN-S and next steps.		
IR-26	CNSC	Precautionary principle and approach	Section 3.4.8 Lands Taken Up from an Indigenous Perspective (p. 3-14)	**Context**: Denison states: "Discrepancies among IK and western scientific information provide an opportunity for Denison to take a precautionary approach. Examples of concrete actions to address uncertainty in cases where IK and LK have differing conclusions on predicted Project effects include addressing uncertainty through monitoring and follow-up programs and communicating results of those monitoring and follow-up programs to demonstrate they have been responsive to the IK shared." (p. 3-14) **Rationale:** CNSC's Generic Guidelines for the Preparation of an EIS state: "In documenting the analyses included in the EIS, the proponent will demonstrate that all aspects of the project have been examined and planned in a careful and precautionary manner in order to avoid significant adverse environmental effects. A document by Canada's Privy Council Office, *A Framework for the Application of Precaution in Science-based Decision Making About Risk, sets out guiding principles for the application of precaution to science-based decision making*." (Section 2.5)	Please clarify how the precautionary principle, and the Privy Council Office's, *A Framework for the Application of Precaution in Science-based Decision Making About Risk, sets out guiding principles for the application of precaution to science-based decision making* has been considered and incorporated into the EA described in the EIS.	Page 3-14 of the EIS notes that "Discrepancies among IK and western scientific information provide an opportunity for Denison to take a precautionary approach." The precautionary approach to the evaluation of effects is described in Section 5.8.1.2.2 of the EIS, which specifically deals with the confidence of predictions and states: "In this EA, the precautionary approach to the evaluation of potential effects was adopted, recognizing areas of uncertainty and uses conservative assumptions and approaches within the assessment process. Areas of uncertainty in the process and in predictions for each VC are identified and discussed in each VC-specific section, or on a KI-specific basis as applicable." "Confidence predictions are defined as low, moderate, or high. Where a high degree of uncertainty regarding a residual adverse effect is evident, the confidence level may be low. A high level of confidence is assigned to predictions that have direct, site-specific quantitative data to support the predictions. Low or moderate degrees of uncertainty are manageable through monitoring and follow-up programs to confirm the absence, presence, and extent of residual adverse effects." The Privy Council Office's, A Framework for the Application of Precaution in Science-based Decision Making About Risk was not specifically referred to in making decisions regarding discrepancies among IK and western scientific knowledge. Rather ERFN, KML/Pinehouse, and the YNLR were offered the opportunity to review select sections of EIS prior to its submission to regulators (see Section 4.3.2.1.4 for ERFN; KML/Pinehouse declined the invitation to review the EIS in advance of filing; Section 4.3.4.2.4 for the YNLR). An example of where greater precaution was exercised is found in the conclusions for effects on Indigenous Land and Resource Use, in which the overall confidence rating was moderate based on the communities' previous experience with the uranium industry, but could not "be considered as high as the Indigenous COIs lack certainty about ISR mining technique" (Section 11.1.6.4).	No EIS updates are anticipated to address this IR.
IR-27	CNSC	Cumulative Effects Analysis	Section 3.4.8	**Context:** During an outreach and engagement trip by CNSC in October 2022, an abandoned exploration camp adjacent to the proposed Wheeler River site was observed. This site has not been identified within the EIS as part of the cumulative effects assessment. As noted in section 3.4.8, KML has also raised concerns with Denison related to abandoned camps and industrial waste left with no programs for clean-up. **Rationale:** Section 9.4.3 of CNSC's Generic Guidelines for the Preparation of an EIS states that "The applicant shall assess any residual adverse environmental effects of the project in combination with other past, present or reasonably foreseeable projects and/or activities within the study area."	Please specify why abandoned exploration camps and industrial waste aren't taken into consideration when completing cumulative effects assessment.	Section 5.9 outlines the general methods and approach for cumulative effects assessments, while each biophysical and human environment assessment provides details on their Valued Component (VC)-specific approach. The inclusion list in Section 5 does include exploration and mining activities, and options for other projects and activities, as appropriate. With this approach the footprint of the abandoned exploration camp was considered within the terrestrial cumulative effects assessment. Section 11 Land and Resource Use notes that existing projects or activities were not considered as part of the cumulative effects assessment because they were captured and assessed within baseline conditions or existing conditions. This approach would include the abandoned exploration camp adjacent to the proposed Wheeler River site.	No EIS updates are anticipated to address this IR.
IR-28	CNSC	Current use of lands and resources for traditional purposes	Section 4, IER and engagement appendices, including: Appendix 2-A Appendix 6-B Appendix 7-B Appendix 8-A Appendix 9-A Appendix 10-B Appendix 11-A Appendix 12-A Appendix 13-A Appendix 14-B	**Context:** The summary of issues tables do not appear to include all of the key issues identified by the Indigenous Nations and communities. For example, some Indigenous Nations and communities have shared concerns with respect to accident prevention and overall safety on the Key Lake road (Highway 914) due to increased traffic, impacts on treaty rights and section 35 rights due to cumulative impacts, and decommissioning, that were not captured in the issues and concerns and summary tables in Section 4.3.2 and in the IER. The tables in the engagement appendices include a column titled "Response (From Denison)". The "Response" column does not include responses, but instead points the reader to where this comment or concern was considered. When navigating to the sections referenced, it is often unclear how this information was considered or influenced the assessment. **Rationale:** Additional detail is required in order to ensure the key issues are all identified and to understand the status of validation for each issue raised and the response provided.	1. Update the summary of issues and concerns tables to include all relevant issues and concerns raised by each of the Indigenous Nations and communities to date, including concerns raised in the Indigenous Knowledge studies provided, additional engagement, and Draft EIS comments. 2. Please include a column in the issues and concerns tables to clearly articulate the specific mitigation/monitoring measures that Denison have committed to, or any other measures, in order to address the concerns raised by each Indigenous Nation and community during the engagement process to date. 3. Denison must demonstrate that each Indigenous Nation and community has validated that the summary of issues and concerns table reflects their understanding or agreement, and/or a path forward to complete the validation throughout the EIS and the updated IER. Validation must be complete by the time the technical review is complete, prior to submission of a final EIS. Should Denison not be able to fully address issues, concerns or feedback raised by any Indigenous Nation or community, through mitigation and monitoring measures, this should be documented, and a rationale provided. 3. Update the response column of the Engagement tables to describe how these were considered in the sections referenced. Consider renaming this column to reflect the nature of the content (i.e., how the information was considered).	Please see response in Attachment IR-28.	• Section 4 general updates since submission of the draft EIS, including updates to clarify the purpose of the Key Issues and Concerns tables and the Engagement Database Summary tables in various appendices • Table 4.3-2: Key Issues and Concerns from English River First Nation (and corresponding table in the IER) • Table 4.3-3: Key Issues and Concerns from Kineepik Métis Local #9 (and corresponding table in the IER) • Table 4.3-4: Key Issues and Concerns from Sipishik Métis Local #37 (and corresponding table in the IER) • Table 4.3-5: Key Issues and Concerns from Patuanak Métis Local #82 (and corresponding table in the IER) • Table 4.3-6: Key Issues and Concerns from Birch Narrows Dene Nation (and corresponding table in the IER) • Table 4.3-7: Key Issues and Concerns from Lac La Ronge Indian Band (and corresponding table in the IER) • Table 4.3-8: Key Issues and Concerns from A La Baie Métis Local #21 (and corresponding table in the IER) • Table 4.3-9: Key Issues and Concerns from Métis Nation – Saskatchewan (and corresponding table in the IER) • Table 4.3-10: Key Issues and Concerns from Ya'thi Néné Lands and Resources Office (and corresponding table in the IER)

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
							• Table 4.4-1: Key Issues and Concerns from the Northern Village of Pinehouse • Table 4.4-2: Key Issues and Concerns from the Northern Village of Beauval • Table 4.4-3: Key Issues and Concerns from the Northern Village of Île-à-la-Crosse A new table will be included for Peter Ballantyne Cree Nation as well into the final EIS and in the IER. • Section 2 Project Description – Appendix 2-A: Engagement Database Summary Table for Project Description • Section 6 Atmospheric and Acoustic Environment – Appendix 6-B: Engagement Database Summary Table for Project Description • Section 7 Geology and Groundwater – Appendix 7-B: Engagement Database Summary Table for Geology and Groundwater • Section 8 Aquatic Environment – Appendix 8-A: Engagement Database Summary Table for Aquatic Environment • Section 9 Terrestrial Environment – Appendix 9-A: Engagement Database Summary Table for Terrestrial Environment • Section 10 Human Health – Appendix 10-B: Engagement Database Summary Table for Human Health • Section 11 Land and Resource Use – Appendix 11-A: Engagement Database Summary Table for Land and Resource Use • Section 12 Quality of Life – Appendix 12- A: Engagement Database Summary Table for Quality of Life • Section 13 Economics – Appendix 13-A: Engagement Database Summary Table for Economics • Section 14 Accidents and Malfunctions – Appendix 14-B: Engagement Database Summary Table for Accidents and Malfunctions • Section 15 Effects of the Environment – Appendix 15-A: Engagement Database Summary Table for Effects of the Environment on the Project
IR-29	CNSC	Current use of lands and resources for traditional purposes	Section 4.3.2 and IER	**Context:** In this section, Denison includes the engagement with BNDN and includes a summary of issues and concerns table for the Nation. Within the history of interactions (Section 4.3.3.2.1). **Rationale**: Denison states that they have been providing information on the project to BNDN in 2019, 2021 and again in 2022 and that Denison and BNDN have not responded to date in order to advance further engagement and dialogue.	Please ensure updated information of any additional engagement activities that Denison has completed with BNDN related to understanding their current and traditional land use and potential interests near the proposed project is provided.	Denison is able to provide the following information with respect to engagement with BNDN. Denison had a meeting with BNDN on February 14, 2023, to provide an overview of the Wheeler River Project. During the meeting, BNDN indicated they would share a traditional territory map and land and occupancy information in relation to the Wheeler River Project subject to reaching suitable confidentiality provisions. On April 25, 2023, Denison shared a draft confidentiality agreement with BNDN. On May 10, 2023, Denison met with BNDN again, to discuss a process for engagement going forward. During the meeting, Denison was advised that BNDN had proposed revisions to the confidentiality agreement, which they would provide to Denison. Also identified in the meeting was that Denison's access to data BNDN previously referenced regarding land use activities in and around the Wheeler River Project would be limited and subject to further funding from Denison to BNDN. Denison continued to request the available site-specific information in order to better understand the potential for adverse impacts to rights from the Wheeler River Project to BNDN in order to potentially adjust engagement approaches with BNDN. On May 11, 2023, Denison was advised to communicate directly with the Chief of BNDN and was provided further information from BNDN that BNDN would connect with Denison in the future to determine next steps together. On June 16, 2023, BNDN contacted Denison to request a meeting toward the latter part of July 2023. Denison responded positively to this request and will be following up with BNDN accordingly. Subject to the development of a specific engagement process between Denison and BNDN, as identified above, Denison is committed to maintaining an open dialogue with BNDN regarding their interests in the Project. Denison will make sure the above information, and any further information in this respect, including potential resolution of issues, will be included in the final EIS and an update to the IER.	Updates will be included in the final EIS Table 4.3-6: Key Issues and Concerns from Birch Narrows Dene Nation (and corresponding table in the IER) as part of response to IR-28.
IR-30	CNSC	Indigenous physical and cultural heritage	Section 4.3.2.1.3, Table 4.3.2	**Context:** Concerns were raised during engagement sessions that "Elders are not being consulted as most of the engagement has been through online means and without a translator".	How has Denison adapted engagement with Elders from the ERFN since receiving this comment on March 31, 2021?	Since receiving the comment about the challenge with virtual engagement activities and associated translation for those requesting it, Denison has incorporated simultaneous Dene translation into the Zoom virtual meeting feature. This was used in a virtual meeting	No EIS updates are anticipated to address this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				Rationale: There's no indication that a translator has been employed to engage with Elders since 2021 in the engagement Table 4.3.2.		undertaken for the Athabasca Basin First Nations and Communities, in September 2021. The feedback received was overwhelmingly positive. Going forward, should Denison have to deploy virtual meetings where translations are required, this tool will be deployed again. For all in person meetings, Denison provides a translator, who can assist with anyone requiring discussion to occur in their language.	
IR-31	CNSC	Indigenous Engagement	Section 4.4.2.1.3, Key Engagement Activities (p. 4-88)	**Context and Rationale:** Regarding the following: "An open house for the general public was planned to be hosted in 2022 on preliminary effects and mitigation, but due to concerns identified by MN-S about hosting a public open house in a community with a significant Métis population, this meeting was postponed by Denison. Denison looks forward to rescheduling the meeting in collaboration with the MN-S." (p. 4-88)	Please provide an update on the evolution or progress of this engagement with local communities, following collaboration with MN-S (or otherwise).	Denison continues to respect the delegated Duty to Consult to the Metis Nation - Saskatchewan for a number of communities with strong presence of Metis Citizens for engagement about the Wheeler River Project. As such, Denison will follow the Metis Nation - Saskatchewan direction in this regard until such time as this direction changes. Denison is pleased to report that on February 11 and 12, 2023, the MN-S coordinated a meeting for Denison, the CNSC, the Province of Saskatchewan and the Metis Locals from Northern Regions 1 and 3 to provide an overview of the Project and respond to questions and concerns.	Updates will be included in the final EIS accordingly.
IR-32	CNSC	Current use of lands and resources for traditional purposes	Section 5.3 Section 9.0 Terrestrial Environment	**Context:** Some sections of the EIS (such as Fish and Fish Habitat, Indigenous Lands and resource use) indicate that Indigenous and/or local knowledge was considered when defining the spatial boundaries. However, this is not included in other sections, such as Terrestrial Environment. **Rationale:** Section 5.2.2 of CNSC's Generic EIS Guidelines require that spatial boundaries be defined by considering, but not limited to, the following criteria: Community and Indigenous traditional knowledge, ecological and technical considerations.	Please provide any additional details about how any comments or concerns raised were considered in defining the spatial boundaries with Indigenous Nations and communities with respect to spatial boundaries, for the Terrestrial Section and which specific Indigenous Nations and communities were engaged on these topics and how their input and knowledge was incorporated into the EIS. If already presented in the EIS text body, please indicate where this information can be found or link to Section 4 of the EIS or in the IER.	The rationale for the definition of study areas for the purpose of the assessment of the Terrestrial Environment valued components (VCs) is described in Section 9.1.1 of the draft EIS. The Project Area and Local Study Area (LSA) were delineated based on the expected extent of potential direct (footprint) and indirect (sensory disturbance) Project effects; whereas, the Regional Study Area (RSA) considered an 8 km buffer around the Project Area to provide an appropriate spatial scale upon which potential Project effects could be evaluated at the landscape scale where key Terrestrial Environment VCs reside and move within and upon which cumulative effects could be assessed. No specific comments or concerns were raised on the spatial scale of the Terrestrial Environment study areas during engagement activities, though considerable input was solicited / received regarding many of the Terrestrial Environment VCs that helped to contribute how the assessment study areas were defined. This is especially true in consideration of the relatively high number of comments received through engagement regarding wildlife (as represented by ungulates, furbearers, woodland caribou, and birds in the draft EIS) and wildlife use by local and Indigenous people/ communities (see Sections 9.3.3.1.2, 9.3.3.2.2, 9.3.3.3.2, 9.4.3.1.2, 9.4.3.2.2, 9.4.3.3.2 in the draft EIS Appendix 9-A for details). Cumulatively, this input puts high importance on and speaks to the broad knowledge of wildlife in the vicinity of the Project, informing the need to define the RSA to an appropriate spatial extent, as was the case on the draft EIS. In addition, and within the context of the IR, it is appropriate to also consider the assessment of terrestrial environment from the perspective of Land and Resource Use per Section 11 of the draft EIS, since the two (Terrestrial Environment and Land Are Resource Use) are so intimately related. For context the Terrestrial Environment RSA, fits within the Indigenous Land and Resource Use RSA. Section 11 of the EIS is focused on Land and Resource Use and includes consideration for various terrestrial VCs and key indicators (KIs) as resources. With respect to Indigenous Land and Resource Use, the definition of spatial boundaries is offered in Table 11.2-2 which notes that the LSA is inclusive of direct and indirect effects to relevant VCs will occur, including the maximum combined extent of supporting VCs associated with the aquatic, terrestrial, noise, and health LSAs. It is inclusive of trapping, fishing, and travel through and adjacent to the Project Area. The RSA is inclusive of trapping block N-18, which represent a familiar reference for local Indigenous communities and capture the broad land usage patterns of local communities. Trapping blocks are defined regions and have membership that is regulated by a local trapping association and membership is generally only open to local Indigenous community residents though non-Indigenous trappers may also participate as members of the trapping association. If resource use activities were displaced, it is likely this would still occur within the N-18 trapping block area where individual resource users already have familiarity.	No EIS updates are anticipated to address this IR.
IR-33	CNSC	Residual Effect Characterization	Section 5.8.1, Definitions for Residual Effects Characterization and Significance Section 5.8.1.1, Residual Effects Characteristics Section 8, Table 8.3-9: Fish and Fish Habitat - Surface Water Quality	**Context:** Denison uses specific criteria (Residual Effect Characteristics: Direction, magnitude, geographic extent, duration, frequency, reversibility, context and likelihood) and associated ratings (e.g., adverse/positive, low/moderate/high) for the predicted effects assessment. However, it is unclear whether an aggregation method was used in order to determine whether impacts will be significant or not significant, depending on the combination of rating categories (i.e., weightings that were calculated, use of decision rules). For example, medium term and long term are both used to represent the same time category: "Effects are expected to last between 3 to 38 years (i.e., effects expected during Construction through to the end of post-Decommissioning)." (See table 8.4-13 on p. 8-200 compared to table 8.4-12 on p. 8-199 and table 8.5-9 on p. 8-246). **Rationale:** The Generic Guidelines state: "The method used to describe the level of the adverse effect should be transparent and reproducible." In Table 8.3-11, duration was moderate, but again uses same rationale. There is no 'moderate' in Table 8.3-8, and by the same rationale, this should be medium-term to be consistent with definitions provided and summary Table 8.3-12. It was noted that all three tables should be deemed medium-term	If an aggregation method was used and ratings (e.g., High, medium, low) were weighted, what weightings were used, how were these calculated? Please also describe any decision rules that informed the determination of significance. If no aggregation was used, how did Denison ensure that results were consistent, given the varying rankings for each of the key criteria, and varying combination? Regarding inconsistencies in ratings, please use consistent terminology for same rating.	Denison did not use an aggregation method with weighted ratings. The assessment approach and methodology was outlined in draft EIS Section 5, Approach and Methodology. Please note that Section 5.8 provided a guide for technical leads to conduct residual effects evaluation; however, Section 5.8 also recognizes that the specific definitions and ratings for some characteristics may be developed on a VC-specific basis as presented in each VC-specific section. Denison reviewed the draft EIS to ensure results were consistent. This included checks on the consistent application of characteristics and ratings along with any supporting rationale. Nevertheless, as pointed out by the CNSC, there appear to be some inconsistencies in Section 8 of the draft EIS. The final EIS will be updated, specifically Section 8 where inconsistencies were highlighted in IR-33 context and rationale text. Importantly, these are effectively editorial issues and do not change the assessment summaries or conclusions.	Ratings for duration and frequency in Section 8 of the final EIS will be updated. Residual effect characteristics and ratings will be consistent between definitions tables and subsequent summary (results) tables within a section. This will include consistent use of the ratings for the residual effect characteristic of duration, as follows: • Short-term – Less than 3 years (i.e., effect happens during Construction only). • Medium-term – 3 years to 38 years (i.e., effect happens from Construction through to the end of Post-Decommissioning). • Long-term – More than 38 years (i.e., effect extends beyond Post-Decommissioning).

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				based on definitions of ratings outlined in Table 8.3-8. Frequency was also showing up as "continuous" and "continuously" in these tables.			This will include consistent use of the ratings for the residual effect characteristic of frequency, as follows: • Infrequent – Effect occurs several times at sporadic intervals. • Frequent – Effect occurs many times on a regular basis. • Continuous – Effect occurs continuously.
IR-34	CNSC	Cumulative Effects Analysis	Section 5.9.2.2 (p. 5-41)	**Context:** Denison identifies the Gryphon deposit as a project that is not reasonably foreseeable. The direct quote from the EIS indicates that the "Development of the Gryphon deposit as an underground mine was evaluated at the prefeasibility level in 2018 but has not advanced to feasibility study or EA. Denison has not announced an intent to proceed with the development of the Gryphon deposit." (p. 5-41) **Rationale:** The guidance Assessing Cumulative Environmental Effects under the CEAA, 2012 defines *Reasonably Foreseeable* as a "physical activity [that] is expected to proceed, e.g. the proponent has publicly disclosed its intention to seek the necessary EA or other authorizations to proceed." In a press release by Denison Mines (2018: Denison announces decision to advance Wheeler River Project following positive PFS results), Denison publicly disclosed intention to seek the necessary EA for Gryphon to proceed: "After careful consideration of the risks and opportunities associated with permitting and concurrent advancement of project engineering activities, the Company has decided to submit a PD and initiate the EA process in early 2019 for the Phoenix ISR operation, and to bring the Gryphon operation forward, at a later date, as required to achieve the PFS plan of Gryphon first production by 2030." Further, Denison's Wheeler River Webpage references a "start of pre-production activities for the Gryphon operation in 2026"	Please update the cumulative effects assessment in the EIS to include the Gryphon deposit as a Present or Reasonably Foreseeable Project.	Denison has not publicly disclosed its intention to seek the necessary EA or other authorizations to proceed with mining the Gryphon deposit on the Wheeler River property at this time and does not meet any of the criteria for a reasonably foreseeable project as per the guidance for Assessment Cumulative Effects under the CEAA 2012 (below). A future physical activity could be considered reasonably foreseeable and should generally be included in the cumulative effects assessment if one or more of the following criteria are met: • The intent to proceed is officially announced by a proponent. This information could be found in news media, the proponent's website or via an announcement from the proponent directly to regulatory agencies. • The physical activity is under regulatory review (i.e., the application is in process). This can be known, for example, if information about the review or application is available on a government website, or an EA notice has been made public. • The submission for regulatory review is imminent. This could be known if the collection of data has already commenced, regulatory authorities have been contacted about information requirements, or through an announcement from the proponent. • The physical activity is identified in a publicly available development plan that is approved or for which approval is anticipated (e.g., a wastewater treatment plant in a city's long term development plan). • The physical activity supports – or is consistent with – the long-term economic or financial assumptions and engineering assumptions made for the project's planning purposes. • A physical activity is required in order for the project to proceed (e.g., rail or port transportation facilities, or a transmission line). • The economic feasibility of the project is contingent upon the future development. • The completion of the project would facilitate or enable the future development. The Gryphon deposit is an exploration phase property and is inherently captured as such in the cumulative effects assessment because the levels of disturbance from these activities to date are captured with the characterization of existing conditions. It would be inappropriate to consider mining of the Gryphon deposit within the cumulative effects assessment as a mining operation as Gryphon cannot be considered a reasonably foreseeable activity. As is widely understood, very few exploration phase projects become operating mines. We note that the press release and the prefeasibility study referenced in the IR were from 2018. The Wheeler River Project Provincial Technical Proposal and Federal Project Description used to initiate the provincial and federal EA processes was submitted in February 2019. This represents Denison's most recent plans for development and the Project scope does not include underground mining of the Gryphon deposit. Denison acknowledges that, if development of the Gryphon deposit as an underground mine is proposed in the future, this would require additional regulatory review and approval.	No EIS updates are anticipated to address this IR.
IR-35	CNSC	Change to an environmental component due to hazardous contaminants	Section 6, Chemicals of Potential Concern	**Context:** The use of petroleum products (e.g., propane, gasoline, and diesel) at the Denison Mines Wheeler River site is associated with vehicles and periodic operational testing of emergency generators as well as stationary pumps for emergency power or fire water systems. Thus, the air emissions will contain acrolein. **Rationale:** This chemical of potential concern (COPC) poses potential risks to human health via inhalation, but acrolein appears to have been missed or deemed insignificant. However, its consideration in the assessment will provide information on the significance of the associated risk.	Please consider acrolein in the assessment or provide a rationale for its exclusion.	An analysis of acrolein risks is provided in Attachment IR-35.	The analysis provided in Attachment IR-35 will be appended in its entirety to Appendix 6-A in the final EIS.
IR-36	CNSC	Other	Section 6, Table 6.1-11 Baseline External Gamma Monitoring	**Context:** For one of the exposures in the summary table for baseline external gamma monitoring (Table 6.1-11), the cell states "Destroyed in Field". **Rationale:** No rationale or indication as to why or how it was destroyed is provided.	Please provide any additional info available as to how equipment was destroyed.	Gamma monitor 8 was destroyed in the field by wildlife.	Table 6.1-11 in the EIS will be updated to say "Destroyed in Field by Wildlife"
IR-37	CNSC	Air Quality	Section 6.1.1.1, CALPUFF model	**Context:** "The Saskatchewan Ministry of Environment (SK MOE) has developed the Saskatchewan Air Quality Modelling Guideline (SK MOE 2012a) to assist proponents in conducting air dispersion modelling assessments in a consistent manner. The guideline defines the recommended approach for dispersion modelling assessments in Saskatchewan, including model selection, emission source characterization, and the determination of compliance criteria to apply."	Please confirm and provide a summary of the consultation with the Saskatchewan MOE on the use of CALPUFF model for the Wheeler River EIS as per provincial air quality guidelines.	As described in Section B.1 of Appendix 6-A, staff at the Saskatchewan Ministry of Environment (Air Quality Branch) were consulted on the selection of CALPUFF and developing the CALMET meteorological data set, beginning in 2019. The CALMET consultation included an initial discussion about the general approach, and once the CALMET run was completed, two technical memos were produced and reviewed by Ministry staff including: 1) a memo completed in March 2020 summarizing the general CALMET approach and results (e.g., wind roses, temperature data, precipitation data); and 2) a follow-up memo completed in May 2021, which answered specific questions posed by Ministry staff. Ministry staff also completed a review and provided feedback on the CALPUFF model setup in August 2021.	No EIS updates are anticipated to address this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				Rationale: Saskatchewan air quality guideline requires consultation on use of CALPUFF model, where it states" The ministry acknowledges that there will be situations where specialized air dispersion models such as CALPUFF, CALQ3HCR and others may be applicable. The use of specialized models requires consultation with the ministry" OR "Pre-consultation with the ministry must be undertaken prior to the facility conducting specialized modelling (p. 3)." It is not clear if Denison Mines consulted with Saskatchewan MOE on use of CALPUFF model. Noted that Section 6.1.4.2 is again referring to Saskatchewan MOE guidance for justification, but no indication that they consulted with them (a requirement).			
IR-38	ECCC	Change to an environmental component due to hazardous contaminants	Section 6.1.4.1, Potential Interactions Between the Project and Valued Component / Key Indicators	**Context:** In this section, the Proponent identifies primary interactions between Project activities and air quality valued components and their associated key indicators. These primary interactions may result in an adverse effect on the valued component. Among the primary interactions are the use of emergency generators in a backup role should there be an interruption of the provincial electrical grid. However, it is not evident what is the anticipated frequency and duration of interruption to grid power. **Rationale:** The Proponent states in the conservative operation scenario that while the site will be powered from the provincial grid at the operations stage, the back-up power generators were assumed to be operating under emergency conditions as a worst-case scenario. ECCC acknowledges the positive impact of extending the electrical grid to the Project site with resultant reduction in generator emissions. The impact of an interruption in grid power would be greatest during the winter months when energy use would be greatest and surface-based temperature inversions, which vertically trap emissions, would be strongest.	Provide an evaluation of a worst-case scenario of grid power interruptions (i.e., average aggregate length of power outages) during the winter months for this section of the electrical power grid.	Denison expects an average of six outages per year based on information provided by SaskPower. An outage would be anticipated to last a few hours per event. The air quality assessment conservatively assumed that the generators would be in operation 24/7 to predict worst-case concentrations in all months of the year, including the winter months. Given the above, Denison can confirm it has evaluated an appropriately conservative worst-case scenario for use of the diesel generators in the air quality assessment.	No EIS updates are anticipated to address this IR.
IR-39	ECCC	Change to an environmental component due to hazardous contaminants	Section 6.1.4.2, Potential Project-Related Effects	**Context:** In this section, the Proponent discusses the approach taken for air dispersion numerical modelling. Using their CALMET data set, the Proponent's CALPUFF model runs indicated exceedances for 24-hour total suspended particulates, 24-hour particulate matter (PM10), 1-hour nitrogen dioxide, and 24-hour uranium concentrations. However, there is no mention of possible diurnal and seasonal occurrences of the exceedances. **Rationale:** Adequate assessment of the modelling results requires knowledge of the temporal characteristics for the exceedances. For example, wintertime exceedances may be due to strong temperature inversions, especially during the overnight to morning hours. These strong inversions are challenging for numerical models to capture. Exceedances during warmer months may be due to specific wind directions, which transport emissions directly to downwind receptors.	Provide additional information on any diurnal and seasonal influences of the modelled exceedances.	Additional information on diurnal and seasonal influences of the modelled exceedances is provided in Attachment IR-39 in this document.	No EIS updates are anticipated to address this IR.
IR-40	CNSC	Air Quality	Section 6.1.6.2.1, Air quality significance determination	**Context:** Significance determination was not conducted for air quality due to interconnectedness with other assessment endpoints. **Rationale**: It is not clear where and how these air quality assessment endpoints were factored into the assessment.	Please provide additional information to demonstrate where and how these air quality assessment endpoints were factored in.	Noted in Section 6.1.1.1 of the draft EIS, Air Quality was identified as an intermediate Valued Component (VC) (i.e., does not have an assessment endpoint). Air quality assessment endpoints and the significance of potential effects of Project-related changes to ambient air quality were considered in Section 9 (Terrestrial Environment), Section 10 (Human Health) and Section 11 (Land and Resource Use). For additional reference, Figure 6.1 2 of the draft EIS is a graphic representation of the main linkages among the Air Quality VC and other VCs, illustrating the flow of assessment information from the Air Quality VC. By way of example, the habitat alteration effects considered for avian and wildlife VC and Key Indicators (KIs) included dust deposition, which could change avian and wildlife use through an indirect effect.	No EIS updates are anticipated to address this IR.
IR-41	CNSC	Air Quality	Section 6.1.6.2.2, Background concentrations	**Context:** The EIS states that "Conservative regional background concentrations from the Saskatchewan Air Quality Modelling Guideline (SK MOE 2012a) and based on the La Loche monitoring station were used for particulate matter, NO2, SO2, and CO. The La Loche monitoring station is located near anthropogenic sources, while the Project is in a remote area removed from anthropogenic sources." **Rationale:** If La Loche monitoring station is located near anthropogenic sources and the project is not, use of this data is not a conservative or realistic representation of background. For a realistic approach, background data considered should be upper 95th percentile (or max if n<10) from an area representative of project location For a conservative approach, background data from an area located even further from anthropogenic sources (if this exists) should be used, or an upper limit of background less than upper 95th should be applied as the background. Upper limit of background is used to screen out COPCs or often subtracted from total to ascertain relative contribution / impact from source, so using a higher upper limit may result in COPCs screening out or appear to have a lower relative contribution. If background was	Please provide additional rationale to justify the appropriateness of La Loche monitoring station concentrations as background for project location.	The Saskatchewan Ministry of Environment requires that background concentration data be added to air model predictions and an accepted set of data is provided in the Saskatchewan Air Quality Modelling Guideline. Following Ministry requirements, the northern regional data set was selected, which is based on monitoring data from the La Loche station. Because the La Loche station is located near anthropogenic sources, the background values are likely higher than background in the Project Area. This means that the total air model predictions (modelled + background) are likely more conservative than would necessarily have been the case had a similar data set been available that was free of any anthropological influence. Further consideration of the use of the La Loche data set is provided in Appendix 6-A, Section 6.0 of the draft EIS.	No EIS updates are anticipated to address this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				added to source, then approach used would be conservative. If this is the case, confirmation and reference to where this is discussed in methodology should be provided.			
IR-42	Health Canada (HC)	Physical stressors (noise and vibration)	Section 6.2.4.2.2, (p. 6-66) Section 6, Section 6.2.9, (p. 6-72)	Nighttime noise impacts are not adequately considered for human receptors. **Context:** The EIS states in Section 6.2.9 that, "While the predicted sound levels were less than the guideline values, the increase from baseline was predicted to be noticeable" (p. 6-72). No information is provided on individual noise events occurring during the nighttime period**.** **Rationale:** While the increase from baseline is predicted to be noticeable, it is important to also consider that changes to the characteristics of the sound from baseline (e.g., a change in frequency, changes in sound modulation, increased impulsiveness or tonality, or a shift in noise from the daytime to being more at night) may cause noise to be even more noticeable. Consult ANSI S12.9-2005/Part 4, clause A.1.3 for further information. In particular, consideration should be given to potential impacts on sleep, where adverse impacts are reported to begin when sound levels inside bedrooms exceed 30 dBA for continuous noise sources and 45 dBA LAmax for discrete noise events (WHO, 1999).	1. Provide a description of the project- related nighttime noise sources that may impact human receptors as well as a qualitative discussion of the resulting potential impacts on perception considering not only changes in sound levels but also sound characteristics (e.g., tonality, impulsivity). 2. Confirm whether individual nighttime noise events exceeding 45 dBA LAMax outdoors (or 30 dBA indoors) are expected to occur more than 15 times over the nighttime period at any nearby potentially noise-sensitive human receptor location(s). This may be of particular concern if some construction and/or operations activities occur during sleeping hours.	1. During Construction, the nighttime noise sources that are the highest contributors to sound levels at the nearest human receptor location are expected to be construction equipment (bulldozers, trucks, cement mixing and crusher). During Operation, the primary contributors are truck traffic and drilling in the wellfield. As these are not impulse or tonal sources, no adjustments were made to the source sound levels per ANSI S12.9-2005 Part 4. 2. For Construction, the crusher was modelled at its maximum sound output. The diesel-powered equipment (dozers, drill rigs) was adjusted for partial operation. When adjusted to provide maximum sound levels instead, the predictions at the nearest human receptors did not exceed 45 dBA Lmax during the nighttime hours for either Construction or Operation. The draft EIS will be updated to include the additional supporting discussion outlined above.	Section 6.2.4.2.2 will be clarified as follows: The nighttime sound levels were not predicted to exceed the PSL of 36 dBA at any of the identified receptors during Construction or Operation. As with the daytime sound levels, the maximum predicted nighttime sound levels were predicted at the property identified as 302586/Risk2. The predictions at this location were 35.9 dBA and 34.0 dBA for Construction and Operation, respectively~~, and were similarly primarily attributable to drilling activity in the wellfield, concrete batching (during Construction), and movement of trucks on the access road~~. **During Construction, the nighttime noise sources that were the highest contributors to sound levels at the nearest human receptor location consisted of construction equipment (bulldozers, trucks, cement mixing and crusher operation). During Operation, the primary contributors at night were truck traffic and drilling in the wellfield. As these are not impulse or tonal sources, no adjustments were made to the source sound levels.** **The crusher was modelled at its maximum sound output, while the diesel-powered equipment (e.g., dozers, drill rigs) were adjusted for partial operation over the respective daytime and nighttime periods. To account for potential issues resulting from equipment operating at maximum levels (as opposed to daytime and nighttime averages), the models were run with the partial operation adjustments removed, for comparison to the Health Canada recommended criteria value of 45 dBA Lmax at night. The predictions at the nearest human receptors did not exceed 45 dBA Lmax for either Construction or Operation."**
IR-43	HC	Physical stressors (noise and vibration)	Section 6.2.5, (p. 6-66) Section 6.2.5, (p. 6-71)	Mitigation measures for project-related noise were not identified for the Construction phase. **Context:** The mitigation measures provided in Section 6.2.5, including a complaint management system is also to be implemented as part of the EMS, are only proposed for the operations phase. However, construction activities are predicted to last more than one year. Construction noise will involve the use of equipment operating at the site, construction of surface facilities, drilling, and partial operation of the freeze plant. It will also include regular truck trips and air traffic for personnel changes. **Rationale:** It is unclear if listed mitigation measures also apply to the construction phase (or only to the operations phase).	1. Clarify whether mitigation measures and the proposed EMS apply to the Construction phase. If not, identify mitigation measures for noise impacts related to Construction phase activities, and consider applying the EMS to the Construction phase and implementing the community complaints and response procedure from the beginning of construction activities. 2. Health Canada suggests that construction noise lasting longer than 1 year be assessed as operational noise, and that noise mitigation measures be applied also to the construction phase. Special consideration should be given to mitigation measures for construction noise that occurs at night, in order to minimize impacts on sleep (i.e., avoiding tonal or impulsive noise sources at night). **Suggestions for mitigation and follow-up measures:** Health Canada recommends use of Appendix H of Health Canada (2017), which identifies additional construction noise mitigation measures that could also be considered to reduce project- related noise.	1. Mitigation measures and the proposed EMS apply to both Construction and Operation. As the Indigenous Communities of Interest with reserves and residential communities most proximal to the Project, Denison will collaborate with English River First Nation (ERFN) and Kineepik Metis Local (KML) on a community specific monitoring regime, suited to each of their interests and needs. As part of these programs, Denison and the Indigenous communities of ERFN and KML will be sharing information in an agreed-upon fashion. If noise from construction activities form part of the interests for each of these Indigenous communities. 2. See response to IR-42 regarding nighttime work and potential for sleep disturbance. The draft EIS will be updated to include the above clarifications.	The first paragraph of Section 6.2.5 will be revised to clarify the applicability of mitigation measures as follows: "Strategies to reduce the likelihood and magnitude of the predicted effects include source elimination and utilizing planning measures to counter the conditions that contributed to the predicted effects. Mitigation measures **to be applied during both Construction and Operation** include:..." The first paragraph of Section 6.2.8 will be revised to clarify the applicability of the EMS as follows: "An EMS will be implemented and include air quality and noise management and monitoring plans to confirm that the Project is compliant with the federal and provincial guidelines that have been adopted for this assessment **during both Construction and Operation**."
IR-44	HC	Physical stressors (noise and vibration)	Section 6.2.8, (p. 6-71)	The noise complaints resolution and response procedure is not sufficiently described in the EIS. **Context:** Section 6.2.8 discusses Monitoring and Follow- up. The proponent indicates: "The EMS will also include a community complaints and response procedure" (p. 6-71). **Rationale:** Details have not been provided regarding how the complaints would be received, addressed or what the timelines will be for providing a response or resolution. It is important to provide information to potentially affected communities in advance of particularly noisy activities. Community consultation and advanced notification of noisy activities has been shown to reduce complaints (see Health Canada, 2017).	1. Provide the details of the noise complaints resolution and response procedure as per Health Canada (2017). 2. Consider conducting community consultations and/or implementing an advanced community notification system to pro-actively reduce the probability noise-related impacts and complaints.	1. Denison is undertaking sequential EA and licensing processes with the CNSC. As such, a detailed management system based on the CNSC's safety and control areas and focused on anticipated compliance verification criteria will be developed over the upcoming months to support licensing activities. Further to this, a framework for monitoring and follow up was presented for each technical EIS discipline in the respective draft EIS section. Environmental monitoring and follow up will fall within the scope of the Environmental Management System (EMS) for which document preparation is ongoing, and as indicated will be fulfilled during licensing. As noted elsewhere in the IR responses the EMS hierarchy will follow a three-tiered system comprising Program, Plan and Procedure level documentation, with detail associates with each becoming more granular and prescriptive at each successive tier. As noted in Section 6.2.8 of the draft EIS, a commitment to have a community complaints and response procedure for noise has been made by Denison. Consistent with Denison's approach to sequential EA and licensing and as highlighted above the specific details associated with this complaints and response procedure, consistent with provincial and federal guidelines, will be developed at that time. Nevertheless, further information concerning the framework / approach to the community complaints and response procedure is provided below for reference.	No updates to the EIS in response to this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates

						Denison is committed to designing the noise monitoring and follow-up plan and an associated procedure in accordance with provincial and federal guidelines and industry best practice.
						
						The plan will identify:
						• Project-related noise sources and control measures;
						• How complaints will be filed, acknowledged, investigated, and resolved, including general timeframes for each phase;
						• How confidentiality of a complainant's identity will be respected, if requested, how anonymous complaints can be filed and how assistance for those who may face barriers to the procedure can be accommodated;
						• How those involved in executing the plan will receive training and be made aware of the plan;
						• How potentially affected communities will be engaged;
						• How complaints and their resolutions will be tracked and recorded;
						• How the performance of the plan will be monitored and evaluated and how this information shall be communicated; and
						• How the plan will be updated.
						
						It is anticipated that the following procedure specific to noise complaints is expected to be applied:
						
						• Each complaint would be logged/recorded and include the following information:
						  ○ the name, address and contact information of the complainant (if provided);
						  ○ the time and date of the complaint;
						  ○ the nature of the complaint; and
						  ○ meteorological conditions at the time of complaint (i.e., wind direction).
						• Determine the specific cause(s) of the complaint and take short-term and immediate actions to resolve the cause of the complaint;
						• Provide a prompt response to the complainant (within 24-hours) and follow-up as needed based on the required actions to resolve the complaint; and
						• Prepare and retain on-site a written report that:
						  ○ identifies the cause of the complaint;
						  ○ identifies the actions taken to appropriately deal with the cause of the complaint; and
						  ○ identifies any recommendations for remedial measures, and managerial or operational changes to reasonably avoid the recurrence of similar incidents.
						
						2. Denison has committed to working with its Indigenous Communities of Interest with reserves and or / residential communities most proximal to the Project (English River First Nation and Kineepik Metis Local), to understand the issues and concerns they have relative to the Project, and resolution of some specific items of interest or concerns may be resolved through the negotiation process of private contractual arrangements or agreements. The noise complaint mechanism will be one area that will be raised specifically with the Indigenous Communities of Interest with reserves and or / residential communities most proximal to the Project (English River First Nation and Kineepik Metis Local).	

IR-45	HC	Change to an environmental component due to hazardous contaminants	Section 6 Air Quality Technical Supporting Document Section 6.3.1	The carcinogenic risks of diesel exhaust from the project should be assessed. **Context:** Section 6.3.1 discusses modelled predictions of exceedances for Particulate Matter (PM). TSD p. 22 states: "concentrations of 24-hour PM2.5 are also elevated around the standby generators at the freeze plant, which emit fine particulate matter from combustion of diesel fuel". However, diesel particulate matter is not evaluated for the whole project in the air quality model or the air quality assessment. **Rationale:** Health Canada has determined that diesel exhaust is carcinogenic in humans which is consistent with the conclusion of the International Agency for Research on Cancer (IARC), and that diesel exhaust is associated with significant population health impacts in Canada. To characterize the carcinogenic risk of diesel exhaust from a project, HC has published a report (2022)1 which provides a quantitative assessment of the relationship between ambient PM2.5 exposure and lung cancer risk. Specifically, this report quantifies the increase in risk of lung cancer mortality (over the baseline rate in the Canadian population) due to PM2.5 exposure. This quantitative assessment is considered appropriate to characterize risks from diesel PM given the contribution of diesel exhaust to ambient PM2.5 in Canada, and that the carcinogenicity of diesel exhaust has generally been evaluated based on the respirable PM fraction1,2,3. **References:** [1] HC. 2022. Lung Cancer and Ambient PM2.5 in Canada: A Systematic Review and Meta-analysis. Available at: https://publications.gc.ca/site/eng/9.907038/publication.html	1. Evaluate the carcinogenic risk of all potential diesel exhaust from the project based on the approach proposed by Health Canada (2022). Additional guidance ("Additional Lung Cancer Mortality from PM2.5: Recommended Approach and Sample Calculation") is provided as an appendix to this comment table.[i]	An evaluation of carcinogenic risk of all potential diesel exhaust from the project based on the approach proposed by Health Canada (2022) is provided in Attachment IR-45.	No updates to the EIS in response to this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				[2] HC. 2016. Human Health Risk Assessment for Diesel Exhaust. Available at: http://publications.gc.ca/collections/collection_2016/sc-hc/H129-60-2016-eng.pdf [3] IARC. 2013. IARC monographs on the evaluation of carcinogenic risks to humans. Volume 109. Outdoor air pollution. https://publications.iarc.fr/Book-And-Report Series/Iarc-Monographs-On-The-IdentificationOf-Carcinogenic-Hazards-To-Humans/Outdoor Air-Pollution-2015			
IR-46	HC	Physical stressors (noise and vibration)	Appendix 6-A Table A-1	Low-frequency noise and associated potential human health effects were not assessed. **Context:** Some equipment that may emit low-frequency noise (LFN) have been listed in Table A-1: Assessment Scenarios and Sound Level Data (Section 6 Appendix A); however, no information describing potential impacts of this type of sound on nearby human receptors are presented. **Rationale**: Low frequency noise can be associated with the introduction of noticeable vibrations and rattles in nearby structures. Research indicates that annoyance related to noise is greater when low-frequency noise is present (ISO 1996-1:2003). As sound environments are usually characterized using A-weighted decibel levels (dBA) that reflect the frequencies most audible to the human ear, the impacts of low- frequency noise may need to be assessed separately.	1. Clarify whether any project-related activities (construction, operation and/or decommissioning) may produce LFN that could impact off-site human receptors. Evaluate LFN in the noise assessment, if and where applicable. See Appendix C of Health Canada (2017) for a discussion of LFN.	Appendix C.2 of Health Canada (2017) identifies an approach to assessing LFN from ANSI, which states that the energy sum of the 16-63 Hz octave bands should be less than 70 dBZ to avoid rattles due to LFN. The energy sum of the 16-63 Hz octave bands at the nearest human receptors is expected to be well below 70 dBZ (predictions indicate the values are in the order of 44 dBZ at the nearest human receptor). The draft EIS will be updated to include the additional supporting discussion outlined above.	The following paragraph will be appended to the end of Section 5.1 of Appendix 6-E: "In addition to the Ldn and %HA assessment methods, Health Canada (2017) also recommends assessing the potential for low frequency noise (LFN) impacts such as noise-induced vibration or rattles in building structures. The recommended approach from ANSI is to combine the predicted receptor sound levels in the 16 to 63 Hz octave bands and compare the total to a criterion of 70 dBZ. The maximum prediction for this assessment was 44 dBZ, and, therefore, LFN is not predicted to be a concern for the Project."
IR-47	ECCC	Air Quality	Appendix 6-A, A.1	**Context and Rationale:** Verification of the following calculation is required for assessing predicted emissions of dust from general construction. It appears the result of 0.70 ton/acre/month is incorrect and should instead be 0.314 ton/acre/month. Appendix 6-A, Appendix A, A.1 (p. A4) TSP Emission Factor for General Construction: $EF\ (TSP) = 0.11 \frac{\frac{ton}{acre}}{month} \times 1.2 \frac{\frac{ton}{acre}}{month} \div 0.42 \frac{\frac{ton}{acre}}{month} = 0.70 \frac{\frac{ton}{acre}}{month}$	Explain how the emission factor total suspended particulates (EF (TSP)) result was obtained or rectify if it is incorrect and update the draft EIS to reflect the correction.	The formula incorrectly displayed the wrong units. It is 0.314 ton/acre/month, which converts to 0.70 tonnes/hectare/month. Denison confirms that this was a typographical error, and the result of the calculation is unchanged.	In Appendix 6-A, the formula will be changed to: $EF\ (\mathrm{TSP}) = 0.11 \frac{\frac{ton}{acre}}{month} \times 1.2 \frac{\frac{ton}{acre}}{month} \div 0.42 \frac{\frac{ton}{acre}}{month} = 0.314 \frac{\frac{ton}{acre}}{month} = 0.70 \frac{\frac{tonnes}{ha}}{month}$
IR-48	HC	Physical stressors (noise and vibration)	Appendix 6-E, Figure 6.2.3, p. 6-57	Noise-sensitive receptors are not included on noise contour maps. **Context:** Noise-sensitive receptors are identified in the acoustic model report in Section 6 Appendix 6-E but not presented on any maps in the atmospheric and acoustic sections of the main report (Figure 6.2-3). **Rationale:** The noise assessment typically includes a map illustrating modelled noise levels from the project at receptor locations in the study area. Certainty regarding the presence of human receptors in the regional study area is also recommended in order to assess cumulative impacts.	1. For more clarity, identify noise-sensitive receptors on Figure 6.2-3: Noise Assessment Study Area as well as on contour maps showing the baseline and predicted noise levels.	A new figure will be added to Section 6.2 of the final EIS showing the Project Area, Local Study Area, the receptor locations, and nearby land leases (both traditional and recreational). A copy of this new figure has been included with this IR response. As noted in the context and rationale for this IR, Denison included the receptor locations on the contour maps with the predicted noise levels (Appendix 6-E, Figures 8 to 15); as such, no edits to the Appendix 6-E figures are proposed in response to this IR.	A new figure will be added to Section 6.2 and a copy of the figure has been included with this IR response in Attachment: IR-48. The new EIS Figure will be 6.2-4; figure numbering will shift and Figure 6.2.4 Baseline Monitoring Locations for Noise in the draft EIS will become Figure 6.2.5 in the final EIS.
IR-49	HC	Physical stressors (noise and vibration)	Appendix 6-E, 4.0 Table A.1	The Noise Source Characterization is incomplete. **Context:** Section 3.0 of the Draft EIS Section 6 Appendix 6- E discusses Source Characterization. There is no detail regarding potential tonal or impulsive noise sources in Section 3.0. **Rationale:** The draft EIS should include a description of sound source characteristics (e.g., tonal, impulsive, highly impulsive) in order to properly inform the quantitative noise assessment and which assumptions/adjustments need to be applied and to properly evaluate impacts of project noise on health of affected receptors.	1. Identify any tonal, regularly impulsive, highly impulsive, or high-energy impulsive noises likely to be produced during project activities that could be audible at noise sensitive receptors. Furthermore, describe the timing (e.g., hours of night-time activities), frequency and duration of noise events, and their sound characteristics, including frequency spectrum. See Health Canada (2017) for details.	No tonal or impulse sources were identified for either assessment scenario. Construction activity was assumed to occur 24-hours per day as a conservative measure. The frequency spectrum data for each source is included in Table A.1 of Appendix 6-E. Appendix 6-E will be updated to include discussion of ISO 1996-1 adjustments and rational for inapplicability to sources identified.	The following paragraph will be appended to the end of Section 3.0 of Appendix 6-E: "Upon establishing the source sound levels for inclusion in the predictive modelling, the list was reviewed to determine whether there were any sources with special sound characteristics such as tonality or impulse noise. Health Canada (2017) recommends the application of source adjustments in accordance with ISO 1996-1 for such sources as these are associated with increased annoyance. No tonal or impulsive noise sources were identified in the Construction or Operation scenarios."
IR-50	HC	Physical stressors (noise and vibration)	Appendix 6-E, 4.0 Table A.1	The description of noise modelling does not document or justify the use of sound level adjustments**.** **Context:** ISO Standard 9613-2 has been used for the sound level modelling; however, it is unclear if all applicable adjustments have been considered as per ISO 1996-1:2016 (Table A.1). **Rationale:** When modelling techniques are used to estimate present (baseline) or future (construction and operational) sound levels, these techniques and any accompanying assumptions, including the use of sound level adjustments, it is important to provide appropriate documentation and justification. Note that in situations where more than one source characteristic	1. Clarify whether ISO-1996-1:2016 has been considered in the modelling to account for any applicable sound level adjustments. Adjustments should be considered when calculating Ln (night- time sound level) and Ldn (day-night sound level). In addition, if applicable, adjustments can be applied depending on the noise characteristic (impulsive, highly impulsive, etc.), and because the project location is considered to be in a quiet rural area. See: ISO 1996-1:2016 and Health Canada (2017) for details.	No tonal or impulse sources were identified for the assessment scenario. As discussed in Section 6.2.1.2.1 of the draft EIS, the assessment did include the 10 dBA nighttime penalty inherent in the calculation of Ldn, and also included the HC recommended adjustment of +10 dBA to the Ldn levels to account for the Project location being in a quiet rural area. Appendix 6-E will be updated to include discussion of ISO 1996-1 adjustments and rationale for inapplicability to sources identified. The noted time-of-day and rural adjustments are already discussed in the draft EIS and applied in the assessment.	Appendix 6-E will be updated, per the paragraph outlined in the response to IR-49, which is expected to resolve the comment about tonal and impulse noise. The comment regarding the adjustment to account for the Project being in a quiet rural area was already accounted for in the draft EIS as outlined in Section 6.2.1.2.1.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				adjustment is applicable (e.g., impulsive or tonal), only the higher of the adjustments is used. However, all time-of-day adjustments and the quiet rural area adjustment are to be added to the highest of the applicable source adjustments.			
IR-51	CNSC	Geology and Groundwater	Section 7, Figure 7.8-1 Appendix 7-C	**Context:** Figure 7.8-1 (p. 7-107, main EIS report) shows monitoring well cluster outside of the freeze wall. **Rationale**: It is not clear what the targeted hydro-stratigraphic units of each monitoring well cluster are. In addition, it is not clear how the establishment of the freeze wall and any leakage from the brine solution will be monitored. If there is any "window" within the freeze wall (i.e., the freeze wall is not continuous), is there any way to identify that?	Please clarify the targeted hydro-stratigraphic units of each monitoring well cluster in Figure 7.8-1 (p. 7-107, main EIS report). Please clarify how the establishment of a continuous freeze wall will be monitored.	1: The information in the legend of Figure 7.8-1 will be updated to indicate that 2 well clusters target the Lower Sandstone Aquifer and the Intermediate Sandstone Aquitard. The target hydrostratigraphic units for the 4 well clusters are the Lower Sandstone Aquifer, the Intermediate Sandstone Aquitard, the Upper Sandstone Aquifer, and the overburden aquifer. 2: The alignment of the freeze wall is located 25 m offset from the lateral extent of the recoverable ore and the freeze wall will grow in thickness both towards the ore and away from the ore. The freeze wall will solidify all liquid porewater and develop into a contiguous impermeable barrier many metres thick. Ground temperature monitoring will be installed through a series of continuous fiberoptic temperature and pressure wells from surface to the depth of impermeable basement rock below the unconformity. Such monitoring wells/systems will be installed on both the ore (inside) and non-ore (outside) sides of the freeze wall to confirm the thickness of frozen ground. There will be sufficient operational controls in place to verify that the freeze plant is operating, to measure the temperature in the ore zone, and to measure the temperature on opposite sides (inside and outside) of the freeze wall so that early detection of any upset conditions can be identified and addressed. Options for addressing issues include: lowering the temperature of the freeze system to draw more heat out; increasing the freeze coolant flow rates in freeze wells nearer to active ISR cells; and/or to adaptively manage the lixiviant injection and recovery rates in cells located nearest to the freeze wall.	1: Figure 7-8.1 has been provided in Attachment IR-51 and will be updated in the final EIS to provide information in the legend on the hydrostratigraphic units being monitored in each well cluster. 2: The following text will appear in Section 2 (2.2.1.5 Monitoring Well Network) regarding monitoring to demonstrate a continuous freeze wall. The alignment of the freeze wall is located 25 m offset from the lateral extent of the recoverable ore and the freeze wall will grow in thickness both towards the ore and away from the ore. The freeze wall will solidify all liquid porewater and develop into a contiguous impermeable barrier many metres thick. Ground temperature monitoring will be installed through a series of continuous fiberoptic temperature and pressure wells from surface to the depth of impermeable basement rock below the unconformity. Such monitoring wells/systems will be installed on both the ore (inside) and non-ore (outside) sides of the freeze wall to confirm the thickness of frozen ground. There will be sufficient operational controls in place to verify that the freeze plant is operating, to measure the temperature in the ore zone, and to measure the temperature on opposite sides (inside and outside) of the freeze wall so that early detection of any upset conditions can be identified and addressed. Options for addressing issues include: lowering the temperature of the freeze system to draw more heat out; increasing the freeze coolant flow rates in freeze wells nearer to active ISR cells; and/or to adaptively manage the lixiviant injection and recovery rates in cells located nearest to the freeze wall.
IR-52	ECCC	Fish and fish habitat	Section 7, Geology and Groundwater Appendix 7	**Context:** According to the Proponent, ''an acidic or low pH mining solution will be used to leach uranium ores from the ground. Mining solution may be a mixture of sulphuric acid, hydrogen peroxide, ferric sulphate, and freshwater (from shallow groundwater well or surface waterbody) or recycled water. Wellfield will consist of a combination of injection and recovery wells, in the general the arrangement of one recovery well in the centre surrounded by four injection wells (5-spot pattern) with about 5 to 10 m between wells. The final wellfield is expected to include approximately 300 wells over an area measuring 90 m wide x 750 m long''. As the components/contaminants mentioned in the description of the hyrogeologic contaminant transport processes above may be transported to Whitesfish Lake through groundwater, the injection and recovery wells should be included in the model. **Rationale:** The hydrogeologic contaminant transport processes described above are an important part of the proposed Project and it is not clear why numerical modelling results and a sensitivity analysis for the above processes was not presented.	1. Explain why 3D hydrogeology and contaminant transport numerical modelling of the injection and extraction wells was not presented. 2. Alternatively, provide simulation results and a sensitivity analysis for the injection and extraction of the acidic solution in the mining area.	Denison used the ISR mine design and the 3D hydrogeology and contaminant transport numerical modelling of the injection and extraction wells to determine the potential interactions between mining activities and the environment. Two key outputs from the ISR mine design and 3D hydrogeology modelling work were used as inputs for the hydrogeologic assessment in the EA. The extent of mining solution migration away from the injection and recovery well screens, as defined by the mining area (50m above the ore zone and within the freeze wall) and groundwater quality of the mining zone following remediation. During the operation phase, and under normal operational conditions there is no interaction between the mining zone and surface or down gradient environment, and the assessment focuses on post removal of the freeze wall, once the groundwater flow returns to pre mining conditions. The injection and recovery wells will be set up such that they are within the confines of the ore itself. Migration of fluids towards the freeze wall and through non ore ground between the ore and freeze wall are minimized because hydraulic gradients will induce preferential flow to recovery wells and away from the freeze wall. If significant excursion of lixiviant were to occur and it were to contact the freeze wall, it is not expected to chemically dissolve the in situ ice and would be contained therein limiting any excursion outside of the mining horizon. Additionally, continuous 3D modelling has been conducted for the purposes of mining operations beginning in 2019 through 2023, which has successfully demonstrated control of the mining solutions and recovered uranium bearing solution to the ore zone depth and not beyond the mining zone within the confines of the freeze wall. Furthermore, modelling had demonstrated that mining solutions will be maintained within the deposit area laterally and not contact the freeze wall, which is located at a 25 m stand-off distance. For more information on how Denison's extensive field testing and lab informed the design of the ISR mine and the mining zone remediation objectives please see the response to IR-6.	No updates to the EIS in response to this IR.
IR-53	CNSC	Geology and Groundwater	Section 7.3, Table 7.3.-2 Appendix 7-C	**Context:** The field-based hydraulic conductivity values (referred to as K values hereafter) in Table 7.3-2 (p. 7-32, main EIS report) indicate that the K value ranges of upper and lower sandstone aquifers have a significant overlap with those of the intermediate sandstone aquitard. However, the calibrated K value in Table 2-2 (p. 2.7, Appendix 7-C)) for the intermediate sandstone aquitard is close to the lower end of the field-based K value range, while the calibrated K values for the upper	Please provide additional information to support the representativeness of the calibrated K values (for example, use graph to present the measured K values and the calibrated K values).	The calibrated hydraulic conductivity values are consistent with observed data. The calibrated K value for the intermediate aquitard was $1x10^{-8}$ m/s, which is in the middle of the range of values reported from point testing within this unit (Range: 10^{-10} to $3.8x10^{-6}$ m/s), and similar to the geomean value ($8.4 x10^{-9}$ m/s). Thus, the calibrated K value is within a factor of 1.2 of, and higher than, the geomean value. The hydraulic conductivity value for the Intermediate Aquitard is similar to that applied by AECL at Cigar Lake ($5x10^{-8}$ m/s). Similarly, the K values applied for the Upper and Lower Sandstone Aquifer units are consistent with the field measured values, particularly for this fractured rock environment. The high end of the	No updates to the EIS in response to this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				and lower sandstone aquifers are close to the upper end of the field-based K value range. **Rationale:** It is not clear how representative the calibrated K values are of the field-based K values for each hydro-stratigraphic unit, and if the significant difference between the K values for the upper and lower sandstone aquifers and those for the intermediate sandstone aquitard is supported by the geological properties of the corresponding stratigraphy units. It is stated in the report (p. 7-36, main EIS report) that "Vertical fracture or fault zones that hydraulically connect the Local (upper) and Semi-Regional (lower) groundwater flow regimes are present throughout the Athabasca Basin". But fractures and fault zones are not explicitly considered in the model. There is possibility that these features could increase the hydraulic connection between the upper and lower sandstone aquifer.		packer tested range of K values varied by 2 orders of magnitude between the aquifer and aquitard units, which is consistent with the definition of aquifer / aquitard differentiation. The interpretation of an aquifer-aquitard-aquifer sequence is consistent with the AECL interpretation of the Athabasca Sandstone at the Cigar Lake mine. When packer testing in fractured rock, the hydraulic conductivity associated with any test depends on whether the packed zone contains a continuous fracture set. However, for the unit as a whole, it is important that the model represent the hydraulic conductivity (or transmissivity) representative of the interconnected fracture network. Thus, it is appropriate that the applied hydraulic conductivity values within the aquifers are consistent with the higher end of tested conductivity values within those units. Within aquitard units, having singular higher conductivity fracture values from packer tests that test local fractures only, does not necessarily indicate large-scale transmissivity. A fault feature is suspected along the western perimeter of the Lower Sandstone Aquifer near Kratchkowsky and Williams Lake, located 1.5 km west of the mine site (also as depicted on the Hydrogeological Conceptual Site Model). This feature was interpreted to exist based on the similarity in groundwater levels between deep and shallow aquifers in that particular area (c.f., water levels along the creek south of Williams Lake and within GWR-029, as well as water levels recorded in open boreholes near Kratchkowsky Lake), as well as geochemistry in GWR-029. The geochemistry and water levels show in the vicinity of GWR-029 are different, however, than conditions within the Lower Sandstone aquifer further east of this area, above and east of the Phoenix deposit. The effect of the fault feature along the western edge of the Lower Sandstone aquifer was incorporated within the numerical model both through enhanced hydraulic conductivity parameters, as required to match observed water levels, and boundary conditions applied to introduce as much inflowing water to the Lower Sandstone Aquifer as the water level data suggest is reasonable.	
IR-54	CNSC	Geology and Groundwater	Section 7.3.1	**Context:** EIS states: "The most important associated topographic features in the region are the northwest to southeast trending drumlins and eskers…." This is not the trend shown on the provided maps, nor described elsewhere in the report, e.g., Section 7.3.2.1 **Rationale:** Inaccurate information in the EIS	Please update the EIS where required to accurately describe the topographical features.	Acknowledged. The typo in the draft EIS, Section 7.3.1 will be corrected in the final EIS.	In Section 7.3.1. the text will be updated to say the following: "The most important associated topographic features in the region are the northeast to southwest trending drumlins and eskers..."
IR-55	NRCan	Fish and fish habitat	Section 7.3.3.1; Appendix 7-A, sections 3.4, 3.5, 3.8, 4.2; Appendix 7-C, section 2.8	**Context**: According to the proponent's conceptual hydrogeological model (EIS, sec 7.3.3, Figure 7.3-7, Table 7.3-2; Appendix 7-A, sec. 3.4, Table 3-4), the horizontal hydraulic conductivity of the Intermediate Sandstone (Iss) aquitard is 8.4 E-09 m/s based on field measurements. The proponent further assumes a 10:1 anisotropy ratio for the unit (Appendix 7-A, sec. 3.5.1) such that its estimated vertical conductivity is 8.4 E- 10 m/s. Based on this information, structural geology and groundwater quality data, the proponent concludes that the connectivity between the Upper sandstone aquifer and the Intermediate Sandstone aquifer (sic) is limited (EIS sec. 7.3.3.3; Appendix 7-A, sec. 4.4). While acknowledging the paucity of conductivity data and the proponent's attempt to mitigate this by leveraging collateral information on fracture frequency and clay content (Appendix 7-A, sec. 3.3.1), NRCan considers that the hydraulic conductivity assigned to the Iss aquitard is unrealistically low and inconsistent with the following lines of evidence: a) The conductivity value for the Iss is based on the geometric mean of 18 field measurements, 12 of which are from the same borehole (WR-695) located in the Gryphon zone, beyond the domain of the numerical model (Appendix 7-A, Appendix C, Table C-1). If the conductivity data were weighted equally, with one value per borehole, the geometric mean would be approximately 1.5 E-07 m/s, or two orders of magnitude higher; b) The proponent notes that vertical fracture or fault zones that hydraulically connect Upper and Lower aquifer systems are present throughout the Athabasca Basin including in the Phoenix area (EIS, sec. 7.3.3.2.2; Appendix 7-A, sec.3.8.1); c) The proponent notes that groundwater chemistry data (major ions) corroborate the presence of structurally controlled vertical hydraulic connections between the Upper and Lower aquifer systems (EIS, sec. 7.3.3.2.2, sec. 7.3.3.3; Appendix 7-A, 4.3.3); d) Groundwater chemistry data (Appendix 7-A, sec. 4.2, Table 4-1) also indicate the presence of detectable levels of "bomb" tritium (indicating recharge waters < 50 years old) in the Lower Sandstone Aquifer (GWR-025, GWR-008, GWR-033) and in the Iss (GWR-009, GWR-034), outside the area of U mineralization. This is also evidence of vertical hydraulic connection through the Iss. In summary, whereas the proponent conceptualizes the Iss as a very low-permeability unit with localized vertical hydraulic connection (WS Shear), NRCan interprets the Iss as a "leaky" aquitard with pervasive fracture-controlled and much higher vertical hydraulic conductivity. **Rationale**: The significance of NRCan's alternative interpretation of the Iss hydrostratigraphic unit is that deep groundwaters, including mining-impacted waters, may represent a greater proportion of baseflow discharge to Whitefish Lake than the 1% currently estimated	In the "Parameter Uncertainty Assessment" for the numerical groundwater flow model (Appendix 7-C, sec. 2.8), NRCan requests that the proponent develop a calibrated numerical model with an alternate conceptualization of the Intermediate sandstone as a "leaky" aquitard with a horizontal hydraulic conductivity on the order of 1 E-07 m/s and a much lower anisotropy ratio. This should involve modifying the model lateral boundary conditions to allow for groundwater inflow/outflow across the entire thickness of the Athabasca Sandstone Group rather than just the Lower Sandstone aquifer.	Denison acknowledges the IR from the review and based on feedback from the assessment team who conducted the hydrogeological modelling for the EA the following is provided in response. The viewpoint from the third-party assessment team does not align with the conceptual model proposed by the reviewer; however, an alternative calibrated groundwater flow model with a hydraulic conductivity of 1.0E-7 for the Intermediate Sandstone unit has been developed. This higher hydraulic conductivity scenario allows more water to flow laterally through the Intermediate Sandstone unit. Specified head values applied at the model boundaries are employed, such that the amount of water entering / leaving the domain is only limited by the simulated transmissivity and hydraulic gradients. Under this revised calibration, the simulated flow to Whitefish Lake from the Lower Sandstone aquifer would be 0.57% (i.e., < 1%, similar to the model presented in the draft EIS) of the discharge to Whitefish Lake, and the simulated travel time from the ore zone to Whitefish Lake is approximately 250 years. The results of this revised calibrated scenario, with a hydraulic conductivity of 1.E-07 within the Intermediate Sandstone unit, are very similar to those obtained in the base calibrated model. This is the case because the higher flow through the Intermediate Sandstone unit migrates laterally until it reaches the desilicified zone, where it merges with flow from the Lower Sandstone Aquifer travelling upward toward Whitefish Lake. The additional flow contribution through the ISS contemplated by the reviewer would enhance dilution within the desilicified zone and thereby reduce concentrations reaching Whitefish Lake.	No updates to the EIS in response to this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				in the proponent's groundwater flow model (EIS, sec. 7.4.2.1, p.7-51; Appendix 7-C, sec. 2.6.3).			
IR-56	CNSC	Geology and Groundwater	Section 7.3.3.2	**Context:** It is stated in Section 7.3.3.2 (p. 7-37, main EIS report) that "Exploration boreholes drilled in the Phoenix area, where left unplugged, have the potential to provide preferential flow paths between the Overburden and Upper and Lower Sandstone Aquifers. Exploration holes were reportedly grouted approximately 10 to 20 m above and below the ore zone, resulting in open holes remaining throughout the overlying materials. These portions of the open holes may act as open conduits for groundwater flow through the 400 m of Athabasca Group Sandstone." **Rationale:** It is not clear why the exploration boreholes have not been decommissioned.	Please clarify why the exploration boreholes have not been decommissioned and the timeline to decommission the boreholes according to appropriate guidelines/procedures. If it is not decommissioned before the ISR operation, what is the potential impact of the unplugged boreholes on the mining solution migration?	All historic exploration boreholes drilled to date containing a mineralized intersection, with grades higher than 1% U3O8, have been grouted a minimum 25 m above and below the mineralized intersection. The addition of grout to these depths is within the defined depths of the hydrogeologically modelled areas from operational mining scenarios conducted to date. The extent of the mining solution migration (i.e. the mining area) for the purpose on the EA extends 50 meters above the ore zone depth. During Operation, select exploration boreholes will be re-utilized for narrow diameter injection wells that will be developed with monitoring devices for the determination of excursions and water levels. Exploration boreholes not selected for the use of narrow injection wells will be grouted to surface to seal off any remaining conduit. Many of the exploration boreholes previously installed through the desilicified zone that overlies the deposit have collapsed, sealing the zone and acting akin to previous and natural state of the desilicified zone itself. The potential impact of the open, unplugged boreholes was evaluated as part of the numerical model sensitivity simulations performed and presented in Appendix 7-C. In general, while these open boreholes have the potential to create preferential flow paths, they were not found to create a meaningful differences in the groundwater flow paths, or mass transport conditions. This is partially because the simulated groundwater gradients are downward above the ore zone where the open coreholes are most prevalent. Further east, within the desilicified zone, unplugged coreholes are interpreted to have collapsed, such that they do not represent preferential transport pathways in the future	No updates to the EIS in response to this IR.
IR-57	NRCan	Fish and fish habitat	Section 7.3.3.2 Appendix 7-A, sections 3.1.2 and 3.7 Appendix 7-C, section 2.5.2	**Context**: The proponent's conceptual model of groundwater flow in the Local Study Area (EIS, sec 7.3.3, Figure 7.3-7) involves an unconfined Upper system hosted by overburden and the Upper sandstone aquifer, and a Lower confined system hosted by the Lower Sandstone Aquifer. The Intermediate Sandstone aquitard acts as a confining unit. Vertical heads gradients are directed downwards west of the Phoenix deposit and upwards beneath surface water receptors including Whitefish Lake (EIS, sec. 7.3.3.2). Using head data from nested monitoring wells (Appendix 7-A, sec. 3.1.2, Table 3-1) the proponent calculates upward gradients in cluster WR-607, between the Lower Sandstone aquifer and the Upper Sandstone aquifer. In cluster LA-5, an upward gradient is calculated between the Upper Sandstone and the overburden unit (Appendix 7-A, Table 3-5). In areas west and south-west of the Phoenix deposit, groundwater is estimated to flow downward under a vertical gradient of approximately 0.015 m/m (Appendix 7-A, p.3-15). **Rationale**: In NRCan's opinion, the proponent's interpretation of vertical head gradients in the LSA is not fully accurate. For the "Up-Gradient" monitoring well cluster, the tabulated head data (Appendix 7-A, Table 3-1) and data logger hydrographs (Appendix 7-A, Appendix B) indicate a downward gradient (0.014 m/m) from the overburden unit to the Intermediate Sandstone and an upward gradient (0.056 m/m) from the Lower Sandstone to the Intermediate Sandstone. Head data from the "NW" monitoring well cluster indicate a similar pattern of downward (0.016 m/m) and upward (0.014 m/m) gradients converging in the Intermediate Sandstone. In the "Downgradient" and "SE" monitoring well clusters, head observations and data logger hydrographs indicate downward gradients from the shallow aquifer system but essentially equal heads in the Intermediate and Lower Sandstones. This more complex picture of groundwater flow systems in the LSA does not appear to have been captured in the proponent's conceptual model. Given the importance of the baseline hydrogeological regime for predicting the transport and fate of COPCs in the post-decommissioning period, the proponent needs to demonstrate that the numerical groundwater flow model accounts for observed vertical head gradients.	In section 2.5.2 of Appendix 7-C (Calibration Results), the proponent should demonstrate that the numerical groundwater flow model reproduces quantitatively or at least qualitatively the vertical head gradients calculated from observations in the nested monitoring well clusters (Appendix 7-A, Table 3-1).	Please see response in Attachment IR-57.	In the final EIS, Section 2.5.2 of Appendix 7-C will be updated to include information provided in Attachment IR-57.
IR-58	ECCC	Fish and fish habitat	Section 7.3.2.4, Ore Deposit	**Context:** The Proponent states that the Phoenix ore bodies are long and narrow (approximately 25 to 50 m wide) and are located within or near a graphitic pelite unit. Hydrothermal alteration associated with the ore zone is a discontinuous envelope of clay alteration and a sulphide-cemented rock zone that extends into the overlying sandstone and the underlying basement (Figure 7.3-3). This black, clay-rich zone is approximately 3 m thick on average and locally hydraulically isolates the ore zone from the overlying sandstones and underlying weathered basement rock. **Rationale:** As indicated by the Proponent, a 3 m black clay rich zone isolates the ore zone from the overlying sandstones and underlying weathered basement rock. It is, however, unclear whether this discontinuous clay layer will prevent downward migration of uranium-bearing solution into the Paleo-weathered basement rock or horizontal flow along the unconformity surface to escape into the	1. Verify that there will be no downward migration of mining solution into the paleo- weathered basement rock or that there is no flow along the unconformity surface. 2. If downward migration of the mining solution occurs, explain how it will be mitigated.	1. A portion of the paleoweathered zone is comprised of high grade mineralization of the deposit and will be subject to mining activities controlled by the inward hydraulic gradient induced by pumping. As is discussed in Section 4.1 of Appendix 7-C, potential exists for downward migration of the solubility enhancing fluids used during mining operation and the UBS because of the density and specific gravity of these fluids (greater than that of sea water). However, the downward migration will be limited by the competent unaltered basement rocks below the paleoweathered zone, which is characterized as having very low hydraulic conductivity (Section 2.3 of Appendix 7-C). 2. As discussed above, some migration of mining fluids in the paleoweathered zone is expected and groundwater quality in this zone remediated post-mining. The entire thickness of the paleoweathered zone beneath the ore zone was included in the numerical model (Appendix 7-C) as having water quality represented by the "Restored Solution" (Figure 4-1 of Appendix 7-C). That assumption is inherent in the conservative source zone applied to all mass transport simulations. Further conservatism within the numerical model was exclusion of low permeability natural barrier zones (i.e., clays) identified in the geological model for the	No updates to the EIS in response to this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				environment. Escape of uranium-bearing solution into the environment will have a negative effect on the receiving environment.		ore zone - meaning, it was not assumed that these zones would serve to mitigate against migration of mining fluids into the paleoweathered zone. If downward migration of the mining solution were to occur this would be under an upset condition where monitoring wells placed below the mining horizon would collect these solutions via installed groundwater pumps preventing further migration away from the mining horizon.	
IR-59	CNSC	Fish and fish habitat	Section 7.4 Assessment of Project-related Effects, Figure 7.4-2 (p. 7-56)	**Context:** Figure 7.4-2: Simulated Change in Groundwater Discharge and Flow through Whitefish Lake Over the Life of the Project appears to be missing information. **Rationale:** Legend is included below the image, but the Legend box is blank. The green dotted line is not represented by anything in the legend.	Please update this Figure to ensure it is complete, and that features are properly indicated in the legend.	Acknowledged. Figure 7-4.2 in the EIS and Figure 2-18 of Appendix 7-C will be replaced for clarity.	The updated figure provided in Attachment IR-59 will replace Figure 7-4.2 in the final EIS and Figure 2-18 of Appendix 7-C.
IR-60	NRCan	Fish and fish habitat	Section 7.4.2.1 Appendix 7-C, section 5.2.1, Appendix B	**Context:** In the discussion of the limitations of the numerical groundwater flow model (Appendix 7-C, sec. 5.2.1), the proponent invokes the well known modeling principles of "Occam's razor" and "Parsimony" which guided the parametrization of hydraulic conductivity in model layers. The proponent states that hydrogeologic property values were applied uniformly for, among other units, the Lower Sandstone aquifer beyond the immediate area of desilicified materials. However, in the layer parametrization for the Lower Sandstone aquifer (Appendix 7-C, Appendix B, Figure B-5), NRCan notes a large zone of enhanced conductivity (1 E-05 m/s) extending south from Kratchkowsky Lake, which contrasts with the value (2 E-07 m/s) assigned elsewhere outside the desilicified zone. NRCan also notes the extremely detailed parametrization of hydraulic conductivity in the clay cap overlying the ore zone where borehole control is dense (Appendix 7-C, Appendix B, Figure B-6). **Rationale**: In NRCan's opinion, these model features appear to violate the principle of "Parsimony" and require greater justification supported by field observations.	NRCan requests that the proponent provide justification based on field evidence for the multiple hydraulic conductivity zones assigned to the Lower Sandstone aquifer and the clay cap above the ore zone.	We reaffirm that the hydraulic conductivity zones applied are consistent with the principles of parsimony and Occam's Razor. The hydraulic conductivity along the western portion of the model area within the Lower Sandstone Aquifer reflects the identified fault zone discussed in IR-53. This zone was added to better represent observed water levels within that portion of the model area. Further, this high hydraulic conductivity zone permits additional water inflow into the Lower Sandstone Aquifer than would otherwise exist if a lower hydraulic conductivity zone were applied here, resulting in conservative modelling predictions of flow through the Lower Sandstone Aquifer (which is consistent with the requests in IR-55). The high-resolution representation of the clap cap zones is consistent with other contemporaneous work within the ore zone completed by Petrotek (2020) and subsequently by Denison. This resolution of parameter values is consistent with the high data density contained at the Phoenix ore body. Extensive hydrogeologic core logging and permeameter sampling were conducted on over 3,000 mineralized and lower sandstone drill cores to demonstrate and identify the spatial distribution of the various hydrogeologic units contained within the ore zone itself, for purposes of optimizing mining scenarios and flow pathways for recovery. Each hydrogeological unit has specific hydraulic conductivity values based on this extensive test work in addition to various field packer and pump/injection test work.	No updates to the EIS in response to this IR.
IR-61	CNSC	Geology and Groundwater	Section 7.4.2	**Context:** There is no discussion of potential induced seismicity from mining processes. **Rationale:** Induced seismicity may lead to a loss of process as identified for natural seismicity.	Please provide information on the potential mining-induced seismicity.	Natural seismic activity in Northern Saskatchewan is quite rare with no significant events in recorded history (refer to draft EIS Section 15.2 Seismic Events). Compared to conventional mining techniques, the potential for mining-induced seismicity from ISR mining is quite low. Potential for mining-induced events for the Project could be postulated to occur as the result of a few sources: 1. collapse of cavity voids from leaching, 2. hydraulic fracturing, and, 3. use of permeability enhancement techniques, and each is discussed further below. 1. **Collapse of cavity voids.** To clarify, the portion of the deposit being mined is never truly a void (as in a large empty underground cavern); rather, what remains will be a honeycomb textured environment with water filled interstices. The mined area is filled with a fluid at all times, whether it be a mining solution, groundwater, or the neutralizing solution. This is different from a more traditional underground operation such as Cigar Lake where there is physical excavation of the orebody, leaving a temporary air-filled space. Although the uranium ore is high-grade by global standards it is not entirely massive in nature. As such, the uranium will be leached in a 'honeycomb' texture leaving behind a structure of partial intact rock mass with the remaining area being filled by fluid. This retains the pressure balance of the mining zone with the adjacent water-saturated rock masses. In terms of void space creation and collapse of the overlying strata, modelling has demonstrated that only 0.05% by volume of desilicified material immediately overlies the ore zone and would be subject to collapse (RESPEC 2023; included here as Attachment IR-21). This low volume and percentage is determined to not be of significant seismic concern. 2. **Hydraulic fracturing.** Draft EIS Section 2.2.1.4.2 Wellfield Operation provides a comparison of ISR mining pressures to conventional fracking pressures used in the oil and gas industry. Conventional fracking pressures used in the oil and gas industry can vary; however, common pressures to induce fracturing can range up to 15,000 psi and require injection of fracking fluids of up to 16,000 liter per minute over periods of three to four days. Fracking fluids are comprised of a slurry of water, proppant (generally silica sand), and chemical additives to support and maintain the open fracture system after fracking is conducted. Conversely, ISR mining for the Project is planned at nominal pressures of 100 psi, intermittent pressures of up 250 psi, and average flow rates of 30 liters per minute within a recovery well. The ISR mining method proposed for the Project is markedly different than fracking. For example, looking at intermittent pressures alone, ISR pressures are anticipated to be 60 times lower than fracking pressures. 3. **Permeability enhancement techniques.** Draft EIS Section 2.2.1.4.3 Permeability Enhancement outlines the three types of techniques being considered for the Project: mechanical, Propellant, and hydraulic options. Propellants are classified as a low hazard explosive (S.1 special-purpose explosives, low hazard explosives, per Explosive Regulations, section 36). Propellants technically do not explode (like classic mine explosives which detonate) but rather burn through a process called deflagration. Deflagration means the material burns slower than the speed of sound, thus no shock waves are generated. Propellant permeability enhancement methods reach injection pressures of up to 8,000 psi and are near instantaneous over periods of milli seconds. Neither ISR mining or permeability enhancement is expected to produce mining-induced seismicity.	No updates to the EIS in response to this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
IR-62	ECCC	Fish and fish habitat	Section 7.4.2, Potential Project-related Effects	**Context:** The Proponent indicates that the mining area includes: • the 'active mining area', which is the target ore zone; • a zone extending between 11 and 13 m above the active mining area that represents the maximum vertical height over which the injected mining fluids will migrate upwards from the ore zone during active mining; and • a zone extending 50 m vertically upwards from the active mining area (that incorporates the active mining area and the 11 to 13 m zone defined in the previous bullet) that was selected to account for potential upset conditions. **Rationale:** It is not clear to ECCC how the Proponent would be able to limit the mining solution migration within 11 & 13 m above active mining as the maximum vertical height over which the injected mining fluid will migrate. As the mining fluid will be injected under pressure into zones with possible presence of fractures, the pressure may also cause additional fractures and given that the solution is warm/hot will possibly dissolve the other cementing material in the sandstone above, making it difficult to accurately predict where the solution will migrate to.	1. Explain plans to limit the upward migration of mining solution into the overlying layer to 11 and 13m above the ore zone. 2. Explain what impacts will occur if the mining solution migrates beyond the predicted height.	1. More detail on engineered controls for containment of mining solution is provided in the draft EIS, Section 2.2.1.4.2 Wellfield Operation; see also the response to IR-08. Continuous monitoring of pump and injection wells will confirm containment of mining solutions to the lower 11 to 13 m above the ore zone during active operations. 2. Additional monitoring wells located above this elevation will be installed to make sure this depth is achieved. These monitoring wells can be retrofitted to be pumping wells if needed to provide additional control of mining solutions. Denison has established a conservative mining area of 50 m above the ore zone in the EIS, which will be remediated to acceptable criteria post mining. Additionally, the freeze wall will be in place throughout Operations and will provide horizontal containment of solutions.	No updates to the EIS in response to this IR.
IR-63	CNSC	Geology and groundwater	Section 7.4.2.1, Potential Effect #1: Groundwater Quantity – Construction to Decommissioning Appendix 7-C, Section 2.7, Groundwater Conditions During Mine Operations	**Context:** The numerical groundwater model described was calibrated to observed water level and stream baseflow data. Table 7.4-3 in the EIS indicates that Denison recognizes the potential for freeze wall operation to impact groundwater quantity. To simulate this impact, the model was adapted to reduce recharge (to 50%) within the freeze wall area, reduce hydraulic conductivity associated with the vertical freeze walls, and simulate pumping within the freeze wall area. Recovery from pumping and effects on discharge to groundwater discharge to Whitefish Lake are discussed in the potential effects section. **Rationale:** Although this assessment considered drawdown of the water table and discharge to Whitefish Lake, the discussion did not address the potential effects of operating the freeze wall on the local and semi-regional groundwater regimes. What would the pathway be for groundwater to pass around the freeze wall? What is the basis for the parameters selected, e.g., 50% recharge and lower hydraulic conductivity for freeze well? These factors need to be considered when evaluating the potential impacts of freeze well operations on groundwater flow conditions and corresponding receptors.	Please provide a more fulsome discussion on the impact of freeze wall operations on local and semi-regional groundwater regimes and potential receptors. Please provide the rationale for assumptions made for key model parameters (e.g., selection of 50% recharge, hydraulic conductivity value used to represent freeze wall). In addition, please discuss the potential pathways for groundwater flow around the freeze wall, complete with figures demonstrating these pathways.	See response in Attachment IR-63.	The information provided in Attachment IR-63 will be attached to Appendix 7-C in the final EIS.
IR-64	ECCC CNSC	Fish and fish habitat	Section: 7.4.2.2, Potential Effect #2: Terrain Morphology and Stability – Operation Appendix 7-A, Appendix K (p. 12)	**Context:** The Proponent stated that the geological assessment predicted maximum vertical displacement in altered sandstone immediately above the mining area (17.5 cm). A very minor change in elevation at ground surface (of less than 7.5 cm) was predicted within a discrete and localized area overlying the ore body. The modelling work is considered to provide a worst-case bounding scenario. If subsidence were to occur over the lifetime of the Project, or in the years following mining, the extent of vertical displacement is not expected to exceed that predicted in the modelling, which is based on an assumed volume extraction. **Rationale:** ECCC notes that the thickness of the ore zone has an average thickness of 5 m with a range of 2 to 17 m, and is 25-50 m wide and that the overburden rock above the ore zone measures about 400 m. Therefore, it is not clear how the Proponent determined that the surface expression of a subsidence on the surface if it occurs will be limited to 7.5 cm and localized. A subsidence greater than 7.5 cm, implies that the void in the ore zone will be narrower, and will affect the amount of water migrating through the zone. It was the recommendation of the consultant who conducted the work in Appendix K that more accurate material properties should be used for future modelling.	Explain: • Will this be revisited with updated data based on extraction feasibility results? • How will the surface expression of a subsidence will be limited to 7.5 cm and localized? **Suggestions for mitigation and follow-up measures:** ECCC recommends that the Proponent consider implementing remediation measures immediately after mining to prevent subsidence from occurring in the first place.	Subsequent to the filing of the draft EIS, Denison undertook additional modelling with refined, more granular inputs including subunits within the altered zone (RESPEC 2023; included as Attachment IR-21) and the surface subsidence has been reduced from 7.5 cm to 2.4 to 2.8 mm. Denison is not anticipating the need for remediation measures with the surface subsidence being negligible within the context of changes in terrain as it relates to decommissioning objectives.	No updates to the EIS in response to this IR.
IR-65	CNSC	Geology and Groundwater	Section 7.4.2.2	**Context:** It is stated the maximum subsidence is 7.5cm based on modeling with an assumed volume extraction. Has subsidence from dewatering/pumping and from lack of inflow of groundwater due to freeze wall been considered? **Rationale:** Surface facilities and wells may be impacted if there is unaccounted for subsidence.	Please provide additional details for any dewatering/pumping induced subsidence.	No pumping and/or dewatering subsidence is anticipated to occur as the fluid balance will remain relatively stable during Operation with no additional stresses placed on the mining horizon. Refer also to response to IR-07. To clarify, the portion of the deposit being mined is never truly a void and what remains after mining will be a honeycomb texture with water-filled interstices. The mined area is filled with a fluid at all times, whether it be a mining solution, groundwater, or the neutralizing solution. This is different from a more traditional underground operation such as Cigar Lake, where there is physical excavation of the orebody, leaving a temporary air-filled space. Although the uranium ore is high-grade by global standards it is not entirely massive in nature. As such, the uranium will be leached in a 'honeycomb' texture leaving behind a structure of partial intact rock mass with the remaining area being filled by fluid. This retains the pressure balance of the mining zone with the adjacent water-saturated rock masses.	No updates to the EIS in response to this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						Although the above provides context on the absence of true, air-filled voids remaining post-mining, the risk of subsidence has been assessed appropriately (included in the draft EIS as Appendix K to Appendix 7-C; see also draft EIS Section 7 Geology Valued Component - Terrain Morphology and Stability Key Indicator and draft EIS Section 9 Terrain Valued Component - Terrain Morphology Key Indicator and Terrain Stability Key Indicator). The analysis shows there is negligible risk of subsistence and the magnitude of subsistence, if it were to occur, is the range of 7.5 cm at surface. Subsequent to the filing of the draft EIS, Denison undertook additional modelling with refined, more granular inputs including consideration of subunits within the altered zone (RESPEC 2023). With this more refined analysis, the potential surface subsidence has been reduced from 7.5 cm to 2.4 to 2.8 mm (RESPEC 2023 is included here as Attachment: IR-21).	
IR-66	CNSC	Geology and Groundwater	Section 7, Table 7.5-1, Row 1, Column 6	**Context:** Column 6 in Table 7.5-1 indicates the mitigation measures for a valued component. For Row 1, Geology, there is no description of mitigation measures but only that contingency plans will be developed if based on monitoring. **Rationale:** Subsidence may impact wells and surface infrastructure.	Please provide additional details on monitoring and contingency plans related to the geological environment (e.g., subsidence), including triggers for implementing such plans.	Please see response to IR-64 for an updated analysis of surface subsidence (2.4 to 2.8 mm at surface; RESPEC 2023 included as Attachment IR-21). The predicted changes at surface related to subsidence is beyond the range of current Lidar technology with resolution at 10 cm. As such, Denison believes the level of risk for subsidence is negligible and that monitoring and contingency plans are commensurate with this low level of risk. Injection and recovery wells will be collared at surface and surveyed regularly to monitor for any changes in collar height over time. This monitoring will be added to Section 7 of final EIS for the Geology VC.	Update to Table 7.5-1 in Section 7 of the final EIS to note that subsidence estimates are in the mm range and mitigation measures are not required. Injection and recovery well collar height monitoring will also be added to Section 7 of the final EIS.
IR-67	CNSC	Geology and groundwater	Section 7.6.2.1 (Remediation Objectives)	**Context:** Metallurgical testing, including batch reaction, coreflood testing and column tests are mentioned frequently throughout Sections 2 and 7 of the EIS. Outside of the composition of restored solutions from coreflood tests #2B and 3C, results from these various tests are not reported in the EIS or any associated Appendices. **Rationale:** The results from metallurgical testing are important to a number of items discussed in the EIS, including (but not limited to): evolution of hydrochemistry during remediation, source of salts in Lower Sandstone Aquifer porewaters, process plans, industrial wastewater treatment, estimating composition and volume of process precipitates, and composition of mining fluids and leachate. In particular, the EIS posits that mining area decommissioning objectives are achievable based on metallurgical testing and provides these objectives in Table 2.3-3. CNSC staff need to understand the specifics of this metallurgical testing, given its importance for the development and justification for mining and remediation activities. Denison must also provide information demonstrating that the proposed restoration actions and remediation targets are As Low As Reasonably Achievable (ALARA).	1. Please provide a summary of the results and the analysis of results of the metallurgical tests within the EIS, or provide the technical supporting document with this information, and ensure the documentation is appropriately referenced in the EIS. This should include sample information for cores (e.g., mineralogy, location, U content, depth), test conditions (e.g., duration, # of iterations, column length, flow rate, temperature, pressure, sample frequency, influent/effluent composition), as well as results and how they are pertinent to the development of ISR activities. 2. Please provide further clarification/justification on how results from two singular coreflood tests (i.e., Coreflood #2B and Coreflood #3C) can justify large-scale remediation activities and targets following solution mining. 3. Please provide material demonstrating that the proposed restoration actions and remediation targets are ALARA.	Please see response to Attachment IR-20, IR-67, IR-69.	No updates to the EIS in response to this IR.
IR-68	NRCan	Fish and fish habitat	Section 7.6.2.2.3 Appendix 7-C, sections 3.3, 4.1, 4.4.4 and 4.7	**Context**: Sources terms for the COPCs considered in 3D reactive transport modeling are given by the composition of "Restoration Solution #1", which the proponent believes is representative of groundwater quality in the ore zone after remediation at decommissioning (Appendix 7-C, sec. 3.3, Table 3-5; sec 4.0). The proponent considers COPC source terms as "initial conditions" for groundwater quality in the ore zone at the start of the model simulation period. During the simulation, no additional mass of COPCs is transferred to groundwater in the ore zone. **Rationale**: In NRCan's opinion, this representation of COPC sources is not conservative as it fails to account for various long-term slow mass release processes. These processes could include redissolution of secondary phases formed during ISR mining (e.g., radium-bearing gypsum or barite, jarosite, alunite) and migration of unrecovered lixiviant or restored solution from low-permeability regions or stagnant zones that were not fully swept during mining or remediation. NRCan notes that scenario #2 in the proponent's transport prediction uncertainty analysis (Appendix 7-C, sec. 4.7) does consider an extended source release period for protons (desorption from chlorite). However, in NRCan's opinion, additional modeling scenarios should consider extended-release periods for other COPCs as well.	NRCan requests that the proponent's reactive transport prediction uncertainty analysis (Appendix 7-C, sec. 4.7) consider extended source release periods for additional COPCs.	Please see response in Attachment IR-68, IR-94, IR-97.	No updates to the EIS in response to this IR.
IR-69	NRCan	Fish and fish habitat	Section 7.6.2.2.3 Appendix 7-C, sections 3.1 and 3.2	**Context**: For hydrogeological and geochemical assessments in support of ISR projects, the proponent identifies two aspects of primary importance (Appendix 7-C, sec. 3.1). These are a) groundwater remediation (Appendix 7-C, sec. 3.1.1); and b) the assimilative capacity of host rocks downgradient from the ore zone (Appendix 7-C, sec. 3.1.2). According to the proponent, the objective of groundwater remediation at decommissioning is to achieve water quality in the mined zone that does not pose a risk to receptors at the point of exposure. Assimilative capacity refers to the ability of groundwater-rock reactions to naturally sequester or attenuate COPCs migrating from the ore zone during the post-decommissioning period. **Rationale:** However, in NRCan's opinion, the proponent has neglected to mention the most fundamental aspect for hydrogeological and geochemical assessments in support of ISR projects. That aspect is the	NRCan requests that the proponent provide a detailed description of the expected mineralogical and hydrogeochemical changes occurring within the ore and barrier zones as a result of the injection of acidic lixiviant.	Please see response to Attachment IR-20, IR-67, IR-69.	No updates to the EIS in response to this IR

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				choice of ISR lixiviant and its effects on the mineralogy and hydrogeochemistry of the ore zone during mining operations. The proponent provides information on the pre-mining mineralogy (Appendix 7-C, sec. 3.2.1) and hydrogeochemistry (Appendix 7-C, sec. 3.2.2) but no information on their expected changes as a result of ISR mining. This Information is important when considering source terms in reactive transport modeling.			
IR-70	CNSC ECCC	Fish and fish habitat Geology and groundwater	Section 7.6.2.2.3, Evaluation of Geochemical Reactive Transport Appendix 7-C, Section 4.4.2, Sub-Domain Model Hydrogeologic Parameters	**Context:** The EIS indicates that "changes to hydrogeological conditions within the mining area were considered during development of the 3D sub-domain model. Dissolution of ore within the active mining area is expected to enhance … hydraulic conductivity". In Section 4.7 (Prediction Uncertainty Analysis), predictive uncertainty scenarios are provided. For scenario 7, the hydraulic conductivity (K) of the ore zone was increased even further than initial model assumptions. The value used is not indicated in the text. **Rationale:** A hydraulic conductivity (K) value of 5x10-6 m/s, which is a factor of five (5) greater than the value assumed for the ore zone, was applied in the base case numerical model to account for this impact. It is unclear from the information provided in Section 7 of the EIS or associated Appendices what the basis of this five-fold increase in K value for the ore zone, and how this was judged to be conservative, or to adequately represent anticipated conditions. This parameter is important as it impacts the rate at which contaminants flow from the ore zone following mining activities. Due to of the dissolution of uranium, larger voids will likely be created, and the hydraulic conductivity may increase by more than a factor of 5 compared to pre-project material. Therefore, a variation of at least one or two orders of magnitude for hydraulic conductivity should be used in the sensitivity analysis. Having a representative, conservative value for hydraulic conductivity is essential for understanding groundwater as a pathway of contaminant transport to Whitefish Lake and potential impacts to aquatic life. The K value used in the predictive uncertainty analysis should be reported.	Please provide a more fulsome discussion on the anticipated impacts of mining on permeability of the ore zone due to mining activities in the EIS or in an Appendix. The value used for scenario 7 of the prediction uncertainty analysis should be provided. The scientific rationale for the use of a K value only a factor of five greater than the value assumed for the ore zone in the 3D regional model should be provided, alternatively, provide simulation results for a more conservative scenario. Specifically, this discussion should address the potential effects of mechanical permeability enhancement with tools, dissolution of ore, gas plugging, chemical plugging, plugging due to ion exchange, and mechanical plugging.	Based on coreflood and column tests performed in the laboratory, a modest increase in the flow rate through the core was observed post-leaching. This is described in more detail in the response to IR-69. Based on the available information, the hydraulic conductivity in the ore zone was raised to be a uniform value of 2E-07 m/s to be represent the effective dissolution of any clay cap materials. However, the post-mining conductivity of the ore zone is not important to the fate and transport of the COPCs in the restored solution towards Whitefish Lake, as it represents a small portion of the flow path. Key parameters controlling transport rates to Whitefish Lake were the hydraulic conductivity of the lower sediments and the desilicified zone. Scenarios 5, 6, and 7 of the parameter uncertainty assessment presented in Section 4.7, Appendix 7-C, systematically explore the highest parameter values consistent with the observed data used for model calibration. As indicated by these scenarios, the geochemical assimilation capacity outweighs the uncertainty in hydraulic conductivity values.	No updates to the EIS in response to this IR.
IR-71	CNSC	Geology and groundwater	Section 7.7.1, Climate Change Considerations	**Context:** The report states that in a scenario of increased precipitation and decreased/constant evaporation, climate change may result in greater flows in the Wheeler River drainage system and increased recharge to groundwater, which would correspond to increased groundwater discharge to Whitefish Lake. Additionally, it is also stated that climate change was evaluated qualitatively. **Rationale:** It is not clear why the impacts of increased evapotranspiration associated with higher average temperatures were not considered, even though these are likely outcomes of temperature increases due to climate change in areas such as the Prairies (Climate trends and projections - Canada.ca). It is also not clear why climate change considerations were not assessed quantitatively.	Please provide a discussion on potential effects of increased evapotranspiration, as well as decreased groundwater recharge for the study area. Provide justification for performing qualitative assessment of impacts of climate change rather than a quantitative one.	The experience of the Project team regarding studies of climate change and the impacts on groundwater at other sites generally shows a range of potential positive and offsetting negative impacts. While warmer temperatures will lead to extended periods of summer drought conditions extending into early fall, warmer winters are predicted as well, resulting in less snowpack accumulation, more frequent snowmelt events, and more frequent rainfall during periods when evapotranspiration is negligible. These warmer winter conditions are often simulated to produce enhanced groundwater recharge during late fall, winter, and early spring conditions. In particular, the lack of enhanced snowpack is simulated to result in less severe spring run-off conditions, indicating that more of the winter precipitation that falls will infiltrate. Overall, this is anticipated to result in enhanced groundwater recharge in the mid- to late-century periods. If, however, lower groundwater recharge was to result from climate change, it would reduce the groundwater driving force for mass transport of mining related fluids, and reduce mass loading to receiving water bodies such as Whitefish Lake. In other words, lower groundwater recharge resulting from higher evapotranspiration would result in slower mass transport to the receiving water bodies, reducing the risk of exposure.	No updates to the EIS in response to this IR
IR-72	CNSC	Geology and groundwater	Section 7.8.2, Groundwater Monitoring	**Context:** Monitoring seems to consider COPCs from surface facilities, and excursion of pumped mine fluid in the Lower Sandstone Aquifer. There does not appear any discussion on how the proposed monitoring program considers potential excursions of brine from freeze wells. **Rationale:** It is unclear how potential excursions of brine from freeze wells will be monitored. Would this be through the fiber optic cables installed within the freeze well network? Or would it be achieved in the monitoring well clusters? If this is the case, how would an excursion of brine from a freeze well be differentiated from an excursion of mining solution?	Please provide further information regarding how potential excursions of brine from freeze wells will be monitored as part of the proposed groundwater monitoring program.	Loss of freezing to the freeze wall is considered an accident and malfunction, and highly unlikely, although if it occurs, will be signaled earlier by operational monitoring than through monitoring of groundwater quality. Details of the monitoring of the integrity of the freeze wall are provided in IR-51 and include ground temperature monitoring achieved through a series of continuous fiberoptic temperature and pressure wells from surface to the depth of impermeable basement rock below the unconformity. Such monitoring wells/systems will be installed on both the ore (inside) and non-ore (outside) sides of the freeze wall to confirm the thickness of frozen ground and will provide early detection of any upset conditions can be identified and addressed. For more information on the freeze was integrity see attached techincal response IR-10 The groundwater monitoring network and plan, as presented in the draft EIS, was designed primarily to detect excursions of mining fluids, but also considers upset conditions related to the freeze wall. The parameters being measured in groundwater include electrical conductivity (EC) and chloride, which is a key indicator of freeze wall brine ($CaCl_2$), but is not expected to be a key indicator of migration of mining fluids. It is acknowledged that there was an oversight in the description of groundwater monitoring in Section 7.8.2 in not including chloride as a key performance indicator related to freeze wall upset conditions and brine migration; it has, however, been included in the Groundwater Monitoring Plan being developed for Licensing. Groundwater monitoring in wells and well clusters detailed in Figure 7-8.1 of the draft EIS (see IR-51 for updates to Figure 7-8.1) will include sampling for chloride and other key indicator parameters as well as continuous monitoring of EC (and pressure) at target hydrostratigraphic depths. The number of wells targeting the Lower Sandstone Aquifer is highest, with one monitoring well placed every 125 to 150 m distance along the freeze wall. The higher frequency of wells in this hydrostratigraphic unit reflects this as the unit where an upset condition with the freeze wall has the highest potential to allow migration of chemical constituents associate with the mining fluids laterally from the mining zone. Monitoring of	No updates to the EIS in response to this IR. The groundwater monitoring plan that will be submitted for licensing includes chloride and EC as key indicator parameters for demonstrating freeze wall integrity and, under upset conditions, delineating migration of brine in groundwater.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						these key parameters will also occur in wells in the overlying hydrostratigraphic units (Intermediate Sandstone Aquitard, Upper Sandstone Aquifer and Overburden Aquifer). The groundwater monitoring network serves as secondary means to demonstrate freeze wall integrity and, under upset conditions, delineate migration of brine in groundwater. In addition, changes in pressure and temperature will be monitored continuously in vibrating wire piezometers (VWPs) surrounding the freeze wall, again every 125 to 150 m along the freeze wall, and changes would be evaluated in terms of potential to signal a freeze wall upset condition.	
IR-73	CNSC	Geology and groundwater	Section 7.8.2.2, In Situ Recovery Mining Area Appendix 7-A, Appendix C	**Context:** The EIS recommends that a follow-up study be carried out to supplement available data on hydraulic conductivity in the Desilicified Zone (DSZ). **Rationale:** Appendix C (Summary of Hydraulic Testing Data and Conductivity Values) of Appendix 7A indicates that only n = 6 hydraulic conductivity values are available for the DSZ, one of which appears unreliable due to a problem with packer sealing. This is relatively few values compared to the Intermediate and Lower Sandstones. Additionally, limited hydraulic head data from boreholes screened in the DSZ is available (GWR-037, GWR-012 and GWR-014; See Figures 16/17 in Appendix 7-A) – most information appears to originate from open core holes. The information presented in its current form is insufficient considering the importance of this zone as a preferential pathway for contaminants following remediation activities, and the heterogeneity of the unit due to intense hydrothermal alteration and fracturing. Further information regarding hydrogeological properties and groundwater flow would aid greatly in validating and refining the numerical groundwater model.	As per the EIS recommendations, please provide additional information to supplement available data on hydraulic conductivity in the DSZ. Please provide the following information as part of the follow-up study: 1. identification of the vertical conductivity (KV) as there is an upward flow component (isotropy was assumed in DSZ for numerical model, this assumption must be verified) 2. quantification of the horizontal and vertical flow gradients in the DSZ; and 3. identification and mapping of any structures with the potential to influence groundwater flow in the DSZ, such as fracture/fault zones.	The specific information being asked for will be included in the final EIS. The detailed Groundwater Monitoring Plan will be provided to support licensing. The need for additional data within the desilicified zone is recognized and Denison has committed to gathering that data during Construction. In the absence of such data, reasonable and conservative assumptions were made regarding the continuity, hydraulic conductivity, porosity and nature of the geochemically reactive solids of the desilicified zone. Conservativism on multiples levels provides confidence that conditions are likely more favourable than simulated within the draft EIS.	Section 7.8.2.2.1 of the final EIS will be updated to include these follow-up commitments related to the desilicified zone: 1. identification of vertical conductivity; 2. quantification of horizonal and vertical flow gradients; and 3. identification and mapping of any structures with the potential to influence groundwater flow in the DSZ, such as fractures/fault zones.
IR-74	CNSC	Geology and Groundwater	Section 7.8.2.3	**Context:** It is stated in Section 7.8.2.3 (p. 7-113, main EIS report) that, at the Post-Decommissioning Stage, "Excursion are signaled by a change in water quality that is outside of that bounded by modelling predictions", and "The model predictions spatiotemporally bound COPC concentrations in the subsurface that do not pose a risk to the receiving environment. Water quality that is outside of this bounding is defined as representing a material increase over a meaningful period compared to the predicted values either in rate of change or magnitude of change of COPC concentrations." **Rationale**: It is not clear in which locations (e.g., is it in the mining area, or downstream of the mining area, or anywhere else?) the water quality is used to compare with the model predictions to determine if excursion occurs.	Please clarify in which locations the water quality data is used to compare with the model predictions to determine if excursion occurs.	These comparisons refer to conditions at the proposed monitoring well locations.	No updates to the EIS in response to this IR.
IR-75	CNSC	Geology and Groundwater	Appendix 7-A, Appendix K	**Context:** The geomechanical study showed that the stability of the remnant ore zone and surrounding rock mass is highly sensitive to the magnitude of the material properties. To quantify this risk, the proponent conducted a sensitivity analysis to assess the influence that material properties have on the stability of key stratigraphic layers. The results of the sensitivity analyses suggest that small variations in the cohesion magnitude and angle of internal friction may significantly influence the stability of the altered sandstone, ore zone, and upper and lower clays. **Rationale:** By considering the potential uncertainties and risks in association with the geomechanical study and the empirically derived rock mass strength parameters and the non-site specific physical parameters of different rock formations used for the modeling, the proponent's consultant suggests to define a laboratory testing program to address data gaps in the current geotechnical data and increase confidence in the material properties, and use more accurate material properties to model the phased extraction of uranium-enriched rock and assess the associated risks for cavity collapse and failure in the steel casing. CNSC staff concurs with these suggestions.	Please provide a plan to implement recommendations for further detailed geomechanical studies to reduce the uncertainties and risks in association with the stability and deformation analyses of ore zone rock matrix and its overlying rock mass formations and assess their impacts on the mine operation.	Additional conservative modelling scenarios were undertaken to address this (and other IRs). The modelling results show that for altered sandstone properties, both ore zone and immediately surrounding rock is marginally stable (1.0 < factor of safety [FS] < 1.25), and no-failure conditions are apparent. The predicted surface displacement remains approximately 2.4 to 2.8 mm (RESPEC 2023; included here as Attachment IR-21). For desilicified sandstone properties, failure conditions are predicted in 12.6% of the modeled desilicified sandstone volume, which is located within 20 to 35 m of the ore zone. Notable observations from modelling include that, based upon the geological model of the Phoenix deposit, the volume of the desilicified sandstone is approximately 4% of the volume of altered sandstone. Approximately 0.05% volume of altered sandstone is desilicified sandstone that is located immediately above the low-grade ore zone. The vertical displacement of the rock mass immediately above the low-grade ore zone ranges between 42 and 49 cm, and quickly reduces to the range between 0 and 7 cm at a distance of 4 – 5 meters from the low-grade ore zone (RESPEC 2023).	No updates to the EIS in response to this IR.
IR-76	CNSC	Geology and Groundwater	Appendix 7-A, Appendix K (p. 12)	**Context:** Based on the consultant's report, the modeled vertical strain is approaching or exceeding the tensile and compressive yield limits for steel casing. **Rationale:** Failure of steel casing may result in process loss or alter groundwater flow and quality.	Please provide additional details on how casing integrity will be monitored and potential effects mitigated.	The well designs and operational monitoring of the wellfield will mitigate accidental release of mining solution or UBS in the sandstone above the mining area. Each well will have double containment: mining solution will travel inside an inner casing with the outer casing acting as secondary containment for the mining fluids. Wells will be continually monitored for operational parameters such as injection pressures, injection flow rates, and recovery flow rates. This data will be transmitted to the processing plant for remote monitoring through a master control system. Through the master control system, operators will be capable of controlling pumphouse production lines remotely. Wellfield monitoring will facilitate detection of any issues with the injection and recovery wells. Specific to the steel casing for the injection and recovery wells, the conservative estimate of vertical strain in the steel casing passing through the altered sandstone provided in Appendix 7-A of the draft EIS is approaching the tensile and compressive yield limits; however, these estimates are likely an over-estimate of the actual casing strains because of the simplified, conservative assumptions used in the analysis. Altered sandstone within 25 m from the boundary of the mined excavation experiences tensile vertical strain greater than the yield limit (0.0018 strain) such that the vertical strain is relatively higher because of the presence	No updates to the EIS in response to this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						of upper clay above the ore zone. The altered sandstone around the mined cavity similarly experiences compressive vertical strain greater than the yield limit (–0.0018 strain) for the radial span of 25 m. Where tensile strain exceeds the yield limit there is potential for well failure. These isolated areas that have been identified from the geomechanical study will need further assessment of well designs should a well be placed in these specific sub locations within the deposit area. A network of monitoring wells installed within the freeze wall area will be equipped with pressure instrumentation for the determination of the vertical strain/stresses placed on the formation to do mining zone space creation. This monitoring network is designed to detect if these strains may be approaching their acceptable levels prior to failure. The injection and recovery wells will also be equipped with devices for pressure and temperature that can detect a breach in the well casing if one were to occur. As a preventative measure, annual mechanical integrity testing is conducted on the wells to ensure their containment and compliancy. Active monitoring will allow for operational shutdown if a scenario is approaching a failure mode.	
IR-77	CNSC	Geology and Groundwater	Appendix 7-A, Appendix K Results of a Geomechanical Study Investigating the Influence of Uranium Extraction on Mining-Cavity Stability for the Wheeler River Uranium Project (Revision 1)	**Context:** It is reported in the appendix K report, within Appendix 7-A, that both phase I scoping analysis and phase II detailed strip model were investigated by numerical modelling. The analysis discussed influence on host rock stability as a result of incremental increase in volumetric extraction and graded conservative treatment of material properties. **Rationale:** As critical components of a numerical geomechanical simulation, initial and boundary conditions are crucially important to the confidence and reliability of the modelling results. However, this information is absent from the current report. In-situ principal stresses largely affects the stability of the excavated host rock, and the vertical strain and surface subsidence. This information is also absent in current form.	Please provide details on the boundary and initial conditions applied on stress loading and strain for the numerical analysis. In particular, the in-situ principal stresses, which are critical to correct understanding of the excavation disturbance to the host rock, should be provided and justified as appropriate.	Several numerical models were conducted for material properties for altered sandstone. Presuming that the entire altered sandstone to be unconsolidated and desilicified. » For 0.0 MPa cohesion value, the numerical model reached equilibrium for friction angle greater than and equal to 27 degree. » For 0.1 MPa cohesion value, the numerical model reached equilibrium for friction angle greater than and equal to 27 degree. » For 0.5 MPa cohesion value, the numerical model reached equilibrium for friction angle of 20 degree.	No updates to the EIS in response to this IR.
IR-78	CNSC ECCC	Fish and fish habitat Geology and groundwater	Appendix 7-A, Section 3.5.2, Porosity Appendix 7-C, Section 2.3.2.1, Porosity Values	**Context:** This section of the report outlines the estimated/assumed effective porosity values. The only reference provided is for permeameter testing on rock core samples (Scibek, 2019). Additionally, the report states that "As tracer test results to estimate effective porosity were unavailable at the time of modelling, effective porosity values for the sandstone bedrock and basement units were sourced from literature values", where literature values are effective porosities from the Cigar Lake study (AECL, 1994), situated approximately 40 km NE of Wheeler River. No on-site Wheeler River field data was used to justify this value. Additionally,, in the Cigar Lake study, the authors reported that, because results from tracer tests and pumping tests were unavailable, "a practical approach was adopted, i.e., to use the porosity values obtained from laboratory measurements made on core samples, and to assume that those numbers were close to the average field kinematic (effective) porosity values". **Rationale:** The source of reported effective porosity values is unclear from Section 3.5.2 in Appendix A (e.g. literature review, field work, laboratory work). In Section 2.3.2.1 of Appendix 7-C, there is a lack of clarity regarding the effective porosity data used in the numerical model. It appears that no site-specific data derived from tracer tests or pumping tests is used in the numerical model. Given the that effective porosity directly correlates to seepage velocity and by extension transport time and distribution of COPCs in groundwater, it is an important parameter. Given its relative importance for contaminant fate and transport, effective porosity should be based on field measurements, or at the very least accounted for in the sensitivity analysis.	1. Please provide the reference for the data substantiating the assumed effective porosity values reported in Appendix 7-A, and used in the numerical model in Appendix 7-C. 2. Please provide information on how the site-specific effective porosity values from tracer tests or pumping tests, were considered in the numerical models. Section 2.2.1.4 of the EIS asserts that tracer tests were carried out in 2021 – this information should thus be available for improving/updating models. Alternatively, provide a sensitivity analysis for the effective porosity in the Desilicified Zone, or contaminant transport simulation results with more conservative effective porosity values.	Effective porosity values applied in the numerical modelling are thoroughly discussed in section 2.3.2.1 and clearly presented in Table 2-4 of Appendix 7-C. Effective porosity values cannot be derived from packer tests, slug tests, or pumping tests. They can be inferred from core, although core is generally a very small sample of the subsurface and is generally limited to total porosity as opposed to the interconnected pore space. In fractured rock environments, the effective porosity is a combination of the fracture porosity and the portion of the total porosity interconnected with the fractures; thus, the effective porosity tends more toward the value of the fracture porosity. Effective porosity is rigorously determined using a successful tracer test; however, the success of a field based tracer test is not easily achieved as much of the tracer volume is often not intersected by downgradient wells. Consequently, most mass transport assessments use literature values for effective porosity (Anderson, Woessner and Hunt, 2015; pg 332). Further, the tracer test performed within a small portion (i.e., 10 m) of the ore zone, was not considered to be informative of the effective porosity values needed for the entire flow path between the ore zone and Whitefish Lake. For this study the effective porosity values applied in the Cigar Lake 3D model were used as a guide. Literature values suggested by Anderson, Woessner and Hunt (2015) would suggest higher values of effective porosity, which would be less conservative (i.e., result in slower groundwater velocities) than applied within this study. Reference: Anderson. M., W. Woessner, and R. Hunt. 2015. Applied Groundwater Modelling. Elsevier Inc.	No update to the EIS in response to this IR.
IR-79	CNSC	Geology and groundwater	Appendix 7-A, Section 4, Groundwater Chemistry	**Context:** Table 4-1 in Section 4 of Appendix 7-A provides groundwater monitoring results from sampling activities carried out at 26 monitoring wells in 2019, 2020, and 2021. The majority of these wells were only sampled once (n = 8) or twice (n = 17). In some cases (Lower Sandstone Aquifer/Intermediate Sandstone Aquitard), the variability of results between sampling events is quite high. Data for the Paleoweathered Zone is sparse. **Rationale:** Insufficient information is presented in the EIS and associated Appendices to concretely define baseline groundwater chemistry for the different hydrostratigraphic units. As defined in the CNSC's Generic Guidelines for the Preparation of an EIS: "Based on the scope of the project, the EIS will present sufficiently detailed baseline information to determine the effects the project could have on the VCs and analyze those effects". This is particularly important given certain features of the study area (i.e., presence of zones of thermal alteration/desilicification, as well as hydraulically active fractures/faults), and the need to adequately characterize baseline	Please provide the statistical basis (number of samples and variability) by which "baseline" is defined and the justification that the current information is sufficient to adequately characterize groundwater quality. In order to ensure sufficient baseline information is collected, further iterations of sample collection for groundwater monitoring wells in all defined hydrostratigraphic units may be required. In addition, groundwater quality downgradient from the proposed mining area should be further characterized to assess spatial influence of alteration and hydraulically active features,	The statistical basis by which baseline groundwater data has been characterized, that is sample numbers included per hydrostratigraphic unit, median, maximum and minimum values, that describe the variability of the groundwater quality data were presented as Table 4-2 of Appendix 7A and Table 3-4 of Appendix 7C to the EIS. The primary purpose of the groundwater data collected as part of the baseline program is to provide a basis for evaluating the incremental change in groundwater quality with mining activites. The magnitude of any incremental changes in groundwater quality associated with the remediated groundwater, which was the focus of the modelling, was such that deviation in water quality from baseline conditions was possible to identify. Supplemental groundwater monitoring will be ongoing during all phases of the Project. Denison is committed to installing additional wells, with a focus on characterizing pre-mining conditions and monitoring through and post-mining immediately surrounding the freeze wall and downgradient of the mining zone, and will be re-initiating routine sampling that captures seasonal variability in 2024. A N288.7-compliant Groundwater Monitoring Plan is being developed to support permitting and licensing and will guide the aforementioned sampling.	No updates to the EIS in response to this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				conditions in the Desilicified Zone downgradient from the proposed mining area. As an example, the US Nuclear Regulatory Commission (NRC) typically requires a minimum of four (4) quarterly samples from (i) surficial aquifers, (ii) production aquifers, (iii) overlying aquifers, and (iv) underlying aquifers to characterize preoperational groundwater quality (E. Striz, pers. comm.).			
IR-80	CNSC	Geology and groundwater	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit	**Context:** This section provides data for groundwater samples collected during the Cigar Lake analogue study and Millennium Project for further regional context. The previous studies are heavily referenced to support interpretations made for the conceptual site model. **Rationale:** The Piper Plots in Figure 26 are difficult to interpret (many overlapping circles with variegated colors), and Cigar Lake samples plot predominantly as Na/K-Cl/SO4 groundwater facies. Conversely, samples collected as part of the Phoenix Project (current), plot either as Ca-HCO3 or Ca-SO4/Cl groundwater facies. No explanation is provided for the observed hydrogeochemical differences between groundwater from the Phoenix project and the Cigar Lake analogue study/Millenium Project.	Please provide additional clarity to and interpretation of Figure 26 in Appendix 7-A, including a revision to the Figure to allow for easier interpretation. This could include clear identification of end members, as well as arrows indicating proposed evolution of groundwater chemistry. Further discussion should be provided describing observed differences between groundwater chemistry at the Phoenix project compared to Millenium/Cigar Lake.	Please see response in Attachment IR-80.	Figure 26 of Appendix 7-A of the draft EIS will be separated into Figures 26 and 27, and the Figure numbering updated accordingly in that Appendix. Also, the text on pages 4.17-4.18 and 4.20 of Appendix 7-A of the draft EIS will be updated. These revised figures and text are outlined in Attachment IR-80.
IR-81	CNSC	Geology and groundwater	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit	**Context:** The report states in the description of hydrochemistry of the Lower Sandstone Aquifer that, "On the basis of groundwater chemistry and tritium values in that groundwater, the authors (of the Cigar Lake analogue study in 1994) concluded that the groundwater reflected a younger water component that had penetrated to depth along hydraulically active fractures/faults. The same conclusion is made here (in the Wheeler River EIS) for the Phoenix study area – meaning that fracture/fault conditions are such that some areas of the MFa are characterized by younger/recharge groundwaters". **Rationale:** Tritium results for most wells in the Lower Sandstone Aquifer (MFa) reported in Table 4-1 of Appendix 7-A exhibit tritium concentrations <15 Bq/L for the 2020 sample, and 0.1 or <0.1 Bq/L for the 2021 sample. Tritium in modern precipitation typically varies from 1 – 3 Bq/L. Conclusions made in the text are not supported by data, especially given that tritium values are not reported in the EIS for local precipitation or surface water. This is important in reinforcing the assumption from the conceptual model that modern meteoric water circulates at depth in the Lower Sandstone Aquifer.	Provide a further discussion on the interpretation of tritium in groundwater, rather than echoing conclusions from the Cigar Lake analogue study. Consideration should be given to the assertion that modern meteoric water circulates at depth in the Lower Sandstone Aquifer. Collection and analysis of stable isotope (e.g., δ2H, δ18O) samples is a cost-effective solution which would greatly improve understanding of groundwater hydrology and support the development of a conceptual model.	Please see response in Attachment IR-81.	No updates to the EIS in response to this IR.
IR-82	CNSC	Geology and groundwater	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit Appendix 7-C, Section 3.5	**Context:** A. In-field measurements of Oxidation-Reduction Potential (ORP) for three (3) out of twenty-six (26) groundwater samples are presented in Table 4-1 of Appendix 7-A. Although sparse, these values are also used to characterize redox conditions for representative groundwaters in Table 3-5 of Appendix 7-C. B. In Section 3.5.5 of Appendix 7-C it is stated that groundwaters in the PHREEQC model were allowed to equilibrate with atmospheric concentrations of oxygen, resulting in oxidizing subsurface conditions. In Section 3.7 of Appendix 7-C it states that input files for 3D reactive transport were generated based on outcomes for PHREEQC modelling. However, in reading Section 4 of Appendix 7-C, it is unclear whether this assumption (equilibration with atmospheric oxygen) was carried forward for the 3D model. C. As per p. 3.49 of Appendix 7-C, "A small amount of reactive pyrite was assumed for the first 500 m of transport away from the ore zone in the model, primarily in the desilicified sediments of the Lower Sandstone Aquifer, and deeper portion of the Intermediate Sandstone Aquitard". **Rationale:** A. Given the importance of redox conditions for U mobilization and precipitation/dissolution of minerals (e.g., pyrite/metal oxyhydroxides) and the corresponding influence on contaminant transport from both a modelling and monitoring perspective, these should be further characterized. It should also be noted that the measurement of Oxidative-Reductive Potential (ORP) in natural waters can be complex and difficult due to the variability and disequilibrium of natural systems and issues inherent to electrode calibration (e.g., Schuring et al., 2000). Measurements of redox couples (e.g., As(III)/As(V); Fe(II)/Fe(III); S(-II)/S(VI)) are typically recommended to accurately characterize redox conditions in natural waters (Schuring et al., 2000). B. The assumptions regarding redox conditions for the 3D solute transport model should be clarified. C. The amount of pyrite (e.g., % by weight) assumed for the purposes of modelling should be clarified, given the potential role of pyrite as a reducing agent in limiting the transport of COPCs. **Reference**:	1. Provide further discussions and information (i.e., ORP measurements or analytical data for redox couples) on redox conditions at the Phoenix site. Particular focus should be given to the spatial heterogeneity of redox processes. Tools such as the reference provided [2] below provide an example of simplified framework for characterizing redox conditions in aquifers. 2. Clarify assumptions regarding initial redox conditions for the 3D solute transport model. 3. Provide the % reactive pyrite by weight assumed for models in the text. Justification for proportions used, such as analytical data, should also be provided. **Reference**: [2] Jurgens, B.C., McMahon, P.B., Chapelle, F.H., and Eberts, S.M., 2009, An Excel workbook for identifying redox processes in ground water: U.S. Geological Survey Open-File Report 2009–1004 8 p.	Please see response in Attachment IR-82.	No updates to the EIS in response to this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				[1] Schuring J.; Schulz, H. D.; Fischer, W.R.; Bottcher, J.; and Duijnisveld, M.H.W. 2000. Redox: Fundamentals, Processes and Applications. Springer: Berlin.			
IR-83	CNSC	Geology and Groundwater	Appendix 7-A, Section 7.4.2.2 and Appendix K	**Context:** Leaching of uranium from the ore zone will generate voids within the ore zone, which could fail and collapse. Failure of the voids would cause displacement in overlying rocks, which will lead to the eventual ground subsidence. Based on the developed geological model, a geomechanical study was conducted to assess potential maximum vertical displacement in the overlying rock formations and predict the ground subsidence. While a layer of altered sandstone is modeled above the ore zone, the desilicified zone, a zone that is comprised of completely to partially unconsolidated sands and has very low rock quality, high fracture intensity, and high friability, and low strength in the area overlying and east of the Phoenix deposit, appears not to have been included in the model for geomechanical modeling. The evaluated displacement/deformation in the overlying rock formation and the resulted ground subsidence would not be conservative without including the desilicified zone. **Rationale:** Stability of the ore zone rock matrix and the potential displacement/deformation in the overlying rock formations when voids in the extracted ore zone collapse are critical for protecting the overlying aquifers, preventing substantial ground subsidence, safeguarding casing integrity, and mitigating plug-off of the remaining ore as well as efficiently mining extraction. The deformed zone in the overlying rock formations will change in hydraulic conductivity that will impact on the assessment of potential effects on groundwater flow and contaminant transport in the zone. Therefore, the rock mass behavior including and above the ore zone should be adequately understood and the potential displacement/deformation should be assessed and quantified with adequately defined geological model.	Please provide details whether and how the desilicified zone is considered in the geomechanical modeling of the detailed strip model. Such details should include figures and the linkage between the geomechanical model including the determination of strength parameters of the desilicified zone and the geological model including information on the core delineation of the desilicified zone.	Information requested here with respect to details of how the desilicified zone is considered in the geomechanical modelling is addressed in IR-75. Details linking the geochemical model with the geological model including core delineation of the desilicified zone above the mining zone is provided in RESPEC (2023), included here as Attachment IR-21.	No updates to the EIS in response to this IR.
IR-84	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** It is stated in Section 2.5.2.4 (p. 2.35, Appendix 7-C) that "In addition to calibrating to water level elevations targets, the model was calibrated to estimates of groundwater discharge to Whitefish Lake. A match between simulated and observed flows helps to support that groundwater recharge rates are reasonable, and to provide validation for water budget assessments. Baseflow calibration targets were developed using point streamflow measurements collected upstream and downstream of Whitefish Lake. Figure 2-10 (p. 2.26, Appendix 7-C) shows the locations of the baseflow calibration targets, and Table 2-7 (p. 2.35, Appendix 7-C) illustrates the model-simulated groundwater discharge rates in relation to the estimated range of baseflow from stream measurements. The simulated baseflow to Whitefish Lake is in good agreement with the estimated representative baseflow". **Rationale:** It is not clear in Figure 2-10 (p. 2.26, Appendix 7-C) where the point streamflow measurements were conducted upstream and downstream of Whitefish Lake. Additionally, it is not clear how the groundwater discharge to Whitefish Lake is simulated, since the model domain does not cover the whole Whitefish Lake.	1) Please clarify in Figure 2-10 where the point streamflow measurements were conducted upstream and downstream of Whitefish Lake. 2) Please clarify how the groundwater discharge to Whitefish Lake is simulated considering that the model domain does not cover the whole Whitefish Lake.	1) As noted in Table 2-7 of Appendix 7-C of the EIS, under the heading "Surface Water Stations", the surface water stations used to evaluate baseflow to Whitefish Lake are stations SA-6 and SA-2. Both of these stations are demarked in Figure 2-10 of Appendix 7-C, illustrating the portion of Whitefish Lake that is monitored by these stations. 2) Stations SA-6 and SA-7 monitor upstream and downstream hydrologic conditions of the portion of Whitefish Lake adjacent to the Project. The difference in baseflow monitored between these stations is interpreted to be the contribution of groundwater to the portion of Whitefish Lake of interest. Within the report, the discharge between these stations has been referred to as "discharge to Whitefish Lake" although it is acknowledged that this refers strictly to the portion of Whitefish Lake adjacent to the Project.	No updates to the EIS in response to this IR.
IR-85	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** Section 2.7.3 (Appendix 7-C) mentions Wells A, B and C, and Figure 2-17 (p. 2.43, Appendix 7-C) illustrates the predicted drawdown ranges at Well B and Well C. **Rationale:** It is not clear where Well A, Well B and Well C are located.	Please provide the locations of Well A, Well B and Well C illustrated in a Figure.	These three wells (referred within Appendix 7-C as "A", "B", and "C") are proposed wells to supply water to the mining operations. They are not yet constructed but are planned to be screened within the Upper Sandstone Aquifer. These wells were demarcated as "Freshwater wells" in Figure 2.2-1 of Section 2 of the EIS but were not labelled. Well A is located 200m northwest of the Phase 5 ISR injection area, Well B is located approximately 600 m south of the Phase 5 ISR injection area, while Well C is located 200 m northwest of the Phase 3 ISR injection area.	Figure 2.2-1 has been updated to label the "Freshwater wells" as "A", "B", and "C". The updated figure is included in Attachment IR-85 and will replace the existing Figure 2.2-1 in the final EIS.
IR-86	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** It is stated in Section 2.7.3 (p. 2.41, Appendix 7-C) that "Both the pumping demand and the recharge changes were incorporated into a transient simulation performed using the calibrated groundwater flow model. The model simulation was started at the beginning of mine construction, with initial conditions taken from the calibrated model. The simulation period was extended for 40 years to include the entire period of construction, operation, and decommissioning, and extending through 17 years post decommissioning". **Rationale:** It is not clear what is the difference between the calibrated model and transient model in terms of parameters (such as the K values for the mining zone), boundary conditions, etc.	Please clarify the parameters, boundary conditions and any other aspects as used in the transient model that are different from the calibrated model.	As stated in draft EIS Appendix 7-C, Section 2.7.2 (page 2.41) the calibrated, steady-state model was used as the basis for the transient model used to evaluate drawdown during operations. Only conditions immediately within the mining zone were altered within the transient model to reflect the proposed changes during mine operations. All boundary conditions that drive regional groundwater flow were unchanged for the transient model, and all hydrogeologic properties outside of the mining area were left unchanged. Changes made to the hydrogeologic properties were implemented transiently to represent the phased implementation of the freeze wall. Groundwater recharge was changed to reflect alterations to surficial land use and the implication of that land use change to groundwater recharge; transient pumping boundary conditions were incorporated to simulate the planned pumping demand for camp and ISR water requirements. The transient version of the model was used to evaluate changes to the groundwater discharge occurring at Whitefish Lake as documented in Appendix 7-C Section 2.7.	No updates to the EIS in response to this IR.
IR-87	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** In Section 2.8 (p. 2.45, Appendix 7-C) Parameter uncertainty assessment, only parameters for certain zones (part of each specific hydro-stratigraphic unit as shown in Figure 2-19, p. 2.46, Appendix 7-C) related to the pathway from the ore zone toward Whitefish Lake were allowed to vary in order to find combinations of parameter values that met statistical calibration criteria. If each hydro-stratigraphic units within the whole model domain were treated as parameter zones that can have varied hydraulic conductivity values, a different combination of parameter values could be obtained that	It is recommended that the parameter zones in the Parameter uncertainty assessment include hydro-stratigraphic units in the whole model domain to investigate the possible combination of parameter values that could make the groundwater in the mined-out zone more active hydraulically.	As per the reviewer's request, PEST++IES was applied to generate 50 calibrated realizations wherein all hydraulic conductivity parameter zones were allowed to vary. Of the 50 scenarios generated, the average contribution to Whitefish Lake from the Lower Sandstone Aquifer was 0.73%, with 48 of the 50 scenarios (96%) confirming the calibrated conceptualization. One of those scenarios is documented in the response to IR-55. It is noted that packer tests provide a small-scale sample indication of the representative hydraulic conductivity, but as shown in the literature (Bradbury and Muldoon, 1990), such local tests are rarely representative of large-scale (i.e., macro) hydraulic conductivities. Macro-scale hydraulic	No updates to the EIS in response to this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				meet statistical calibration criteria too. **Rationale:** The parameter values for parameter zones between the mining area and Whitefish Lake is important in determining the hydraulic connection between the mining area and Whitefish Lake. Parameter values in other parameter zones could also be important. For example, if the K values for the intermediate sandstone aquitard are significantly larger than in the current calibration results, the interaction between the upper sandstone aquifer and the lower sandstone aquifer could be more active, and the mined-out zone could be more active hydraulically and groundwater in the minded-out zone could have a shorter residence time than in the current calibrated model. Additionally, it is noted that Figure 2.19 (p. 2.46, Appendix 7-C) illustrates the parameter zone for the intermediate sandstone aquitard. However, Figure 2.20 (p. 2.49, Appendix 7-C) did not include the intermediate sandstone aquitard in the results.		conductivities are best determined using long-term pumping tests, or a model and calibrating to observed water level trends. Please note that only parameter sets which are consistent with field observations (i.e., observed water level, baseflow, or geochemical observations) are considered relevant for prediction uncertainty analyses. References: Bradbury K. R., and M.A. Muldoon. 1990. "Hydraulic Conductivity Determinations in Unlithified Glacial and Fluvial Materials." Groundwater and Vadose Zone Monitoring. ASTM STP 1053. D.M. Nielsen and A. I. Johnson Editors., American Society for Testing and Materials. Philadelphia, 1990. pp. 138-151.	
IR-88	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** The conceptual hydrogeological model includes upper sandstone aquifer, intermediate sandstone aquitard, and lower sandstone aquifer. The desilicified zone above the ore zone have enhanced hydraulic conductivity. The boundary condition for the lower sandstone aquifer on the west (upstream) side was assigned to have specified head, which provide source of water for the lower sandstone aquifer. As a result of the conceptual model setup, the upper sandstone aquifer is hydraulically active and the groundwater residence time within the upper sandstone aquifer is relative short. In contrast, the lower sandstone aquifer (and the ore zone) is hydraulically inactive, and the groundwater residence time in the lower sandstone aquifer is relatively long (as shown in the particle tracking results in Figure 7.6-2 (p. 7-71, main EIS report), and the simulated plume for chloride in Figure 7.6-7(p. 7-86, main EIS report)). It is stated in Section 2.6.4 (Appendix 7-C) that "As noted above in section 2.6.3, it is estimated that 99% of the groundwater discharge to Whitefish Lake is derived from groundwater that has only flowed through shallow deposits (i.e., Overburden and Upper Sandstone Aquifers). Contribution of deep groundwater flow through the Desilicified Zone within the Intermediate Sandstone Aquitard is estimated to be < 1% of the groundwater discharging to Whitefish Lake". This simulation result is reflective of the conceptual model. Section 7.3.3.3 (p. 7-42) states that "The Lower Sandstone Aquifer is characterized spatially by two types of groundwater. The first groundwater type is most like that observed in the Local Flow System. This reflects hydraulically active fractures and fault systems that allow fresh recharge water to penetrate and mix with deeper waters in the aquifer. The second type of groundwater is within the zone of thermal alteration around the ore zone ……". The hydraulic connectivity of the ore zone with the upper sandstone aquifer has important implication on the groundwater restoration. The ore zone is not hydraulically active locally because it is enclosed by a clay zone before the mining operation. But if it is located within a hydraulically active area, or on a groundwater flow pathway that is hydraulically active, the mined-out zone (with much larger porosity and hydraulic conductivity) could become active hydraulically after mining operation is finished. Figure 7.6-7 (p. 7-86, main EIS report) shows that the chloride plume is most persistent within the mined-out mining area. This seems to indicate the mined-out zone is hydraulically inactive after the mining operation is finished. It is stated in Section 7.3.3.2 (p. 7-37, main EIS report) that "Exploration boreholes drilled in the Phoenix area, where left unplugged, have the potential to provide preferential flow paths between the Overburden and Upper and Lower Sandstone Aquifers. Exploration holes were reportedly grouted approximately 10 to 20 m above and below the ore zone, resulting in open holes remaining throughout the overlying materials. These portions of the open holes may act as open conduits for groundwater flow through the 400 m of Athabasca Group Sandstone." So, there is possibility that the unplugged borehole could increase the hydraulic connection between the upper and lower sandstone aquifer. **Rationale:** It is important to understand if the larger area containing ore zone is hydraulically active. Additional confidence would be gained if there is any other evidence that support that the area containing the ore zone is not hydraulically active, and groundwater residence time in	It is recommended to conduct the following work to demonstrate if the mined-out zone is hydraulically active: 1. Determine the groundwater residence time in the lower sandstone aquifer and compare it with the simulated residence time in the numerical model. 2. Conduct additional particle tracking to demonstrate where groundwater originating from the mined-out zone flow towards (forward tracking) and where groundwater flowing towards the mined-out zone originates from. This would help determine why groundwater in the mined-out zone is not hydraulically active. 3. Conduct sensitivity analysis to investigate the effect of higher K values for the intermediate sandstone aquitard and the K and porosity values of the mined-out zone on the plume migration.	1) Denison believes that the best way to determine residence time as part of the EA is with the modelling approached used in the draft EIS. It is unclear how it would be possible to "determine the groundwater residence time within the Lower Sandstone Aquifer" other than by using a model. Available data (e.g., geochemistry) provide an indication of residence time, but not timing that can be compared to modelled results. The groundwater residence time within the Lower Sandstone Aquifer, downgradient of the ore zone, is simulated using the model to be 150 years or greater. Simulated residence time within the Lower Sandstone Aquifer upgradient of the ore zone is approximately 500 years. 2) Particle tracking from the "mined-out" ore zone was incorporated within the EIS, as illustrated on Figure 4-4 of Appendix 7-C. The particle traces presented illustrate groundwater migration flow paths, path lengths, travel times, and velocities for water migrating from the mined-out ore zone. Reverse particle tracking indicates flow through the Lower Sandstone Aquifer flowing from upgradient areas flowing into the ore zone. 3) The prediction uncertainty analysis (i.e., "sensitivity analysis") presented in Appendix 7-C included an evaluation of the change in the model prediction (i.e., plume migration) with respect to changes in the conductivity of materials along the flow path to the receptor, Whitefish Lake (i.e., Scenarios 4, 5, and 6) as well as regarding the hydraulic conductivity of the mined-out ore zone. As such we feel that the work requested by the reviewer has already been completed and reported upon within the draft EIS. In addition, the uncertainty of the Intermediate Sandstone Aquifer was evaluated (see IR55), where higher hydraulic conductivity within the Intermediate Sandstone Aquifer were found to reduce the proportion of water from the ore zone reaching Whitefish Lake, which would have the effect of further reducing (i.e., diluting) concentrations simulated and presented in the EIS documentation. As such, the conditions documented in the draft EIS are already conservative with respect to the uncertainty in these parameters.	No updates to the EIS in response to this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				the lower sandstone aquifer surrounding the ore zone is comparable with the simulated results. Table 2-4 (p. 2.16, Appendix 7-C) shows the effective porosity (0.01-0.05) of the ore body. Figure B7 (p. B.8, Appendix 7-C) shows that the calibrated K values for the mined-out zone is 1x10-6 m/s. Section 3.5.2 (p. 3.24, Appendix 7-C) states that "The same average linear velocity was assumed for the mining area (source zone), following from the discussion in Section 4.4.2, where the hydraulic conductivity value in this zone following mining was set to 5x10-6 m/s, and a porosity of 0.2 is assumed for the ore zone (Table 4-2)". It is not clear what the justification is for the selection of the porosity and K values for the mined-out area, and whether they are conservative. It is also not clear, what the potential impact on the groundwater flow and COPCs transport would be If the mined-out zones collapse.			
IR-89	ECCC	Fish and fish habitat	Appendix 7-C, Numerical Modelling: Post-Decommissioning Evaluation, Section 2.3.1.4, Desilicified Zone	**Context:** The Proponent states that a hydraulic conductivity value of 5x10-6 m/s was uniformly assigned to the model layers representing the Desilicified Zone. They additionally state that this value is consistent with packer and pumping tests screened in this unit that have interpreted hydraulic conductivity values ranging from 1x10-6 to 3x10-5 m/s (Appendix C), with a geomean of 6.0x10-6 m/s. Considering that the Desilicified Zone is of particular interest because it is the main pathway for the COPC to reach Whitefish lake, and that hydraulic conductivities are not entirely understood, ECCC recommends that a larger range of hydraulic conductivities be simulated to understand potential effects on fish and fish habitat. **Rationale:** The Desilicified Zone is a critical layer in the hydrogeological model as it represents a key potential pathway of contaminants to Whitefish Lake. The base case hydraulic conductivity value (5x10-6 m/s) is even lower than the geometric mean, not to mention the highest value found. When simulating geochemical processes and contaminant transport within this important pathway a more conservative approach should be employed. Modifying this parameter will affect travel times and distribution of COPC in the subsurface.	1. Provide an in-depth rationale for choosing a value of 5x10-6 m/s as the base case for the hydraulic conductivity, in both the PH REdox EQuilibrium (PHREEQC) and Finite-Element Ground Water Flow (FEFLOW) models. 2. Provide a rationale for keeping the sensitivity analysis within one order of magnitude considering the lack of physical data on the Desilicified Zone. Alternatively, provide contaminant transport simulation results with more conservative hydraulic conductivity (e.g., more than 3x10-5 m/s) values in the Desilicified Zone. See also related: IR-96.	1) Application of 5E-6 as the value for hydraulic conductivity within the desilicified zone is appropriate; the values of 5E-6 and 6E-6 are essentially the same number, particularly at the scale over which it is applied. We agree that the hydraulic conductivity of the desilicified zone is an important parameter to the fate and transport of dissolved minerals from the ore zone toward Whitefish Lake; that is why scenarios 4, 5, and 6 were designed to evaluate the prediction uncertainty related to the uncertainty of the desilicified zone, along with other hydraulic conductivity values along the transport migration pathway. Further, we recognize that packer tests provide a small-scale sample indication of the representative hydraulic conductivity, and as shown in the literature (Bradbury and Muldoon, 2000), such local tests are rarely representative of large-scale (i.e., macro) hydraulic conductivities. Macro-scale hydraulic conductivities are best determined using a large-scale pumping test or a model calibrated to observed water levels, which is the approach we completed; the value of 5E-6 for the desilicified zone hydraulic conductivity provides an excellent match to observed water levels and baseflow discharge. In addition, packer tests in fractured rock tend to bias the hydraulic conductivity to be higher than is representative on the large scale, as testing is generally targeted on observed fracture zones. Given all this, we reaffirm that the applied hydraulic conductivity of 5E-6 is representative for the conductivity of the desilicified zone. 2) Calibration-constrained uncertainty analyses were performed (i.e., the state of the practice) to evaluate the range of potential hydraulic conductivity values that could exist within the desilicified zone while still maintaining calibration. That analysis is presented in section 2.8 of Appendix 7-C. The most conservative of the parameter scenarios that are consistent with the field observational data were used for the prediction uncertainty analyses presented in Appendix 7-C, section 4.7. Scenarios 4, 5, and 6 explore higher hydraulic conductivity values which are supported by the observation data (i.e., calibration-constrained uncertainty analysis). The range of desilicified-zone hydraulic conductivity incorporated within those scenarios (Figure 2-21) is 1.6 to 3.2 m/d (i.e., 1.8E-5 to 3.7E-5 m/s); 3.2 m/d was the highest conductivity value for the desilicified zone (referred to as the Altered Zone within the Intermediate Aquitard on Figure 2-21) for all 50 calibrated realizations generated using PEST. As such, the EIS presented the prediction uncertainty with the highest hydraulic conductivity values supported by the observation data. It would not be appropriate to test scenarios with even higher values of hydraulic conductivity which would not be supported by the field observed groundwater levels. Thus, we do not feel it is appropriate to test scenarios where the hydraulic conductivity of the desilicified zone is orders of magnitude greater than suggested by field observations. References: Bradbury K. R., and M.A. Muldoon. 1990. "Hydraulic Conductivity Determinations in Unlithified Glacial and Fluvial Materials." Groundwater and Vadose Zone Monitoring. ASTM STP 1053. D.M. Nielsen and A. I. Johnson Editors., American Society for Testing and Materials. Philadelphia, 1990. pp. 138-151.	No EIS updates are anticipated to address this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
IR-90	ECCC	Fish and fish habitat	Appendix 7-C, Section 2.4 and 2.6	**Context:** Hydraulic conductivities and hydraulic gradients play an important role in groundwater flow, geochemical modeling, and contaminant transport for the PHREEQC and FEFLOW models. Although there is an important vertical component to the contaminant transport, there is no distinction made between lateral and vertical hydraulic conductivities of hydraulic gradients. **Rationale:** According to the conceptual model, there is an important vertical aspect to the groundwater flow thus incorporating any vertical hydraulic gradient or hydraulic conductivity information into the calibration would increase confidence in the results. Providing a distinct value for vertical hydraulic conductivity will improve the accuracy of the model in regards to the transport of contaminants to Whitefish Lake through the Desilicified zone, which is important to understand potential impacts to aquatic life.	1. Explain if the vertical and lateral hydraulic gradients and hydraulic conductivities are assumed to be equivalent. 2. Provide a rationale for not distinguishing between vertical and lateral hydraulic gradients. 3. Alternatively, provide both lateral and vertical hydraulic gradient estimates and the implications on contaminant transport.	1. Lateral and vertical hydraulic conductivity values are assigned for every model element within the numerical modelling domain. In most areas, the vertical hydraulic conductivity is assumed to be 1/10th of the lateral hydraulic conductivity due to variability in the depositional environment (i.e., intermittent periods of quiet water deposits, and higher-energy water deposits) and fracturing (typically bedding plane fractures are more prevalent than vertical joints). 2. In the case of the desilicified zone the thermal alteration was conservatively assumed to have resulted in equivalent hydraulic conductivity values in the lateral and vertical directions. This conservative assumption within the desilicified zone is designed to over-predict mass transport potential to surface receptors. 3. The gradients applied are considered reasonable and defensible. By calibrating to 3D point observations of groundwater levels, and using surface water levels for hydrogeologic boundary conditions, the model has been inherently calibrated to 3-dimensional hydraulic gradients. Thus, lateral and vertical hydraulic gradients are incorporated within the analysis presented.	No updates to the EIS in response to this IR.
IR-91	NRCan	Fish and fish habitat	Appendix 7-C, section 2.5.2	**Context**: The numerical model calibration quality plot (Appendix 7-C, sec. 2.5.2.1, Figure 2-13) contains a small error. The vertical (simulated heads) and horizontal (observed heads) axes do not have the same scales (499 to 521 masl versus 499 to 522 masl). Therefore, the line of ideal fit is offset. **Rationale**: As a result, NRCan notes that observed heads in the 510-512 masl range are underpredicted by the model. NRCan also notes that the calibration statistics (Appendix 7-C, sec.2.5.2.3) are highly leveraged by two data points from open boreholes south of Kratchkowsky Lake where simulated values are largely controlled by the nearby constant-head boundary in the Lower Sandstone aquifer (520 masl).	The proponent should correct the scales on the axes of Figure 2-13 in Appendix 7-C. The proponent should also comment on the effect on calibration of the clustering of most observation wells in the ore zone.	The scales on Figure 2-13 of Appendix 7 have been corrected and included in Attachment IR-91. From a regional perspective, the available groundwater levels are clustered around the Phoenix deposit. However, Denison advanced monitoring well clusters to support hydrogeologic (and hydrochemical) characterization upgradient, downgradient, and cross-gradient to the deposit. Data from all of these wells were used to calibrate the numerical model. It is acknowledged that the hydrogeologic conditions are extrapolated from the available data; this is consistent with the state of the practice.	The corrected Figure 2-13, which will be included in the final EIS, is appended as Attachment IR-91.
IR-92	CNSC	Geology and groundwater	Appendix 7-C, Section 3.2.1, Mineralogical Composition	**Context:** Table 3-2 summarizes the clay content of the Athabasca Group sandstones and the Paleoweathered Zone. Although minimum, maximum and median values are provided, the number of samples and variability of the dataset are not. Rationale for incorporating illite into reactive transport modelling and excluding kaolinite/dichlorite is provided in the text. From p. 3.29 in Appendix 7-C: "The illite content was based on the normative clay composition determined from site-specific corehole elemental analysis (median illite by mass is 7.68%; Table 3-2) and using portable infra-red mineral analysis indicating median illite content by mass is 13.1% (data not shown)" From p. 3.30 in Appendix 7-C: "Using the minor amount of illite compared to the more dominant chlorite is conservative in that not all sorptive capacity of the clays is accounted for in the simulated paleoweathered zone". This conservative assumption appears contrary to assumptions for the desilicified zone (DSZ) and Athabasca Group sandstones "Illite was used to represent the total clay content, which varies from 1.74% to 5.85% by mass in the hydrostratigraphic units within the Athabasca Group sandstones and Desilicified Zone". **Rationale:** Information is missing in the EIS regarding the clay composition of hydrostratigraphic units. Results from infrared mineral analysis are not reported. The assumption for the solute transport model is that all clays in the downgradient DSZ are illite. However, clay content in the Read Formation (Lower Sandstone Aquifer) downgradient of the ore zone is low in illite (0.42%) compared to kaolinite (0.52%) and dichlorite (1.18%). A value of 3.9% illite clay by weight is used for the DSZ, but Table 3-2 indicates median content is 2.42% illite. It is not clear why illite was used to represent total clay content for the DSZ, as opposed to the conservative assumptions used for the Paleoweathered Zone, nor has any basis or justification been given.	1. Please provide in Table 3- the number of samples and variability of the datasets used to estimate the clay content of hydrostratigraphic units for the model. Include results from infrared mineral analysis in the text if the information is used to support assumptions for modelling. 2. Please provide further information/discussion within the EIS relating to the assumptions of clay content in hydrostratigraphic units for modelling. Provide further justification and rationale as to why total clay content in the Athabasca Group sandstones and Desilicified Zone is assumed to be illite, and how this assumption is conservative. This discussion could include a comparison of the properties (cation exchange capacity, surface area) of illite vs. kaolinite vs. dichlorite for the anticipated range of subsurface conditions (pH, redox, U concentrations, etc.).	Please see response in Attachment IR-92.	The updated version of Table 3-2 (provided in Attachment IR-92) will be included in the final EIS Appendix 7-C. To reflect the discussion in Attachment IR-92 and updates to Table 3-2 of Appendix 7-C, the following text will be included on page 3.29-3.20 of Appendix 7-C in the final EIS: Conceptually, the paleoweathered zone mineral assemblage was made up of 9% clay by mass, as illite, and 25% quartz. The illite content was based on the normative clay composition determined from site-specific corehole elemental analysis (median illite by mass is 9.20%; Table 3-2). Portable infra-red mineral analysis supported the normative clay content in that chlorite is the dominant clay mineral (69.5% relative abundance) followed by illite (median 13.1% relative abundance). The quartz content was based on a regional study by Macdonald (1980) evaluating the mineralogical composition of the weathered bedrock/saprolite regionally. The mineral composition of the paleoweathered zone was conceptualized in this manner because the data set for the project with respect to clay minerals was for the sorptive properties of illite. Using the relatively smaller illite content of the paleoweathered zone compared to the more dominant chlorite content is conservative in that not all sorptive capacity of the clays is accounted for in the simulated paleoweathered zone.
IR-93	CNSC	Geology and Groundwater	Appendix 7-C, Table 3-10: Properties of	**Context:** In Appendix 7-C, section 3.5.6.2.2 Ion Exchange and Surface Complexation, the consideration of ion exchange and surface complexation and the corresponding parameters and chemical	Please provide additional evidence to justify the model parameter of site density for goethite, applied to the numerical model. If necessary, the reactive transport	Please see response in Attachment IR-93.	The updates to Table 3-10 of Appendix 7-C are detailed in Attachment IR-93 and will be included in the final EIS.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
			Adsorbing Mineral Phases	reaction are discussed. **Rationale:** The site density of sorbent Geothite was reported in Table 3-10 to be 1.6E3 mol/kg. Taking into account the specific surface area of 60 m2/g, this equals to 1600/6E4 mol/m2, or 0.0266 mol/m2, 1.6e4 sites/nm2. This value largely overestimates the site density of goethite, which is reported to be in the range of 2~6 sites/nm2. The reference used in the EIS report indicates the similar range of variation for this specific parameter. There are plenty of similar studies on SCM of iron oxides in literature. It is suggested to consult with more than one single study to enhance the reliability of model parameters. The overestimation of sorption site density will directly result in underestimation of the affected COPCs' concentrations in pore fluid. This will result in underestimation of COPC transport plume in the affected underground space, and potentially the dissolved concentrations in the hydrogeological sink.	modelling should be re-run to update the contents presented in the EIS report.		
IR-94	CNSC	Geology and Groundwater	Appendix 7-C, Numerical modelling: post-decommissioning evaluation, Section 3.5.5, Subsurface Conditions Incorporated	**Context:** It is reported in this section the assumed subsurface conditions that were applied in the geochemical site conceptual models. Critical phenomenon of pH tail was mentioned. Inclusion and exclusion of corresponding geochemical reactions were discussed briefly. **Rationale:** It was reported that the residual reduced minerals of uraninite and pyrite were not included in the modelling of the remediated mining area. The argument was based on consideration of the upstream groundwater, passing through the mined zone, will not be oxidizing and groundwater conditions are expected to be similar to pre-mine conditions. However, this ignores the pH tail effect that releases proton H+ sorbed to solid surface during ISR flooding. By ignoring this process, there is a potential risk of underestimating the source terms for some key COPCs. Exclusion of uraninite and pyrite in remediated mining area modelling is contradictory to pH-tail effect. The justification is not sufficient in the current form.	Please provide additional evidence to justify the approach for excluding uraninite and pyrite from the analysis of remediated mining area. This may require the results from additional modelling.	Please see response in Attachment IR-68, IR-94, IR-97.	No updates to the EIS in response to this IR.
IR-95	CNSC	Geology and Groundwater	Appendix 7-C, Table 3-11	**Context:** The Table 3-11 reported the Solid-Phase Concentrations and Partitioning Constants for COPCs. Data were both measured and simulated. **Rationale:** It is unclear how the partition coefficients of various COPCs upon desilicified and paleoweathered rocks were obtained. It was not reported at what pH were these Kd analyzed. Sorption of chemicals on solid phase is known to be pH dependent. It is unclear whether pH influence was considered in the measurement and analysis of apparent partition coefficients. In addition, uptake of metals on clay is highly nonlinear, and always has a maximum capacity. Even with a very strong affinity towards specific metal ions, the sorption will be saturated at elevated concentrations. Therefore, assuming a linear correlation needs to be cautious of the concentration range of target COPC species, and the applicable sorption capacity of the clay mineral. In the current model, only the linear form of sorption is considered, although with discussion of Kd value selection. Additional rationale is needed to justify if the applied methodology is sufficient for assessment.	Please justify the choice of applying a linear form partition coefficient for the modelling and assessment, and whether it provides a conservative approach to the assessment results. Clarity around the experimental conditions during the measurement of partitioning coefficient of various COPCs on the target rocks may help support this assumption.	Please see response in Attachment IR-95.	The updated version of Table 3-11 (provided in Attachment IR-95) will be included in the final EIS Appendix 7-C.
IR-96	CNSC	Geology and groundwater	Appendix 7-C, Section 4.4.4, Sub-Domain Model Transport Boundary Conditions	**Context:** From the text, "Transport parameters were specified for diffusion (1x10-9 m2/s), longitudinal dispersivity (10 m along the plume trajectory), and transverse dispersivity (5 m)". The source of this information is not provided in Appendix 7-C. It is unclear if the values used are defaults in the modelling software, from literature, from small-scale laboratory tests, or are site-specific values determined through tracer tests. **Rationale:** The use of a calibrated flow model does not imply that the solute transport model is calibrated. The transport parameters (such as effective porosity, dispersivity and reactive transport parameters) can only be calibrated by matching simulated and observed spatial and/or temporal distributions of a solute. Sensitivity analysis indicates that decreasing longitudinal and transverse dispersivities by a factor of two resulted in exceedances of groundwater criteria for both selenium (Se) and cobalt (Co). Given the clear influence of these values on contaminant transport, it is important that transfer parameter values are justified in the solute transport model. In addition, the influence of large-scale heterogeneity on dispersion and solute transport predictions should be discussed, to identify any uncertainty in the	1. Please provide the source of the numerical value used for diffusion and longitudinal and transverse dispersivity, and provide justification if default values by the model code were used. 2. Please provide a discussion on the influence of large-scale heterogeneity on dispersion and solute transport predictions in the modelling report. See also related: IR-89.	Please see response in Attachment IR-96.	No updates to the EIS in response to this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				model predictions, and provide confidence that the applied model is adequately representing groundwater flow and solute transport. Further guidance on solute transport modelling can be found in BC MOE (2012) [1]. **Reference**: [1] British Columbia Ministry of the Environment (BC MOE). 2012. Guidelines for Groundwater Modelling to Assess Impacts of Proposed Natural Resource Development Activities. Report no. 194001, 385 p.			
IR-97	ECCC	Fish and fish habitat	Appendix 7-C, Figures 4-6, 4-7a, 4-7b, 4-8a, 4-8b, 4-9a, 4-9b	**Context:** Appendix 7, Figures 4-6, 4-7a, 4-7b, 4-8a, 4-8b, 4-9a, 4-9b present contaminant transport simulations of chloride, selenium, cadmium, and uranium. All simulations use initial condition concentrations at t=0 (or end of mining operations. In the 3D FEFLOW contaminant transport model it is not clear why initial condition concentrations were chosen rather than a constant concentration boundary. It is also unclear if mining activities will cause mobilization of the contaminants beyond the end of operations. **Rationale:** The choice of boundary conditions may impact the predicted transport of contaminants that reach Whitefish Lake through groundwater, which may have impacts to aquatic life.	1. Explain and clarify if mining operations will mobilize contaminants beyond operations? 2. Clarify if the source of contamination, (e.g., uranium, selenium) will cease after operations? 3. For the 3D model please provide the rationale for using initial concentrations rather than constant concentration boundary conditions for contaminant concentrations.	Please see response in Attachment IR-68, IR-94, IR-97.	No updates to the EIS in response to this IR.
IR-98	CNSC	Change to an environmental component due to hazardous contaminants	Section 8, Aquatic Environment	**Context:** It states in EIS in Section 8.3.7.1 (p. 8-151) that "Cameco's Key Lake Operation will overlap spatially and temporally with the Project". **Rationale:** It is not clear whether there is the possibility that planned Denison discharges would eventually flow into and influence a background reference lake used by Key Lake operation.	Please provide supporting information to demonstrate whether discharges from the proposed operation will not eventually flow into a reference lake used by another existing operation.	Denison understands that Alpha Lake and McGowan Lake are used as reference lakes for a Cameco operation within the area of Denison's proposed project. Denison will communicate with Cameco through the Saskatchewan Mining Association to highlight the timing of the start of the Project as it may relate to Cameco's use of regional lakes for reference lake purposes. McGowan Lake will no longer be suitable as a reference lake for Cameco once the Wheeler River Project starts operating, since it will be downstream of treated effluent release. Alpha Lake (LA-9 in Denison's aquatic baseline studies) will likely be outside of any influence from Denison's activities. Please note that Denison has previously been in communication with the Saskatchewan Ministry of Environment, Environmental Protection Branch regarding the baseline study work Denison completed as part of the Environmental Assessment process and the potential changes to McGowan Lake (a Cameco's reference lake) from the proposed Wheeler Project. Reference: Email from Janna Switzer (Denison) to George Bihun (MOE) on May 12, 2020.	No EIS updates are anticipated to address this IR.
IR-99	CNSC	Aquatic environment	Section 8, Water Quality, Table 8.2-13	**Context:** Table 8.2-13 shows the maximum concentration of hazardous and radiological COPC's in surface water throughout the local study area. However, the concentration for all constituents is stated as mg/L. **Rationale:** It is unusual for radiological COPC's to be displayed in mg/L, radiological constituents are typically displayed in Bq/L	Please use Bq/L when displaying concentration of radiological COPC's. If this was a typographical error in the table, please indicate as such and revise the table to indicate values are indeed in Bq/L. Please also review other tables displaying concentrations of radiological constituents to ensure this error is not repeated in other tables.	The values provided in Table 8.2-13 for radiological COPCs are presented as Bq/L and the units provided in the sub-title (mg/L) are not consistent with the data provided. Table 8.2-13 is consistent with the data provided in Appendix 10-A (Environmental Risk Assessment), which specifies the concentrations as having been measured in Bq/L. Subsequent updates of the EIS will correct this inconsistency. Denison will review the final EIS to ensure this error is not repeated in other tables.	Table 8.2-13 will be revised to ensure the units for radiological parameters are expressed in Bq/L. The revised table is provided in Attachment IR-99.
IR-100	HC	Indigenous Peoples' health / Socio-economic conditions	Section 8, (p. 8-195) Section 8.5.3, Table 8.5-2, (p. 8-226)	Mercury is excluded as a COPC in the assessment. Inadequate consideration of mercury and methylmercury in fish and other country foods, and use of incorrect Hg-related health guideline values can underestimate the risks to human health among country food consumers. **Context:** Section 8 states "Mercury has not been identified as a COPC for the Project as it is currently not present in the receiving environment (i.e., background condition) at detectable concentrations and will not be produced as part of the mine process; therefore, it will not be discharged to the aquatic environment. However, it is understood that potential nutrient enrichment-related effects are possible and can be linked to increases in mercury in the environment" (p. 8-195). Table 8.5-2 shows that there is mercury present in the tissues of Northern Pike and White Sucker sampled in the waterbodies within the local study area and in Russell Lake. These fish are regularly consumed by nearby communities according to the ERFN 2017 dietary survey. In Section 8.5.3, fish tissue concentrations are compared to Health Canada's human health risk- based maximum permissible mercury concentration (0.5 µg/g wet weight), which is applicable to most species of commercially sold fish rather than country foods. **Rationale:** It is recommended that mercury be listed as a COPC considering it is in fact present in fish tissue under existing conditions, the significant consumption of fish by the local Indigenous communities, and its toxicological significance to human health. Further, the Health Canada provisional tolerable daily intake (pTDI) value of 0.2 µg/kg/bw/day (Health Canada, 2007) is a more	1. Include mercury (including methylmercury) as a COPC in the assessment given the baseline presence of mercury in sampled fish, the potential increase of methylmercury in receiving waters due to nutrient enrichment resulting from the project, the significant fish consumption by the local population and that country foods, particularly fish, are an important source of dietary exposure to mercury. 2. Assess health risks from fish consumption by calculating hazard quotients for baseline and predicted methylmercury levels in country foods using Health Canada's pTDI for methylmercury (Health Canada, 2007). 3. Clarify whether mercury data represented throughout the EIS represents total mercury, inorganic mercury or methylmercury. **Suggestions for mitigation and follow-up measures:** Health Canada recommends including methylmercury in the list of COPCs to be monitored in fish throughout all project phases. See also related Advice to the Proponent: AD-31.	1. The intent is not to include mercury (and methylmercury) as a COPC for the assessment. As indicated in EIS Section 8.4.6.1, Residual Effects Characterization, mercury is not associated with the local geology and is not expected to be released in the effluent at measurable levels and was therefore not identified as a COPC. Denison notes that there is potential for increased methylmercury production in the receiving environment under a certain combination of factors to which the Project may contribute, such as increased nutrient levels in the environment; however, prediction of methylmercury production is not practical. Denison commits to monitoring mercury and methylmercury in the aquatic environment over the life of the Project to determine the potential changes in mercury concentrations in fish tissue over time. 2. As the Project advances and operational monitoring is underway, Denison will assess health risks from fish consumption by comparing fish tissue data collected during operation from the monitoring program against Health Canada's mercury guideline of 0.5 ug/g wet weight. This is a human health risk-based maximum permissible concentration. 3. Mercury data presented throughout the draft EIS represents total mercury. Denison agrees to included methylmercury as part of the constituents monitored in fish throughout all project phases.	A commitment will be added to Section 8 of the final EIS that as the Project advances, Denison will assess health risks from fish consumption by comparing fish tissue data collected during operation from the monitoring program against Health Canada's mercury guideline of 0.5 ug/g wet weight. It will be clarified in the final EIS that mercury data presented is total mercury.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				appropriate reference level when evaluating consumption of mercury in fish by Indigenous people, as it allows for the consideration of food consumption patterns in the risk assessment that differ from the general population and is protective of the most sensitive sub-group (i.e., developing foetus). It is important to note that methylmercury, rather than inorganic mercury, is generally the predominant mercury species present in fish and is also the most toxicologically significant form. The assumption of 100% of mercury in fish and other country food items being present as methylmercury ensures that the potential health risks are not underestimated. It is unclear, however, if the mercury data presented throughout the EIS represent total mercury, inorganic mercury or methylmercury.			
IR-101	ECCC	Fish and fish habitat	Section 8.1.1.3, Section 8.2.1.3 Aquatic Environment	**Context:** In Section 8.1.1.3 Spatial and Temporal Boundaries the Project Area, Local Study Area (LSA) and Regional Study Area (RSA) are established as they pertain to surface water quantity. The same is done in Section 8.2.1.3 for surface water quality. In Section 8.1.1.3 Figure 8.1-4, the locations of the Project Area, LSA, RSA and surface water features and monitoring stations are provided. However, the locations of wetlands located near the Project area and within the LSA and RSA have not been provided. The location of wetlands within or near the Project footprint, as well as the other wetlands existing within the LSA can be confirmed from Part II_S9 Terrestrial Environment, Section 9.2.3.3 Figure 9.2.-8, including the wetland classifications. There appears to be at least one shallow open water wetland and several bogs located within the Project Area. There is no consideration of wetlands or potential effects to wetland hydrology, surface water or sediment quality throughout the aquatic environment assessments. There is no baseline information regarding wetlands and their status as fish habitat and ecological function, or assessment of potential effects to flow rates, water levels, water quality, sediment quality, or biota. **Rationale:** There is currently not enough information provided for ECCC to provide advice on the potential risks of the proposed Project to wetland hydrology, surface water and sediment quality within the LSA. This pathway of effects is important to assess in terms of potential effects to wetland habitat availability and quality due to changes in flow rates, water levels, water quality, sediment transport, sediment quality and potential effects to terrestrial and aquatic receptors. It is necessary to evaluate if changes in groundwater and surface water runoff flows and routing will affect water levels and habitat availability within wetlands. Potential effects from COPCs and radionuclides to surface water and sediment, or potential effects to ecological receptors within wetlands have not been evaluated.	1. Provide baseline information regarding wetland characterization within the Project Area and LSA, including: locations, wetland type, size, water surface elevation, depth, water flow pathways, and the presence of wildlife receptors including presence of fish/fish habitat within the Aquatic Environment section of the draft EIS. If this information is available in annexes or baseline studies, summarize it within the main body of the Aquatic Environment section of the draft EIS with references to respective documents for review. 2. Provide baseline information on wetland surface water and sediment quality characterization for wetlands within the Project footprint. 3. Provide an assessment of potential effects to wetlands within the LSA and potential effects to ecological receptors during all phases of the proposed Project. 4. Provide further information on mitigation measures and monitoring that would be applied for the protection of wetlands.	Responses are numbered as listed in the IR. Figures associated with this IR are provided in Attachment IR-101. 1) Below indicates the information that is presented in the draft EIS regarding wetland characteristics. This information was housed within the terrestrial environment component and potential impacts to wetlands as a valued component is further assessed under Section 9.2 of the draft EIS, and specifically Section 9.2.6.4. The following list indicates what information was provided in the draft EIS specific to information request #1. As such, repackaging the available information in Section 8 would be redundant and therefore in Denison's view unnecessary. *a) Locations of Wetlands* **Section 9, Figure 9.2-8** on page 9-83 of the draft EIS presents a map of the RSA and LSA detailing the locations of various wetland features including bogs and fens. b) *Wetland Types* **Section 9, Figure 9.2-8** on page 9-83, and **Table 9.2-8** on pages 9-91 to 9-92 of the draft EIS provides the geographical distribution and listing of the following wetland types within the LSA: i. BS17 – Black spruce treed bog ii. BS18 – Labrador tea shrubby bog iii. BS19 – Graminoid bog iv. BS19/24 – Graminoid bog/Graminoid fen v. BS20 – Open bog vi. BS21 – Tamarack treed fen vii. BS23 – Willow shrubby rich fen viii. BS24 – Graminoid fen ix. BS25 – Open fen x. BS27 – Sedge rocky shore (shallow open water) c) *Wetland Size* **Section 9, Table 9.2-8** on pages 9-91 to 9-92 of the draft EIS lists the following wetland types and the cumulative area they encompass within the LSA: i. BS17 – 18.2 ha ii. BS18 – 23.3 ha iii. BS19 – 2.8 ha iv. BS19/24 – 0.8 ha v. BS20 – 0.6 ha vi. BS21 – 1.9 ha vii. BS23 – 0.6 ha viii. BS25 – 0.4 ha ix. BS27 – 4.2 ha *d) Wetland Water Surface Elevation* Surface elevations for the wetland have been assessed and the information is summarized below and in the Attachment IR-101 **Figure 1 Elevations of wetland features in the LSA**. • Wetlands 1.5 km west of the SSA range from 526-524 masl • Waterbodies and their surrounding wetlands directly to the east of the SSA are at an elevation of between 506 and 500 masl • Waterbodies and surrounding wetlands 2 km east of site are approximately between 499 and 497 masl • Wetlands north of the SSA and in the vicinity of the proposed air strip range from 514-508 masl. • Wetlands situated further north of the SSA in the LSA were at an elevation of approximately 526 masl • Southern wetlands that will interact with the proposed hydro corridor extension for the mine have an elevation of 491masl • Most wetland evaluated south of the SSA had elevations ranging from 491-488 masl e) *Wetland Depth* – information associated with wetland depth for those in the LSA is not available.	No EIS updates are required for this response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						f) *Wetland Flow Pathways* - Nearly all wetlands are connected or adjacent to rivers and tributaries, and thus flow pathways are discernable in **Figure 9.2-8** of the draft EIS. g) *Presence of Fish and Fish Habitat* For the purposes of this assessment the bogs and fens within the area can be assumed to provide supporting fish habitat to the adjacent lake and river water bodies in the vicinity of the LSA. Section 9.2.6.4.1 of the draft EIS described the estimated change in the aerial extent of wetland due to direct impacts of the Project footprint (see also Figure 9.2-8). The assessment indicated a total loss of 0.5 ha (less than 0.1%) of all wetlands within the Terrestrial RSA. 2) As noted in other parts of this IR response, the wetlands within the Project footprint are limited to two areas (i.e., stream crossings along the access road to the airstrip and powerline connection SE of Highway 914 [See Figure 2: Denison Wheeler River Project SSA and Wetland Feature Distribution in Attachment IR-101]) and these wetland areas can be avoided through design and construction mitigations. As such, no direct impact to any wetlands or waterbodies are expected as part of the Wheeler River Project that may impact fish or fish habitat. In regard to baseline information on wetland surface water and sediment quality characterization for wetlands within the Project footprint: a) <u>Surface water quality in wetlands</u> – surface water quality was not specifically sampled in the wetland complexes adjacent to the project footprint during the original baseline assessment. However, surface water quality was sampled and assessed at stream and lake stations situated upstream and downstream of wetland areas. These stations were selected for sampling as they were identified as providing repeatability (i.e., relative water depth) and informative with respect to desired segments of the system. For example, water quality was sampled at SA-4, SA-5, LA-6, SA-6 and LA-5 following the flow path from upstream to downstream, respectively. The water quality at these nodes was inclusive of upstream wetland influences. For further reference to surface water sampling station during baseline, please refer to Figure 8.2-4 of the EIS. b) <u>Sediment quality in wetlands</u> - sediment quality was not specifically sampled in the wetland complexes adjacent to the project footprint during the original baseline assessment. However, sediment quality was sampled and assessed at depositional lake stations situated upstream and downstream of wetland areas. The sediment quality at these nodes would be inclusive of upstream wetland surface water and sediment influences. For further reference to sediment sampling stations during baseline, please refer to Figure 8.2-4 of the EIS. 3) For the purposes of this assessment the bogs and fens within the area can be assumed to provide supporting fish habitat to the adjacent lake and river water bodies in the vicinity of the LSA. Section 9.2.6.4.1 of the draft EIS described the estimated change in the aerial extent of wetland due to direct impacts of the Project footprint (see also Figure 9.2-8). The assessment indicated a total loss of 0.5 ha (less than 0.1%) of all wetlands within the Terrestrial RSA However, when further scrutinizing the potential overprinting of wetland features as a result of the Project it is evident that even this loss is avoidable. The interaction of the Project with wetlands is relegated to those areas where stream crossings for access roads and powerline connections are proposed (**See Figure 2: Denison Wheeler River Project SSA and Wetland Feature Distribution (Attachment IR-101)**). Wetlands associated with stream crossings have been identified to have mitigative designs (clear-span) to ensure no impacts to fish and fish habitat. The hydro-line as shown in Figure 1 will be constructed to avoid direct impacts to fish and fish habitat following best installation practices. As such, no direct impact to any wetlands or waterbodies are expected as part of the Wheeler River Project that may impact fish or fish habitat. As discussed in Section 8.1.6.1 of the EIS, water levels in the ponds and lakes in the vicinity of the of the Project are expected to experience negligible effects, with magnitudes of changes in water levels predicted to be in the sub-centimeter range. As natural fluctuations in lake water levels were approximately 0.4 m from 2011 to 2019, Project-related changes are not expected to be of a magnitude to compromise the Surface Water Quantity VC. It can then be considered a reasonable assumption that any changes to wetland features will have similar sub-centimeter impacts to water levels due to changes in surface flow and/or groundwater and therefore do not pose an indirect effect to water quantity or fish and fish habitat associated with these wetland features. 4) As no impact is expected due to overprinting or due to draw down effects by the ISR, additional mitigation measures are not warranted. Updated baseline information on wetland depths and water-levels may be useful in providing a frame of comparative reference to potential changes during the operation, decommissioning and post-decommissioning phases of the project. However, such changes are expected to be less than measurable.	
IR-102	ECCC	Fish and fish habitat	Section 8.1.3.1 Appendix 8-C, including	**Context:** Only one measured-results dataset for baseline stream flow exists that is relevant to the Project data from the Water Survey of Canada (WSC) station for Wheeler River (06DA005), and the Proponent used constructed records. The Proponent states that data	1. Provide more information on the extension of Project hydrometric station data using WSC station 06DA005.	Please note: Figures and tables associated with this IR response as noted below are provided in Attachment IR-102. See also response IR-236.	Wording errors in Appendix 8-C, Appendix II, Table 1 will be updated in the final EIS as follows: - SA-2 extension method = Unit Area Runoff with Scaling and Offset

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
			Appendix II, Table 1 (p. 2)	from 06DA005 was used to extend local hydrometric station records and calculate baseline water quantity metrics. However, this was done through a complex combination of daily data correlation or monthly unit area runoff relationship, with or without offset, where some stations were based off constructed records instead of the real long-term dataset at 06DA005 (see Section 8.1.3.1 and Appendix II of Appendix 8-C, Table 1, p.2 (PDF p. 569)). Appendix 8-C references previous reports in its own appendices, but no equations are shown and there is no description of the accuracy of the fit, or explanation for not referring back to the one dataset (WSC station). Subsequent statistics calculated from these constructed records (e.g., 7Q10 needed for SK water licenses) would be affected by this uncertainty. **Rationale:** Fish habitat can be altered by changes to depositional and erosional patterns in streams. Confidence in the Proponent's estimate of baseline water quantity, and by extension Project effects to fish habitat, cannot be established without a complete description of the method applied, as well as a discussion of its accuracy.	2. Discuss the accuracy of any correlations/relationships and justify any deviations from simple unit area runoff relationships in the estimation of baseline water quantity values for the Project hydrometric stations. Constructing records from records that are themselves constructed is not recommended. 3. If baseline water quantity metrics need to be revised, discuss (if any) resulting changes to the effects assessment.	1. As mentioned by ECCC and discussed in the draft EIS, baseline hydrometric datasets are available for the Project at various nodes throughout the watershed and these datasets are extended to cover a broader period of record to the Wheeler River station (06DA005) operated by Water Survey Canada. Datasets for local stations measured at the Project cover a range from 2010 to 2019, though the date records are not continuous over this period. There is value in the hydrometric data collected at the Project site and these data should inform the long-term estimates of flow at Project nodes. As such, relationships are established to link 06DA005 first to SA-1 via correlation, than SA-1 to the other stations at the Project via correlation, unit area runoff relationships and unit area runoff relationships with scaled and/or offset influences. The use of 06DA005 solely to extend the record at the Project is reasonable given that it is a direct receiver from the Project watersheds and has a watershed area approximately one order of magnitude larger the SA-1 which is the largest watershed monitored at the Project. Further, trends in the datasets for coincident dates are generally similar and correlated are sufficiently in agreement. 06DA005 is not a perfect proxy for long-term record extension; in particular a flow event in October 2016 results in proportionally greater flow rates than were observed at 06DA005. That said, it is the best available station and incorporates locally and regionally measured data which is standard practice. A wording error in Table 1 of Appendix II of Appendix 8-C indicates that for Assessment Nodes SA-2 and SA-3 the extension method is listed as Unit Area Runoff with Offset. Rather, SA-2 should be listed as Unit Area Runoff with Scaling and Offset and SA-3 should be listed as Unit Area Runoff with Scaling. Also, the source station for SA-5 should be noted as SA-6. These corrections will be made in the final EIS. All record extension methods follow the same equation format (presented below) where the variable Q represents discharge. Correlations may have influence over all five variables while Unit Area Runoff methods may only use one or two. The variable A through E are adjusted to define the fit of the extension method. The fit of the extension method is determined as the summation of the differences between the observed and estimated daily average discharge (or instantaneous measured discharge if the station did not have an installed datalogger) for coincident days in the datasets. Variables A through E are adjusted through a solver algorithm such that the summation of the differences is as near to zero as possible. $$Q_{Assessment\ Node} = A \cdot [B + C \cdot (Q_{Source\ Station} + D)^E]$$ Table 1 in Attachment IR-102 presents the variable used for each assessment node and indicates the source station for the calculation. In Attachment IR-102 following Table 1, figures 1 to 7 are presented for each assessment node show the estimated hydrograph for the station as well as measured discharges and reported hydrographs as daily average discharge. Figures are not presented for nodes LA-1 and LA-5 as there are no measured discharges immediately at the outlet of those lakes. 2. Simple unit runoff relationships from larger watersheds are a reasonable approach when no other data are available for use at a Project. in this approach larger watersheds tend to have attenuation which impacts the timing and magnitude of runoff events When local data are available it is a better approach to understand the relationship of local flow rates within the broader context. As an example, at SA-3 if the unit area relationship is used from 06DA005 direct to that watershed it results in a dramatic under prediction; the measured data indicate that that watershed is capable of generating larger flow rates than would be expected simply based on a unit runoff. Regarding the comment on the use of constructing records based on constructed records, the same methodology is incorporated into developing hydrographs at the Project as is used to estimate flows at 06DA005. The long-term extension of the Project data simply relates the datasets in a manner which is acceptable to the Proponent's technical experts. Using the record extension methodologies presented in Table 1 of Attachment IR1-2, ensures the data provide a better fit ultimately to 06DA005 as understood within the regional context. 3. The proponent is of the professional opinion that the baseline water quantity metrics do not need to be revised and the information presented in the draft EIS and supporting documents is suitable for the intended purpose. As noted in the draft EIS, Section 8.1.6.2, "The confidence in the assessment of predicted effects on hydrology is quite high due to available hydrological data for the LSA. Uncertainty is minimal with the assumptions that water withdrawal and discharge scenarios presented herein represent the bounding case and hydrogeological modelling projections are not changed."	- SA-3 extension method = Unit Area Runoff with Scaling - Source station for SA-5 = SA-6
IR-103	ECCC	Fish and fish habitat	Section 8.1.3.4 Climate Change Influenced Extreme Events	**Context:** The Proponent notes that Intensity duration frequency (IDF) curves are used to estimate the size of water management structures around a site and that the IDF curves are often specific to climate monitoring stations. The Proponent used the IDF_CC Tool 5.0 developed by the Institute for Catastrophic Loss Reduction (2021) which generates Intensity Duration Frequency (IDF) curves at ungauged locations in order to estimate future IDF curve values under influences of climate change. This tool generates sub-daily values at ungauged locations by interpolation and distance weighing from gauged locations. **Rationale:** IDF trends exhibit random behavior at some locations and	Provide the gauged stations used to generate the sub daily duration values found in Table 8.1-6: Baseline of Intensity Duration Frequency data. **Technical Discussion Required**: Yes	ECCC correctly notes that the tool generates sub-daily values at ungauged locations by interpolation and distance weighing from gauged locations. The closest gauged location to the Project is located 35 km south southwest at the Key Lake Mine (KLM) and the IDF values at KLM for historical and future scenarios (Tables 1 and 2 below) are substantially lower than those predicted for the Project. The IDF-CC Tool estimated 1:100-year, 24-hour return period events of 79.9 and 88.6 mm during the current and predicted future values, respectively. As per Tables 1 and 2 those values are substantially larger, and more conservative than, the coincident values of 56.4 and 62.0 mm for KLM. The predicted values for the Project are likely strongly influenced by Cree Lake (4061861; 85 km west southwest) and Collins Bay SK (4061620; 130 km northeast). The interpolation may also be influenced by Stony Rapids A (4067PR5; 196 km north). The Cree Lake, Collins Bay SK and Stony Rapids A stations are all substantially higher than KLM; however, the	No EIS updates are anticipated to address this IR.

<table>
<tr><th>Ref. #</th><th>Department</th><th>Project Effects Link</th><th>Reference to EIS, appendices, or supporting documentation[1]</th><th>Context and Rationale</th><th>Information Requirement (IR)[2]</th><th>Denison Response</th><th>Final EIS Updates</th></tr>
<tr><td></td><td></td><td></td><td></td><td>correlated behavior at other locations. The choice of gauged locations will infer the statistics for the ungauged locations, including the IDF trends. Without identification of the gauged locations, it is not possible to assess if the modelled data is realistic or not. If the modelled data is not accurate the design of water management structures on the site may not be sufficient resulting in the potential for impacts to the Project from flooding or extreme weather events.</td><td></td><td>geography, and likely the climate of KLM, is more similar to those of the Project than from the more distant stations.

Despite the potential for the IDF_CC Tool to use weighting factors, the estimates provided by the tool for the purposes of assessing impacts of the project on the surface water hydrology are robust and conservative including in consideration of flooding or extreme weather events.

<u>IR-103 Table 1: Key Lake (4063753) – Historical IDF</u>
<table>
<tr><th>T (years)</th><th>2</th><th>5</th><th>10</th><th>20</th><th>25</th><th>50</th><th>100</th></tr>
<tr><td>5 min</td><td>5.39</td><td>6.66</td><td>7.11</td><td>7.37</td><td>7.43</td><td>7.56</td><td>7.65</td></tr>
<tr><td>10 min</td><td>7.46</td><td>10.11</td><td>11.40</td><td>12.39</td><td>12.66</td><td>13.37</td><td>13.94</td></tr>
<tr><td>15 min</td><td>9.22</td><td>12.44</td><td>13.97</td><td>15.12</td><td>15.42</td><td>16.23</td><td>16.86</td></tr>
<tr><td>30 min</td><td>11.50</td><td>16.59</td><td>19.20</td><td>21.24</td><td>21.81</td><td>23.36</td><td>24.63</td></tr>
<tr><td>1 h</td><td>13.72</td><td>18.91</td><td>21.28</td><td>23.00</td><td>23.45</td><td>24.61</td><td>25.49</td></tr>
<tr><td>2 h</td><td>15.71</td><td>22.25</td><td>26.04</td><td>29.31</td><td>30.29</td><td>33.09</td><td>35.61</td></tr>
<tr><td>6 h</td><td>21.93</td><td>27.85</td><td>30.92</td><td>33.36</td><td>34.05</td><td>35.92</td><td>37.48</td></tr>
<tr><td>12 h</td><td>26.57</td><td>33.31</td><td>36.50</td><td>38.87</td><td>39.50</td><td>41.17</td><td>42.46</td></tr>
<tr><td>24 h</td><td>35.57</td><td>44.63</td><td>48.82</td><td>51.86</td><td>52.67</td><td>54.76</td><td>56.35</td></tr>
</table>

<u>IR-103 Table 2: Key Lake (4063753) – 2020 – 2050 Predicted IDF using CMIP6 Raw GCMs and SSP5.85</u>
<table>
<tr><th>T (years)</th><th>2</th><th>5</th><th>10</th><th>20</th><th>25</th><th>50</th><th>100</th></tr>
<tr><td>5 min</td><td>5.80</td><td>7.21</td><td>7.72</td><td>8.03</td><td>8.10</td><td>8.29</td><td>8.41</td></tr>
<tr><td>10 min</td><td>8.06</td><td>10.96</td><td>12.42</td><td>13.45</td><td>13.78</td><td>14.70</td><td>15.55</td></tr>
<tr><td>15 min</td><td>9.95</td><td>13.49</td><td>15.21</td><td>16.43</td><td>16.80</td><td>18.04</td><td>18.82</td></tr>
<tr><td>30 min</td><td>12.47</td><td>17.99</td><td>20.90</td><td>23.10</td><td>23.78</td><td>26.00</td><td>27.69</td></tr>
<tr><td>1 h</td><td>14.88</td><td>20.51</td><td>23.16</td><td>25.08</td><td>25.68</td><td>27.36</td><td>28.61</td></tr>
<tr><td>2 h</td><td>16.85</td><td>24.13</td><td>28.27</td><td>31.65</td><td>32.77</td><td>36.06</td><td>39.23</td></tr>
<tr><td>6 h</td><td>23.50</td><td>30.23</td><td>33.64</td><td>36.05</td><td>36.88</td><td>39.24</td><td>41.27</td></tr>
<tr><td>12 h</td><td>28.59</td><td>36.18</td><td>39.67</td><td>42.08</td><td>42.85</td><td>44.99</td><td>46.74</td></tr>
<tr><td>24 h</td><td>38.26</td><td>48.47</td><td>53.03</td><td>56.20</td><td>57.14</td><td>59.86</td><td>62.03</td></tr>
</table>
</td><td></td></tr>
<tr><td>IR-104</td><td>ECCC</td><td>Fish and fish habitat</td><td>Section 8.1.3.4.2 Probable Maximum Precipitation (PMP) Events

Appendix 8C</td><td>**Context and Rationale:** The Proponent notes: “The probable maximum precipitation (PMP) event is a design standard value for an extreme rainfall event. The PMP event does not have an estimated return period but is instead based on the theoretical maximum amount of water that a storm could produce based on the maximum persisting dew point.”

The Proponent provides a PMP value of 489.3 mm, which is based on data and methodologies available in 1999, taken from the <u>Atmospheric Environment Branch Report (1999), Report Number AHSD-R99-01</u>. The Proponent references Appendix 8C for details. Appendix 8C contains no supplementary information other than what is already provided in Section 8.1.3.4.2.

The assumptions and methodologies presented in the report are the results of time series analyses available in 1999. As time series evolve so do the derived statistics. In order to assess potential flood risks and impacts to the Project from flooding, data that is current and representative of the changing climate is needed. The Proponent should explain why they’ve used data from 1999 rather than using up to date data, describe what alternative methods for determining PMP they have considered, and describe how they will support their use of 489.3 mm as a PMP, or describe how they will generate a refreshed PMP. The main factor that influences the statistical data output is the length of the time series hence the reason to keep the statistical data. The PMP values can be substantially (>10%) different if two decades of data is used in the statistical analysis.</td><td>1. Provide a revised PMP value (using up to date data) or justify the use of a PMP that is based on data and methodologies from 1999 as opposed to a more recent time series analysis.

2. Describe the alternative methods for determining PMP values that were considered. Include descriptions of both “statistical” outcomes and “rational” outcomes as applicable.

Technical Discussion Required: Yes</td><td>Please see response to IR-15, IR-236 and AD-15. Although there are a variety of methods available to derive a PMP, Denison’s selected PMP for engineering design (i.e., 493 mm; see response to IR-15; based on Canadian Climate Program [1994]) is over 5 times higher than observed and predicted 24 hour precipitation events (both 1 in 100 year, 24 hour return precipitation events and 24-hour maximum precipitation events; see response to AD-15), and as such, Denison is confident that the Project water management infrastructure will be appropriately designed. The PMP included in Section 8 of the draft EIS was 489.3 mm from a more recent publication (Atmospheric Environment Branch [1999]). Denison retained the higher of the two PMP values (i.e., 493 mm) for design purposes.

The proponent will address the information requirements in reverse order of the way they are presented.

2. The World Meteorological Organization (WMO) issued Manual on Estimation of Probable Maximum Precipitation (PMP) in 2009 (WMO-No. 1045), the third edition of this manual. This document presents several methodologies for estimation of PMP and is preceded by the similar second edition 1986 document titled “Manual for Estimation of Probable Maximum Precipitation (WMONo.332)”. The 1986 document served as part of the foundation for analyses presented by Atmospheric Environment Branch (1999). WMO indicates that the 2009 document “keeps a majority of the content from the second edition” and newly added content since 1986 is for “directly estimating PMP for the requirements of a given project in a design watershed on probable maximum flood (PMF) in China, the United States of America, Australia and India.” As such, the proponent believes the Atmospheric Environment Branch (1999) analysis remains current within the context of the Project.

Atmospheric Environmental Branch (1999) builds upon a similar document produced in 1994 (Canadian Climate Program, 1994). The 1994 text discusses methodology and results of analyses for northern Saskatchewan. Though the author is confident in their assessment, the author does indicate that values estimated through northern Saskatchewan may be “spurious” due to the scarcity of climatological data in the region. The use of the term “spurious” seems to be in reference to predicted PMP values which are substantially higher than those where data are available.

Additional analyses would be possible for this assessment; however, climatological data remain scarce in northern Saskatchewan. Though there is uncertainty as to the result of</td><td>No changes to the EIS are required.</td></tr>
</table>

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						reassessment of PMP values in the vicinity of the Project, others have completed their own reassessment of PMP values based on locally monitored data which yielded a much smaller result for the PMP. In that situation the proponent opted to stay with a value of 489.3 mm as estimated by Atmospheric Environment Branch (1999) even though it was substantially larger than their reassessed value (NexGen Energy Ltd., 2022). 1. Though it is presumed that methodologies have not changed appreciably to justify a reassessment of the PMP, the data scarcity component would also influence the potential for accurate estimation of the design storm. No new stations have been added in northern Saskatchewan with sufficient data record to improve regional observations which play a role in Hopkinson's analyses. Anecdotally speaking, the estimates of 489.3 mm across the northern Saskatchewan region are considered very high by other practitioners in the industry. This seems to be supported by additional analyses completed for NexGen Energy Ltd. (2022). The acceptance of 489.3 mm or 493 mm as the PMP for the Project falls in line with magnitudes used by existing operators in the area and is likely a conservative estimate. References: Atmospheric Environment Branch. 1999. Environment Canada Prairie and Northern Region – Point Probable Maximum Precipitation for the Prairie Provinces. Atmospheric Environment Branch, Atmospheric and Hydrologic Sciences Division. Regina, Saskatchewan. Report No. AHSD – R99 – 01. Canadian Climate Program. 1994. Point Probable Maximum Precipitation in Northern Saskatchewan. R.F. Hopkinson. Scientific Services Regina Operations Building, Regina Airport. Regina, Saskatchewan. Report No. CSS – R94 – 01. NexGen Energy Ltd. 2022. Rook I Draft Environmental Impact Statement. June 2022.	
IR-105	Directorate of Fisheries and Oceans (DFO)	Fish and fish habitat	Section 8.1.4.1, Potential interactions between project and valued component/key indicators Surface Water Quantity Section 8.1.4.2.2, Surface Water Taking 8.3.4.1, Potential interactions between project and valued component/key indicators	**Context:** Table 8.1-8 and Table 8.3-6 in the EIS indicates a potential for freeze wall operation to influence groundwater interactions and surface water quantity and as a result, impact fish and fish habitat. Section 8.1.4.2.2 references Section 7 Geology and Groundwater for details on potential impacts. In addition, IR-63 notes the groundwater model does not describe the pathway in which groundwater would pass around the freeze wall during operation and any resulting potential effects on groundwater discharge to Whitefish Lake. **Rationale:** As per IR-63, the groundwater model analysis is insufficient to make conclusions on the potential effects of the freeze wall on groundwater discharge into Whitefish Lake. DFO requires this information to fully understand if altered groundwater regimes will result in changes to Whitefish Lake water levels and any potential impacts to fish and fish habitat as a result of changing water levels.	1. Provide a more fulsome analysis of the potential impact of freeze wall operations on local and semi-regional groundwater regimes, and subsequently to fish and fish habitat within Whitefish Lake. The analysis should provide a rationale of how the scope of the groundwater model is relevant to and able to detect changes at the scale of fish and fish habitat. 2. If impacts to fish and fish habitat in Whitefish Lake are predicted to occur due to changes in the groundwater regime, describe any mitigation measures that could be used to avoid these impacts. 3. If impacts are predicted that cannot be avoided, characterize residual effects on fish and fish habitat.	Please refer to the disposition for IR-63 for a fulsome explanation of the minor impact that the freeze wall will have on the area and regional groundwater flows. It was concluded that the freeze-walled area is a relatively small disruption to the regional groundwater flow system. Potential indirect impact to the surface water hydrology at Whitefish Lake as a result of project induced changes to the hydrogeology of the area was considered as part of Section 8.1 and discussed in Appendix 8-C. The project impacts were inclusive of changes in groundwater contributions to LA-5 as listed in Table 4-1 of Appendix 8-C. The analysis included the most up to date information during the preparation of the EIS and which indicated a potential loss in contribution of 4-6 L/s of groundwater reporting to LA-5 through the operation and decommissioning phase. This input is anticipated to return to pre-disturbance conditions for Post-Decommissioning. More recent calculations of the potential loss of groundwater contribution to Whitefish Lake as 9.9 L/s. This change is within the same magnitude of that previously modelled and therefore is not likely to constitute a change in the assessment of significant effects for the aquatic environment. Recent modelling using a loss of 9.9 L/S indicates that the majority of this change is due to dewatering of the ISR area and not due to the freeze wall itself. As indicated in Attachment IR-63, the groundwater flow contours will locally deviate from their original paths due to the installation of the freeze wall and the pumping, yet this will not impact the larger spatial migration of groundwater to the lake. Furthermore, groundwater discharge distribution (i.e., seeps and upwellings) will continue to occur in a similar pattern during pumping as to pre-pumping. This indicates that while the overall groundwater discharge rate is reduced, the areas of primary groundwater discharge will remain unchanged. As such, fish which utilize LA-5 for critical life-history periods (namely Northern Pike) will not be impacted due to changes in groundwater interactions directly, or indirectly due to reductions in surface water levels or flow. As such, additional mitigation measures outside that currently proposed in the draft EIS are not suggested.	Based on the response no revisions to the EIS are needed.
IR-106	CNSC	Change to an environmental component due to hazardous contaminants	Section 8.1.4.2.3, Surface Water Discharge	**Context:** It is stated in this section under construction that all site contact water will be held in the Clean Waste Rock Pond. **Rationale:** It is unclear from this section what will happen to the contact water held in the Clean Waste Rock Pond, and whether it will be removed from site or released at a later time. What is the contingency plan if more contact water is produced during construction than the Clean Waste Rock Pond has capacity for.	Please indicate what will happen to the contact water stored in the Clean Waste Rock Pond during construction activities, will it be released after the wastewater treatment plant is installed? Further, please describe the contingency plan if contact water produced exceeds estimates and will exceed the volume of the clean waste rock pond?	During Construction, no effluent is expected to be released to the aquatic environment. Contact water stored in the Clean Waste Rock Pond during Construction will be held onsite until the Industrial Wastewater Treatment Plant (IWWTP) is commissioned. At that time the water from the pond would be conveyed to the IWWTP, treated, and released to Whitefish Lake per permit / license requirements. The sequence for Construction activities will occur in a logical manner based on Project execution plans. For example, construction of the wellfield runoff pond will be prioritized during the early part of Construction and it will able to hold 38,200 m^3 of water. This will provide contingency and additional water storage capacity if contact water produced exceeds estimates or the volume available in the Clean Waste Rock Pond. Other secondary contingency measures are also available should the volume of water requiring management exceed site infrastructure storage volume. This could include use a hydrovac for offsite disposal.	No changes to the EIS are required.
IR-107	CNSC ECCC	Aquatic environment	Section 8.2.3.3, Existing Surface Water Quality	**Context:** Under the methodology and metrics section (8.2.3.1) it is stated baseline water quality was sampled in 2016, 2018, and 2019. Looking at the data in Appendix A of Appendix 8D it seems that some waterbodies have little data available for baseline characterization. For example, Whitefish Lake only has 3 and 5 samples taken between its two sample stations, with sampling frequency seeming intermittent. **Rationale:** The amount of data available for baseline water quality	Please clarify what data quality objectives were used for the baseline characterization data. Please provide justification whether the number of datapoints collected with inconsistent frequency in baseline surface water characterization is sufficient to meet data quality objectives and to adequately characterize the baseline, and whether Denison is confident that the data collected is enough for a robust water quality baseline characterization.	Surface water quality was sampled through 2016, 2018, and 2019 on a monthly basis which is generally consistent with federal requirements for assessing potential impacts through EA. Hydrological assessment has occurred from 2011 to 2019. Mean Annual Discharge (MAD) (m^3/s) as measured at the Water Survey Canada (WSC) Wheeler River Watershed Station (06DA005) during 2016, 2018 and 2019 was 17.07, 17.34 and 19.23, respectively, all of which were slightly above the 43 year (1977 to 2019) average of 16.82. The MAD in 2016 and 2018 can be considered near average, with 2019 being considered an average-high flow year, but well below the maximum observed for the timeseries (27.62 m^3/s). Since this period, there	No changes to the EIS are required.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				characterization does not seem sufficient to adequately characterize the baseline and the variation it would experience. An effective baseline characterization is vital to ensure water quality is indeed not being affected by the project. In addition, it is not clear if data quality objectives were applied to determine baseline information was adequate. To meet CEAA 2012 requirements, and CNSC expectations outlined in REGDOC 2.9.1, Environmental Principles Assessments and Protection Measures, the applicant is required to complete a characterization of the baseline environment. As described in REGDOC 2.9.1 Appendix B.2, Characterization of the Baseline Environment for Environmental Assessment Under CEAA 2012, the "baseline information should be sufficient to support the use of an aquatic dispersion model to conduct the site-specific ERA and to support an assessment of the effects of the environment on the facility or activity" In addition, the "applicant or licensee should include an assessment of any limitations or gaps in the quality and extent of baseline data and methods, as well as the method(s) by which they have been addressed."	**Suggestions for mitigation and follow-up measures:** CNSC recommends that additional water samples are collected and analyzed at a consistent frequency to ensure a robust baseline	have been no land use changes within the area that would constitute a major change in water quality. Baseline water quality samples were collected during years of average to average-high flows in the Wheeler River system and therefore representative of background conditions for assessment of potential impacts in the EIS. Additional conservatism was included in the impact assessment by using the 95th percentile values for baseline parameter concentrations when modelling potential effluent effects. As such, the surface water quality data collected are suitable for the intended purpose of assessing potential impacts and the additional conservativisms that were included as part of the assessment were precautionary. Given the above, Denison feels strongly that the baseline water quality data collected are suitable for the purposes of the EIS and the application of additional conservatisms in the use of the data provide a conservative (i.e., protective) framework for evaluating potential effects. Denison commits to the collection of additional surface water quality baseline data prior to project development starting to ensure updated baseline information is available for identification of any changes that might influence estimates of Project impacts. These data will be used to support permitting and licensing through updates to the ERA.	
IR-108	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.3.3 Aquatic Environment	**Context:** Tables 8.2-2 and 8.2-3 provide summaries of the baseline surface water quality in the LSA. No justifications for the selection of water quality guidelines have been provided. COPCs that require calculations based on other parameters such as hardness, pH, or temperature to derive guidelines (i.e., ammonia, cobalt, zinc, etc.) should be indicated within the table, with a note specifying the parameter values used in the calculations, so that thresholds may be confirmed. No baseline data for un-ionized ammonia has been provided, which is a Schedule 4 substance requiring monitoring under the MDMER. For cobalt, manganese, and vanadium, Federal Environmental Quality Guidelines (FEQGs) and/or CCME Canadian Water Quality Guidelines (CWQGs) for the Protection of Aquatic Life have not been included. A guideline of 26 mg/L has been provided for molybdenum as a Saskatchewan Environmental Quality Guidelines (SEQG), however the actual SEQG is 31 mg/L and the CCME CWQG is 0.073 mg/L. **Rationale:** In order to assess potential changes to surface water quality from Project related activities, ECCC requires that data on all parameters that require MDMER effluent and receiving environment monitoring be provided for assessment, including accurate water quality guidelines where available.	1. Update Tables 8.2-2 and 8.2-3 to include all COPCs that require effluent characterization and receiving environment monitoring under the MDMER. 2. Update Tables 8.2-2 and 8.2-3 to include missing or corrected water quality guidance thresholds, and information on values used to derive thresholds for COPCs that are dependent on general parameters.	Please see Attachment IR-108.	Tables 8.2-2 and 8.2-3 will be updated in the final EIS, per Attachment IR-108.
IR-109	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.1.1 Aquatic Environment	**Context:** In this section it is stated "Treated water from the IWWTP will be pumped to the three Effluent Monitoring and Release Ponds (each 3,300 m3). These ponds will be designed to hold effluent for 72 hours for testing before discharge to the environment" (p. 8-75). It is unclear what procedure will be followed if effluent in monitoring ponds does not meet discharge requirements following testing. Additionally, it is also stated that "Treated water in the Effluent Monitoring and Release Ponds will be monitored prior to release to a surface waterbody or injected into groundwater via deep well injection." However, the MDMER pursuant to the Fisheries Act requires all mine effluent and seep. from the mine site that contain deleterious substances be discharged through a final discharge point. **Rationale:** In order to fully understand effluent management, more information is required regarding the procedure for managing effluent in monitoring ponds that does not meet discharge requirements. It is unclear how effluent that does not meet discharge requirements will be managed if it needs re-treatment and re-testing prior to discharge. ECCC reminds the Proponent that Project effluent from all final discharge points must meet federal legislation requirements.	Provide further information regarding management of effluent in monitoring ponds that does not meet the requirements for discharge under the MDMER.	Section 2 Project Description, Section 2.2.3.9 Treated Effluent Monitoring and Release Ponds of the draft EIS outlines Denison's commitment to test effluent prior to discharge to Whitefish Lake, to ensure it meets federal and provincial discharge limits. Any pond not meeting the criteria will be recycled back to the Industrial Wastewater Treatment Plant via the process water pond.	No EIS updates are anticipated to address this IR.
IR-110	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.1.1 Aquatic Environment Appendix 8-E, Section 2.1	**Context:** It is stated that the diffuser at the final effluent discharge point will be located in approximately 3m of water. However, in Figure 8.2-5 displaying the location of the proposed diffuser and lake bathymetry, the diffuser location seems to be located in 2-2.5m of water. A similar image in Figure 1 Section 2.0 of Appendix 8-E also indicates that the diffuser seems to be located in 2-2.5m of water. Additionally, while thermal effects are unlikely, this cannot be confirmed until a more detailed diffuser design is provided for review. **Rationale:** The Proponent should confirm the location and depth of the proposed diffuser in order to confirm that modelling predictions for effluent discharged into the receiving environment are accurate.	Provide confirmation of the diffuser depth and location. ECCC requests the opportunity to review the finalized diffuser design once it is available.	The diffuser will be placed at a depth between 2.5 and 3 m. The mapping provided in the draft EIS and Appendix 8-E is based on coarse bathymetric information, which will be supplemented with more robust bathymetric surveys to support final siting and design associated with permitting and licensing.	No EIS updates are anticipated to address this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
IR-111	CNSC	Fish and fish habitat	Section 8.2.4.2.2, Controlled Discharge	**Context:** This section of the EIS indicated that the scenario was assessed using a conservative assumption of a continuous freshwater withdrawal rate of 40.5 m3/hr, and a continuous effluent discharge rate of 81.0 m3/hr. **Rationale:** The withdrawal rate assessed is half of the effluent rate, it is unclear from the text where the other half of the volume of effluent is coming from, if not drawn from the lake.	Please clarify where the other half of the total volume of effluent discharged is from in the water balance between water intake and effluent.	Process water will be drawn from both groundwater and surface water (when required). The 81.0 m^3/hr discharge rate conservatively assumes withdrawal from both sources at the maximum proposed rates. Please refer to Section 2.2.3 and specifically Figures 2.2-14, 2.2-15 and 2.2-16 of the draft EIS which depict the water balance for the Project for each of Construction, Operation and Decommissioning phases.	No EIS updates are anticipated to address this IR.
IR-112	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.2.2, Aquatic Environment Appendix 8-E, Section 1.2.1 Appendix 10-A (ERA), Section 3.1	**Context:** This section of the EIS states that, "for the purpose of assessing the scenario of greatest potential effects, the Project was assessed as having a continuous freshwater withdrawal rate of 40.5 m^3/hr and a continuous effluent discharge rate of 81.0 m^3/hr." (p. 8-21) However, several sentences later it is stated that, "The approach to assessing Project-related effects on the Surface Water Quality VC was conservative for the following reasons: The assessment was based on a continuous (year-round) discharge rate at an expected average effluent discharge of 0.0101 m3/s (or 36.5 m3/hr) throughout Construction, Operation, and Decommissioning…" This is a continuous theme throughout Section 8, Aquatic Environment, where the discharge rate for the surface water quality assessment changes between 36.5 m3/hr and 81.0 m3/hr. However, in Appendix 10-A (ERA) the 36.5 m3/hr discharge rate is the only value used for the near and far-field modelling. It should be made clear in the main body of the draft EIS that the average effluent discharge rate of 36.5 m3/hr has been used as the input for the near- and far-field modelling for effluent, surface water and sediment quality predictions. The maximum upper bound discharge rate is 81 m3/hr; however, modelling for effluent, surface water and sediment quality was not completed for this discharge rate. **Rationale:** It remains unclear throughout the draft EIS that all predictions of COPC concentrations in effluent, and receiving environment surface water and sediment are based upon the effluent discharge rate of 36.5 m3/hr, and not the maximum upper bound discharge rate of 81 m3/hr. All conclusions about risk to the environment and aquatic and terrestrial biota must make this clear. If the Proponent wishes to make conclusions based on the maximum upper bound discharge rate of 81 m3/hr, modelling needs to be conducted using this rate of discharge.	1. Confirm that the surface water quantity, quality, and aquatic biota risk assessments and modelling, were conducted using the discharge rate for 36.5 m3/hr within the draft EIS. 2. Revise any statements or conclusions in the draft EIS to improve clarity about the usage of the maximum upper bound discharge rate of 81 m3/hr. Remove statements regarding use of the discharge rate of 81 m3/hr during modelling and risk assessments to the receiving environment as needed.	1. Denison confirms that the surface water quantity, quality, and aquatic biota risk assessments presented in the draft EIS and ERA (Appendix 10A) were conducted using the discharge rate for 36.5 m^3/hr. 2. Denison provides the following summary to clarify effluent discharge rates and identify updates to the final EIS: • Section 8.2.4.2.2 of the EIS will be modified (see details in EIS Updates column). • Appendix 8-E used an effluent discharge rate of 36.5 m^3/hr, which is correct. No changes required. • Appendix 10-A used an effluent discharge rate of 36.5 m^3/hr in the modelling and ERA results; however, in Section 6.2 of the ERA in Appendix 10-A, a sensitivity analysis was conducted to assess the effects on surface water and sediment when the effluent discharge rate is increased to the upper bound discharge rate of 81 m^3/hr. No changes required.	The sentence in Section 8.2.4.2.2 will be updated in the final EIS as follows: Denison does not intend to include constant freshwater withdrawal or effluent discharge throughout Operation; however, for the purpose of assessing the scenario of greatest potential effects, the Project was assessed as having a continuous freshwater withdrawal rate of 40.5 m^3/hr and a continuous effluent discharge rate of ~~81.0~~ **36.5** m^3/hr.
IR-113	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.2.3 and Section 8.4.7.6, Aquatic Environment	**Context:** No quantitative assessment of climate change has been conducted. Representative concentration pathways (RPC) projections for climate change have not been integrated with near-and far-field modelling to assess impacts to surface water quality or sediment quality in the future. **Rationale:** Changes in air and water temperatures, precipitation, snow melt, ice formation, etc., due to climate change can all influence COPC concentrations in surface water and sediment. It is not possible to assess the potential impacts from climate change on predicted surface water and sediment COPC concentrations with the current information.	Provide a quantitative analysis of the potential impacts of predicted COPCs from mine effluent to surface water and sediment quality with climate change scenarios for the Project lifespan incorporated into modelling. Include modelling predictions regarding the influence of changes to air and water temperatures, precipitation, snow melt, ice formation, etc., on COPC concentrations in surface water and sediment.	Section 8.1.3.4 (and Appendix 8-C) provides a quantitative assessment of the potential changes in surface water quantity due to climate change. The 1:100 year, 24-hour return period rainfall events for the baseline and climate change influenced IDF curves are 79.9 mm and 88.6 mm, respectively. The PMP for the Project is estimated to be 493 mm (refer to IR-15 and AD-15) which is well above both 24-hour maximum precipitation and 1:100, 24 hour return precipitation events. The PMP is very conservative (e.g., assumes effectively a full year of precipitation in one event) under both existing and future conditions (climate change). The potential impacts of climate change to precipitation and therefore flows was summarized in Appendix 6-C, Table 10 with the total annual precipitation and the maximum 1-day events being variable over the next four decades (Table 1). Regardless, the climate change scenario indicates a potential increase in event based assimilative capacity in the receiving environment. TABLE 1- **Existing and Predicted Precipitation Data for Key Lake (provided in EIS, Appendix 6-C, Table 10)**	No EIS updates are anticipated to address this IR.

Year	**Total Annual (mm)**				**Maximum 1-day (mm)**			
	Measured	RCP 2.6	RCP 4.5	RCP 8.5	Measured	RCP 2.6	RCP 4.5	RCP 8.5
2011-2020	455	518	509	508	48	29	27	27
2030		528	503	537		27	24	26
2040		487	498	514		28	29	24
2050		504	524	520		26	29	33
2060		513	515	523		26	33	26
2070		527	534	568		29	31	28
2080		539	551	547		30	33	28
2090		543	545	548		31	32	35
2100		546	535	559		23	25	28
Overall Increase:		28	26	51		-6	-2	1

To mitigate the potential for unplanned release of deleterious substances into the surface water environment even during the next 40 years of climate change, the PMP of 493 mm was

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						used for water management engineering designs. During a PMP, water requiring management will report to the wellfield runoff pond which will be sized to accommodate a PMP event at the site. This pond has been sized to 38,200 m^3 (excluding a freeboard of 1 meter). From the wellfield runoff pond, water will then be sent to the process water pond for treatment if required. In Section 2.8 Project Design Features, Denison notes that "Ponds will be designed to maintain a minimum freeboard of at least 1.0 m to allow for continued functioning during a probable maximum precipitation (PMP) event." As such, the project has been designed to manage water during PMP and greater, and therefore mitigation of potential impacts to water quality due to climate change has been initially included as part of the EIS. As a result, it is Denison's opinion that a quantitative assessment of potential impacts to surface water quality is not warranted as it is likely to indicate improved results from the conservative assessment of potential water quality changes during operation and decommissioning phases. Continued monitoring of background, effluent and receiver water quality will be undertaken and provide the ability for adaptive management throughout the life of the mine in association with potential climatic changes to the local and regional area.	
IR-114	ECCC CNSC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.2.3 and Section 8.2.4.2.4	**Context:** Tables 8.2-9, 8.2-10 and 8.2-13 demonstrate predicted maximum effluent concentrations of COPCs and maximum predicted receiving environment concentrations in the near- and far-field. General parameters such as temperature, pH, conductivity, etc. that would require Project thresholds and monitoring under the MDMER have not been provided in this table. Lead, nickel, TSS and un-ionized ammonia were not provided, despite all being Schedule 4 substances with maximum monthly concentrations under the MDMER. Aluminum, iron, nitrate, thallium, and manganese have not been provided despite being required parameters under Schedule 5 Section 4 of the MDMER for effluent characterization. For zinc, it is unclear how guidelines have been calculated when CCME thresholds can only be derived with hardness values <250 mg/L. Additionally, water quality thresholds appear to have been calculated using estimated effluent concentrations rather than receiving environment baseline concentrations. Mercury has been identified as a COPC of interest to Indigenous groups for the proposed Project. Table 8.2-8 indicates that background concentrations of mercury in LA-5 are low, and predicted effluent concentrations are also low. However, no information has been provided on background methylmercury concentrations or expected atmospheric deposition of mercury from Project related emissions. Predicted effluent concentrations of 3915 mg/L of sulphate are quite high, and sulphate is known to increase mercury methylation rates in aquatic environments. **Rationale:** A review of all modelling results for all COPCs under the MDMER will assist ECCC in understanding the potential risks to the receiving environment. ECCC recommends the use of the most stringent guidelines for the protection of aquatic biota. All water quality thresholds should be derived from receiving environment parameters to determine any baseline receiving environment and effluent COPC exceedances of water quality thresholds. Increased sulphate availability can lead to increased methylation rates of mercury and methylmercury in sediment and surface water. Methylmercury is a toxin that can bioaccumulate within the food chain and present risks to aquatic biota and wildlife consuming aquatic biota. Potential changes to methylmercury concentrations in water quality, sediment and fish tissues should be assessed due to the proposed sulphate loadings in effluent. Additionally, in accordance with the MDMERs, Denison will be required to demonstrate that their effluent quality meets the limits in the MDMER. Denison is expected to provide the predicted effluent quality for lead, nickel, and un-ionized ammonia to demonstrate compliance with the MDMERs.	1. Update all tables to include all COPCs with required monitoring under the MDMER including acute and chronic thresholds. 2. Ensure all selected water quality thresholds are derived using baseline receiving environment concentrations and use water quality guidelines that are protective of aquatic biota. 3. Provide baseline data on the concentrations of methylmercury in surface water, sediment and fish tissues (i.e., large- bodied sports fish and small-bodied forage fish) in the LSA and RSA receiving environment to establish a baseline prior to potential Project impacts. 4. Provide an assessment of risk from methylmercury to ecological receptors due to changes in sulphate concentrations in effluent, and potential deposition of mercury from Project related atmospheric emissions in the receiving environment.	See response in Attachment IR-114.	Tables 8.2-9, 8.2-10, and 8.2-13 will be updated in the final EIS. The updated tables are provided in Attachment IR-114.
IR-115	ECCC	Fish and fish habitat	Section 8.2.4.2.3 Aquatic Environment Appendix 10-A (ERA), Section 3.1.1.1	**Context:** Table 8.2-8 demonstrates baseline concentrations of COPCs in LA-5 South Whitefish Lake, their respective water quality guidelines from applicable sources, and proposed Project thresholds. General parameters such as temperature, pH, conductivity, etc. that would require Project thresholds and monitoring under the MDMER have not been provided in this table. Lead, nickel, Total Suspended Solids (TSS) and un-ionized ammonia were not provided, despite all being Schedule 4 substances with maximum monthly concentrations under the MDMER. Aluminum, iron, nitrate, thallium, and manganese have not been provided despite being required parameters under Schedule 5 Section 4 of the MDMER for effluent characterization. Water quality thresholds appear to have been calculated using estimated effluent concentrations rather than receiving environment baseline concentrations. The water quality objective selected for molybdenum is the 31 mg/L SEQG rather than the CCME guideline of 0.073 mg/L. **Rationale:** ECCC recommends the use of guidelines that will ensure the protection of aquatic biota. All water quality thresholds should be	1. Update Table 8.2-8 to include all COPCs with required monitoring under the MDMER. 2. Ensure all selected water quality thresholds are derived using baseline receiving environment concentrations and are at levels protective of aquatic life. 3. Provide additional information to justify the use of the selected water quality guideline for molybdenum.	1. Table 8.2-8 has been updated and provided in Attachment IR-115 2. Denison believes that the water quality thresholds used in the assessment (Section 8.2.4.2.3, Aquatic Environment; Appendix 10-A (ERA), Section 3.1.1.1) were appropriate and reflect levels that are protective of aquatic life. The predictive water quality analysis considered the effects of toxicity modifying factors, such as hardness, on water quality. Specifically, the analysis considered induced hardness - that is hardness that is derived from or includes contributions from on site sources and in this case discharge from the IWWTP. It is a reasonable in this case to utilize induced hardness since the water quality assessment directly considers the potential effect of IWWTP discharge on the receiving environment. The hardness added to the receiver from the discharge represents a constant source during periods of discharge. The effluent hardness value used in the analysis was derived from bench scale testing and is considered to be a reasonable estimate of expected hardness in effluent. With that in mind, the predictive water quality analysis reflects the water quality conditions that are anticipated to prevail in the receiver and therefore presents an appropriate platform on which to base the effects assessment.	Table 8.2-8 of the draft EIS will be replaced per the IR response as indicated.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				derived from receiving environment parameters to determine any baseline receiving environment and effluent COPC exceedances of water quality thresholds.		3. Denison has selected the Saskatchewan specific guideline for molybdenum of 31 mg/L to be the most appropriate for the Project. It was derived from recent data following the CCME (2007) protocol. The molybdenum water quality objective based on the 5th percentile (HC5) of the species sensitivity distribution (SSD) according to the CCME protocol; 18 data points for 12 different species were used, mainly EC10 data (WSA, 2017). The CCME guideline is identified as an interim guideline and was based on multiplying the lowest chronic toxicity value, the 28-d LC50 of 0.73 mg/L for rainbow trout (O. mykiss), by a safety factor of 0.1. This original study by Birge (1978) has not been reproducible, either using the original methods or using standard methods (Davies et al. 2005). No changes to the EIS are proposed in this regard. <u>References:</u> Birge, W.J. 1978. Aquatic Toxicology of Trace Elements of Coal and Fly Ash. Special Collections, USDA National Agricultural Library. Accessed February 16, 2023, https://www.nal.usda.gov/exhibits/speccoll/items/show/5224. CCME. 2007. A protocol for the derivation of water quality guidelines for the protection of aquatic life. Davies, T.D., J. Pickard and K.J. Hall. 2005. Acute molybdenum toxicity to rainbow trout and other fish. Journal of Environmental Engineering & Science 4: 481-485. WSA (Saskatchewan Water Security Agency). 2017. Saskatchewan Water Quality Objective for the Protection of Aquatic Life – Molybdenum. Fact Sheet. Report No. WSA 514.	
IR-116	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.2.5, Section 8.4.4.2.5 and Section 8.5.4.2.3	**Context:** Tables 8.2-14, 8.4-9 and 8.5-5 demonstrate predicted mass flux (in mg/s) of COPCs in groundwater during the future centuries scenario. The table does not provide any information on actual surface water concentrations of COPCs or accumulation in concentrations over time. It is not possible to determine what the COPC concentrations in surface water and sediment will be during the future centuries scenario with the current information. Additionally, only a subset of parameters have been provided in this table based on parameters that were elevated in effluent after treatment. Groundwater may have a variety of different COPCs with elevated concentrations as it will migrate directly from the ore body area and not receive treatment. **Rationale:** It is not possible for ECCC to assess the predicted concentrations of COPCs in surface water and sediment, and therefore risk to aquatic biota during the future centuries scenario with the provided information.	1. Provide the predicted water and sediment quality concentrations of COPCs in the receiving environment for the future centuries scenario. 2. Include data for a greater suite of COPCs that were assessed as having potential to be at elevated concentrations in groundwater.	See response in Attachment IR-116.	The EIS will be updated with the information provided in Attachment IR-116. Specifically, Table 8.2-14 and Table 8.4.9 of the EIS will be replaced by Table 1 of Attachment IR-116 and Table 8.5.5 will be replaced by Table 2 of Attachment IR-116..
IR-117	CNSC	Human health with respect to hazardous contaminants	Section 8.2.4, Table 8.2-9	**Context:** CNSC staff note that some of the effluent quality predictions in the EIS are quite high for a uranium mine and mill facility compared to the existing facilities. For example, the upper bound effluent quality of molybdenum is 2.5 mg/L. In 2021, the highest monthly mean concentration at the existing uranium mine and mill facilities is 0.213 mg/L. Also, the upper bound effluent quality of copper is 0.022 mg/L. In 2021, the highest monthly mean concentration at the existing uranium mine and mill facilities is 0.002 mg/L. **Rationale:** Surface water quality models should be based on the anticipated effluent quality. From discussions with Denison, it appears that the effluent quality predictions may change based on the results of more bench scale tests that are still being conducted and continued optimization of the design of the water treatment plant.	Please provide the anticipated effluent quality of the constituents of potential concern during normal operations. Once Denison has refined the effluent quality predictions, Denison is expected to update the inputs into the surface water quality model.	The anticipated effluent quality of constituents of potential concern during normal operations presented in the draft EIS is based primarily on lab tests conducted by Denison with a safety factor of three added. Section 3.1.1.2 of the ERA (Appendix 10-A) states: "The reasonable upper bound treated effluent was derived using a combination of information available from lab tests conducted by Denison as well as derived effluent quality based on not exceeding water and sediment quality guidelines in the middle part of Whitefish Lake. Effluent treatment feed solution was prepared by leaching drill core material from the Phoenix deposit, and further processing that solution through two steps (process precipitate removal and yellowcake precipitation) prior to effluent treatment testing. Effluent treatment tests incorporated three stages: low pH, high pH, and neutralization. A combination of reagents (iron sulphate, barium chloride, lime, and sulphuric acid) was used to facilitate precipitation of constituents. After each stage, solid-liquid separation was conducted by mixing flocculant with solution to settle solids to the bottom of the test vessel. The supernatant liquid was used for the following stage. The solids were washed, filtered, and dried to determine solids mass generation for mass balance purposes. For each stage, the liquids and solids were assayed for various COPCs. The reasonable upper bound effluent was usually an expected effluent quality from Denison multiplied by a safety factor of three." The derived effluent quality based on not exceeding a water and sediment quality guideline was only used for a handful of constituents. The ERA will be revised to remove lead-210 from the list of constituents that used the derived effluent quality, as the concentration was based on Denison lab tests. In addition, Section 3.1.1.2 of Appendix 10-A will be modified to state: "The derived effluent quality was used for a handful of constituents including cadmium, chromium, and selenium". Denison intends to continue to refine effluent quality predictions as part of the BATEA assessment and licensing phase of the Project. The effluent quality predictions provided in the EIS will continue to bound the assessment and provide a conservative representation of risk to human health and the environment. No changes to the EIS are proposed in this regard. See also responses to IR-16 and IR-18.	Revisions to the draft EIS and ERA (Appendix 10-A) will be made per the IR response as indicated below. Section 10.1.4.2.2 of the EIS and Section 3.1.1.2 of the ERA (Appendix 10-A) will be revised to remove lead-210 from the list of constituents that used the derived effluent quality, as the concentration was based on Denison lab results. The text in both sections will read "The derived effluent quality was used for a handful of constituents including cadmium, chromium, and selenium."
IR-118	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.6.1, Section 8.4.6.1 and Section 8.5.6.1, Aquatic Environment	**Context:** It is unclear if Tables 8.2-16, 8.4-12, 8.5-7 and 8.5-8 take into consideration potential effects from groundwater seepages of COPCS to surface water and sediment quality in the future centuries scenario. No information regarding the future centuries scenario has been provided in the rationale summary for ratings. **Rationale:** Groundwater seepage of COPCs may have future impacts to surface water quality, sediment quality and aquatic receptors; however, the extent of residual effects is unclear without further information.	Provide further information regarding how groundwater seep. of COPCs may have future impacts to surface water quality, sediment quality, and aquatic receptors, and any residual effects that may persist.	It can be confirmed that Tables 8.2-16, 8.4-12, 8.5-7 and 8.5-8 did take into consideration potential effects from groundwater seepages of COPCs to surface water and sediment quality in the future centuries scenario. Ground water contributions to surface water as a result of excursions or migration from the shallow groundwater aquifer to Whitefish Lake was well documented in Section 7 and Appendix 7-C. For the COPCs identified in the effluent, the predicted mass flux from groundwater into Whitefish Lake Middle starting 200 years after the Project phases, during the future centuries, was input to the IMPACT model to predict the water and sediment concentrations over time at the exposed locations. The COPCs in groundwater will be released to Whitefish Lake Middle at a predicted mass flux as shown in Table 3-4 (Appendix 7-C) The results of the predictive modelling were then used to support	No EIS updates are anticipated to address this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						the environmental risk assessment to assess potential impacts and risks to surface water, sediment and aquatic biota. The IMPACT model scenario for the future centuries was undertaken specifically to investigate the potential for groundwater migration to Whitefish Lake in future centuries to impact the aquatic environment of Whitefish Lake. For each medium or receptor (i.e., surface water, sediment or aquatic biota) no risk was identified during the future centuries period (Appendix 10-A). Additional information concerning potential impacts of groundwater interactions with Whitefish Lake are provided in IR-116.	
IR-119	CNSC	Fish and fish habitat	Section 8.3.1.2, Table 8.3-1, Sediment quality	**Context:** Sediment quality isn't considered a key indicator for fish and fish habitat, but the accumulation of contaminants in sediment porewater without habitat alteration is similar to the key indicator 'change in surface water quality from baseline conditions' that is considered. **Rationale:** It is not clear whether sediment was just considered for physical disturbance, and why chemical changes are missing from key indicator list for fish and fish habitat.	Please provide the rationale for exclusion of sediment quality from the key indicator list for fish and fish habitat.	Sediment quality was not included as an indicator for the Fish and Fish Habitat VC, rather Sediment Quality and Benthic Invertebrates were elevated to VCs within the EIS (Section 8.4). In the draft EIS Section 8.4.1.1, Sediment Quality VC was identified as having interrelations or linkages to Benthic Invertebrates (VC) as their medium of support to life-cycles as well as the Fish and Fish Health VC. Specifically, the sediment that benthic invertebrates inhabit as the medium responsible for their ability to carry out their life processes. Benthic invertebrates provide an important forage base for fish species. Aquatic sediments and benthic invertebrates (food supply) are inferred as part of the definition of fish habitat under subsection 2(1) of the Fisheries Act, 1985 (Government of Canada 2019). Alterations to Sediment Quality in an aquatic environment can directly affect Fish and Fish Habitat and this was taken into consideration both with respect to physical and chemical changes. Under Section 8.4.1.2 and Table 8.4.1, key indicators and measurable parameters for sediment quality were provided and included: - Sediment quantity and physical quality (particle size) from baseline conditions - Change in sediment quality (chemical) from baseline concentrations The results of the assessment of potential effects and significance of those effects for sediment quality as a VC are directly translatable to Fish and Fish Habitat as identified in Sections 8.3.1.1 and 8.4.1.1. As such, providing the same assessment within both sections is considered redundant.	No EIS updates are anticipated to address this IR.
IR-120	CNSC	Aquatic species	Section 8.3.3 and 8.5, Aquatic Environment	**Context:** Although downstream impacts are not predicted by Denison it is important from an ecosystem perspective to establish baseline locations to monitor for potential cumulative effects to the aquatic environment due to the Key Lake and Wheeler River Operations to ensure the aquatic environment is being protected from cumulative impacts. Denison should consider adding a far-field exposure location and collecting baseline aquatic ecosystem baseline data in Russell Lake including: • Water quality/chemistry • Sediment chemistry/quality • Benthic invertebrate chemistry /community • Large-bodied fish tissue/chemistry **Rationale:** Russell Lake is identified as part of the RSA for the aquatic environment, but it appears that no detailed aquatic baseline data was completed in far-field location in Russell Lake. In addition, several Indigenous Nations and communities and local resource users have indicated that Russell Lake is an important body of water both culturally for traditional use and was once used as commercial fishery.	If Denison has not collected baseline aquatic studies in the far-field downstream receiving environment of Russell Lake, please provide a rationale for why. If a far-field Russell Lake location was sampled as part of baseline data collection, more information about the process and results with regards to sampling at Russell Lake should be included in the EIS. This information would be valuable to help determine potential cumulative effects downstream in the Russell Lake drainage system (due to the Key Lake Operation) which has been identified as a key concern and area of interest by several Indigenous Nations and communities.	Aquatic baseline surveys were conducted at two stations (LAB-1 and LAB-2) in Russell Lake and were considered 'far-field' stations in relation to the proposed mining plan for the Wheeler River Project. Data collection methods and results are presented in the draft EIS throughout the applicable subsections of **Section 8**. • **Section 8.2** details the Surface Water Quality methods and results, • **Sections 8.3** and **8.5** detail fish habitat, community, and health methods and results; and • **Section 8.4** details sediment quality and benthic invertebrate community and chemistry methods and results. A breakdown of where specific processes and results are located for each of these components is presented below: ***<u>Surface Water Quality/Chemistry</u>:*** Surface Water Quality was sampled in Russell Lake. Methods and metrics are presented in **Section 8.2.3.1**. Water was sampled in Russell Lake and presented in **Table 8.2-2** (Pages 8-60 to 8-62) of **Section 8.2.3.3** of the EIS report, and summarized in **Table 8.2-4.** Surface Water predicted maximum Constituents of Potential Concern for the Russell Lake Inlet (LAB-1) are presented in **Table 8.2-13** of **Section 8.2.4.2.4.** Cumulative effects are also assessed in **Section 8.2.7**. Detailed baseline summary data is presented in **Appendix 8-D** of the report in **Table 3-3.** ***<u>Sediment Quality/Chemistry</u>*:** Sediment was sampled in Russell Lake, and the sample methodology is presented in **Section 8.4.3.1.** Sediment grain size results are summarized in **Table 8.4-2** in **Section 8.4.3.2.1**, and full data is presented in **Appendix 8-D, Table 3-4.** Sediment chemistry was summarized in **Table 8.4-3**, and full data is in **Appendix 8-D, Table 3-5.** ***<u>Fish Habitat, Tissue Chemistry, and Community</u>***: Russell lake is not clearly indicated in the initial list of sample areas presented in **Section 8.3.3** or **Section 8.5.3**; however, habitat information is presented in the Fish Habitat table (**Table 8.3-4**) of **Section 8.3.3.2**, and both Russell Lake sample locations (LAB-1 and LAB-2) and their associated fish community data are presented in the fish community map (**Figure 8.3-6**). Fish community and information is also presented in **Table 8.3-4.** Baseline fish community information is presented in **Appendix 8-D** of the report in **Table 3-9.** Fish chemistry summary data (Mean, Max, Min) for Northern Pike and White Sucker bone and tissue samples is presented in **Table 8.5-2** of **Section 8.5.3** of the Draft EIS. Detailed fish tissue data summary is presented in **Appendix 8-D** of the report in **Table 3-10.** ***<u>Benthic Invertebrate Chemistry and Community</u>:*** Benthic invertebrates were sampled in Russell Lake, and the sample methodology is presented in **Section 8.4.3.1.** Benthic invertebrate endpoints are summarized in **Table 8.4-4** of **Section 8.4.3.2.4**, and benthic invertebrate chemistry is summarized in **Table 8.4-5.** Detailed baseline benthic invertebrate community and chemistry data is presented in **Appendix 8-D** of the report in **Table 3-8,** and community data in **Tables 3-7A to 3-7D**. Also, refer to Cumulative Effects sections (Section 8.X.7) within each part of the Aquatic Environment assessment in the draft EIS for a discussion of potential cumulative effects in Russell Lake. (i.e., Section 8.2.7 for surface water quality; Section 8.3.7 for fish and fish habitat, 8.4.7 for sediment quality and benthic invertebrates, and 8.5.7 for fish health).	No updates to the draft EIS are needed based on this IR response.
IR-121	CNSC	Fish and fish habitat	Section 8.3.3.1, Methodology and Metrics	**Context:** In the description of methodology for fish communities and spawning surveys, there's no mention that could be found for an any evaluation of fish condition, other than sexual condition.	Please provide reference to where fish condition is considered or provide a justification for its exclusion.	Field work was conducted by aquatic biologists that are familiar with the identification of fish condition and abnormalities as it pertains to fish sampling protocols and the MDMER EEM guidance and protocols. As such, the lack of record of such gross abnormalities is reflective of fish populations of good condition. Any supplemental baseline surveys or future	No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				Rationale: Exposure to other pre-existing stressors could result in abnormal conditions or deformation(s) in existing population, but the extent of existing conditions should be evaluated to ascertain whether the rate is increasing as a result of proposed activities once in operation.		environmental effects monitoring will include documentation of fish condition and abnormalities.	
IR-122	CNSC	Fish and fish habitat	Section 8.3.8, Monitoring and Follow-up	**Context:** Section 8.3.8 of the EIS states: "Changes in fish communities/populations will be assessed through comparison of Construction, Operation, and Decommissioning results to pre-development." **Rationale:** Tracking changes in fish communities / populations in reference lakes over time should be conducted, as reference lakes can be used to differentiate natural temporal variation with potential project impacts.	Please include reference lakes, and if it is provided, please reference where in the EIS these are discussed. If there are no reference lakes, these should be included in the monitoring program.	The preparation of a study design under the MDMER EEM program strives to ensure that a single reference area or multiple reference areas are as representative of a control condition as possible. Best practice is to undertake an analysis of candidate reference areas using the existing baseline information and investigate their utility as controls prior to project development. A preliminary EEM study can be completed prior to the commencement of ISR operations that will allow for a Before-After-Control-Impact study design, that will provide the ability to monitor change not only in the exposure areas, but in the reference areas, thereby allowing for a reasonable assessment of potential mine related impacts.	No updates to the draft EIS are needed based on this IR response.
IR-123	ECCC	Change to an environmental component due to radiological contaminants	Section 8.4.3.2.3, Aquatic Environment Appendix 8-D, Table 3-5	**Context:** Table 8.4-3 provides a summary of the baseline concentrations of COPCs in sediments in the LSA. Sediment quality thresholds and justification for the selection of those thresholds have not been provided. Table 3-5 in Appendix 8-D does provide benchmarks but the selection of benchmarks is not discussed, and the most stringent guidelines are not used for some COPCs. Additionally, there is no data provided for sediment concentrations of mercury, which is a COPC that requires surface water quality monitoring and effluent characterization under the MDMER. **Rationale:** Further information should be provided regarding any exceedances of sediment quality thresholds in baseline concentrations of COPCs, which should be recommended for further assessment of risk due to effluent discharges.	1. Provide sediment quality thresholds and justification for the selection of those thresholds for comparison against measured baseline COPC concentrations in the LSA. 2. Provide data on baseline concentrations of mercury in sediment. 3. Identify any COPCs with baseline concentrations that exceed sediment quality thresholds in the LSA.	1) Please see Attachment IR-123, Table 1, for a summary of baseline sediment concentrations and their respective screening criteria. As indicated in Appendix 10-A Section 3.1.2.3, "Burnett-Seidel and Liber (2013) was selected as the preferred source for the Project thresholds in the sediment quality assessment, as the reported NE2 and REF values are specifically applicable to Saskatchewan waterbodies." Burnett-Seidel and Liber (2013) was used even if higher than CCME quality guidelines or Thompson et al (2005). In some instances, the NE2 value was lower than the REF value from Burnett-Seidel and Liber (2013). In those instances, the REF value was still used, as screening values should not be lower than background concentrations. 2) Mercury was not analyzed specific to sediments within the LSA during the initial baseline data collection period. Analysis of mercury at a low-level in sediment was not considered necessary for two reasons: 1. mercury is not associated with the uranium mining and milling process and 2. water quality sampling within the LSA indicated levels of mercury below detection at an acceptable level of detection (i.e., 0.00001 to 0.0000001 mg/L). Denison will collect background information pertaining to sediment total and methyl mercury from LSA lakes and streams prior to site development. 3) Please see Table 1 of Attachment IR-123 for a summary of baseline sediment concentrations and their respective screening criteria. One sample concentration for Cadmium of 0.7 µg/g (LAB-2-3) at Russell Lake exceeded the CCME ISQG of 0.6. Another value of 0.6 µg/g (LAB-2-CORE) at Russell Lake equaled to the CCME ISQG of 0.6. All other samples had cadmium concentrations below any screening criteria. References: Burnett-Seidel, C., Liber, K., 2013. Derivation of no-effect and reference-level sediment quality values for application at Saskatchewan uranium operations. Environ. Monit. Assess. 185, 9481–9494. Thompson, P.A., Kurias, J., Mihok, S., 2005. Derivation and use of sediment quality guidelines for ecological risk assessment of metals and radionuclides released to the environment from uranium mining and milling activities in Canada. Environ. Monit. Assess. 110, 71–85.	No updates to the draft EIS are needed based on this IR response.
IR-124	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.4.4.2.3, Aquatic Environment	**Context:** Table 8.4-7 provides maximum concentrations of surface water COPCs in sediment. The following COPCs, which are required to evaluate the risk from effluent to sediment quality, were not evaluated: 1. COPCs that have monitoring requirements in receiving environment surface water and effluent under the MDMER, 2. COPCs that exceed water quality guidelines in effluent, and, 3. COPCs that have baseline concentrations that exceed sediment quality thresholds in the receiving environment. **Rationale:** Due to the lack of information on COPCs with baseline concentrations that exceed sediment quality guidelines, and COPCs that require monitoring under the MDMER, a determination on risk to sediment quality and aquatic biota cannot be made.	1. Provide the information on baseline exceedances of COPCs in sediment. 2. Provide an assessment of risk for any COPCs that have baseline exceedances of sediment quality thresholds in the receiving environment. 3. Provide an assessment of risk from any COPCs that require monitoring in the receiving environment and effluent under the MDMER. Please include any COPCs in effluent that will exceed water quality guidelines.	1) The information on the baseline exceedance of COPCs in sediment are provided as part of Attachment IR-123. The table indicates that only the maximum concentration of cadmium exceeded the CCME ISQG on one occasion when assessing all sediment samples over the course of baseline surveys in the LSA. 2) Only one sample concentration for Cadmium of 0.7 µg/g (LAB-2-3) at Russell Lake exceeded the CCME ISQG of 0.6 within the RSA. Another value of 0.6 µg/g (LAB-2-CORE) at Russell Lake equals to the CCME ISQG of 0.6. All other samples had cadmium concentrations below any screening criteria. Cadmium was included as one of the constituents identified as a COPC under the non-radiological Ecological Risk Assessment (Appendix 10-A). No significant adverse effect on either aquatic or terrestrial populations or communities, as a result of releases from the Project, are predicted during the Project phases or during the future centuries. All estimated total HQs for all COPCs (arsenic, cadmium, chromium, cobalt, copper, molybdenum, selenium, uranium, zinc, chloride, and sulphate) for all ecological receptors are predicted to remain below the HQ benchmark of 1. 3) Denison has provided an analysis of the parameters that are identified under MDMER Schedule 4 and therefore have specified effluent discharge criteria. Schedule 5 parameters will be monitored as per the MDMER once under this regulation (i.e., meeting regulated criteria of discharge to the environment [50 m3/day). Please refer to Table 8.2-13 of attachment IR-114. In these cases, COPCs including Schedule 4 parameters were below screening criteria.	Changes suggested for Table 8.2-13 as consistent with IR-114.
IR-125	CNSC	Fish and fish habitat	Section 8.5, Aquatic Environment and Fish health	**Context:** Indigenous Knowledge studies and information collected in relation to the Project clearly identified the importance of water quality and fish health to local Indigenous peoples and is discussed throughout the Draft EIS. For example: • "Russell is one lake where I commercially fish. How will this effluent impact the water quality, fish health? Will I be able to sell fish from here? If there is going to water" pollution, I just want to know" (19-LK-ERFNTrap-134.255) " • "How are you going to protect the water quality? We are concerned about mercury in fish, other animals, etc. Is there mercury or arsenic in the uranium solution?" (p. 8-53)	One of the many mitigation measures mentioned throughout the aquatic environment section states: "Denison will work with the associated communities to develop and implement the Project-specific monitoring programs and a framework to share the results for the purpose of assessing the performance of the water management system." (p.10-32) Has Denison considered the collection of additional baseline fish tissue species that are of importance to Indigenous Nations and communities and local cabin owners from	Fish tissue chemistry (bone and muscle) was collected for Northern Pike and White Sucker and presented in Table 8.5-2 of Section 8.5.3. Tissue was not collected for Walleye or Lake Whitefish, however, the tissue analysis of Northern Pike and White Sucker would be key indicators for the fish community in Russel Lake. Northern Pike is a piscivorous top predator much like Walleye, which would address concerns of bioaccumulation of mercury and other metals of concern. White Sucker is a generalist bottom feeding species that is often used to assess metal concentrations at a lower trophic level of the food chain. This information provides an initial baseline understanding of the tissue metal concentrations for the fish of Russell Lake. The outcomes of the impact assessment demonstrated there will be no expected impact to Russell Lake with respect to water quality, sediment quality or fish and fish habitat. As	No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				Rationale: Several Indigenous Nations and communities and local resources users have indicated Russell Lake is an important body of water both culturally for traditional use and was used as commercial fishery in the past and from an aquatic ecosystem perspective.	Russell Lake? Assuming the species would be walleye (commercially and recreationally) and lake white whitefish that is traditionally an important species consumed. Please provide more information on the engagement to date on the development of the Surface Water Management Program and Monitoring program that Denison is developing and engagement to date with interested Indigenous Nations and communities in the region on fish and fish health.	discussed in the response to IR-120 and this IR, historic information from Russell Lake is available, but may require supplementation prior to project development to monitor potential changes to the aquatic environment in the lake. Engagement on licensing requirements, such as the development of the environmental monitoring program and the associated surface water quality and monitoring regime will occur in later in 2023 and 2024. As the Indigenous Communities of Interest with reserves and residential communities most proximal to the Project, Denison has committed to collaborating with English River First Nation and Kineepik Metis Local on monitoring regimes, suited to each of their interests and needs. As part of these programs, Denison and the Indigenous community of ERFN and KML will be sharing information in an agreed-upon fashion. Denison expects that important country foods harvested for food and cultural purposes (i.e moose, fish species, etc), surface water quality, and other areas of interest will form part of this monitoring program, including the potential to report on wildlife-vehicle mortality or other such areas of potential concern as they evolve over time. It is expected that the data collected through such monitoring regimes as described above would also be relevant to other Indigenous nations who may have interest in the Project.	
IR-126	ECCC	Aquatic species	Section 8.5.3 Appendix 10-A (ERA), Section 5.3.1.1.8	**Context:** The Proponent has used the US Environmental Protection Agency (US EPA) guidelines for the assessment of selenium fish tissue concentrations in Section 8.5.3 of the draft EIS and in the Environmental Risk Assessment (ERA) in Appendix 10-A (ERA) of Section 10. **Rationale:** ECCC's Federal Environmental Quality Guidelines of 6.7 ug/g dry weight fish whole body tissue for selenium should be used, as it is more protective than the US EPA guidelines.	Update the selenium fish tissue assessment in the draft EIS and the Wheeler River ERA (Appendix 10-A (ERA) in Section 10) as needed using ECCC's FEQG.	Denison is aware of the ECCC Federal Environmental Quality Guideline for selenium in fish. The ECCC FEQG is for fish tissue egg-ovary and whole-body. Denison selected the US EPA guideline over the ECCC guideline since US EPA provides guidelines for fish tissue muscle as well. The fish assessed in the ERA were large-bodied fish including northern pike and white sucker. A fish tissue muscle TRV is appropriate for assessment of large-bodied fish; therefore, the US EPA selenium fish tissue muscle benchmark was preferred over the whole body value from ECCC.	No updates to the draft EIS are needed based on this IR response.
IR-127	CNSC	Aquatic environment	Appendix 8-E, Section 1.2.1, Hydrological Inputs	**Context:** Within this section it states that the 7Q10 low flow rate used in the mixing assessment "was provided verbally to Ecometrix by NewFields Canada during a project meeting on 26 April 2022" **Rationale:** The statement that this value was provided verbally is not an infallible method of communicating data, as the value could have been misheard, misremembered, or recorded improperly.	Please verify that the 7Q10 value used in the assessment is the correct value determined by NewFields.	The value used in the assessment (0.616 m^3/s) is the correct value determined by NewFields. The value was calculated by NewFields as the inflow from SA-6 to Whitefish Lake and therefore considered representative of the flow in the northern basin of LA-5. This value will be specifically updated in Appendix 8-C (Table 3-3: 7Q10 Estimated Discharge) and Appendix 8-E (Section 1.2.1 to be changed to reference Appendix 8-C, Table 3-3) for clarity.	Appendix 8-C Table 3-3:7Q10 Estimated Discharge will be updated as shown below. **TABLE 3-3: 7Q10 ESTIMATED DISCHARGE** Assessment Node — 7Q10 Flow Rate (m^3/s) LA-1 — 0.874 LA-5 — 0.616 Note: m^3/s = cubic meters per second
IR-128	CNSC	Current use of lands and resources for traditional purposes	Section 9 Various pages in section 11.1, Land and Indigenous Resource Use Section 12 Section 14	**Context:** The increased road traffic (14-18 trucks per day during construction/operations) may have indirect impact on ungulates, furbearers and wood land caribou presence/absence for traditional and subsistence hunting have been raised to CNSC staff when meeting with Indigenous Nations and communities and are presented in the EIS. **Rationale:** The increased traffic and therefore dispersal of game (moose, woodland caribou) due to increased traffic has been raised as a concern with respect to increased mortality on wildlife and decreased ability to practice traditional rights.	How have the potential residual impacts with respect to increased traffic and noise (due to current and future operations) been communicated to Indigenous Nations and communities who use the road #914 for cultural and traditional activities (such as moose harvesting, berry picking and small game and birds)? Please provide any additional information on the engagement that has taken place to date with Indigenous Nations and communities with respect to concerns and potential impacts on current use of lands and resources due to increased road traffic, and any mitigation measures proposed by Indigenous Nations and communities to minimize the potential impacts.	The potential residual impacts with respect to increased traffic and noise were communicated to ERFN and KML during engagment and through pre review of the EIS and have documented their regular use of the road. Proposed mitigation measures in relation to vehicle traffic were also communicated. Please see draft EIS, Section 4 record of consultation (ROC) 618, 619 and 620. The findings in relation to the potential for residual impacts as a result of change in traffic will be shared again in future engagement activities, expected in late September and early October 2023. Any additional input will be integrated into the final EIS, as part of the commitment made under IR-28. As the Indigenous Communities of Interest with reserves and residential communities most proximal to the Project, Denison has collaborated with ERFN and KML to develop additional mitigation measures specific to these Communities. These include: 1) Assisting ERFN to provide clear highway identification for the location for the Mawdsley Reserve, where many cultural camp activities occur 2) The same is offered to KML; however, the current km 67 Culture Camp for KML was burned in the May 2023 forest fires, and so this will be executed in the future at such time as KML selects a new location. 3) The commitment by Denison to slow truck traffic down for a minimum of 2.5 km on either side of the culture camp(s) to 40 km/hr, during the months of September and October. 4) To communicate this new slowing protocol to Denison's contractors and other operators in the area, to inspire best practice for other operators in the area.	The EIS will be updated to reflect the additional mitigations to which Denison has committed, per the IR response. Specifically, the following will be added to the text of Section 11.1.5.3 and 12.3.5 within the context of traffic mitigation <u>Traffic</u> • Assist ERFN to provide clear highway identification for the location for the Mawdsley Reserve. • If requested, assist KML to provide clear highway identification at the km 67 Culture Camp or other selected location. • Require Denison truck traffic to slow to 40km/hr for a minimum of 2.5 km on either side of the culture camp(s), during the months of September and October. • Communicate the slowing protocol to Denison's contractors and other operators in the area, to encourage best practice for other operators in the area.
IR-129	CNSC	Current use of lands and resources for traditional purposes	Section 9 Section 10 Section 11, including Section 11.1.4.3.1 (p. 11-46) Section 12 Section 16	**Context:** ERFN indicated they are concerned about declining moose populations from an influx of hunters; more people may be accessing the area year after year, and worried populations may be affected by the Project (21-EN-ERFN-473.13). Further, the EIS highlights that: "Vehicle collisions are the most likely source of direct mortality for moose. Effective mitigation measures (e.g., breaks in snowbanks; speed limits; and exclusion fencing around contaminated waste pads and ponds) will be implemented to reduce moose mortality." (p. 11-46) **Rationale:** The <u>Technical Guidance for Assessing the Current Use of Lands and Resources for Traditional Purposes under CEAA 2012</u> notes: "The views of affected Aboriginal groups on mitigation be considered and included in the EIS. This could assist in ensuring that the environmental effects on the current use of land and resources for traditional purposes are at an acceptable level for the community." Sources for indirect moose mortality (e.g., increased hunter access, changes to health due to sensory disturbances, changes to predator-prey dynamics) may result in mortality outside the Wildlife LSA. The	Please provide additional information on the discussions Denison has had with Indigenous Nations and communities on how to mitigate any residual project impacts on their traditional harvesting activities of large game such as moose. More information is required to determine if Denison has engaged directly with ERFN/KML and other Indigenous Nations who utilize the area to harvest moose to determine current baseline harvest numbers that provide subsistence, continued cultural identity and community well-being, as well as discussions on how the project could potentially impact moose populations and the harvesting of moose for traditional practices.	Potential project related changes to moose are detailed in Section 9 of the EIS, and include potential changes associated with vegetation removal and/or ground disturbance (i.e., loss of habitat), sensory disturbances, and vehicular collisions. Mitigations to minimize these potential effects include minimizing the extent of the Project area and associated disturbances to the extent practicable, standard mitigation measures to minimize air emissions, dust, light and noise, exclusion fencing around waste pads and ponds, and measure to minimize direct mortality through vehicular collisions through driver training and safety practices. Baseline harvest information was shared by the Indigenous Communities of Interest through Indigenous and traditional knowledge studies which were considered by all discipline leads in the assessment process. Information on moose is specifically documented in: • Wheeler River Project - Summary of Traditional Knowledge Study Results (ERFN and SVS 2022b) • English River First Nation Country Foods Study Final Report (CanNorth 2017a) • Land use and occupancy maps shared with Denison by the Kineepik Metis local • Kineepik Valued Ecosystem Components – KML Pre-statement for Denison (KML 2022) Although Denison understands these documents are not representative of the complete extent of Indigenous moose harvest, recorded harvests proximal to the Project are document	No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				residual effect of change in moose mortality is likely to occur. Although mitigation measures are expected to reduce, but not fully eliminate, the residual effect on moose. The potential residual impact on the moose and other large game populations in the broader regional study area may potentially impact Indigenous treaty rights, culture, and community well-being if the harvesting of moose and large game declines due to increased traffic, noise, and vehicle mortality or increased outside hunting pressure.		in Section 11.1.4.3.1 of the EIS, and further harvest in the local and regional study areas are noted in each. Moose is central to the traditional diets of these communities, and as noted in the English River First Nation Country Foods Study Final Report (CanNorth 2017) were the most commonly consumed species by ERFN citizens. Interest and concerns about the Project's potential interactions with moose populations are also noted in the engagement record, for example the engagement record notes that, for ERFN, moose is a [hunting and food] mainstay and there is concern for how moose would be impacted. To address potential concerns specific to Project related effects to wildlife species of interest to the Indigenous Communities of Interest, Denison has committed to collaborating with ERFN and KML on a monitoring regime suited to each of their interests and needs. As part of this program, Denison and KML will be sharing information in an agreed-upon fashion, about agreed-upon species of interest. Denison expects that important country foods harvested for food and cultural purposes (i.e., moose, fish species, etc.), surface water quality, and other areas of interest will form part of this monitoring programing, including the potential to report on wildlife-vehicle mortality or other such areas of potential concern as they evolve over time. It is expected that the data collected through such monitoring regimes, as described above, would also be relevant to other Indigenous First Nations who may have interest in the Project.	
JSIR-130	CNSC	Physical stressors (noise and vibration) on wildlife	Section 9, Terrestrial Environment	**Context:** Sensory disturbances such as noise have been identified as stressors for selected wildlife (Ungulates, Furbearers, and Woodland Caribou), birds and amphibians in the project area. However, there is no consideration of impacts from vibrations on these species. Also, impacts of noise and vibration on reptiles have not been assessed in the project area. **Rationale:** While noise has been qualitatively assessed for selected wildlife, birds, and amphibians, there is no consideration of project-related vibrations as a sensory disturbance/physical stressor. Sensitive terrestrial species (specifically, herpetofauna, amphibians, invertebrates, and caribou) can be impacted by vibrations emanating from the operation of heavy machinery, blasting activities, and other anthropogenic activities at the project site. Also, impacts of physical stressors (noise and vibration) on reptiles were not assessed. These species should be included in this assessment due to their sensitivity to noise and vibrations.	Please provide a discussion of impacts of physical stressors (specifically vibrations) on wildlife, birds, and amphibians in the project area. Specific mitigation measures and/or monitoring for impacts from project-related vibrations should be considered, as appropriate. Also, include reptiles in the assessment of project-related noise and vibrations as sensory disturbance/physical stressor, or a justification for their exclusion.	Vibration is a sensory disturbance that may affect some species and is inherently accounted for in the effects assessment by way of consideration of the sensory disturbance buffers that are recognized as areas of altered habitat (i.e., zone of influence) that may not be used as a result of the Project. Consideration of Project-related vibrations are considered in the responses to IR-46 within the context of vibrations generated by Low Frequency Noise (LFN). Unlike a conventional mining operation, vibration derived from LFN by the proposed operation is not expected. By extension, vibration related sensory disturbance outside the sensory disturbance buffer for habitat alteration already considered in the assessment would not be expected. Nevertheless, in response to the IR, specific mention of vibration will be added in the EIS where sensory disturbance is defined to provide further context to the assessment. Reptiles were not identified as a VC as part of the initial community consultations when the VCs were selected, and their ranges do not typically extend into northern Saskatchewan, and therefore, were not included in the effects assessment. Also, the potential for occurrence of reptiles within the Project footprint is expected to be low.	In the final EIS, discussion of habitat alteration in Sections 9.3 and 9.4 will be updated to include consideration of vibrations. For example: "Habitat alteration through sensory disturbance effects (such as noise, dust deposition, **vibrations,** and artificial light) is expected to result in reduced habitat quality and effectiveness near Project components and infrastructure reaching beyond the Project Area into the Wildlife LSA."
IR-131	CNSC	Migratory birds, Wildlife and Wildlife Habitat	Section 9, Terrestrial Environment	**Context and Rationale:** As per the requirement outlined in Section 79 of the Species at Risk Act (SARA): *The person must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plans. This is accomplished by ensuring that the Proponent has identified, avoided, lessened and will monitor effects to species at risk.* As per the CNSC's Generic Guidelines for the Preparation of an EIS pursuant to the Canadian Environmental Assessment Act, 2012: "*The EIS will then describe mitigation measures that are specific to each environmental effect identified. Measures will be written as specific commitments that clearly describe how the proponent intends to implement them and the environmental outcome the mitigation is designed to address. The EIS will describe mitigation measures in relation to species and/or critical habitat listed under the Species at Risk Act (SARA). These mitigation measures will be consistent with any SARA permit, applicable recovery strategy and/or action plan*". The draft EIS neither lists the adverse effects to all listed schedule 1 SARA species, nor outlines the measures that will be taken to avoid or lessen these effects. The Proponent references that additional species-specific mitigations will be detailed in environmental management plans but has not provided those plans for review.	Identify all species at risk listed on Schedule 1 of the Species at Risk Act and their critical habitat that are likely to be affected by the Project and describe how they may be adversely affected by the Project. Describe what measures will be taken to avoid or lessen the effects of each Project activity and stage, and how these effects will be monitored to ensure they are avoided or minimized.	As Key Indicators of Valued Components, the EIS includes terrestrial wildlife and avian species that may occur in the Project study areas and are listed on Schedule 1 of the federal Species at Risk Act. Project effects on these species and their habitats are described and assessed, and mitigation measures are included to avoid or reduce the potential for adverse effects on these species and their habitats. The Project effects and associated mitigation measures described in the draft EIS are broadly applicable to SAR species that occupy the same ecological niches. In response to the IR further information has been developed that is specific to SAR and included as Attachment IR-131. This includes a listing of all SAR species potentially occurring in the Project study areas, with links to applicable and appropriate mitigation measures described in the EIS. It is proposed the content of Attachment IR-131 will be added as a new appendix (Appendix 9-D) to Section 9 of the final EIS. The information provided in the SAR appendix includes a summary of the life history requirements, the expected Project effects, proposed mitigation measures, and anticipated residual effects on these listed species.	A new SAR appendix (new Appendix 9-D) will be added to Section 9 of the final EIS. It has been included here as Attachment IR-131.
IR-132	ECCC	Wildlife and Wildlife habitat	Section 9, Terrestrial Environment	**Context and Rationale:** ECCC has identified that three species at risk arthropods (yellow banded bumble bee, transverse lady beetle, and nine-spotted lady beetle) have ranges overlapping the Project area and these were not mentioned in the draft EIS.	1. Conduct an effects assessment for arthropod species at risk. 2. Explain what mitigation measures will be used to minimize potential effects.	Consideration of the three arthropod species at risk are included in Attachment IR-131.	A new SAR appendix (new Appendix 9-D) will be added to Section 9 of the final EIS. It has been included here as Attachment IR-131.
IR-133	ECCC		Section 9, Terrestrial Environment	**Context and Rationale:** There is potential for some species at risk (e.g., myotis species, barn or bank swallows, common nighthawk) to be attracted to and use mine infrastructure (buildings, roads etc.) once constructed for nesting, roosting, or foraging. Details on mitigation measures and adaptive management with respect to attraction to Project components should be identified to assess residual and cumulative impacts to species at risk.	For all Project phases, describe the mitigation measures and adaptive management to prevent and minimize effects on species at risk that may utilize mine infrastructure.	Specific exclusion measures will be added to the mitigation measures in Sections 9.3.5 and 9.4.5 of the EIS. These measures will be designed and appropriately applied to prevent or reduce access to Project infrastructure for roosting, nesting, and foraging, and are expected to address adverse Project-related effects on myotis species, barn and bank swallows, and common nighthawk. If bird nests (or tree cavities) should be encountered, any subsequent activities will be conducted in accordance with the 2022 Migratory Birds Regulations. The results of mitigation measures implemented, and any associated wildlife observations will be considered in an adaptive management process to determine if/when/where additional mitigation measures may be required.	The below exclusion measures will be added to Sections 9.3.5.2.5 and 9.4.5.2.4 in the final EIS: Buildings and other Project infrastructure will be designed and maintained to exclude birds (e.g., barn swallows) and bats as much as possible. This would include installing solid barriers (e.g., corner slope panels, wooden panels) or flexible barriers (e.g., netting, tarps or geotextiles) under roof eaves or other exterior surfaces.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
IR-134	ECCC	Wildlife and Wildlife habitat	Section 9, Terrestrial Environment	**Context and Rationale**: The draft EIS states in multiple places that vegetation clearing may occur year-round. In order to correspond with the timing of emergence from hibernation, tree clearing should not be conducted during the bat roosting period. If maternity roost trees are removed after pregnant females have established a roost area, there is a higher likelihood of abortion than there would be otherwise. Species-specific mitigations are required to protect bat SAR.	Provide important roosting dates for bat species at risk in the Project area.	Maternity roosts are used by pregnant females in late spring (April/May) either alone or in small groups. Females and their offspring roost in groups in nursery colonies in late summer/early fall prior to hibernation. Denison will adjust the activity timing windows to include the April/May maternity roosting period and the July/August nursery roosting period, to the extent practicable. Pre-construction surveys will identify all sensitive wildlife habitat features, including potential roosting trees (e.g., hollow trees, trees with defects, trees with cavities, and tree stumps). Should potential roosting trees be detected, consultations with the regulators will be initiated, and appropriate mitigation measures will be designed and implemented. This information above is provided in Attachment IR-131. This new SAR appendix (new Appendix 9-D) will be added to Section 9 of the final EIS.	A new SAR appendix (new Appendix 9-D) will be added to Section 9 of the final EIS. It has been included here as Attachment IR-131.
IR-135	ECCC	Migratory birds, Wildlife and Wildlife Habitat	Section 9, Terrestrial Environment	**Context and Rationale:** The mitigation measures for birds and wildlife presented in the draft EIS are very general. Additional detail is required for a complete assessment of residual and cumulative Project effects to birds and wildlife. The Proponent has committed to providing a number of plans including, a Decommissioning Plan, a Spill Response Plan, a Waste Management Plan, a Surface Water Monitoring Plan, a Remediation and Closure Plan, a Radiation Protection Plan, a Soil and Vegetation Monitoring Plan, a Wildlife Monitoring Plan, and a Woodland Caribou Management Plan. In order to assess potential affects to migratory birds and wildlife from Project related activities, ECCC requires details on species-specific mitigation measures, and monitoring plans.	The following information should be included in the various plans and should be provided for review during the environmental assessment: 1. For all Project phases, describe the species-specific mitigation measures and responses to prevent and minimize effects on migratory birds or species at risk (SAR) birds and mammals that may utilize mine infrastructure. 2. Explain how light pollution will be managed and what specific mitigation measures will be used to minimize effects to migratory birds and SAR birds and mammals. 3. Provide details on what methods will be used for erosion control and how they will prevent sediment from entering waters frequented by migratory birds or SAR. Explain what actions will be taken if the erosion control measures are not successful. 4. Provide details on noise and other sensory disturbance monitoring and mitigations if noise levels surpass thresholds. 5. Describe time windows and species- specific mitigations related to maintenance activities such as vegetation management, road or building repair and stream crossing replacements.	As noted in the draft EIS Section 1.7.5, Licensing and Permitting, the Project is proceeding through a sequential EA and licensing process. The IR refers to "plans" and that these plans should be provided in the environmental assessment for review. Commitments to develop such plans, and in some cases conceptual level information regarding a number of the proposed plans has been provided in the draft EIS. Given the sequential process to which Denison has committed to, it is Denison's opinion that the level of information provided in the draft EIS and its supporting documents (including supplemental information provided in response to the IRs) is appropriate at this stage of the Project. It is planned that further detail will be developed and provided during licensing and permitting and that this information will be available for review at that time. Denison understands that the Project cannot move forward until the appropriate Program / Plan / Procedure documentation is in place and has received approval through the regulatory process. Denison believes that this context (that is, that the detailed "plan" information needed to support licensing and permitting has not be included in the EIS) is valuable in considering this IR, as well as other IRs with a similar theme. 1. The mitigation measures referenced to in Part 1 of the IR are considered in the response to IR-133 and the reviewer is referred there for additional information. Specific exclusion measures will be added to Sections 9.3.5 and 9.4.5 to prevent or reduce access to Project infrastructure, as noted in the response to IR-133 (and in the adjacent column). 2. Means to manage light pollution and specific mitigation measures to minimize the potential for adverse effects on migratory birds and SAR birds and mammals will be added to Section 9.4.5.2.5 of the EIS as noted in the adjacent column. 3. Erosion control measures have been identified in Section 8, Aquatic Environment, of the draft EIS. These same proven mitigation measures will be effective at mitigating adverse effects on waters frequented by migratory birds or SAR. For completeness, the erosion control measures from Section 8, Aquatic Environment, of the draft EIS will be added to Sections 9.3.5 and 9.4.5 of the draft EIS, as highlighted in the adjacent column. 4. Proposed mitigation measures related to noise and sensory disturbance outlined in Section 6.2.5 of the draft EIS are considered to be adequate and appropriate to limit/localize potential adverse effects on wildlife and wildlife habitat, and include the following: • not using the concrete batching plant and crusher during nighttime hours, where possible; • locating the concrete batching operation as far away from sensitive wildlife features as possible; • directing the generator discharge openings away from sensitive features; • making use of available on-site obstructions to control sound exposure at sensitive areas (i.e., locate sources behind buildings); and • collecting sound level measurements from the identified sources once they are operating and determining whether the actual effect is lower than that which was modelled. Regarding monitoring, as outlined in Section 6.2.8 of the draft EIS, an EMS will be implemented and include noise monitoring plans to confirm that the Project is compliant with the federal and provincial guidelines. Sound levels will be monitored on a continuous basis using calibrated Class 1 sound level meters and data loggers, calibrated to a National Institute of Standards and Technology traceable standard within one year of its use in the program, and field calibrated using a Class 1 acoustic calibrator. Where possible, the sound level meters will utilize the same monitoring locations as were used in the baseline program to allow direct comparison and may be expanded to include the location of the nearest sensitive receptor where access is granted. Should monitoring show noise levels surpass modelled sound levels, Denison will implement corrective action to identify noise sources and reduce sound levels. Details of noise monitoring and an adaptive management process for the Project will be developed to support Project permitting and licensing. 5. Information related to timing windows and species as it concerns Project activities has been provided in response to IR-134. As noted in the response to IR-134, Denison will schedule Project activity timing windows to appropriately consider all Valued Components and SAR requirements/sensitivities. For reference, additional information that will be added to the final EIS is described in the response to IR-134.	EIS updates in response to IR-135, part 1 are outlined in EIS Updates for IR-133. Section 9 of the final EIS will be updated to address the response to IR-135, part 2 as follows: Proposed mitigation measures related to light pollution will be added to Section 9.4.5.2.5. This includes using low lighting and/or task lighting (e.g., downturned shaded fixtures to prevent sky-lighting or bird disorientation), putting building lighting on sensors or timers, and potentially using a higher lumen/watt ratio on all new buildings or building expansions. Section 9 of the final EIS will be updated to address the response to IR-135, part 3 as follows: Erosion control measures that are designed to prevent sediment from entering waters frequented by migratory birds or SAR include (but not limited to) the installation of silt fence, straw wattles, and/or erosion control blankets to prevent erosion and limit sediment transport. Additionally, vegetated barriers will be maintained between Project components and wetland features, as much as practical. Further information on erosion and sediment control measures will be provided in the applicable management plans which will be developed to support Project permitting and licensing. Routine inspections and management would be completed to document the effectiveness of the erosion control measures, and any required /replacement of these structures would be completed as required. Section 9 of the final EIS will be updated to address the response to IR-135, part 4 as follows: Proposed mitigation measures related to noise and sensory disturbance outlined in Section 6.2.5 of the EIS are considered to be adequate and appropriate to limit/localize potential adverse effects on wildlife and wildlife habitat. The proposed monitoring related to noise and sensory disturbance outlines in Section 6.2.8 of the EIS are considered to be adequate and appropriate to monitor changes in sound levels. EIS updates in response to IR-135, part 5 are outlined in EIS Updates for IR-134.
IR-136	CNSC	Soil Salvage Monitoring	Section 9.1.8.2	**Context:** The proponent plans to salvage and stockpile soil and organic matter/peat in order to use it in reclamation activities during decommissioning. Periodic monitoring of the stockpiles is proposed to be conducted to verify that soil and organic matter/peat are delineated, stripped, handled, and stockpiled as recommended, and to evaluate the stability of salvaged soil, e.g., in relation to potential erosion and/or degradation. It is unclear whether monitoring includes soil quality in terms of concentrations of COPCs.	Please clarify if COPC concentrations monitoring is planned to be performed for stockpiled soil and organic matter/peat.	Per the Residual Effects Characterization: "Predicted changes in concentrations of COPCs (i.e., soil quality) associated with open-source dust, process-source dust and process emissions are expected to be within acceptable health and safety guidelines; no threshold exceedances are predicted." Monitoring of COPCs in soil stockpiles during the life of the Project is not presently being considered, but the need for such monitoring could be revisited within the context of monitoring of sources that could contribute to COPCs to stockpiled soil and organic matter/peat. For example, if source monitoring data exceed predictions	No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				Rationale: It is expected that project-related activities (road and airport traffic, drilling) can result in open-source (i.e., fugitive) dust and process-source dust (incl. radionuclides), which can accumulate and result in changes in soil quality of the stockpiled soil and organic matter/peat as described in Sections 9.1.4.2.2 and 9.1.4.2.3).		presented in the EA that may provide rationale for sampling and analysis of COCPs in stockpiled materials. A soil salvage monitoring program/protocol (or equivalent) is expected to verify soil salvage volumes and reclamation suitability. Denison is proposing to support reclamation trials/research at the Project to inform and refine the revegetation strategy. It is understood that reclamation trials/research will include investigations into soil conditions, preparation techniques and amendment strategies (to the standard of the day). These ancillary investigations may include analysis of COPCs, although this is not expected at this time, but as highlighted above would be considered as may be warranted.	
IR-137	ECCC	Migratory birds, Wildlife and Wildlife Habitat, Vegetation and Wetlands	Section 9.2.1.3, Spatial and Temporal Boundaries for Vegetation and Ecosystems, Listed Plant Species and Wetlands Section 9.3.1.3.1, Spatial Boundaries for Ungulates, Furbearers and Woodland Caribou 9.4.1.3.1, Spatial Boundaries for Raptors, Migratory Breeding Birds, and Bird Species at Risk	**Context and Rationale:** The CNSC's Generic Guidelines for the Preparation of an EIS Pursuant to the Canadian Environmental Assessment Act, 2012 states that: "The EIS will describe the spatial boundaries, including local and regional study areas, for each VC to be used to assess the potential adverse environmental effects of the Project and provide a rationale for each boundary. Spatial boundaries will be defined taking into account the appropriate scale and spatial extent of potential environmental effects, community knowledge and Indigenous knowledge, current or traditional land and resource use by Indigenous groups, ecological, technical, social and cultural considerations." The information provided in the EIS does not enable a biologically relevant assessment of the Project's effects. The Proponent did not provide rationale for the selection of study areas for individual vegetation, wildlife or migratory bird valued components (VC). Different VCs may have different spatial boundaries for the LSA and/or RSA. For wildlife and bird VCs, the LSA is defined as a 1.7-km buffer from the Project area, and the RSA is defined as a 6.6-km buffer around the LSA. There is no information on how the spatial boundaries were derived. Specific to Woodland Caribou, boreal population (hereafter referred to as boreal caribou): Project Footprint: In a scientific assessment of critical habitat (Environment Canada, 2011) [1] ECCC demonstrated that the application of a 500-m buffer to mapped anthropogenic features best represents the combined effects of increased predation and avoidance on caribou population trends at the national scale. Adding a 500-m buffer to the Project footprint is required to represent functional habitat loss. The draft EIS does not appear to use a buffer for their Project area. The draft EIS (Section 9.3.1.3.1) states: "Project Area: the area within which the Project and all components/activities are located (i.e., the area of maximum physical disturbance). The Project Area covers 169.6 ha and is not VC-specific, but consistent throughout the EA." (p. 9-168) LSA: The defined LSA for boreal caribou has to consider avoidance of disturbed areas, predator access to undisturbed areas, reduction in connectivity and sensory disturbance. This required information is not detailed in the draft EIS. Adverse effects of Projects including predator and prey access to undisturbed areas, reduction in connectivity, and sensory disturbance to individual boreal caribou can vary and extend several kilometers depending on Project activities and ecological context. At minimum, the LSA should capture the above- mentioned effects. For boreal caribou, the Project footprint should be defined as the immediate area to be cleared, plus a 500-m buffer to represent functional habitat loss. Following this guidance, the LSA should be defined as a buffer of the Project footprint with the 500-m buffer. RSA: The Amended Recovery Strategy for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada states: *Mitigation of adverse effects from individual projects/activities will require a coordinated approach and management of cumulative effects within and among ranges. A cumulative effects assessment is essential to position the proposed project/activity in the context of all current and future development activities. The cumulative effects assessment will:* • *Assess the impact of all disturbances (anthropogenic and natural) at the range-scale;* • *Monitor habitat conditions, including the amount of current disturbed and undisturbed habitat, and amount of habitat being restored;* • *Account for planned disturbances; and* • *Assess the distribution of disturbance in large ranges for risk of range retraction in parts of the range.*	Provide a biologically relevant rationale for the delineated study boundaries (LSA and RSA) for all different valued components. Include the following information: • Descriptions of how the RSA and LSA boundaries were derived for all VCs. Specific to boreal caribou: Project Footprint: • Include a 500-m buffer of area of maximum physical disturbance to represent functional habitat loss for boreal caribou LSA: • Include a description of how the LSA takes into account boreal caribou avoidance of disturbed areas, predator access to undisturbed areas, reduction in connectivity and sensory disturbance to individuals. RSA: • Include a description of how the RSA used in the draft EIS is an accurate representation of the SK1 boreal caribou range; **or** • Re-do the assessment with the RSA at the scale of the range See also related IRs: IR-154 and IR-156.	The Project Area was delineated to capture all direct, and most indirect, likely adverse effects on caribou; as this is the zone of influence most likely to affect caribou in the vicinity of the Project (i.e., in the vicinity of human activity, equipment use and vehicle use). The Project Area (169.6 ha) is the direct footprint of proposed Project infrastructure (74.8 ha) with a buffer applied, thereby representing the area of maximum physical disturbance. The Project Area is not VC-specific, but consistent throughout the EIS. The Wildlife LSA was designed to capture the majority of the Project effects. The LSA extends beyond Project Area of the site to include a reasonable estimation of where sensory disturbance from Project-related activities would extend and where effects on wildlife including caribou are most likely to occur. That is the primary rationale for selection of the spatial extent of the LSA – Denison believes this is an appropriate spatial scale that applies broadly to the wildlife VCs as a whole given the perceived mechanism of VC-Project interaction. Importantly, as noted in draft EIS Section 9.3.6.4, in the caribou assessment, the Project Area had a 500 m buffer applied to account for indirect effects/habitat alteration; this area is within the wildlife LSA (refer to Figure 9.3-14 for a map showing the spatial areas). The 500 m buffer for habitat alteration for caribou was selected in accordance with ECCC's (2020) assessment of disturbed areas, which buffered (500 m) anthropogenic disturbances to evaluate woodland caribou habitat. The alteration of available woodland caribou habitat is quantified in this EIS by applying a buffer of 500 m around the Project Area in which Project effects in the form of sensory disturbance are likely to affect available woodland caribou habitat and make it functionally unavailable for use. Boreal caribou occur as one continuous population across the SK1 range, including within the Terrestrial RSA. It was decided to not use the entire SK1 range as an assessment area (e.g., due to the dilution factor) and instead use the Terrestrial RSA to appropriately and adequately assess residual and cumulative effects in proportion to the Project. It was deemed to be not feasible to use a large area like the SK1 range to assess residual Project effects because this would provide inappropriate context or "dilute" the adverse effects of the Project on the caribou that have a home range that overlaps with the RSA. The cumulative effect assessment of the draft EIS compares the Project-specific habitat effects (i.e., the Project Area plus a 500 m buffer to account for sensory disturbance) at the scale of the SK1 range (as the applicable management unit for portion of the woodland caribou population that uses the Terrestrial RSA). The result showed that the Project is expected to add 0.001% of anthropogenic disturbance at the scale of the SK1 Boreal Shield Woodland Caribou Management Unit (Section 9.3.7.3.3 of the EIS). References: Environment and Climate Change Canada (ECCC). 2020. Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada. Species at Risk Act Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. xiii + 143pp.	No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				The proposed Project's cumulative effects for boreal caribou are possible at the scale of the SK1 boreal caribou range. The RSA used for boreal caribou for this Project is only 40,173.6 ha, compared to the SK1 range, which is 18,034,870 ha. As such, it is too small to capture cumulative effects to this species and does not follow the Scientific Assessment to Support the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada (Environment Canada, 2011) or the Amended Recovery Strategy for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada. **Reference**: [1] Scientific Assessment to Support the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada (Environment Canada, 2011).			
IR-138	CNSC	COPC in Lichen	Section 9.2.4.2.2 Appendix 10-A (ERA)	**Context:** A quantitative assessment using modelling dispersion and uptake of COPCs in the environment was completed for the Project as part of the ERA, to support conclusions drawn in the EIS. In Appendix 10-A (ERA), COPCs in plant tissue was estimated for lichen. Table 5-5 of the ERA (p. 5.24) named "Complete Exposure Pathways for All Selected Ecological Receptors to be Assessed using the IMPACT Model" lists the exposure pathway for lichen as direct contact on soil. **Rationale:** Airborne COPC can deposition on lichen and subsequently enter the food chain; therefore, the "contact with air" pathway should be considered. In fact, lichen species are frequently used to monitor the deposition and accumulation of airborne contaminants (e.g., dust, metals). It is also noted that based on sampling results of the 2017 baseline studies, lichen frequently contain higher concentrations of COPC than blueberry (compare Table 9.2-6 and Table 9.2-7 in the EIS), especially at sampling sites with elevated concentrations (e.g., RSV9 and RSV10).	Please include the exposure pathway of direct deposition (dry and wet) of airborne contaminants on lichen in the quantitative ERA, or justify why this exposure pathway was not considered. See also related: IR-189.	Denison agrees that the air to lichen pathway is the primary exposure route for lichen. The ERA (Appendix 10-A) modelled the deposition of air to lichen as an exposure pathway and considered the uptake from soil to lichen as negligible. This will be clarified in Table 5-5: Complete Exposure Pathways for All Selected Ecological Receptors to be Assessed using the IMPACT Model. In the column "Environmental media" for lichen, "On soil" will be replaced by "air". Additionally, the conceptual site model shown in Figure 5-1 of the ERA will be updated to include a pathway arrow from air to lichen.	Minor change. In Table 5-5 of Appendix 10-A, the column "Environmental media" for lichen, "On soil" will be replaced by "air". Additionally, the conceptual site model shown in Figure 5-1 of the ERA will be updated to include a pathway arrow from air to lichen.
IR-139	ECCC	Change to an environmental component due to hazardous contaminants	Section 9.2.5.2.7, Waste and Hazardous Materials Management	**Context:** In this section, the Proponent outlines various measures to mitigate air emissions, including implementation of the air quality programs within the Environmental Management System, regular maintenance and inspection of equipment, and elimination of unnecessary idling of equipment. However, the intention to use industry-standard emission control systems has not been substantiated. **Rationale:** For the protection of air quality, it is important to specify the emission standards that equipment will have (e.g., Tier 3 or Tier 4 engines). Vehicles and equipment with Tier 4 engines have much lower emissions of contaminants than those with Tier 3 engines. If non-Tier 4 engines are used, ECCC recommends that best management practices are followed, including proper maintenance of the engine and anti-idling measures.	Confirm if vehicles and equipment will be equipped with Tier 4 engines where feasible.	Denison confirms that vehicles and equipment will be equipped with Tier 4 engines where feasible.	No updates to the draft EIS are needed based on this IR response.
IR-140	CNSC	Change in the Areal Extent of Wetlands	Section 9.2.6.4	**Context:** Predicted residual effects on the areal extent of wetlands include the direct effect of loss of wetlands and several indirect effects of alteration of wetlands. As stated in the EIS, wetlands can exhibit low resilience and high susceptibility to disturbance. At the same time, wetlands tend to support a high species diversity, and are considered to have a moderate to high potential to support listed plant species. Lastly, wetlands are rare on the landscape compared to terrestrial ecosites (see Table 9.2-5). **Rationale:** Several wetland ecosites (BS19/24, BS25, BS27) occur only in small areas (< 30 ha) in the RSA but are predicted to experience disturbance of 6-64%, most notably the ecosite BS19/24 where 0.8 of 1.2 ha are predicted to be disturbed. It is noted that wetlands are scattered throughout the landscape as shown in Figure 9.2-8. More information is requested regarding the ecological impact of this disturbance.	1. Please provide a discussion on the ecological impact of disturbance to rare wetland ecosites. 2. Please provide information on whether adequate other habitat is available for species impacted in these disturbed sites in close proximity, taking into account the home ranges of susceptible species. 3. Please provide additional information on whether wetland connectivity is maintained through the landscape within the LSA/RSA. See also related: IR-141. **Suggestions for mitigation and follow-up measures:** CNSC recommends that Denison conduct monitoring of species present in wetlands before and after disturbance, with a focus on listed plant species.	1. As described in footnote 3 of Table 9.2-8 and table 9.2-16 of the draft EIS, the ecosite BS19/24 is not a unique ecosystem and is instead an artifact of mapping uncertainty, as baseline mappers were unable to distinguish between BS19 (graminoid bog) and BS24 (graminoid fen) ecosites within these areas due to a lack of available information (e.g., soil information, vegetation field plots, water quality data). If all BS19, BS24 and BS19/24 were combined into a single combined "graminoid peatland" category, only 2.1% (3.6 ha of 170.7 ha) would be expected to be indirectly disturbed. No direct disturbance on wetland ecosites BS19/24, BS25, or BS27 is anticipated. Indirect disturbance with the potential to adversely affect these ecosites includes the introduction and/or proliferation of invasive plants, edge effects, changes to water quantity and quality, and dust deposition during all Project phases (further described in Section 9.2.4.2.1). Wetland ecosites BS19/24 (graminoid bog/fen) and BS25 (open fen) are peatland ecosystems typically characterized by high water tables (i.e., a very moist or very wet moisture regime), while BS27 (sedge rocky shore) is a sparsely vegetated ecosystem predominated by rocky substrates, typically occurring adjacent to lakes and ponds (McLaughlan et al. 2010). Because these ecosystems rely on high water tables and existing water bodies, alteration of water quantity would be expected to have the highest potential to cause an adverse effect, and thus maintenance of wetland hydrology is expected to be the most effective mitigation to sustain these wetland ecosites within the Terrestrial LSA throughout the Project lifespan. 2. No listed plant species have historically been observed to be associated with ecosites BS19/24 (graminoid bog/fen), BS25 (open fen), or BS27 (sedge rocky shore). As described in Table 2.4.4 of Appendix 9-B of the EIS, populations of the listed plant Alaskan clubmoss were observed to be associated with open Jack pine stands and transitional areas between upland and wetland/riparian areas. As stated in Section 2.2.2 of Appendix 9-B of the EIS the listed plants angle-leaved sundew and neat spike-rush were not observed in ecosites BS19/24, BS25 or BS27 either (see also the response to IR-175). With regard to wildlife, ecosites BS19/24, BS25, and BS27 are not limiting habitats for ungulates, furbearers, woodland caribou, raptors, or migratory breeding birds (as described in Sections 9.3 and 9.4 of the EIS) in the Terrestrial RSA. In fact, these ecosites were observed to exhibit low species richness and species diversity for breeding and migratory songbirds (Section 9.4.3.2.3). For bird species at risk, ecosites BS19/24 and BS25 are considered to provide suitable habitat for Short-eared Owl, Yellow Rail, and Rusty Blackbird; however, these ecosites are not anticipated to be limiting. Up to 2.9% of available Short-eared Owl habitat and up to 2.4% of Yellow Rail and Rusty	1. Section 9.2.6.4.1 will be updated to include the following: As noted in footnote 3 of Table 9.2-8 and table 9.2-16 of the draft EIS, the ecosite BS19/24 is not considered a unique ecosystem and is instead an artifact of mapping uncertainty, as it was not possible to distinguish between BS19 (graminoid bog) and BS24 (graminoid fen) ecosites within these areas during the wetland mapping process due to a lack of available information (e.g., soil information, vegetation field plots, water quality data). If all BS19, BS24 and BS19/24 were combined into a single combined "graminoid peatland" category, only 2.1% (3.6 ha of 170.7 ha) would be expected to be indirectly disturbed. However, no direct disturbance on wetland ecosites BS19/24, BS25, or BS27 is anticipated. Indirect disturbance associated with the potential to adversely affect these ecosites includes the introduction and/or proliferation of invasive plants, edge effects, changes to water quantity and quality, and dust deposition during all Project phases (as described in Section 9.2.4.2.1). Wetland ecosites BS19/24 (graminoid bog/fen) and BS25 (open fen) are peatland ecosystems typically characterized by high water tables (i.e., a very moist or very wet moisture regime), while BS27 (sedge rocky shore) is a sparsely vegetated ecosystem predominated by rocky substrates, typically occurring adjacent to lakes and ponds (McLaughlan et al. 2010). Because these ecosystems rely on high water tables and existing water bodies, alteration of water quantity would be expected to have the highest potential to

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						Blackbird habitat within the Terrestrial RSA may be altered or lost as a result of the Project during all Project phases (Section 9.4.6.4.1). 3. Surface drainage continuity and hydrologic connectivity is expected to be maintained across the Project Area with the engineering, construction and maintenance of surface water management features (e.g., culverts and ditches) as appropriate and as per Project design specifications along access roads and facility sites. A post-construction monitoring program will be developed to document the performance of surface water management structures adjacent to wetlands to evaluate areas (if any) where additional surface water management is considered to be necessary to maintain natural drainage. The monitoring program is expected to verify the presence and condition of surface water management structures, including any areas of water impoundment (e.g., upgradient of a road), erosion, or dead or dying vegetation. Culverts will be regularly inspected to identify where maintenance, repair, upgrade, and/or replacement is necessary to maintain natural surface drainage and the resultant wetland connectivity. This post-construction surface water management monitoring program is expected to identify issues (if any) in a timely manner and allow the adaptive management process, in consideration of the vegetation monitoring results, as vegetation species composition can be a lagging indicator of hydrologic change.	cause an adverse effect, and thus maintenance of wetland hydrology is expected to be the most effective mitigation to sustain these wetland ecosites within the Terrestrial LSA throughout the Project lifespan. 2. No updates to EIS required. 3. Section 9.2.5.2.3 will be updated to include the following: Hydrologic connectivity is expected to be maintained across the Project Area with the engineering, construction and maintenance of surface water management features (e.g., culverts and ditches) as appropriate and as per Project design specifications along access roads and facility sites. A post-construction surface monitoring program will be developed to document the performance of surface water management structures adjacent to wetlands to evaluate areas (if any) where additional surface water management is considered to be necessary to maintain natural drainage. The monitoring program is expected to verify the presence and condition of surface water management structures, including any areas of water impoundment (e.g., upgradient of a road), erosion, or dead or dying vegetation. The monitoring program is expected to identify issues (if any) in a timely manner and allow the adaptive management process, in consideration of the vegetation monitoring results, as vegetation species composition can be a lagging indicator of hydrologic change. Culverts will be regularly inspected to identify where maintenance, repair, upgrade, and/or replacement is necessary to maintain natural surface drainage and the resultant wetland connectivity.
IR-141	ECCC	Wetlands	Section 9.2.6.4.1	**Context and Rationale:** The Proponent states that: "Direct loss of wetlands has been mitigated by reducing the size of the Project Area to the extent practicable during Project design. However, up to 0.5 ha (less than 0.1%) of all wetlands within the Terrestrial RSA are anticipated to be removed from the Project Area during Construction (Table 9.2-16)." Information is not provided on whether wetlands in the terrestrial RSA are considered ecologically, economically or socially important to the region. Information on the regional importance of the wetlands that will be lost is needed in order to assess effects, including a wetland compensation plan if the wetlands are considered regionally important.	1. Provide information that accounts for whether wetlands are considered ecologically, economically and socially important to the region. 2. If the above is affirmative provide a wetland compensation plan to offset the loss. Consistent with the Operational Framework For Use of Conservation Allowance [1] a minimum ratio of 2:1 should be the starting point when determining the amount to be offset. [1] Available at : https://publications.gc.ca/site/eng/9.696852/publication.html See also related: IR-138.	During engagement activities, no specific comments or concerns were raised that would suggest wetlands near the Project are considered to be particularly ecologically, economically, and socially important to the region. Drainage in the Wheeler Upland Landscape Area of the Athabasca Plain Ecoregion is very weakly developed, and with numerous poorly drained wetland areas in lower landscape positions (Acton et al. 1998). This pattern is reflected in the Terrestrial RSA, where wetlands and water bodies are commonly scattered, comprising 16.6% of all mapped ecosystems (Section 9.2.3.3; Figure 9.2-8 of the draft EIS). Wetlands in this region provide ecological, economic, and social functions and values, and Denison has appropriately considered this during Project planning (i.e., avoidance to the extent practical). The Project Area has been reduced to the extent practicable, and the Project footprint has been sited to avoid wetlands to the extent feasible (Figure 9.2-8). Where wetland avoidance was not feasible, mitigation measures have been designed to reduce disturbance and maintain surface water connectivity (Section 9.2.5; see also response to IR-140 and IR-101). A small area of direct wetland disturbance is anticipated (0.5 ha; less than 0.1% of all wetlands within the Terrestrial RSA), predominantly associated with access road development. This area includes 0.4 ha of BS17 (black spruce treed bog), <0.1 ha of BS18 (Labrador tea shrubby bog), and <0.1 ha of BS23 (willow shrubby rich fen). These areas of direct wetland disturbance are small and located adjacent to existing access routes, and mitigation measures to maintain surface water connectivity across access roads will be implemented and monitored (see response to IR-140). The re-establishment of appropriate hydrologic conditions during Decommissioning is expected to lead to the re-establishment of wetland ecosystems within these directly disturbed areas. As such, it is Denison's opinion that a wetland compensation plan is not warranted.	No updates to the draft EIS are needed based on this IR response.
IR-142	ECCC CNSC	Wildlife and Wildlife habitat	Section 9.3.3.2.1 Scientific Literature Review – Wolverine Section 9.3.5 Mitigation Measures Section 9.3.6 Residual Effects Evaluation	**Context:** The Proponent did not conduct any field work to identify potential wolverine dens in the Project area and therefore did not present any mitigations for the potential impacts to wolverine dens. In Section 9.3.3.2.1, the Proponent states: "Denning females are sensitive to disturbance during denning season in February to April and may abandon their dens and, in some cases, their litter, which may decrease their reproductive success. " In Section 9.3.6, the Proponent states: "In the Project Area, 145.0 ha or 100% of available wolverine habitat is assumed to be removed and will not be available to wolverine for the duration of the Project (Table 9.3-13). Similarly, 145.0 ha (3.4%) of available wolverine habitat within the Wildlife LSA is anticipated to be removed, all from the Project Area, during site clearing in Construction. In the Terrestrial RSA, up to 0.5% (145.0 ha; from the Project Area) of available wolverine habitat is anticipated to be removed during site clearing in Construction." The residual effect assessment estimates that 8.2% of available wolverine habitat within the Terrestrial RSA may be altered or lost	1. Please provide additional information on whether the lost and/or altered wolverine habitat overlaps with wolverine home ranges. 2. Describe any important wolverine habitat feature (i.e., dens) that may be lost as a result of the Project. 3. Assess the need for pre- construction/pre-clearing surveys to identify any wolverine denning sites. 4. Please provide additional information on whether the remaining, available, undisturbed wolverine habitat size is suitable to maintain populations.	1. While wolverine were not observed during baseline studies for the Project, it is assumed that the Project (Project Area, LSA) may overlap with wolverine home ranges. As described in the EIS, wolverine occur in low densities across all forest stand and vegetation types but are generally absent from areas of human development and activities. 2. No wolverine dens were identified during any of the baseline studies. It is not anticipated that wolverine denning sites will be lost and/or altered because there are no specific landscape features typically used by wolverine as potential denning sites located in the Project footprint. Further, much of the proposed Project footprint will be developed within previously disturbed areas, including roads and cutlines. 3. Pre-construction surveys will be completed to identify all sensitive wildlife habitat features, including wolverine denning sites. 4. Most of the Project footprint is already disturbed through previous exploration activities. The total expected direct habitat loss of 169.6 ha includes the already disturbed areas. In the Terrestrial RSA, 8.2% of available wolverine habitat may be altered or lost; this includes 0.5% that will be cleared within the Project Area during Construction, and an additional 7.7% that may be altered through indirect effects (sensory disturbance). The magnitude of this effect was characterized as being "moderate" and the residual effect is not expected to result in a	1. No updates to the draft EIS are needed based on this IR response. 2. No updates to the draft EIS are needed based on this IR response. 3. Section 9.3.5.2.4 Work Timing Windows (third bullet will be updated to include): Pre-construction wildlife clearance surveys will be conducted within the Project Area in accordance with a wildlife monitoring plan and the draft Caribou Mitigation Plan. This would include surveying for important wildlife features that would include wolverine den sites. 4. No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				(Table 9.3-20). **Rationale**: As Wolverine is a Species at Risk Act Schedule 1 listed species, effects need to be identified, avoided, lessened and monitored. Mitigations, such as setback distances, should be used to protect important habitat features, such as dens. Wolverine occupy large home ranges and, therefore, need vast tracts of undisturbed land to maintain viable populations. The species avoids most human footprint types and linear features.		change that will alter wolverine habitat integrity to the point where it would not be able to sustain the regional populations of wolverine. This considers that no wolverine were observed during the baseline investigations, the small Project footprint, and the typically large size of a wolverine home range.	
IR-143	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3, Baseline Studies	**Context and Rationale:** The baseline caribou data is insufficient to understand potential Project impacts to this species. Presence/absence detection was provided by camera traps, incidental observations, winter track and pellet survey. Additional information and analyses on caribou use of the landscape during all life stages of the Project area is required to assess impacts and to determine significance of impact from the Project to caribou.	Provide details on the baseline caribou data including: • Revision of map 9.3-8 to include all observations, categorized by type, season and year (see also IR-145); and • Description of seasonal use of the LSA, RSA and caribou range. • Description of Project areas used by caribou. • Description of future studies planned to assess habitat use by caribou. Include specific details on how many additional years of aerial surveys will be completed to assess the caribou baseline conditions. Utilizing additional data noted above and specified in IR-145, explain how caribou use of the area could be affected by the Project throughout all seasons and life stages (e.g., calving, post-calving, rutting, wintering). See also related: IR-152.	The baseline data collection program was not specifically designed to collect seasonal caribou habitat use but to document caribou presence in the Project Area, Wildlife LSA and Terrestrial RSA. Based on this information, the EIS assumed caribou to be present in the study areas throughout all seasons and life stages. It should be noted that discrete calving areas have not been documented for the SK1 range. As described in the EIS, caribou may use open fen and treed bog habitat types for calving during the spring/summer period. Information from IK was included in the EIS, including potential calving areas in the Terrestrial RSA. Additional wildlife camera data have been obtained and analyzed to further describe seasonal use of the Project study areas. Updated Figure 9.3-8 (included in Attachment IR-143) provides the caribou sightings from baseline studies and updated to reflect seasonality of all sightings, where such data are available. There is insufficient information to provide further explanation on how caribou use of the area could be affected by the Project throughout all seasons and life stages (e.g., calving, post-calving, rutting, wintering)); however, the EA appropriately addressed direct and indirect effects on caribou and their habitat. Denison's intent is to develop the specific details related to environmental monitoring in general, and Caribou specifically, as part of licensing. A conceptual framework for monitoring and follow up was presented for each technical EIS discipline in the respective draft EIS section (see Section 9.3.9 for terrestrial wildlife). Environmental monitoring and follow up will fall within the scope of the Environmental Management System (EMS) for which document preparation is ongoing as indicated will be fulfilled during licensing. As noted elsewhere in the IR responses the EMS hierarchy will follow a three-tiered system comprising Program, Plan and Procedure level documentation, with detail associates with each becoming more granular and prescriptive at each successive tier. At this time no aerial surveys are planned. Denison approached the Province with proposals for aerial surveying for the purpose of the baseline program in 2016/2017 but the Province would not provide Denison with permits for aerial surveys. Based on recent discussion with the Province this position has not changed, nor is it Denison's understanding that it is likely to.	Applicable sections of Section 9.3.3.3 will be updated in the final EIS to include a description of seasonal use of the RSA. This would include: Wildlife Camera Study Wildlife camera locations were spread across three categories of linear features in mature and regenerating forest types: road (a maintained or seasonally accessible road supporting traffic), trail/rough road (a cleared disturbance over 2 m in width), and hand-cut line (a cleared disturbance under 2 m in width) (Appendix 9-B). Trails/rough roads and roads had the highest frequency of wildlife detection, with woodland caribou being the second most commonly photographed species (after snowshoe hare). Of the 34 caribou observations that were recorded, most were documented in the winter, with one observation from the spring and one in the summer. Seven data points had no date associated with the observations. Of the winter observations that were documented, seven occurrences were located in the northern portion of the RSA and the remainder located in the eastern portion of the RSA (Figure 9.3-8). Figure 9.3-8 included in Attachment IR-143 has been updated to include additional camera data on caribou presence and seasonal use and will replace Figure 9.3-8 in the draft EIS The Conceptual Caribou Mitigation Plan is included with the IR response package (Attachment IR-149). This Plan includes description of ongoing studies to assess linear feature use by caribou and will be included in the final EIS as new Appendix 9-E.
IR-144	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3, Baseline Studies – map 9.3-8	**Context and Rationale:** The mapping of caribou observations during baseline studies provided in Figure 9.3-8, "Caribou Sign Observations in the Wildlife Study Areas," is insufficient to enable conclusions to be drawn. ECCC is not able to review the spatial aspect of caribou observations without a map of all available observations. Additional information is available, as stated in Section 9.3.3.3.3: *"A total of 200 observations were made between 2017 and 2019 and recorded as either caribou sign (i.e., tracks, pellets, and evidence of feeding activity based on ground feeding craters and arboreal feeding evidence) or photographs (collected through the wildlife camera study) to document caribou presence in the LSA and RSA. Most observations occurred in the Terrestrial RSA, with observations concentrated in the north and southeast portions.* *Three observations occurred in the southeast portion of the Wildlife LSA, and no caribou sign was observed in the Project Area. Figure 9.3-8 provides an overview of some caribou sign observed during the baseline studies."*	Update map 9.3-8 to show all caribou observations during baseline studies, broken down by type of observation (camera, incidental, pellet, track) and season/year when the observation was made. Include additional data from the Province of Saskatchewan (see also IR-145) to help characterize caribou use on a spatial map.	Refer to the Attachment IR-143 for the updated version of Figure 9.3-8. Denison acquired data from the Province of Saskatchewan which has been included in Attachment IR-145. As shown in the figure, the data is not available in a format that can be imported for analysis and incorporated into a spatial map. The data does not specify seasonality of the observations. Regardless, this data relates to the information provided by McLoughlin (2019 and 2021) and confirms caribou have been previously documented within the RSA, particularly in the eastern portion. References: McLoughlin, P. D. 2021. Associate Professor, University of Saskatchewan, Saskatoon, SK. Personal Communication. January 2021. McLoughlin, P. D., C. Superbie, K. Stewart, P. Tomchuk, B. Neufeld, D. Barks, T. Perry, R. Greuel, C. Regan, A. Truchon-Savard, S. Hart, J. Henkelman, and J. F. Johnstone. 2019. Population and habitat ecology of boreal caribou and their predators in the Saskatchewan Boreal Shield. Final Report. Department of Biology, University of Saskatchewan, Saskatoon. 238 pp.	No updates to the draft EIS are needed based on this IR response.
IR-145	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3, Woodland Caribou	**Context and Rationale:** The Proponent has not provided sufficient information on how caribou use the landscape, including identification of areas for different life stages of caribou (calving, post-calving, rutting and wintering). The University of Saskatchewan published a report entitled Population and habitat ecology of boreal caribou and their predators in the Saskatchewan Boreal Shield. This report contains information on habitat types that are used during different life stages. Additionally, Appendix H of the Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 20202 [1] details habitat characteristics required by boreal caribou to carry out life processes necessary for survival and recovery.	1. Provide, based off existing literature or available data and the Amended Recovery Strategy for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada: • information on known important habitat features or biophysical attributes in Project areas for different caribou life stages (calving, post-calving, rutting, wintering), • a map(s) of the type and spatial extent of important caribou habitat features or biophysical attributes of the study areas as defined in Appendix H of the Recovery Strategy, ○ mapping should be at the RSA/LSA level as well as larger-scale mapping at the scale of the Project footprint.	Denison considers the EA to be a planning and decision-making tool that assesses the potential effects of the Project in a careful and precautionary manner and integrates results of engagement with Indigenous nations and communities. As such, the EA is a process for identifying the Project's potential interactions with the biophysical and human environment, predicting potential adverse effects, identifying mitigation measures, and evaluating residual and cumulative effects remaining after mitigation. The EA also outlines the proposed efforts for monitoring and reporting to verify compliance with the terms and conditions of EA approval and to assess the accuracy and effectiveness of predictions and mitigation measures presented in the EA. Denison views the EIS as an important planning tool that will be used to support future activities and represents one stage in the rigorous overall approvals process for a uranium mining facility in Canada. Denison is completing a sequential EA and licensing process for the Project. In the EIS, a framework for the Environmental Management System (EMS) is provided along with a clear commitment for Denison to include Project design and	The map included in Attachment IR-145 along with supporting text will be added to Section 9.3.3.3 of the final EIS.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				The scientific literature review (Section 9.3.3.3.1) on Woodland Caribou states: "While calving areas have not been documented within the SK1 range, it is recognized that caribou may use open fen and treed bog habitat types for calving during the spring/summer period. In Saskatchewan, caribou habitat used during the calving season in the SK2 range demonstrated a strong selection for treed muskegs, but avoidance of jack pine, mixed hardwood stands, and roads (Dyke 2008)." ECCC is not able to verify the Proponent's effects assessment without sufficient information on important habitat or biophysical attributes for caribou within the study areas. [1] https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/recovery-strategies/woodland-caribou-boreal-2020.html#toc0	2. Assess the potential direct and indirect effects based on additional information on caribou from bullet A above. See also related IRs: IR-143 and IR-152. **Suggestions for mitigation and follow-up measures:** ECCC recommends that the Proponent contact the Province of Saskatchewan to enquire about obtaining caribou telemetry data in the Project area. The data can be analyzed to determine important habitat features in the Project area.	species-specific mitigation measures into the EMS documents as they are developed / as the Project proceeds through the licensing and permitting phases. The selection of valued components (VC), with key indicators (KI), and associated measurable parameters is an important part of scoping in each biophysical and human environment assessment. Woodland caribou were selected as a VC in the Terrestrial Environment assessment for a variety of reasons including a recognition of caribou as an important cultural and subsistence species, the conservation status of caribou, and that Project activities and infrastructure may affect woodland caribou populations. For the woodland caribou VC, the KI selected was also woodland caribou. The measurable parameters for the caribou VC/KI were: 1. amount of habitat that may be altered or lost relative to its availability in the Terrestrial RSA; and, 2. woodland caribou mortalities directly or indirectly attributable to the Project. The main Project interactions identified in the caribou assessment were: direct habitat loss, sensory disturbance, collisions with Project vehicles and equipment, and harvest and/or predation. Accordingly, the potential effects evaluated for caribou were: 1. amount of habitat that may be altered or lost relative to its availability in the Terrestrial RSA; and, 2. mortalities directly or indirectly attributable to the Project. Denison undertook the evaluation and assessment of potential effects on caribou in a conservative fashion to provide confidence in the assessment conclusions. For instance, where granular data concerning seasonal distribution and specific landscape uses were not available the approach was to assume the caribou at all life stages were present during all seasons. Additionally, the caribou assessment used conservative assumptions to categorize 'available' habitat. Denison also committed to important mitigation measures such as pre-clearance surveys, among other things. The EIS has demonstrated that the Project, as proposed and assessed, is predicted to minimize the potential for environmental adverse effects on caribou and their habitat before any Project specific construction occurs. The conclusions of the assessment predicted that the likely residual effects of the Project on caribou were not significant. The EIS uses "available caribou habitat" as a basis to assess the Project effects. Available habitat was determined as the ecosites in which caribou / caribou sign were detected most frequently during the baseline studies, and the EIS used a precautionary approach by assuming caribou use of these areas during all seasons and life stages. Subsequent to filing of the draft EIS and as committed to ECCC during an April 20, 2023 meeting between Denison and ECCC, Figure 9.3-8 has been updated (included in Attachment IR-143) to address seasonal use by caribou within the terrestrial study areas. In May 2023, Denison received caribou data from the Province of Saskatchewan that included both incidental observations and telemetry point data within the terrestrial study areas. These data were provided to Denison as a figure, and this figure has been included herein as Attachment IR-145. The information made available to Denison by the Province was not broken down to reflect the timing (seasonality) of the reported data and therefore does not specifically contribute to the description of seasonal use of the Project study areas by caribou. For reference, and based on the data that have been made available, the conservative assessment approach utilized in the draft EIS of assuming caribou presence in the terrestrial study areas throughout all seasons will not be changed.	
IR-146	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3.1, Woodland Caribou, Scientific Literature Review - Predation	**Context and Rationale:** The information on impacts of predation and apparent competition for caribou in relation to the proposed Project are insufficient. In the section on caribou predators (9.3.3.3.1), the Proponent provided details on densities of wolves and their overlap with caribou and speaks of apparent competition. The Proponent did not examine other predators, such as black bear. The analysis on impacts of predation and apparent competition is insufficient since known predators have been omitted without explanation from the assessment of effects. ECCC is not able to verify the Proponent's effects assessment since important species have not been considered in the assessment.	Provide further information and analyses on all potential predators of caribou, including impacts from apparent competition.	Effects from predation as a factor contributing to indirect mortality are discussed and qualitatively assessed in the EIS. Section 9.3.3.3 describes current knowledge of caribou mortality in or around the Project study areas (i.e., the existing studies describe wolf predation and hunting). It is acknowledged that black bear may also prey on caribou; however, this would be expected to follow the same effect pathways and is included in the qualitative indirect mortality assessment. Effects of apparent competition are included in the EIS and are part of the qualitative indirect mortality assessment.	In the final EIS, 9.3.3.3.1 Scientific Literature Review Denison will replace Predation section with the following: Predation McLoughlin et al. (2019) observed that mortality of adult caribou occurred mostly during the snow-free season; however, mortality could not be confirmed for most of the caribou, with only the fate of 1 of 94 collared caribou confirmed in the four years of the study (which had been harvested by a hunter). Relatively low predator (e.g., wolf and black bear) densities in their study area were documented by McLoughlin et al. (2019), with other prey species, such as moose, also occurred at relatively low densities (i.e., 45.7 moose/1,000 km^2). While the effect on adult caribou survival by black bear is anticipated to be marginal compared to that by wolves, they may still be a predator of caribou calves and potentially a limiting factor to recruitment (McLoughlin et al. 2019). McLoughlin et al. 2019 noted that there was spatial separation between caribou and wolves as well as black bear, although this was found to be variable amongst individuals. Caribou did not seem to avoid existing linear features (such as roads, trails, and transmission lines) in the area, while wolves established their territories away from linear features. Unlike caribou, who preferred mature conifer stands, wolves selected

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
							for wetlands and patches of deciduous-mixed forest, avoiding stands of mature conifers. Black bears also used mixed-wood forests but particularly in the summer and fall they selected for jack pine stands <40 years. (McLoughlin et al. 2019). While predation is believed to be the limiting factor for woodland caribou, Neufeld et al. (2021) suggested that habitat- or disturbance-mediated apparent competition only plays a minor role in the Saskatchewan woodland caribou population. Habitat or disturbance-mediated apparent competition occurs when natural (e.g., forest fires) and anthropogenic (e.g., human development or activities) disturbances increase the abundance of other ungulates, which in turn may increase predator densities, which then increases predation risk to caribou. Neufeld et al. (2021) concluded that Northern Shield and Taiga ecoregions are of low productivity where caribou may compete with only one ungulate species (i.e., moose) and therefore, caribou and wolf dynamics do not follow general habitat- or disturbance-mediated apparent competition models.
IR-147	ECCC	SAR - Boreal Caribou	Section 9.3.4.2.1, Alteration and/or Loss of Habitat	**Context and Rationale:** The process of in-situ recovery mining will likely create changes to the surface topography and potential ground subsidence as well as changes to groundwater elevations. These changes can affect the plant communities and ecosite types. In Section 9.3.4.2.1 the Proponent states that: "Following decommissioning and reclamation, wildlife habitat is expected to recover to baseline conditions." A more thorough explanation regarding post-decommissioning landscape is required to assess Project impacts.	1. Provide further rationale and/or analysis regarding the return of wildlife habitat to baseline conditions post-decommissioning. Incorporate other environmental impacts including: • Ground subsidence and impacts on wildlife habitat • Changes to aquifers and impacts on wildlife habitat 2. Describe reclamation activities/measures, including temporal information that will be implemented to help in the recovery to baseline conditions.	1. The risk of ground subsidence has been assessed as part of the draft EIS (see Appendix K to Appendix 7-C). Subsequent to the filing of the draft EIS, Denison undertook additional modelling with refined, more granular inputs including consideration of subunits within the altered zone (RESPEC 2023). With this more refined analysis, the potential surface subsidence has been reduced from 7.5 cm to 2.4 to 2.8 mm (RESPEC 2023 is included here as Attachment: IR-21). Overall, the analysis shows there is negligible risk of subsidence and the magnitude of subsidence, if it were to occur, is in the range of millimeters at surface. Further, this potential subsidence would be limited to the footprint directly above the deposit. In consideration of the above, with specific reference to the expected level of ground subsidence, no effects on wildlife habitat nor aquifers that support wildlife habitat are expected. Moreover, Denison does not foresee that ground subsidence would be a risk to the success of wildlife habitat restoration / reclamation during Post-Decommissioning, within the context (potential for adverse effects on wildlife habitat and/or changes to aquifers that may adversely affect wildlife habitat) raised by the IR. As outlined in Section 2.3.3 of the draft EIS, as part of the Conceptual Decommissioning Plan (CDP), reclamation activities, including replanting, will take place once the asset removal, decontamination, demolition, and disposal are completed, and the site has been cleared and leveled. Notwithstanding the execution of major decommissioning activities, Denison will look for opportunities to proactively reclaim inactive areas of the Project site as is possible in a timely manner and without delay. Progressive reclamation is considered in more detail below. Future discussions will be held with Indigenous and general public Interested Parties to determine the amount of access to the area they wish to maintain in the future (post-decommissioning). Based on the results of these discussions, roads associated with the Project site that are no longer needed will be graded and scarified to promote natural revegetation. Access roads or trails required for post-closure monitoring or deemed useful by Interested Parties may be left to facilitate continued access. Access to the site may be restricted by gates and/or berms for safety. Laydown areas will be scarified, covered with 0.5 to 1.0 m of stockpiled overburden, and vegetated with native, self-sustaining species. The footprints of other infrastructure, such as the camp, will be scarified and vegetated with native, self-sustaining species as required. The topsoil and brush stockpiled during pre-construction activities will be used during reclamation. Lessons learned from progressive decommissioning and any site-specific reclamation studies will be incorporated into the detailed reclamation design. Additionally, information from other northern Saskatchewan mine sites will be examined to help Denison select the reclamation tools, including revegetation options, that will contribute towards decommissioning success. 2. Specific details concerning reclamation activities / measures, including detailed temporal information for restoration will be developed as part of future updates to the decommissioning plan. The CDP included in the draft EIS contains information related to site restoration; see also the Conceptual Caribou Mitigation Plan provided in Attachment IR-149. The CDP contains the appropriate level of detail for this stage of the Project. Briefly, the three main physical decommissioning activities include: • mining area remediation; • asset removal; and • decontamination, demolition, and disposal. Physical decommissioning activities are followed by reclamation. The expected duration for decommissioning is 5 years (from year 18 to 23 of the Project). Importantly, during physical decommissioning, the majority of Project components are scheduled to be removed from site which is expected to facilitate reclamation activities. Also, because of the selected mining method, there are no large site aspects, such as waste rock	No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						piles or tailings management facilities, for which large scale and potentially complex reclamation strategies are needed. Denison has committed to progressively reclaim areas no longer necessary to support/facilitate Operations to limit the amount of disturbance at any given time. Reclamation of inactive areas will take place when/as these areas become available. The progress and success of these activities will be assessed annually. Progressive reclamation and ecosystem-based revegetation will be conducted on disturbed areas as soon as safely and logistically practicable with the use of suitable/appropriate native vegetation species and in accordance with the Reclamation and Closure Plan. As described in Section 2.3.3 and outlined above, the details of the decommissioning plan, including site restoration, will evolve and become more specific as the Project advances. The subsequent iteration of the decommissioning plan will be the preliminary decommissioning plan (PDP). The PDP will be submitted to regulators as part of Project licensing and permitting and will provide additional detailed information with respect to site decommissioning, including site restoration. The PDP would reflect input that will be solicited from Indigenous Nations and communities and others prior to its submission. Prior to executing decommissioning activities, Denison shall prepare and submit a detailed decommissioning plan (DDP) to regulators for acceptance, which builds on the PDP. In this case the DDP would reflect input that will be solicited from Indigenous Nations and communities and others prior to its submission and would also be informed by conditions on the ground at the site at that time, operational experience that has been gained and the regulatory landscape at that time. As is highlighted above, the decommissioning plan, including site restoration, will evolve over time and the plan will become more refined as the Project advances.	
IR-148	ECCC	Wildlife and Wildlife habitat	Section 9.3.4.2.1, Alteration and/or Loss of Habitat	**Context and Rationale:** ECCC analyzes disturbance for caribou at the range level, in this case within the SK1 range. However, the Proponent did not provide an adequate assessment of total disturbance at the range level. The draft EIS (Section 9.3.4.2.1 p. 9-211) reads: "The SK1 Boreal Shield Woodland Caribou Management Unit has relatively low levels of anthropogenic disturbance and was exposed to large fire disturbances in the past 40 years (ECCC 2019). Environment and Climate Change Canada (2019) identified this caribou population as being self-sustaining at a threshold of 40% undisturbed habitat with the total anthropogenic disturbance not exceeding 5% of their habitat. The current anthropogenic disturbance levels (without areas burnt by past forest fires) for the study areas are below this threshold (with the exception of the already disturbed Project Area) and are estimated as: 24.8 ha (14.6%) for the Project Area, 168 ha (3.5%) for the Wildlife LSA, and 599 ha (1.5%) for the Terrestrial RSA." Analysis of habitat disturbance should be calculated at the range level in order to assess impacts and determine significance. Analysis should be consistent with the methodology described in the document Scientific Assessment to Support the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada (Environment Canada, 2011) [1]. [1]https://publications.gc.ca/site/eng/401605/publication.html, p. 28/41	Provide the following in order to support analysis of habitat disturbance: 1. Calculation of total disturbance including natural and anthropogenic disturbance at the range level. 2. Description of effects on existing habitat at the scale of the range (for < 40% undisturbed habitat in the SK1). Include: • an account (and GIS file if available) of existing habitat affected, using the following formula: (Project footprint + 500m buffer) - overlapping (permanent alteration(s) + 500m buffer) 3. A map of the SK1 range showing all disturbed and undisturbed habitat, including predicted disturbance (direct and indirect) resulting from the Project. 4. Description of whether the Project is expected to compromise the ability of the range to be restored to the undisturbed habitat threshold, and provide a rationale for the conclusion. See also related: IR-154.	1., 2., and 3.: This calculation (for Project Area + 500 m buffer) is provided for the Project at the SK1 range level in the Cumulative Effects Assessment (see Section 9.3.7.3.3). Project-specific values are provided as they add to the known existing reported anthropogenic disturbance in the SK1 range and the result shows that the Project would be adding 0.001% of anthropogenic disturbance at the scale of the SK1 Boreal Shield Woodland Caribou Management Unit (refer to response to IR-137). Existing anthropogenic disturbance was mapped at the scale of the Terrestrial RSA (i.e., the assessment area - see Figure 9.3-15); the mapping was not extended to the entire SK1 range because: (1) this was not determined to be the assessment area (explained in response to IR-137) and (2) shapefiles are not publicly available for all developments in the SK1 range. 4. The Project is not expected to compromise the ability of the range (i.e., SK1 range) to be restored to the undisturbed habitat threshold. This opinion is based on the small amount of disturbance (i.e., 0.001%) of anthropogenic disturbance and Denison's commitment to progressive reclamation as well as final reclamation as part of the Decommissioning phase. Also considered was the ecology of the boreal forest which is influenced, primarily by forest fires that continue to "reset" the seral stage of forest, typically at a much larger scale than that of the Project Area. The reclamation efforts will be monitored, and deficiencies noted and addressed appropriately in a timely manner, so that lands are returned to comparable land use capability and habitat (i.e., regenerating forest), that existed prior to the Project. The Project is not expected to adversely affect the habitat within the SK1 range to the extent that the range/habitat is unable to support caribou.	No updates to the draft EIS are needed based on this IR response.
IR-149	ECCC CNSC	Wildlife and Wildlife habitat	Section 9.3.5.2, Additional Wildlife- specific Mitigation Measures	**Context:** The EIS describes that ongoing research is performed to inform the development of a Woodland Caribou Management Plan. This includes studies on the effectiveness of linear disruption features on predator/prey movements, and a field program for long-term reclamation planning. Moreover, it is stated that the Plan will include a detailed assessment of the need for habitat offsets. The draft EIS Section 9.3.5.2 states: "A wildlife monitoring plan and a Woodland Caribou Management Plan will be developed to address wildlife-specific mitigation measures based on proven and accepted mitigation following standard industry guidelines and BMPs. The plans will provide guidance to avoid or minimize potential adverse effects of the Project on wildlife and wildlife habitat, including monitoring and follow-up programs, as appropriate. It will be in place during all phases of the Project and will be subject to ongoing review and revision as required. If monitoring identifies a need for additional or revised mitigation measures, a process of adaptive management (as described in the plan) will be triggered." **Rationale**: The draft EIS does not present sufficient species-specific mitigation measures for boreal caribou. ECCC is not able to assess potential residual impacts to caribou without specific mitigations. Since the Woodland Caribou Management Plan is still under development, it is difficult to judge whether the measures will be adequate to mitigate and/or offset potential project effects on Woodland caribou and its critical habitat.	Provide the Woodland Caribou Management Plan, to demonstrate effective mitigation of potential project effects, along with wildlife-specific mitigation measures for review. The Plan should be informed by and consistent with the Boreal Caribou Recovery Strategy and demonstrate that avoidance and minimization measures will be applied to mitigate for predicted Project effects to boreal caribou and its critical habitat prior to considering offsetting measures. That is, the Plan should follow the mitigation hierarchy and information should be provided as outlined below: 1. AVOID: Describe all measures that will be taken to avoid effects to boreal caribou and avoid the destruction or alteration boreal caribou critical habitat. 2. MINIMIZE: Describe all measures that will be taken to minimize the effects to boreal caribou and minimize the destruction of boreal caribou critical habitat. 3. RESTORE ON-SITE: describe the measures that will be taken to restore disturbed areas of the project, related to construction, operation and maintenance, on boreal caribou critical habitat, remaining after considering the avoidance and minimization measures. 4. Characterize the risk of the adverse effects that are likely to result from the project on boreal caribou and its critical habitat after avoidance minimization, and onsite restoration measures have been considered.	Denison considers the EA to be a planning and decision-making tool that assesses the potential effects of the Project in a careful and precautionary manner and integrates results of engagement with Indigenous nations and communities. As such, the EA is a process for identifying the Project's potential interactions with the biophysical and human environment, predicting potential adverse effects, identifying mitigation measures, and evaluating residual and cumulative effects remaining after mitigation. The EA also outlines the proposed efforts for monitoring and reporting to verify compliance with the terms and conditions of EA approval and to assess the accuracy and effectiveness of predictions and mitigation measures presented in the EA. Denison views the EIS as an important planning tool that will be used to support future activities and represents one stage in the rigorous overall approvals process for a uranium mining facility in Canada. Denison is completing a sequential EA and licensing process for the Project. In the EIS, a framework for the Environmental Management System (EMS) is provided along with a clear commitment for Denison to include Project design and species-specific mitigation measures into the EMS documents as they are developed / as the Project proceeds through the licensing and permitting phases. The selection of valued components (VC), with key indicators (KI), and associated measurable parameters is an important part of scoping in each biophysical and human environment assessment. Woodland caribou were selected as a VC in the Terrestrial Environment assessment for a variety of reasons including a recognition of caribou as an important cultural and subsistence species, the conservation status of caribou, and that Project activities and infrastructure may affect woodland caribou populations. For the woodland caribou VC, the KI selected was also woodland caribou. The measurable parameters for the caribou VC/KI were: 1. amount of habitat that may be altered or lost relative to its availability in the Terrestrial RSA; and, 2. woodland caribou mortalities directly or indirectly attributable to the Project. The main Project interactions identified in the caribou assessment were: direct habitat loss, sensory disturbance, collisions with Project vehicles and equipment, and harvest and/or predation. Accordingly, the potential effects evaluated for caribou were: 1. amount of habitat that may be altered or lost relative to its availability in the Terrestrial RSA; and, 2. mortalities	The Conceptual Caribou Mitigation Plan, provided in Attachment IR-149, will be included in the final EIS as a new appendix (Appendix 9-E) to Section 9.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
					5. OFFSET: Describe the measures that will be implemented outside the Designated Project area to mitigate adverse effects, destruction or alteration of boreal caribou critical habitat by the Designated Project during construction and operation. 6. Characterize the risk of the adverse effects that are likely to result from the project on boreal caribou and its critical habitat after avoidance, minimization, onsite restoration, and offset measures have been considered. Describe all relevant uncertainties on the effectiveness of the measures to address adverse effects on boreal caribou and the rationale for the selected measure, in light of the mitigation hierarchy. See also related IRs: IR-149 and IR-157.	directly or indirectly attributable to the Project. Denison undertook the evaluation and assessment of potential effects on caribou in a conservative fashion to provide confidence in the assessment conclusions. For instance, where granular data concerning seasonal distribution and specific landscape uses were not available the approach was to assume the caribou at all life stages were present during all seasons. Additionally, the caribou assessment used conservative assumptions to categorize 'available' habitat. Denison also committed to important mitigation measures such as pre-clearance surveys, among other things. The EIS has demonstrated that the Project, as proposed and assessed, is predicted to minimize the potential for environmental adverse effects on caribou and their habitat before any Project specific construction occurs. The conclusions of the assessment predicted that the likely residual effects of the Project on caribou were not significant. Denison met with ECCC representatives on April 20, 2023, and agreed to provide a conceptual caribou mitigation plan as part of the IR response package, and also include the conceptual plan in the final EIS. As such, the Project's Conceptual Caribou Mitigation Plan is provided as Attachment IR-149 and will be included in the final EIS. The framework for the Conceptual Caribou Mitigation Plan (the Plan) was developed during discussions between Denison and Saskatchewan Ministry of Environment (ENV) in May and June 2023. The Plan is an evergreen document. It will be consistent with the management goals of ENV for the SK-1 caribou conservation unit and will be developed/refined in consultation with local communities including English River First Nation and Kineepik Métis Local in Pinehouse and ENV. Since the boreal caribou range plan for SK-1 is under development, it is understood that this Plan will be updated as more information becomes available. The conceptual nature of the Plan at this time is in part due to the absence of range plan priorities and reflects Denison's commitment to continue to work with ENV to meet the management objectives and management strategies for the SK1 range. This approach acknowledges that the responsibility for woodland caribou management lies with the Province of Saskatchewan. Broadly, the province is responsible for developing range plans or management plans which build on the federal recovery strategy by setting goals and objectives for maintaining sustainable population levels. The EIS has demonstrated that the Project, as proposed and assessed, is predicted to minimize the potential for environmental adverse effects on caribou and their habitat before any Project specific construction occurs. The conclusions of the assessment predicted that the likely residual effects of the Project on caribou were not significant.	
IR-150	ECCC	Wildlife and Wildlife habitat	Section 9.3.5.2.1, Best Management Practices for working in Boreal Woodland Caribou Range in Saskatchewan	**Context and Rationale:** In the draft EIS Section 9.3.5.2.1, the Proponent states: "Denison proactively initiated research to provide field-based findings on the effectiveness of linear disruption features on predator/prey movements." "Results will help the development of proactive and meaningful restoration strategies as an ongoing part of the overall Project (Omnia 2022). Additionally, the 2023 field program will support a program that uses the results from the 2021/2022 Caribou Trail Study in long-term reclamation planning. The program will be led by the University of Saskatchewan and is funded by Denison, an Indigenous-owned environmental company, the Northwest Communities Environmental Services (Métis owned), Mitacs, and the Natural Science and Engineering Research Council of Canada through an alliance grant. The Caribou Trail Study and the reclamation plan will culminate with the development of a Woodland Caribou Management Plan." ECCC is available to support the Proponent through review of study programs should those programs be made available during the review process. ECCC requests to see the 2021/2022 study to further our review of caribou use in the Project area.	Provide the report for 2021/2022 Caribou Trail study for long-term reclamation planning for ECCC review.	The report titled *Pilot Program: Linear Feature Mitigation Interim Report- Status Update and Preliminary Results* is included as attachment IR-150.	No EIS updates in response to this IR.
IR-151	ECCC	Wildlife and Wildlife habitat	Section 9.3.6.4	**Context and Rationale:** In the analysis of residual and cumulative effects for woodland caribou, information and analyses on impacts to connectivity and movement across the landscape is lacking.	1. Using available reports and data, provide an analysis of impacts to landscape connectivity for woodland caribou at the LSA and Range scales. 2. Determine whether the Project is expected to result in a reduction of connectivity within or between the ranges and provide a rationale for the conclusion. Describe how movement corridor(s) may be affected by Project activities and infrastructure.	To appropriately focus the EA, using an accepted/proven methodology, the EIS considers two effects: (1) alteration and/or loss of habitat and (2) change in mortality. Effects on movement corridors were not assessed specifically as this is not an infrastructure project that is expected to affect movement patterns across the landscape (i.e., landscape connectivity is not expected to be affected). This also considers the life stages and biology of woodland caribou, including their movement patterns. A "wildlife corridor" ~6 km south of the Project Area (as depicted in Figure 4. Map B, page 16 of ERFN and SVS 2022) was identified by IK that was appropriately considered in the assessment, as this feature overlaps with the Terrestrial RSA. However, this feature was not expressly discussed in the residual effects assessment because there is no anticipated spatial overlap of those areas with direct or indirect Project effects. Further, the effect of habitat alteration does consider changes in species' habitat use, including movement. This approach was appropriate considering the small Project Footprint, the progressive reclamation, the baseline data, the available Indigenous Knowledge and the biology of caribou (e.g., no large-scale movement patterns) potentially using portions of the Terrestrial RSA.	No updates to the draft EIS are needed based on this IR response.
IR-152	CNSC	Woodland Caribou Residual Effects Evaluation	Section 9.3.6.4, Appendix 9-B	**Context:** Baseline studies for Woodland caribou include: • Winter Track Count Survey to assess presence, abundance, feeding activity, and ecosite affiliation; • Pellet Group/Browse Availability Survey to detect presence and abundance of caribou, and frequency of occurrence and abundance of lichen;	Please provide a summary of available baseline data on habitat use during all seasons and life stages, in particular sensitive stages such as calving, and how habitat use during all seasons and life stages was considered in the residual effect analysis. See also IR-145 and IR-143.	Refer to the responses to IR 143 and IR 145.	No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				• Covert Camera Survey to determine presence and use of linear features (roads, trails, and hand-cut lines). The Saskatchewan Conservation Strategy for Boreal Woodland caribou [1] states that caribou are very susceptible to predation during the calf-rearing period, and populations are extremely sensitive to even minor changes in mortality rates. **Rationale:** It is unclear if, or how, any data on seasonal and spatial use of habitat was considered in the residual effect analysis, for example summer/winter home ranges, sensitive life stages including calving (e.g., location of calving sites). It should be noted that the English River First Nation have identified caribou calving areas in the vicinity of the project footprint. **Reference**: [1] Saskatchewan Ministry of Environment. 2013. Conservation Strategy For Boreal Woodland Caribou (Rangifer tarandus caribou) in Saskatchewan. Saskatchewan Ministry of Environment. Fish and Wildlife Technical Report 2014.			
IR-153	CNSC	Woodland Caribou Residual Effects Evaluation	Section 9.3.6.4.1	**Context:** According to ECCC (2020), forest fires can directly alter habitat, making it unsuitable for boreal caribou (e.g., through loss of mature conifer stands, loss of lichens and other forage plants, barriers to movement). Boreal caribou generally do not return to burned areas for several decades until the forest is old enough to support lichens and other food sources, although they may make limited use of burned areas to feed on new growth. The residual effects evaluation of alteration and/or habitat loss lists ecosites BS3 and BS7 (regenerating forest types) as available habitat in Table 9.3-22, which represent 43.5% of the Regional Study Area. **Rationale:** It is unclear whether the ecosites BS3 and BS7 (regenerating forest types) represent suitable habitat for Woodland caribou year-round. More information is required on the habitat quality (e.g., time since last forest fire) and suitability for different life stages of caribou. For conservatism, it is recommended to perform a second residual effect analysis not including regenerating forest ecosites.	1. Please provide further information on the suitability of ecosites BS3 and BS7 for Woodland caribou in different life stages. 2. Please provide the results of a residual effect analysis not including ecosites BS3 and BS7 for conservatism. 3. If 2 leads to habitat fragmentation, consider connectivity of habitat patches in the residual effect analysis.	1. Caribou were observed within these regenerating ecosites (B53 and BS7) during baseline studies and therefore, to be inclusive of all life stages, they were included in the "available habitat" for woodland caribou. 2. The EIS followed a conservative approach by including these ecosites in the available year-round habitat to appropriately inform the effects assessment. No additional analysis related to connectivity of habitat patches is considered to be warranted for the Project, considering the baseline data, available Indigenous Knowledge and the biology of the caribou potentially using portions of the Terrestrial RSA 3. Effect on habitat connectivity and fragmentation were considered in the habitat-based effects assessment within the context of habitat loss/alteration. The effects assessment considered that the project footprint had been previously disturbed/fragmented and connectivity altered. The assessment appropriately considered effects on wildlife habitat at the LSA and RSA levels	No updates to the draft EIS are needed based on this IR response.
IR-154	CNSC	Woodland Caribou Alteration and/or Loss of Habitat	Section 9.3.6.4.1	**Context:** Lichen, the primary food source for Woodland caribou (up to 70% of the year-round diet), can be exposed to airborne contaminants and dust deposition at distances of 1–40 km (e.g., increased metal concentrations or dust were detected in lichen at distances of 1–40 km from a mine site [1, 2]). **Rationale:** Further information is requested on how the potential for contamination of the food source "lichen" is reflected in the applied buffers of direct and indirect disturbance for woodland caribou. **References**: [1] Watkinson et al. (2021). Effects of dust deposition from diamond mining on subarctic plant communities and barren-ground caribou forage. Journal of Environmental Quality 50(4): 990-1003. doi: 10.1002/jeq2.20251. [2] Chen et al. (2017). Does dust from arctic mines affect caribou forage? Journal of Environmental Protection 8(3): 258-276. doi: 10.4236/jep.2017.83020.	1. Please provide additional justification for how the potential for contamination of the food source "lichen" is reflected in the applied buffers for sensory disturbance. See also related IRs: IR-137, IR-148 and IR-156. **Suggestions for mitigation and follow-up measures:** CNSC recommends the following: • COPC in Lichen monitoring is recommended in transects from the Project site to assess COPC concentrations and confirm whether the chosen buffer is conservative.	Potential effects on caribou as the result of exposure to COPCs, including dietary pathways inclusive of lichen, were assessed as part of the Ecological Risk Assessment (ERA) (see draft EIS, Appendix 10-A). Hazard Quotients (HQs) associated with the exposure pathways analyses were below the benchmark of 1 for all COPCs. The reviewer is referred to Appendix 10-A, as well as the responses to IRs 138 and 189 for additional information.	No updates to the draft EIS are needed based on this IR response.
IR-155	ECCC	Wildlife and Wildlife habitat	Section 9.3.6.4.1, Alteration and/or Loss of Habitat	**Context and Rationale:** In Section 9.3.6.4.1 of the draft EIS, the Proponent presents figure 9.3-14 and table 9.3-22, which "depicts available woodland caribou habitat in the Project study areas" and provide a summary of available Woodland Caribou Habitat in the Project Area, Wildlife Local Study Area, and the Terrestrial Regional Study Area. The Proponent does not provide a biologically relevant explanation on the ecosites that are considered available woodland caribou habitat. According to the amended recovery strategy for Caribou, all habitat within SK1 range has been designated as critical habitat. To align with best current knowledge and the amended recovery strategy, the map and table should show the biophysical attributes, as outlined in Appendix H of the recovery strategy.	1. Provide a biologically relevant explanation about how available caribou habitat was determined or determine available habitat based on new data from the province of Saskatchewan (See IR-145). 2. Consider referencing Appendix H of the Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 2020 to define important biophysical features.	Available woodland caribou habitat was identified in the draft EIS to comprise the ecosites with observations of caribou and caribou sign during the baseline studies. This was done without seasonal differentiation because it was assumed that caribou may use these ecosites during all seasons and life stages. Section 9.3.6.4.1 of the draft EIS describes these habitat types. A reference to Appendix H of the 2020 Amended Recovery Strategy and important biophysical features will be added to Section 9.3.6.4.1. in the final EIS. Please see the response to IR-145 related to the acquisition of data received from the Province of Saskatchewan.	Per the IR response, Section 9.3.6.4.1 in the final EIS will be updated to add: "To be conservative, the environmental assessment assumed caribou use of all habitat types during all seasons, as appropriate. This is expected to appropriately address all of the biophysical features outlined in Appendix H of the Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 2020."
IR-156	ECCC	Wildlife and Wildlife habitat	Section 9.3.6.4.1 Section 9.3.7.3.1	**Context and Rationale:** In Section 9.3.6.4.1 of the draft EIS, the Proponent identified that 142 ha of available caribou habitat within the Project footprint will be directly impacted or lost, while an additional 1,165 ha will be indirectly impacted by Project activities such as sensory disturbance. They assessed the residual and cumulative effect of alteration to habitat for woodland caribou as not	Provide a revised assessment of residual and cumulative effects, taking into consideration that the disturbance within the SK1 range is above the disturbance management threshold required for survival and recovery of the species. See also related IRs: IR-137 and IR-154.	The EA appropriately assessed the residual effects and the cumulative effects within the RSA, as per standard, accepted EA methodology. As described in Section 9.3.7.3.3 of the draft EIS, ECCC identified the caribou population in the SK1 range as being self-sustaining at a threshold of 40% undisturbed habitat and recommended that total anthropogenic disturbance in that range should not exceed 5% with	No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				significant: "The residual effect of alteration and/or loss of available woodland caribou habitat is not expected to result in a change that will alter caribou habitat integrity to the point where it would not be able to sustain the regional woodland caribou population. Therefore, the effect is assessed as not significant." Section 9.3.7.3.1 of the draft EIS states: "It is not expected that the cumulative effects of alteration and/or loss of habitat will alter the integrity of woodland caribou habitat within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions. Therefore, the cumulative effects resulting from the Project's residual effect interacting with residual effects from other projects and activities is predicted to be not significant." For the residual effect of alteration and/or loss of available caribou habitat (Section 9.3.6.4.1, Table 9.3-24), the proponent assessed the magnitude as low, the geographic extent as local, the duration as long-term, the frequency as frequent, the reversibility as fully reversible, the context as high and the likelihood as likely. The rationale provided by the proponent is insufficient to determine the accuracy of these assessments, given the lack of data and the small size of the assessment area. ECCC does not support the residual effects assessment of low magnitude, given the uncertainties related to seasonal use by caribou in the project area and the current level of disturbance in the SK1 range. For the cumulative effect of alteration and/or loss of available caribou habitat (Section 9.3.7.3.3 , Table 9.3-30), the proponent assessed the magnitude as moderate, the geographic extent as beyond the RSA, the duration as long-term, the frequency as frequent, the reversibility as fully reversible, the context as high, the likelihood as likely, the significance as not significant and the level of confidence as moderate. The rationale provided by the proponent is insufficient to determine the accuracy of these assessments, given the lack to data presented for caribou and the small size of the RSA, compared to the SK1 region. ECCC does not support the conclusion of the cumulative effects assessments or for the level of confidence. The Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 2020 states that the range is currently at the 60% disturbance management threshold. Therefore, any activity likely to result in the alteration or destruction of critical habitat may impact on the species survival and recovery. In addition, the Proponent's assessment was based on information that was lacking data on calving, wintering and rutting areas, and connectivity and caribou movements. The absence of considerations of the regional context of disturbance does not provide a conclusion based on best available information.		55% being attributed to natural disturbance. In 2020, approximately 58% of the SK1 Boreal Shield range were affected by past forest fires and 3% of the range were affected by anthropogenic disturbances (i.e., 61% of the range were disturbed mostly due to fires). As described in the Cumulative Effects Assessment (Section 9.3.7.3.3 of the draft EIS), the Project-related (i.e., anthropogenic) disturbance was predicted to add 0.001% at the scale of the SK1 Boreal Shield Woodland Caribou Management Unit. Refer to the response to IR-137 for a rationale of the assessment area for the effects assessment (i.e., the Terrestrial RSA). Please also refer to IR-149 and the attached Conceptual Caribou Mitigation Plan (the Plan), specifically Section 5.1 of the Plan. A mapping exercise was completed to provide context on the Project-related habitat loss in consideration of the woodland caribou range (SK1) disturbance management threshold (ECCC 2020). Based on the analysis in Section 5.1 of the Plan using ECCC (2020) criteria, should the Project proceed, the disturbance management threshold for SK1 range would remain unchanged.	
IR-157	ECCC	Wildlife and Wildlife habitat	Section 9.3.9 Ungulates, Furbearer and Woodland Caribou Summary	**Context and Rationale:** The Proponent has committed to developing a Woodland Caribou Management Plan, which will include a "detailed assessment for the need for habitat offsets." The Woodland Caribou Management Plan will support ECCC's review of the Proponent's assessment of residual effects following mitigation and offsetting. This plan should consider ECCC's Operational Framework for Use of Conservation Allowances (ECCC, 2012). ECCC is available to assist the Proponent in the determination of appropriate offsets that would balance against Project adverse effects after the application of measures to avoid, minimize and restore on-site are adopted. Based on the Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 2020, anthropogenic impacts to local caribou populations experience a lag effect, which occurs over extended periods. This lag effect needs to be adequately considered when proposing offsets. ECCC is available to assist the Proponent in understanding how critical habitat is described in the Recovery Strategy and the determination of appropriate offsets that would balance against Project effects based on the predicted impacts to caribou habitat.	Provide the Woodland Caribou Management Plan for review. The plan should clearly demonstrate efforts to avoid and minimize any Project effects and restore on-site any disturbed areas prior to the consideration of offsetting. Details on how severity of disturbance and vulnerability of the species were considered should be explained. See also related: IR-149. **Suggestions for mitigation and follow-up measures:** ECCC notes that the Woodland Caribou Management Plan should clearly explain efforts to address Project effects, including any contribution to cumulative adverse effects, after it has been determined that all options in the previous steps of the mitigation hierarchy (i.e., avoidance, and minimization,) have been fully considered and applied. In the Woodland Caribou Management Plan, provide details on how the factors outlined in the Operational Framework for Use of Conservation Allowances (ECCC, 2012) were considered in determining the offsetting amounts, including the severity of disturbance and vulnerability of the caribou population. Important factors including time lag (the amount of time from restoration work to when the habitat would be considered caribou habitat) would also need to be considered. ECCC typically recommends a minimum offset multiplier of 4:1 (offset outcome: area disturbed). This is a benchmark ratio applied to a project that is in the lower end of the risk spectrum, such as one with a low severity impact adversely affecting a low vulnerability ecological component. In general, the minimum 4:1 multiplier accounts for time-lags to restoration, uncertainty in outcomes, a precautionary	Refer to response to IR-145.	No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
					approach, and the adverse impact itself in its specific context. Offset multipliers are variable and determined by project-specific circumstances and associated risks and uncertainties.		
IR-158	ECCC	Migratory birds	Section 9.4.1.2, Key Indicators and Measurable Parameters	**Context and Rationale:** In Section 9.4.1.2 the Proponent outlined key indicators for "Migratory Breeding Birds" which includes Waterbirds and Waterfowl, Upland Game Birds and Migratory Songbirds. These are broad categories, which do not allow for assessment of the variation in habitat requirements or ecology of individual species or guilds. ECCC advises the Proponent to identify additional focal species that have the ability to represent anticipated impacts to a broader guild of species. Indicator species should be demonstrably sensitive to the potential effect of interest, and suitable for inferring effects on other species. Species may be grouped into guilds for assessment based on similarities in ecology or vulnerability to Project effects (e.g., species at elevated risk of collision with vehicle traffic).	Identify focal species/guilds for each key indicator species within the Migratory Breeding Birds valued components. Provide an updated analysis of Project effects on migratory birds.	The habitat-based assessment presented in the draft EIS appropriately evaluated potential adverse effects on avian species. The VCs and KIs were selected following extensive consultation with Indigenous nations and communities and other Interested Parties; the VCs and KIs appropriately focused the EA. Waterbirds and Waterfowl, Upland Game Birds and Migratory Songbirds were considered as species guilds themselves, and appropriately identified as Key Indicators of the Migratory Breeding Birds Valued Component and were adequately assessed separately (i.e., at the Key Indicator level) for each Project effect and only rolled up to the Valued Component level for the significance determination. This approach was identified as the appropriate assessment method to identify Project effects on migratory breeding birds and to focus the assessment. The potential effects were identified and described for those species (within the Key Indicator group) that are most affected, and was then applied to all Key Indicator species, including those that may be less affected (e.g., risk of vehicle collisions, risk of entrapment) using a conservative, inclusive approach that considered the baseline data and the habitat. Further selection of focal species within each of these species guilds is not anticipated to affect the outcome of the assessment results or the conclusions	No updates to the draft EIS are needed based on this IR response
IR-159	ECCC	Migratory birds	9.4.3.2.3 Baseline Studies – Migratory Songbirds Appendix 9-B, Section 2.10.2, Results	**Context and Rationale:** Information presented in the draft EIS is insufficient to accurately predict Project impacts to breeding birds. The Proponent collected a single year of breeding songbird point counts and aerial waterfowl surveys (including avian species at risk). A single year of surveys in which birds may be unusually scarce or abundant could severely compromise interpretation of post-construction monitoring data. Additionally, data presented in the draft EIS is from 2017 and ECCC advises that more recent data is needed for a comprehensive baseline to verify Project impacts. Data from the Saskatchewan Conservation Data Centre (HABISask), the Saskatchewan Breeding Bird Atlas and the Boreal Avian Modelling project contain information on avian densities and avian species at risk that could supplement field data. The national standard for major projects recommends a minimum of two years of field surveys to be provided, so that temporal variability can be considered when comparing post-construction against baseline records and other available data.	Supplement breeding bird point count data and aerial waterfowl data collected during 2017 with additional pre-construction field data or existing post-2017 data/modelling to provide a comprehensive baseline that can be used to verify Project impacts during construction and operational phases.	The baseline data presented in the draft EIS are sufficient for the intended purpose – that is the data are sufficient, in conjunction with regionally available data, to identify potential project effects. The data collected as part of the baseline studies for birds was focused on the habitat types and areas most likely to be disturbed as a result of the Project. Conducting additional baseline surveys for waterfowl, raptors, and breeding birds is not anticipated to result in changes to the assessment outcomes and predictions made as part of the effects assessment, which was habitat-based, for avian species. The assessment methods used a conservative approach with the assumption that following the implementation of site-specific mitigation measures, the proposed Project activities would have a residual effect on these species guilds regardless of species presence on site. As described in the EIS, pre-construction surveys will be conducted prior to the commencement of any vegetation clearing or soil disturbance. Avian species will also be routinely monitored throughout the life of the Project. Results from the surveys and monitoring activities are expected to inform the adaptive management process to update Project design and identify the need for additional mitigation measures, if required. Note: Section 9.4.3.3 of the draft EIS includes all available information from the HABISask database at the time of the assessment. While recent surveys from Environment and Climate Change Canada and the Saskatchewan Breeding Bird Atlas have expanded surveys into the northern boreal forest, these data are not yet publicly available or published to make inferences on population trends for migratory songbirds that could use the available habitat in the Terrestrial RSA.	No updates to the draft EIS are needed based on this IR response
IR-160	ECCC	Migratory birds	Section 9.4.3.2.3 Baseline Studies – Migratory Songbirds	**Context and Rationale:** ECCC advises that the results of the field studies need to be interpreted/analyzed in the context of the study area. The Proponent presents results on areas with highest richness and diversity but does not make a link to habitat that will be lost or experience indirect effects. Results from baseline studies as well as other supplemental information as per IR-159 should be used in effects assessment.	Provide results interpreted in the context of Project direct and indirect effects. Include discussion on the habitat types that will be lost or indirectly impacted during the Project and the overall impact on the avian community, using results from the analysis of baseline studies and other supplemental data (as per IR-159). Discussion should support the conclusions of the effects assessment. See also related IRs: IR-161 and IR-162.	The methodology for the habitat-based assessment appropriately evaluated potential adverse effects on avian species using the accepted VC and KI approach for focus of the assessment. The EIS provides a discussion and subsequent quantitative assessment of the habitat types lost and/or altered based on the Valued Components and Key Indicator species. Species richness and diversity (as evaluated in the baseline report) were included as part of the selection of "available habitat" (e.g., for migratory songbirds, ecosites with low richness and diversity were excluded; refer to the response to IR-169 for a description of these ecosites). This approach provided an appropriate assessment of the Project effects on available habitat as it relates to the direct and indirect effects on the avian community.	No updates to the draft EIS are needed based on this IR response
IR-161	CNSC	Bird Species at Risk	Section 9.4.3.3 Appendix 10-A (ERA)	**Context:** For the assessment of effects on Bird Species at Risk (SAR), in the EIS it was decided to use representative species for certain SAR birds: • Olive-sided Flycatcher and Common Nighthawk were selected to represent Barn Swallow. • Yellow Rail and Rusty Blackbird were selected as substitutes for Horned Grebe. No further rationale is provided to demonstrate that the identified surrogate species are representative of the Barn Swallow and Horned Grebe in the EIS. For example, do they share a common diet? Moreover, in the residual effects assessment, limited discussion is provided on the conservatism of chosen suitable habitat types for both surrogate and represented species, in the calculation of habitat loss and alteration, as well as change in mortality. For example, how does habitat for Common Nighthawk and Barn Swallow overlap (do they use identical habitat types?) and how does this affect the calculation of habitat loss and alteration used to evaluate the magnitude of residual effect? Finally, in the ERA, Lesser Scaup is the surrogate for Horned Grebe. Yellow Rail is also represented by Lesser Scaup but Rusty Blackbird is represented by Olive-sided Flycatcher. **Rationale:** It is unclear what criteria were applied to select surrogate species for Barn Swallow and Horned Grebe, and how the chosen	1. Please provide additional information to justify the selection of surrogate species for Barn Swallow and Horned Grebe in the EIS. This should include a description of the similarity of SAR and associated surrogate species and any relevant uncertainties. 2. Please provide conservative estimates of habitat loss and alteration for the represented and not directly assessed species (Barn Swallow, Horned Grebe). 3. Please provide clarity as to why different surrogate species are used for Horned Grebe between the EIS and ERA. See also related IRs: IR-160 and IR-162.	1.a. The methodology for the habitat-based assessment appropriately evaluated potential adverse effects on avian species using the accepted VC and KI approach for focus of the assessment. As described in the EIS, the Common Nighthawk (similar to the Barn Swallow) is an aerial insectivore that uses a variety of habitats, including anthropogenically disturbed and cleared areas (Section 9.4.3.3.1). As such, effects on these anthropogenically disturbed areas were appropriately assessed in the habitat-based EA methodology. Since Barn Swallows nest almost exclusively on human-made structures, specific Barn Swallow exclusion methods will be added as mitigation measures to the EIS (Section 9.4.5). If Barn Swallow nests should be encountered, any subsequent activities would be conducted in accordance with the 2022 Migratory Birds Regulations. 1.b. To focus the effects assessment on key species, it was decided to use the provincially listed Yellow Rail (and Rusty Blackbird) as surrogates for Horned Grebe. Horned Grebe use similar wetland habitat types for nesting, foraging and protective cover as Yellow Rail. As such, potential effects on these habitat types were assessed appropriately. 2. The habitat-based approach for the assessment supports the use of surrogates that are known to utilize the same habitat types. Habitat loss and alteration were assessed for the Key Indicator species included in this Valued Component. A conservative approach of identifying available habitat for these species was chosen to include habitat for those species not directly assessed (i.e., Barn Swallow through Common Nighthawk habitat and Horned Grebe through Yellow Rail and Rusty Blackbird habitat). Please refer to the response to IR-131. A new species at risk appendix has been included with the IR response package and will become Appendix 9-D to the final EIS. This new final EIS appendix lists all avian species at risk (under Schedule 1 of the *Species at Risk Act*), their conservation status in Saskatchewan, and references to species-specific mitigation measures.	The below barn swallow exclusion methods will be added to Section 9.4.5.2.4 in the final EIS: Buildings and other Project infrastructure will be designed and maintained to exclude birds (e.g., barn swallows) and bats as much as possible. This would include installing solid barriers (e.g., corner slope panels, wooden panels) or flexible barriers (e.g., netting, tarps or geotextiles) under roof eaves or other exterior surfaces.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				surrogates relate to Barn Swallow and Horned Grebe in terms of habitat type and range, nesting, and feeding requirements etc. There is also inconsistency with respect to the use of surrogate species for the Horned Grebe between the EIS and ERA supporting document.		3. The rationale for the use of the surrogates in the ERA was provided in the draft EIS Appendix 10-A, Section 5.1.1 Receptor Selection. The summary of species at risk and associated surrogates was provided in the draft EIS Appendix 10-A, Table 5-2. In the ERA, Lesser Scaup was selected as the surrogate for other omnivore ducks and gulls (e.g., Bufflehead, Mew Gull, Herring Gull, Bonaparte's Gull, Horned Grebe, and Yellow Rail). These riparian bird species would all experience exposure to aquatic release through water, food (invertebrates), and sediment. As such, in the ERA, Lesser Scaup is expected appropriately address the assessment and protection of a number of other riparian bird species, including Horned Grebe and Yellow Rail.	
IR-162	ECCC	Migratory birds	Section 9.4.3.3, Bird Species at Risk	**Context and Rationale:** Not all avian species at risk present in the study area were included as Key Indicators in the avian species at risk (SAR) valued component (VC). Barn swallow and horned grebe were recorded in the study area, but not included as VCs. Additionally, bank swallow may inhabit the Project area. Impacts to Species at Risk Act Schedule 1 listed species need to be identified, avoided, lessened and monitored. In Section 9.4.3.3. the Proponent states: "It is acknowledged that the listed Barn Swallow (Hirundo rustica) and Horned Grebe (Podiceps auratus) could potentially occur in the Terrestrial RSA. Incidental observations occurred during the baseline studies (Appendix 9-B). To focus the effects assessment on a few key species (described in the following) it was decided to use Olive-sided Flycatcher and Common Nighthawk to represent Barn Swallow as well, and to use Yellow Rail and Rusty Blackbird as a substitute for Horned Grebe. Unlike Horned Grebe, Yellow Rail and Rusty Blackbird are also listed provincially." Barn swallow, bank swallow and horned grebe may have different nesting habitat requirements than the representative species discussed in the draft EIS. An explanation of how differing species are representative of one another is required, or if an explanation cannot be provided, the species should be assessed individually.	1. Explain how nesting habitat requirements of barn swallow is represented by common nighthawk and olive-sided flycatcher as a VC or assess individually each SAR that overlaps with the Project and is likely to be affected. 2. Explain how nesting habitat requirements of horned grebe are represented by yellow rail and rusty blackbird as a VC, or assess individually each SAR that overlaps with the Project and is likely to be affected. 3. Assess individually each SAR that overlaps with the Project and is likely to be affected. See also related IRs: IR-160 and IR-161.	1. It is acknowledged that Barn Swallows (unlike Common Nighthawks) nest almost exclusively on human-made structures; therefore, specific Barn Swallow exclusion methods will be added as mitigation measures to the final EIS (Section 9.4.5). If Barn Swallow nests should be encountered, any subsequent activities will be conducted in accordance with the 2022 Migratory Birds Regulations. 2. Horned Grebe nesting requirements will be addressed by implementing appropriate activity-restriction setback distances. While the Saskatchewan Activity Restriction Guidelines for Sensitive Species (SARGSS) do not specify measures for Horned Grebe, the setback distances for Yellow Rail will be followed: the SARGSS specify setback distances between 150 and 350 m around nesting birds for medium and high disturbance categories, respectively, between May 1 and July 15. 3. The environmental assessment approach was chosen to focus the habitat-based effects assessment; mitigation measures will be updated to include species-specific approaches as determined through the adaptive management process. Note that additional text and a new table will be added to a new Species at Risk appendix to Section 9, listing all avian species at risk (under Schedule 1 of the Species at Risk Act), their conservation status in Saskatchewan, and links to species-specific mitigation measures as they relate to the potential adverse effects on wildlife.	1. The following Barn Swallow exclusion methods will be added to Sections 9.4.5.2.4 in the final EIS: Buildings and other Project infrastructure will be designed and maintained to exclude birds (e.g., barn swallows) and bats as much as possible. This would include installing solid barriers (e.g., corner slope panels, wooden panels) or flexible barriers (e.g., netting, tarps or geotextiles) under roof eaves or other exterior surfaces. 2. The species at risk new EIS appendix (Appendix 9-D; refer to IR-131) includes the following specific mitigation measure for Horned Grebe: Active and/or suspected breeding and roosting locations identified during the pre-clearing wildlife surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) for other grebe species (as there is currently no activity restriction guidelines for Horned Grebe in Saskatchewan) in accordance with the level of the disturbance and species until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations). 3. A new SAR appendix (new Appendix 9-D) will be added to Section 9 of the final EIS. It has been included here as Attachment IR-131.
IR-163	ECCC	Migratory birds	Section 9.4.3.3.3, Baseline Studies – Avian species at risk VCs	**Context and Rationale:** The baseline studies and data analysis for species at risk (SAR) birds is insufficient to accurately predict Project effects. ECCC recommends the use of predictive modeling in relation to survey data and habitat attributes to produce distribution and density maps. Sites within the study area that support particularly high densities or diversity of an individual species, based on direct observation and, where appropriate, distribution or occupancy models, would greatly improve confidence in Project impact predictions. Additional information on specific habitat use or models of habitat used by SAR would facilitate a more complete analysis of Project effects.	Provide additional information, including mapping/modelling of specific habitat requirements for each avian species at risk or provide a justification of models used in the draft EIS.	Denison is of the professional opinion that the data presented and analysis provided in the draft EIS is sufficient given the local / regional environment and the level of interaction with SAR birds that is expected. The habitat-based EIS approach did not include more detailed mapping/modelling because of the small Project footprint and the location (i.e., bird densities are not expected to be limited by habitat regionally). The habitat-based assessment appropriately evaluated potential adverse effects on avian species. The VCs and KIs were selected following extensive consultation with Indigenous nations and communities and other Interested Parties. The VCs and KIs appropriately focused the EA; no additional modelling or assessment is considered to be required. In addition, further modeling is not expected to affect or change the findings and conclusions of the EIS. Based on the results of the baseline studies, supplemented by available additional data sources (e.g., HABISask), most avian species were conservatively assumed to be present and breeding in the Project study areas. Species-specific mitigation measures have been included and additional measures will be added (e.g., Barn Swallow exclusion measures; refer to IR-131 and IR-163). Pre-clearing surveys, ongoing monitoring during all Project phases, adaptive management (refer to the response to IR-159), and accepted, species-specific mitigation measures have been designed and will be implemented to avoid and minimize the potential for adverse Project effects. In response to a variety of IRs, further information has been developed that is specific to SAR and included as Attachment IR-131. This includes a listing of all SAR species potentially occurring in the Project study areas, with links to applicable and appropriate mitigation measures described in the EIS. It is proposed the content of Attachment IR-131 will be added as a new appendix (Appendix 9-D) to Section 9 of the final EIS. The information provided in the SAR appendix includes a summary of the life history requirements, the expected Project effects, proposed mitigation measures, and anticipated residual effects on these listed species.	No updates to the draft EIS are needed based on this IR response.
IR-164	ECCC	Migratory birds	Section 9.4.4.2.1, Alteration and/or Loss of Habitat – Migratory Breeding Birds	**Context and Rationale:** The discussion on impacts to migratory songbirds presented by the Proponent is not sufficient to understand the impacts on various guilds of birds (e.g., aerial insectivores, forest birds, wetland birds, habitat specialists). As per IR-158, focal representative species/guilds should be used as key indicators (KI) in the Migratory Breeding Birds Valued Component. A greater level of detail on Project impacts to migratory songbirds with differing habitat requirements is needed for a fulsome assessment of effects.	1. Provide further discussion on impacts to different focal species/guilds within the Migratory Breeding Birds Valued Component. 2. Provide mapping of important features or habitat types that will be lost due to the Project for different guilds of migratory birds.	1. Refer to the response to IR-158. 2. Section 9.4.3.2.3 Baseline Studies provides an overview of the avian species identified within the various habitat types that were surveyed. No important wildlife or wildlife habitat features have been identified. The effects assessment included appropriate consideration of habitat loss and/or alteration related to migratory birds (regardless of different guilds).	No updates to the draft EIS are needed based on this IR response.
IR-165	CNSC ECCC	Birds (all species)	Section 9.4.4.2.2 Section 9.4.5.2.4, Avian Deterrence	**Context:** On p. 9-364 of the EIS, it is stated that exposure to hazardous materials through contact with contaminated waste ponds could affect avian health and contribute to mortality.	Please perform an ecological risk assessment with avian receptors located at the contaminated waste ponds, including:	The response to this IR is provided in Attachment IR-165.	No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
			and Prevention of Entrapment Appendix 10-A (ERA)	However, the ERA places the avian receptors only in waterbodies and locations outside of the Project area (see Figure 5-2 in the ERA), i.e., Whitefish Lake, McGowan Lake, the inlet to Russell Lake, and Kratchkowsky Lake. Further, there are insufficient details on the potential effects of the water quality in the water management and treatment facilities on birds, species at risk, and other wildlife, including the risk of bioaccumulation of contaminants. The Proponent should assess potential effects of water quality from these areas using applicable CCME guidelines. **Rationale:** It is unclear whether the ecological risk assessment based on the chosen exposure locations is protective and conservative for avian species potentially exposed to contaminated waste ponds on the Project site. While mitigation measures such as physical, visual, and/or auditory deterrents are proposed in Section 9.4.5.2.4, the possibility of avian species coming into contact with waste ponds cannot be excluded based on the available information in the EIS. The possibility of birds, species at risk, and other wildlife accessing the water management and treatment facilities for drinking water or other purposes is not discussed in the draft EIS.	1. Describe and analyze the possibility of birds, species at risk and other wildlife using the water or waste management facilities and provide an analysis to determine if there is a risk to wildlife that may access these areas. 2. Identify the potential toxicity of water management ponds to aquatic migratory birds and species at risk (SAR). 3. Describe what measures will be taken if the waters are found to be toxic to migratory birds and SAR. **Suggestions for mitigation and follow-up measures:** CNSC recommends that Denison ensure adequate mitigation measures are implemented to minimize the potential for avian exposure to pond waters.		
IR-166	ECCC	Migratory birds	Section 9.4.5.2 Additional Avian Species-specific Mitigation Measures	**Context and Rationale:** Avian species-specific mitigation measures are not presented in the draft EIS. The Proponent has committed to providing a variety of environmental management plans. Section 9.4.5.2 reads: "Additional mitigation measures specific to the Raptors, Migratory Breeding Birds, and Bird Species at Risk VCs, in accordance with the Migratory Birds Convention Act, and tailored to Project features will be incorporated into various Project management and monitoring plans such as the, erosion and sediment controls, soil and vegetation monitoring, wildlife monitoring, the Decommissioning Plan, air quality monitoring, Spill Response Plan, Radiation Protection Plan, surface water and effluent monitoring, and Waste Management Plan." Migratory birds, the nests of migratory birds and/or their eggs can be inadvertently harmed or disturbed as a result of many activities, including but not limited to clearing trees and other vegetation, draining or flooding land, or using fishing gear; this is known as incidental take. This inadvertent harming, killing, disturbance or destruction of migratory birds, nests and eggs is prohibited under the MBCA. Incidental take, in addition to harming individual birds, nests or eggs, can have long-term consequences for migratory bird populations in Canada, especially through the cumulative effects of many different incidents. For further details, please refer to the Avoiding Harm to Migratory Birds website at: https://www.canada.ca/en/environment-climate- change/services/avoiding-harm-migratory-birds.html In order to assess the effectiveness of species-specific mitigations and need for additional mitigations ECCC requires details on the species-specific mitigation measures proposed, and the monitoring plans.	Provide details on species-specific mitigations for species at risk (SAR) and other avian species that will include: • details on what activity restrictions will be implemented for migratory birds and SAR and when they will be applied; • details on mitigations used during regular maintenance activities such as vegetation management (e.g., mowing), access road repair (e.g., aggregate stockpiles), and infrastructure repair; • details on methods used to detect species listed on Schedule 1 of the *Migratory Birds Convention Act* (e.g., Pileated Woodpecker) and mitigations/setback distances and timing to reduce risk to these species.	In response to a variety of IRs, further information has been developed that is specific to SAR and included as Attachment IR-131. This includes a listing of all wildlife SAR potentially occurring in the Project study areas, with links to applicable and appropriate mitigation measures described in the EIS. It is proposed the content of Attachment IR-131 will be added as a new appendix (Appendix 9-D) to Section 9 of the final EIS. The information provided in the SAR appendix includes a summary of the life history requirements, the expected Project effects, proposed mitigation measures, and anticipated residual effects on these listed species. Species-specific timing windows and setback distances from the SARGGSS were included in the species-specific sections of the draft EIS (see Section 9.4.3 in the draft EIS). Refer to 3.3 Species-Specific Mitigation Measures for Wildlife Species at Risk in Attachment IR-131. This section provides a summary of the species-specific mitigation measures that will be implemented during Project activities. Mitigation measures specific to the Wildlife SAR that were not included or that were revised from what was described in the draft EIS are provided in bold text. These will be added to the final EIS. Denison considers the EA to be a planning and decision-making tool that assesses the potential effects of the Project in a careful and precautionary manner and integrates results of engagement with Indigenous nations and communities. As such, the EA is a process for identifying the Project's potential interactions with the biophysical and human environment, predicting potential adverse effects, identifying mitigation measures, and evaluating residual and cumulative effects remaining after mitigation. The EA also outlines the proposed efforts for monitoring and reporting to verify compliance with the terms and conditions of EA approval and to assess the accuracy and effectiveness of predictions and mitigation measures presented in the EA. Denison views the EIS as an important planning tool that will be used to support future activities and represents one stage in the rigorous overall approvals process for a uranium mining facility in Canada. Denison is completing a sequential EA and licensing process for the Project. In the EIS, a framework for the Environmental Management System (EMS) is provided along with a clear commitment for Denison to include Project design and species-specific mitigation measures into the EMS documents as they are developed / as the Project proceeds through the licensing and permitting phases. Please also refer to response to IR-133, IR-135, and IR-167.	No updates to the draft EIS are needed based on this IR response. Final EIS updates related to wildlife SAR, including new species-specific mitigation measures, are outlined in response to IR-131 and exclusion methods are provided in response to IR-135.
IR-167	ECCC	Migratory birds	Section 9.4.5.2.1 Work Timing Windows and Habitat Disturbance	**Context and Rationale:** The Proponent has stated that when it is not practicable to clear outside of the breeding bird window, they will conduct pre-clearing surveys. Section 9.4.5.2.1 states: "Prior to commencing any site clearing (i.e., vegetation clearing and/or soil disturbance) during the nesting season, pre-clearing nest surveys will be conducted at that location within the Project Area." ECCC does not recommend the use of nest searches or pre-clearing surveys for active bird nests during the breeding season as a mitigation, given the difficulty associated with finding nests reliably and the high likelihood of disturbing nesting birds when searching. Instead, ECCC recommends that clearing and grubbing activities not be conducted during the breeding bird season. The Migratory Birds Regulations 2022 (MBR 2022) brings new scenarios that need to be considered: 1. Most migratory birds: - Nests are protected only when they are in use or when live eggs or chicks are present. 2. Migratory birds listed in MBR 2022 Schedule 1: - For the 18 species of migratory birds identified on Schedule 1, the MBR 2022 provide year-round nest protection until they can be deemed abandoned. 3. Migratory birds listed under SARA: - For some SARA listed migratory birds, the residence prohibition (s.33) will protect nests that are not active, but	Provide the following information: • details on how vegetation clearing related to site development will be conducted to minimize risk to migratory birds and species at risk (SAR). • the timing window that will be used for vegetation removal to reduce risk to migratory birds and SAR	Site clearing and other works that involve disturbance of vegetation and/or soil will be completed during least-risk timing windows for migratory birds and SAR (i.e., winter), where practical, to avoid disturbance during sensitive time periods. It is noted that additional information related to timing windows and species as it concerns Project activities has been provided in response to IR-134. Pre-clearing surveys will be conducted and set-back buffers implemented, as needed. The pre-clearance surveys will be completed prior to all clearing events, regardless of the time of year / season when clearing is set to occur. If nests or tree cavities should be encountered during pre-construction surveys or ongoing monitoring activities, any subsequent Project activities will be in accordance with the 2022 Migratory Birds Regulations.	No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				are re-used in subsequent years, and the critical habitat prohibition (s.58) will protect nests that are part of the critical habitat identification. Those prohibitions apply everywhere in Canada and at all times of the year. In these cases, a SARA permit will be required.			
IR-168	ECCC	Migratory birds	Section 9.4.5.2.4, Avian Deterrence and Prevention of Entrapment	**Context and Rationale:** The Proponent mentions that avian deterrents will be used on power transmission lines, buildings and other Project infrastructure. However, the Proponent does not mention any deterrents that will be used for deterring birds from the water or waste management facilities. Details on deterrents for all Project components should be identified to assess residual and cumulative impacts to migratory birds.	1. Provide information on avian deterrents to be used to prevent birds or other wildlife entering water or waste management ponds. 2. Explain how proposed timing of use of deterrents will reduce risk of migratory birds making contact with treatment waters outside of the nesting season (i.e., during migration and stop overuse). 3. Explain which deterrents will be used, which deterrents were considered, and what alternative, adaptive measures will be considered if deterrents are unsuccessful for any Project components.	Refer to response to IR-165 for a discussion on the need for additional avian deterrents at water management and treatment facilities. The following is an excerpt from IR-165: Mitigation measures outlined in the draft EIS to minimize the potential for avian exposure to pond water include: • Employees and contractors will be provided with wildlife education and awareness training, including education about potential avian issues on site and training on the mitigation measures to avoid or minimize potential adverse Project effects on avian species and their habitat. • Employees and contractors will be educated on waste management policies that limit human-avian interactions. • Designated employees will be trained in appropriate avian deterrent techniques to minimize avian interactions with the Project. • Employees and contractors will be requested to report avian observations on site, injured or dead birds (which will be reported to SK MOE). Avian encounters and outcomes will be monitored, and logbooks will be used to record observations. Logbooks and reports will be available to employees. • Physical, visual, and/or auditory deterrents and exclusion measures will be employed around hazardous materials to discourage avian use, as required. • Vegetation management will be incorporated in the vicinity of waste ponds to discourage avian use of potentially affected vegetation. Adaptive management will be a component of the wildlife management plan which will be developed to support licensing. . If birds are observed on site ponds, additional deterrent techniques could be employed. Examples of other deterrent options to dissuade birds from landing on ponds under an adaptive management framework are provided here: • Visual deterrents: Reflective tape/flagging could be properly and appropriately installed on infrastructure and/or over the ponds. Predator decoys (i.e., plastic hawks, owls) could be strategically installed on visible high points, such as building roofs and fence posts. Brightly coloured flags flown from posts and/or inflatable tube dancers could be installed along the perimeter of the ponds and/or on the facilities, as appropriate. Inflatable tube dancers are similar to scarecrows, but determined to be more effective (Lukas et al. 2020) likely resulting from the constant motion caused by the wind. A combination of the above visual deterrents would be expected to provide the best results. • Auditory deterrents: Ultrasonic deterrent systems create a "net" that has been shown to repel birds from an area (Ezeonu et al. 2012). Propane cannons are another effective method shown to deter birds. The use of propane cannons has been more widely studied and are recommended over ultrasonic deterrent systems. Propane cannons have been shown to be more effective when paired with a radar-activated on-demand system that fires cannons when birds are entering the area (Ronconi and Cassady St. Clair, 2006), as birds can habituate to a timely, consistent firing/noise event. References: Exeonu, SO, Amaefule, DO, Okonkwo, GN. 2012. Construction and Testing of Ultrasonic Bird Repeller. Journal of Natural Sciences Research 2(9): 8-17. Lukas, S, Clark, L, Davis, A, Sanchez, D, Brewer, L. 2020. Nonlethal Bird Deterrent Strategies: Methods for reducing fruit crop losses in Oregon. Oregon State University Extension Service. Ronconi, RA, St. Clair, CC. 2006. Efficacy of a radar-activated on-demand system for deterring waterfowl from oil sands tailings ponds. Journal of Applied Ecology 43: 111-119	No updates to the draft EIS are needed based on this IR response.
IR-169	ECCC	Migratory birds	Section 9.4.6.3, Residual Effects Evaluation for Migratory Birds, Table 9.4-15 and Map 9.4-11	**Context and Rationale:** The analysis of available habitat types for migratory songbirds appears incorrect. In their interpreted ecosite mapping, the Proponent identified 25 different ecosite types. In their table 9.4-15 and map 9.4-11, the Proponent only lists 8 ecosite types that are available migratory songbird habitat. Section 9.4.6 Residual Effects Evaluation for Migratory Songbirds reads: "Considering the baseline data (Appendix 9-B), migratory songbird habitat is described in the following text without species-specific differentiation and referred to as available habitat for migratory songbirds. Based on the baseline study results, 66.8%, 52.2%, and 50.7% of the Project Area, Wildlife LSA, and Terrestrial RSA, respectively, are assumed to provide available habitat for migratory songbirds (Table 9.4-15)." All Project areas, except some anthropogenic features and open water, would be considered available habitat for migratory songbirds. Although some ecosite types may have lower density and diversity, it is expected that all ecosites provide migratory songbird habitat.	1. Explain how information in Table 9.4-15 and map 9.4-11 were derived. 2. Explain why other habitat types were not considered as available habitat for migratory songbirds.	1. As per accepted methodology, to appropriately focus the habitat-based effects assessment, as per accepted EA methodology, the most frequently used habitat types (i.e., the ecosites experiencing the highest species richness, highest mean number of breeding songbird pairs, and highest species diversity) within the Project study areas were included as "available habitat" as shown in draft EIS Table 9.4-15 Summary of Available Habitat for Migratory Songbirds in the Project Study Areas and Figure 9.4-11 Available Habitat for Migratory Songbirds. For all three indicators (i.e., highest species richness, highest mean number of breeding songbird pairs, and highest species diversity), the three ecosites with the lowest representation were BS25 (open fen), BS19 (graminoid bog), and BS24 (graminoid fen). These three ecosites were excluded from the description of available habitat for migratory songbirds, as their use/suitability is expected to be low. Denison is confident that this approach is appropriate. Additionally, inclusion of these "low quality" habitat types would not be expected to alter the analysis of the residual effect nor the conclusions of the EA (i.e., the residual effect of habitat loss on Migratory Birds was predicted to be not significant).	No updates to the draft EIS are needed based on this IR response

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						2. Although the habitat types excluded from the assessment are "available" to migratory birds, their low "suitability" to the KI species selected to focus the EA, resulted in these habitat types not included in the assessment. In Denison's opinion, including these low suitability habitat types to the analysis would provide no additional value to the EA process, and would not alter the findings of the analysis nor the conclusions contained in the draft EIA (i.e., the residual effect of habitat loss on Migratory Birds was predicted to be not significant).	
IR-170	ECCC	Migratory birds	Section 9.4.6.4, Residual Effects Evaluation for Bird SAR, Table 9.4-19	**Context and Rationale:** The table and map presented by the Proponent do not appear representative of all available habitat for common nighthawk (CONI). Although CONI do preferentially use open areas such as gravel (often an anthropogenic disturbance) and regenerating forest, as identified in the draft EIS, they also use rock outcrops that can be within forested areas. As this area lies within the pre- Cambrian shield, there are likely rock outcrops that are also available habitat. As aerial insectivores, CONI select nesting areas in close proximity to wetlands or lakes where there is abundant forage. Habitat requirements and preferences for all species at risk is required for developing effective mitigations and adaptive management.	1. Provide an updated table and map that considers all available habitat for common nighthawk. 2. Additionally, as part of environmental management plans the Proponent should include species-specific mitigations that are biologically relevant to all the species at risk for all Project phases and components.	1. The methodology for the habitat-based assessment appropriately evaluated potential adverse effects on avian species. The VCs and KIs were selected following extensive consultation with Indigenous nations and communities and other Interested Parties; the VCs and KIs appropriately focused the EA; no updated table or map is considered to be required. In addition, further mapping is not expected to affect or change the findings and conclusions of the draft EIS. 2. Common Nighthawk were observed in the Project study areas during the baseline studies and are considered to be present and breeding. Rocky outcrops were not reported during the baseline studies (see Section 9.2.3). Pre-clearing surveys will be conducted, set-back buffers implemented, and pre-clearing survey and monitoring results will be used for adaptive management purposes (see also response to IR-159). Species-specific mitigation appropriate for Common Nighthawk is largely related to loss and/or alteration of habitat (including both direct and indirect effects).	No updates to the draft EIS are needed based on this IR response.
IR-171	ECCC	Migratory birds	Section 9.4.6.4, Residual Effects Evaluation	**Context and Rationale:** Section 9.4.6.4 Residual Effects Evaluation for Bird SAR – Common Nighthawk reads: "Progressive reclamation is anticipated to begin during Construction. However, a conservative approach is used, with Common Nighthawk (CONI) habitat in the Project Area considered to be unavailable for the duration of the Project, only becoming available as habitat following Post-Decommissioning (i.e., during the regeneration of vegetation following Decommissioning)." CONI may nest on the roadsides of access roads within the Project area. As such, the Project area should still be considered available habitat for the duration of the Project and appropriate mitigations and adaptive management should be discussed for this species.	Develop mitigation plans appropriate for avoiding collisions of common nighthawks with vehicles, when and where nighthawks are observed foraging near or roosting on gravel roads. Demonstrate how the planned mitigation activities will result in reduced residual effects from this pathway.	Project design measures and species-specific mitigation measures outlined in draft EIS are expected to be appropriate to avoid or limit the risk of Project effects on Common Nighthawks. The cited text in the IR context and rationale from Section 9.4.6.4 refers to the anticipated duration of the Project effect. As described in the EIS, a Road and Traffic Management Plan will be implemented and mitigation measures (also described in Section 9.4.5.2.6) will include reduction of traffic volume, implementation of speed limits, installing visible signage at locations with potential for wildlife crossings (including avian species), communication (and reporting) of wildlife collisions, and maintenance of ditches and culverts. This mitigation is expected to reduce/limit potential for interactions between the Project activities and Common Nighthawk and their habitat, thereby limiting the risk of a potential adverse effect.	No updates to the draft EIS are needed based on this IR response.
IR-172	CNSC	Birds (all species)	Section 9.4.6.4.2	**Context:** Populations of listed species may be less resilient to changes in mortality. CSA N288.6:22 Clause 7.2.4.3 states that effects on a few individuals of endangered, threatened, or vulnerable species would not be acceptable. The residual effects assessment for "Change in Mortality" for bird species at risk states that Project mitigation measures identified in Section 9.4.5 are expected to limit interactions between bird species at risk and potential sources of direct and indirect mortality. However, the mitigation measures are not discussed with respect to their effectiveness to limit interactions, specifically for bird species at risk. **Rationale:** It is unclear if the proposed mitigation measures are effective in preventing mortality in bird species at risk for which even only a few deaths could negatively impact the population.	Please provide a discussion on mitigation measures with respect to their effectiveness in minimizing mortality for bird species at risk, for which effects on a few individuals would not be acceptable.	Mitigation measures provided in the EIS were selected in consideration of their proven effectiveness and applicability to the Project, including the habitat types and species that could be adversely affected. A component of the effectiveness of the proposed mitigation is appropriately addressed in the discussion on "Confidence" for each of the residual effect assessment in the EIS. The new Species at Risk appendix that will be added to the final EIS (see IR-131) includes discussions of the effectiveness of mitigation measures that Denison is proposing to implement to avoid or reduce mortality of Bird Species at Risk.	The new Species at Risk appendix that will be Appendix 9-D to Section 9 of the final EIS has been included in this IR response package (Attachment IR-131). This new EIS appendix includes the species-specific, proven, mitigation measures and their effectiveness, that Denison is proposing to implement during the Project to mitigate adverse effects on bird species at risk.
IR-173	ECCC	Migratory birds	Section 9.4.8 Monitoring and Follow-up	**Context and Rationale:** Monitoring and follow up programs are part of adaptive management and implementation of additional mitigations. In Section 9.4.8 the Proponent states: "Considering the Project planning, baseline survey results, and proposed mitigation measures, no follow-up programs are considered to be warranted at this time." Project impacts related to mortality of birds, such as collisions with the transmission line, mortality along roads and use of waste and water management facilities should be monitored during all phases of the Project and adaptively managed.	Provide details on the follow-up program to monitor impacts to avian mortality. The follow-up plan should include: • Monitoring of avian use of waste and water facilities • Monitoring of mortality along access roads • Monitoring of mortality related to transmission lines • Monitoring of effectiveness of avian deterrents.	As described in the draft EIS, a wildlife monitoring plan will be developed to support permitting and licensing and implemented as the Project proceeds. The wildlife monitoring plan will provide details on the monitoring and follow-up programs outlined in Section 9.4.8 of the EIS. In Section 9.4.8 of the draft EIS, Denison has outlined the following as part of monitoring programs: "Avian movements across the Project study areas may bring species or individuals into contact with Project components (e.g., buildings, power transmission lines, waste ponds and waste pads) and activities (i.e., vehicle and aircraft traffic), which can result in mortalities and changes to habitat use. Project design and mitigation measures (Section 9.4.5) have been identified that are expected to minimize the likelihood of adverse Project effects. However, changes in avian habitat and habitat use over the life of the Project require an adaptive management process to update Project design and additional mitigation measures, if required. The potential for these changes will require appropriate monitoring for changes in avian mortality or encounters to determine, in a timely manner, whether changes are warranted through the adaptive management process." Specifically, as it concerns monitoring avian mortality the following is noted and will serve as the basis of the framework for this component of the wildlife monitoring plan. The objective of this component of the plan would be to (1) document and mitigate potential effects of Project activities on avian mortality; and, (2) reduce interactions between wildlife (in this case birds) and people. Avian mortalities observed by Denison staff would be reported immediately to the Environment Department, and an inspection by Environment staff will be made to determine the probable cause of death. Obvious injuries, the position of the animal, and anything considered unusual would be photographed and recorded. Further information such as time, date, location, estimated time of death, and any sightings of other wildlife in the area would also be recorded. A procedure would be developed for carcass removal to prevent attraction of carnivores and other scavengers to the Project site. Wildlife mortality monitoring would be undertaken as required, continuously throughout the life of the Project. All mortalities would require follow-up to determine if anything can be done to prevent	Section 9.4.8 of the final EIS will be updated to note that Denison is committed to monitoring avian mortality related to avian use of waste and water facilities, as well as mortality events associated with interactions with access roads (particularly related to large-bodied carcasses) and transmission lines as documented in the IR response. It will be further noted that such mortalities will be documented and reported to the Saskatchewan Ministry of Environment on a basis as determined in consultation between the Ministry and Denison.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						similar mortalities from occurring in the future. Data related to avian mortalities would be compiled to identify trends over time and to determine the cause of mortalities and identify any further mitigation would be appropriate. Further, it is noted that avian mortality related to avian use of waste and water facilities, as well as mortality events associated with interactions with access roads (particularly related to large-bodied carcasses) and transmission lines will be documented and reported to the Saskatchewan Ministry of Environment on a basis as determined in consultation between the Ministry and Denison. Further, Denison has committed to collaborating with English River First Nation and Kineepik Metis Local on developing scope of monitoring regimes, which could include monitoring programs and the reporting on wildlife-vehicle mortality. Additionally, as noted in draft EIS Section 1.7.5, Licensing and Permitting, the Project is proceeding through sequential EA and licensing process. Commitments to develop such plans, and in some cases conceptual level information regarding a number of the proposed plans has been provided in the draft EIS. Given the sequential process to which Denison has committed it is believed that the level of information provided in the draft EIS and its supporting documents (including supplemental information provided in response the IRs) is appropriate at this stage of the Project. It is planned that further detail will be developed during licensing and permitting and that this information will be available for review at that time. Denison understands that the Project cannot move forward until the appropriate Program / Plan / Procedure documentation is in place and has received approval through the regulatory process. Denison believes this context (that is, that the detailed "plan" information needed to support licensing and permitting has not be included in the EIS) is valuable in considering this IR, as well as other IRs with a similar theme.	
IR-174	ECCC	SAR - Bats	Appendix 9-B, Denison Mines Corporation Wheeler River Project, Terrestrial Environment, Wildlife and Vegetation Baseline Inventory, Section 2.1.4 Acoustic Bat Surveys	**Context and Rationale:** The Proponent conducted acoustic surveys for bats and confirmed presence of two Species at Risk Act (SARA) schedule 1 listed bat species in the Project area, little brown myotis (Myotis lucifugus) and northern myotis (Myotis septentrionalis). However, the Proponent did not do an effects assessment of either of these bat species. Although bats are present in the study area, no work was done to identify hibernaculum or maternal roosting sites. All species at risk that are expected to be present in the Project area should be assessed and species-specific mitigations detailed.	1. Conduct an effects assessment for little brown myotis and northern myotis, including the likelihood that tree clearing during the bat roosting period, is likely to 'kill', 'harm', or 'harass' Little Brown Myotis and Northern Myotis and its ability to carry out its life processes. 2. Describe and map locations of suitable myotis hibernacula and/or maternal roost habitat within the Local Study Area and Regional Study Area and explain how these habitats may be affected by Project activities. 3. Describe what mitigation measures will be taken to avoid the breeding period for bats. 4. Describe any pre-construction/pre- clearing surveys will be conducted to identify any hibernaculum and maternal roosting sites. Describe how monitoring will support adaptive management.	As Key Indicators of Valued Components, the EIS includes terrestrial wildlife and avian species that may occur in the Project study areas and are listed on Schedule 1 of the federal Species at Risk Act. Project effects on these species and their habitats are described and assessed, and mitigation measures are included to avoid or reduce the potential for adverse effects on these species and their habitats. The Project effects and associated mitigation measures described in the draft EIS are broadly applicable to SAR species that occupy the same ecological niches. In response to a variety of IRs, including this IR, further information has been developed that is specific to SAR and included as Attachment IR-131. This includes a listing of all SAR species potentially occurring in the Project study areas, with links to applicable and appropriate mitigation measures described in the EIS. It is proposed the content of Attachment IR-131 will be added as a new appendix (Appendix 9-D) to Section 9 of the final EIS. The information provided in the SAR appendix includes a summary of the life history requirements, the expected Project effects, proposed mitigation measures, and anticipated residual effects on these listed species. This new EIS appendix provides information on little brown myotis and northern myotis. We note Denison's commitment to pre-construction surveys to identify potential for maternity and nursery roosting habitat. Refer to response to IR-134 for the timing of clearing activities outside of roosting periods. Results from pre-construction surveys and continuous monitoring (described in Section 9.3.8) will be used in the adaptive management process to update Project design and additional mitigation measures, if required.	No updates to the draft EIS are needed based on this IR response.
IR-175	CNSC	Provincially Listed Species	Appendix 9-B; section 2.2.2	**Context:** Vegetation and wildlife habitat characterization field surveys were completed in 2017, based on which ecosite factsheets were prepared. The factsheets list observations of two provincially listed plant species with a rank of S3 (vulnerable/rare to uncommon; Table 2.4-2) according to the Saskatchewan Conservation Data Centre, which are not discussed in the main EIS document: • Angle-leaved sundew (Drosera anglica) observed in ecosites BS19, BS20, BS22, BS25 • Neat Spike-rush (Eleocharis nitida) observed in ecosite BS25 Table 9.2-12 in section 9.2.6.2.1 of the EIS indicates that there may be indirect disturbance to some of these ecosites (BS19, BS20, BS25). In section 9.2.6.3.1 it is discussed that listed plant species are not likely to return once lost from a specific location. **Rationale:** Given that not all areas in the revised Project footprint were surveyed for listed plant species in baseline studies, there is uncertainty as to whether any species were missed, in particular those that have been observed in ecosites present in the LSA/RSA (e.g., Drosera anglica and Eleocharis nitida, see also Appendix 2 Table of Appendix 9-B). It should also be noted that rare plant surveys were completed in summer 2017 only (section 2.4.2 of Appendix 9-B), which may underestimate annual rare species that may be dormant in the seed bank in some years due to specific seed emergence requirements. It is acknowledged that the proponent committed to pre-construction listed plant surveys targeted on ecosites encountered in the Project Area but not previously surveyed, as well as ecosites within the Project Area with high potential to support listed plants. More information is requested on the potential indirect effects on rare plant species as well as the planned pre-construction surveys.	1. Please provide a discussion on the potential risks from indirect effects on ecosites with observed rare plant species 2. Please provide additional information on the ecosites included in the planned pre-construction listed plant surveys **Suggestions for mitigation and follow-up measures:** CNSC recommends focusing monitoring on ecosites that have known observations of listed plant species outside of the Project Area (e.g., BS19, BS20, BS22, BS25).	1) As described in Sections 9.2.4.2.1 and 9.2.6.3.1 of the EIS, listed plants may be affected indirectly by the introduction and/or proliferation of invasive plants, dust deposition, edge effects, and changes to water quantity and quality. Mitigation measures planned to address these potential effects are described in Section 9.2.5, and include developing the Project footprint within previously disturbed areas to the extent practical (reducing edge effects); reducing dust deposition on vegetation by directing processing plant exhaust through a scrubber prior to release, appropriate stack height design for optimal dispersion, controlling property access, providing a wash bay, undertaking road watering and traffic controls, and monitoring dust during Construction and Operation; maintaining surface water flow (see response to IR-140); and undertaking invasive plant management. The specific risks of residual indirect effects on a given listed plant population are dependent on a suite of site-specific factors, including (but not limited to) the life requisites of the listed plant species, the species' resilience to disturbance, the size of the population, and the location of the population in relation to Project activities. As described in Section 9.2.8.1, pre-construction listed plant surveys will be undertaken within the Project Area within ecosites that were not encountered during the 2017 surveys, as well as within selected areas of the Project Area with the potential to support listed plants (e.g., transitional habitats favoured by Alaskan clubmoss). Surveys will be undertaken to verify EA predictions and identify mitigation measures to protect Listed Plant Species, as appropriate. Should Listed Plant Species be identified within the Project Area, site- and species-specific mitigation measures will be developed by a qualified vegetation ecologist to avoid and/or minimize potential Project effects. 2) Ecosites planned to be included during pre-construction listed plant surveys include all ecosites with the potential to support listed plants that may be directly or indirectly affected by the Project (i.e., ecosites located within the Terrestrial LSA). This includes ecosites where Alaskan clubmoss were historically observed (BS3/BS7, BS4, BS23); ecosites within the Project Area that were not previously surveyed (BS7, BS9, BS23, Waterbody); and ecosystems known to support angle-leaved sundew and neat spike-rush populations (BS19, BS20, BS25). It is noted that ecosite BS22 has not been mapped within the Terrestrial LSA and is not expected to experience direct or indirect Project effects; as such, it is not planned to be included within pre-construction listed plant surveys.	No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
IR-176	CNSC	Human Health with respect to radiation exposure	Section 10.1.4.2.1 Section 10.1.6.1.4 Appendix 10-A (ERA)	**Context:** In section 10.1.4.2.1, the proponent provides an evaluation of air quality constituents of potential concern to human health. It states: "A screening value for radon gas of 200 becquerels per cubic metre (Bq/m3) was available from Health Canada, which applies to total radon including background sources (Health Canada 2009). The radon concentrations which were predicted are incremental concentrations (i.e., above background) and were therefore compared to the applicable incremental screening value of 60 Bq/m3 for indoor air established by the Canadian Nuclear Safety Commission (CNSC) (Health Canada 2010a; Radiation Protection Regulations. SOR/2000-203)." The 60 Bq/m3 radon concentration value also appears in section 7.1.2 of Appendix 10-A (ERA). Further in section 10.1.6.1.4, it is stated: "Radon dose was calculated separately from the dose due to other radionuclides; however, the predicted radon concentration was compared against the CNSC incremental concentration limit of 60 Bq/m3." The Radiation Protection Regulations do not stipulate a limit for radon above background for sites licensed by the CNSC. The effective dose limits for Nuclear Energy Workers (NEWs) and persons that are not NEWs are listed in section 13 of these regulations, and in subsection 1(3) of these regulations for the general public. The annual effective dose from all sources associated with the licensed activities and within the scope of the Nuclear Safety Control Act and Regulations must be compared to the applicable effective dose limit. For members of the public this limit is 1 mSv per calendar year. In Section 4.2.5.3 of Appendix 10-A (ERA), there appears to be no reference mentioned for the radon equilibrium factors. These factors are a significant input into the dose calculations for radon. **Rationale:** The reason for the requested change is to ensure consistency with the Radiation Protection Regulations.	The EIS and appendices should be aligned with the Radiation Protection Regulations by: 1. Removing the reference to a 60 Bq/m3 limit. 2. Reporting the assessment results as the total dose, from all radionuclides combined including radon progeny, and by comparing this annual effective dose to the effective dose limit. Provide a summary of the conservative assumptions that have been included in the dose calculations. Provide a reference that shows how the radon equilibrium factors were determined.	1. While 60 Bq/m^3 (incremental) has been used in CNSC Oversight reports for uranium mines and mills, and referenced by Health Canada, it seems to be no longer used based on the updated Radiation Protection Regulations. Denison will remove any reference to 60 Bq/m^3 from the EIS and Appendix 10-A. 2. The predicted radon concentrations will be compared to 200 Bq/m^3 (total) and total effective dose including radon and U-238 decay chain radionuclides will be compared to the 1 mSv/a dose limit. The total dose to the camp worker from radon (1.3E-01 mSv/a) and U-238 decay chain radionuclides (2E-02 mSv/a) is predicted to be 1.5E-01 mSv/a which is below the dose limit for a non-NEW of 1 mSv/a. This will be included in Section 4.4.1.3 of the ERA. <u>Conservative Assumptions:</u> - For calculation of radon dose it was conservatively assumed that the camp worker spends 100% of their time indoors when on site (section 4.2.5.3 of ERA). - Receptors are exposed to the maximum exposure concentrations at their location for each model scenario and Project phase (section 4.2.6 of ERA). - For radionuclides in the U-238 decay chain (other than radon), the camp worker is also exposed through ingestion (water and food) pathways resulting in a conservative dose when also factoring in the dose from radon indoors. The radon equilibrium factors were calculated as described in section 2.4.3 of the IMPACT Model Report, which is Appendix A of the ERA (Appendix 10-A). The equilibrium factors calculated are shown in Table 4-11 of Appendix 10-A.	Per the IR response any reference to 60 Bq/m^3 from the EIS and Appendix 10-A and Section 4.1.1.3 will be revised as indicated.
IR-177	HC	Change to an environmental component due to radiological contaminants	Section 10.1.4.2.1 (p. 10-22) Appendix 10-A (ERA): Appendix B Table B.9, Ref. 19-2638 Section 6, Table 6.1-1 (p. 6-7)	**Context:** Section 10.1.4.2.1 states that, "Screening values for radionuclide concentrations in ambient air were not available. All relevant radionuclides were assessed in the HHRA in terms of their contribution to the total radiological dose to human and ecological receptors" (p. 10-22). Section 10 Appendix 10-A (ERA) states that, "No formal screening was conducted for radionuclides. However, since radiation dose to human receptors is of public and regulatory interest, the radionuclides in the uranium-238 decay series are carried forward as COPCs for further assessment" (Appendix 10-A (ERA): Appendix B Ref. 19-2638). Table 6.1-1 lists radionuclides as a key indicator for air quality, but only uranium and radon are considered in Section 6, and Section 10 Table B.9 does not include doses from uranium progeny in air. **Rationale:** Health Canada recommends using screening values that are available for radionuclides if they are appropriate for the dose and if the screening values have listed assumptions (such as particulate size and worker exposure time that can be adapted to in Denison's models). Two examples are ICRP 96, which CNSC uses in their regulatory reports to derive reference air quality values for Pb-210, Ra-226, and Th-230 (CNSC: Regulatory Oversight Report for Uranium Mines and Mills in Canada 2019); and Health Canada's Guidelines for Management of NORM (Health Canada: Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials, 2011).	1. Assess predicted radionuclides in Section 10 Appendix 10-A (ERA) using appropriate available screening values. Alternatively, provide a justification for why a screening wasn't conducted for radionuclides despite the availability of screening values (e.g., ICRP 96 and NORM Guidelines, 2011). 2. Clarify if uranium progenies in air are considered in the atmospheric transport and air quality modelling and are simply not reported, or if they are not included in the models because no screening criteria are available.	1. The methodology used in the ERA was to carry all radionuclides in the U-238 decay chain forward for quantitative dose calculations. As such, a formal screening was not conducted. No radionuclides were removed from the process, but rather all were considered constituents of potential concern (COPCs). Clause 7.2.5.4.3 of CSA N288.6-22 states "Certain COPCs may be carried forward into the EcoRA for reasons of public perception, even if screening benchmarks are not exceeded. For example, the most important radionuclides may be carried forward to demonstrate acceptable risk based on expressed public concern rather than exceedance of screening criteria." 2. Section 3.2 of Appendix 10-A (ERA) states that based on the ISR process the main source is yellowcake (uranium oxide) and not uranium ore. As such, at the point of release, the uranium mass is almost entirely uranium-238, and on an activity basis the uranium-238 and uranium-234 are equal. Ingrowth of progenies including Th-230, Ra-226 and Pb-210 were not considered in air since compared to the life of the Project ingrowth in air would be minimal. This was confirmed using the WISE Uranium Calculator (https://www.wise-uranium.org/rccu.html). Ingrowth of other radionuclides including Th-230 and Ra-226 is included in the air deposition to soil model. Ingrowth of Pb-210 and Po-210 in soil was considered negligible. The human dose results include the soil internal and external exposure pathways and are provided in the ERA results (see Appendix B, Table B.9).	No updates to the draft EIS are needed based on this IR response.
IR-178	HC	Change to an environmental component due to hazardous contaminants	Section 10.1.4.2.1 (p. 10-22) Section 6.1.4.2, Potential Project Related Effects (p. 6-31)	The Baseline + Project scenario was not provided for radon levels. **Context:** Section 6.1.4.2 states that the predicted levels for radon were not added to the respective baseline air quality levels (p. 6-31), and further explains that "In all modelled phases of the Project, annual average radon concentrations at receptors beyond the Property Boundary are expected to be indiscernible from background levels." In Section 10.1.6.1.4, a different approach to evaluating predicted radon levels is mentioned: "the predicted radon concentration was compared against the CNSC incremental concentration limit of 60 BQ/m3"(p. 10-44). **Rationale:** Without a rationale as to why baseline levels of radon were not included in the assessment, HC cannot fully evaluate the appropriateness of the air quality assessment. While Health Canada is of the opinion that using background radon levels as a screening value	1. Provide further information on whether and how baseline radon concentrations in air were determined. 2. Include baseline radon concentrations in the predicted total concentrations when comparing to existing guidelines; alternatively, provide a rationale for why baseline concentrations of radon were not included. 3. Discuss the potential health implications of the project-only increment-over-baseline radon levels	1: The baseline range of <7.4-25 Bq/m^3 referenced in the air quality assessment is discussed in Section 6.1.1.2.3 of the draft EIS and comes from the CNSC document "The Regulatory Oversight Report for Uranium Mines and Mills in Canada" (2018). Measured baseline values presented and discussed in Section 6.1.3.2.3 of the EIS also fall within this range. 2. The rationale for not adding baseline to modelled incremental radon concentrations in the air quality assessment is presented in Section 6.1.1.2.3. This approach was discussed and confirmed with the CNSC during a technical meeting on Sep. 17, 2021. 3. As discussed in the response to IR 176, the total incremental dose to the camp worker from radon and U-238 decay chain radionuclides is below the dose limit for a non-NEW of 1 mSv/a.	No updates to the draft EIS are needed based on this IR response

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				is appropriate in this case from a health perspective, different approaches to screening predicted radon levels in different sections appear to be used (i.e., background radon levels vs. CNSC incremental concentration).			
IR-179	CNSC	Groundwater quality decommissioning objectives.	Section 10.1.4.2.2, Release of Treated Effluent to Whitefish Lake During Decommissioning	**Context:** It is stated that "This process would continue until the recovered water meets acceptable groundwater quality decommissioning objectives". **Rationale:** The information provided does not include groundwater quality decommissioning objectives nor a reference to these objectives.	Please provide groundwater quality decommissioning objectives or a reference to the information.	The "groundwater quality decommissioning objectives" referred to in Section 10.1.4.2.2 of the draft EIS are the mining area decommissioning objectives provided in Table 2.3.3 of Section 2.3.3.1.1 in the draft EIS. The mining area decommissioning objectives have been developed through groundwater modelling work and are achievable based on metallurgical testing. Groundwater modelling and metallurgical testing are described in Section 7.6.2.1 of the EIS and in Appendix 7C of the EIS. For clarity, Section 10.1.4.2.2 will be modified in the final EIS to state: "This process would continue until the recovered water is demonstrated to be stabilized (maintained) at acceptable mining area decommissioning objectives (Section 2.3.3.1.1, Table 2.3-3)."	Section 10.1.4.2.2 in the final EIS will be modified as follows: This process would continue until the recovered water **is demonstrated to be stabilized (maintained) at** ~~meets~~ acceptable ~~groundwater quality~~ **mining area** decommissioning objectives **(Section 2.3.3.1.1, Table 2.3-3)**.
IR-180	CNSC	Human health with respect to hazardous contaminants	Section 10.1.6.1.1, Human Receptors Selection and Characterization	**Context:** Within the Human Health assessment, offsite receptors during the operation period are only considered downstream of Whitefish Lake. The only identified concern was for Se to the Fisher/Trapper located at Russel Lake. This section cites Indigenous Knowledge as informing the receptor selection and location. **Rationale:** While the assessment is fairly conservative in the assumptions made on intake and receptor habits, it stands to reason that if the trapper receptor was located closer to the operation, such as at McGowan or Whitefish Lakes, this exceedance of Se could be more pronounced. In terms of maintaining a conservative assessment, if the most vulnerable receptor can be shown to be protected at the point of highest expected COPC concentration, it can be concluded that this receptor would be protected further away from the project. Considering this, why was the hunter/trapper receptor not also assessed at Whitefish or McGowan Lake? Was Indigenous Knowledge specific in mentioning Whitefish or McGowan Lakes were not used for the activities carried out by identified receptors?	Please provide justification for excluding a receptor from occupancy at lakes closer to the project during operation (McGowan, Whitefish). Alternatively, conduct a risk assessment to a receptor at these lakes during operation to determine if there is a predicted risk that may require monitoring or mitigation. **Suggestions for mitigation and follow-up measures:** CNSC recommends the following: • Assessment of a receptor located closer to the point of effluent release may need to be considered to ensure there are negligible risks • If Se is expected to exceed hazard quotients further upstream, selenium removal technology may be required as part of the effluent treatment process as a mitigation measure. Other COPC's exceeding an HQ of 1 may also be identified under this process that could require specific monitoring or mitigation measures.	The traditional land use activities closest to the Project site are reported to occur in the Russell Lake area. However, a potential recreational lease has been identified in the McGowan Lake area. As such, a human receptor (Recreational Fisher/Hunter) was assessed at McGowan Lake in Appendix 10-A (ERA). The Fisher/Trapper was included at Russell Lake based on engagement with a local fisher/trapper (Bobby John), who had a cabin at Russell Lake. Overall, based on Indigenous and Local Knowledge, use of the area near Whitefish Lake for fishing, hunting, gathering is limited. As such the closest human receptor assessed during the Project phases was at McGowan Lake. No unacceptable risk was identified for the human receptor (Recreational Fisher/Hunter) at McGowan Lake due to releases from the Project. The ingestion rates for the receptor at McGowan Lake are more reflective of the average country foods diet and consumptions rates expected for human receptors in the area (based on the ERFN country foods study) than the diet of the Fisher/Trapper which would represent a higher consumption of traditional foods. As indicated in Section 4.4.1.1 of the ERA, the annual fish consumption based on engagement with a local fisher/trapper from ERFN was assumed to be 183 kg/yr (approximately 1 to 2 servings per day), which is conservative compared to an annual fish consumption of 27 kg/yr (2 servings per week) from the ERFN's Country Food Study (CanNorth, 2017) and 88 kg/yr (approximately 1 serving per day) for the high consumer for the Boreal Shield in the First Nations Food, Nutrition and Environment Study for Saskatchewan (Chan et al., 2018). <u>References:</u> CanNorth, 2017. English River First Nation Country Foods Study – Final Report (No. Project No. 2147). Canada North Environmental Services. Chan, L., Receveur, O., Sadik, T., Schwartz, H., Ing, A., Fediuk, K., Tikhonov, C., 2018. First Nations Food, Nutrition and Environment Study (FNFNES): Results from Saskatchewan (2015). University of Ottawa, Ottawa.	No updates to the draft EIS are needed based on this IR response
IR-181	CNSC	Human Health with respect to radiation exposure	Section 10.1.6.1.4	**Context:** In section 10.1.6.1.4, it is stated: "The maximum incremental radon concentration at the camp worker site during Operation was predicted to be 12.4 Bq/m3, which is below the CNSC limit of 60 Bq/m3 for incremental radon." As per IR-176, there is no such CNSC limit for incremental radon. The camp worker would be considered a person who is not a nuclear energy worker (NEW) and subject to the dose limits of section 13 and 14 of the Radiation Protection Regulations, not the dose limit for the general public as per subsection 1(3) of the Radiation Protection Regulations. The CNSC has regulatory requirements for the ascertainment and recording of doses of radiation as per section 5 of the Radiation Protection Regulations. Every licensee must ascertain and record the magnitude of exposure to radon progeny, the effective dose and equivalent dose received by and committed to a person who performs duties in connection with any activity that is authorized by the Nuclear Safety and Control Act or is present at a place where that activity is carried on. The camp worker performs duties in connection with the licensed activity and is present at the location where the activity is carried out. Hence, they are not considered to be a member of the general public (who has no connection with the activity) Further, the proponent indicates that the maximum incremental radon dose to the camp worker was estimated to be 0.13 mSv/year during Operation. The assessment assumes that the camp worker spends 100% of the time indoors. Table 10.1-11 shows the maximum total incremental dose for the camp worker to be 0.02 mSv/year. This appears to be a discrepancy. Table 5.2 in Appendix 10-C provides internal annual dose from radon inhalation. The radon doses to some NEW workers (9.44E-02 mSv/a Driller 1 and 1.03E-01 mSv/a Wellfield Operator 1, 2) here appear less than the radon dose (0.13 mSv/year from section 10.1.6.1.4) to the camp worker, who is a non-nuclear energy worker. **Rationale:** The reason for the requested change is to ensure	The EIS and appendices should be aligned with the Radiation Protection Regulations by: 1. Removing the reference to a 60 Bq/m3 limit for incremental radon. 2. Revising all references to the 'public dose limit' applied to camp workers (non-NEWs) to align with section 13 and 14 of the Radiation Protection Regulations. The proponent should explain why the radon dose for the camp worker appears as 0.13 mSv/year in one instance and 0.02 mSv/year in another. The proponent is also asked to provide the rationale as to why a non-NEW has a higher radon dose than a NEW.	1. The reference level of 60 Bq/m^3 for incremental radon will be removed from the EIS and Appendix 10-A (ERA). The health impact will instead be interpreted based on dose. The incremental radon dose to the camp worker is 0.13 mSv/year during Operations, which is below the dose limit for a non-NEW of 1 mSv/year. The ERA text will be updated. 2. The ERA text and Section 10 of the EIS will remove the term "public dose limit" for the camp worker and use the term dose limit for a non-NEW. Note that the same dose limit of 1 mSv/year is applied. Section 10.1.6.1.4 will be modified to state: "Incremental radiation doses due to radionuclides in the uranium-238 decay series were compared to the regulatory public dose limit **and dose limit for a non-NEW** of 1 mSv/yr as described in the Radiation Protection Regulations under the *Nuclear Safety and Control Act*." The radon dose to the camp worker is predicted to be 0.13 mSv/year during operations and 0.02 mSv/year during Construction. See Table 4-12: Predicted Radon Dose to Camp Worker during all Project Phases in Appendix 10-A (ERA). No changes to the appendix are required. The radon dose to a NEW is presented in Appendix 10-C (Worker Dose Assessment). The radon dose to a NEW is higher in most instances than to a non-NEW at the camp. As indicated in Section 5.2 of Appendix 10-C, the dose from radon to NEWs in the ISR plant area is predicted to range from 0.53 to 2.27 mSv/year. Radon dose to NEWs from the core shack is expected to be 2.3 mSv/year. Radon dose to the Driller 1 and Wellfield Operator 1, 2 is based on exposure to radon outdoors where exposure is much lower than exposure to radon indoors for the camp worker.	Per the IR response any reference to 60 Bq/m^3 from the EIS and Appendix 10-A and the ERA text and Section 10 of the EIS will remove the term "public dose limit" for the camp worker and use the term dose limit for a non-NEW.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				consistency with the Radiation Protection Regulations and the environmental impact statement.			
IR-182	HC	Change to an environmental component due to radiological contaminants	Section 10.1.6.1.4, (p. 10-44)	**Context:** Section 10.1.6.1.4 states, "The limit is incremental and is exclusive of natural background, such as natural levels of radon and medical exposures. A dose constraint of 0.3mSv/yr was established for the public from all radionuclides and all pathways for the Project, as recommended by Health Canada (2010a). The dose constraint represents a dose lower than the public dose limit that ensures the combined dose from multiple sources does not result in exceedance of the public dose limit. Radon dose was calculated separately from the dose due to other radionuclides; however, the predicted radon concentration was compared against the CNSC incremental concentration limit of 60 BQ/m3" (p. 10-44). **Rationale:** Calculating radon separately from all radionuclides may underestimate the health risks by not considering combined doses from multiple sources when comparing to the public dose limit constraint of 0.3 mSv/yr recommended by Health Canada (2010a).	1. Provide clarification on how combined doses from all sources would be accounted for in respecting the public dose limit of 0.3 mSV/yr if radon concentrations are being calculated separately.	Health Canada guidance recommends reporting the dose from radon separately. See HC PQRA(rad) document in Section 5.8 Total Dose "In general, it is appropriate to compare the combined dose from external and internal radiation to a dose limit or a reference dose and to compare radon to its own criterion." The existing tables will be kept the same for total dose without radon and a new table for the total dose with radon will be added in Appendix 10-A (ERA) for the camp worker only which includes one column for radon dose and one column for other U-238 decay chain radionuclides. Note that total dose for the camp worker with radon included would be 0.15 mSv/year which is lower than the defined dose constraint of 0.3 mSv/yr. Additionally, the following text will be added to Section 4.4.1.4 of Appendix 10-A and Section 10.1.6.1.4 of the EIS, "The total incremental dose to the camp worker from all radionuclides in the U-238 decay chain including radon would be 0.15 mSv/year, which is below the dose limit for a non-NEW of 1 mSv/yr".	Per the IR response a new table for the total dose with radon will be added in Appendix 10-A (ERA) for the camp worker only which includes one column for radon dose and one column for other U-238 decay chain radionuclides. Section 4.4.1.4 of Appendix 10-A and Section 10.1.6.1.4 of the EIS will be updated to include the following statement, "The total incremental dose to the camp worker from all radionuclides in the U-238 decay chain including radon would be 0.15 mSv/year, which is below the dose limit for a non-NEW of 1 mSv/yr".
IR-183	CNSC	Human Health with respect to radiation exposure	Section 10.2 Appendix 10-C	**Context:** Exposure scenarios for workers have been identified and high-level summaries of the assumptions and resultant dose estimates have been provided. However, the detailed dose calculations have not been provided. **Rationale:** The method used to estimate effective, equivalent and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data, for at least the most dose significant scenarios.	Provide the dose calculations for deriving the dose estimates for workers in all exposure scenarios, for at least the most dose significant scenarios.	Example dose calculations are provided in Appendix A of the Worker Dose Assessment, which is Appendix 10-C of the draft EIS. As noted in responses to IRs 185, 186, and 187, some revisions to Appendix A are detailed in Attachment IR-183 to 187.	Changes to Appendix 10-C of the EIS, including example calculations in Appendix A of Appendix 10-C, are as described in response to IRs 185, 186 and 187 (see Attachment IR-183 to 187).
IR-184	CNSC	Human Health with respect to radiation exposure	Section 10.2 Appendix 10-C, 2.0	**Context:** It is stated in Appendix 10-C, section 2.0 that: "In addition, the CNSC has proposed a 100 mSv 5-year equivalent dose to lens of eye, in accordance with recent recommendations of the International Commission for Radiological Protection (ICRP, 2012a). This implies an average annual equivalent dose to lens of 20 mSv/a and will be considered as an applicable dose limit for workers." As per section 14 of the Radiation Protection Regulations, the equivalent dose limit for the lens of an eye for nuclear energy workers (NEWs), effective January 1, 2021, is 50 mSv in a one-year dosimetry period. **Rationale:** The reason of the requested change is to ensure consistency with the Radiation Protection Regulations.	The EIS and Appendix 10-C should be aligned with the Radiation Protection Regulations regarding the equivalent dose limit for the lens of an eye for NEWs.	The text cited by the reviewer from Section 2.0 of Appendix 10-C about a proposed additional limit for 5-year equivalent dose to lens of eye will be deleted to be consistent with the Regulation. See Attachment IR-183 to 187.	Per the IR response, in Section 2.0, p.2-1, of Appendix 10-C of the final EIS the following text will be deleted: ~~In addition, the CNSC has proposed a 100 mSv 5-year equivalent dose to lens of eye, in accordance with recent recommendations of the International Commission for Radiological Protection (ICRP, 2012a). This implies an average annual equivalent dose to lens of 20 mSv/a and will be considered as an applicable dose limit for workers.~~
IR-185	CNSC	Human Health with respect to radiation exposure	Section 10.2.3.2 Appendix 10-C Table 3.10-3.12	**Context:** The Geometries for External Exposure Scenarios Modelled in MicroShield for Sources in various locations were provided in tables 3.10-3.12 in appendix 10-C. The doses from those scenarios were omitted. **Rationale:** The method used to estimate effective, equivalent, and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data.	The proponent is asked to provide all the necessary information and assumptions required to perform the MicroShield calculations independently and to list the resulting calculated values from the listed scenarios.	The source radiochemistries, geometries, and distance/time assumptions that are inputs to the external dose calculation are provided in the Worker Dose Assessment, which is Appendix 10-C of the draft EIS. The calculation of external dose is detailed in Appendix A (Table A.3) of the Worker Dose Assessment. This calculation uses dose rates at distance as output from MicroShield. As we have noticed several typos in Table A.3 and have changed inputs for drying and packaging in response to IR-186, a revised table is provided here (see Table A.3 in Attachment IR-183 to 187) that will replace Table A.3 in Appendix A of Appendix 10-C.	Per the IR response, revised Table A.3 from the memo will replace Table A.3 in Appendix A of final EIS Appendix 10-C. Tables 5.3 and 5.4 of Appendix 10-C will be revised in the final EIS to show the same small changes in external dose (see Attachment IR-183 to 187).
IR-186	CNSC	Human Health with respect to radiation exposure	Section 10.2.3.2.4 Section 10.2.3.2.6 Section 10.2.4 Appendix 10-C, Section 3.2	**Context:** In sections 10.2.3.2.4 and 10.2.3.2.6, as well as section 3.2 of Appendix 10-C, the proponent has stated that workers in the drying and packaging areas of the processing plant will be required to wear powered air purifying respirators (PAPR) to reduce/eliminate inhalation exposure. Further in section 10.2.4, which elaborates mitigation measures, it is stated: "For the drying and packaging/loading areas of the ISR plant, use of PAPR has been assumed. It will be needed in these areas, and it has been planned in these areas to substantially reduce doses from inhalation of uranium dust. Dust levels in these areas will be monitored and kept ALARA." The use of respirators appears to be in contradiction of the requirements of section 13 of the Uranium Mines and Mills Regulations, which states: *No licensee shall rely on the use of a respirator to comply with the Radiation Protection Regulations unless the use of the respirator (a) is for a temporary or unforeseen situation; and (b) is permitted by the code of practice referred to in the licence.* The proponent is also reminded that respirators should not be the first choice for dose reduction in workplaces. They should only be used when the hierarchy of control (elimination, substitution, engineering, or administrative controls) is not possible. **Rationale:** At this stage of the project, the proponent is expected to identify design improvements to these areas of the ISR plant/processing plant following the hierarchy of control for the	Provide the rationale for mandating the use of respirators by workers in the drying and packaging areas of the processing plant. Include the demonstration of the application of the hierarchy of control for radiological protection within the design of these areas of the processing plant. Justify that this approach complies with section 13 of the Uranium Mines and Mills Regulations.	A very conservative dust level in drying and packaging areas had been used (representing equipment sources of dust to the exhaust system). While the dust hazard cannot be eliminated or substituted, engineering controls will minimize the pathway. As a primary engineering control, the equipment and exhaust will be in a negative pressure enclosure. Under normal operation, workers will not be inside the enclosure. To support a more realistic exposure assessment for drying and packaging, a conservative design estimate for potential dust levels in the main room has been obtained. It is anticipated that workers in these areas will not require PAPR under normal circumstances. As an administrative control, dust levels in the room will be monitored, and individual worker exposures will be monitored and managed. PAPR will be available if needed as a control of last resort. The approach will respect the hierarchy of control and will comply with Section 13 of the Uranium Mines and Mills Regulations. A new worker exposure assessment has been completed for the drying and packaging areas, using the design estimate for dust levels in the main room, a revised time spent in the area, and no routine use of PAPR (see revised Tables A.1 and A.3 in Attachment IR-183 to 187).	Revised Table A.1 provided in Attachment IR-183 to 187 will replace Table A.1 in Appendix A of final EIS Appendix 10-C. Tables 5.1 and 5.4 of EIS Appendix 10-C will be revised to show the same changes in inhalation dose. Tables 5.3 and 5.4 of Appendix 10-C will be revised in the final EIS to show the changes in external dose related to the revised time allocation. References to reliance on PAPR as an exposure control will be removed from text throughout the EIS.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				radiological protection of workers, as per regulatory requirements and as described in REGDOC-2.7.1, *Radiation Protection.*			
IR-187	CNSC	Human Health with respect to radiation exposure	Section 10.2.3.2.4 Section 10.2.3.2.6 Appendix 10-C, Section 3.3, 6.0	**Context:** The exposure scenarios and assumptions for the workers in the drying area and the packaging/loading area of the processing plant include the wearing of PAPRs, which is assumed to provide a 1000-fold reduction in dust exposure. Further to reference IR-186, the use of a respirator as well as in worker dose predictions for the project, appears to contravene section 13 of the Uranium Mines and Mills Regulations, and does not follow the hierarchy of controls for radiological protection of workers as described in REGDOC-2.7.1, Radiation Protection. **Rationale:** At this stage of the project, the proponent is expected to identify design improvements to these areas of the ISR plant/processing plant following the hierarchy of control for the radiological protection of workers, as per regulatory requirements and as described in REGDOC-2.7.1, *Radiation Protection.*	Modify the exposure scenarios and assumptions (i.e., remove the use of a respirator) for the workers in the drying area and the packaging/loading area of the processing facility. Assess the resultant exposures against CNSC regulatory dose limits and the ALARA principle. Identify mitigation measures as per the hierarchy of control for radiological protection.	As described in response to IR-186, a new worker exposure assessment has been completed for drying and packaging areas, using the design estimate for dust levels in the main room, a revised time spent in the area, and no routine use of PAPR (see revised Tables A.1 and A.3 provided in Attachment IR-183 to 187). The in-design engineering controls will include negative pressure enclosure of source equipment and exhaust, as well as ventilation controls in the main rooms (drying and packaging areas). Administrative controls will include area and individual monitoring and time-exposure management. It is shown that CNSC regulatory dose limits can be met without PAPR. This will be confirmed by air and dose monitoring during the commissioning phase as the control system is optimized. PAPR will be available as needed for non-routine situations, such as any necessary work within the enclosures.	Per the IR response Revised Table A.1 provided in Attachment IR-183 to 187 will replace Table A.1 in Appendix A of final EIS Appendix 10-C. Tables 5.1 and 5.4 of Appendix 10-C will be revised in the final EIS to show the same changes in inhalation dose. Tables 5.3 and 5.4 of Appendix 10-C will be revised in the final EIS to show the changes in external dose related to the revised time allocation. References to routine use of PAPR as an exposure control will be removed from text throughout the EIS. Mitigation measures will be described as per the hierarchy of controls.
IR-188	CNSC	Human Health with respect to radiation exposure	Section 10.2.4	**Context:** The following is stated in section 10.2.4: "Dust inhalation is also a potentially substantial component of worker dose at the core shack. At this location, PAPR will not be required; however, N95 masks will be used, and dust levels will be monitored here…It may be possible to increase air exchange in the core shack, above the planned six exchanges per hour, should this be necessary. This would also reduce radon exposure in the core shack." If it is possible to increase air exchanges in the core shack, it is not clear why this was not assessed and incorporated in the design of the core shack. **Rationale:** It appears that a control measure (e.g., air exchange protocols in the core shack) to reduce the exposure to workers has been identified. However, it is not certain if it has been formally documented to ensure that it is incorporated in the engineered design of the core shack.	Provide details on how the control measures to reduce the exposure to both workers through the air exchange protocols in the core shack have been formally documented to ensure that it is incorporated in the engineered design of the core shack.	Denison is completing feasibility designs for the Project in 2023. Detailed design to support Project licensing and permitting will begin later in the year. The engineering design of the core shack including control measures to reduce core shack worker exposure will be included in the detailed design and the core shack HVAC design criteria will be provided to the CNSC during Project licensing. The design mitigation measures in the EIS (Appendix 10-C) include: - Ventilation (assumed as 6 room changes per hour) - Monitoring of dust and radon, and worker doses (assumed 3 cores in shack, calculated radon level as 1.18E+3 Bq/m^3, and assumed dust level as 0.0675 mg/m^3) - Managing worker exposure time and dose (time assumed as 120 d/a, 11 h/d) Although use of N95 masks was mentioned, masks were not factored into the exposure estimation. As described in Section 10.2.4 Mitigation Measures, worker health is managed under the Radiation Protection Program (RPP), which is a worker health and safety plan specifically for radiation exposures. The RPP designates the roles and responsibilities of Denison and contractors, specifies the radiation dose limits, action levels and administrative levels, describes procedures to monitor and manage worker exposures (dust and radon monitoring, personal dose monitoring), and describes the processes for training and record-keeping. The successful implementation of the RPP, in conjunction with in-design measures described for the various project activities, is key to maintaining acceptably low doses of radiation exposure to workers during all phases of the Project.	No updates to the draft EIS are needed based on this IR response.
IR-189	CNSC	Woodland Caribou Ecological Model	Appendix 10-A (ERA)	**Context:** In the ERA (p. C.12, section 2.3.6 Woodland Caribou) it is stated: "For the ecological model a diet comprised of 50% browse, 20% lichen and 30% macrophytes is assumed for the woodland caribou." In the EIS, section 9.3.3.3.1, it is stated: "Research has shown that up to 70% of the year-round diet of caribou may consist of ground and arboreal lichens." **Rationale:** It is unclear whether the assumptions in the ecological model in the ERA regarding Woodland caribou diet are conservative, given only 20% lichen intake in the model. Lichen is known to accumulate COPC such as metals and dust from the atmosphere.	Please provide additional evidence to support that those Woodland Caribou who may have higher consumption rates of lichen as part of their diet, will remain protected. This can be provided through including a second model that assumes 70% lichen in the diet. See also related: IR-138.	A second woodland caribou with a diet of 70% lichen, 20% browse, and 10% macrophytes was modelled for comparison to the existing woodland caribou with a diet comprised of 50% browse, 20% lichen and 30% macrophytes. Compared with the woodland caribou with the lower lichen diet (50% browse, 20% lichen and 30% macrophytes), the predicted total radiological dose for the woodland caribou with the higher (70%) lichen diet increased 65% to 0.0118 mGy/d, which is below the 2.4 mGy/d radiation dose benchmark for terrestrial biota. The predicted maximum hazard quotient (HQ) for the woodland caribou with higher (70%) lichen diet would generally increase by 5 to 81% with the exception of copper and molybdenum where the HQ decrease due to the copper and molybdenum concentration in lichen being lower than in browse. However, all HQs for both the woodland caribou with the lower and higher lichen diet are below the benchmark of 1 for all COPCs.	No updates to the draft EIS are needed based on this IR response
IR-190	HC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Table 3-8 (p. 3.31) and Table 3-9 (p. 3.36) Appendix 6, Table 5 (p. 16)	NO2 criteria is not being consistently compared. **Context**: Provincial and federal air quality criteria/screening values for NO2 have been used inconsistently. Table 3-9 in Appendix 10-A (ERA) uses the 2015 Saskatchewan Ambient Air Quality Standards (SAAQS) value of 300 µg/m3 to compare the maximum concentrations of NO2 at receptor locations for the 1-hour average period, while Table 5 of Appendix 6 uses the 2025 Canadian Ambient Air Quality Standards (CAAQS) of 79µg/m3 for the same average period time. **Rationale**: By utilizing the SAAQS screening value for NO2, the maximum concentrations at receptor locations exceed the 1-hour threshold solely during the decommissioning stage (Table 3-9). However, if the 2025 CAAQS are applied, the screening values would be exceeded at receptor locations for all project phases. It is best practice to use the more protective air quality standards to evaluate potential human health risks associated with project activities.	1. Compare the predicted maximum concentrations to the most protective applicable air quality standards available. Alternatively, provide a rationale as to why the SAAQS for NO2 were used rather than the more protective 2025 CAAQS to determine potential exceedances and screen for the need for additional mitigation measures. **Suggestions for mitigation and follow-up measures:** Health Canada recommends use of the standards from the 2025 CAAQS for NO2 in future mitigation and follow-up plans.	The CAAQCs are applicable to measured ambient air concentrations over a three-year period and are not applicable to modelled results from a single facility. In technical meetings between Denison and ENV, the province agreed to the approach of utilizing 1-year of site-specific meteorological data. Use of the CAAQCs would require a three-year site specific data set. Denison agrees to using the 2025 CAAQCs for NO2 in future mitigation and follow-up plans.	No updates to the draft EIS are needed based on this IR response
IR-191	HC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Table 3-9 (p. 3.36) and Table 3-10 (p. 3.46)	Non-threshold substances are not included in screening and monitoring plans. **Context:** Fine particulate matter (PM2.5) is not being considered further in secondary air quality screening for short and long-term exposure at human and ecological receptors because it is not predicted to exceed the screening values of the Ontario Ambient Air	1. Include PM2.5 and PM10 in the secondary air quality screening for short and long- term exposure at human receptors. 2. Include PM10 and PM2.5 in the air quality monitoring plan as they are non- threshold substances.	1. PM2.5 and PM10 baseline (background) concentrations were compared to the Project AQ Criteria in Appendix 6-A, Table 5: Model Predicted COPC Concentrations for the Construction Scenario. PM2.5 and PM10 background concentrations were found to be below the Project AQ Criteria. Appendix 10-A will be updated to note that baseline concentrations were compared to the Project AQ Criteria and to reference Appendix 6-A, Table 5. As noted by the reviewer, PM2.5 was not included for the secondary air quality screening because the predicted maximum concentrations (which includes background air concentrations) did not	Per the IR response, Section 3.2 in Appendix 10-A will be updated to note that baseline concentrations were compared to the Project AQ Criteria and to reference Appendix 6-A, Table 5. The commitment to include PM10 and PM2.5 to the air quality monitoring plan during

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
			Section 6.1.8 (p. 6-44)	Quality Criteria (OAAQC) or the Canadian Ambient Air Quality Standards (CAAQS) for both annual and 24-hour average periods (Tables 3-9 and 3-10). Furthermore, it is not compared against the baseline for analysis. Table 3-9 indicates that coarse PM (PM10) is predicted to exceed the 24-hour CAAQS during all phases of the project. However, Appendix 10-A p. 3.46 states that, "There were no exceedances of PM2.5 which is generally considered to be a more reliable indicator of potential health effects. However, health effects would be infrequent and reversible, subsiding after exposure; therefore, PM10 was not considered for further quantitative assessment in the ERA." PM10 and PM2.5 were not included in the air quality monitoring plan (Section 6.1.8). **Rationale:** Particulate matter and NO2 are considered non- threshold pollutants, meaning that health effects can occur at any level of exposure, The CAAQS for PM2.5 PM.10, and NO2 recognize that there is no population health threshold for human health effects; therefore, any increase in exposure will result in an incremental population risk (Environment Canada and Health Canada, 2012; CCME, 2000). The CAAQS values should not be construed as limits to which polluting up to is allowed. In addition, based on the principles of keeping clean areas clean and continuous improvement, proposed mitigation measures should not be confined to meeting the standards but should also be targeted towards reducing population exposure to CACs associated with the proposed project. Furthermore, although health risks associated with PM2.5 are higher than those associated with PM10, both fractions are considered non-threshold pollutants and identified by IARC (2013) as causes of cancer. **Reference**: [1] International Agency for Research on Cancer (IARC). 2013. IARC monographs on the evaluation of carcinogenic risks to humans. Volume 109. Outdoor air pollution. Lyon: International Agency for Research on Cancer.	3. Provide a discussion of the significance of predicted exceedances of health- based standards. 4. Identify additional mitigation measures to reduce concentrations of non- threshold air contaminants associated with the project. **Suggestions for mitigation and follow-up measures:** Health Canada recommends use of the 2025 CAAQS Management Levels to develop mitigation measures that reduce project contributions of non-threshold pollutants (e.g., PM2.5, NO2).	exceed the Project AQ Criteria. This is considered an appropriate approach as PM2.5 is not exceeding an acceptable risk level for PM 2.5. In the case of PM10, this constituent was included in the secondary air quality screening as it exceeded its Project AQ Criteria. 2. Denison agrees to include PM10 and PM2.5 as part of the air quality monitoring plan during construction and determine based on adaptive management if monitoring during future phases is required. 3. PM10 and PM2.5 are associated with adverse human health effects because these particulate sizes can be inhaled and entrained within the respiratory system (WHO, 2006). Although there are a broad number of health effects associated with the inhalation of PM10 and PM2.5, the effects target primarily the respiratory and cardiovascular systems. Epidemiological studies indicate that the adverse effects of PM are evident for both short-term and long-term exposures of PM, with the risk for adverse health effects increasing with increased exposure duration (WHO, 2006). As such, the exceedances of PM10 health-based standards, as noted in Appendix 10-A, Section 3.2.1.3.2.2, is the potential for unacceptable adverse effects associated with respiratory symptoms such as coughing or difficulty breathing, or asthma symptoms and chronic bronchitis, with effects being reversible and subsiding after exposure. 4. The results of the air quality assessment and ERA do not warrant additional mitigation measures for air quality. However, Denison agrees to using the 2025 CAAQCs in future mitigation and follow-up plans. References: World Health Organization (WHO). 2006. WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide Global update 2005, Summary of risk assessment.	construction will be added to Section 6.1.8 and Section 16 in the EIS.
IR-192	CNSC	Human Health with respect to radiation exposure	Appendix 10-A (ERA), Section 3.1.1.2, including Tables 3-1 and 3-2	**Context:** Section 3.1.1.2 in Appendix 10-A (ERA) provides the method of how select constituents including cadmium, chromium, selenium and lead-210 were determined. This section does not mention how the other constituents as listed in Tables 3-1 and 3-2 are determined. The values for Th-230 and U-238 in Table 3-1 are unexpected. Typically, these values should be at equilibrium. **Rationale:** The technical basis for the selection of constituents of concern is required as part of the environmental and human health risk assessments.	1. Provide the methodology of how all listed constituents are determined. 2. Provide the rationale as to why Th-230 and U-238 are not in equilibrium.	1. In the first paragraph of Section 3.1.1.2 of the ERA (Appendix 10-A), the text explains that for most constituents the effluent values were based on the results from lab tests conducted by Denison, with a safety factor of three included. Cadmium, chromium, and selenium were singled out because the effluent quality for those constituents were determined based on the back-calculated concentration from a water quality guideline. As stated in the response to IR-117, the ERA will be revised to remove lead-210 from the list of constituents that used the derived effluent quality, as the concentration was based on Denison lab tests. Section 3.1.1.2 of Appendix 10-A will be modified to state: "The derived effluent quality was used for a handful of constituents including cadmium, chromium, and selenium". 2. The effluent quality for Th-230 and U-238 were based on lab results from Denison with a safety factor of 3. U-238 and Th-230 are not expected to be in secular equilibrium in the effluent as they have come out of a chemical process in which uranium and thorium partition differently. The effluent quality will continue to be refined through the licensing process based on continued testing conducted by Denison. No changes to the EIS.	Per the IR response, a minor edit, same as response to IR-117. Section 3.1.1.2 of Appendix 10-A will be modified to state: "The derived effluent quality was used for a handful of constituents including cadmium, chromium, and selenium".
IR-193	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Section 3.1.1.2 Section 8.2.4.2.3	**Context:** Appendix 10-A (ERA) Table 3-1 'Screening of Effluent Quality against Surface Water Quality Guidelines for the Wheeler River ERA' does not include acute water quality thresholds for all COPCs compared against predicted effluent quality. For example, it is stated that the final effluent quality discharge target for uranium is 0.057 mg/L. However, the CCME water short term (acute) water quality guidelines for the protection of aquatic life is 0.033 mg/L. The proposed effluent discharge target for uranium exceeds the acute water quality guidelines, indicating effluent may pose the risk of being acutely lethal to aquatic biota at end-of-pipe. All water quality thresholds should be derived from receiving environment parameters, and there are discrepancies between the values used in Appendix 10-A (ERA) Table 3-1 and the values presented in Tables 8.2-8 and 8.2-10 in Section 8.2.4.2.3 of the draft EIS. No selected screening value for TSS has been calculated from baseline conditions. Un-ionized ammonia, which is a regulated Schedule 4 substance under the MDMER, has not been included. **Rationale:** A review of all modelling results for all COPCs under the MDMER will assist ECCC in understanding the potential risks to the receiving environment.	1. Provide acute and chronic water quality thresholds for all required COPCs with monitoring required under the MDMER. 2. Ensure all water quality thresholds are derived from receiving environment baseline parameters and that these thresholds are consistently applied throughout the draft EIS.	1. The application of acute water quality thresholds will be added to Section 8.2.4.2.3 and will be used to refine the effluent quality during the licensing phase (see the response to IR 114 for the updated mixing zone model results). The effluent presented in Table 8.2-9 is based on maximum effluent concentrations; however, Denison is committed to ensuring all effluent released will be below MDMER limits as well as short-term CCME guidelines for protection of aquatic life. 2. Water quality thresholds have been applied appropriately in the draft EIS and fit for purpose. Water quality thresholds in Section 3.1.1.2 of the ERA (Appendix 10-A) were based on site-specific hardness of 5.26 mg/L (95th percentile of LA-5 and LA-6). This was to provide a conservative screening for COPCs to be carried forward for further quantitative assessment in the ERA. Water quality thresholds in Section 8.2.4.2.3 are based on Project induced hardness which is assumed to be 250 mg/L. This results in known discrepancies for some water quality parameters that are hardness induced such as cadmium, copper, zinc, and sulphate.	Per the response the application of acute water quality thresholds will be added to Section 8.2.4.2.3 and where applicable are presented in Attachment: IR-114.
IR-194	ECCC	Aquatic species	Appendix 10-A (ERA), Section 3.1.1.2 and Section 3.1.2.3	**Context:** In the ERA, COPCs should be selected for further assessment based upon the following factors: 1. COPC concentrations in effluent that exceed selected water quality guidelines for the protection of aquatic biota, and	1. As noted in IR-114, provide the information on predicted effluent quality for COPCs with required monitoring under the MDMER. 2. Provide the information on predicted maximum receiving	1. See response to IR-114. No revisions to Appendix 10-A, ERA are needed based on the response. 2. See response to IR-114 for the predicted maximum receiving environment surface water concentrations for constituents regulated under Schedule 4 of MDMER. As indicated in Section 3.1.1 of the ERA in Appendix 10-A a long list of constituents was initially identified for	No EIS updates are anticipated to address this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				2. Baseline COPC concentrations in the LSA that exceed selected surface water and sediment quality guidelines for the protection of aquatic biota. However, only COPCs that had concentrations in effluent that exceeded guidelines were assessed further. Baseline concentrations of COPCs in sediment were not considered. In addition to this, not all COPCs that require monitoring under the MDMER had predicted effluent concentrations. From Section 8.2.3.3 Table 8.2-2 of the Aquatic Environment Report, it appears Aluminum in McGowan Lake and Whitefish Lake South and North, and pH in Whitefish Lake North exceed water quality guidelines. Predicted effluent concentrations or near-field surface water concentrations for Aluminum and pH are not provided. **Rationale:** It is not possible to determine if there is risk from effluent to the receiving environment and aquatic receptors based on the current information provided.	environment surface water concentrations for COPCs with required monitoring under the MDMER in IR-114. 3. Update the ERA to assess the risk of any additional MDMER COPC concentrations in effluent that exceed water quality guidelines. 4. Update the ERA to assess the risk of COPCs that had elevated baseline water and sediment quality concentrations in the receiving environment.	consideration in the ERA based on they are known to be present in treated effluent, have existing water quality guidelines or were identified in MDMER (with the exception of cyanide). The focus of the MDMER constituents were those regulated under Schedule 4. Denison will monitor for all MDMER constituents with required monitoring in the environment. This will be included as part of Denison's Effluent and Emissions Plan to support licensing. 3. As indicated in Section 3.1.1.1 of the ERA in Appendix 10-A the long list of constituents was reduced further based on potential for exceedance of a water quality guideline (for both protection of human health and aquatic life). Any MDMER constituent that was identified as exceeding a water quality guideline was considered a COPC and assessed further in the ERA (see Table 3-1 in the ERA). For example, effluent quality for arsenic, copper, and zinc which are all Schedule 4 constituent were identified as COPCs in the ERA based on exceeding a water quality guideline. 4. The ERA followed the guidance in CSA N288.6-22 which does not require COPCs with elevated baseline concentrations to be considered COPCs for further quantitative assessment in the ERA. Clause 6.2.5.9 indicates that constituents with naturally elevated concentrations should be excluded from further consideration as a COPC. As indicated in Section 8.2.3.3 of the EIS constituents in baseline water quality that exceeded water quality guidelines included aluminum, and occasional exceedances for cadmium, iron, and lead. All of these constituents were considered in the ERA screening; however, were not identified for further assessment (other than cadmium) since based on a conservative screening of effluent quality water quality guidelines would not be exceeded. Section 8.4.3.2.3 of the EIS did not identify any constituents where baseline sediment quality exceeded sediment quality guidelines. Section 3.1.2.3 of the ERA in Appendix 10-A provides the predicted maximum sediment quality in Whitefish Lake for a list of constituents. These concentrations included background concentrations and are screened against sediment quality guidelines. The only constituents that exceed sediment quality guidelines are molybdenum and selenium; however, other COPCs are assessed further in the ERA (see Table 3-14 in the ERA in Appendix 10-A) even though sediment quality guidelines are not anticipated to be exceeded.	
IR-195	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Section 3.1.2.1	**Context:** Figure 3-2 depicts modelled concentrations of COPCs in the receiving environment surface water during all Project phases. Effluent discharge rates during Operations and Decommissioning are not anticipated to differ significantly. However, COPC concentrations seem to decrease rapidly after the end of the operations period despite effluent releases continuing into the decommissioning phase. **Rationale:** There has been no information provided on predicted changes in effluent COPC concentrations and discharge rates during the decommissioning phase. It remains unclear how COPC concentrations would decrease so quickly following the end of operations.	1. Provide further information on modelled maximum COPC concentrations for each individual Project phase with estimated timing for peak concentrations to appear in the receiving environment. 2. Provide further information on predicted effluent quality during the Project decommissioning phase. 3. Update ERA figures and conclusions as needed.	1. Per the draft EIS effluent is conservatively assumed to be discharged to the Whitefish Lake Middle during the operations (15 years) and decommissioning (5 years) phases at the same constant discharge rate of 36.5 m^3/hr (10.1 L/s) with the same stable effluent quality as shown in Table 3-2. Therefore, the modelled maximum COPC concentrations in water are the same for operations and decommissioning phases (which is considered conservative), the same peak concentrations appear annually due to the variation of the monthly local inflow. Since COPCs are accumulated in sediment, the modelled maximum COPC concentrations in sediment appear at the end of each individual Project phase, which are year 20 for the operations and year 25 for the decommissioning in Figure 3-3. 2. The predicted effluent quality during the Project decommissioning phase is expected to be the same as those during the operations. Effluent was set to be released during operations but not during the decommissioning phase in the current model. 3. The model has been updated to include effluent discharge during the decommissioning phase, and the ERA figures and result tables will be updated in the next submission accordingly. **See attachment IR-195 for the updated Table 3-3 and Figure 3-2.**	Per the IR response, edits will be made to Table 3-3 and Figure 3-2 in Appendix 10-A. These edits are provided in Attachment IR-195.
IR-196	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Section 3.1.2.3	**Context:** Table 3-6 provides predicted maximum sediment concentrations of COPCs compared to sediment quality guidelines. Several selected sediment screening values are not the most stringent sediment quality guidelines, with no justification provided. Additionally, copper and lead appear to be missing guidelines that are available from the Burnett-Seidel and Liber (2013) study. **Rationale:** The most stringent guidelines should be used for the sediment quality risk assessment in the ERA. Use of the most stringent guidelines will allow the most protective assessment to analyze risks to the receiving environment, aquatic and terrestrial biota.	1. Provide further information and justification for the selection of less stringent thresholds. 2. Update the ERA as needed.	1. As indicated in Appendix 10-A Section 3.1.2.3, "Burnett-Seidel and Liber (2013) was selected as the preferred source for the selection of the Project thresholds in the sediment quality assessment, as the reported NE2 and REF values are specifically applicable to Saskatchewan waterbodies." Burnett-Seidel and Liber (2013) was used even if higher than CCME quality guidelines or Thompson et al (2005). In some instances, the NE2 value was lower than the REF value from Burnett-Seidel and Liber (2013). In those instances, the REF value was still used, as screening values should not be lower than background concentrations. 2. The guidelines for copper, lead, and vanadium from Burnett-Seidel and Liber (2013) were inadvertently excluded from Table 3-6 in Appendix 10-A which results in changes to selected screening values for copper (9.1 mg/kd dw), lead (16.3 mg/kg dw), and vanadium (35.1 mg/kg dw). The predicted sediment quality for copper, lead, and vanadium are still below the sediment quality guidelines; therefore, no changes to the table are needed other than changes to the sediment quality guidelines identified above. The updated Table 3-6 is provided in Attachment IR-196 – red text indicates a change from the existing table in the draft EIS, Appendix 10-A. <u>References:</u> Burnett-Seidel, C., Liber, K., 2013. Derivation of no-effect and reference-level sediment quality values for application at Saskatchewan uranium operations. Environ. Monit. Assess. 185, 9481–9494. Thompson, P.A., Kurias, J., Mihok, S., 2005. Derivation and use of sediment quality guidelines for ecological risk assessment of metals and radionuclides released to the environment from uranium mining and milling activities in Canada. Environ. Monit. Assess. 110, 71–85.	Per the IR response edits to Appendix 10-A, Table 3-6, as shown in Attachment IR-196, will be made in the final EIS.
IR-197	ECCC	Aquatic species	Appendix 10-A (ERA), Section 3.2	**Context:** It remains unclear if atmospheric deposition from Project related emissions has been incorporated into modelling for the ERA and surface water and sediment quality assessments. **Rationale:** While expected Project air emissions are unlikely to have direct impacts on the aquatic receiving environment and aquatic biota, this Project effect pathway may have indirect effects through accumulation of COPCs over time or deposition of contaminants that	Incorporate atmospheric deposition from Project-related emissions into water quality modelling and assess any Project related effects to aquatic receptors from this pathway.	Consistent with CSA N288.1-20, Clause 5.1.5, atmospheric depositions to large water bodies such as lakes, are considered negligible; therefore, the air to surface water pathway has been excluded for the ecological risk assessment. The rationale for exclusion of atmospheric deposition to lakes and rivers is explained in detail in Section G9, Appendix G of the COG DRL Guidance Document (Hart, 2019). Typical transfer parameters from source to air and source to water are on a similar magnitude to each other. The transfer parameter from air to water is orders of magnitude lower indicating that atmospheric deposition to the lake would have a negligible effect. Rationale on the exclusion of the air to water pathway can be included in	Per the IR response, the following statement will be added to Section 2.2 in Appendix A to Appendix 10-A "Atmospheric deposition to Whitefish Lake is considered negligible. This is consistent with the COG DRL guidance (COG, 2019) which shows (assuming a modest flow rate for a lake of 0.1 m/s and an assumed water depth of 10 m) that the transfer of constituents from

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				are not expected in effluent, which should be evaluated with predicted emissions data incorporated into water quality modelling predictions.		the ERA in Appendix 10-A. The following statement will be added to Section 2.2 in Appendix A to Appendix 10-A "Atmospheric deposition to Whitefish Lake is considered negligible. This is consistent with the COG DRL guidance (COG, 2019) which shows (assuming a modest flow rate for a lake of 0.1 m/s and an assumed water depth of 10 m) that the transfer of constituents from the atmosphere to large bodies of water (including lakes and rivers) is considered negligible." References: Hart, D. 2019. Derived Release Limits Guidance. COG-06-3090R4-I	the atmosphere to large bodies of water (including lakes and rivers) is considered negligible."
IR-198	HC	Change to an environmental component due to radiological contaminants	Appendix 10-A (ERA) Appendix B, Tables B.7 and B.8 Ref. 19-2638 Appendix 10-A (ERA), Table 4-3 Ref. 19-2638 (p. 4.17)	**Context:** Section 10 Appendix 10-A (ERA) contains Table 4-3 (p. 4.17), which lists ingestion rates for traditional foods and includes the category "organs" for Mammals. Tables B.7 and Table B.8 in Section 10 Appendix 10-A (ERA) Ref. 19-2638 provide the predicted concentrations of radionuclides for ecological receptors during the project phases and during future centuries, respectively. They list the concentrations of radionuclides in moose and in moose organs, which is presented as a single cumulative organ value. Other terrestrial and aquatic animals (such as the black bear and woodland caribou) that are a part of the traditional diet of nearby Indigenous communities have higher concentrations of radionuclides than moose, yet concentrations are not provided for organs of these species. **Rationale:** While Health Canada is not aware of transfer factors to individual organs, or to organs in animals that are not ruminants, it would be beneficial to have a better understanding of radionuclide concentrations in the organs of other animals that may be consumed by local Indigenous communities.	1. Provide more clarification on how the mammalian organ ingestion rates are calculated (which animals and relative contribution percentages). 2. Provide a rationale for why concentrations of radionuclides were not assessed in organs of animals (other than moose) that are consumed as country foods by Indigenous people harvesting in the area.	The response to IR-198 is provided in Attachment IR-198.	No updates to the draft EIS are needed based on this IR response.
IR-199	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Sections 3.2.1 and 3.3.1, Wheeler River Project IMPACT Model	**Context:** Model calibrated concentrations of selenium, uranium, and lead- 210 are under-predicted compared to measured baseline concentrations for water quality in the IMPACT modelling based on Figure 3-2. Calibrated concentrations of cobalt are under-predicted and there is poor agreement between model calibrated and measured concentrations of arsenic, lead-210, polonium-210, and radium-226 for sediment quality in Figure 3-3. **Rationale:** It is unclear how poor agreement between model calibrated and measured baseline concentrations of COPCs impacts the near-field and far-field modelling predictions of COPCs during all Project phases. It is also unclear why measured concentrations of COPCS could not be used directly as model inputs when there was poor agreement.	1. Provide justification as to why model calibrated concentration inputs of COPCs were preferable for use in predictive modelling of water and sediment quality over measured baseline concentrations. 2. Provide a rationale detailing how under- or over-predicted model calibrated COPC concentration inputs influence IMPACT model predictions and uncertainty for water and sediment quality. Provide specific details on how this may impact the risk analysis for parameters that have been highlighted as having poor agreement between calibrated and measured concentrations (i.e., arsenic, selenium, uranium, lead-210, polonium-210, and radium-226).	1. Model calibrated concentration inputs of COPCs were preferable over measured baseline concentrations because of the interrelation of metals and radionuclides between water and sediment. In all cases the measured baseline concentrations were used to verify that the modelled relationship between water and sediment for each constituent was considered valid. The geometric mean values of the measured baseline data were preferentially used as the baseline inputs for COPCs that had a good amount of measured data over the detection limit, which is the case for most of the COPCs in Figure 3-2 (where the modelled values overlap with the measured geometric mean values in the plots). In the case of COPCs for which most or all measured values in water were under the detection limit (i.e., 140 out of 142 measured selenium concentrations are below its detection limit), but their sediment concentration measurements were over the detection limit, the baseline water concentration was calculated from the geometric mean of the sediment measurements using the regional water-to-sediment partitioning coefficients (Kd). 2. The "poor" agreement between calibrated and measured concentrations for selenium, uranium and lead-210 is the result of more than 95% of the measured concentrations in water being reported as less then the detection limit for selenium (140 out of 142), uranium (141 out of 142) and lead-210 (136 out of 142). It's unlikely that these three COPCs are under-predicted in water. Poor agreement between modelled and measured concentrations in sediment for arsenic and radium-226 may be a result of only one sampling campaign being available for sediment. The modelled sediment concentrations can be refined in the future when more measured sediment data are available as the Project progresses. Even though arsenic and radium-226 are conservatively over-predicted in sediment, no significant adverse effect on either aquatic or terrestrial populations or communities are predicted during the Project phases or during the future centuries.	No updates to the draft EIS are needed based on this IR response.

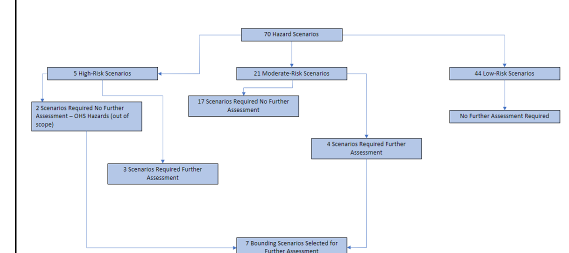
Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
IR-200	HC	Indigenous Peoples' health / Socio-economic conditions	Section 10 (p. 4.10) Appendix 10-A (ERA), Table 4-4 (p. 4.19)	Indigenous consultation should be included in the Country Foods analysis. **Context**: The Proponent obtained country food consumption data through engagement with a single local fisher/trapper and from a dietary survey administered by CanNorth to the English River First Nations (ERFN) in 2017. However, the potential health risks to consumers of traditional food were only assessed using the data obtained from the CanNorth dietary survey. Section 10 of the EIS *states the following:* **"**The diet assumptions for the fisher/trapper are conservative and are based on engagement with a local fisher/trapper. The diet of the fisher/trapper is representative of one person, who consumes a unique composition and quantity of traditional foods (e.g., ingestion rate of 175 kg/yr of caribou, equivalent to approximately 2 to 3 servings per day). Most people fishing, hunting, and trapping in the Local Study Area and Regional Study Area would consume traditional foods more consistent with the average traditional foods consumer diet which was developed from the ERFN country foods study. In comparison, the ERFN country foods study in Section 10 Appendix 10-A (ERA) Table 4- 4 indicates a caribou ingestion rate of 2.6 kg/yr (1 to 2 servings per month) and a total game ingestion rate of 21.3 kg/yr**"** *(p. 4.10).* **Rationale:** Health Canada is in general agreement that the dietary habits of the local fisher/trapper may be an outlier and not necessarily representative of most of the local population. However, a rationale has not been provided to demonstrate whether and how the 2017 ERFN dietary survey results are representative of consumption patterns of local Indigenous communities. Also, it is unclear whether or how the ERFN dietary survey results account for the consumption patterns of vulnerable or more sensitive subgroups (e.g., heavy consumers, children and women of child-bearing age)	1. Evaluate the suitability of using the 2017 EFRN survey results and consider surveying additional community members (such as local hunters/trappers) to obtain more representative country food consumption rates for use in the traditional foods risk assessment, and for communicating the results to the communities. 2. Additionally, consider evaluating consumption patterns (and applicable TRVs) of sensitive or vulnerable populations (e.g., elders, toddlers, women of childbearing age) in the traditional food risk assessment and provide risk levels for these sub-groups separately. **Suggestions for mitigation and follow-up measures:** Health Canada recommends providing the community with the opportunity to validate the ERFN 2017 survey results.	The 2017 report was authored by ERFN and as such there is no need for Denison to ask ERFN to validate their own report.	No updates to the draft EIS are needed based on this IR response.
IR-201	ECCC	Aquatic species	Appendix 10-A (ERA), Section 5.0	**Context:** For the ERA methodology the Proponent followed CSA N288.6-12 for the assessment of risk to aquatic biota from radionuclide and non-radionuclide COPCs. This is the 2012 version, and a more recent 2022 version was publicly released. **Rationale:** The Proponent should review the most up-to-date version of the standard to ensure no changes to the methodology of the COPC exposure assessment are required for the ERA.	Update the COPC exposure assessment methodology in the ERA using the most recent CSA N288.6-22 standard, as needed.	Denison confirms that the updated CSA N288.6-22 was reviewed and that no changes to the ERA methodology are required. Denison confirms that the ERA is also compliant with CSA N288.6-22. The EIS and ERA (Appendix 10-A) will be updated to reference the most recent 2022 version of the standard, CSA N288.6-22.	Per the IR response all references to N288.6-12 will be replaced with N288.6-22 in the EIS and Appendix 10-A.
IR-202	CNSC	QA/QC	Appendix 10-A (ERA), Section 6.0-Quality Assurance	**Context:** This section provides only Quality Assurance (QA) of the ERA, including planning and preparation of the ERA. **Rational:** The Quality Control (QC) aspects are not included. Both QA and QC aspects provide confidence that ERA results are defensible and fit for use in decision-making. The N288.6 (Clause 10.2) requires that "Appropriate QA/QC requirements shall exist for all aspects of the ERA and should be specified prior to conducting the ERA".	Please include appropriate QC aspects, as per a Clause 10.2 of the N288.6.	The ERA (Appendix 10-A) was completed in alignment with CSA N288.6-22 including the specific QA/QC requirements in Clause 10.2 and 10.3 of the standard. The ERA following the Ecometrix Quality Management System for review and verification ensuring that modelling results were correct and accurate. The ERA report as well went through a thorough review and verification by senior technical staff. The ERA utilized environmental monitoring data collected as part of the baseline monitoring program which followed either Ecometrix' Quality Management System for the monitoring conducted by Ecometrix or the Quality Management System for Denison's other subcontractors. The data collected during the baseline monitoring program was considered fit for use in the ERA. Another layer of review included Denison's review of the ERA. Final acceptance and submission of the ERA with the EIS package indicated Denison's acceptance of the final product. Section 6.1 of the ERA in Appendix 10-A will be updated to include some additional discussion of QA/QC activities. Specifically, the following will be added. "The ERA utilized environmental monitoring data collected as part of the baseline monitoring program which followed either Ecometrix' Quality Management System for the monitoring conducted by Ecometrix or the Quality Management System for Denison's other subcontractors. The data collected during the baseline monitoring program was considered valid and appropriate for use in the ERA. The ERA was reviewed and accepted by Denison in accordance with Denison's QA requirements Denison provides inputs to the ERA based on metallurgical test work that has been conducted under the QA/QC protocols of the Saskatchewan Research Council. The metallurgical test plan and test results are validated by a third-party Qualified Person. Once Denison provides the input values to be utilized in the ERA, Ecometrix summarises the data and provides the summary to Denison for acceptance by a Professional Engineer or a Professional Geologist prior to running the ERA model.	Section 6.1 pf Appendix 10-A will be updated to include the following statement: "The ERA utilized environmental monitoring data collected as part of the baseline monitoring program which followed either Ecometrix' Quality Management System for the monitoring conducted by Ecometrix or the Quality Management System for Denison's other subcontractors. The data collected during the baseline monitoring program was considered valid and appropriate for use in the ERA. The ERA was reviewed and accepted by Denison in accordance with Denison's QA requirements."
IR-203	CNSC	Sediment Quality and Benthic Invertebrates	Appendix 10-A (ERA), Section 6.2 Future Centuries Sensitivity Analysis	**Context:** This section of the ERA states "If treated effluent was released at the maximum upper bound discharge rate, the modelled concentrations of all COPCs are expected to be below their corresponding sediment quality guidelines." It appears from Figure 6-2: "Comparison of maximum concentrations of COPCs in sediment at expected and upper bound discharge rate" that cadmium and vanadium would be over their sediment quality guidelines indicated if maximum upper bound discharge rates are used.	Please provide clarity on if cadmium and vanadium are expected to be over the sediment quality guidelines for the maximum upper bound discharge rate scenario.	As part of the sensitivity analysis, if treated effluent is released at the maximum upper bound discharge rate, the modelled vanadium concentration in sediment is expected to be below the Severe Effect Level (SEL) of 160 mg/kg but exceed the Lowest Effect Level (LEL) of 35.2 mg/kg in Whitefish Lake Middle/South. The SEL and LEL values are defined by Thompson et al. (2005). The cadmium concentration in Whitefish Lake Middle/South is expected to be over the CCME sediment quality guideline of 0.6 mg/kg dw for the maximum upper bound discharge rate scenario.	Per the IR response, Section 6.2 of Appendix 10-A will be updated to the following, "If treated effluent was released at the maximum upper bound discharge rate, the modelled concentrations of all COPCs are expected to be below their corresponding sediment quality guidelines, **<u>with the exception of cadmium and vanadium</u>**."

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				Rationale: It is not clear which is correct; the statement that no exceedances of sediment quality guidelines when considering the maximum upper limit effluent release, or the figures indicating there could be exceedances for cadmium and vanadium. This discrepancy in the ERA should be explained and corrected.		The plots in Figure 6-2 are correct. The statement in Section 6.2 will be updated to the following, "If treated effluent was released at the maximum upper bound discharge rate, the modelled concentrations of all COPCs are expected to be below their corresponding sediment quality guidelines, **with the exception of cadmium and vanadium.**"	
IR-204	CNSC	Human health with respect to hazardous contaminants	Appendix 10-A (ERA), 7.1.1, Non-radiological Human Health Risk Assessment	**Context:** In the human health risk assessment of the non-radiological COPCs, it was determined that the project incremental HQ was predicted to remain below 0.2 for all non-carcinogens and all pathways during all phases of the project, except for selenium for the fisher/trapper at Russell Lake from the fish ingestion pathway. **Rationale:** Given that the fisher/trapper receptor will likely be exposed to higher concentrations of selenium from the consumption of fish at Russell Lake, there is an elevated risk of selenosis in exposed individuals. This potential for selenosis would be further exacerbated in individuals who consume fish taken from other lakes closer to the mining operation. There is, however, no discussion of mitigation of these risks to exposed individuals.	Please provide a discussion of measures that could be applied to mitigate the risk of selenosis in exposed individuals who consume fish from Russell Lake and other waterbodies closer to the mining operation. **Suggestions for mitigation and follow-up measures:** CNSC recommends the following: • Selenium abatement technologies may be considered to eliminate or reduce selenium in effluent entering the lake system. • If HQs continue to exceed 0.2, then it may be necessary to post fish consumption advisories, in consultation with the Medical Officer of Health for the jurisdiction where the project is located.	Health Canada (2017) conducted a screening assessment of selenium and its compounds under the Canadian Environmental Protection Act. Selenium is an essential element for humans; however, there may be potential human health risks at elevated exposure levels. Selenosis (also known as chronic selenium toxicity), is considered by Health Canada as the critical health effect for selenium. The symptoms of selenosis may include: intestinal upset, hair loss, nail loss, changes in nail morphology, excessive decay and discolouration of teeth, garlic odour in breath, nervous system abnormalities, and fatigue. The BC MOE (2014) identified 7.3 mg/kg dw of selenium in fish as an appropriate limit for subsistence fishing. This would equate to 1.8 mg/kg fw, assuming a dry weight to fresh weight ratio of 0.25 from CSA N288.1-20 for fish. The maximum selenium concentration in Whitefish Lake (LA-5) is predicted to be 1.57 mg/kg fw for northern pike and 2.29 mg/kg fw for white sucker (see Table B.5 in Appendix 10-A). The maximum predicted selenium concentrations in McGown Lake for northern pike and white sucker are 1.02 mg/kg fw and 1.39 mg/kg fw, respectively. The maximum predicted selenium concentrations in Russell Lake for northern pike and white sucker are 0.81 mg/kg fw and 1.06 mg/kg fw, respectively. As such, based on current predictions in lakes where fish consumption is assumed to occur (McGowan Lake and Russell Lake), fish tissue concentrations for selenium are expected to be below the BC MOE limit, indicating people eating fish from these lakes would likely be protected from selenosis. Any further selenium abatement technologies will be considered through the BATEA process during licensing. References: British Columbia Ministry of Environment, Beatty JM, Russo GA. 2014. Ambient Water Quality Guidelines for Selenium. Technical Report Update. Water Protection and Sustainability Branch. Environmental Sustainability and Strategic Policy Division, British Columbia Ministry of Environment. 270 pp Health Canada. 2017. Screening Assessment: Selenium and its compounds. December. https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/screening-assessment-selenium.html#toc71	No updates to the draft EIS are needed based on this IR response.
IR-205	CNSC	Geology and Groundwater	Section 7, appendix H	**Context:** In this appendix the analytical concentration of various groundwater samples taken from monitoring wells is reported. **Rationale:** There is one sample labeled as "Tracer Tank" with no definition available in the current report. It is difficult to judge whether the results presented are relevant to the EIS and how it may impact the findings therein.	Please clarify the definition of "tracer tank".	The 'Tracer Tank' label referred to the predetermined KCl tracer concentration of 15% (75,000 to 85,000 ppm Cl and K) utilized for injection as part of the 2021 Tracer Test. This clarification will be added to Appendix 7-A, Appendix H.	Per the IR response the clarification will be made as indicated in Appendix 7-A, Appendix H.
IR-206	ISRD	Current use of lands and resources for traditional purposes	Section 11 Section 12 Section 15 Section 16	**Context:** Impacts to Lands and Resources Use have been identified by Indigenous Nations and communities. **Rationale:** Additional information is required to demonstrate whether Indigenous Nations and communities were engaged directly by Denison regarding the cumulative effects assessment, significance determination and residual effects, and thus the overall conclusions on potential adverse impacts of the project on the potential or established Indigenous and/or treaty rights and effects of changes to the environment on Indigenous peoples, pursuant to paragraph 5(1)(c) of the CEAA 2012.	Please describe any outstanding or residual issues or concerns raised by Indigenous Nations and communities that Denison was unable to address. In addition, outline any plans to find solutions or continue discussions with the potentially impacted Indigenous Nations and communities.	Refer to response to IR-28.	Refer to IR-28.
IR-207	CNSC	Current use of lands and resources for traditional purposes	Section 11, Perceived Risks to Lands and Resources	**Context:** The EIS states: "Resource users may also experience changes in their perception of the quality of resources for consumption such as the palatability of fish or wildlife or have apprehensions about the safety of resources for consumption. These changes may affect the patterns of ILRU during all Project phases including Post Decommissioning. The ERFN refer to this indicator as a "psycho-social' effect, meaning that even if people know their fears are "*perceived fears, the fear … is real and has real impacts on ERFN members' perception of their overall health and well-being*" (ERFN and SVS 2022a)." (p. 11-11) Resource harvesters may experience Project-related disturbances and, depending on how these changes are perceived, it may cause some resource harvesters to avoid the Project Area. Reductions in harvests may occur based on fear or uncertainty about the ongoing quality of country foods. For example, "*People stopped picking berries in this area when Key Lake mine was established because of concerns about health impacts*" (ERFN and SVS 2022b). **Rationale:** CNSC's Generic Guidelines for the Preparation of an EIS state: "The EIS will document specific suggestions raised by Indigenous groups for mitigating the effects of changes to the environment on Indigenous peoples (section 5(1)(c) of CEAA 2012). For the mitigation measures intended to address the effects of changes to the	How does Denison plan to work directly with Indigenous Nations and communities who currently use the potentially impacted areas, including the RSA, to mitigate and monitor the perceived risks and/changes to the RSA? Has Denison had discussions with the potential impacted Indigenous Nations and communities on how fear and avoidance behaviors and related impacts on traditional land use will be mitigated, especially within the RSA? Additional information is needed to determine if Denison has engaged directly with the Indigenous Nations and communities to develop potential mitigation measures to address fear and avoidance impacts, such as a community monitoring program, which could help to reduce the perceived risk to lands and resource use through education, collaboration, and long-term monitoring with Indigenous Nations, in order to build trust. **Suggestions for mitigation and follow-up measures:** It is recommended that Denison consider engaging with potentially impacted Indigenous Nations and communities on the collaborative development and implementation of a monitoring program to help address concerns about potential impacts on lands and resources as a result of the	Denison believes that the EIS conclusions are applicable, as evidenced by continued use of Indigenous communities proximal to other uranium sites in northern Saskatchewan, and in part due to their continued efforts to engage meaningfully with Indigenous communities relative to the Project which support continued relationship and trust building. Denison acknowledges that not all project impacts can be eliminated in their entirety. Denison continues to work with its Indigenous Communities of Interest with reserves and residential communities most proximal to the Project, Denison has committed to collaborating with English River First Nation and Kineepik Metis Local on a community specific monitoring regime, suited to each of their interests and needs, in an agreed-upon fashion. One of the key goals of such collaboration with each Indigenous nation will be to provide the information necessary to the communities such that it provides confidence to community members regarding the impacts from the Project to the aspects of the environment which matter the most to them. Denison is committed to continual improvement in relation to such collaborative monitoring programs, in order to adapt to areas of interest which can change over time. Denison expects that important country foods harvested for food and cultural purposes (i.e. moose, fish, etc.), surface water quality, and other areas of interest will form part of this monitoring program. It is expected that the data collected through such monitoring regimes, as described above, would also be relevant to other Indigenous First Nations who may have interest in the Project. The details of monitoring and follow-up plans are being developed to support the separate process of Project licensing and permitting. The specific means by which provincial and federal authorities, and Indigenous Nations and communities will be engaged in developing the follow-up and monitoring program, including the information-sharing program, are	No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				environment for Indigenous peoples, the proponent must discuss the residual effects with the Indigenous groups prior to submitting the EIS." These changes may affect the patterns of ILRU during all Project phases including Post Decommissioning.	project. The program(s) could help to monitor changes over time related the potential perceived risk of contamination of the land from Project activities and subsequent effects on the quality of fish, vegetation, and wildlife resources, which in turn could affect the safety of traditional foods and human health, and impacts on culture practices, and overall community well-being that travel to region yearly.	currently under consideration with the Denison project team. It is noted that Section 4.2.1 of the draft EIS provides the variety of ways in which Denison has engaged with Interested Parties to date and it is assumed it would continue to use these means and others that may be identified to fulfil its key corporate principals for developing positive relationships (see draft EIS Section 4.2).	
IR-208	CNSC	Indigenous physical and cultural heritage	Tables 11.1-3, 11.1-4 and 11.1-5 Section 11.1.3.2.6	**Context:** Black bear is listed as a species hunted by several Indigenous nations, including Pinehouse residents. CNSC participated in an in-person engagement with Pinehouse residents in October 2022 and bears eating waste was identified as a concern for hunting and consumption. **Rationale:** Perceived risk of eating animals that are contaminated by hazardous or radiological wastes could deter community members from harvesting animals that are normally part of their traditional diet. Fencing for waste was specified as a deterrent for human trespassers, not animals.	Please specify measures that Denison will take to ensure bears and other animals do not scavenge from waste facilities.	Denison has proposed a number of Project design measures and wildlife-specific mitigation measures that will limit wildlife scavenging activities. Project design measures include waste characterization and segregation, and fencing the domestic and industrial landfills (refer to Section 2.8 Project Design Features and 9.3.5.1 Project Design Measures). Importantly, Denison is proposing to segregate and compost organic wastes on site in a composting system, reducing the volume of material in the landfill generating odours. For the wildlife-specific mitigation measures, refer to Section 9.3.5.2.5 Wildlife Deterrence and Prevention of Wildlife Entrapment and Section 9.3.5.2.8 Waste and Hazardous Materials Management.	No updates to the draft EIS are needed based on this IR response.
IR-209	CNSC	Indigenous Peoples' health / Socio-economic conditions	Section 12.1.4.2.1 (p. 12-22) Section 12.1.5 Section 12.1.6.2	**Context:** KML indicates that working at a mine camp could inhibit community members from participating in cultural activities and sharing them with family and community members, resulting in a loss of cultural knowledge and language, thus impact knowledge transmission (p. 12-22). **Rationale:** Denison addresses this by briefly identifying culturally sensitive policies which would eliminate residual effects (p. 12-30)	Please provide detailed proposed mitigation measure for KML's concerns related to loss of cultural knowledge and language should they work for Denison.	Denison respects the concern raised by KML regarding language and culture related to working at an industrial operation. Denison and KML will be working on specific items of interest to mitigate these types of concerns through private contractual arrangements, which may include specific mitigation and accommodation measures in this respect. Mitigation measures associated with potential effects to cultural continuity (including knowledge transfer and language) are described in Section 12.1.5 and include: - working with Indigenous COIs to understand culturally important periods relative to harvest times and cultural camps to facilitate Indigenous employees taking time off to participate in such activities; - implementation of Denison's Indigenous Peoples Policy and advancement of reconciliation - Using a commuter rotation system has also shown to be effective in allowing Indigenous employees continued opportunities to spend time on the land, and important factor in the transmission of knowledge and language (see Section 11 for a description of potential effects to land use). In discussions with Indigenous Communities of Interest since the filing of the draft EIS, it has become apparent that Denison should add additional commitment / mitigation measure in relation to this area of interest, as follows: - Encouragement to speak languages of choice while at site, except during safety sensitive situations	Section 12.1.5 of the final EIS will be updated to include the additional commitment / mitigation measure in relation to culture and language, as follows: - Encouragement to speak languages of choice while at site, except during safety sensitive situations.
IR-210	CNSC	Current use of lands and resources for traditional purposes	Section 12.1.4.2.2, Potential Effect 2: Change in Traditional Diet, Perceived Suitability of Country Foods (p. 12-26)	**Context:** The EIS states: "Project activities could change the perceived suitability of country foods. An ecological risk assessment (ERA) was conducted to consider both radiological and toxicological risks to ecological receptors such as terrestrial and aquatic invertebrates, terrestrial and aquatic vegetation, fish, and terrestrial and aquatic mammals and birds. Results for the radiological assessment predicted no exceedances of the radiation dose benchmark for the ecological receptors. For non-radiological COPCs, no exceedances were predicted except for selenium in fish from Russell Lake, based on a conversative dietary assumption for one resource user. The traditional foods diet for the fisher/trapper is conservative as it assumes that their annual fish consumption (183 kg of fish per year) would be obtained from Russell Lake, meaning the exceedance of the benchmark for selenium from fish would only occur if fish were only sourced from this one lake. This one exceedance could potentially change the perceived safety of country foods for community members and make country foods a less desirable part of a traditional diet. <u>Experience from other uranium operations in northern Saskatchewan suggests that resource use will continue despite the potential selenium exceedance. An examination of members of the Hatchet Lake Denesųłiné First Nation who live in Wollaston Lake near the Rabbit Lake operation found that over years of being active on the landscape both with and without the presence of the uranium industry, members had developed their own culturally appropriate practice of risk assessment and management based on their relationship with the land. Hatchet Lake Denesųłiné First Nation members appear to be more concerned with the direct effects of uranium mining on the local environment and less concerned about uranium mining's effects on their health through consumption of plants and animals. This is likely due to their high level of confidence in recognizing affected plants and wildlife and avoiding them (Elias et al. 1997).</u> The usage patterns of the ERFN Trapper have similarly allowed for continued use and access to areas proximal to other uranium operations. The ERFN Trapper had a positive relationship with other uranium operations in the ILRU LSA. He also continued to trap (i.e., used his trapline in Fur Block N-18), fish, and opportunistically pick berries, and consumed those resources during operations (KPI Program 2021). Good relationships between Denison and a new trapper who eventually	Given concerns with psycho-social impacts and the influence of perception discussed by ERFN earlier on in the EIS, does Denison have information on the perspectives from Indigenous Nations and communities to validate this conclusion is applicable?	Denison believes that the EIS conclusions are applicable, as evidenced by continued use of Indigenous communities proximal to other uranium sites in northern Saskatchewan, combined with the fact that ERFN, KML, and the YNLR were offered the opportunity to review select sections of EIS prior to its submission to regulators (see Section 4.3.2.1.4 for ERFN; KML declined the invitation to review the EIS in advance of filing; Section 4.3.4.2.4 for the YNLR). Denison acknowledges that not all project impacts can be eliminated in their entirety. Denison continues to work with its Indigenous Communities of Interest with reserves and residential communities most proximal to the Project, Denison has committed to collaborating with English River First Nation and Kineepik Metis Local on a community specific monitoring regime, suited to each of their interests and needs, in an agreed-upon fashion. One of the key goals of such collaboration with each Indigenous nation will be to provide the information necessary to the communities such that it provides confidence to community members regarding the impacts from the Project to the aspects of the environment which matter the most to them. Denison is committed to continual improvement in relation to such collaborative monitoring programs, in order to adapt to areas of interest which can change over time. It is expected that the data collected through such monitoring regimes as described above would also be relevant to other Indigenous nations who may have interest in the Project. See also response to IR-212.	No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				takes over the trapline from the ERFN Trapper would promote continued use." (p. 12-26) **Rationale**: The underlined reference suggests that negative perceptions may not prevent traditional resource users from continuing to consume, due to adaptation to potential risks in the environment.			
IR-211	CNSC	Accidents and Malfunctions	Section 14.6.1, Bounding Scenario 1, Vehicle Accident and Aquatic Release of Radioactivity	**Context:** Scenario 1 describes a spill of uranium concentrate into the lake. It's not clear how the ecological risk assessment was performed. It is stated that sediment concentrations in post-remediation conditions are expected to exceed the benthic invertebrate benchmark and that these results indicate that a spill of uranium concentrate could potentially affect benthic invertebrate populations following a spill, but the spatial extent would be limited. For water, it is stated that when evaluating the potential effect, a comparison was made between the results of the estimated short-term water quality 1,892 µg/L (1.892 mg/kg) and the guideline (33 µg/L). This indicates that there may be some aquatic species that could be affected, but the effects are expected to be transient as the water concertation quickly drops to a long-term level of 0.19 µg/L. However, when looking at dose to other receptors, the results of the ecological risk assessment indicated short-term ingestion of contaminated water resulting from an accident would not result in potential risks to grouse, vole, or deer, however rationale for how these receptors were chosen is not provided. **Rationale:** It's not clear from the EIS, why the receptors grouse, vole, and deer were chosen to evaluate ecological effects from a potential spill, and why they differ from receptors in the ERA. It is also not clear if the pathway from sediment ingestion/contact was considered for semi-aquatic receptors as they could be exposed to the increased concentrations post-spill. It is also not clear if SARA species exposure to sediment and water post-spill was considered.	Please clarify why grouse, vole, and deer were chosen as receptors for the ecological risk assessment performed for accidents and malfunctions scenario 1 and clarify if the sediment pathway to receptors post-spill was considered, as well as if SARA species were considered.	The indicated species were utilized to ensure representation of a variety of both aquatic and terrestrial species that could be affected by the release scenario to ensure relevant potential contaminant pathways were considered in the assessment, understanding however that exposure of local aquatic species was the most direct exposure pathway since Bounding Scenario 1 was a release to the aquatic environment. To clarify, the sediment pathway to receptors post-release was consider in the assessment. Also to clarify, specific SAR were not considered in the assessment; however as noted, representative aquatic and terrestrial receptors were considered that include the exposure pathways to which SAR species would also be subject and therefore the assessment and its results can be more broadly applied.	Based on the response no revisions to the EIS, nor to the A&M technical supporting document (Appendix 14-A) are needed.
IR-212	HC	Human health with respect to hazardous contaminants	Section 14 (p. 14-3) Appendix 16-C (p. 14 & 15)	The follow-up plan does not sufficiently describe how various parties will be engaged in the design, implementation, and review of monitoring programs. **Context:** Section 14 of the EIS states that "The overarching fear of contamination from the mine is woven in to almost every other concern noted by participants in the TK study. It is worth acknowledging this concern separately given the potential for mental health impacts related to people's experiences of fear and anxiety" (p. 14- 3). The commitment regarding monitoring and follow-up activities appears limited to *"shar[ing] information in a transparent manner with the General Public, and specifically those Communities of Interest and Nearby Land Users with whom Denison is regularly engaging about the Project. Such an information-sharing program would consider the involvement of the Regulators to make sure the information available addresses the issues identified as concerns"* (p. 14). **Rationale:** Country food safety is not regulated federally unless foods are sold commercially. Certain aspects of country food safety and availability may be covered by provincial regulators. It is unclear whether and how various levels of government and potentially affected communities would be involved in the development of the follow-up and monitoring program. It is also unclear what the information sharing program entails and how it would inform any adaptive management if monitoring results deviated from the predictions.	1. Provide details of how local, provincial and federal authorities, and Indigenous Nations and communities will be engaged in developing the follow-up and monitoring program, including the information-sharing program. 2. Describe the steps that will be taken if there are any exceedances of established benchmarks or deviation from predictions. **Suggestions for mitigation and follow-up measures**: Health Canada recommends that the proponent's plan for communicating follow-up results (environmental and country foods) aims at, among other things, responding to community concerns regarding country foods to minimize avoidance of this resource. This goes beyond a passive dissemination of information and developing a strategy based on dialogue and the direct involvement of communities in monitoring, surveillance, and risk communication activities.	We refer the reviewer to the following sections of the draft EIS, which are more applicable as it concerns engagement activities within the context of information sharing related to follow-up and monitoring compared to the sections listed in the *Reference to EIS, appendices, or supporting documentation* column of the IR: - Draft EIS Section 1 Project Introduction and Overview. Refer to Section 1.7.5 Licensing and Permitting for text describing that the Project is proceeding through sequential EA and licensing process. While a preview of the permits, approvals, and licences required after the EA process is complete is important to consider and provides valuable context, detailed information needed to support licensing and permitting has not be included in the EIS. - Draft EIS Section 2 Project Description. Section 2.9 outlines the timing and framework for the Project's management system. - Draft EIS Section 4 Engagement. Section 4.2 outlines Denison's engagement approach. Section 4.7 outlines future engagement activities. - Section 11 Land and Resource Use provides a fulsome assessment of both Indigenous (Section 11.1) and other (Section 11.2) land and resource use. These assessments include the Key Indicator of *perceived suitability of lands and resources therein*. 1. The details of monitoring and follow-up plans are being developed to support the separate process of Project licensing and permitting. Engagement on licensing requirements, such as the environmental monitoring program and the associated surface water quality and monitoring regime will occur later in 2023 and into 2024. The specific means by which provincial and federal authorities, and Indigenous Nations and communities will be engaged in developing the follow-up and monitoring program, including the information-sharing program, are currently under consideration with the Denison project team. It is noted that Section 4.2.1 of the draft EIS provides the variety of ways in which Denison has engaged with Interested Parties to date and it is assumed it would continue to use these means and others that may be identified to fulfil its key corporate principals for developing positive relationships (see draft EIS Section 4.2). Denison's plans are in line with Health Canada's recommendations to go beyond passive dissemination of information and the intent is to solicit involvement of the Interested Parties during follow-up program development and subsequently execution. Denison is committed to sharing information with Indigenous Communities of Interest (COIs) in a mutually agreed-upon fashion. Overall, the approach that will be utilized with respect to Indigenous community engagement will be aligned with Denison's Indigenous Peoples Policy. Denison's Indigenous Peoples Policy commits the company to respecting Indigenous knowledge and values regarding environmental stewardship and Indigenous peoples' connection to the land. The relevant monitoring plans for the species/resources that support a traditional diet will reflect and incorporate these values, and will be reflective of the Indigenous COIs priorities. The monitoring plans when drafted will include more detail about	No updates to the draft EIS are needed based on this IR response.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						communication methods and their effectiveness would be assessed through ongoing engagement with communities. Denison will solicit input and involvement in program development and execution from Indigenous COIs. Environmental monitoring results will be presented in an accessible way including a focus on country food if relevant to Indigenous COIs. As the COIs with reserves and residential communities most proximal to the Project, Denison will be collaborating with English River First Nation and Kineepik Metis Local on a community-specific monitoring regime, suited to each of their interests and needs. As part of these programs, Denison and the Indigenous community of ERFN and KML will be sharing information in an agreed-upon fashion. Denison expects that surface water management and monitoring will form part of this information-sharing process. It is expected that fish species that will be monitored will be those species that have been identified as important by ERFN in their 2017 Country Foods Study, as well as using the KML Land and Occupancy Map and associated information. These programs may be adjusted based on community feedback throughout the life of the Project. Regulators will be involved with setting specific requirements for follow-up and monitoring, as well as reporting, through licence conditions (CNSC) and provincial approvals. A number of monitoring and reporting requirements will be generated through the completion of the environmental assessment process. Denison and its lifecycle regulators will be in regular communication throughout the life of the Project as part of routine reporting, site inspections, licence and permit renewals. Denison is committed to ongoing engagement with regulators and recognizes that this will include information sharing related to follow-up and monitoring results and any needed adaptive management plans. It is also noted for further reference that there are existing, non-Denison monitoring programs such as the CNSC's Independent Environmental Monitoring Program (https://nuclearsafety.gc.ca/eng/resources/maps-of-nuclear-facilities/iemp/index.cfm), and the Eastern Athabasca Regional Monitoring Program (www.earmp.ca/). Results from these programs provide relevant information and can complement Denison's Project-specific monitoring program. One forum for discussion of monitoring results is the Northern Saskatchewan Environmental Quality Committee (https://www.saskatchewan.ca/residents/first-nations-citizens/saskatchewan-first-nations-metis-and-northern-initiatives/northern-saskatchewan-environmental-quality-committee). 2. The relevant focus for country food intake are changes in COPC concentrations. These are integrated into the CSA N288.6 framework with ongoing updates to the ERA with new monitoring results. There are very few parameters with intake guidelines where advisories would be implemented. Adaptive management triggers and conceptual triggers will be developed as the Project advances.	
IR-213	CNSC	Accidents and Malfunctions	Section 14.5.3 Appendix 14-A	**Context:** The proponent states that the assessment of accidents and malfunctions began with the initial identification of hazard scenarios. Hazard scenarios were identified using a systematic approach that considered the existence of sources of hazards and initiating events for the Project in consideration of Project activities and components. The hazard identification was conducted to identify a comprehensive list of potential project-related accident and malfunction scenarios associated with the key project components and activities with further details provided in Appendix 14-A. The initial hazards were then screened qualitatively based on likelihood and consequence to determine overall risk level using a risk matrix approach. Bounding scenarios were then selected from this initial list of hazard scenarios. The results of numerical analyses (RESPEC, 2021) of detailed strip model suggest that the deformation imposed on the cemented steel casing from downward movement of the rock mass may exceed the assumed casing-strain yield limits and the failure limit locally after extracting the uranium ore. However, this potential hazard is not identified in the hazard identification. **Rationale:** Exceedance of steel casing yield limits and failure limit would either compromise the steel casing integrity or damage the steel casing and result in the leakage of injected solution, which could impact on mine operation and contaminate the surrounding groundwater.	Please include the hazard of steel casing yield or damage in the table of hazard identification evaluation and conduct an initial risk screening and further detailed assessment as required.	Table 3-2 of Appendix A in the A&M technical supporting document (Appendix 14-A) includes a hazard scenario "piping failure in the well field" that was characterized as a "low" likelihood scenario (Score 2) with "moderate" consequence (score 3) for an overall risk ranking of "low". This scenario is thought to generally be consistent with and cover off the scenario envisioned by the IR; nevertheless, and as recommended a new hazard scenario will be added to the hazard identification evaluation to specifically reflect the FIRT review comment. The new hazard scenario will be added to Table 3-2 in Appendix A of Appendix 14-A as Scenario 2.4 Well Casing Yield and/or Damage (refer to Attachment: IR-213 for the updated table). For reference, and based on hazard screening analysis, this scenario is evaluated to be a low likelihood scenario (2) with moderate consequence (score 3) for an overall risk ranking of low. The scenario is viewed as a low likelihood scenario due to the proposed multilayer design of the injection / recovery well design. Further, and contrary to the comment, we do not believe the RESPEC (2021) analysis shows an increased likelihood of subsidence that could be an initiating event to a pipe casing failure; rather, anything more than very minor ground subsidence in the well field is interpreted as a very low probability event. Potential subsidence and the analysis thereof is discussed in more detail in response to IR-21 and the reviewer is referred to that response for further information. The scenario is viewed as one having moderate consequence. Despite the fact the scenario would result in a temporary loss of control of mining solution associated with one or a limited number of injection/recovery wells the volume of solution would be limited to the volume of solution in the pipe(s) and the release would occur within the freeze wall where it would be contained limiting the spatial extent of effects and increasing the likelihood of success of recovery. Overall, and based on the screening methodology used for the hazard identification / screening process this scenario has been ranked as having a moderate level of risk and as a result would not be passed on for more detailed analyses in the accidents and malfunctions analysis.	Based on the response, revisions to Appendix 14-A and the draft EIS are needed. With respect to Appendix 14-A the following is noted. The new hazard scenario will be added to Table 3-2 in Appendix A of Appendix 14-A as shown in Attachment: IR-213. In addition, editorial changes to the report reflecting the increase of one additional hazard scenario being evaluated will be made (Section 4.0; " ... a total of 69 70 hazard scenarios were identified and evaluated.") and indicating an increase of one further scenario being characterized as having low overall risk (Section 4.0; "The balance of the scenarios evaluated, 41 42, were characterized as low-risk scenarios, ..."). With respect to the EIS, editorial changes will be made in Section 14.5.5 to reflect the editorial changes highlighted above.
IR-214	CNSC	Accidents and Malfunctions	Section 14.5.3 Appendix 14-A, section 3.2.3	**Context:** Hazard scenarios were identified using a systematic approach that considered the existence of sources of hazards and initiating events for the Project in consideration of Project activities and components. Details for how each of these project components and activities are considered in the initial hazard scenario identification process are provided in the accidents and malfunctions TSD (see Appendix 14-A; Ecometrix 2022). However, in Table 3-1 to Table 3-14 in Appendix A of Appendix 14-A, the following inconsistencies were identified: i. consequences for the hazards ID# 1.1, 1.5, 1.7, 14.2 include occupational major injuries; however, the severity (S) is	Please clarify or correct all inconsistent and/or inaccurate information in Tables 3-1 to 3-14 in Appendix A of Appendix 14-A.	The clarifications identified by the review comment will be revised in the final version of the Appendix 14-A as recommended. Revisions to Appendix 14-A that also translate to revisions in the draft EIS will be made for consistency. For reference, the proposed revisions to Appendix 14-A are shown in Attachment IR-214 and include editorial changes to Tables 3-1 to 3-14, as appropriate. The tables are annotated with comments in Attachment IR-214 for transparency. Comments include rationale for likelihood or consequence scoring where requested by the IR. It is noted that the revisions highlighted do not affect the outcome of the screening evaluation and do not necessitate consideration of additional bounding scenarios by way or more detailed analyses.	Based on the response, revisions to Appendix 14-A and the draft EIS are needed. As noted, the clarifications identified by the review comment will be revised in the final version of the Appendix 14-A as recommended. The proposed revisions are shown in Attachment IR-214 and include editorial changes to Tables 3-1 to 3-14, as appropriate. The tables are annotated with comments in Attachment IR-214 for clarity to support IR response review.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				denoted as number 2 that appears to be inconsistent with consequence rating number in Figure 14.5-2 ii. Hazard ID# 1.5 has a L=2, but it is described as a highly unlikely event, which is inconsistent with the term in Figure 14.5-2 iii. Hazards ID# 3.6 and 3.7 have a L=1, but they are described as low probability event that is inconsistent with the term in Figure 14.5-2 iv. Hazards ID# 8.2, 8.3, 9.1, 10.1 to 10.5, 11.1, 11.5 have a L=1, but they are described as unlikely events, which are inconsistent with the term in Figure 14.5-2. Rationale needs to be provided how stockpile erosion is considered to have a L=1 v. Hazard ID# 12.1 has a L=2 and S=3, but it's risk ranking is moderate, which is inconsistent with the term in Figure 14.5-2 vi. Hazard ID# 13.3 has a L=2. Based on the operation experience in the similar projects in the northern Saskatchewan, ponds lining failure and leakage is a very likely event. Rationale needs to be provided to support L=2 or change the number for L. **Rationale:** Inconsistent or inaccurate/incorrect information was included in Accidents and Malfunctions assessment.			Revisions to Appendix 14-A that also translate to revisions in the draft EIS will be made for consistency. Specifically, the revisions identified in the tables will be reflected in changes to the text of Section 14.5.5 of the EIS describing the outcome of the screening process (including revision to Figure 14.5-3). Section 14.5.5 of the EIS will read as follows: "A summary outlining the results of the initial risk screening of accident and malfunction scenarios is provided in this subsection and summarized in Figure 14.5 3. Three of the hazard scenarios characterized as high risk were recommended for further assessment. An additional four moderate/ALARP-moderate scenarios were identified as requiring further detailed assessment for more accurate characterization of risk. Twenty-one of the scenarios evaluated were characterized as moderate-risk scenarios. Generally, the moderate-risk scenarios were deemed to represent a tolerable level of risk in consideration of proposed safeguards and design features that reduce the risk level to ALARP. As previously mentioned, four moderate/ALARP-moderate scenarios require additional detailed assessment for more accurate characterization of risk. The four moderate-risk scenarios that are subsequently assessed in more detail are associated with a contaminant release to the environment, which may have potential effects that are more far reaching than can adequately be assessed by the screening assessment. As such, a more quantitative evaluation was deemed appropriate. The remaining scenarios evaluated (44) were characterized as low-risk scenarios based on low likelihood of occurrence and/or low consequence in consideration of planned existing safeguards and design features. Low-risk scenarios were not carried forward for more detailed analysis as they were considered to be adequately characterized by the screening process.  Figure 14.5-3: Summary – Initial Screening of Accident and Malfunction Scenarios"
IR-215	CNSC	Human health with respect to hazardous contaminants	Section 14.6	**Context:** One of the potential risks of a uranium mine and mill is a spill of untreated effluent. **Rationale:** In the EIS, it doesn't appear that the scenario of a spill of untreated effluent to the environment has been considered. A failure of the piping containing the untreated effluent could result in an uncontrolled release to the environment and could affect the groundwater, soil quality, and terrestrial biota.	Please evaluate and provide the results for a bounding scenario of a spill of untreated effluent or provide justification for its exclusion.	The scenario envisioned in the IR has in fact been considered in the hazard screening process (Appendix 14-A) and based on that process the scenario was not passed on for more detailed analysis as a Bounding Scenario. More specifically, Table 3-12, Appendix 14-A, considers accident and malfunction scenarios associated with the wastewater treatment system, including equipment and piping failures, effluent clarifier overflows and equipment and control system failures. The overall risk ranking associated with these scenarios were ALARP-moderate, ALARP-moderate and low, respectively, in consideration of likelihood and consequence and design safeguards and features (i.e., mitigations). Per the evaluation methodology outlined in Appendix 14-A and EIS Section 14, these scenarios were not carried forward for further detailed assessment as they do not meet the threshold for such detailed analyses.	Based on the response no revisions to the EIS, nor to the A&M technical supporting document (Appendix 14-A) are needed.
IR-216	CNSC	Human Health with respect to radiation exposure	Section 14.6.1 Section 14.6.7 Appendix 14-A	**Context:** Radiological doses to human receptors, including workers (i.e., driver(s) of the vehicles), from the Bounding Scenarios 1 (Vehicle Accident Including Rollover, Collision, Run Off Road) and 7 (Vehicle Accident Including Rollover, Collision, Run Off Road) have not been assessed. **Rationale:** An estimate of the effective doses to human receptors, including workers, are required to determine whether the expected doses meet the dose limits set out in the Radiation Protection Regulations.	Provide estimates (including calculations) of the potential radiological doses to human receptors, including workers, resulting from Bounding Scenarios 1 and 7.	While it is understood that potential radiological doses to human receptors are an important consideration for operations such as that proposed by the Project, issues related to worker health are beyond the scope of the Accident and Malfunctions Assessment (Appendix 14-A), which focuses on environmental receptors. Worker health, including the issue raised by the review comment, will be addressed independently and part of the licensing process as required. This is why chemical toxicity was selected as the basis for the assessment of risk in this case. With specific regard to public risk the following is noted. Radiological risk was not considered an appropriate pathway of exposure in these scenarios since there is little chance of exposure to members of the public. As noted above, chemical toxicity was selected as the basis for the assessment of risk in this case since it is the relevant exposure pathway for these scenarios.	Based on the response no revisions to the EIS, nor to the A&M technical supporting document (Appendix 14-A) are needed.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
IR-217	CNSC	Accidents and Malfunctions	Sections 14.6.1 and 14.6.2	**Context:** Highway 914 crosses the Wheeler River 10 km southwest of the access road junction. A vehicle accident, including a rollover, collision, or run off road, at or near the bridge could potentially result in a release of uranium concentrate and release of fuels and chemicals into the surface water at this location. Denison believes that a release of uranium concentrate and a release of fuels and chemicals at this location would bound the releases at any other water crossing along the transportation corridor. However, no information on what other water crossings along the transportation corridor exist and how bounding scenarios 1 and 2 would bound the risk of releasing uranium concentrate and fuels and chemicals at other crossings. **Rationale:** The release of uranium concentrate and fuels and chemicals at water crossings would contaminate the water body at the crossings and pose a risk to the environment and public health.	Please provide information on all water crossings along the transportation corridor and justification why bounding scenarios 1 and 2 would bound the effects of the accidental releases of uranium concentrate and fuels and chemicals at these crossings.	As recommended by the reviewer a review of water crossings associated with the transportation route have been identified. This information is provided in a technical memorandum that accompanies this IR response/disposition table (please see Attachment IR-217). For reference, the analysis considers Hwy 914 south from the project site to its junction with Hwy 165. Hwy 165 was further considered east to Hwy 2 and west to Hwy 155. The information in the technical memorandum will be added to Appendix 14-A during preparation of the Final EIS. As noted by the reviewer, the potential aquatic environment release scenarios focused on the Wheeler River crossing location. This location was chosen as it represents an important location to resource users in the study area. The scenarios provide examples of the consequences of such releases to local receptors. That is, the results of the assessment of the releases at this location would be expected to be representative of crossings along the transport route since the key endpoint in the assessment is overall risk, as defined for the assessment process as probability multiplied by consequence. For reference, the crossing analysis reference above and presented in the technical memorandum has identified in excess of 100 water crossings along the transportation route as described. It is not practical to assess each of these crossings. While the specific conditions at these crossings may differ in size or nature, the results of the analysis presented can generally be applied more broadly as indicated above. The approach used is consistent with past practice for comparable assessments for uranium projects in the province.	Based on the response, revisions to Appendix 14-A are needed. Specifically, the technical memorandum provided as Attachment IR-217 will be added in its entirety as an appendix (Appendix B) to technical supporting document Appendix 14-A. No changes to the draft EIS would be needed.
IR-218	CNSC	Accidents and Malfunctions	Sections 14.6.1.1 and 14.6.1.4	**Context:** Table 14.6-1 indicates that the average flow of Wheeler River south of Russel Lake is 17,340 L/s or 17.34 m3/s. This rate is used for uranium dissolution rate calculation. However, in section 14.6.1.4, it states that the average annual flow is 24.3 m3/s. In Table 14.6-3, the last two rows appear to be added wrongly. It also states that sediment quality results are shown in Table 14.6-5 for post-remediation conditions. During minimum flow conditions, the affected volume is expected to be smaller, resulting in a higher sediment concentration. In comparison, higher flow conditions are expected to result in a greater footprint and lower concentrations. However, in Table 14.6-5, the average sediments concentration and porewater concentration appear to be incorrect and switched between average flow and maximum flow. **Rationale:** Inconsistent/inaccurate information provided in the EIS.	Please clarify and correct the inconsistent information on average flow rate of Wheeler River at the crossing and incorrect information in Table 14.6-3, and average sediment concentration and porewater concentration under average and maximum flow conditions in Table 14.6-5.	Acknowledged. The transcription errors identified will be corrected in the final EIS as recommended. Refer to Attachment IR-218 for revised Table 14.6-5 and Table 8-5.	Based on the response, revisions to the EIS Appendix 14-A are needed. Specifically, revision to the transcription errors noted will be provided, as follows: <u>Revisions to Section 14:</u> - The last two rows of Table 14.6-3 will be removed. - From Section 14.6.4.1, second to last sentence in first paragraph, "The flow rates considered for this assessment were 5th percentile annual flows of 10.9 m^3/s (minimum flow), the average annual flow of ~~24.3~~ 17.3 m^3/s (average flow), and the 95th percentile annual flow of 24.67 m^3/s (maximum flow)." - Table 14.6-5 to be revised as shown in Attachment IR-218. <u>Revisions to Appendix 14-A:</u> - From Section8.1, second to last sentence in first paragraph, "The rivers flows considered for this assessment are 5th percentile annual flow of 10.9 m^3/s (minimum flow), the average annual flow of 24.3 m3/s (average flow), and the 95th percentile annual flow of 24.67 m^3/s (maximum flow)." - Table 8-5 to be revised shown in Attachment IR-218.
IR-219	CNSC	Accidents and Malfunctions	Sections 14.6.1.1.1 and 14.6.1.4.1; Sections 5.1.1 and 8.1 of Appendix 14-A	**Context:** When assessing the release characterization of Bounding Scenario 1, the proponent assumed that 95% of the released uranium concentrate can be recovered from the release location without sufficient justification, and that different water column depths, i.e., 10 cm and 5 cm, and average water depth of 1.2 m at the release location were used without explanation. **Rationale:** As the recovery rate of the uranium concentrate would have an impact on the assessment of its potential effects, it is necessary to understand how the recovery rate and water level were selected for assessing this bounding scenario.	Provide further rationale for assuming 95% recovery rate and for using different water column depths for uranium concentrate release characterization.	The rationale for the 95% recovery is explored in Section 8.1 of Appendix 14-A where the hypothetical uranium concentrate release is examined. The density of uranium concentrate particles is high (8.3 g/cm3) and settling of these particles in the aquatic environment is expected to be rapid (USDOE 2001). As such the concentrate is not expected to be transported far from the incident/release location. Figure 8-2 from Appendix 14-A shows the modeled distribution of deposited uranium concentrate from the release location under different flow scenarios and is reproduced below for reference. As can be seen in the figure most (>95%) of the mass of the uranium concentrate would settle within a short distance of the release, even under high flow conditions. This indicates that the hypothetical release would be confined to a small area. Given the relatively small area affected it is reasonable to assume that the affected area can be successfully remediated and that there would be a very high level of uranium recovery. For these reasons, it is believed the 95% recovery rate is a reasonable assumption. <u>**Reference**</u> USDOE (United States Department of Energy). 2001. Characteristics of Uranium and Its Compounds. U.S. Department of Energy, Office of Environmental Management, Depleted Uranium Hexafluoride Management Program, Fall 2001. https://web.evs.anl.gov/uranium/pdf/UraniumCharacteristicsFS.PDF	Based on the response no revisions to the EIS, nor to the A&M technical supporting document (Appendix 14-A) are needed.
IR-220	CNSC	Accidents and Malfunctions	Section 14.6.1.1.1 Appendix 14-A, Section 5.1.1	**Context:** The proponent states that based on drum deformations performed in a previous analysis (McSweeney et al. 2004), if a drum experienced a crush force of 100,000 lbs., then the deformation of the drum would cause the lid to detach from the drum. Using this drum failure mechanism, and assuming the drums weigh 450 kg and are arranged four across in the truck, at a speed of 48 km/h, the front 25% of the drums would fail, at 60 km/h to 97 km/h 55% would fail, at 145 km/h 75% would fail, and at ≥193 km/h all would fail. Given that the	Please provide information and/or rationale as to whether drum stacking would impact drum failure at different speeds and confirm whether 55% drum fail for such an accident is still valid.	While the review comment correctly indicates that drum stacking would impact drum failure, Denison will not stack drums for shipment and the analysis has been completed based on that assumption. The assumption is supported given that the trucks that will be used for transport are 26 ft long by 10 ft wide and can accommodate 13 rows of drums with 5 drums per row for 2 ft diameter drums. As noted in the draft EIS and Appendix 14-A it is anticipated that 40 drums would be shipped from the site per day.	Based on the response no revisions to the EIS, nor to the A&M technical supporting document (Appendix 14-A) are needed.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				speed of the truck is likely between 60 km/h to 97 km/h, it was concluded that less than 55% of the drums would fail upon a traffic accident scenario. It is assumed to be 40 drums per shipment, so some stacking or rows of drums should be expected in this scenario. The drums stacked above could be at greater risk of deformation in a traffic accident. It is not clear whether drums stacking was considered in the previous study cited by the proponent and whether less than 55% fail is still an adequate percentage of drum failures in such traffic accident scenarios if drums stacking is needed. **Rationale:** Drum failure percentage will impact the release quantity of uranium in such an accident scenario and then impact the consequence assessment. Therefore, the drum failure should be adequately assessed and supported with sufficient information and justification.		For further reference, the following is also noted with respect to the McSweeney et al. (2004) document on which the drum failure mode is based. The document discusses the most common failure mode of the top of the drum coming off - that is, for the scenario assessed in the A&M evaluation 55% of the drum lids are assumed to fail (come off) at truck speeds between 60 and 97 km/h. Conservatively the analysis assumed that all of the contents of these drums would be released to the environment, though this is not likely to be the case. References: McSweeney, T. I., S. J. Maheras, and S. B. Ross. 2004. Radioactive Materials Transport Accident Analysis. Proceedings of 14th International Symposium on the Packaging and Transportation of Radioactive Materials (PATRAM 2004). Berlin, Germany, September 20–24, 2004. Paper #274.	
IR-221	CNSC	Accidents and Malfunctions	Section 14.6.1.3, Appendix 14-A, Section 7.1	**Context:** It is projected that there would be about 100 drums packaged per mill operating day. One trip per day for 330 days per year is assumed for the probability evaluation. This means 100 drums per trip, which is inconsistent with description in section 14.6.1.1.1 where assuming 40 drums in one shipment per day. **Rationale:** Shipments per day will impact the probability evaluation, and number of drums per trip will impact the release of uranium during an accident.	Please clarify the number of shipments per day and number of drums per shipment that are expected and re-calculate the probability as necessary.	In Section 7.1 of Appendix 14-A and Section 14.6.1.3 its states that there would be approximately 100 drums packaged per mill operating day. This was incorrectly stated in both Appendix 14-A and Section 14 of the draft EIS. As noted elsewhere in Project documentation there will be 40 drums packaged per day and Denison has confirmed this number. The 40 drums per day can be transported in one shipment per day and therefore the calculation of probability that has assumed one trip per day is correct and need not be revised. The text of Appendix 14-A and the EIS will be revised accordingly.	Based on the response, revisions to the EIS Appendix 14-A are needed. Specifically, revision to the number of drums of uranium concentrate that will be package per day (40 and not 100) will be provided. The revision to Appendix 14-A, Section 7.1 would be as follows: "In the case of the accident scenario envisioned, calcined uranium concentrate would be packed into standard 205 L (45 gal) steel drums for shipping. It is projected that there would be about 40 ~~100~~ drums packaged per mill operating day (Wheeler River project description documentation). It was also assumed that a traffic accident on the bridge or within 40 m from either side of the bridge has the potential for release to the Wheeler River. The revision to the Section 14.6.1.3 of the EIS would be as follows: "In the case of the accident scenario envisioned, UOC would be packed into standard 205 L (45 gal) steel drums for shipping. It is projected that there would be approximately 40 ~~100~~ drums packaged per mill operating day (Denison 2019). It was also assumed that a traffic accident on the bridge, or within 40 m of either side of the bridge, would have the potential for release to the Wheeler River."
IR-222	CNSC	Accidents and Malfunctions	Section 14.6.2.4	**Context:** Bounding Scenario 2 consists of the aquatic release of fuel and hazardous chemicals due to traffic accidents. The EIS states that amongst the fuels considered for this scenario, the consequences of the release of gasoline and solvents are bounded by the consequences associated with the release of diesel. Both gasoline and solvents are lighter with higher vapour pressure; therefore, they have a shorter half-life in the aquatic environment and a lesser tendency for adsorption to sediments and suspended solids in the water column. There is no other justification provided to show that the release of diesel can bound other chemicals such as sulfuric acid and sodium hydroxide that are heavier than diesel. **Rationale:** The release of either sulfuric acid or sodium hydroxide during accident could change the water PH significantly at the releasing location, which would post a negative impact on the local environment.	Please provide further justification that the consequences of the release of sulfuric acid and sodium hydroxide can be bounded by the consequences associated with the release of diesel.	Strictly speaking the review comment is correct in that the release of organic chemicals, including fuel does not bound the non-organic chemicals such as acids or bases and this will be clarified for context in the final EIS as well as Appendix 14-A for clarity. The following is noted however and provides rationale the release of fuel (diesel) was carried forward for more detailed analysis. Through the hazard identification process (see Appendix 14-A Section 3.0 and Appendix A), the overall risk of the release of acids and bases was characterized as "moderate" and "ALARP" and as such consistent with the A&M assessment methodology was not carried forward further evaluation. Rather, since the release of organic compounds (such as diesel) would have the potential for downstream transport as a compound in distinct liquid phase from that of the water in the receiving environment. In this sense it produces a greater challenge of potential contamination over a larger spatial extent and timespan than the release of acid, while coincidentally necessitates the need for / opportunity for proactive response and clean-up. In contrast, the released acids and bases dissolve in water relatively quickly and effects to local biota can be expected to be experienced on a more local basis and over a shorter timeframe. There is little likely mitigation that can be applied in that scenario and therefore, the risk mitigation measures are limited to those that prevent accidents or reduce the probability to ALARP as mentioned in the draft EIS and Appendix 14-A.	Based on the response, revisions to the EIS Appendix 14-A are needed. Specifically, clarity around the choice to carry the diesel releases as opposed to the release of acid will be provided. The following will be added to Section 8.2 of Appendix 14-A, *"For the purpose of assessing the potential effects on the aquatic environment from a release of fuels and hazardous chemicals, as described in Section 5.2, the release of diesel fuel was chosen as a representative scenario, rather than other chemical such as acids and bases. Through the hazard identification screening process (see Appendix A), the overall risk of the release of acids and bases was characterized as "moderate" and "ALARP" and as such consistent with the scenario screening assessment methodology was not carried forward further evaluation. Rather, since the release of organic compounds (such as diesel) would have the potential for downstream transport as a compound in distinct liquid phase from that of the water in the receiving environment. In this sense it produces a greater challenge of potential contamination over a larger spatial extent and timespan than the release of acid, while coincidentally necessitates the need for / opportunity for proactive response and clean-up. In contrast, the released acids and bases dissolve in water relatively quickly and effects to local biota can be expected to be experienced on a more local basis and over a shorter timeframe. There is little likely mitigation that can be applied in that scenario and therefore, the risk mitigation measures are limited to those that prevent accidents or reduce the probability to ALARP."*
IR-223	CNSC	Accidents and Malfunctions	Section 14.6.4.1	**Context:** The EIS states that the 3D strip numerical model predicted that stresses and displacements did not show instability in the altered	Please provide information on the stresses and displacements/deformation of the area northeast of the	Additional conservative modelling scenarios were run which determined that for altered sandstone properties, both ore zone and immediately surrounding rock is marginally stable	No updates to the EIS in response to this IR.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
			Appendix 7-A, Appendix K	sandstone or basement rock at the location where a freeze wall would be placed around the Phoenix Deposit boundary (RESPEC 2021). The potential damage to the freeze wall due to mine-induced stresses and displacements under this scenario is excluded. **Rationale:** One outer section of the freeze wall (i.e., north-east freeze wall of the phase 4 mining area) and some internal cross walls are located in the desilicified zone. The RESPEC 2021 report (i.e., Appendix K of Appendix 7-A) appears not to have included the desilicified zone in the geomechnical modeling, nor is provided the stresses and the displacements/deformation of the area northeast of the phase 4 ore body where a significant extent of the desilicified zone exists.	phase 4 ore body from the geomechanical studies to demonstrate the resulted stresses and displacements will not impact on the freeze wall integrity after IRs for geomechanical studies for ore extraction are addressed. **Technical Discussion Required**: Yes	(1.0 < factor of safety [FS] < 1.25), and no-failure conditions are apparent (RESPEC 2023; included here as Attachment: IR-21). The predicted surface displacement is negligible at approximately 2.4 to 2.8 mm. For desilicified sandstone properties, failure conditions are predicted in 12.6 % of the modeled desilicified sandstone volume, which is located within 20 – 35 meters of the ore zone. The updated results are considered negligible by the author. Notable observations from modelling include that based upon the geological model of the Phoenix deposit, the volume of the desilicified sandstone is approximately 4% of the volume of altered sandstone. Approximately 0.05% volume of altered sandstone is desilicified sandstone that is located immediately above the low-grade ore zone. Freeze walls, when fully developed, are capable of withstanding significant external pressures because the ice in the pore voids greatly improves the bulk strength of the soil. For example, in the province of Saskatchewan ground freezing is used to support the sinking of deep potash mine shafts which must penetrate through the Mannville formation at a depth between 400 and 500 m below surface. The Mannville formation is often described as saturated, unconsolidated beach sand and it would not support shaft excavation in a thawed state. Freezing is used to create a structural and impermeable wall up to 5m thick which can resist a stress gradient driven by full hydrostatic and/or lithostatic pressures on the outside of the wall, and an open to atmosphere excavation within the shaft. This loading condition is much more extreme than any condition the freeze walls at the Phoenix deposit will experience because there is no mechanism in the ISR process to create a zero stress "atmospheric" state on the ore side of the freeze wall. While freeze walls are very strong when fully developed, they are also plastic in nature. This means that they can slowly deform without failing in response to localized ground deformations. As the freeze wall deforms towards a lower stress zone, it maintains its thickness and integrity. While the above example referred to potash shafts, other examples can be drawn from the experience at the McArthur River or Cigar Lake uranium mines. NGI is very familiar with both projects as the author of this memorandum was the responsible engineer for the initial freeze designs and oversight at both mines. At McArthur River, open stopes are generated directly adjacent to a freeze wall that is a nominal 4 m thick. At Cigar Lake, open mine cavities 10 m high and several meters in diameter commonly exist within the frozen ground. Neither site has had a breach of the freeze wall during mining activity. Given that the freeze wall at Denison will be much thicker than at McArthur River and that it is located up to 25 m from the ore zone, it is not anticipated that it will be exposed to a stress environment that will put it at risk.	
IR-224	CNSC	Human Health with respect to radiation exposure	Section 14.6.5.4 Appendix 14-A	**Context:** For the Bounding Scenario 5 (Process System and Piping Failure), doses to receptors at distances of 100 and 500 metres (0.25 and 0.01 mSv respectively) are predicted. The assessment also indicated that the dose to the unprotected worker staying inside the processing plant during the spill could exceed the 50 mSv dose limit specified by CNSC if workers did not leave the area quickly after the spill. The proponent did not provide the dose calculations for deriving the dose estimates. **Rationale:** The method used to estimate effective, equivalent, and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data.	Provide the dose calculations for deriving the dose estimates for workers and members of the public for Bounding Scenario 5 (Process System and Piping Failure).	As noted in Appendix 14-A (see Section 5.5, 8.5) and the draft EIS (see Section 14.6.5) the dose calculations presented for Bounding Scenario 5 are based on scenarios presented in the US Nuclear Regulatory Commission (NRC) issued Generic Environmental Impact Statement (GEIS) for In-Situ Leach Uranium Milling Facilities (US NRC 2009). In the GEIS, the potential environmental effects from the postulated accidents involving the operation of in situ recovery facilities located in four geographic regions of the western United States were assessed. One of the scenarios assessed involved the release of radon from failed or leaked thickener. The assessment assumed 20% of the contents of the thickener was released inside the processing building (US NRC 2009). Typical radon concentrations in circulating lixiviant range from 300 to 7,000 Bq/L (Brown 2008). The GEIS used a concentration of approximately 4,000 Bq/L for its assessment and this is in the range of activity of radon that is expected in lixiviant before entering the processing building. For transparency, a hyperlink to the US NRC document is as follows: https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1910/index.html The reviewer is directed to Chapter 4, Section 4.2.11.2.2 Radiological Impacts to Public and Occupational Health and Safety From Accidents for further reference. References Brown, S. 2008. The New Generation of Uranium in Situ Recovery Facilities: Design Improvements Should Reduce Radiological Impacts Relative to First Generation Uranium Solution Mining Plants, WM 08 Conference, February 25 – March 1, 2008, Phoenix, AZ Abstract #8414. US NRC (Unite States Nuclear Regulatory Commission). 2009. Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities. Final Report. NUREG-1910, Vol. 1	Based on the response no revisions to the EIS, nor to the A&M technical supporting document (Appendix 14-A) are needed. As noted, a hyperlink to the US NRC document is as follows: https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1910/index.html and the reviewer is directed to Chapter 4, Section 4.2.11.2.2 Radiological Impacts to Public and Occupational Health and Safety From Accidents for further reference.
IR-225	CNSC	Human Health with respect to radiation exposure	Section 14.6.5.4 Appendix 14-A	**Context:** With the Bounding Scenario 5 (Process System and Piping Failure), the proponent states that Denison ensures that the process is designed to include control measures to reduce the exposure to both workers and members of the public as low as achievable. The measures would ensure that the processing plant is adequately ventilated, and that spills or leaks are detected by loss of system pressure, observation, or flow imbalance. It is not indicated where these additional measures have been detailed/elaborated within the EIS. **Rationale:** Control measures to reduce the exposure to both workers and members of the public as low as achievable, that are identified in the assessment of Bounding Scenario 5, must be formally documented to ensure that they are carried over into the engineered design of the processing plant.	Provide details on how the control measures to reduce the exposure to both workers and members of the public, identified in the assessment of Bounding Scenario 5, have been formally documented and incorporated in the engineered design of the processing facility.	As highlighted in the hazard identification section of the A&M technical supporting document (Appendix 14-A) the control measures to reduce exposure to workers and the public in relation to Bounding Scenario 5 include: • Development and implementation of the Occupational Health and Safety Program, including specific plans, procedures and PPE that would protect workers, in particular from the exposures envisioned by Bounding Scenario 5. • Development and implementation of the Emergency Response Plan which includes the procedures for the chemical spill emergencies. • Personnel training and orientation for related to spill response and management • Inspection and maintenance of the equipment and process components to ensure their integrity and reliability. This will aim to lower the probability of such events. • Building ventilation to maintain the workplace air quality. • Ambient air monitoring for post-accident assessment. Where programs, plans and procedures are referenced above, such documentation is in the process of being developed as part of Project-related licensing and would be available for review and acceptance by the CNSC as part of that process. In addition to the control measures noted above, the design criteria considered for the EA included • Equipment Shielding • Reducing time near facilities • Increasing distance in elevate zones	Based on the response no revisions to the EIS, nor to the A&M technical supporting document (Appendix 14-A) are needed.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						• Control systems with safe shut down interlock Denison has recently completed feasibility designs for the Project in 2023 and has incorporated design for safety principles (DFS), including: **Eliminate** – Remove hazardous materials, processes and activities. **Minimize** – Use smaller quantities of hazardous substances, minimize the number of hazardous activities or process / equipment items. **Substitute** – Replace a hazardous material with one that is less hazardous, substitute a hazardous activity for one that is less hazardous. **Moderate** – Minimize the impact of a release of hazardous material or energy, by changing the layout, adopting less hazardous operating conditions or a less hazardous form of a material, facilities, or by reducing the number of people exposed. **Simplify** – Design facilities to eliminate unnecessary complexity, thus minimizing causes of hazards and human errors. While DFS is often applied to process design and process safety hazards, it can be applied to design in general and in areas other than design. Examples of DSF principles include: • manning philosophies – minimize the number of staff required for operations and maintenance, during construction, installation and hook-up and/or commissioning • process design – maximize simplicity of plant, maximize use of technology and equipment that is environmentally friendly, minimize hydrocarbon inventories, moderate operating conditions, minimize leak potential, maximize integrity of containment envelope from internal to external in-design effects and accidental loads. Detailed design to support Project licensing and permitting will begin later in the year. Any engineering design control measures identified in Bounding Scenario 5 will be included in the detailed design and will be provided for acceptance by the CNSC during Project licensing.	
IR-226	CNSC	Accidents and Malfunctions	Sections 14.6.6.1 and 14.6.6.4	**Context:** It is stated that in the case of the accident and for a release amount of 1 kg inside the processing plant, the dose to offsite receptors at 200 m from the project site was calculated to be less than the CNSC public dose limit of 1 mSv. The analysis also indicated that the dose to a worker in a full-face-piece powered air-purifying respirator who stays in the area would be 88 mSv, which exceeds the annual worker dose limit of 50 mSv. **Rationale:** Section 14.6.6.1 indicates that 2 kg of uranium concentrate could be released in case of the accident. No rationale is provided why 1 kg rather than 2 kg uranium concentrate is used for dose calculation. If 2 kg is used as the source term, the dose to offsite receptors at 200m and workers in the area would be higher.	Please provide the rationale for using a source term of 1 kg rather than 2 kg of uranium concentrate for the dose calculation to offsite receptors and workers. If sufficient rationale cannot be provided, the doses to offsite receptors and workers should be recalculated using 2 kg uranium concentrate, and the results provide.	The rationale for the 1 kg source term is provided in Section 5.6 of Appendix 14-A. The 2 kg source term was calculated but as noted was thought to be an overly conservative value based on the conservatism layered upon conservatism. The professional decision was made to use the source term of 1 kg consistent with the referenced 2009 US NRC study as a more realistic but still conservative value.	Based on the response no revisions to the EIS, nor to the A&M technical supporting document (Appendix 14-A) are needed.
IR-227	CNSC	Accidents and Malfunctions	Section 14.6.6.1.1	**Context:** Bounding Scenario 6 involves a fire and/or explosion within the processing plant, resulting in the release of a large amount uranium to the atmosphere. The airborne source term for this scenario is estimated with equation developed by the United States Department of Energy (USDOE), where the respirable faction is assumed to only include particles of 10 mm and smaller. **Rationale:** No rationale was provided to support the consideration of only 10 mm and smaller particles. As provided in Table 14.6-3, the particle size of uranium <15 mm is less than 20%. Majority of the uranium particle size is larger than 10 mm. The airborne source term is an important factor for the effects assessment and should be calculated with transparent and justified information/data.	Provide rationale for only considering 10 mm and smaller particles for the respirable fraction.	Note that the assessment in Appendix 14-A assumed a particle size of 10 µm, not 10 mm as stated by the reviewer. As noted in Appendix 14-A (Section 5.6) a 10 micron diameter particle size (or smaller) is a commonly assumed size fraction as a respirable/inhalable particle and is referenced by various organizations as such US EPA (see https://www.epa.gov/pm-pollution/particulate-matter-pm-basics). Uranium particles emitted from the fire would be secondary particles or aerosols that are formed during the fire. In most cases these aerosols are sub-micron in size. In consideration of this, the 10 micron diameter assumption is conservative assumption since it essentially contemplates that that all the particles are therefore respirable. Moreover, as noted in Section 5.6 of Appendix 14-A the value "1" has been used for the respirable fraction (RF) to develop the exposure source term. This again is conservative because it assumes that all the uranium content formed as particles are respirable.	Based on the response no revisions to the EIS, nor to the A&M technical supporting document (Appendix 14-A) are needed.
IR-228	CNSC	Human Health with respect to radiation exposure	Section 14.6.6.4 Appendix 14-A	**Context:** For the Bounding Scenario 6 (Facility Fire and/or Explosion), the predicted dose is less than 1 mSv to a member of the public 200 metres away from the project site. The analysis also indicated that the dose to a worker in a full-face powered air-purifying respirator who stays in the area would be 88 mSv, which exceeds the annual worker dose limit of 50 mSv. The proponent did not provide the dose calculations for deriving the dose estimates. **Rationale:** The method used to estimate effective, equivalent, and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data.	Provide the dose calculations for deriving the dose estimates for workers and members of the public for Bounding Scenario 6 (Facility Fire and/or Explosion).	As noted in Appendix 14-A (see Section 5.6, 8.6) and the draft EIS (see Section 14.6.6) the dose calculations presented for Bounding Scenario 6 are based on scenarios presented in the US Nuclear Regulatory Commission (NRC) issued Generic Environmental Impact Statement (GEIS) for In-Situ Leach Uranium Milling Facilities (US NRC 2009) and the dose calculations are presented therein. In the GEIS, the potential environmental effects from the postulated accidents involving the operation of in situ recovery facilities located in four geographic regions of the western United States were assessed. One of the scenarios assessed involved the release of yellow cake inside the processing plant due to an explosion in the dryer. The scenario considered a release of 1 kg and conservatively assumed the fraction respirable was 100 percent. For transparency, and details related to the analysis, a hyperlink to the US NRC document is as follows: https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1910/index.html The reviewer is directed to Chapter 4, Section 4.2.11.2.2 Radiological Impacts to Public and Occupational Health and Safety From Accidents for further reference. References Brown, S. 2008. The New Generation of Uranium in Situ Recovery Facilities: Design Improvements Should Reduce Radiological Impacts Relative to First Generation Uranium Solution Mining Plants, WM 08 Conference, February 25 – March 1, 2008, Phoenix, AZ Abstract #8414. US NRC (Unite States Nuclear Regulatory Commission). 2009. Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities. Final Report. NUREG-1910, Vol. 1	Based on the response no revisions to the EIS, nor to the A&M technical supporting document (Appendix 14-A) are needed. As noted, a hyperlink to the US NRC document is as follows: https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1910/index.html and the reviewer is directed to Chapter 4, Section 4.2.11.2.2 Radiological Impacts to Public and Occupational Health and Safety From Accidents for further reference.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
IR-229	CNSC	Human Health with respect to radiation exposure	Section 14.6.6.4 Appendix 14-A	**Context:** With the Bounding Scenario 6 (Facility Fire and/or Explosion), the proponent states that Denison would ensure that the design of the plant includes control measures to reduce the exposure to both workers and members of the public to levels that are as low as achievable. The measures would ensure that the processing plant is adequately ventilated. It is not indicated where these additional measures have been detailed/elaborated within the EIS. **Rationale:** Control measures to reduce the exposure to both workers and members of the public as low as achievable, that are identified in the assessment of Bounding Scenario 6, must be formally documented to ensure that they are carried over into the engineered design of the processing plant.	Provide details on how the control measures to reduce the exposure to both workers and members of the public, identified in the assessment of Bounding Scenario 6, have been formally documented and incorporated in the engineered design of the processing facility.	As highlighted in the hazard identification section of the A&M technical supporting document (Appendix 14-A) the control measures to reduce exposure to workers and the public in relation to Bounding Scenario 6 include: • Development and implementation of the Occupational Health and Safety Program, including specific plans, procedures and PPE that would protect workers, in particular from the exposures envisioned by Bounding Scenario 6. • Development and implementation of the Emergency Response Plan which includes the procedures for fire and explosion related emergencies. • Personnel training and orientation for related to spill response and management • Inspection and maintenance of the equipment and process components to ensure their integrity and reliability. This will aim to lower the probability of such events. • Fire safety plan and firefighting systems to ensure fire safety and effective fire fighting system to ensure the damage from the fire is limited. • Ambient air monitoring for post-accident assessment. Where programs, plans and procedures are referenced above such documentation is in the process of being developed as part of project-related licensing and would be available for review and consideration as part of that process. In addition to the control measures noted above, the design criteria considered for the EA included • Equipment Shielding • Reducing time near facilities • Increasing distance in elevate zones • Control systems with safe shut down interlock Denison has recently completed feasibility designs for the Project in 2023 and has incorporated design for safety principles (DFS), including: **Eliminate** – Remove hazardous materials, processes and activities. **Minimize** – Use smaller quantities of hazardous substances, minimize the number of hazardous activities or process / equipment items. **Substitute** – Replace a hazardous material with one that is less hazardous, substitute a hazardous activity for one that is less hazardous. **Moderate** – Minimize the impact of a release of hazardous material or energy, by changing the layout, adopting less hazardous operating conditions or a less hazardous form of a material, facilities, or by reducing the number of people exposed. **Simplify** – Design facilities to eliminate unnecessary complexity, thus minimizing causes of hazards and human errors. While DFS is often applied to process design and process safety hazards, it can be applied to design in general and in areas other than design. Examples of DSF principles include: • manning philosophies – minimize the number of staff required for operations and maintenance, during construction, installation and hook-up and/or commissioning • process design – maximize simplicity of plant, maximize use of technology and equipment that is environmentally friendly, minimize hydrocarbon inventories, moderate operating conditions, minimize leak potential, maximize integrity of containment envelope from internal to external in-design effects and accidental loads. Detailed design to support Project licensing and permitting will begin later in the year. Any engineering design control measures identified in Bounding Scenario 5 will be included in the detailed design and will be provided for acceptance by the CNSC during Project licensing. Denison is completing feasibility designs for the Project in 2023. Detailed design to support Project licensing and permitting will begin later in the year. Any engineering design control measures identified in Bounding Scenario 6 such as ventilation will be included in the detailed design and will be provided to the CNSC during Project licensing.	Based on the response no revisions to the EIS, nor to the A&M technical supporting document (Appendix 14-A) are needed.
IR-230	CNSC	Accidents and Malfunctions	Section 14.6.7.4	**Context:** It is stated that a conservative penetration time of 15 min was applied in the assessment. Based on this assumption, the maximum depth of contamination could be 90 cm (for penetration rate of 0.1 cm/s). It is not clear why the penetration time of 15 minutes is considered conservative as the penetration time would depend on the time needed for the emergency response team to respond. It is also stated that the wide range of the calculated velocities is a result of variation of soil conditions and the slope of the surface. The distance that the groundwater can travel under these extreme (i.e., conservative) conditions ranges from 0.15 m to 100 m. It is not clear how the groundwater travel distance of 0.15m and 100m is calculated. **Rationale:** The penetration time will influence the penetration depth of the released materials, which in turn, considering the groundwater travel distance, will impact the potential areas and volumes of contaminated soils and shallow groundwater.	Please provide justification for applying 15 minutes of penetration time, and why it is considered conservative. In addition, please provide information on how the groundwater travel distance of 0.15 m and 100 m was obtained.	The calculations showed that the release of 30 m^3 partially saturates soil to the depths less than 1 m. Contamination deeper than 1 m is not expected due to released diesel availability and volume. If the penetration rate is slower than what was used in calculations, the released hydrocarbon would stay on the surface and the depth of contamination would be less. Therefore, 15 minutes is a conservative assumption that produces the maximum depth of contamination for the volume of hydrocarbon released. Eventually the depth of the contamination is more dependent on the volume of release than the time of the penetration. If the penetration is faster, the contamination would occur faster but would be limited by volume so would not penetrate deeper. With respect to the groundwater travel distance the distances provided in the Section 14.6.7.4 of the draft EIS the following are noted. The values provided are the upper and lower bound values associated calculated from the range of input parameters in the report. The calculations are based on the attenuation / degradation of diesel at the release site which is expected to occur within 75 days (Berry and Burton, 1997; Ledezma-Villanueva et al., 2015). In review of the text of Section 14.6.7.4 in preparation of this response a typo was noted and therefore to address the typo and provide some further clarity with respect to the groundwater travel distance the following revision will be made. The third from the last paragraph of Section 14.6.7.4 will be changed as follows (proposed ne text in bolded for reference): *"The wide range of the calculated velocities is a result of variation of soil conditions and the slope of the surface.* ***Studies by Ledezma-Villanueva et al. (2015) and Berry and Burton (1997) show that residual contamination in soil and groundwater is degraded within 75***	Based on the response, revisions to the EIS Appendix 14-A are needed. Section 14.6.7.4 in the EIS would be revised per the IR response. A similar revision would be made to Appendix 14-A.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
						days. *The distance that the groundwater can travel under these extreme (i.e., conservative) conditions ranges from ~~0.15 m~~ 0.03 m to 100 m.* ***• Dmax = 1.5 × 10-5 m/s x 75 days x 24 x 3600 ~ 100 m*** ***•Dmin = 4.4 × 10-9 m/s x 75 days x 24 x 3600 ~ 0.03 m*** ***As highlighted by the calculation,*** *~~D~~during this time period, no major migration of groundwater is expected. Thus, the contamination of soil and shallow groundwater is expected to be limited to a small area near the release location,* ***given that release site remediation would occur well within the 75 day window****."* References Berry, K.A.T. and D/L. Burton. 1997. Natural attenuation of diesel fuel in heavy clay soil. Can. J. Soil. Sci. 77: 469–477. Ledezma-Villanueva, A. J. M. Adame-Rodríguez, I.A. O'Connor-Sánchez, J.F. Villarreal-Chiu and E.T. Aréchiga-Carvajal. Biodegradation kinetic rates of diesel-contaminated sandy soil samples by two different microbial consortia. Ann. Microbiol. (2016) 66:197–206.	
IR-231	CNSC	Accidents and Malfunctions	Sections 14.6.6.4 and 14.6.6.5	**Context:** The EIS states that in the unlikely event of an unmitigated accidental release of uranium due to a dryer explosion, doses to the workers are expected to have a moderate effect, while doses to members of the public are expected to have a minor effect. Based on this evaluation, the severity of the consequences of this accident and malfunction scenario is predicted to be moderate. In consideration of both probability and consequences, the overall risk related to Bounding Scenario 6 is predicted to be low. **Rationale:** When there is an explosion within the process plant, it is likely there will have worker fatality. The severity of the consequences of an explosion would be catastrophic and the risk of Bounding Scenario 6 would be higher.	Please re-evaluate the consequence and the risk of Bounding Scenario 6 by considering the potential worker fatality resulted from an explosion.	There was no attempt to minimize the consequence of the explosion scenario with respect to a potential fatality of a worker in the draft EIS. The hazard screening evaluation for this scenario that was presented in Appendix 14-A did acknowledge worker fatality as a potential consequence on an explosion; however, the more detailed evaluation of the scenario as presented in Bounding Scenario 6 focused on the release, for which we believe the consequence ratings were appropriate. Protections afforded to workers are assumed to be ALARP and therefore from this perspective there is no further analysis specific to a potential worker fatality that could be considered further within the assessment. It is acknowledged that the text could have been more explicit as to the above and additional text will be added to the text of the EIS and to Appendix 14-A.	Based on the response, revisions to the EIS Appendix 14-A are needed. Specifically, clarity around the decision to carry the exposure scenario forward for further analysis, rather than the potential fatality aspect of the explosion will be provided. The following text will be added to Section 5.6 of Appendix 14-A, "*For reference it is acknowledged that this accident scenario could result in significant worker injuries and/ore fatalities and therefore this the reason that it was rated as "catastrophic" from a consequence perspective in the hazard identification screening evaluation (see Appendix A). The more detailed evaluation of the scenario as presented herein as Bounding Scenario 6 focuses on the release of uranium to the atmosphere. Protections afforded to workers in the processing plant are assumed to be ALARP and therefore from this perspective there is no further analysis specific to a potential worker fatality that could be considered further within the assessment."*
IR-232	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 14-A, Table 3-7, ID# 7.1 Appendix 14-A, Table 5-5	**Context:** The Proponent indicates in Appendix 14-A, Table 3-7 that a release of sulfuric acid is a low consequence event therefore would not require further assessment. However, according to a Safety Datasheet on high concentrated sulfuric acid (ICSC 0362 - SULFURIC ACID, concentrated (> 51% and < 100%) (ilo.org)), the substance is incompatible with certain materials and can give off toxic fumes. Furthermore, it reacts with various metals to produce hydrogen gas, which is explosive. The Proponent provides estimates of chemicals, including sulfuric acid, to be transported to site in Appendix 14-A, Table 5-5. The annual consumption of sulfuric acid is estimated at 15,417 m3, in 617 trucks per year, but the concentration is not stated. **Rationale**: Given the high reactivity and inherent corrosive nature of sulfuric acid combined with the volume and concentration that may be stored on site, ECCC requests that the Proponent provide a detailed risk assessment related to a terrestrial spill of sulfuric acid, specifically at the processing plant.	1. Provide the volume and the concentration of sulfuric acid that will be stored on site. 2. Provide a detailed risk assessment of the fate and behavior of sulfuric acid during a release into the environment.	In response to Question 1 the following is noted. It is expected that a maximum of 143 m^3 of 93% sulfuric acid will be stored on site at any given time. Per Section 2.2.7.6.3 of the draft EIS, bulk storage tanks for chemicals that will be used for mining, processing, and water treatment, including sulfuric acid, will be located inside the processing plant, in a separate contained space away from the processing equipment. The storage tanks will sit inside appropriately designed and sized concrete secondary containment basins. The secondary containment basin for each applicable chemical system will be physically separated from the containment basins for other chemical systems. In response to Question 2 the following is provided. We do not feel a detailed risk assessment of the fate and behaviour of a sulfuric acid release to the environment is warranted at this time. The A&M assessment has considered the transport and use on site of sulfuric acid and in neither case did the screening assessment conclude that additional more detailed assessment was needed. As noted in response to IR 222, through the hazard identification process (see Appendix 14-A Section 3.0 and Appendix A), the overall risk of the release of acids and bases was characterized as "moderate" and "ALARP" and as such consistent with the A&M assessment methodology that scenario was not carried forward further evaluation. It was reasoned that released acids and bases dissolve in water relatively quickly and effects to local biota can be expected to be experienced on a more local basis and over a shorter timeframe. There is little likely mitigation that can be applied in that scenario and therefore, and the risk mitigation measures are limited to those that prevent accidents or reduce the probability to ALARP as mentioned in the draft EIS and Appendix 14-A. As noted above sulfuric acid will be stored in a dedicated area with secondary containment provided. There is no pathway from storage to the environment on which to assess risk and therefore consideration of such risks are not warranted. The hazard identification process considered use of sulfuric on site and its release in the process plant through a piping failure and concluded a low overall risk. It was specifically considered a low consequence event because the release would be contained in the process plant and there was no plausible pathway for the acid to the environment outside the plant. Overall, the risks of transport, storage and use sulfuric acid are well understood and characterized, and risks from sulfuric acid resulting from the Project to workers and the environment will be mitigated to ALARP.	Based on the response no revisions to the EIS, nor to the A&M technical document (Appendix 14-A) are needed.
IR-233	HC	Human health with respect to hazardous contaminants	Appendix 14-A, Section 8.7 (p. 8.10)	An effects assessment for a transportation accident scenario involving radioactive materials was not included. **Context:** The proponent provided an effects assessment relating to a diesel spill on the ground (Section 14 Appendix 14-A, Section 8.7). However, no information was provided regarding the potential human health effects of a uranium concentrate release at the two locations considered (Section 14 Appendix 14-A p. 8.10).	1. Assess and describe the potential health effects (chemical and radiological) of a transportation accident involving a uranium concentrate spill at the following locations: a) km 160 of Hwy 914, which is the location of a cultural camp that has been established by the ERFN. b) km 67 of Hwy 914, which is a gathering location for the Kineepik Métis Local associated with the Northern Village of Pinehouse.	Such a release as envisioned by the Information Request was considered in the A&M assessment (Appendix 14-A) and summarized in the draft EIS. The assessment focused generically on hazardous chemicals and utilized the release of diesel fuel to ground as a means to describe the potential spatial extent of effects and resulting consequences. A release of uranium concentrate to ground as the result of a transportation accident was not directly quantitatively evaluated for two primary reasons. Firstly, given the relative importance of such an event it is assumed that containment and removal would be high priorities within the emergency response and spill response plans. Response and isolation of	Based on the response no revisions to the EIS, nor to the A&M technical document (Appendix 14-A) are needed.

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				Rationale: An accident involving radioactive material may have an impact on human receptors, based on the proximity of receptors and the proposed response protocols.	c) All other potential sites of importance for the public and Indigenous peoples.	the material is expected to be rapid, and clean-up is expected to be timely, efficient and complete. Secondly, the spatial extent of effects is expected to be small in size and essentially limited to the immediate vicinity of the accident location given the small size of the gamma field that would be associated with the uranium concentrate. In these regards exposure to members of the public is expected to be mitigated and based on the A&M assessment methodology did not warrant consideration from a detailed perspective beyond initial screening. As noted in the review comment, the release to ground accident scenario focused on the two locations of interest along Hwy 914. The locations were developed with the Denison team and reflected the result of and input from Denison's Interested Party engagement activities. These locations can serve more broadly to represent release to ground scenarios at additional locations along the transportation corridor. Since the outcomes of the accident scenarios are specifically tied to conditions at the release location as the are to the nature of the release it would not be practical to conduct such an assessment at all points of interest as suggested by the review comment. The use of representative locations, such as was done in the current A&M assessment, is consistent with past practice on similar project proposals.	
IR-234	CNSC	Effect of Environment	Section 15.2.2	**Context:** Effects of seismic events on the uranium extraction and post decommissioning are not assessed. **Rationale:** Seismic events could further exacerbate the stability of the voids induced by the uranium extraction, which will result in extra stresses and displacements/deformation in the overlying rock formations. These extra stresses and displacements/deformation could impact on the mine operation and post decommissioning groundwater flow and contaminant transport.	Please provide an assessment of seismic events on the mine-induced voids stability and the resulted effects on the mine operation and post decommissioning. **Technical Discussion Required**: Yes	See response to IR-64 that concerns potential for ground subsidence. To clarify, the portion of the deposit being mined is never truly a void and what remains will be a honeycomb texture with water filled interstices. The mined area is filled with a fluid at all times, whether it be a mining solution, groundwater, or the neutralizing solution. This is different from a more traditional underground operation such as Cigar Lake where there is physical excavation of the orebody, leaving a temporary air-filled space. Although the uranium ore is high-grade by global standards it is not entirely massive in nature. As such, the uranium will be leached in a 'honeycomb' texture leaving behind a structure of partial intact rock mass with the remaining area being filled by fluid. This retains the pressure balance of the mining zone with the adjacent water-saturated rock masses.	No EIS updates are anticipated to address this IR.
IR-235	ECCC	Fish and fish habitat	Section 15.5.2, Expected Environmental Conditions	**Context:** In this section it is stated that: "Table 15.5-1 and Table 15.5-2 summarize the predicted mean values of the climate variables for the Tomblin Lake regional grid unit, following the RPC4.5 and RCP8.5 scenarios, respectively, as indicated by the Climate Atlas (PCC 2019)." RCP4.5 represents predicted climate conditions of a moderate carbon future. RCP8.5 represents predicted climate conditions under a high carbon future. The values shown in Tables 15.5-1 and 15.5-2 show averages of 25.9 and 26.7 mm for RCP4.5 and 25.9/27.5 mm for RCP8.5. These values do not correspond to the source indicated by the Proponent. **Rationale:** Based on the Proponent's description we would expect to find the same values for "Max 1-Day Precipitation (mm)"in the Climate Atlas for RCP4.5 and RCP8.5 scenarios. ECCC was unable to duplicate the results. ECCC queried the Climate Atlas for Tomblin Lake and returned a result of "Region Geikie River." https://climateatlas.ca/find-local-data ECCC then queried the Climate Atlas for Max 1 Day Precipitation (mm). https://climateatlas.ca/data/grid/782/maxdaypr_2030_85/line https://climateatlas.ca/data/grid/782/maxdaypr_2030_45/line The results displayed an array of values ranging from 83.6 mm (2050) to 87.3mm (2092) for a Regional Concentration Pathway RCP8.5 scenario and values ranging from 48.9mm (2050) to 89.5 mm (2083) for an RCP4.5 scenario. These values do not match the averages shown in Tables 15.5-1 and 15.5-2.	1. Provide the source of the data displayed in Max 1-Day Precipitation (mm) category in Tables 15.5.1 and 15.5-2. 2. Provide detailed calculations for the following average values: • 25.9 mm 26.7 mm in Table 15.5-1: Predicted Climate Conditions of a RCP4.5 Moderate Carbon Future • 25.9 mm 27.5 mm in Table 15.5-2: Predicted Climate Conditions of a RCP8.5 High Carbon Future 3. Explain how the data shown in Tables 15.5.1 and 15.5.2 were used in the precipitation risk assessment. 4. Denote the differences between "mean", "value/max value", and "fluctuation", in the calculation of extreme event risk. 5. Compare model derived data against: 1. Natural variability of the observed data. 2. Variability in the statistics generated via observation based time series. **Technical Discussion Required**: Yes	As a preamble to this IR response, Denison notes that ECCC used a different spatial scale (Geike River is a 'large grid' area) in the Climate Atlas compared to what was presented in Section 15 of the EIS for Tomblin Lake (which is a 'small grid' area). Although Tomblin Lake region is within the Geike RIver region, this difference in spatial scale explains the discrepancies noted by ECCC in their IR context and rationale and explains why ECCC was unable to duplicate the results. 1. The links to the Tomblin Lake regional grid unit are as follows. Tomblin Lake 4.5: https://climateatlas.ca/data/grid50k/074H06/maxdaypr_2030_45/line Tomblin Lake 8.5: https://climateatlas.ca/data/grid50k/074H06/maxdaypr_2030_85/line The Tomblin Lake chart data were downloaded from the Climate Atlas for each scenario. 2. We used average function in excel to calculate mean values from the chart data. Historical Mean = Average of annual mean historical values from 1976 to 2005. As shown in Table 15.5-1, the historical mean for the Max 1-Day Precipitation was 24.1 mm. Ensemble mean – Near term = Average of predicted annual mean values from 2021 to 2050. As shown in Table 15.5-1, the near term mean for the Max 1-Day Precipitation was 25.9 mm under the RCP4.5 scenario. As shown in Table 15.5-2, the near term mean for the Max 1-Day Precipitation was 25.9 mm under the RCP8.5 scenario. Ensemble mean – Far term = Average of predicted annual mean values from 2051 to 2080 As shown in Table 15.5-1, the far term mean for the Max 1-Day Precipitation was 26.7 mm under the RCP4.5 scenario. As shown in Table 15.5-2, the far term mean for the Max 1-Day Precipitation was 27.5 mm under the RCP8.5 scenario. 3. The information in Section 15 was not used in Section 8. Section 8 PMP was conservative to account for any changes in future precipitation. 4. The ensemble model is made up of many different models (compilation). The variability is depicted for each model, and the ensemble model predicted data are presented as the annual mean and include the 10th and 90th percentiles for each annual mean. 5. The data in Section 15 was not used in other assessments and the PMP used in Section 8 is conservative.	No EIS updates are anticipated to address this IR.
IR-236	ECCC	Fish and fish habitat	Section 15.5.2, Expected Environmental Conditions	**Context:** It is stated that, "Table 15.5-1 and Table 15.5-2 summarize the predicted mean values of the climate variables for the Tomblin Lake regional grid unit…" As per the Proponent's description, Tomblin Lake was chosen as representative location for Wheeler when Climate Atlas was used as data source. **Rationale:** In those two tables, for the "Max 1-Day Precipitation (mm)" the historical average is given as 24.1mm. Local time series analysis for the climatic region in which Wheeler Project is located provide averages (for 1-day max precipitation) of approximately 30+ mm. It is the Proponent's responsibility to keep the required database current and up to date, because the length of the time series influences all derived statistics. Statistical analysis of extreme events is	1. Provide a clear explanation on how the historical mean for 1-Day Max Precipitation was calculated. 2. Compare the values obtained via various means (ex: copied from the internet, modeled via some online algorithm, derived from specialty literature), against time series analysis based on observations. **Technical Discussion Required**: Yes	1. In the draft EIS Tables 15.5-1 and 15.5-2, the maximum 1-day precipitation values were obtained from the chart data file downloaded from the Climate Atlas for the Tomblin Lake regional grid (refer to IR-235 for links to the datasets on Climate Atlas). The Historical Mean value was calculated as the average of annual mean historical values from 1976 to 2005 = 24.1 mm. 2. The values provided in Section 15 for the maximum 1-day precipitation are correctly referenced and summarized from the Climate Atlas and have been used appropriately in the assessment. The discrepancy in spatial scale and how it effects the representation of the data between Geike River and Tomblin Lake is described in IR-235. See also response to AD-15. As discussed during the April 19, 2023 meeting between Denison and ECCC, the final EIS will be updated to include new tables comparing precipitation estimates for existing and future climate toas context for the Project design PMP. These have been included here as Attachment IR-236; Attachment IR-236 will be appended to Appendix 6-C of the final EIS.	The information in Attachment IR-236 will be added as Appendix D Summary of Precipitation Values Presented in the EIS to Appendix 6-C in the final EIS. The following sentence will be added to Section 15.5.2 in the final EIS: "Please refer to Appendix D to Appendix 6-C for a summary of precipitation values presented in the EIS."

Ref. #	Department	Project Effects Link	Reference to EIS, appendices, or supporting documentation[1]	Context and Rationale	Information Requirement (IR)[2]	Denison Response	Final EIS Updates
				highly dependent of the mean with extreme values reaching values 3 to 4 times higher than the mean.			
IR-237	CNSC	EA follow-up and monitoring program	Appendix 16-C throughout, including Table 1.5-1: Wheeler River Monitoring and Follow-up Program Summary (p. 8-15)	**Context:** CNSC's Generic Guidelines for the Preparation of an EIS state: "The EIS should provide discussion on the follow-up program's requirements, and include: • objectives and structure of the follow-up program and the VCs targeted by the program • tabular summary and explanatory text of the main components of the program including: ○ a description of each monitoring activity under that component ○ which of the two generic program objectives the activity is relevant to (e.g., verify EA predictions, determine effectiveness of mitigation measures) ○ the specific statement from the EA that goes along with that generic objective and will be the focus for that activity (e.g., program objective: verify predicted effects; environmental assessment effect: no potential adverse effects) ○ the specific monitoring objective for that activity ○ planned schedule • roles and responsibilities to be played by the proponent, regulatory agencies, Indigenous people, local and regional organizations and others in the design, implementation and evaluation of the program results • possible involvement of independent researchers • program funding sources • information management and reporting (reporting frequency, methods and format) • possible opportunities for the proponent to include the participation of the public and Indigenous groups, during the development and implementation of the program The follow-up program plan should be sufficiently described in the EIS to allow independent judgment as to the likelihood that it will deliver the type, quantity and quality of information required to reliably verify predicted effects (or absence of them) and confirm the effectiveness of mitigation measures." (Section 11) **Rationale:** The Summary of Monitoring and Follow-up Programs provided in Appendix 16-C contains very high-level information, and while some of the aspects detailed in the Generic EIS Guidelines are included, the aspects underlined are missing or appear incomplete. Further, all information from throughout the EIS should be incorporated into this Summary. For example, the EIS notes that: "Groundwater samples will be collected at least monthly and semi-annually in the wells within the freeze wall and on the freeze wall perimeter, respectively" (p. 7-109) and that "At least five to seven multi-well clusters are proposed across the mined area (Figure 7.8-2). Sampling will include KI parameters or the full suite of COPC at different times in the remediation process" (p. 7-111). These details (only examples) are not included in Appendix 16-C.	It is recognized that this document will evolve over the planning process and be finalized prior to the EA Decision; however, as plans are developed and revised, CNSC staff expect that updates will be made to this document and provided with any future versions of the EIS. Appendix 16-C Summary of Monitoring and Follow-up Programs must include sufficient details to allow CNSC staff to determine the likelihood that it will deliver the type, quantity and quality of information required to reliably verify predicted effects (or absence of them) and confirm the effectiveness of mitigation measures. This includes concrete monitoring plans (sampling locations, frequency, etc.). Additionally, please incorporate any relevant information included in the EIS into this Summary.	Please see response in Attachment IR-237.	Section 16-C in the final EIS will be updated to reflect the final summary of monitoring and follow-up programs. Compared to the version contained in the draft EIS, it will be updated to include changes resulting from the FIRT review process and the Saskatchewan Ministry of Environment review process. This section will align with the Project's Commitment Report which will be provided as part of the final EIS documentation. Refer to Attachment IR-237 where **bold underlined** text indicates where Denison commits to revising or adding information into the final EIS.
IR-238	CNSC	Current use of lands and resources for traditional purposes	Various sections of the EIS, including: Section 8 Section 9 Section 10 Section 11 Section 12 Section 15 Section 16 Appendix 16-C (p. 3)	**Context:** The EIS indicates that "further detailed [follow-up and monitoring programs] will be developed as Project designs are finalized that may influence the nature, frequency, and locations of monitoring. In addition, input from regulatory agencies, the public and Indigenous Peoples will be considered." (Appendix 16-C, p.3) It is not clear in several section(s) of the EIS and the Indigenous Engagement Report, whether Denison has provided the interested Indigenous Nations and communities with the opportunity to participate in the development, implementation, and review of monitoring and mitigation measures, as per the guidance of REGDOC-3.2.2 and CNSC's Generic EIS Guidelines. **Rational:** As outlined in Section 11 of CNSC's Generic Guidelines for the Preparation of an EIS, please include roles and responsibilities to be played by the proponent, regulatory agencies, Indigenous people, local and regional organizations and others in the design, implementation and evaluation of the monitoring program results as well as possible opportunities for the proponent to include the participation of the public and Indigenous Nations and communities, during the development and implementation of the program.	Please provide additional information to demonstrate whether Indigenous Nations and communities were engaged directly on the potential mitigation and monitoring measures to address the concerns raised regarding potential impacts of the project on the potential or established Indigenous and/or treaty rights. Provide a rationale if this engagement has not been completed. As the Project develops, please provide concrete actions Denison will take in the follow-up and monitoring programs to engage Indigenous Peoples to alleviate concerns and incorporate their interests, and when this engagement is planned to take place.	Denison provided ERFN, KML, and the YNLR with the opportunity to review select sections of EIS prior to its submission to regulators (see Section 4.3.2.1.4 for ERFN; KML declined the invitation to review the EIS in advance of filing; Section 4.3.4.2.4 for the YNLR). Mitigation and monitoring was part of an in-person engagement tour undertaken in 2022 with the Indigenous and non-Indigenous Communities of Interest. Further, information about mitigation and monitoring measures were mailed out in booklets, and will be topics revisited in engagement activities set to occur in fall 2023. As the Indigenous Communities of Interest with reserves and residential communities most proximal to the Project, Denison has committed to collaborating with English River First Nation and Kineepik Metis Local on a monitoring regime, suited to each of their interests and needs. As part of these programs, Denison and the Indigenous community of ERFN and KML will be sharing information in an agreed-upon fashion. Denison expects that important country foods harvested for food and cultural purposes (i.e moose, fish species, etc.), surface water quality, and other areas of interest will form part of this monitoring program, including the potential to report on wildlife-vehicle mortality or other such areas of potential concern as they evolve over time. It is expected that the data collected through such monitoring regimes as described above would also be relevant to other Indigenous nations who may have interest in the Project. See also response to IR-28, IR-125, IR-128, IR-129 and IR-212.	No EIS updates are anticipated to address this IR.

[1] **Additional Lung Cancer Mortality from PM2.5: Recommended Approach and Sample Calculation**
Health Canada, Water and Air Quality Bureau, October 2022

Health Canada (2022) provides a quantitative estimate of the risk of lung cancer associated with exposure to PM2.5 in Canada. The pooled hazard ratio (HR) for lung cancer mortality in the Canadian population is 1.127 (95% CI: 1.085, 1.170) per 10 µg/m3 increase in long-term exposure to ambient PM2.5. The slope coefficient (β) for this relationship is 0.01196, as derived below:

$$e^{(\beta \times 10\,\mu g/m^3)} = pooled\ hazard\ ratio\ per\ 10\ \mu g/m^3$$

$$e^{(\beta \times 10\,\mu g/m^3)} = 1.127$$

$$\beta \times 10\ \mu g/m^3 = \ln 1.127$$

$$\beta = (\ln 1.127)/(10\ \mu g/m^3)$$

$$\beta = 0.01196$$

The additional lung cancer mortality (over the baseline rate) from PM2.5 derived from a given source can be determined using the equation below, based on the attributable fraction or (HR-1)/HR (Greco et al. 2020):

$$ALCM = \left[\left(e^{\beta \cdot Exposure} - 1\right) / e^{\beta \cdot Exposure} \right] \cdot Baseline\ rate \cdot Years$$

ALCM = additional lung cancer mortality cases per 100,000 population

β = 0.01196 (slope coefficient from meta-analysis in Health Canada (2022))

Exposure = estimated PM2.5 exposure concentration from the relevant source(s) (µg/m3) (does not include baseline PM2.5 exposure)
Baseline rate = 45.5 per 100,000 (current Canadian Age Standardized Mortality Rate (ASMR) for lung cancer from Canadian Cancer Statistics Advisory Committee 2021); the Canadian baseline rate is appropriate as the slope coefficient was derived from Canada-wide studies and an updated ASMR of Canada (if available) would be appropriate for use in the calculation

Years = years of project or project phase

Sample calculation:
Project estimates an exposure from relevant source(s) of 0.067 µg/m3 over 50 years of operation

$$ALCM = \left[\left(e^{\beta \cdot Exposure} - 1\right) / e^{\beta \cdot Exposure} \right] \cdot Baseline\ rate \cdot Years$$

$$ALCM = \left[\left(e^{0.01196 \cdot 0.067} - 1\right) / e^{0.01196 \cdot 0.067} \right] \cdot 45.5 \cdot 50$$

ALCM = 1.8 additional lung cancer mortality cases per 100,000

References:

[1] Canadian Cancer Statistics Advisory Committee in collaboration with the Canadian Cancer Society, Statistics Canada and the Public Health Agency of Canada. Canadian Cancer Statistics 2021. Toronto, ON: Canadian Cancer Society; 2021. Available at: cancer.ca/Canadian-Cancer-Statistics-2021-EN
[2] Greco, S.L., MacIntyre, E., Young, S. et al. An approach to estimating the environmental burden of cancer from known and probable carcinogens: application to Ontario, Canada. BMC Public Health 20, 1017 (2020). https://doi.org/10.1186/s12889-020-08771-w
[3] Health Canada. Lung cancer and ambient PM2.5 in Canada: a systematic review and meta-analysis.
[4] Health Canada, 2022. Available online at: https://publications.gc.ca/site/eng/9.907038/publication.html

Attachment: IR-06

Number	IR-06
Dept.	CNSC
Project effects link	Geology and groundwater
Reference to EIS, appendices, or supporting documentation	Section 2.2.1.4, Wellfield for In Situ Recovery Mining
Context and Rationale	Context: This Section of the EIS indicates that a tracer test was completed in 2021 and a feasibility field test was initiated in 2022. No information from these tests is included in the EIS and no reporting timelines are provided. Rationale: Guidance from the IAEA (2001) and best practices highlighted by regulatory regimes in other countries such as the United States (IAEA, 2016) and Australia (Geoscience Australia, 2010) indicates that single and multi-well trial (feasibility) testing for mining and remediation techniques should be carried out before a licence for full-scale operations can be granted . This is part of the requirement for proponents to demonstrate to government authorities that all potential risks have been considered during the life of operation and post-remediation of the mine. Additionally, Section 8.5.2 of the Generic EIS Guidelines states: “Units may be characterized as aquifers or aquitards, and unit descriptions should include their geochemical characteristics, vertical and lateral permeabilities, transport mechanism (diffusion versus advection) and the directions of groundwater flow”, And that “The applicant or licensee should present a conceptual and numerical hydrogeological model that discusses the hydrostratigraphy and groundwater flow systems”. Outcomes from the tracer test inform model parameters such as effective porosity (see IR-78), dispersion, and dispersivity (see IR-96). The wellfield leach tests and remediation trails ultimately inform environmental monitoring during site activities, and the source term for the groundwater model. This source term represents the contaminants which flow through the desilicified zone into Whitefish Lake, which represents a source of contamination considered in the ERA. References:

	[1] International Atomic Energy Agency (IAEA). 2001. Manual of Acid in Site Leach Uranium Mining Technology. IAEA-TECDOC-1239. Vienna. 283 p. [2] International Atomic Energy Agency (IAEA). 2016. In Situ Leach Uranium Mining: An Overview of Operations. IAEA Nuclear Energy Series No. NF-T-1.4. Vienna. 76 p. [3] Commonwealth of Australia (Geoscience Australia). 2010. Australia's in situ recovery uranium mining best practice guide. ISBN 978-1-921672-95-8. Canberra. 33 p.
Information Requirement	1. Please provide a summary of the results of field tests (i.e., tracer tests, wellfield leach tests, and remediation trials) in the EIS, or provide a technical supporting document with this information, and ensure the documentation is appropriately referenced in the EIS. 2. Please indicate how outcomes from these field tests inform the design of In Situ Recovery . This information should include: • feasibility of meeting remediation targets. • groundwater flow conditions and validation of flow models. • mobilization of contaminants (e.g., Al, Se or V). • potential for free gas evolution/two-phase flow. • identifying composition of lixiviant and production solutions. • success despite presence of >2% carbonate minerals (siderite, $FeCO_3$) in the ore zone (see Table 4-3 of Appendix 7-A). • site-specific data to parameterize, validate, and refine solute transport models (hydraulic conductivity, effective porosity, dispersivity, diffusion, etc.). 3. Please provide further information of proposed operations including % recovery, uranium concentrations, optimal liquid/solid ratios, anticipated reagent consumption, etc.

Response to IR-06 Part 1

Denison used the ISR mine design and the 3D hydrogeology and contaminant transport numerical modelling of the injection and extraction wells to determine the potential interactions between mining activities and the environment. Two key outputs from the ISR mine design and 3D hydrogeology modelling work were used as inputs for the groundwater assessment (Section 7): 1) The extent of mining solution migration away from the injection and recovery well screens, as defined by the mining area (50m above the ore zone and within the freeze wall) and 2) groundwater quality of the mining area following remediation. Monitoring will be completed during operations and decommissioning to confirm these inputs.

During the operation phase, and under normal operational conditions there is no interaction between the mining area and surface or down gradient environment, and the assessment focuses on the post-decommissioning period following removal of the freeze wall, once the groundwater flow paths return to pre-mining conditions.

Denison provided the FIRT team with a presentation and summary of the test work completed to date on June 16, 2023, to address IR-06. Summaries of relevant field and lab tests including the 2021 Tracer Test, 2022 Feasibility Field Test (FFT), and various site-specific lab tests are provided as part of this IR response and additional details will be provided to support licence applications.

Tracer test

An ion tracer test was completed in 2021 and the key results are summarized as follows:

- The test achieved the commercial-scale production flowrate assumed in the 2018 Pre-Feasibility Study (SRK 2018).
- The test demonstrated hydraulic control of injected solution. No elevated values of the tracer were observed in the monitoring wells surrounding the commercial-scale test pattern.
- The test established breakthrough times between injection and recovery wells, spaced 5 to 10 meters apart, that were consistent with previous proof of concept hydrogeological modelling conducted by Petrotek Corporation.
- The clean-up phase completed after the conclusion of the tracer test demonstrated the ability to remediate the test pattern. The clean-up phase was successful; the tracer concentrations were reduced to as low as 4% of peak test levels within eight days of remediation.

Feasibility Field Test (FFT)

The purpose of the FFT was to validate previous field and laboratory testing and determine the feasibility of the ISR mining methodology. The leaching and neutralization phases of the FFT were completed in 2022. The leaching phase was designed to assess the effectiveness of the ISR mining method. This phase included controlled injection of an acidic solution into the mineralized zone with recovery of the solution through existing test wells. The neutralization phase involved the injection of a mild alkaline (basic) solution into the leaching zone to neutralize the area and verify the groundwater in the area is returned to acceptable, permitted conditions.

The FFT provided the following results:

Leaching Phase:

- Recovered approximately 14,400 lbs U3O8 over ten days of active leaching following completion of initial acidification of the Leaching Area.
- Returned maximum uranium head grade of recovered solution of 43 g/L when the leaching phase of the FFT was completed, with grades still rising (indicative of the ramp-up segment of a well production profile).
- Achieved suitable acidification for ISR mining within 7 days post initial injection at 5 metre well spacing (GWR-41) and within 17 days for 10 metre well spacing (GWR-38).
- Demonstrated ability to achieve and maintain uranium mass flow rate consistent with the assumptions in the 2018 Pre-Feasibility Study (SRK 2018).
- Further demonstrated hydraulic control of injected solution during the FFT, reporting no responses in the monitoring wells outside of the designed FFT test area.
- Confirmed breakthrough times between injection and recovery wells, consistent with the Project's hydrogeological model and the previously completed tracer test.

Neutralization Phase:

Sampling of groundwater monitoring wells around the FFT site has confirmed the successful restoration of the leaching zone to environmentally acceptable pH conditions, as outlined in the applicable regulatory approvals for the FFT and summarized in Table IR-06-1 below.

Table IR-06-1: Feasibility Field Test Leaching Zone Remediation Targets compared to Interim (December 2022) Groundwater Well Monitoring Results

Parameter	Units	Leaching Zone Remediation Target	Neutralization Phase Results [1]
pH	pH units	3.5	6.24
Aluminum (Al)	mg/L	9.1	3.3
Arsenic (As)	mg/L	0.7	0.05
Barium (Ba)	mg/L	0.2	0.07
Calcium (Ca)	mg/L	535	203
Cadmium (Cd)	mg/L	0.3	0.00001
Cobalt (Co)	mg/L	0.24	0.0001
Chromium (Cr)	mg/L	0.38	< 0.0005
Copper (Cu)	mg/L	0.19	0.001
Iron (Fe)	mg/L	390	144
Potassium (K)	mg/L	45	185
Magnesium (Mg)	mg/L	8.92	22.6
Molybdenum (Mo)	mg/L	0.16	0.04
Sodium (Na)	mg/L	628	193
Nickel (Ni)	mg/L	1.17	0.02
Lead (Pb)	mg/L	2	0.04
Sulfate	mg/L	4,147	1114
Selenium	mg/L	0.47	0.0002
Uranium	mg/L	501	85

Parameter	Units	Leaching Zone Remediation Target	Neutralization Phase Results [1]
Vanadium	mg/L	19.3	0.2
Zinc	mg/L	17.1	0.5

1 Results are the average of three groundwater monitoring wells (GWR-038, -040 -041) sampled in December 2022

__Response to IR-06 Part 2__

Field programs conducted over the past 4.5 years were focused on de-risking key elements related to the implementation of the ISR mining methodology specific to the Phoenix deposit in a high-grade Athabasca Basin setting. These key elements were focused on:

- Permeability
- Leachability
- Containment
- Processing

De-risking programs were carried out in the lab and field setting initially on an individual basis. As the programs progressed, elements were combined in additional test work ultimately culminating in the FFT, where all elements were evaluated in a single test to inform the design of ISR.

Response to IR-06 Part 2a: Feasibility of meeting remediation targets

Groundwater remediation targets provided in the draft EIS were from derived from metallurgical test results completed from 2017 to 2021 with over 125 kg of material recovered from Phoenix deposit that underwent leaching and neutralization test work (see response to IR-67). In 2022 and 2023, metallurgical test work continued to further optimize remediation and strategies and confirm test work results presented in the draft EIS. It is expected that metallurgical test work will continue in the future to further optimize remediation targets, and this will be advanced through updates to the Decommissioning Plan.

The FFT provided additional confirmation that pH target and remediation targets could be met. Data gathered during the neutralization phase of the FFT provide confidence that groundwater targets proposed in the draft EIS can be met technically and economically.

Based on laboratory testing and the results of the 2022 field testing, subsurface remediation is planned to consist of rinsing the ore zone with 35 pore volumes of fresh water, slowly raising the pH and then pumping about 75 pore volumes of basic solution through the same portion of the ore zone. This basic solution will in effect further raise the pH to a level that impedes further leaching of the deposit and reduces aqueous concentrations of contaminants of concern to below their environmental target levels.

Response to IR-06 Part 2b: Groundwater flow conditions and validation of flow models

__Background of Data Collection__

Hydrogeological investigations have been ongoing in the field and in laboratories since 2014. Packer, open hole, and cross hole tests have been completed in conjunction with exploration drilling programs. As well, permeability tests have been completed on sections of available competent core within the

Phoenix deposit. Open hole water level surveys have been completed across the site in 2015, 2017, 2021 and 2022. The hydraulic conductivity related field and laboratory test work data are summarized in Table IR-06-2.

Table IR-06-2: Hydraulic Conductivity Related Data Set from Phoenix and Regional Wells

Test Type	Location	Number of Data Points[1]
Field – Packer / Injection / Pumping / Slug	Athabasca Group	56
	Unconformity	173
	Basement	20
Lab – Permeability	Athabasca Group	721
	Unconformity	1149
	Basement	1250
Total		3,369

Note: [1] This is not necessarily the number of tests conducted, as a single test can yield multiple data points.

Additionally, the following hydrogeological characterization work has been completed at Phoenix:

- Geophysics surveys including:
  - Neutron survey x 5
  - Borehole or nuclear magnetic resonance (BMR or NMR) x 10
  - Sonic x 1
  - Acoustic televiewer x 9
  - Gamma/caliper x 9
  - Electromagnetic flow meter (EMFM) x 9
- Tracer Test (2021)
  - Advanced FFT (2022)

Lithology at Phoenix is considered in terms of nine HGUs that have been defined to be present adjacent to or define the main Phoenix mineralized zone (Phases 1 to 5) including:

- HGUs 1a and 1b: Athabasca Group (overlying the mineralized zone)
- HGU 2a: Upper clay cap
- HGUs 2b, 2c, 2d: Main body of the mineralized zone
- HGU 2e: Lower clay cap
- HGUs 3a and 3b: Weathered and unweather basement.

In the mineralized zone, HGUs 2b, 2c and 2e (in that order) have the highest hydraulic conductivities.

Hydraulic conductivity values in the mineralized zone in Phase 1 average 1E-06 m/s, with the southeastern half of the phase generally having higher values than the northwestern half. Phases 1 and 3 do not appear to be hydraulically connected. In Phase 2 there is considerably less data than for Phase 1. There appears to be no hydraulic connection between Phases 1 and 2. Based on aquifer testing and electromagnetic flow meter (EMFM) data, mineralized zone hydraulic conductivity values in Phase 2 (~4E-06 m/s) are on the same order of magnitude as those in Phase 1 and approximately one order of magnitude greater than those in Phases 3 and 4. In Phase 3 the mineralized zone hydraulic conductivity values (~6E-07 m/s) average one order of magnitude lower than those in Phase 2. The mineralized zone Phase 4 has been tested at four locations. With one exception, all values obtained from pumping, injection and slug tests have been in the range 1E-08 to 8E-07 m/s. The hydraulic conductivity values (~3E-07 m/s) are on the same order of magnitude as those in Phase 3. Much of the mineralized zone water in Phase 4 is capillary bound, but there are some reasonably fractured intervals in Units 2c, 2d and 2e. Comparison of mineralized zone hydraulic conductivities, averaged by mining phase, indicates that Phases 1 and 2 have the highest values due to the large presence of a thick and relatively continuous section of HGU 2b in these phases. Phases 3 and 4 have intermediate values and Phase 5 has the lowest permeability due to a thinner HGU 2b unit, and relative abundance of the clay zones in this phase.

There are several lines of evidence (from laboratory testing, observations during the FFT and geomechanical modelling of the deposit) that localized hydraulic conductivity increases may occur due to the dissolution of uranium from the mineralized zone.

<u>Numerical Modelling</u>

Numerical groundwater modelling has been conducted by SRK (2018), Petrotek (2020 and 2021), and Ecometrix (draft EIS Appendix 7-C). The degree of complexity and the purposes of these models have varied. SRK (2018) created a two-dimensional model that was bound by geological outline of the defined mineral resource in the mineralized zone as part of their PFS. This simplified approach was used based on the assumption that there was a freeze cap above the deposit (the earlier version of the freeze wall). Homogenous K values were assigned to the model and incrementally increased by roughly half an order of magnitude to estimate flow rates.

Petrotek (2020, 2021) built and calibrated several models which had differing purposes. These models were calibrated to the observed responses to aquifer tests conducted in 2019, 2020 and 2021 but they assumed that there was no vertical heterogeneity within mineralized zone and only simulated the response in Phases 1 and 3. Potential well configurations and well spacings were investigated and used to predict the response to the 2021 tracer testing. A high degree of variability in the travel times from the various injection wells and to the pumping wells was found. The variability was attributed to the high degree of heterogeneity in hydraulic conductivity and storage within the mineralized zone. One of the main purposes of this work was to provide a demonstration of proof of concept for application of ISR to the Phoenix deposit.

EcoMetrix (draft EIS Appendix 7-C) developed a regional three-dimensional FEFLOW groundwater flow and transport model that was used to both evaluate residual effects from the FFT and then as part of Denison's draft EIS to examine the post decommissioning effects on regional receptors. The model was calibrated to the regional groundwater flow patterns, was consistent with their conceptual model and was also consistent with the observed hydrochemistry in the Upper and Lower Sandstone Aquifer systems. The groundwater flow in the vicinity of the deposit was observed and simulated in the calibrated groundwater model to travel eastward within the Lower Sandstone Aquifer before moving upward through the desilicified zone in the Athabasca Group sandstone units and overlying overburden deposits toward Whitefish Lake.

As part of the Feasibility Study, Denison retained Dr. Walter Illman and his Ph.D candidate Ning Luo from the University of Waterloo. The University of Waterloo group conducted hydraulic tomography (HT) analysis of the hydraulic test data from the Phoenix deposit to aid in the characterization of the subsurface heterogeneity in K and specific storage (Ss). The areas of the HT model, with high confidence estimation were incorporated into the 2023 WSP FEFLOW model as they represented the best estimation of the 3D distribution of the hydraulic conductivity and storativity. The FEFLOW model is a numerical representation of the site hydrogeology and groundwater flow regime in the mineralized zone and was calibrated to hydraulic testing data that has been collected for the site. FEFLOW model specified well designs including well screen locations and any planned permeability enhancements to specific wells or HGUs within wells.

The FEFLOW results were used as an input into GoldSim (GoldSim V14, Technology Group, LLC). GoldSim is a mathematical model that uses the outputs from FEFLOW to estimate the uranium dissolution by HGU and by extraction well with time. GoldSim simulated the dynamic nature of the lixiviant injection and uranium recovery systems associated with the wellfield.

Recovery Curve

The test work and derivation of the recovery curve from laboratory testing that has been standardized to one condition and grade. The recovery curve indicates the concentration of uranium bearing solution (UBS) produced as a function of pore volumes (PVs) recovered. Therefore, by determining the hydrogeological flow field for an array of injection and recovery wells and the related PVs recovered with time, an aggregate wellfield recovery can be calculated by applying the recovery curve to each recovery well's PV distribution.

The recovery curve is scaled in the modelling to account for variations in in situ grade.

Hydrogeological Modelling

The numerical groundwater flow modelling methodology was conducted using FEFLOW and was described earlier. The physical setting of the mineralized zones was numerically represented in FEFLOW based on the Denison geological block model. FEFLOW was used as the basis of wellfield layout and the simulation of the lixiviant flow within the mineralized zone. For production modelling, the following values for each of the FEFLOW numerical elements in 3 dimensions was output:

- Production unit or well capture zone that element belonged to
    - Flow per unit time
    - Element volume
    - Effective porosity
    - HGU and uranium in situ grade

<u>Wellfield Production Modelling</u>

Using the FEFLOW simulation outputs for each mesh unit, GoldSim calculated the uranium recovery based on the number of PVs through the unit and the corresponding concentration of U_3O_8 in each recovery well. The mesh units are aggregated based on the associated recovery well number from FEFLOW.

Wells are started and stopped in GoldSim to simulate the progression of mining in the wellfield. Well starting is set manually. The end of operation for each well is determined by a cutoff recovery grade. In this way the overall production from the wellfield is controlled to provide process plant feed of the required flow and grade over time. At a detailed level, well operating times can be adjusted to smooth the mass flow rate of uranium to the plant, within the limits of the model granularity.

Optimizing the production rate and total quantity required several iterations of FEFLOW and GoldSim modelling. GoldSim outputs were analyzed to identify wells that were under-performing compared to expectations. The number and position of injection and recovery wells and their flow rates were adjusted based on these results, and the FEFLOW model was re-run. This iterative process involved examination of the under-performing areas and adjustment to the flows in these areas in both FEFLOW and GoldSim.

Throughout the optimization iterations, the number of unexpected low-performing wells was reduced. When it appeared the effort had reached its asymptote the remaining low performing wells were reviewed. A statistical analysis showed that four wells patterns or production blocks were outliers. These four wells that were located in areas with otherwise consistent recovery had shown more reasonable response in prior iterations. The results from these four production units was therefore assumed to be non-representative. It was assumed these production units can be mined by varying the pumping rates, wellfield stimulation and/or adding possibly adding additional wells. Recovery from these four wells were therefore added at the average rate per HGU for their Phase and included in the overall production.

Data gathered during the field tests have been utilized for both the EA groundwater model as well as the mining model.

Response to IR-06 Part 2c. Mobilization of contaminants (e.g., Al, Se or V)

Contaminants mobilized during the FFT were similar in concentration compared to the UBS solutions that were collected during lab scale core and column leach testing at SRC which suggests that the testing Denison conducted at lab scale and the information collected is representative of the deposit. The column test assay results in Table IR-06-3 below include the maximum as well as weighted average from all phases of the leaching and remediation test. The FFT result presented in Table IR-06-3 below was the sample with the highest concentration of uranium during the test.

Table IR-06-3: Potential for Mobilization of Contaminants - Comparison of Results from Lab Scale Column Tests and Groundwater Results from the Feasibility Field Test

	Column Tests		FFT
Analyte	**Max**	**Weighted Avg**	**GWR-041, Oct 13, 2022**
U, ppm	48222.3	13902.0	43400
Al, mg/L	783.9	284.1	180
Fe, mg/L	7029.1	1757.4	1200
Ca, mg/L	1135.1	445.8	1100
Mg, mg/L	672.3	170.5	10
K, mg/L	329.6	54.0	150
Na, mg/L	927.4	52.0	90
Pb, mg/L	16.4	3.3	1
Mo, mg/L	296.6	24.8	15
P, mg/L	44.5	6.8	20
Cd, mg/L	6.2	0.2	0
Mn, mg/L	263.3	57.9	83
Cr, mg/L	14.1	0.8	5
V, mg/L	148.3	33.8	22
Sr, mg/L	17.1	2.5	16
Ba, mg/L	6.4	1.9	5
Cu, mg/L	1610.8	280.8	2
Zn, mg/L	1276.2	38.8	5
Co, mg/L	49.3	4.1	1
Ni, mg/L	166.2	6.6	1
As, mg/L	95.9	10.4	3
Se, mg/L	1.6	0.1	1
S, mg/L	24115.4	14740.9	12333

Response to IR-06 Part 2d. Potential for free gas evolution/two-phase flow

Calcium carbonate is known to be present in the deposit in relatively low percentage amount. The reaction between acid and calcium carbonate can release CO2 gas and therefore cause two phase flow, especially when going from the hydrostatic pressure of the deposit to the atmospheric pressure at surface which will encourage degassing of solution. It is expected two-phase flow will occur during the mine life, especially as carbonate containing material are being decomposed with the sulfuric acid of the lixiviant. The FFT provided confirmation that the proposed radon degassing surge tank directly fed by downhole recovery pump is adequate for operations and does not pose additional Health & Safety or environmental risks.

Response to IR-06 Part 2e. Identifying composition of lixiviant and production solutions

As part of the metallurgical test program, over 125kg of core from the Phoenix deposit has been leached in a variety of settings, including bottle rolls, column tests, and intact core tests. This has helped to predict concentrations of both the lixiviant as well as the production solutions.

The lixiviant (mining solution) concentrations will vary depending on each individual well production profile. To ensure reagent consumption is effective and efficient it will be varied during the life of each well dependent on its characteristics.

The initial acidification of the well requires a lower acid content to ensure the formation does not plug due to precipitation, whereas during periods of high production the well can accept a higher acid concentration. Towards the end of the recovery curve, the uranium is more difficult to access and therefore the strength of the acid or the flow rate to the well need to be optimized to ensure efficient use of reagents.

It is expected that the lixiviant concentrations will vary between 0-60 g/L H_2SO_4, and 0-20g/L H_2O_2 and will be situationally dependent. There is also the capability to add $Fe_2(SO_4)_3$, however it is not expected that this will be required in significant concentration due to the natural abundance of iron in the deposit.

Table IR-06-4: Representative Concentration Ranges of Uranium Bearing Solution

	Lower-end Concentrations	Upper-end concentrations
U, ppm	2976	116395
Al, mg/L	25.8	8506.1
Fe, mg/L	134.0	21737.9
Ca, mg/L	99.7	10736.0
Mg, mg/L	21.7	1776.4
K, mg/L	8.0	756.2
Na, mg/L	7.0	5361.9
Pb, mg/L	0.1	124.5
Mo, mg/L	0.1	64.8
P, mg/L	4.0	276.6
Cd, mg/L	0.1	66.4
Mn, mg/L	8.0	980.7

	Lower-end Concentrations	Upper-end concentrations
Cr, mg/L	0.1	145.9
V, mg/L	3.4	942.4
Sr, mg/L	0.6	178.8
Ba, mg/L	0.1	104.8
Cu, mg/L	1.7	1337.9
Zn, mg/L	2.7	987.9
Co, mg/L	0.5	114.9
Ni, mg/L	0.1	216.4
As, mg/L	0.1	96.5
Se, mg/L	0.1	203.2
S, mg/L	1751.3	29671.1

Response to IR-06 Part 2f. Success despite presence of >2% carbonate minerals (siderite, FeCO3) in the ore zone (see Table 4-3 of Appendix 7-A)

The metallurgical test work and FFT completed to date has shown that carbonate minerals present in deposit does not pose a material impact on the ISR mining method proposed for the project.

Response to IR-06 Part 2g. Site-specific data to parameterize, validate, and refine solute transport models (hydraulic conductivity, effective porosity, dispersivity, diffusion, etc.)

Please see summary above under response to IR-06 Part 2b under the heading Background of Data Collection.

Response to IR-06 Part 3

Expected total recovery from deposit is 80.6%. Average uranium concentrations recovered from wellfield is estimated to be 22.5/L U. The nominal case ISR wellfield reagent consumptions are shown in the Table IR-06-5.

Table IR-06-5 Nominal ISR Wellfield Reagent Consumptions

Area	Reagent	kg/kg U in feed	kg/m^3 UBS feed
In situ leach (ISL)	93% sulphuric acid	1.40	12
	70% hydrogen peroxide	0.40	-
	50% ferric sulphate	0.024	-
ISL remediation	50% sodium hydroxide		15

Solutions recovered contain minimal solids based on test work completed to date. Any entrained solids in solutions will be removed through the precipitation circuits of the process plant. Should they contain appreciable of uranium, solids can be processed at another licensed facility.

References:

Petrotek. 2020. Interim Hydrogeologic Report – Wheeler River Project Phoenix Deposit. Unpublished report prepared for Denison Mines Corp. March 2020.

Petrotek 2021. Groundwater Model Report Phase 1, Phoenix Deposit Wheeler River Project. Prepared for Denison Mines. December 2021.

SRK Consulting. 2018. Prefeasibility Study Report for the Wheeler River Uranium Project, Saskatchewan, Canada. Report prepared for Denison Mines Corp. October 2018

Attachment: IR-10

Number	IR-10
Dept.	ECCC
Project effects link	Fish and fish habitat
Reference to EIS, appendices, or supporting documentation	Section 2.2.1.4.2.3, Tertiary Containment of Mining Solution - Freeze Wall
Context and Rationale	**Context:** The Proponent stated that as a tertiary means of containment for the mining area, the uranium deposit is proposed to be surrounded by a freeze wall that extends from the surface to the basement rock, isolating the mining area from regional groundwater. Current plans are for the freeze wall to be a minimum of 10 m thick, be installed 25 m away from the uranium deposit, and extend 30 m into the basement rock (Figure 2.2-6). As explained in Section 2.2.1.4.2.2, mining solution will be injected into the ore zone under pressure and will likely react, not just with the uranium in the ore zone, but also the binding or cementing material in the sandstone. This means that some portion of the sandstone above the uranium layer and perhaps some portions of the freeze wall will dissolve, thereby creating more void than just the thickness of the uranium layer or horizon. The void may affect the integrity of the freeze wall as containment. **Rationale:** It is not clear how the Proponent will monitor the freeze wall to verify whether portions of the freeze wall are being dissolved in the mining process and how it plans to verify the integrity of the freeze wall as a containment for the mining solution. In addition, if the dissolution reaction of the uranium ore is exothermic, then the heat generated may also affect the integrity of the freeze wall.
Information Requirement	1. Explain how the integrity of the freeze wall will be maintained as a means of containment that prevents migration of the mining solution out of the ore zone into the receiving environment. 2. Demonstrate that the mining solution injected under pressure will not compromise the integrity of the freeze wall as a containment.

	3. Demonstrate how both exothermic and chemical reactions of the mining solution used to dissolve the uranium ore will not compromise the integrity of the freeze wall as a containment. Technical Discussion Required: Yes. ECCC would like to better understand the chemical constituents that compose the mining solution and the chemical reactions that it will cause

Response:

The general theme of the comments and questions stated above seem to be related to:

- verification of the freeze wall extents;
- response of the freeze wall to potential chemical interaction with the lixiviant;
- response of the freeze wall to induced hydraulic or lithostatic stress; and
- response of the freeze wall to potential exothermic processes related to ISR.

The alignment of the freeze wall is located 25 m offset from the lateral extent of the recoverable ore and the freeze wall will grow in thickness both towards the ore and away from the ore. The freeze wall will solidify all liquid porewater and develop into a contiguous impermeable barrier many metres thick. Ground temperature monitoring will be installed on both the ore and non-ore sides of the freeze wall to confirm the thickness of frozen ground and to validate thermal finite element models of the entire area. Thermal models can very accurately represent real conditions because ground thermal properties used in the analyses only vary by a factor of two to four across all ground types, unlike hydraulic or strength properties, which can vary by many orders of magnitude across relatively short distances.

The figures below are an example of field data validating modelled predictions for a shaft freeze wall at depth.

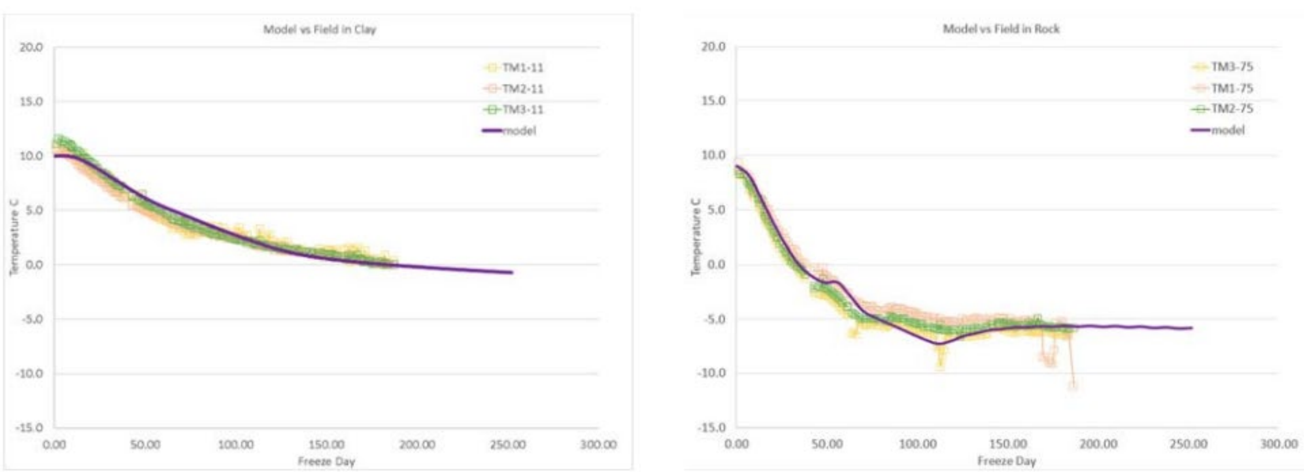


Figure 1: Illustration of a calibrated FEM model for freezing in clay (left) and rock (right). Temperatures were measured offset from the freeze wall pipe locations and compared with model predictions at the same location.

The injection and recovery wells will be set up such that they are within the confines of the ore itself and migration of fluids towards the freeze wall and through non ore ground between the ore and freeze wall should be minimized because hydraulic gradients will induce preferential flow to recovery wells and away from the freeze wall. Having said that, if significant excursion of lixiviant were to occur and it were to contact the freeze wall, it is not expected to chemically dissolve the in situ ice. The freezing point depression of the lixiviant proposed for this project was determined to be -1°C and, as such, it would freeze off and become immobile before significant volume could negatively impact the freeze wall. If the lixiviant were to dissolve some of the host soil / rock binding material at the freeze wall surface, it would occupy the resulting void space, but then freeze off, which would halt further migration within the freeze wall.

Freeze walls, when fully developed, are capable of withstanding significant external pressures because the ice in the pore voids greatly improves the bulk strength of the soil. For example, in the province of Saskatchewan, ground freezing is used to support the sinking of deep potash mine shafts, which must penetrate through the Mannville formation at a depth between 400 and 500 m below surface. The Mannville formation is often described as saturated, unconsolidated beach sand and it would not support shaft excavation in a thawed state. Freezing is used to create a structural and impermeable wall up to 5 m thick, which can resist a stress gradient driven by full hydrostatic and/or lithostatic pressures on the outside of the wall, and an open to atmosphere excavation within the shaft. This loading condition is much more extreme than any condition the freeze walls at the Phoenix deposit will experience because the interior side of the freeze wall where active ISR mining is occurring is not open to atmosphere and is fluid filled in the same way that the regional groundwater system is on the exterior side of the freeze wall, creating a balanced pressure system, where loading is equal on both the interior and exterior sides.. While freeze walls are very strong when fully developed, they are also plastic in nature. This means that they can slowly deform without failing in response to localized ground deformations. As the freeze wall deforms towards a lower stress zone, it maintains its thickness and integrity. While the above example referred to potash shafts, other examples can be drawn from the experience at the McArthur River or Cigar Lake uranium mines. At McArthur River, open stopes are generated directly adjacent to a freeze wall that is a nominal 4 m thick. At Cigar Lake, open mine cavities 10 m high and several metres in diameter commonly exist within the frozen ground. Neither site has had a breach of the freeze wall during mining activity. Given that the freeze wall at Denison will be much thicker than at McArthur River and that it will be located up to 25 m from the ore zone, it is not anticipated that it will be exposed to a stress environment that will put it at risk.

The leaching process has the potential to be exothermic and generate heat, which may flow toward the freeze wall. In this instance, there is low sulphur content in the ore zone and the exothermic reaction will be minimal. Despite this, all thermal modelling in support of the freeze design assumed that the freeze wall had to develop and be sustained in the presence of an ore zone that generated a nominal amount of heat—sufficient enough to sustain a minimum temperature of 10°C even though it would naturally tend to cool below this in response to the freeze system. It is understood that the lixiviant may be heated as part of the pre-injection process, so some accounting for heat in the ore zone was included in the analysis to date. Should the lixiviant generate more exothermic reaction than predicted, there is a very low risk of it degrading the freeze wall in any significant amount. Referring back to the potash mine shaft freezing illustration, it is not uncommon for in shaft excavation activity and concrete work to generate temperatures between 30 and 60°C that act on a freeze wall only 5 m thick and only a few metres away from the exposed shaft wall. In this extreme case, the freeze wall is more than capable or removing the generated heat. The physics of heat flow are such that heat generated by the ISR process would be free to flow towards the freeze wall; however, most of it would flow to the coldest location (e.g., the actual freeze pipes at the mid-point of the wall thickness) before it is manifested as an observable significant rise in ground temperature. Even if the heat were to warm the ore side of the freeze wall, it would not impact the non-ore side of the wall (which is where half of the total wall thickness presides). This heat may penetrate to the center of the wall but if the refrigeration plant is operating, that heat can not then flow “up gradient” on the non-ore side of the wall and thaw that side.

The concentration of the lixiviant (max ~8% sulfuric acid conc.) has a freezing point of ~-4°C. The lixiviant itself will not react chemically with the freeze wall, other than having a slightly different freezing point than formation water. The main reaction expected is dissolution of uraninite with the combination of sulfuric acid, hydrogen peroxide, and ferric iron. This reaction is exothermic, but there are several natural mitigating factors of the wellfield that aid in minimizing heat transport to the freeze wall:

- The wellfield will have flexibility in terms of reagent concentrations being added. With the bulk of the uranium being contained within a higher-grade core (interior to the deposit), the exterior of the deposit will see either lower injection/recovery flows or lower concentrations of lixiviant to be efficient with reagent consumption. Whether the concentration or flow is reduced, this limits the reaction rate and therefore total heat generation at the extremities of the deposit.
- There is no refortification of reagents underground compared to typical uranium tank leaching. This prevents additional heat generation from dilution of sulfuric acid or hydrogen peroxide.
- The heat capacity of lixiviant/UBS should be higher than the ore in the deposit, which means the UBS solution will carry the majority of the heat to surface rather than keeping the heat of reaction at depth.
- In the event the freeze wall thickness monitoring network detected an actionable thinning to the freeze wall, the concentration of lixiviant could be decreased which would reduce the heat generated per m3 of lixiviant and re-establish the desired freeze wall thickness.

To summarize the risk of the degradation of the freeze wall due to exothermic reaction, it is almost impossible—with the freeze plant operating—to practically add sufficient sustained heat to thaw the proposed freeze wall to the point hydraulic containment is compromised. Sufficient operational controls will be in place to verify the freeze plant is operating, to measure the temperature in the ore zone, and to measure the temperature on adjacent sides of the freeze wall so that early detection of any upset conditions can be identified and addressed. Options for addressing issues are to lower the temperature of the freeze system to draw more heat out, to increase the freeze coolant flow rates in freeze wells nearer to active ISR cells, or to adaptively manage the lixiviant injection and recovery rates in cells located nearer the freeze wall.

Attachment: IR-18

Number	IR-18
Dept.	ECCC
Project effects link	Change to an environmental component due to hazardous contaminants
Reference to EIS, appendices, or supporting documentation	Section 2.2.3.9, Project Description Appendix 8-E
Context and Rationale	**Context:** In Table 2.2-1 the upper bound Industrial Wastewater Treatment Plant (IWWTP) effluent quality final discharge targets for Constituents of Potential Concern (COPCs) are provided. General parameters (e.g., temperature, pH, etc.), and several Schedule 4 Substances with maximum authorized concentrations (lead, nickel, suspended solids, and un-ionized ammonia) under the Metal and Diamond Mining Effluent Regulations (MDMER) have not been provided in this table. There are several COPCs (aluminum, mercury, iron, nitrate, thallium, phosphorus and manganese) for effluent characterization under Schedule 5 Section 4 of the MDMER that have not been provided in this table. Additionally, no information on water quality guidelines has been provided in this table. Furthermore, it is stated that the final effluent quality discharge target for uranium is 0.057 mg/L. However, the Canadian Council of Ministers of the Environment (CCME) water short term (acute) water quality guidelines for the protection of aquatic life is 0.033 mg/L. The proposed effluent discharge target for uranium exceeds the acute water quality guidelines, indicating effluent may pose the risk of being acutely lethal to aquatic biota at end-of-pipe. **Rationale:** ECCC requests the Proponent include the general water quality parameters that influence water quality thresholds, parameters in Schedule 4 and Schedule 5 Section 4 of the MDMER, and their respective water quality guidelines for consideration and transparency. Discharges from the proposed Project will alter water quality in the immediate receiving area, and this may include some sublethal effects on aquatic biota, which must be minimized. It remains the Proponent's responsibility to adhere to the MDMER to ensure that effluent at the end-of-pipe from all final discharge points be non- acutely lethal and meet requirements for prescribed deleterious substances under Schedule 4 of the regulations.
Information Requirement	1. Update Table 2.2-1 and Appendix 8-E to include all general parameters required for environmental effects monitoring: pH, temperature, hardness, alkalinity, and conductivity.

	2. Update Table 2.2-1 and Appendix 8-E to include missing Schedule 4 Substances under the MDMER with maximum authorized concentrations: lead, nickel, suspended solids, and un-ionized ammonia. 3. Update Table 2.2-1 and Appendix 8-E to include missing Schedule 5 Section 4 parameters required for effluent characterization under the MDMER: aluminum, mercury, iron, nitrate, thallium, phosphorus and manganese. 4. Include all acute and chronic water quality thresholds for each parameter in Table 2.2-1 and Appendix 8-E. 5. Describe additional mitigation measures that can be considered to minimize impacts to aquatic biota from uranium concentrations in effluent.

<u>Supporting table to the response provided in IR table:</u>

Table 2.2-1 - Upper Bound Industrial Wastewater Treatment Plant Effluent Quality (updated)

Constituent	Unit	Screening Concentration	Source of Screening Concentration	Predicted Site Discharge Concentration
Chloride	mg/L	120	SEQG/CCME	**600**
Sulphate (Hardness)	mg/L	429	BC MOE*	**3915**
Sulphate	mg/L	128	BC MOE	**3915**
TDS	mg/L	500	SEQG	**6420**
TSS	mg/L	15	Schd 4 - MDMER	6
Arsenic	mg/L	0.01	SEQG/CCME	**0.006**
Cadmium	mg/L	0.0003	SEQG/CCME*	**0.0018**
Chromium	mg/L	0.001	SEQG/CCME	**0.025**
Cobalt	mg/L	0.0003	FEQG	**0.0030**
Copper	mg/L	0.004	SEQG/CCME*	**0.022**
Lead	mg/L	0.005	CCME	0.0003
Molybdenum	mg/L	0.07	WHO	2.5
Nickel	mg/L	0.07	WHO	0.014
Selenium	mg/L	0.001	SEQG/CCME	**0.042**
Uranium	mg/L	0.02	SEQG/CCME	**0.057**
Vanadium	mg/L	0.12	FEQG	0.059
Zinc	mg/L	0.1	FEQG**	0.042
Mercury	mg/L	0.000026	SEQG/CCME	0.000001
Ammonia (as N)	mg/L	5.74	SEQG/CCME	3.9
Un-ionized Ammonia	mg/L	1.00	MDMER Sched 4	0.0078
Phosphorus	mg/L	0.015	BC MOE	N/A
Thorium-230	Bq/L	0.6	HC	**0.9**
Radium-226	Bq/L	0.11	SEQG	**0.15**
Lead-210	Bq/L	0.2	HC	**0.419**
Polonium-210	Bq/L	0.1	HC	**0.15**

Notes
(1) Bolded values are those that exceed the screening concentrations
* Hardness induced guideline, assuming hardness >250 mg/L
** Hardness induced guideline, assuming hardness >250 mg/L, pH=7.0, DOC = 5.26 mg/L
Un-ionized ammonia calculated

Attachment: IR-20, IR-67, IR-69

Number	IR-20
Dept.	NRCan
Project effects link	Fish and fish habitat
Reference to EIS, appendices, or supporting documentation	Section 2.3.3.1.1 Appendix 7-C
Context and Rationale	**Context**: The proponent's objective for mining area remediation is to restore the groundwater within the confines of the freeze wall to an acceptable remediation target (EIS, sec. 2.3.3.1.1). The proponent's acceptable decommissioning objectives for groundwater quality are provided in EIS Table 2.3-3 and in Table 3-5 of Appendix 7-C. These objectives were based on laboratory core flood tests performed by flushing samples of ore with groundwater and groundwater amended with sodium hydroxide or sodium bicarbonate. The composition of the remediated groundwater observed in the core flood tests serves as the source term for the post-decommissioning reactive transport modeling presented in section 4 of Appendix 7-C. **Rationale**: In NRCan's opinion, it is important for reviewers to be able to assess the level of remediation achieved in order to reach the proponent's decommissioning groundwater quality objectives. Therefore, the proponent should provide complete water quality data for the pregnant lixiviant that remains in the ore zone after the end of mining and prior to any remediation.
Information Requirement	NRCan requests that the proponent revise Table 3-5 of Appendix 7-C to show the water quality in lixiviant remaining in the ore zone at the end of mining, prior to remediation activities.

Number	IR-67
Dept.	CNSC
Project effects link	Geology and groundwater
Reference to EIS, appendices, or supporting documentation	Section 7.6.2.1 (Remediation Objectives)
Context and Rationale	Context: Metallurgical testing, including batch reaction, coreflood testing and column tests are mentioned frequently throughout Sections 2 and 7 of the EIS. Outside of the composition of restored solutions from coreflood tests #2B and 3C, results from these various tests are not reported in the EIS or any associated Appendices. Rationale: The results from metallurgical testing are important to a number of items discussed in the EIS, including (but not limited to): evolution of hydrochemistry during remediation, source of salts in Lower Sandstone Aquifer porewaters, process plans, industrial wastewater treatment, estimating composition and volume of process precipitates, and composition of mining fluids and leachate. In particular, the EIS posits that mining area decommissioning objectives are achievable based on metallurgical testing and provides these objectives in Table 2.3-3. CNSC staff need to understand the specifics of this metallurgical testing, given

	its importance for the development and justification for mining and remediation activities. Denison must also provide information demonstrating that the proposed restoration actions and remediation targets are As Low As Reasonably Achievable (ALARA).
Information Requirement	1. Please provide a summary of the results and the analysis of results of the metallurgical tests within the EIS, or provide the technical supporting document with this information, and ensure the documentation is appropriately referenced in the EIS. This should include sample information for cores (e.g., mineralogy, location, U content, depth), test conditions (e.g., duration, # of iterations, column length, flow rate, temperature, pressure, sample frequency, influent/effluent composition), as well as results and how they are pertinent to the development of ISR activities. 2. Please provide further clarification/justification on how results from two singular coreflood tests (i.e., Coreflood #2B and Coreflood #3C) can justify large-scale remediation activities and targets following solution mining. 3. Please provide material demonstrating that the proposed restoration actions and remediation targets are ALARA.

Number	IR-69
Dept.	NRCan
Project effects link	Fish and fish habitat
Reference to EIS, appendices, or supporting documentation	Section 7.6.2.2.3 Appendix 7-C, sections 3.1 and 3.2
Context and Rationale	**Context**: For hydrogeological and geochemical assessments in support of ISR projects, the proponent identifies two aspects of primary importance (Appendix 7-C, sec. 3.1). These are a) groundwater remediation (Appendix 7-C, sec. 3.1.1); and b) the assimilative capacity of host rocks downgradient from the ore zone (Appendix 7-C, sec. 3.1.2). According to the proponent, the objective of groundwater remediation at decommissioning is to achieve water quality in the mined zone that does not pose a risk to receptors at the point of exposure. Assimilative capacity refers to the ability of groundwater-rock reactions to naturally sequester or attenuate COPCs migrating from the ore zone during the post-decommissioning period. **Rationale:** However, in NRCan's opinion, the proponent has neglected to mention the most fundamental aspect for hydrogeological and geochemical assessments in support of ISR projects. That aspect is the choice of ISR lixiviant and its effects on the mineralogy and hydrogeochemistry of the ore zone during mining operations. The proponent provides information on the pre-mining mineralogy (Appendix 7-C, sec. 3.2.1) and hydrogeochemistry (Appendix 7-C, sec. 3.2.2) but no information on their expected changes as a result of ISR mining. This Information is important when considering source terms in reactive transport modeling.
Information Requirement	NRCan requests that the proponent provide a detailed description of the expected mineralogical and hydrogeochemical changes occurring within the ore and barrier zones as a result of the injection of acidic lixiviant.

<u>Response:</u>

It is also important to note that Denison is completing a sequential EA and licensing process for the Project (see draft EIS Section 1). Detailed ISR mining-related information needed to support licensing and permitting has not been included in the EIS; it will be provided to regulators as part of permitting and licensing.

For the EIS, an initial understanding of the mining area remediation was needed to initiate the assessment of migration of constituents of potential concern in groundwater out of this area in the post-decommissioning period. The findings and conclusions of the EIS were also used, in turn, to inform and bound the engineering and feasibility work. The coreflood 2b and 3c, plus the Pre-Feasibility work (Denison, 2018) on mining area remediation (Section 2 (decommissioning section), Section 7, Appendix 7-C) was used in the draft EIS. This IR response provides additional information to support the selection of these studies.

Response to #1

1.0 Summary of Test Work

This response is focused on the metallurgical test work done to support an understanding of the:

a) mineralogy and hydrogeochemical changes in the ore and barrier zones as a result of the lixiviant (mining solution) injections (see IR-69);

b) the composition of the uranium bearing solution (UBS) at the end of mining and prior to any remediation (see IR-20); and

c) water quality and secondary mineral phases formed during remediation of the ore zone (IR67; this IR).

Metallurgical testing completed, the objectives and results of the work, and the information carried forward for discussion in this response are summarized in Table 1.

Further details on the metallurgical testing, including the sample information for cores (e.g., mineralogy, location, U content, depth), test conditions (e.g., duration, # of iterations, column length, flow rate, temperature, pressure, sample frequency, influent/effluent composition) are provided in the sections below. All data presented herein are from the metallurgical test programs used to support the 2018 Prefeasibility Study (Denison 2018) and the Feasibility Study (Denison 2023).

Table 1: Summary of Metallurgical Testing

Years	Description	Objective	Results	Information informing IR-20, IR-67 and IR-69
2017-2018	Batch leach tests and bottle roll/agitation leach tests	Early testing of leaching with alkaline and acidic based lixiviants	Supported decision for Acid Leaching	No discussion herein; very preliminary testing.
	A column leach test conducted using sulfuric acid followed, which also included simulated groundwater restoration tests.	Initial column test with acid leaching and evaluation of groundwater remediation	Early indication of groundwater remediation needs	Water Quality of UBS at the end of mining and Restoration Phase/flushing solution (groundwater remediation)
2021	Column leach tests on blended crushed ore	Test leach recoveries on a range of feed grades. Determine potential recovery and generate a representative sample for process plant testing.	Operationally, the feed sample for Column 1 is was verified as a reasonable blend to represent ISR wellfield production of UBS. Groundwater remediation with groundwater and alkaline solutions	Water Quality of UBS at the end of mining and Restoration Phase/flushing solution (groundwater remediation). Mineralogy.
2022	Column leach and remediation tests on crushed and screened core from individual hydrogeologic units	• Develop information to support geochemical modelling of the deposit, including leaching and neutralization phases. • Generate a detailed chemical and mineralogical characterization of the dominant hydrogeological units(HGUs) within the ore zone • Evaluate behaviour of different HGUs during ISR and neutralization, in particular those hosting the majority of the resource. • Compare the efficacy of neutralization of different HGUs, with the use of dilute sodium hydroxide	Uranium leachability was found to vary amongst the HGUs. Also, there were some indications of an HGU ("2A") to be avoided during operations to prevent clay mobilization.	Water Quality of UBS at the end of mining.
2018	Static uranium ore dissolution (jar) test on intact core	Room temperature, 1,138 hours (48 days) exposure of drill core to concentrated sulphuric acid (35 g/L) in a very slow-motion shaker.	Provided visual indication that with sufficient soak time, lixiviant will penetrate into intact high grade uranium pieces. The incomplete recoveries at the end of the tests can be attributed largely to requiring longer residence time	No discussion herein; testing limited to visual information.
2018-2022	Coreflood tests on intact core in 2018 to 2022	Simulate the in situ field conditions, to understand and develop the lixiviant conditions necessary for successful full-scale ISR. Objectives were to: evaluate the rate of uraninite dissolution and changes in permeability of the core with leaching; generate laboratory scale test results applicable to planning the 2022 field test; and delineate a life-of-well-pattern production profile.	Results were inconsistent in the early work (Coreflood 1 to 3C) due to highly variable reagent dosages in this pioneering work. Coreflood 4 and 5 (2021-ongoing). In Coreflood 4, as uranium mass gradually leached away, there was a mild trend of increasing flow rate at the same pressure, indicating permeability increase. Lessons learned from past testing, particularly with respect to reagent adjustments, were put into practice with this testing to enable completion of the longest test run to support the feasibility work. In total, 51.8% of the initial dry mass of the sample was removed by leaching; 50% of this was the result of uranium leaching. Feed grade was 26.66% U3O8. In Coreflood 5 is ongoing and is focused on HGU 2B, which has the majority of contained uranium, highest grade and highest natural permeability. The methodology was different from the other coreflood tests in that the flow was directed through a pencil hole in core. Cumulative recovery at end of February 2023 was 33%.	Water Quality of UBS at the end of mining and Restoration Phase/flushing solution (groundwater remediation). Mineralogy.
2022	Feasibility field test (FFT) leaching and remediation in 2022	The FFT was a full-scale proof of concept in an ISR method; to demonstrate injection of lixiviant and recovery of UBS from the CSW test pattern. Injection was into 1 well (GWR-041).	After pH below 3 was achieved in GWR-041, active leaching of uranium began. UBS grade from GWR-041 rose while pH declined. Uranium grade trended upwards to 25 g/L over four days, while injection pressure decreased. This suggests that leaching played a role in reducing resistance to flow. A peak sample grade of 43 g/L U was collected from GWR-041 after a further three days, so the acid injection phase was ended (on October 12). A global leaching recovery curve could be developed using the field testing and coreflood tests.	No discussion included herein.

1.1 2018 Column Leach and Groundwater Restoration Test

In early 2018, a column leach test with acid lixiviant was performed. The core material used for testing came from three drill holes. Select intervals of overlying very low-grade sandstone was blended with very high-grade intervals to create a composite feed grade of 24.2% U. Details on the core material used in the leach tests are provided in Appendix A to this response, in Table A1.

A total of 137 pore volumes (PVs) of uranium bearing solution (UBS) was generated at flow rate ranging between 2 to 4 PV/d. A 90% recovery was achieved with a peak individual sample uranium grade of 27.4 g/L and average UBS grade of 8.4 g/L U. Following the leaching, the column was flushed with simulated groundwater to simulate groundwater restoration. Analytical results from the first pore volume of water removed from the column during the restoration phase are incorporated into the range in UBS composition at the end of mining presented in Table IR-20, IR-67, IR-69-2.

Table 2 addresses IR-20. **This table summarizes information from the metallurgical testing with respect to composition of the UBS at the end of mining, prior to remediation**. See further discussion below in Section 1.3.

Flushing of the column with simulated groundwater (Phase 1 of restoration) was continued for 84 pore volumes. Phase 2 (RPV 84-108) circulated simulated ore zone water quality fortified with 1 g/L Bicarbonate [from $NaHCO_3$]. The test simulated the operation of a Reverse Osmosis (RO) water treatment step where solution exiting the column would be treated prior to being re-introduced. Phase 3 (RPV 108-114) re-established injection of simulated groundwater quality. The objective of this phase was to displace the bicarbonate and to ensure ground water stability once the circulation of fluid is halted. Analytical results for groundwater collected during this restoration process are shown in Table 9 and Table 10. Information presented in those tables is discussed further in Section 2.0.

1.2 Column and Coreflood Tests

The following were common to all column and coreflood tests performed**:**

- The pore volume was determined by pumping water (deionized water, site groundwater) into each column or core until filled.
- Temperature was controlled to 10°C by placing the apparatus in a walk-in cooler.
- An online UBS or Remediation/Flushing Solution sample was taken daily.

Table 2:UBS Chemistry at end of Leaching (Mining)

Test	Units	Coreflood 2B (2021)	Coreflood 3C	Number of Samples	Range of Values of UBS constituent concentrations across Metallurgical tests from 2018-2021 representative of End of mining conditions		Baseline Ore Zone Groundwater Chemistry
Sample Name		**D-CF2B-57**	**D-CF3C-142**		**Minimum**	**Maximum**	**GWR-032 (2021-06-04)**
Acidity	mg/L			5	65000	87000	
Bicarbonate	mg/L	-	-	6	0	<1	118
Carbonate	mg/L			5	<1	<1	<1
Chloride	mg/L			1	<10	1220	220
Hydroxide	mg/L			0	<1	<1	<1
P. alkalinity	mg/L			0	<1	<1	<1
pH	pH units	2.1	1.1	13	0.63	2.10	6.83
Specific Conductance	uS/cm			9	52100	303000	860
Eh	mV			10	580	870	
Sum of ions	mg/L			5	52700	70100	504
Total alkalinity	mg/L			5	<1	<1	97
Total hardness	mg/L			5	202	1480	182
Nitrate	mg/L			5	<4	<40	<0.04
Fluoride	mg/L			5	1	34	0.23
Total dissolved solids	mg/L			5	8970	47900	599
Calcium	mg/L	557	723	13	58	723	55
Magnesium	mg/L	47	<63	13	<10	240	11
Potassium	mg/L	148.8	<86	13	6.2	149	4.6
Sodium	mg/L	17.9	<77	13	6.0	12300	81
Aluminum, dissolved	mg/L	1738	71	13	69	4609	0.0006
Antimony, dissolved	mg/L			5	0.040	1	<0.0002
Arsenic, dissolved	mg/L	<0.1	<1	13	<0.1	21	0.2
Barium, dissolved	mg/L	<0.1	<1	13	<0.05	<0.5	0.063
Beryllium, dissolved	mg/L			5	0.07	0.4	<0.0001
Boron, dissolved	mg/L			1	<1	<10	0.43
Cadmium, dissolved	mg/L	<0.1	<1	13	0.018	1.809	<0.00001
Chromium, dissolved	mg/L	9.1403	<1	13	<0.1	9.140	<0.0005
Cobalt, dissolved	mg/L	5.41	<1	12	0.5	15	<0.0001
Copper, dissolved	mg/L	5.16	10.23	13	5.2	964	<0.0002
Iron, dissolved	mg/L	3309	4094	13	820	4094	4.2
Lead, dissolved	mg/L	0.97	19.45	13	0.20	19	<0.0001
Manganese, dissolved	mg/L	16.35	<81	13	2.70	41	0.22
Molybdenum, dissolved	mg/L	1.65	59.57	13	1.65	60	0.0038
Nickel, dissolved	mg/L	15.7	<1	13	<1	27	0.001
Selenium, dissolved	mg/L	18.4	<1	13	<0.025	26	<0.0001
Silver, dissolved	mg/L			5	<0.005	<0.05	<0.00005
Strontium, dissolved	mg/L	5.2	<1	7	0.60	5	1.66
Thallium, dissolved	mg/L	-	-	5	0.05	<0.2	<0.0002
Tin, dissolved	mg/L	-	-	5	0.07	0.30	-
Titanium, dissolved	mg/L			5	2.80	32	<0.0002
Uranium, dissolved	mg/L	7.45E+03	3.88E+04	13	7.70E+02	3.88E+04	1.10E-02
Vanadium, dissolved	mg/L	160.88	62.57	13	6.16	161	<0.0001
Zinc, dissolved	mg/L	134.37	4.03	13	2.30	331	2.62
Sulfur	mg/L	9,263	22,877	13	5211	209411	4.3
Phosphorous	mg/L	-	75.4	13	2	75	<0.01
Silica, soluble, dissolved	mg/L	-	-	6	31	192	13.3
Radium-226*	Bq/L	-	-	4	230	3000	180
Radium-228*	Bq/L	-	-	1	5	5	-
Lead-210*	Bq/L	-	-	4	600	1700	2200
Polonium-210*	Bq/L	-	-	4	290	2000	110
Thorium-230*	Bq/L	-	-	4	21000	220000	7
Thorium-232*	Bq/L	-	-	4	2	12	-
Radium-226*	mg/L	-	-	4	6.29E-06	8.21E-05	4.92E-06
Thorium-230*	mg/L	-	-	4	2.75E-02	2.88E-01	9.17E-06

Notes

* Analytical results for radionuclides are limited. The ranges of radionuclide concentrations (Bq/L) provided are considered conservative because they reflect composite samples collected over the ISR leaching period in the 2021 column samples, not UBS at the end of mining

(blue shading) Analytical results for Coreflood 2B and 3C are provided (in addition to the range of UBS Constituent Concentrations) because results from the remediation portion of these tests was used for development of the Restored Solutions modelled in the draft EIS (Appendix 7-C)

(yellow shading) Used to highlight baseline groundwater quality in the ore zone for comparison with UBS Composition at end of mining.

2021 UBS Column Tests

The objective of the 2021 column tests was to test leach recoveries on a range of feed grades. Four samples were generated from nine drill holes, all proximal to the WS Shear where most of the resource lies. The samples contain varying amounts of uraninite, sulphides, clay and iron and represent blends of the various hydrogeologic units within the deposit (HGUs). Samples were crushed to -10 mm. Columns with a diameter of ~100 mm were packed with the samples. Four column tests were conducted, with details for each sample listed in Table 3.

The 2021 column tests used the full-size distribution of crushed core and achieved relatively high mineral liberation in contact with lixiviant. This results in relatively rapid leach kinetics compared to intact core. The initial flow rate was calculated based on a retention time of eight hours (3 column pore volumes per day (PV/d)).

Table 1:Summary of Samples for Column Test 1 to 4

Column No.	Sample ID	Mass (g)	Feed U_3O_8 (wt%)[a]	HGUs in Blend[b]	Hole IDs	Number of PVs - Leaching	Number of PVs - Remediation
1	Sample A	27,338	48.1	2A/B/C/D	GWR-10, 16, 19, 21	116	6.7 (D.I. Water)
2	Sample B	18,619	46.1	2B	GWR-10, 19, 23, 26	120.4	16.5 (Site GW, 10g/L NaOH Solution)
3	Sample D	9,180	1.8	2A/C/D/E	GWR-15, 16, 19, 26	14.7	15.5 (Site GW, 10g/L NaOH Solution)
4	Samples C&E	8,742	26.9	2A/C/D/E	GWR-01, 19, 22	29.7	11.2 (Site Water, 1.5g/L NaHCO3)

Notes
[a] Back Calculated
[b] HGUs = Hydrogeological Units in the Ore Zone

A single pass flow of dilute sulfuric acid and hydrogen peroxide lixiviant was run between 22 to 38 days. Lixiviant strength was generally decreased over the course of each run. UBS composition from each of the column leach tests at the end of leaching is shown in Table 2.

On completion of the leaching tests, each column was flushed with water (de-ionized water or groundwater) and for columns #2, #3 and #4, neutralization of groundwater was evaluated using alkaline solutions. Solutions used and porewater volumes flushed are summarized in Table 3. Analytical results for solution composition during the remediation phase are included in Table 9 and Table 10.

Mineralogy of the column samples pre-testing were analyzed by XRD and QEMSCAN; the mineral assemblages aligned with the overall understanding of the ore zone mineralogy, provided as Table IR-20, IR-67, IR-69-A2 (Appendix A to this response). XRD results for the fine particles are provided as Table 4. These results show the formation of secondary sulphate minerals during the uranium ore leaching process. The other mineral phases are associated with the (pre-mining) ore zone mineralogy, provided in the draft EIS as Table 3-1 of Appendix 7-C, and provided herein in Appendix A as Table 2.

Table 4: XRD Results for Fine Particles in UBS, Column Experiments #1 to #4 (2021)

Mineral Phase	Column #1	Column # 2	Column #3	Column #4
Anglesite	18.1	9.8	-	6.6
Anhydrite	7	-	-	-
Biotite	-	38	24.2	8.3
Chlinochlore	62.6	21.2	20.3	20.1
Gypsum	-	4.4	-	-
Kaolinite	-	22	41.1	57
Quartz	-	-	5.4	-
Pyrite	12.3	4.6	8.9	7.1

Notes
(shaded) Secondary Minerals

2022 Column Leaching and Remediation Tests

A suite of 5 column leaching tests was undertaken to support remediation planning. Whereas core flood testing may more realistically represent the ISR conditions with respect to operational conditions (i.e., using intact core and pressure applied), this phase of column testing used crushed material to accelerate the testing process and, thus, provide key information on the remediation phase and prepare for the (2022) field feasibility study.

The 2022 column testing program consisted of five 100mm diameter columns loaded with samples from different HGUs providing characterization of ore variability. The samples were selected from a blend of assay sample splits of fresh core from GWR-054 through GWR-061, supplemented by preserved core from GWR-016, GWR-022 and GWR-024 stored frozen by Denison. The hole locations are shown Figure 1 ranging along the length of the deposit. Intervals from five to eight different drill holes were composited to meet required sample mass and/or to meet representativeness for each HGU.

The samples were hand crushed to minimize fines generation, to a maximum size of 30 mm. Minimum size fraction was +0.212 mm by wet screening out fines. This was designed to promote flow through the column and minimize exposed mineral surface area. Overall procedures were like 2021 column tests. The lixiviant was a mixture of sulphuric acid and hydrogen peroxide and was prepared using Wheeler River groundwater. Lixiviant was injected upwards in essentially flooded plug flow conditions. The flow rate was calculated based on ~0.67 measured column PV/d. Test parameter variables were minimized, so the differences between HGUs could be distinguished.

Initially, all five columns were fed lixiviant from a common tank. The low-grade columns 2A and 2E were run until fully leached. From that point forward, 2A and 2E were fed from a separate tank to perform groundwater flush and neutralization. A summary of details of the column tests including pore volumes during leaching, during post-leaching flushing with groundwater, and during neutralization are provided in Table 5.

UBS composition at the end of the leaching period is provided in Table 2, and groundwater quality following the groundwater flushing and neutralization is provided in Table 9 and Table 10.

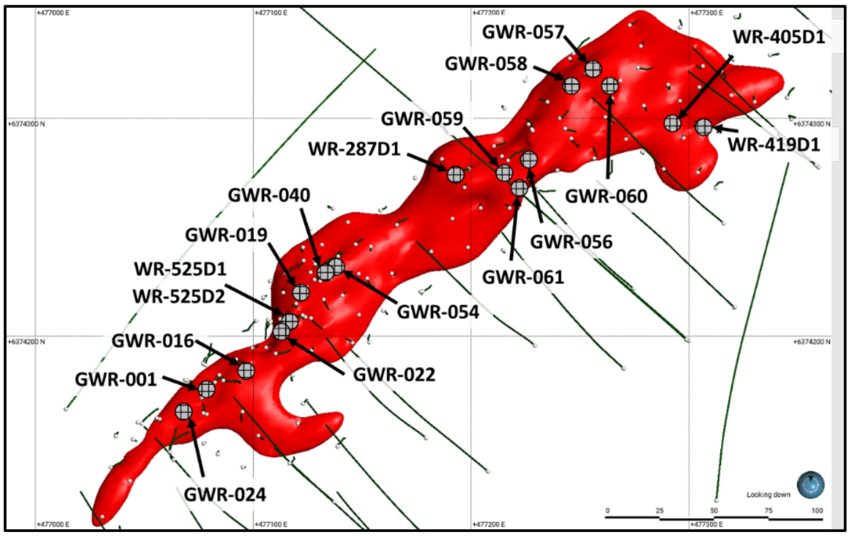


Figure 1: Metallurgical Hole Locations for 2022 Column Leach Testing

Table IR-20, IR-67, IR-69-2: 2022 Column Leach Testing Details

Columns	2a	2b	2c	2d	2e
Estimated Grade (wt % U3O8)	5.0%	58.3%	41.3%	46.1%	1.6%
	Numbers of Pore Volumes				
Phase 1: Groundwater equilibration	2.9	3.1	3.0	2.8	3.1
Phase 2: In-Situ Recovery (ISR)	20.8	66.7	64.1	62.4	19.4
Phase 3: Groundwater Flushing	15.0	16.2	15.1	11.6	14.9
Phase 4: Neutralization	4.4	4.2	11.0	2.6	3.7
Total Pore Volumes	43.1	90.3	93.1	79.4	41.1
pH at end of Phase 2	0.93	0.95	0.91	0.91	0.95
pH at end of Phase 4	9.53	7.1	3.8	7.22	7.87

QEMSCAN was done on the column pre-testing and at the end of the flushing period. The results are presented as Table 6. Mineral phases that reflect basement-derived materials in the ore zone residuals include biotite, spodumene, petalite and garnet.

Table 6: 2022 Column Leach Test QEMSCAN results

QEMSCAN	Column 2a		Column 2b		Column 2c		Column 2d		Column 2e	
	Pre-Test (Feed)	Post-Test (Residuals)	Pre-Test (Feed)	Post-Test (Residuals)	Pre-Test (Feed)	Post-Test (Residuals)	Pre-Test (Feed)	Post-Test (Residuals)	Pre-Test (Feed)	Post-Test (Residuals)
Mineral	**2A-BATCH-1**	**DCL-2a-R**	**2B-BATCH-1**	**DCL-2b-R**	**2C-BATCH-1**	**DCL-2c-R**	**2D-BATCH-1**	**DCL-2d-R**	**2E-BATCH-1**	**DCL-2e-R**
Anglesite		3.84		3.28		3.99		14.18		1.15
Biotite	4.84	1.38	0.25	0.44	4.26	0.83	1.16	1.41	2.96	1.98
Bornite	0.36	0.07					0.70	1.15	0.43	0.20
Calcite			0.42	0.69		0.14				
Chalcocite (CuS)			1.54		0.28		0.31		1.28	
Chalcopyrite	12.37	13.03	0.71	2.27	0.11	0.16		0.25	8.76	3.48
Chlorite				3.15						
Clinochlore-(Fe)		11.34				0.8		9.39		52.26
Covellite (CuS)	0.35	0.38	0.19	2.61	0.39	1.34	0.06	0.18	0.10	0.20
Fe-oxide		0.03				1.15		0.53		0.03
Galena	0.63	0.40	0.43	1.23	0.25	0.3	0.53	3.06	0.10	0.02
Garnet	0.25				2.52		1.47		0.43	
Goethite-Clay mix	4.31	0.03	0.35	0.10	7.37	16.78	10.95	1.66	1.52	0.41
Illite	0.21	0.52		0.05					0.32	0.67
Ilmenite		0.08				0.09				0.47
Kaolinite	42.04	40.41	1.52	3.28	7.12	11.67	0.75	2.09	62.20	28.63
Muscovite	9.46	6.09	0.79	3.35	0.81	1.2	0.15	2.06	13.69	8.79
Petalite		0.15		0.05				0.03		0.02
Pyrite	8.48	10.44	1.49	3.38	0.98	1.58	0.12	0.09		0.84
Quartz	4.40	9.11		1.05	0.05	0.42		1.74	1.01	0.12
Rutile	0.61	0.58	0.07	0.04	0.04	0.04			0.44	0.32
Sphalerite	0.56	0.41		0.04	0.03			0.02		
Spodumene		0.17		0.05		0.16				0.05
Uraninite	10.70	1.07	92.10	74.89	75.74	58.72	83.73	61.93	6.67	0.29
Zircon	0.36	0.45	0.06	0.02		0.04				
Siderite						0.54				

2018-2022 Coreflood Tests

Core testing machines (CTM) were typically used to study in situ oil recovery processes, for flooding uranium deposit drill core with lixiviant to simulate ISR conditions on a micro scale which are referred to as coreflood tests. All drill cores tested were from vertically oriented drill holes allowing the flow from end to end of the coreholder to simulate flow in the vertical direction of the deposit. This is tangential to the intended predominantly horizontal flow path between wells in situ.

From late 2019 to mid-2021, coreflood tests numbered 1, 2A, 2B, 3A, and 3C were performed. The main objective was to simulate the in situ field conditions, to understand and develop the lixiviant conditions necessary for successful full-scale ISR. Priority was placed on testing a large number of samples over short durations. Tests were ended early, so, uranium recoveries were low relative to later testing (generally < 10%). Results for Coreflood 2B and 3C are discussed further herein.

Coreflood 2B and 3C

Details for the testing of Coreflood 2B and 3C are provided in Table 7.

Table 7: 2021 Coreflood Test Details

Coreflood	**2B**		**3C**	
Corehole	GWR-024		GWR-019	
Core Dimensions (average diameter, average length), in mm	60 x100		78*70	
Core Pore volume (mL)	36.9		53.1	
Estimated Grade (wt % U3O8)	24		70.7	
	Number of Pore Volume	pH (at end of Leaching or Remediation Phase)	Number of Pore Volume	pH (at end of Leaching or Remediation Phase)
In-Situ Recovery (ISR)	34.4	2.1	82.7	0.98
Groundwater Flushing	22.7	1.91	91.6	2.83
Neutralization with NaOH	55.6	11.92	-	-
Neutralization with $NaHCO_3$	-	-	62.4	6.87
Post-Neutralization Groundwater Flush	9.3	11.47	17.2	6.43
Total Pore Volumes	122	-	253.9	-

The UBS composition at the end of leaching for Coreflood 2B and 3C is provided in Table 2. The analytical results for these samples were provided in Table 2 because Corefloods 2B and 3C were the primary basis for the development of the restored solutions. UBS composition during flushing for these coreflood tests is discussed further in Section 2.0 and is summarized in Table 9 and Table 10.

At the end of testing, the core from Coreflood 2B was frozen. The frozen core was cut in the middle into two sides. XRD, QEMSCAN and SEM was done on one half of the sample, on the inside cut. The XRD results indicated:

- 19.5 wt% Kaolinite
- 26.7 wt % Montmorillonite
- 45.3 wt % Dickite
- 2.9 % Fluorite
- 5.6 % Pyrite

The cumulative uranium recovery for core 2B was low, and thus the sample (post-leaching) has a mineralogical composition comparable to that of the unmined ore zone. The portion of the sample that underwent mineralogical analysis was also rich in clay minerals. The QEMSCAN results are shown in Figure 2. The SEM image (not shown) shows the presence of uraninite, pyrite, and sphalerite.

The QEMScan shows a minor amount of mineral phase suggestive of a small amount of jarosite ("Fe-Al-Si-S") closely associated with pyrite. This suggests formation of oxidation products/secondary minerals in the core with exposure to lixiviant.

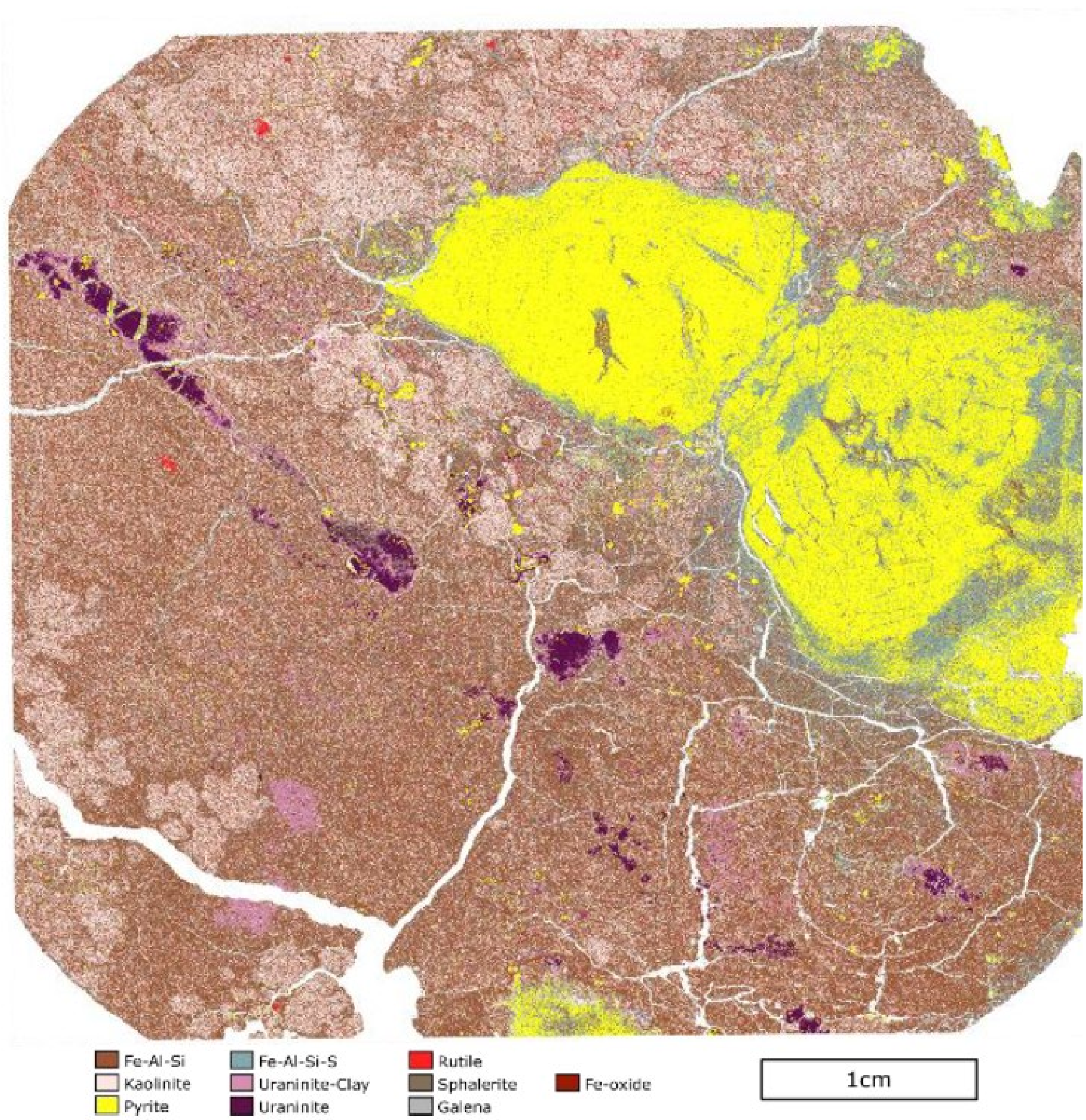


Figure 2: Coreflood 2, QEMSCAN

Coreflood 4

The Coreflood 4 sample was taken from a high-grade segment of HGU 2C from hole GWR-040, which is the middle CSW in the planned field feasibility test (FFT) well pattern. Thus, it was an excellent candidate to correlate with subsequent FFT results.

Coreflood 4 feed sample side view is shown in Figure 3. Near-horizontal mineral banding is evident.

Figure 3: Coreflood 4 Feed Sample Side View, Prior to Placement in Coreflood Machine

Coreflood 4 ran for a total of 113 PVs over 391 days, with life-of-test average UBS grade of 18.7 g/L U and reagent consumptions of 2.78 kg H_2SO_4 and 0.35 kg H_2O_2 per kg U. Part of the difficulty of production ramp-up of Coreflood 4 was due to the flow constraint of low micro scale permeability through the intact core, particularly with generally lower permeability in the vertical flow direction of coreflood samples. As uranium mass gradually leached away, there was a mild trend of increasing flow rate at the same pressure, indicating permeability increase.

In total, 51.8% of the initial dry mass of the sample was removed by leaching. Just over half of the mass loss is accounted for by uranium leaching, and the remainder is accounted for by gangue mineralization leaching. The feed grade was back calculated from measurements of the total uranium in UBS collected throughout the test plus leach residue sections. Feed grade was 26.66% U_3O_8, and final recovery was 97.1%. Coreflood 4 is the most comprehensive simulation of ISR for the Phoenix FS, with the highest recovery demonstrated from an intact core to date.

Coreflood 4 provides the most information about the mineralogical and hydrogeochemical changes that are occurring in the ore zone during mining. Post-leaching, the core leached in Coreflood 4 was cut into segments, as shown in Figure 4, assayed and visually examined (photographed) for changes to the core due to leaching. The mineralogy of each section was determined.

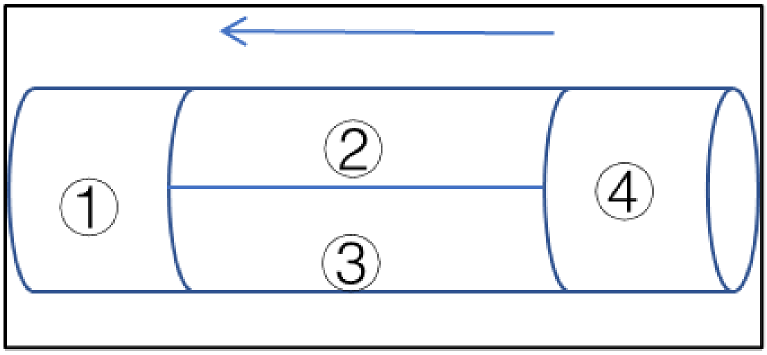


Figure 4: Coreflood 4 Cut Sections and Direction of Flow

Coreflood 4 feed side puck (Section 4), inlet face view is shown in Figure 5. The feed end was deeply eroded, nearly through to the discharge side of the section.

Figure 5: Coreflood 4 Feed Side Puck (Section 4), Inlet Face View

Coreflood 4 middle (Section 2), centre longitudinal cut face view is shown in Figure 6. It was strongly bleached throughout, with cracks that appeared after drying.

Figure 6: Coreflood 4 Middle (Section 2), Centre Longitudinal Cut Face View

Coreflood 4 discharge end puck (Section 1), inlet face view, dried, is shown in Figure 7. It was strongly bleached across the entire cross-section.

Figure 7: Coreflood 4 Discharge End Puck (Section 1), Inlet Face View, Dried

XRD for each of the sections is given in Table 8. Mineral phases that reflect basement-derived materials in the ore zone residuals include anorthite.

Table 8: XRD Results for Coreflood 4 Core Sections

Mineralogical Composition Post-Extraction	D-CF4A-1	D-CF4A-2	D-CF4A-3	D-CF4A-4
Location/section in the coreflood column	Discharge End	Midsection	Midsection	Feed End
Kaolinite (Al2Si2O9H4)	74.7	22.1	38.3	43.8
Pyrite (FeS2)	17.9	20	12.4	16
Chamosite (Mg2.518Fe2.482)Al1.2Si3.8O18H10) (Chlorite Group)	7.3	5.8	1.4	--
Gypsum (CaSO6H4)	--	7.5	4.5	4.8
Barite (BaSO4)	--	1.6	0.7	--
Anorthite (CaSiAl2O8)	--	30.7	31.8	--
Goethite (FeO2H)	--	12.4	10.9	4.3
Anglesite (PbSO4)	--	--	--	31.1

1.3 Composition of the UBS remaining in the Ore Zone at the end of Mining (IR-20)

The analytical results for the UBS composition in Coreflood 2B and 3C are shown in Table 2 along with a range of UBS composition that was developed from the relevant analytical results for a total of 13 samples from across the column and coreflood tests. The ranges of values for constituents of potential concern (COPCs), as defined in Appendix 7-C of the draft EIS, are provided in Table 2. Uranium and other COPC concentrations generally vary by 2-3 orders of magnitude. There is expected variability in the UBS composition because of the nature of the deposit, which has been captured in the conditions of the metallurgical testing, and the nature of the testing (e.g., core vs. crushed rock, test duction, lixiviant composition, etc.). The analytical results were given explicitly for Coreflood 2B and 3C because of the use of results from these coreflood tests to develop the restored solutions, which is discussed further in Section 2.0.

The range of UBS composition at the end of mining has been included in Table 3-5 of Appendix 7-C as was requested as part of IR-20, such that UBS quality at the end of mining and remediated conditions (represented by the Restored Solutions) can be compared. **The updated Table 3-5 has been added to this response as Appendix B.**

1.4 Mineralogical and Hydrogeochemical Changes to the Ore Zone with Mining (IR-69)

Understanding of changes in the mineralogy of the ore zone with mining are informed by the XRD results from Coreflood 4, as this test was terminated at the completion of the ISR process, and QEMSCAN results for the 2022 columns, because these tests provide quantitative information on the mineral assemblage following mining and with remediation. The following conclusions are made with respect to changes in the mineralogy in the ore zone with mining:

- The mining process is effective as leaching uraninite from the ore zone and also results in partial dissolution of sulphide minerals (pyrite, sphalerite, galena, etc.);
- Secondary sulphate minerals are formed as a result of the mining process. The associated equations are shown in Appendix A. Jarosite minerals were suggested surrounding pyrite particles in the QEMSCAN of Coreflood 2, but were not detected in any of the other post-mining residuals. Gypsum and barite were detected in XRD but not present at quantifiable levels in association with the 2022 column residuals. Formation of anglesite is shown by XRD and QEMSCAN in post-mining residuals.

- The elevated concentration of aluminum in solution evidences clay mineral dissolution, but overall the relative abundance of clays in the ore zone increases with ISR mining, as would be expected with ore dissolution.

The hydrochemistry of the ore zone post-mining is presented in Table 2. Consistent with the dissolution of parent minerals and the pH of the UBS, most COPCs concentrations in the UBS at the end of mining are elevated with respect to baseline groundwater conditions in the ore zone.

2.0. Composition of the Restored Solutions (Addresses Question #2 of IR-67)

The restored solutions were developed using the metallurgical data that were available when conditions in Post-Decommissioning were being conceptualized in 2020-2021 for numerical modelling and effects assessment (Appendix 7-C of the draft EIS). This included the early results on acid leaching of the core (2018) and Coreflood 2B and 3C results. At that time, the coreflood tests provided the most detailed information from which to develop the chemistry of the Restored Solutions #1 and #2, using the remediation portion of the tests. From the results of that testing, "Restored Solution #1" and "Restored Solution #2" (Table 3-5) were developed to represent the bounding scenarios for groundwater quality considered in the reactive transport model to evaluate the potential for environmental effects following remediation of the mining area. As is discussed further below, these solution compositions were developed to reflect remediation of the ore zone through flushing and neutralization, without over-neutralization – meaning, base addition past circumneutral conditions to alkaline conditions.

Since that time, more information from the column and coreflood tests has become available that supports the composition of the Restored Solutions put forward in the draft EIS as being representative of porewater within the mining zone with remediation.

When developing the restored solutions for the draft EIS, the approach was generally to select concentrations for any given element/parameter that represented a low to mid-range value for the COPC from the metallurgical testing solutions, to be conservative with respect to evaluating potential effect, but also to reflect the goal of the remediation (to align with ALARA, as is discussed below). For dissolved uranium, the concentration in Restored Solutions #1 and #2 were set to upper bounds of 100 mg/L and 30 mg/L, respectively. In some cases, like Co and Ni, the values selected for modelling were identified to be on the high end upon subsequent metallurgical testing. Thus, the concentrations for these elements modelled are conservative with respect to anticipated pore water concentrations of these elements post-remediation.

The basis of the selected concentrations for Restored Solution #1, which was the solution modelled in Appendix 7-C of the draft EIS, is provided below in Table 9. As Restoration Solution #1 contains the higher remaining concentrations, and lower pH (i.e., differs more from baseline conditions in the ore zone), this solution was carried forward for geochemical reactive transport modelling to evaluate environmental effects.

Table 9: Groundwater Chemistry basis for Restored Solution #1

Metallurgical Test		2018 Pre-Feasibility; Restoration Phase Data	Coreflood 2B	Coreflood 2B	Coreflood 2B	Coreflood 3C	2021 Column, 2	2021 Column, 3	2021 Column, 4	2022 Column, 2a	2022 Column, 2c	2022 Column, 2d	2022 Column, 2e	2022 Column, 2e	Restored Solution #1	Notes on Value Carried Forward in Restored Solution for Model
Sample Name		RPV30-23	D-CF2B-121-143	D-CF2B-134-144,146	D-CF2B-COMBINED-1 (D-CF2B-134-144,146)	D-CF3C-225-237	D-CL2-FW-2	D-CL3-FW-2	D-CL4-FW-2	D-CL2A-68	D-CL2C-114	D-CL2D-111	D-CL2E-63	D-CL2E-68		
Statistic		-	Average Value[a]	Average Value[a]	-	Average Value[a]				-	-	-	-	-		
Remediation Method		GW Flush	NaOH Neutralization	NaOH Neutralization	NaOH Neutralization	Bicarbonate Neutralization	Groundwater	Groundwater	NaOH Neutralization	NaOH Neutratlization	GW Flush	GW Flush	GW Flush	NaOH Neutratlization		
pH	pH units	3.87	4.4	4.42		2.97	2.6	2.44	2.66	3.80	2.58	2.46	2.48	4.05	4.3	High end of observed
Eh	mV		520	525	Same as adjacent (D-CF3C-238-256)	598					570	542	426	648	-	Set in model to reflect oxidized conditions
Pore Volumes of remediation	-	30-32	59-74	69-76		109-130				19.4	15.1	11.6	14.9	18.6	-	
Aluminum, dissolved	mg/L	5.6	9.7	10.3	7.0	<5	5.4	26	9.1	9.0	9.9	12	32.8	15.6	7	Low end of observed
Arsenic, dissolved	mg/L	<0.010	0.17	0.22	0.03	0.48	0.15	0.31	0.1	0.02	0.14	0.06	0.4	0.012	0.06	Low end of observed
Barium, dissolved	mg/L	<0.05	0.10	<0.1	<0.05	<0.1	<0.005	<0.05	<0.05	<0.05	<0.05	<0.05	0.006	0.018	0.05	Mid range of observed
Total Inorganic Carbon (C(4))	mg/L		-	-	-										58	Assumed to be approximately equivalent to GW values and considers some bicabonate
Calcium	mg/L	109	228	210	-	81.7	11	43	23	21	22	380	20	35	110	Mid range of observed
Cadmium, dissolved	mg/L	<0.001	<0.1	<0.1	0.015	<0.1	0.061	0.033	0.020	0.051	0.001	0.004	0.0004	0.0003	0.015	Mid range of observed
Chloride	mg/L	37			-		1	<1	1	33	<1	6	3	9	200	Very limited information available. Set to a higher value to consider potential for values closer to baseline ore zone water quality
Cobalt, dissolved	mg/L		2.8	2.1	2.0	<0.1				0.15	0.03	0.16	0.53	0.42	2	High end of observed
Chromium, dissolved	mg/L	0.04	0.22	0.14	<0.05	<0.1	0.18	0.76	0.16	<0.05	<0.05	<0.05	0.17	0.013	0.05	Mid range of observed
Copper, dissolved	mg/L	2.23	0.21	0.24	0.17	<0.1	6.2	5.8	9.2	25	3.1	3.2	20.1	4.7	0.17	Low end of observed
Fluoride	mg/L	NA	-	-	-		2.4	0.32	1.6	3	6.0	4.2	2	3		No data available at time of developing Restored Solution
Iron, dissolved	mg/L	54.1	378	334	324	13.0	23.2	92	40	124	33	75	74	57	100	Mid range of observed
Potassium	mg/L	<1	10.1	9.5	-	<8	3.5	4.7	1.5	3.7	1.5	5.6	1.9	1.4	9	High end of observed
Magnesium	mg/L	3.7	-	-	-	<6	0.6	11	0.2	3.0	0.4	4.4	38	43	6	Mid range of observed
Manganese, dissolved	mg/L	0.68	9.3	-	3.4	<8	0.57	0.63	0.85	2.0	0.98	4.1	0.31	0.30	3.4	Mid range of observed
Molybdenum, dissolved	mg/L	0.05	0.22	0.22	0.10	<0.1	0.16	2.1	0.10	0.05	0.05	0.03	0.58	0.019	0.1	Mid range of observed
Sodium	mg/L	221	283.2	351.0	-	120	3.1	4.1	2.8	760	3.0	4.3	3.7	378	190	Mid range of observed
Nickel, dissolved	mg/L	0.20	12.8	10.0	9.7	<0.1	0.56	3.2	0.75	0.55	0.06	0.35	1.04	0.92	9.7	High end of observed
Lead, dissolved	mg/L	3.08	2.9	3.41	3.1	1.8	4.97	0.68	0.96	1.3	0.22	0.10	2.64	0.50	3.1	Mid-high range of observed
Sulfate	mg/L	860	2700	2724	-	679	300	750	480	2180	470	1460	690	1220	620	Mid range of observed
Selenium, dissolved	mg/L	<0.025	0.31	0.23	0.08	<0.1	0.39	0.10	0.13	0.01	0.02	0.05	0.042	0.098	0.08	Mid range of observed
Si	mg/L	71.9	-	-	-										40	limited information available; value similar to available data assumed
Strontium, dissolved	mg/L		4.5	4.4	4.4	3.2	0.32	0.70	0.22	0.62	0.43	0.58	0.67	0.76	4.4	Upper range of observed
Zinc, dissolved	mg/L	1.48	1.6	1.4	1.4	0.14	1.7	3.6	3.0	10	0.14		0.20	0.13	1.4	Mid-range of observed
P	mg/L		-	-		<4									4	applied limited information
Uranium	mg/L	105	586	334	338	45.2	92	217	579	145	288	328	38.1	30.8	100	Mid-low end of observed; value set as upper bound in the EIS
Vanadium, dissolved	mg/L	0.09	2.9	0.8	0.51	0.32	0.35	2.8	1.1	0.13	0.70	0.51	1.8	0.006	0.51	Low end of observed
Polonium-210	Bq/L	6.3+/-0.5	-	-	1600	-	-	-	-	-	-	-	-	-		Not modelled (lack of thermodynamic constants)
Radium-228	Bq/L	-	-	-	<10	-	-	-	-	-	-	-	-	-		Not modelled
Thorium-228	Bq/L	-	-	-	<3	-	-	-	-	-	-	-	-	-		Not modelled
Thorium-230	Bq/L	105+/-9.6	-	-	<500	-	-	-	-	-	-	-	-	-		See Below for values in mg/L
Radium-226	Bq/L	65.8+/-0.3	-	-	<200	-	-	-	-	-	-	-	-	-		See Below for values in mg/L
Lead-210	Bq/L	530+/-1.3	-	-	2400	-	-	-	-	-	-	-	-	-		Not modelled (transport behaviour taken into account with Pb
Thorium-232	Bq/L	0.2+/-0.04	-	-	0.05	-	-	-	-	-	-	-	-	-		Not modelled
Radium-226	mg/L	1.80E-06	-	-	<5.47E-06	-	-	-	-	-	-	-	-	-	5.47E-06	Limited data, high end value[b]
Thorium-230	mg/L	1.38E-04	-	-	<6.55E-04	-	-	-	-	-	-	-	-	-	3.93E-06	Limited data set[b]

Notes

(shaded) Data Available when developing the Restored Solutions for the modelling in Appendix 7-C of the EIS

a Arithmetic average values, calculated using detected measurements or where all values were non-detect, assumed the detection limit. pH value is the median, not the arithmetic average.

b Limited data set meant that PFS groundwater flushing data at pH 5.8 was also considered in setting this value, with a Th-230 concentration of 2.62E-07 mg/L and a Ra-226 value of 1E-05 mg/L (see Table IR-67-10)

Table 10: Groundwater Chemistry basis for Restored Solution #2

Metallurgical Test		2018 Pre-Feasibility; Restoration Phase Data			Coreflood 3C	Coreflood 3C	2021 Column, 4	2022 Column, 2b	Restored Solution #2	Notes on Value Carried Forward in Restored Solution for Model
Sample Name		RPV 38-42	RPV 42-53	RPV 54-57	D-CF3C-238-256	D-CF3C-COMBINED-1 (D-CF3C-238-256)	D-CL4-FW-3	D-CL2b-116		
Statistic		-	-	-	Average[a]	-		-		
Remediation Method		GW Flush	Neutralization ($NaHCO_3$)	GW Flush	Bicarbonate Neutralization	Bicarbonate Neutralization	Distilled Water Flush Post NaOH Neutralization	NaOH Neutratlization		
pH	pH units	5.8	8.5	8.3	6.51	Same as adjacent (D-CF3C-238-256)	7.48	6.51	6.1	Low end of Observed
Eh	mV				402		-	387	-	Set in model to reflect oxidized conditions
Pore Volumes of remediation	-	76-84	82-108	-	131-162		-	18.70	-	
Aluminum, dissolved	mg/L	0.27	1.32	4.4	<5	0.56	0.70	10	0.56	Low end of observed
Arsenic, dissolved	mg/L	0.10	0.04	0.06	0.25	0.1	<0.01	0.000259	0.1	Upper end of observed
Barium, dissolved	mg/L	<0.05	0.05	0.04	<0.1	0.05	<0.05	0.2	0.05	Mid range of observed
Total Inorganic Carbon (C(4))	mg/L	-	-	-	-				105	Assumed to be approximately equivalent to GW values and considers some bicabonate neutralization
Calcium	mg/L	28	13	5	48.1		16	127	10	Low end of observed
Cadmium, dissolved	mg/L	0.002	<0.001	<0.001	<0.1	0.004	0.004	<0.1	0.004	Mid range of observed
Chloride	mg/L	15	2	12			6	-	50	Set to a higher value to consider potential for values closer to baseline ore zone water quality
Cobalt, dissolved	mg/L				0.11	<0.01		<0.1	0.01	Low end of observed
Chromium, dissolved	mg/L	<0.01	<0.01	<0.01	<0.1	<0.05	0.05	<0.1	0.05	Mid range of observed
Copper, dissolved	mg/L	0.04	<0.01	<0.01	0.12	<0.02	0.33	0.2	0.02	Low end of observed
Fluoride	mg/L	0.5	1.2	0.8			1.4	-	0.8	Mid range of observed
Iron, dissolved	mg/L	6.13	0.44	1.23	9.1	4.7	1.7	10	4.7	Mid range of observed
Potassium	mg/L	<1	<1	2	<8		1.2	<8	3.5	Mid range of observed
Magnesium	mg/L	<1	<1	<1	6.7		1.2	<6	3	Mid range of observed
Manganese, dissolved	mg/L	0.07	0.02	0.05	<8	0.48	0.28	<8	0.48	Mid range of observed
Molybdenum, dissolved	mg/L	0.03	0.05	<0.005	0.47	0.13	<0.01	0.4	0.13	Mid range of observed
Sodium	mg/L	36	235	87	251		351	887	90	Low range of observed
Nickel, dissolved	mg/L	0.03	<0.01	<0.01	0.10	<0.01	0.21	0.1	0.01	Low end of observed
Lead, dissolved	mg/L	2.13	0.36	0.39	0.20	0.32	0.25	10.0	0.32	Mid range of observed
Sulfate	mg/L	174	117	100	718.7		440	2480	136	Low end of observed
Selenium, dissolved	mg/L	<0.025	<0.025	0.026	0.86	<0.01	0.09	<0.1	0.01	Low end of observed
Si	mg/L	43.7	43.8	44.4				132.6	40	Mid range of observed
Strontium, dissolved	mg/L				2.0	2.4	0.20	0.7	2.4	Upper end of observed
Zinc, dissolved	mg/L	0.08	<0.01	<0.01	0.10	<0.05	0.46	0.1	0.05	Mid-range of observed
P	mg/L				<4			<5	4	applied limited information available
Uranium (mg/L)	mg/L	3.5	4.1	0.5	19.3	26.4	187	38.7	30	Upper End of Observed
Vanadium, dissolved	mg/L	<0.01	0.007	0.03	0.13	0.16	0.03	0.2	0.16	Upper end of observed
Polonium-210	Bq/L	14.9+/-0.3	1.9+/-0.1	2.7+/-0.1	-	280	-	-		Not modelled (lack of thermodynamic constants)
Radium-228	Bq/L	-	-	-	-	<2	-	-		Not modelled
Thorium-228	Bq/L	-	-	-	-	<1	-	-		Not modelled
Thorium-230	Bq/L	0.2+/-0.03	1.36+/-0.14	3.2+/-0.4	-	<100	-	-		See Below for values in mg/L
Radium-226	Bq/L	389+/-0.7	262+/-0.5	129+/-0.4	-	370	-	-		See Below for values in mg/L
Lead-210	Bq/L	301+/-0.7	40+/-0.3	22+/-0.2	-	660	-	-		Not modelled (transport behaviour taken into account with Pb modelled)
Thorium-232	Bq/L	<0.01	<0.01	<0.01	-	0.007	-	-		Not modelled
Radium-226	mg/L	1.06E-05	7.17E-06	3.53E-06	-	1.01E-05	-	-	1.01E-05	Limited data, high end value
Thorium-230	mg/L	2.62E-07	1.78E-06	4.19E-06	-	<1.31E-04	-	-	1.31E-06	Limited data set ; Low end of observed

Notes

(blue shading)	Data Available when developing the Restored Solutions for the modelling in Appendix 7-C of the EIS
(yellow shading)	Data Available when developing the Restored Solutions for the modelling in Appendix 7-C of the EIS, but not considered in the development of Restored Solution #2 as pH was alkaline
a	Arithmetic average values, calculated using detected measurements or where all values were non-detect, assumed the detection limit. pH value is the median, not the arithmetic average.

3.0. Remediation of Mining Area within the context of ALARA (Addresses Question #3 of IR-67)

Section 2.2.3 of the draft EIS presents the conceptual decommissioning plan (CDP). As part of the CDP, and as highlighted in Section 2.3.3.1.1 of the draft EIS, remediation of the mining area will continue until recovered water reaches and is demonstrated to be stabilized (maintained) at acceptable mining area decommissioning objectives. Such decommissioning objectives consider protection of plausible downgradient water uses. For the purpose of the assessment "plausible use" has been determined to be the protection of aquatic life in Whitefish Lake, since numeric 3D groundwater modelling has indicated that Whitefish Lake is where groundwater associated with the remediated mining area will discharge to. It is within this frame of reference therefore that the ALARA concept should be considered. That is, ALARA can be defined for the purpose of the remediation of the mining area to the extent that subsequent discharge of groundwater to Whitefish Lake does not adversely affect aquatic biota in the lake.

The metallurgical testing done to date evidences an amelioration of UBS quality post-mining with flushing using groundwater and base (hydroxide or bicarbonate) to a restored solution of pH in the range of 4.5-5.5. The intent of the remediation approach is to raise the pH consistently but incrementally, so as to avoid over-neutralizing and yielding an alkaline solution. Alkaline pH conditions favour the formation of precipitates that are not desired from a physical (clogging) or chemical standpoint (secondary solids formed in place of removal of COPCs in the dissolved-phase from the subsurface). Potential environmental effects were thus evaluated based on plausible use, as defined above, at a pH and groundwater conditions that were shown to be achievable through groundwater flushing and addition of base without the risk of over-neutralization. Restoration Solution #1 contains the higher remaining concentrations, and lower pH (i.e., differs more from baseline conditions in the ore zone) and was carried forward for geochemical reactive transport modelling to evaluate environmental effects.

It is noted that the freeze wall will remain in place during mining area remediation (see draft EIS Section 2.3.3.1.1), until decommissioning objectives are achieved to ensure there is no loss of tertiary control of the mining fluid (even in a diluted state). Refinement of the mining area decommissioning objectives and associated modelling will be done as the Project progresses through updates to the Decommissioning Plan; nevertheless, the objectives as they may evolve will be bound by the objectives evaluated in the EIS, which as shown are protective of aquatic biota in Whitefish Lake. The final acceptable mining area decommissioning objectives will be developed prior to initiation of groundwater remediation, as part of the Detailed Decommissioning Plan (DDP).

References

Denison (Denison Mines Corp), 2018. Prefeasibility Study Report for the Wheeler River Uranium Project, Saskatchewan, Canada. Report dated: September 24, 2018.

Denison (Denison Mines), 2023. Feasibility Study.

IR-20, IR-67, IR-69 Appendix A

2018 Column Leach Testing

Table A1: Sample Inventory for 2018 ISR Column Leach Test

Original Sample Purpose	Sample I.D.	WR Hole No.	Lithology	Est. U%	Mass (g)	Mass U (g)
Porosity/Perm.	S066906	419D1	BSMT	0.22	320	0.61
Porosity/Perm.	S066907	525D2	SDST	0.06	323	0.17
Porosity/Perm.	S066908	405D1	SDST	0.06	270	0.14
Porosity/Perm.	S066909	405D1	BSMT	0.08	299	0.21
Porosity/Perm.	S066910	525D1	BSMT	51.72	843	375
Leach Testing	S066911	525D1	SDST	0.06	282	0.17
Leach Testing Composite Sample	S066912-S066916	525D1 525D2	SDST & BSMT	29.4	1,090	276
Leach Testing Total Composite Sample	S066906-S066916	405D1 419D1 525D1 525D2	SDST & BSMT	19.03 (wet)	3,427 (wet)	652.3

Table A2: Mineralogy of the Ore Zone*

Unit	Mineral	Ideal Formula	Major (≥2% w/w)	Minor (< 2% w/w, or, shown to be present in Petrography or core logging)
Ore Zone	Pyrite	FeS2	X	
	Galena	PbS	X	
	Chalcopyrite	CuFeS2	X	
	Quartz	SiO2	X	
	Chlorite	(Fe,Mg)2(Al;Fe3+)3Si3AlO10(OH)8	X	
	Muscovite/Illite	KAl2(Si3Al)O10(OH;F)2	X	
	Kaolinite	Al2Si2O5(OH)4	X	
	Fe-oxy-hyroxides	FeO(OH)·nH2O	X	
	Uraninite	UO2	X	
	UO2.33	U3O7	X	
	UO2.25	U4O9	X	
	Schoepite	UO3:2H2O	X	
	Siderite	FeCO3	X	
	Fluorite	CaF2	X	
	Gersdorffite	NiAsS		X
	Nickeline	NiAs		X
	Dravite	NaMg3Al6(Si6O18)(BO3)3(OH)3(OH)		X
	Pyrrhotite	$Fe_{1-x}S$ (x=0-0.17)		X
	Sphalerite	(Zn,Fe)S		X
	Feldspar	KAlSi3O8		X
	Calcite	CaCO3		X
	Apatite	Ca5(PO4)3(F,Cl,OH)		X
	Corundum	Cr2O3		X
	APS Minerals	CaAl3(PO4)(PO3OH)(OH)6		X

Notes
*The table above is excerpted from Table 3-1 of Appendix 7-C of the draft EIS (mineralogy for other "Units" provided therein are not shown here)
Uraninite **Blue bolded text** indicates dominant minerals; can be present at values exceeding 40% w/w

Reactions forming secondary sulphate minerals

K-Jarosite

$$KFe_3(SO_4)_2(OH)_6 + 6H^+ = K^+ + 3Fe^{+3} + 2SO_4^{-2} + 6H_2O$$

Barite

$BaSO_4 = Ba^{+2} + SO_4^{-2}$

Anglesite

$PbSO_4 = Pb^{+2} + SO_4^{-2}$

Gypsum

$CaSO_4{:}2H_2O = Ca^{+2} + SO_4^{-2} + 2H_2O$

IR-20, IR-67, IR-69 Appendix B

Table 3-5: Restored Solutions, UBS Composition representative of End of Mining conditions, and Representative Groundwater Composition by Hydrostratigraphic Unit

Parameter/ Groundwater or Restored Solution	Unit	Ore Zone (GWR-032)	PWZ (GWR-031 and Cigar Lake)	Lower Sandstone Aquifer and Decilisified Zone (GWR-011)	Intermediate Sandstone Aquitard (GWR-046)	Overburden and Upper Sandstone Aquifer (GWR-036, Primarily)	Range of Values of UBS constituent concentrations across Metallurgical tests from 2018-2021 representative of End of mining conditions		Restored Solution #1	50% Restored Solution #1	Restored Solution #2	50% Restored Solution #2
							Minimum	Maximum				
pH	unit	6.83	6.7	6.46	7.053	6.45	0.63	2.1	4.3	5.1	6.1	6.3
pe	unitless	-1.3	1.9	2.3	4.5	1.2	9.80	14.7	10	(set) 7	7.8	(set) 4
temp	^{0}C	7	7	7	7	7	7	7	7	7	7	7
Al	mg/L	6.00E-04	3.40E-02	5.20E-02	8.00E-01	3.70E-02	6.90E+01	4.61E+03	7.00E+00	3.53E+00	5.60E-01	3.06E-01
As	mg/L	2.00E-04	5.00E-02	1.30E-03	4.75E-06	3.00E-04	<0.1	2.12E+01	6.00E-02	3.07E-02	1.00E-01	5.07E-02
Ba	mg/L	6.30E-02	3.60E-02	5.40E-02	2.41E-01	5.70E-03	<0.05	<0.5	5.00E-02	5.20E-02	5.00E-02	5.20E-02
C(4)	mg/L	1.76E+02	1.54E+02	8.66E+01	1.01E+02	3.39E+01	-	-	5.80E+01	7.23E+01	1.05E+02	9.58E+01
Ca	mg/L	5.50E+01	6.76E+00	9.78E+00	1.07E+01	2.70E+00	5.80E+01	7.23E+02	1.10E+02	6.00E+01	1.00E+01	9.89E+00
Cd	mg/L	1.00E-05	1.00E-05	1.00E-05	3.36E-05	1.00E-05	1.80E-02	1.81E+00	1.50E-02	7.52E-03	4.00E-03	2.01E-03
Cl	mg/L	1.90E+02	8.65E+01	7.20E+00	8.63E+00	6.86E+00	<10	1.22E+03	2.00E+02	1.04E+02	5.00E+01	2.86E+01
Co	mg/L	1.00E-04	1.00E-02	1.00E-04	5.84E-03	4.00E-04	5.00E-01	1.49E+01	2.00E+00	1.00E+00	1.00E-02	5.05E-03
Cr	mg/L	5.00E-04	4.50E-03	5.00E-04	1.69E-03	5.00E-04	<0.1	9.14E+00	5.00E-02	2.53E-02	5.00E-02	2.53E-02
Cu	mg/L	2.00E-04	5.00E-03	1.80E-03	6.29E-03	6.00E-04	5.16E+00	9.64E+02	1.70E-01	8.60E-02	2.00E-02	1.09E-02
F	mg/L	2.30E-01	5.30E-01	1.80E-01	5.90E-02	6.00E-02	1.00E+00	3.40E+01		9.00E-02	8.00E-01	4.90E-01
Fe	mg/L	4.20E+00	4.90E-01	8.60E-01	6.03E+00	4.05E-01	8.20E+02	4.09E+03	1.00E+02	5.05E+01	4.70E+00	2.78E+00
K	mg/L	4.60E+00	5.60E+00	2.00E+00	6.77E+00	2.80E+00	6.20E+00	1.49E+02	9.00E+00	5.51E+00	3.50E+00	2.75E+00
Mg	mg/L	1.10E+01	3.09E+00	1.60E+00	3.91E+00	1.80E+00	<10	2.40E+02	6.00E+00	3.80E+00	3.00E+00	2.30E+00
Mn	mg/L	2.20E-01	7.00E-01	3.60E-01	3.91E+00	1.40E-01	2.70E+00	4.10E+01	3.40E+00	1.88E+00	4.80E-01	4.20E-01
Mo	mg/L	3.80E-03	1.28E-02	4.20E-03	3.89E-03	7.00E-04	1.65E+00	5.96E+01	1.00E-01	5.22E-02	1.30E-01	6.71E-02
Na	mg/L	8.10E+01	7.61E+01	6.10E+00	8.96E+00	2.90E+00	6.00E+00	1.23E+04	1.90E+02	9.82E+01	9.00E+01	4.81E+01
Ni	mg/L	1.00E-03	1.50E-02	1.00E-04	4.87E-02	1.80E-03	<1	2.68E+01	9.70E+00	4.86E+00	1.00E-02	5.05E-03
Pb	mg/L	1.00E-04	1.00E-04	1.00E-04	1.57E-03	1.00E-04	2.00E-01	1.95E+01	3.10E+00	1.55E+00	3.20E-01	1.60E-01
S(6)	mg/L	1.30E+01	4.55E+00	4.70E+00	1.01E+01	1.90E+00	5.21E+03	2.09E+05	7.03E+02	3.54E+02	1.36E+02	7.04E+01
S(-2)	mg/L	1.00E-08	1.00E-09	1.00E-09	1.00E-09	1.00E-09	-	-	1.00E-09	1.00E-09	1.00E-09	1.00E-09
Se	mg/L	1.00E-04	1.00E-04	1.00E-04	3.59E-04	8.00E-04	<0.025	2.64E+01	8.00E-02	4.01E-02	1.00E-02	5.05E-03
Si	mg/L	1.33E+01	9.18E+00	2.41E+01	1.31E+01	2.62E+01	3.07E+01	1.92E+02	4.00E+01	3.21E+01	4.00E+01	3.21E+01
Sr	mg/L	1.66E+00	1.17E+00	1.20E-01	1.15E-01	1.20E-02	6.00E-01	5.19E+00	4.40E+00	2.26E+00	2.40E+00	1.26E+00
Zn	mg/L	2.62E+00	4.25E-03	1.20E-02	1.25E-02	4.40E-03	2.30E+00	3.31E+02	1.40E+00	7.07E-01	5.00E-02	3.10E-02
P	mg/L	1.00E-02	1.00E-02	1.00E-01	5.00E-02	4.00E-02	2.20E+00	7.54E+01	4.00E+00	2.05E+00	4.00E+00	2.05E+00
U	mg/L	1.10E-02	1.24E-02	7.00E-04	2.26E-02	5.00E-04	7.70E+02	3.88E+04	1.00E+02	5.01E+01	3.00E+01	1.50E+01
V	mg/L	1.00E-04	1.00E-04	1.00E-04	1.20E-03	1.00E-04	6.16E+00	1.61E+02	5.10E-01	2.55E-01	1.60E-01	8.01E-02
^{226}Ra	mg/L	4.92E-06	5.47E-09	1.37E-08	2.54E-08	1.64E-09	6.29E-06	8.21E-05	5.47E-06	2.75E-06	1.01E-05	5.06E-06
^{230}Th	mg/L	9.17E-06	1.00E-06	1.31E-07	2.62E-07	2.62E-08	2.75E-02	2.88E-01	3.93E-06	2.02E-06	1.31E-06	7.14E-07

Attachment: IR-21

Number	IR-21
Dept.	ECCC
Project effects link	Change to an environmental component due to hazardous contaminants
Reference to EIS, appendices, or supporting documentation	Section 2.3.3.1.3, Project Description
Context and Rationale	Context: The decommissioning process for the wellfield and associated infrastructure is discussed, however there is no information provided on the potential risk for subsidence of the ground above the depleted uranium deposit. After the uranium has been dissolved and pumped to the surface, a cavity will be formed in the area where the uranium used to exist. This could destabilize the overlying substrates, causing the ground at the surface to sink in the future. There is currently no information regarding this risk, and how it may alter the overlying environment, surface water features, runoff, or existing nearby waterbodies. Rationale: From a surface water and sediment quality perspective, it is important to understand how potential subsidence in the future post-decommissioning may affect the existing environment. It is currently unclear if there is any risk to the aquatic environment if subsidence were to occur and alter existing waterbodies, create new surface water features, or if there will be any risk to the decommissioned onsite industrial landfill and industrial wastewater treatment plant precipitate pond.
Information Requirement	Provide further information on the potential risks from subsidence including the probability of occurrence, how it may affect surface water features, and if there exists any risk to the planned decommissioning of waste management infrastructure.

<u>Response:</u>

RESPEC (2023) memo is attached here to support the IR response provided in the table.

EXTERNAL MEMORANDUM

To: Xavier Lu Dac
Dana Harris
Denison Mines Corporation
230-22nd Street East
Suite 200
Saskatoon, SK S7K 0E9

cc: Project Central File 02924

From: Neel Gupta
Cody Vining
Brett Dueck
RESPEC
3824 Jet Drive
Rapid City, SD 57703

Date: July 14, 2023

Subject: Results of a Geomechanical Study Investigating the Stability of the Rock Mass in Response to In Situ Recovery of Uranium-Enriched Rock for the Wheeler River Uranium Project

Denison Mines Corporation (Denison), a uranium exploration and development company, has a flagship Wheeler River Uranium project. This project is the largest undeveloped in situ recovery (ISR) uranium project in Northern Saskatchewan's eastern Athabasca Basin. The project site is located approximately 35 kilometers (km) north-northeast of the Cameco Corporation (Cameco) Key Lake operation and 35 km southwest of the Cameco McArthur River operation in the eastern Athabasca Basin. Denison proposes developing the Phoenix deposit in this region.

At the Phoenix deposit, Denison plans to drill the set of injection/recovery wells for ISR of uranium-enriched rock through leaching with a freeze wall isolating the operations from the surrounding rock mass. In response to the leaching process, the remnant ore zone may displace or fail and may no longer be able to support the overburden load while causing instability in the surrounding rock mass because of the stress redistribution. Denison, therefore, has requested a geomechanical study to analyze the geomechanical stability of the rock mass around the excavation and freeze wall from the leaching process. This memorandum documents the geomechanical study and briefly discusses the study objectives and approach, significant results, and conclusions.

3824 JET DRIVE
RAPID CITY, SD 57703
P.O. BOX 725 // RAPID CITY, SD 57709
605.394.6400

STUDY OBJECTIVES AND APPROACH

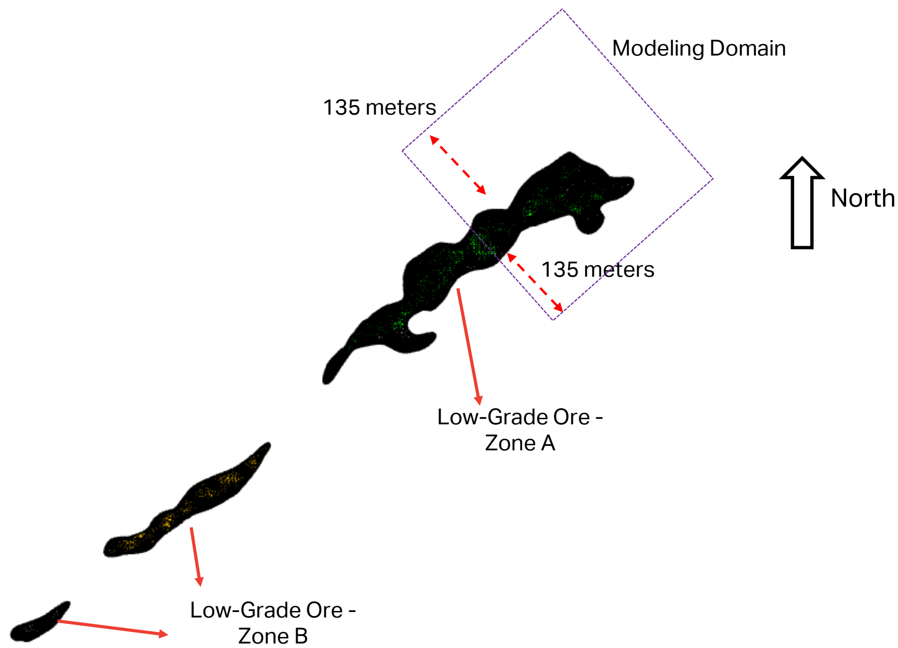
In a recent geomechanical study [Vining et al., 2023], RESPEC Company, LLC (RESPEC) developed a three-dimensional (3D) strip model of a specific geological section where maximum ore extraction is planned to investigate the stability of the mined cavity and estimate the surface disturbance. The boundary conditions of the strip numerical model assumed an infinite array of the modeled cross-section, where ore extraction is maximum, along the length of the Phoenix deposit. Considering the boundary conditions of the strip model and presuming the average material properties of key stratigraphic layers, the numerical model predicted surface displacement of approximately 7.5 centimeters (cm) and marginal stability of the rock mass limited to the extent of 16 meters (m) from the top extent of mined excavation.

The primary objectives of the current study are evaluating the geomechanical stability of the rock mass around the excavation and proposed freeze wall in response to the in situ leaching operations in Zone A of the Phoenix deposit. To achieve the desired objectives, RESPEC modified the previously developed 3D strip model [Vining et al., 2023] to create a full-scale 3D model using the structural finite difference program *FLAC3D* [Itasca Consulting Group, Inc., 2021] while presuming the similar, average material properties of key stratigraphic layers. Considering the computational time and analysis effort, creating a numerical model that extends across the entire extent of Zone A is impractical. Because the *FLAC3D* program imposes a plane of symmetry along its boundaries, RESPEC, in consultation with Denison, simulated the half-length of Zone A, and the modeling domain encompasses the Phoenix deposit's northeast extent, as shown in Figure 1. The vertical extent of the 3D model is assumed to be 1,000 m below ground surface (bgs), and the lateral boundary is approximately 135 m away from the extent of the low-grade ore zone. The model boundaries located far away from the excavation boundaries isolated the influence of model boundaries on the excavation response. The kinematic boundary conditions of the numerical model prevent normal (horizontal) displacements along the four vertical boundaries of the model and vertical displacements of the bottom boundary. These constraints allow the interior portion of the model to move freely. In situ stress data were not available for the Phoenix deposit. The vertical stress was assumed to be lithostatic (i.e., equal to the weight of the overburden) and determined as a function of depth from the weight of the overburden. In rock mass, the horizontal stress is considered isotropic (i.e., maximum and minimum horizontal stress equal to the vertical stress). For instance, at the depth of 400 m bgs, the average in situ vertical stress is approximately 10 megapascals (MPa).

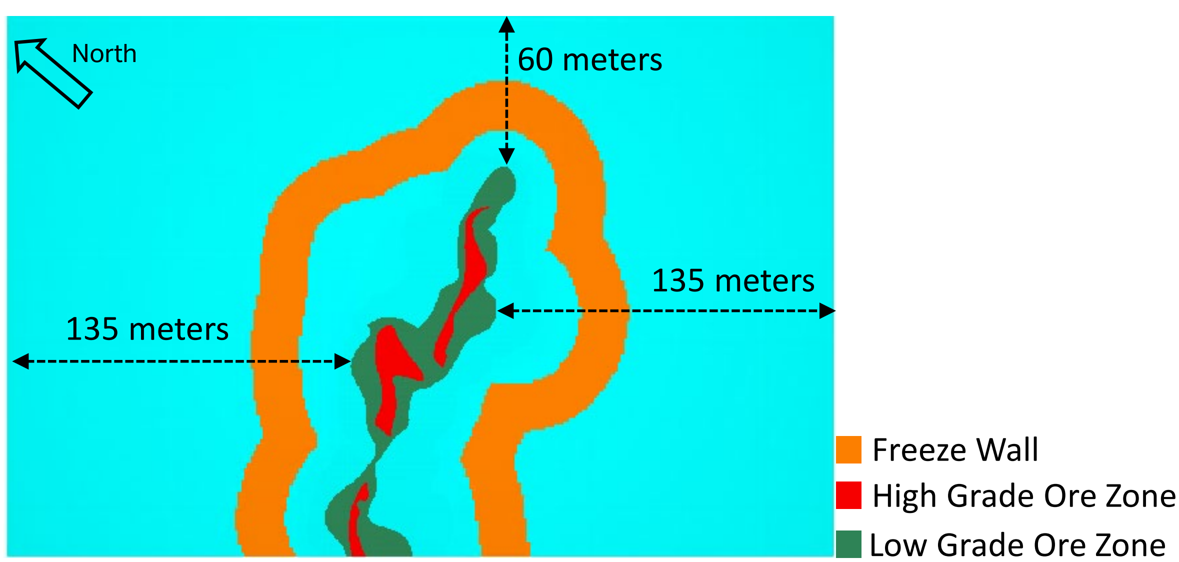
Denison provided the AutoCAD drawings of key stratigraphic layers in the Phoenix deposit, which were used to develop the 3D structural model. Table 1 summarizes these stratigraphic layers. Figure 2 presents the elevation view of the 3D model, which illustrates the continually changing elevations and thicknesses of the rock layers, for example, upper and lower clay, sandstone with sulfide, and altered basement. Except for the desilicified sandstone and sandstone with sulfide, the modeled stratigraphic units and their material properties are consistent with the 3D strip model in the previous geomechanical study [Vining et al., 2023]. In consultation with Denison, RESPEC assumed the Mohr-Coulomb property of sandstone with sulfide was similar to altered sandstone and the desilicified sandstone was similar to sand [Terzaghi and Peck, 1967].

Random rock removal was adopted to represent the in situ leaching process in the numerical model. Rock removal included the instantaneous excavation of 30 percent of rock by volume from the high-grade ore zone and 3 percent from the low-grade ore zone. According to Denison, high- and low-grade ore zones are based on the uranium grade and encompass different stratigraphic layers (e.g., upper clay, lower clay, ore zone) within the Phoenix deposit. Denison plans to adopt the freeze wall design for ISR of uranium-enriched rock; therefore, RESPEC explicitly modeled the freeze wall, which was 20 m thick and located at a distance of 15 m from the extent of the low-grade ore zone. Figure 3 presents the vertical extent of the high- and low-grade ore zones on the vertical plane and surrounding freeze wall.

In the numerical simulation, the pressure at the excavation surface was maintained at a pressure equivalent to a wellhead pressure of 0 MPa with a freshwater gradient of 0.01 MPa/m. Considering that the overlying sandstone is fractured and permeable, and the elevation of the potentiometric surface is near the ground level, RESPEC also simulated the influence of porewater pressure on the predicted stresses and displacement, which is consistent with the previous study [Vining et al., 2023].



(a)



(b)

Figure 1. Plan View of the (a) Low-Grade Ore in Zone A and Zone B of the Phoenix Deposit and (b) Extent of Modeling Domain.

Table 1. Average Material Properties

Stratigraphy	Cohesion (MPa)	Friction Angle (degree)	Rock-Mass Compressive Strength (MPa)	Tensile Strength (MPa)	Rock-Mass Modulus (MPa)	Poisson's Ratio (—)	Density (g/cc)
Overburden	1.44	26.93	4.84	4.7	2,241.65	0.20	2.6
Stiff Sandstone	1.44	26.93	4.84	4.7	2,241.65	0.20	2.6
Altered Sandstone	1.07	22.54	3.39	1.0	1,363.76	0.25	2.1
Sandstone with Sulfide	1.07	22.54	3.39	1.0	1,363.76	0.25	2.1
Desilicified Sandstone	0.0	30.0	0.0	0.0	1,363.76	0.25	2.1
Upper Clay	0.03	16.6	0.12	0.20	55.17	0.28	1.7
Ore Zone	0.22	20.11	0.54	0.51	188.75	0.28	4.2
Lower Clay	0.15	18	0.48	0.20	206.43	0.28	1.7
Altered Basement	2.72	25.88	9.17	1.2	4,254.55	0.15	2.1
Stiff Basement	5.57	31.46	20.34	10.7	11,564.83	0.11	2.7

g/cc = grams per cubic centimeter

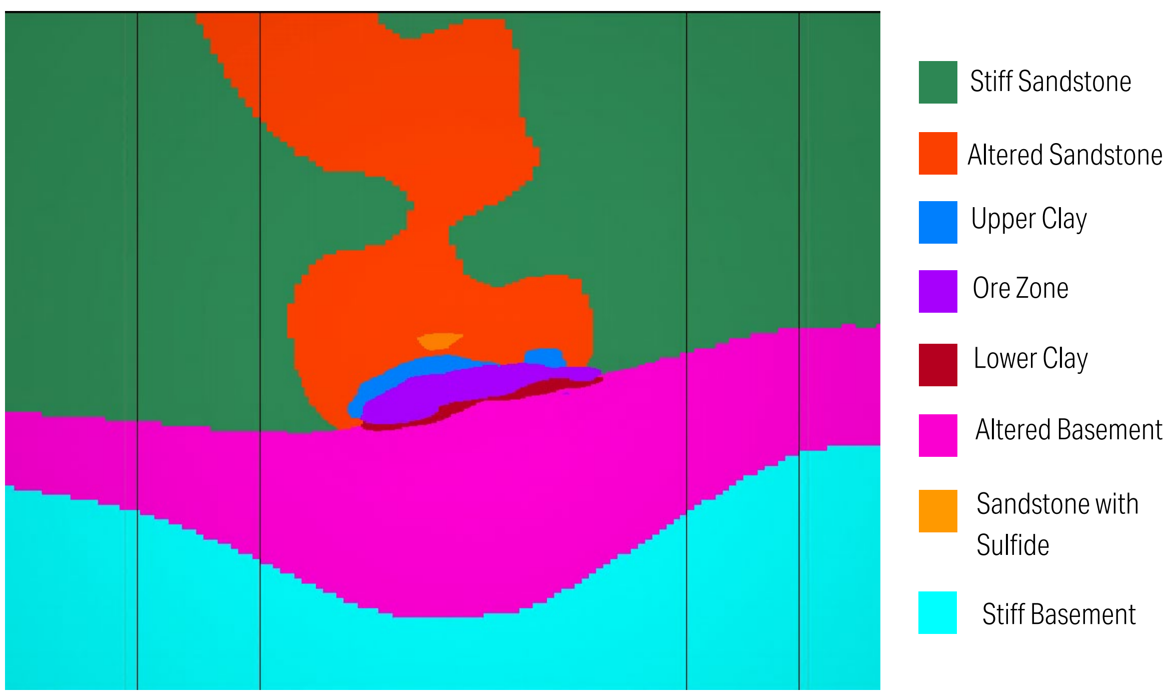


Figure 2. Elevation View of the Numerical Model Illustrating Changing Elevation of Different Stratigraphic Units Represented in the Structural Model.

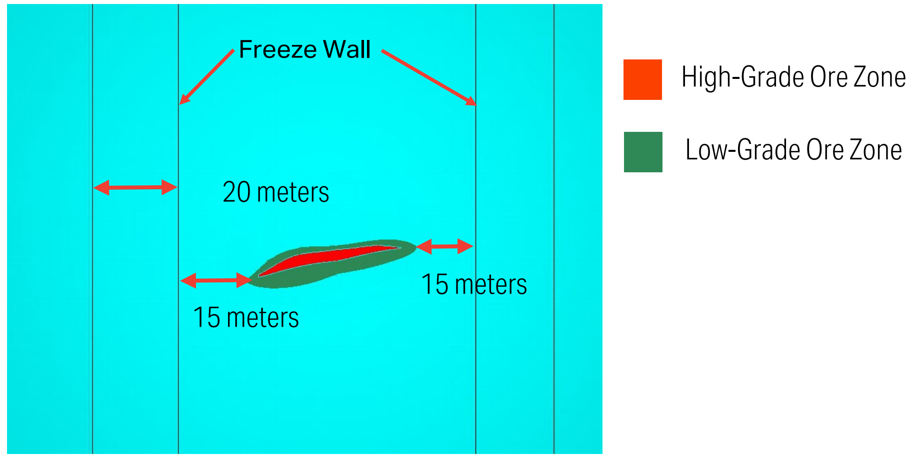


Figure 3. Elevation View of the Numerical Model Illustrating the Relative Location of the Freeze Wall to the High- and Low-Grade Ore Zones in Zone A of the Phoenix Deposit.

RESULTS

The numerical model-predicted stresses and displacements were scrutinized to assess the surface subsidence and the stability of the remaining ore zone, surrounding rock mass, and freeze wall. The outcomes of the numerical simulation are discussed in the following subsections.

ROCK STABILITY

RESPEC simulated the rheological behavior of rock presuming the Mohr-Coulomb constitutive model for each stratigraphic unit to analyze the stress redistribution in case of failure of the remnant rock around the excavation. In the post-simulation analysis, the Mohr-Coulomb Factor of Safety (MCFS) was determined to quantify the competency of the rock mass based on the predicted stress fields. The MCFS value greater than, equal to, or less than 1.0 quantifies the material as not failing, at failure, or failed, respectively. The potential for tensile fracturing in the rock mass was also analyzed using the least compressive principal stress (LCPS). The magnitude of LCPS will be positive at locations where a tensile stress component exists in any direction. Site-specific strength properties of the rock after freezing were unavailable at the time of the study; therefore, RESPEC took a conservative approach and assumed that the properties of the freeze wall were similar to the host rock.

Figures 4 and 5 present the MCFS contour and LCPS contour, respectively, on a horizontal plane passing through the depth of 390, 399, 406, and 413 m bgs. Figures 6 and 7 present the MCFS and LCPS contour on multiple vertical planes. MCFS contour (Figures 4 and 6) presents that the failure conditions (i.e., red contour) are limited within the close proximity (i.e., 5 to 8 m) of the low-grade ore zone, and its lateral extent varies with the depth of the ore zone below the ground surface. However, the MCFS is always greater than 2.50 within the modeled extent of the freeze wall. LCPS contour (Figures 5 and 7) presents that the marginally compressive stress conditions (i.e., yellow and red contours) are predicted within the extent of the low-grade ore zone, and compressive stresses greater than 5 MPa are predicted within the proposed extent of the freeze wall. Figure 8 quantifies the failure volume predicted within the different stratigraphic units. Within the modeled domain of Zone A, the predicted failure volume was approximately 8, 22, 41, and 26 percent of the modeled volume of sandstone with sulfide, upper clay, ore zone, and lower clay, respectively. However, the failure volume is less than 0.02 percent of the modeled volume of stiff or altered sandstone, desilicified sandstone, and altered and stiff basement rock. Additionally, 0 percent failure volume is predicted within the freeze wall.

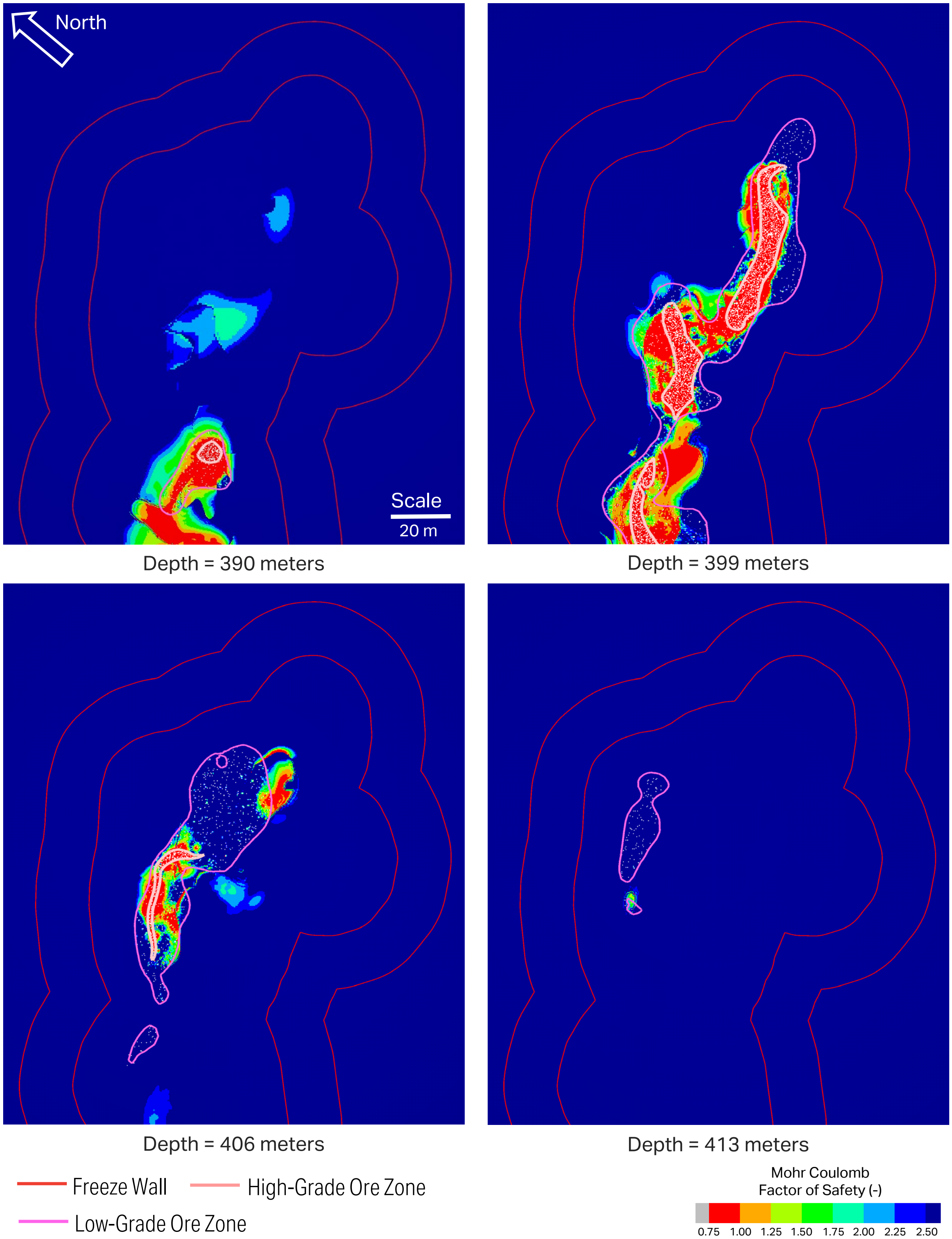


Figure 4. Plot of Mohr-Coulomb Factor of Safety Values on a Horizontal Plane Passing at a depth of 390, 399, 406, and 413 Meters Below Ground Surface.

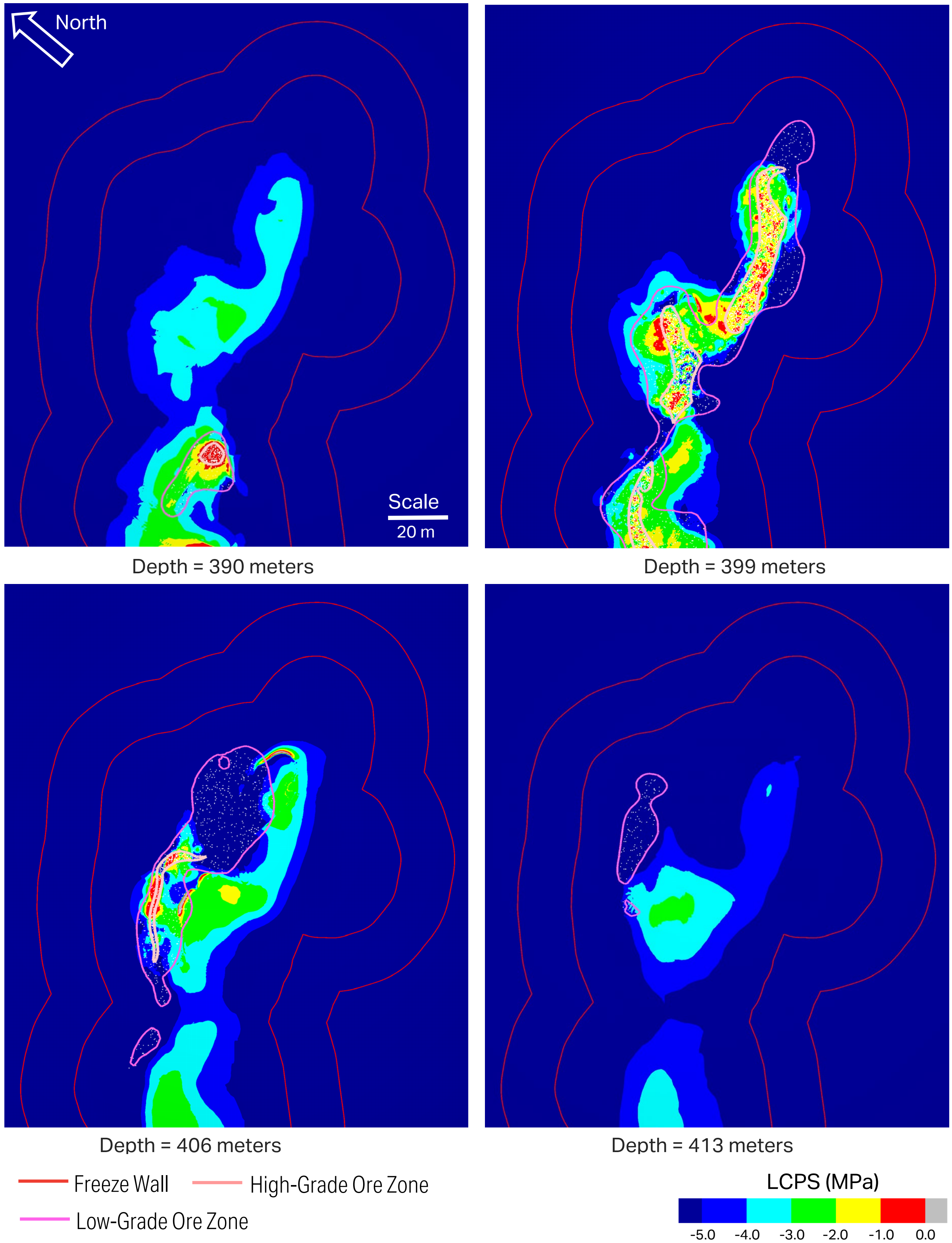


Figure 5. Plot of Least Compressive Principal Stress Values on a Horizontal Plane Passing at a Depth of 390, 399, 406, and 413 Meters Below Ground Surface.

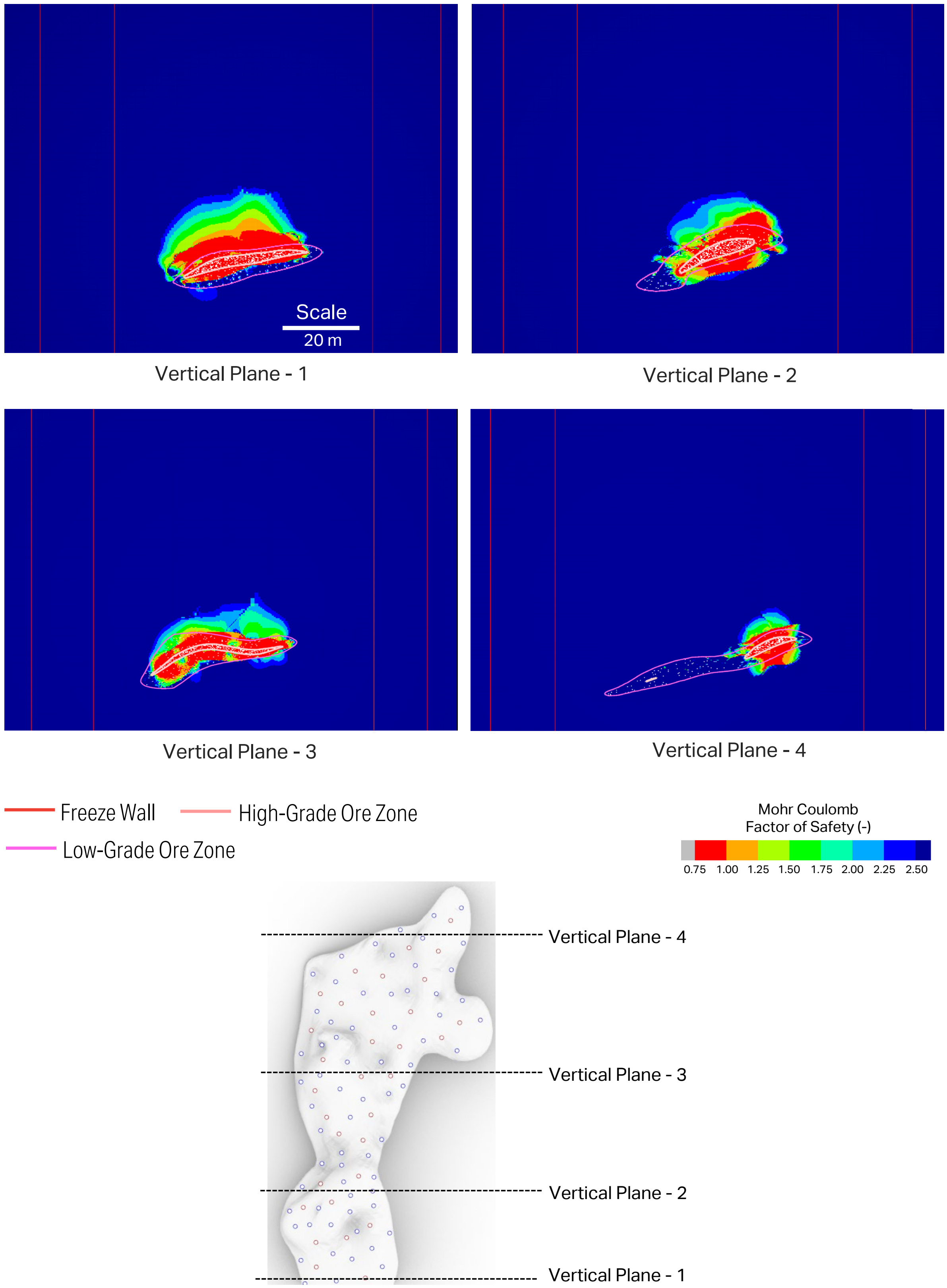


Figure 6. Plot of Mohr-Coulomb Factor of Safety Values on Multiple Vertical Planes.

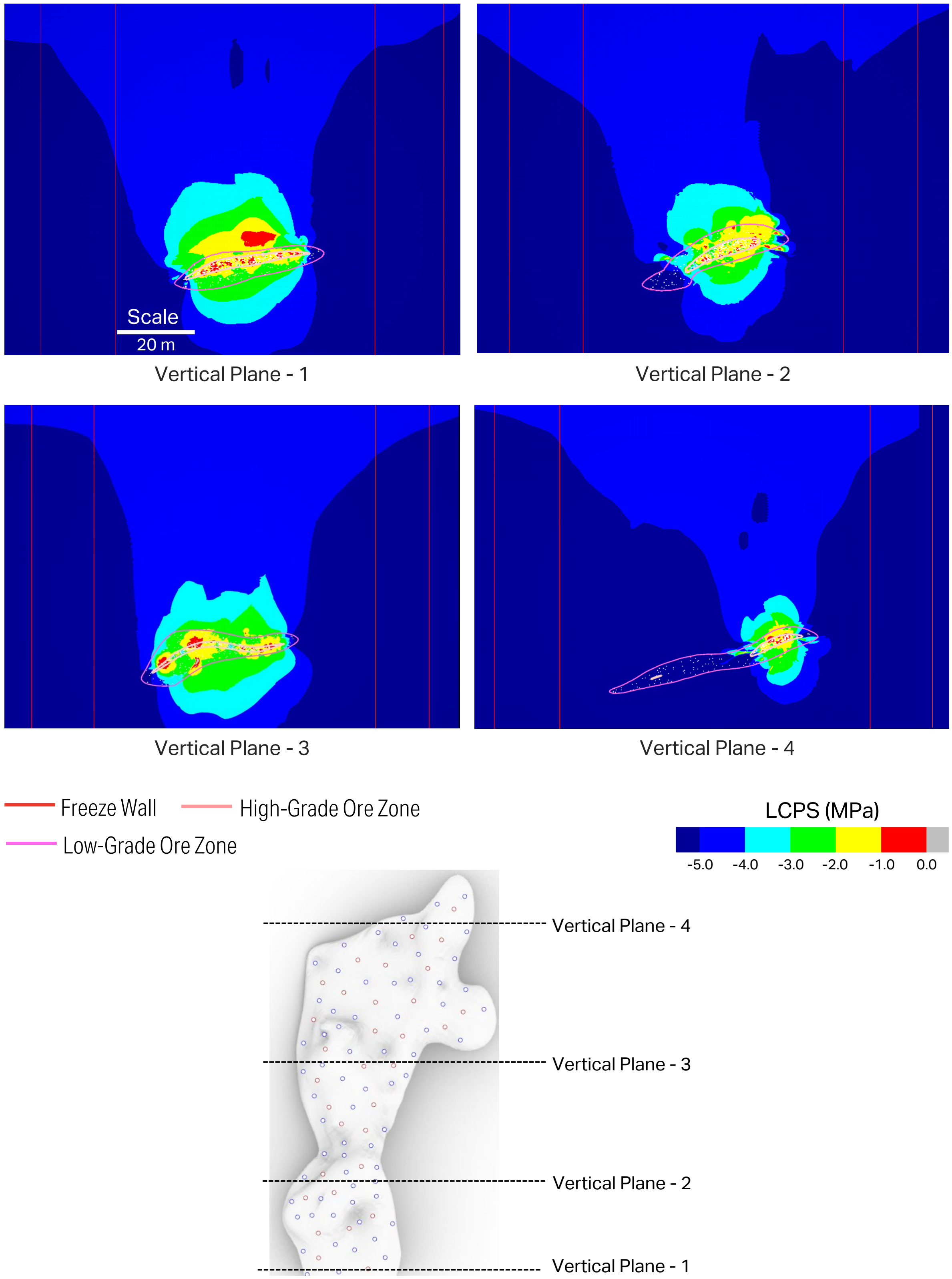


Figure 7. Plot of Least Compressive Principal Stress Values on Multiple Vertical Planes.

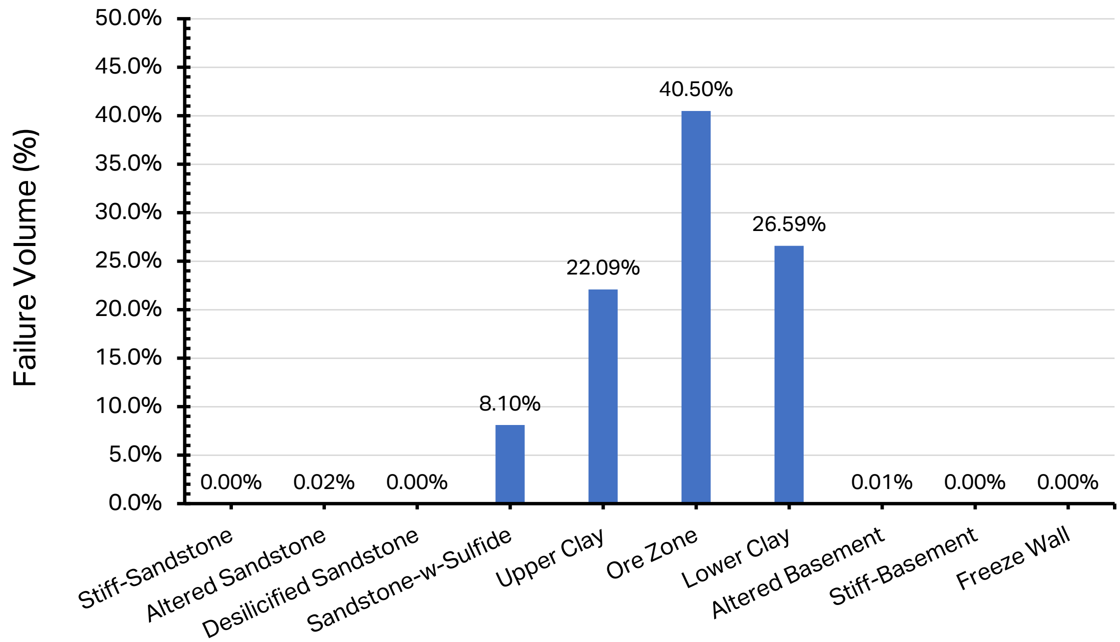


Figure 8. Failure Volume in Different Stratigraphic Units.

SURFACE SUBSIDENCE

In response to the proposed leaching process, the surrounding host rock will displace into the mined cavity, which manifests as subsidence at the ground surface. The numerical model predicted the negligible vertical displacement of approximately 2.5 millimeters (mm) on the ground surface. Figure 9 presents the contours of vertical displacement predicted on a vertical plane passing through the modeling domain's southern boundary. The contour on the vertical plane presents that the vertical displacement of the rock mass immediately above the low-grade ore zone ranges between 42 and 49 cm and quickly reduces to the range between 0 and 7 cm at a distance of 4 to 5 m from the low-grade ore zone. The current study's numerical model-predicted surface subsidence is significantly smaller than the surface subsidence of 7.5 cm predicted in the previous geomechanical study [Vining et al., 2023], which is likely attributed to the difference in the modeling domain and boundary conditions between the two models. In the previous study, the 3D strip model presumed an infinite array of modeled cross sections and corresponding excavation of uranium-enriched rock; in the current study, the full-scale model included the representative extent of Zone A at the Phoenix deposit.

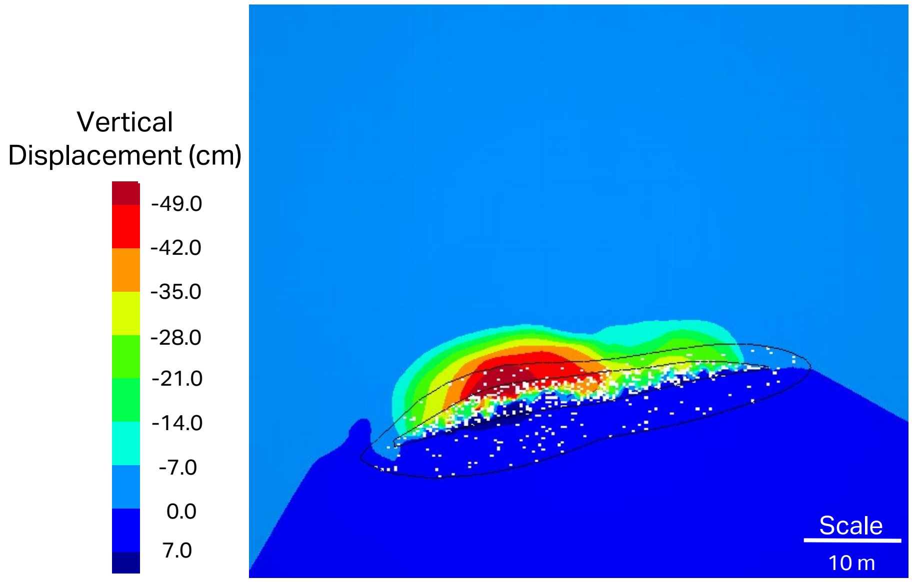


Figure 9. Contour of Vertical Displacement After the Proposed Volumetric Extraction on a Vertical Plane Passing Through the Modeling Domain's Southern Boundary.

CONCLUSIONS

The study objective was to better understand the anticipated response of the surrounding rock mass, particularly the freeze wall, after proposed volumetric rock extraction from the high- and low-grade ore zone. The significant outcomes from this study are as follows:

- **The geomechanical numerical model predicted stability against shear or tensile failure within the proposed extent of the freeze wall.** Considering the average estimate of the material properties of modeled stratigraphic layers, the predicted failure conditions in the rock mass are limited to 5 to 8 m of the extent of the low-grade ore zone. Within the proposed extent of the freeze wall, the MCFS values are greater than 2.50, and the magnitude of LCPS is greater than 5 MPa in compression, indicating the limited potential of instability in the freeze wall.
- **The numerical model predicted vertical displacement at the surface in response to the proposed volumetric extraction is negligible.** The vertical displacement of the rock mass near the modeling domain's southern extent is at a maximum immediately above the low-grade ore zone, ranging between 42 and 49 cm, which reduces to the range between 0 and 7 cm at a distance of 4 to 5 m from the low-grade ore zone. At the ground surface, the average vertical displacement is approximately 2.5 mm.

REFERENCES

Itasca Consulting Group, Inc., 2021. *FLAC3D: Fast Lagrangian Analysis of Continua in 3 Dimensions*, 7th Edition (Version 7.00.154), Minneapolis, MN.

Terzaghi, K., and R. B. Peck, 1967. *Soil Mechanics in Engineering Practice*, 2nd Ed., John Wiley & Sons, New York, NY.

Vining, C. A., N. Gupta, and J. Nopola, 2023. *Results of a Geomechanical Study Investigating the Influence of Uranium Extraction on Mining-Cavity Stability for the Wheeler River Uranium Project (Revision 2)*, RSI(RCO)-2924/5-21/14, prepared by RESPEC, Rapid City, SD, for X. Lu Dac and D. Harris, Denison Mines Corporation, Saskatoon, SK, February 9.

Attachment: IR-24

Number	IR-24
Dept.	CNSC
Project effects link	Alternative Means
Reference to EIS, appendices, or supporting documentation	Section 2.10.2 Alternative Means
Context and Rationale	Context: While Appendix 2-C (Alternative Means Assessment) is detailed and includes all aspects of the Alternative means assessment that are required, the summary of the analysis and conclusions in Section 2.10.2 of the EIS lacks the level of detail required to understand the methodology used, and how Denison arrived at these conclusions. Rationale: As noted in the Agency's Operational Policy Statement on Addressing "Purpose of" and "Alternative Means" under the CEAA 2012: "If a preferred means is selected, the analysis and the rationale for the choice should be explained from the perspective of the proponent, and be documented in the EIS in sufficient detail to provide context for public and technical comment periods during the project EA, and ultimately to allow the decision maker to understand the choice."
Information Requirement	Please summarize the analysis of the alternative means assessment within the body of the EIS, in sufficient detail that a reader of the EIS has adequate information to understand the methodology used, and how Denison arrived at these conclusions. Note: In addition to the adding text to summarize, Table 6 in Appendix 2-C could be useful to understanding table 2.10.1 in the EIS.

Response:

Revised test for final EIS, Section 2.10.2.

2.10.2 Alternatives Means Assessment

Denison first evaluated production potential from the Project in 2010. Since that time, the Project has undergone significant design and review stages and has naturally evolved into the Project described and assessed in this EIS. Appendix 2-C provides details related to the alternative means assessment framework employed and the results of the alternatives assessment for key Project components and activities; this section of the EIS provides a summary of Appendix 2-C.

Alternative means are the various ways Denison considered to implement Project components and activities. During the planning process, it is common to consider various means by which to fulfill a specific aspect of the Project.

A systematic assessment of these alternatives was used to select preferred alternatives that are carried forward as Project design elements in a manner consistent with Canadian Environmental Assessment Agency's operational policy statement (Canadian Environmental Assessment Agency 2015). These preferred alternatives ultimately become the basis upon which potential Project-related effects are evaluated in the EIS. The preferred alternatives have been presented in the preceding section of this Project Description. The documentation of this systematic alternative assessment provides transparency and traceability with respect to decision making on Project design. It also documents how input received by Indigenous groups and other Interested Parties has been considered in the design/planning process.

The alternative means assessment has been carried out in a stepwise fashion as follows (Figure 2.10-1):

1. Identification of Alternative Means: Project components for which alternate means were considered are identified;
2. Consideration of Technical Feasibility, Economic Feasibility, and Land Use Factors: the technical and economic feasibility of these alternate means is considered along with a specific screening for land use intensity and importance. Only alternate means that are deemed technically feasible, economically feasible, and passed the land use screening are carried forward in the evaluation.
3. Potential Residual Effects Associated the Alternative Means: the potential residual effects of each alternative, in consideration of mitigation, are described; and,
4. Evaluation of Alternative Means: a comparative evaluation of alternative means that considers the potential residual effects for each alternative relative to various assessment criteria and indicators.

A description of the above four steps along with an example from Appendix 2-C (for Mining - Method) is provided in the following sections.

2.10.2.1 Identification of Alternative Means

Several Project components and activities had alternate means or options considered:

- Mining
  - Method
  - Freeze design for tertiary containment of mining solution
  - Permeability enhancement

  - Mining solution
- Processing
  - Location of processing
  - On-site processing method
- Water management
  - Freshwater supply
  - Drinking water
  - Treated effluent discharge location
  - Treated effluent discharge location to surface water
- Waste management
  - Organic waste disposal
  - Process precipitate management
  - Domestic waste disposal
- Access and transportation
  - Access road alignment
  - Stream crossing structures
  - Worker transportation
- Power
  - Primary power supply
- Support facilities
  - Camp location optimization

For each Project component or activities listed above, a variety of options were considered. For example, the options considered under Mining – Method included:

- Option 1: Open pit
- Option 2: Jet boring
- Option 3: Surface boring
- Option 4: Micro tunnel boring
- Option 5: ISR

2.10.2.2 Consideration of Technical Feasibility, Economic Feasibility, and Land Use Factors

Alternative means considered in an EIS must be technically and economically feasible (CEAA 2015).

Denison integrated an additional category at this early stage in the alternative means assessment framework: land use screening. Although technical feasibility can include land use considerations, Denison opted to include land use separately to provide greater transparency on the approach taken and also in recognition of the importance of local land use that has been communicated by interested parties. In conjunction with screening for technical and economic feasibility, an initial evaluation was conducted to review Indigenous and other land use in the area to identify alternative means that may interact with areas of high land use intensity or areas of cultural importance (e.g., known gravesites). Consideration was given to information made available to Denison in the early stages of project planning. Note that subsequent, additional consideration of engagement information, including Indigenous and other land and resource use is completed at later stages in the alternatives means assessment framework (Section 2.10.2.4). The purpose of considering land use information at this stage was to identify land use that could compromise the feasibility of the Project and screen an alternative means out from additional evaluation.

For each Project component or activity, a consideration of the technical, economic, and land use characteristics of each alternative was considered. The purpose of this step in the alternative means assessment framework is to identify feasible alternatives for further assessment and to eliminate those alternative means that are not considered to be feasible from a technical, economic, or land use lens. Only those alternatives that are deemed technically and/or economically feasible and avoided interaction with areas of high intensity or high importance land use, are carried forward for further assessment.

For example, at this step in the alternative means assessment framework Option 1 Open pit mining (under Mining – Method) was screened out due to economic factors. For Mining – Methods, the remaining four options were carried forward for further assessment.

2.10.2.3 Potential Residual Effects Associated the Alternative Means

For all alternative means carried forward from the previous step, the expected residual effects following application of mitigation measures were considered. This step in the alternative means assessment framework identifies the potential residual effects which are then brought forward to the evaluation of alternative means. Again, as an example, the information related to Mining - Method (from Appendix 2-C, Table 4) is summarized here in **Table 2.10-1**.

2.10.2.4 Evaluation of Alternative Means

Detailed comparative evaluations of alternative means is presented in Appendix 2-C, Table 6 to Table 22. These evaluations considered the relative residual effects of each of the technical and economically feasible alternatives for each of the evaluation criteria identified in **Table 2.10-2** (same as Table 5 from Appendix 2-C), following the application of mitigation measures (described in Appendix 2-C Table 4).

By way of example (refer to Appendix 2-C for details), a detailed evaluation of Mining – Method from Appendix 2-C has been provided here as **Table 2.10-3**.

Based on the above alternative means assessment process, a preferred alternative means for each respective Project component or activity evaluated was selected. Rationale for the selection based on the comparative evaluation of alternatives is provided in Appendix 2-C including input received by Indigenous groups and other Interested Parties.

For reference, the alternative means assessment is conducted at a screening level, appropriate for the stage of the Project when the alternatives were considered. The assessment considered both quantitative (where possible) and qualitative information as available. The comparative evaluation identified more preferred versus less preferred alternatives. The preferred alternative(s) was selected and evaluated in much greater detail in the EA. A summary of the alternative means carried forward into the EA is provided in **Table 2.10-4**.

2.10.3 Summary of Influence of Indigenous Knowledge, Local Knowledge, and Engagement on the Alternative Means Assessment

As described above, Indigenous Knowledge, local knowledge, and engagement has influenced the alternative means assessment, specifically in step 2 (Consideration of Technical Feasibility, Economic Feasibility, and Land Use Factors) and step 4 (Evaluation of Alternative Means) of the alternative means assessment framework.

Alternative means considered in an EIS must be technically and economically feasible (CEAA 2015). Denison opted to integrate an additional category at this early stage in the alternative means assessment framework: land use screening. Denison included land use separately to provide greater transparency on the approach taken and also in recognition of the importance of local land use that has been communicated by Interested Parties. At this step in the alternative means assessment framework, an option for treated effluent discharge location was eliminated due to land use screening in conjunction with technical considerations.

Denison's specific engagement initiatives on Project alternatives are outlined in Appendix 2-C for the 1) mining method, 2) freeze design for tertiary containment of mining solution, 3) treated effluent discharge location to surface water, and 4) access road alignment. In addition to these targeted engagement sessions, information gathered more broadly during engagement was also considered in Project alternatives through the consideration of general concerns or statements. The comparative evaluation of alternative means includes specific input received from

Indigenous groups and other Interested Parties that contributed to the selection of the preferred option, when applicable. Refer to the row titled *Input received from Interested Parties* in **Table 2.10-3** below for an example of how engagement influenced the selection of mining method.

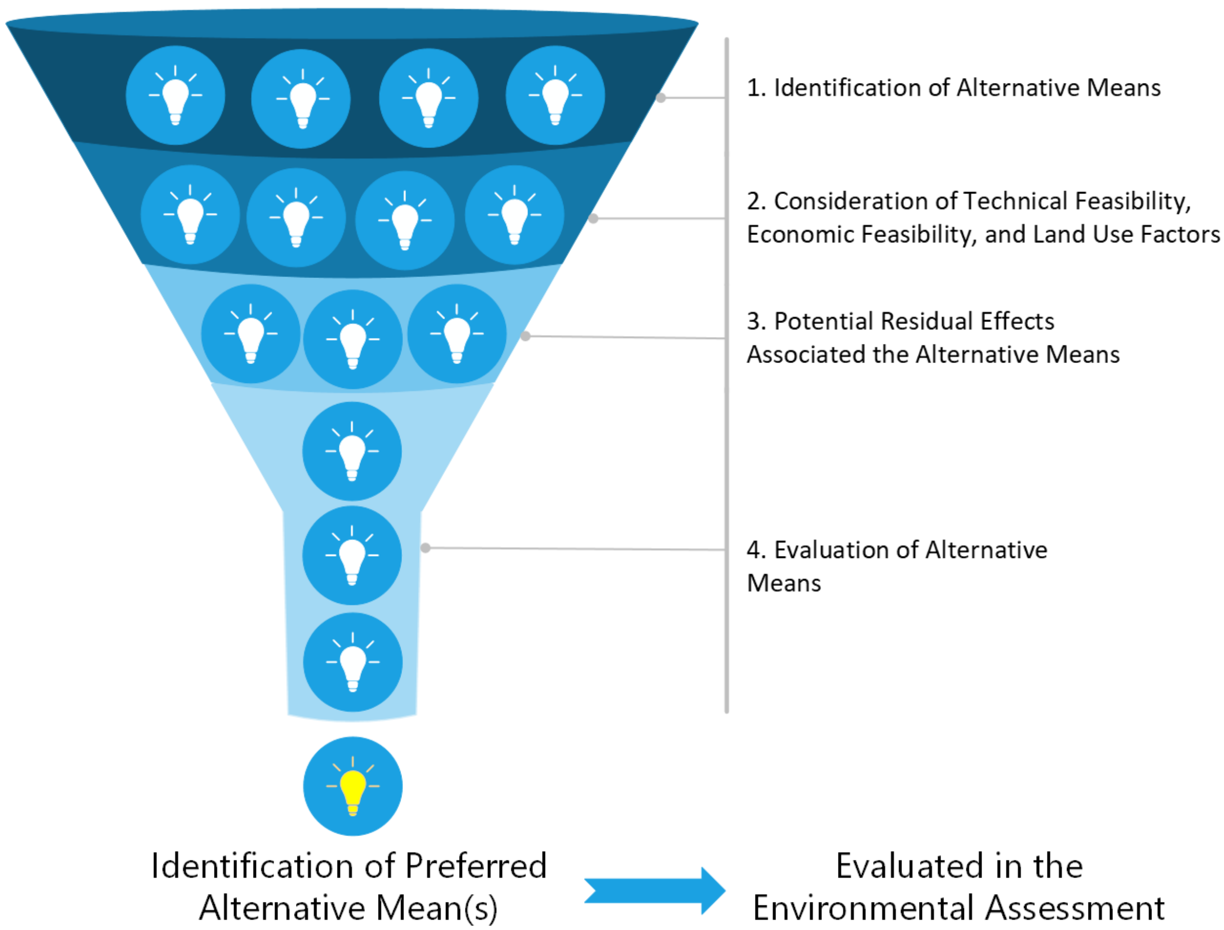


Figure 2.10-1: Alternative Means Assessment Framework for the Project

Table 2.10-1: Mitigation Measures and Residual Effects for Mining - Method (Excerpt from Appendix 2-C Table 4)

Project Component		Alternative Means Carried Through after Screening for Technical, Economic, and Land Use Factors	Mitigation Measures	Residual Effects
Mining	Method	Option 2: Jet Boring	Through design and monitoring, make sure emissions from ventilation meet applicable air quality emissions criteria Any water associated with workings and mining activities meets applicable discharge quality criteria prior to release Limit any surface development to extent practical and avoid areas of significance Follow best management practices and standards for waste characterization and management, containment of hazardous material, liner designs, fuel management	Effects to local geology by development of underground workings Effects on local vegetation, soil, bird, and wildlife habitat as a result of clearing required to develop surface infrastructure to support mining Effects on air quality via emissions from ventilation of underground workings Effects on groundwater quantity and flow paths based on need to dewatering underground mine workings Effects to surface water quality and surface water related receptors whereby mine water is released to local surface water features
		Option 3: Surface Boring	Through design and monitoring, make sure emissions from ventilation meet applicable air quality emissions criteria Any water associated with workings and mining activities meets applicable discharge quality criteria prior to release Limit any surface development to extent practical and avoid areas of significance Follow best management practices and standards for waste characterization and management, containment of hazardous material, liner designs, fuel management	Effects to local geology by development of underground workings Effects on local vegetation, soil, bird, and wildlife habitat as a result of clearing required to develop surface infrastructure to support mining Effects on air quality via emissions from ventilation of underground workings Effects on groundwater quantity and flow paths based on need to dewatering underground mine workings Effects to surface water quality and surface water related receptors whereby mine water is released to local surface water features
		Option 4: Micro Tunnel Boring	Through design and monitoring, make sure emissions from ventilation meet applicable air quality emissions criteria Any water associated with workings and mining activities meets applicable discharge quality criteria prior to release Limit any surface development to extent practical and avoid areas of significance	Effects to local geology by development of underground workings Effects on local vegetation, soil, bird, and wildlife habitat as a result of clearing required to develop surface infrastructure to support mining Effects on air quality via emissions from ventilation of underground workings Effects on groundwater quantity and flow paths based on need to dewatering underground mine workings

Project Component		Alternative Means Carried Through after Screening for Technical, Economic, and Land Use Factors	Mitigation Measures	Residual Effects
			Follow best management practices and standards for waste characterization and management, containment of hazardous material, liner designs, fuel management	Effects to surface water quality and surface water-related receptors whereby mine water is released to local surface water features
		Option 5: ISR	Through design and monitoring, make sure emissions from ventilation meet applicable air quality emissions criteria Any water associated with workings and mining activities meets applicable discharge quality criteria prior to release Limit any surface development to extent practical and avoid areas of significance Follow best management practices and standards for waste characterization and management, containment of hazardous material, liner designs, fuel management	Effects to local geology by development of ISR mining area Effects on local vegetation, soil, bird, and wildlife habitat as a result of clearing required to develop surface infrastructure to support ISR mining Effects on groundwater quantity and flow paths based on development of ISR wellfield (injection and recovery well systems) Effects on groundwater quality by introduction of ISR mining solutions to the mining area Effects to surface water quality and surface water related receptors whereby mine water is released to local surface water features

Table 2.10-2: Detailed Alternatives Means Assessment Evaluation Criteria and Metrics (same as Table 5 in Appendix 2-C)

Criteria	Section	Valued Component	Indicator	Metric
Biophysical Environment	Atmospheric and Acoustic Environment	Air quality	Changes in air quality, including concentrations of dust, combustion products, uranium, metals and/or radionuclides	Alternatives that minimize changes in air quality and effects on ecological and human receptors are preferred.
		Noise	Changes in sound levels	Alternatives that minimize the increase in sound levels, and subsequent effects on wildlife and human receptors, are preferred.
	Geology and Groundwater	Geology	Changes in geology	Alternatives that avoid or minimize effects on geology are preferred
		Groundwater quantity	Changes in groundwater levels, groundwater flow patterns, and discharge rates to local surface water bodies	Alternatives that minimize interaction with groundwater quantity are preferred.
		Groundwater quality	Changes in concentrations of physical and chemical parameters in groundwater with consideration of discharge to local surface water bodies	Alternatives that minimize changes in groundwater quality, in the context of groundwater discharge to surface water bodies, are preferred.
	Aquatic Environment	Surface Water Quantity	Changes in surface water quantity through water taking, surface water discharge, and project overprinting of drainage areas (footprints)	Alternatives that minimize Project footprint, as well as surface water intake and release to surface water bodies, are preferred.
		Surface Water Quality	Changes in physical and chemical parameters of surface water quality can result from discharge of treated effluent to surface water bodies and land disturbance and clearing can mobilize solids into the aquatic environment	Alternatives that minimize Project footprint and changes in surface water quality and effects on fish, and other ecological receptors, are preferred.
		Fish and Fish Habitat	Changes in fish and fish habitat may develop from Project overprinting of fish habitat (habitat alteration or loss), changes in surface water quantity, surface water quality (physical and chemical parameters), sediment quality, or benthic invertebrates	Alternatives that minimize interaction with fish and fish habitat are preferred.
		Sediment Quality	Changes in sediment quality mainly from discharge of treated effluent to surface water bodies	Alternatives that minimize effects on sediment quality are preferred.
		Benthic Invertebrates	Changes in benthic invertebrate communities and quality from uptake of chemical parameters	Alternatives that minimize effects on benthic invertebrates are preferred.

Criteria	Section	Valued Component	Indicator	Metric
		Fish Health	Changes in fish health mainly from discharge of treated effluent to surface water bodies	Alternatives that minimize effects on fish health are preferred.
	Terrestrial Environment	Terrain	Changes to terrain	Alternatives that minimize interaction with terrain are preferred.
		Soil	Changes in soil quantity or quality	Alternatives that minimize loss or alteration of soil quantity, and minimize changes in soil quality, are preferred.
		Organic matter/peat	Loss of organic matter/peat	Alternatives that minimize loss or alteration of organic matter/peat are preferred.
		Vegetation and Ecosystems	Change in areal extent of vegetation habitat types and ecosystems	Alternatives that minimize loss vegetation and ecosystems are preferred.
		Listed Plant Species	Change in number of listed plant species	Alternatives that minimize direct and indirect effects on listed plant species are preferred.
		Wetlands	Change in areal extent of wetlands	Alternatives that minimize loss or alteration of wetlands are preferred.
		Ungulates	Changes in ungulate habitat (loss and/or alteration) and indirect or direct mortality of individuals	Alternatives that minimize ungulate habitat loss or alteration and minimize ungulate mortality are preferred.
		Furbearers	Changes in furbearer habitat (loss and/or alteration) and indirect or direct mortality of individuals	Alternatives that minimize furbearer habitat loss or alteration and minimize furbearer mortality are preferred.
		Woodland caribou	Changes in woodland caribou habitat (loss and/or alteration) and indirect or direct mortality of individuals	Alternatives that minimize woodland caribou habitat loss or alteration and minimize woodland caribou mortality are preferred.
		Raptors	Changes in raptor habitat (loss and/or alteration) and indirect or direct mortality of individuals	Alternatives that minimize raptor habitat loss or alteration and minimize raptor mortality are preferred.
		Migratory breeding birds	Changes in migratory breeding bird habitat (loss and/or alteration) and indirect or direct mortality of individuals	Alternatives that minimize migratory breeding bird habitat loss or alteration and minimize migratory breeding bird mortality are preferred.
		Bird species at risk	Changes in bird species at risk habitat (loss and/or alteration) and indirect or direct mortality of individuals	Alternatives that minimize bird species at risk habitat loss or alteration and minimize bird species at risk mortality are preferred.

Criteria	Section	Valued Component	Indicator	Metric
Human Environment	Human Health	Human Health	Changes in human health from exposure to non-radiological and radiological constituents in air, water, and food	Alternatives that minimize negative changes in human health are preferred.
		Worker Health	Worker conventional health and safety and radiation exposure	Alternatives that reduce conventional health and safety risks and radiation exposure are preferred.
	Land and Resource Use	Indigenous Land and Resource Use	Changes in the area of land available for Indigenous land and resource use, as well as resource availability, and perceived suitability of land and resources for safe use	Alternatives that minimize negative changes in Indigenous land and resource use are preferred.
		Other Land and Resource Use	Changes in the area of land available for non-Indigenous land and resource use, as well as resource availability, and perceived suitability of land and resources for safe use	Alternatives that minimize negative changes in other land and resource use are preferred.
		Heritage Resources	Change in the number of known archaeological resources	Alternatives that minimize direct or indirect alteration or loss of archaeological resources are preferred
	Quality of Life	Cultural Expression	Changes to knowledge transmission and traditional diet, including perceived changes in the suitability and safety of resources that support a traditional diet	Alternatives that minimize direct or indirect adverse effects on cultural expression are preferred.
		Community Well-being	Change in income of local workers and community cohesion	Alternatives that minimize direct or indirect adverse effects on community well-being are preferred.
		Infrastructure and Services	Changes in traffic, community infrastructure and services	Alternatives that minimize direct or indirect adverse effects on infrastructure and services are preferred.
	Economics	Economy	Changes in participation in the traditional economy	Alternatives that minimize direct or indirect adverse effects on economy are preferred.

Other Evaluation Factors		
Criteria		**Metric**
Technical Factors	Complexity of design, construction, operation, and decommissioning	Simple or straightforward designs, construction techniques, and operational procedures based on tested and proven technologies are preferred. Alternatives that are more amenable to decommissioning and/or reclamation are preferred.
Cost Factors	Capital, operating, and decommissioning costs	Lower capital costs are preferred to reduce the pre-production costs and influence the project economic viability. Lower operational costs are preferred to maintain project economics. Lower decommissioning costs are preferred to reduce long term liabilities

Table 2.10-3: Mining – Methods - Alternative Means Assessment (same as Table 6 in Appendix 2-C)

Table Criteria	Section	Valued Component	Option 2: Jet Boring	Option 3: Surface Boring	Option 4: Micro Tunnel Boring	Option 5: ISR
Biophysical	Atmospheric and Acoustic Environment	Air quality	Less preferred option. Air quality on surface would be influenced by slurry handling, radon gas, radioactive dust in vent exhaust, dust from surface stockpiles including clean waste rock. Air quality in the mine workings would be managed with ventilation.	More preferred option. Size of mine rock stockpiles and their influence on air quality would be similar to Option 5. Changes in concentrations of radon in air from well development would be similar to option 5.	Less preferred option. Air quality in the mine workings would be managed with ventilation. Air quality on surface would be influenced by hoisted cuttings or slurry, radon gas, radioactive dust in vent exhaust, dust from surface stockpiles including clean waste rock.	More preferred option. Size of mine rock stockpiles and their influence on air quality would be similar to Option 3. Changes in concentrations of radon in air from well development would be similar to option 3.
		Noise	No appreciable difference was identified among the alternatives for changes in noise. Continual noise from surface ventilation fans and noise from mobile equipment. Similar to Option 4.	No appreciable difference was identified among the alternatives for changes in noise. No fans, noise from production drilling from surface includes compressors and mobile equipment would be continual.	No appreciable difference was identified among the alternatives for changes in noise. Continual noise from surface ventilation fans and noise from mobile equipment. Similar to Option 2.	No appreciable difference was identified among the alternatives for changes in noise. No fans, noise from surface drilling equipment includes compressors and mobile equipment would be intermittent as drilling is done only as required.
	Geology and Groundwater	Geology	Less preferred option for changes to geology, compared to options 3 and 5.	More preferred option for geology compared to options 2 and 4 since this is a surface method requiring less excavation.	Less preferred option for changes to geology, compared to options 3 and 5.	More preferred option for geology compared to options 2 and 4 since this is a surface method requiring less excavation.
		Groundwater quantity	Less preferred compared to option 3. Volume of groundwater management during mining would be similar to Option 4.	Preferred option with smallest interaction on groundwater quantity compared to options 2, 4 and 5.	Less preferred compared to option 3. Volume of groundwater management during mining would be similar to Option 4.	Less preferred compared to option 3. Use of ground freezing temporarily interacts with groundwater flow during operations.
		Groundwater quality	No appreciable difference was identified among the alternatives for changes to groundwater quality. Groundwater quality would interact with mine workings in a limited way due to groundwater management during mining.	No appreciable difference was identified among the alternatives for changes to groundwater quality.	No appreciable difference was identified among the alternatives for changes to groundwater quality. Groundwater quality would interact with mine workings in a limited way due to groundwater management during mining.	No appreciable difference was identified among the alternatives for changes to groundwater quality. Mining area remediation during decommissioning would mitigate effects on groundwater quality.

Table Criteria	Section	Valued Component	Option 2: Jet Boring	Option 3: Surface Boring	Option 4: Micro Tunnel Boring	Option 5: ISR
	Aquatic Environment	Surface Water Quantity Surface Water Quality Fish and Fish Habitat Sediment Quality Benthic Invertebrates Fish Health	Less preferred than options 3 and 5. The volume of water requiring treatment and release would be high, because of the groundwater management required for mine development. This could result in a larger effect on the aquatic environment. Quality of treated effluent expected to the similar among all four options.	More preferred option compared to options 2 and 4. The volume of water needed treatment and release to a surface waterbody would be minimal, and as such, this option would have a smaller effect on the aquatic environment. Quality of treated effluent expected to the similar among all four options.	Less preferred than options 3 and 5. The volume of water requiring treatment and release would be high, because of the groundwater management required for mine development. This could result in a larger effect on the aquatic environment. Quality of treated effluent expected to the similar among all four options.	More preferred option compared to options 2 and 4. The volume of water needed treatment and release to a surface waterbody would be minimal, and as such, this option would have a smaller effect on the aquatic environment. Quality of treated effluent expected to the similar among all four options.
	Terrestrial Environment	Terrain Soil Organic matter/peat Vegetation and Ecosystems Listed Plant Species Wetlands Ungulates Furbearers Woodland caribou Raptors Migratory breeding birds Bird species at risk	This option is less preferred as it may result in a greater potential effect (loss) of terrain, soil, organic matter/peat, vegetation, listed plant species, wetlands and related loss and alteration of wildlife habitat. Largest amount of disturbance due to underground waste rock creating stockpiles of acid generating, contaminated and clean waste rock. Footprint estimated to be similar to Option 4 and double the total disturbance of Option 5.	Direct surface footprint/mining disturbance expected to be the second lowest of the four options. This option is more preferred than option 2 and 4, similar to option 5 with regard to potential effects on the terrestrial environment.	This option is less preferred as it may result in a greater potential effect (loss) of terrain, soil, organic matter/peat, vegetation, listed plant species, wetlands and related loss and alteration of wildlife habitat. Largest amount of disturbance due to underground waste rock creating stockpiles of acid generating, contaminated and clean waste rock. Footprint estimated to be similar to Option 2 and double the total disturbance of Option 5.	Direct surface footprint/mining disturbance expected to be the lowest of the four options. This option is more preferred than option 2 and 4, similar to option 3 with regard to potential effects on the terrestrial environment.
Human Environment	Human Health	Human Health	Less preferred. Potential exposure to non-radiological and radiological constituents in air, water, and food may be higher with this option compared to options 3 and 5 due to 1. changes in air quality from mine	More preferred compared to option 2 and 4 due to smaller changes in air quality and smaller volume of treated effluent release	Less preferred. Potential exposure to non-radiological and radiological constituents in air, water, and food may be higher with this option compared to options 3 and 5 due to 1. changes in air quality from mine rock,	More preferred compared to option 2 and 4 due to smaller changes in air quality and smaller volume of treated effluent release

Table Criteria	Section	Valued Component	Option 2: Jet Boring	Option 3: Surface Boring	Option 4: Micro Tunnel Boring	Option 5: ISR
			rock, slurry handling, and mine ventilation and 2. larger volume of treated effluent release to the aquatic environment.		slurry handling, and mine ventilation and 2. larger volume of treated effluent release to the aquatic environment.	
		Worker Health	No appreciable difference was identified between alternatives because with application of mitigation measures and monitoring, all options would protect worker health and maintain radiation exposure within limits for nuclear workers. Within this context, underground work is higher risk than surface due to confined working area with heavy equipment underground and higher contaminates in underground atmosphere compared to open air conditions on surface.	No appreciable difference was identified between alternatives because with application of mitigation measures and monitoring, all options would protect worker health and maintain radiation exposure within limits for nuclear workers. Surface operation with specialized surface equipment to drill horizontal cavities at ore depth. Physical ore cuttings will need to be rehandled on surface to either slurry for wet transport or dewater for dry transport increasing dose relative to Option 5 (which has a fraction of the drill cuttings to handle). Good conventional H&S as there is minimal mobile surface equipment.	No appreciable difference was identified between alternatives because with application of mitigation measures and monitoring, all options would protect worker health and maintain radiation exposure within limits for nuclear workers. Within this context, this option has potentially the highest dose as workers will have greater potential exposure to radiation while servicing equipment that is working within the ore zone. Underground work is higher risk than surface due to confined working area with heavy equipment underground and higher contaminates in underground atmosphere compared to open air conditions on surface.	No appreciable difference was identified between alternatives because with application of mitigation measures and monitoring, all options would protect worker health and maintain radiation exposure within limits for nuclear workers. Lowest dose of the four mining options evaluated in terms of dose associated with drill cuttings. The main contributor to worker dose would be radon associated with drilling the ISR wells. Surface piping of UBS, pumphouses, and well maintenance will also be a source of dose during pipeline repairs and inspection of equipment.
	Land and Resource Use	Indigenous Land and Resource Use	Less preferred compared to options 3 and 5 because of larger potential changes in resource availability linked to: 1. Larger footprint (changes to terrestrial environment) and 2. Higher volume of treated effluent (changes to aquatic environment). For all options, the area immediately around the mining activity would not be available for Indigenous land and resource use activities during operations for safety reasons. Perceived suitability of land and	More preferred compared to options 2 and 4 because of smaller potential changes in resource availability linked to: 1. smaller footprint (and changes to terrestrial environment) and 2. lower volume of treated effluent (and changes to aquatic environment). For all options, the area immediately around the mining activity would not be available for Indigenous land and resource use activities during operations for safety reasons. Perceived suitability of land	Less preferred compared to options 3 and 5 because of larger potential changes in resource availability linked to: 1. Larger footprint (changes to terrestrial environment) and 2. Higher volume of treated effluent (changes to aquatic environment). For all options, the area immediately around the mining activity would not be available for Indigenous land and resource use activities during operations for safety reasons. Perceived suitability of land	More preferred compared to options 2 and 4 because of smaller potential changes in resource availability linked to: 1. smaller footprint (changes to terrestrial environment) and 2. lower volume of treated effluent (changes to aquatic environment). For all options, the area immediately around the mining activity would not be available for Indigenous land and resource use activities during operations for

Table Criteria	Section	Valued Component	Option 2: Jet Boring	Option 3: Surface Boring	Option 4: Micro Tunnel Boring	Option 5: ISR
			resources for safe use expected to be similar for all options.	and resources for safe use expected to be similar for all options.	and resources for safe use expected to be similar for all options.	safety reasons. Perceived suitability of land and resources for safe use expected to be similar for all options.
		Other Land and Resource Use	Less preferred compared to options 3 and 5 because of larger potential changes in resource availability linked to: 1. Larger footprint (changes to terrestrial environment) and 2. Higher volume of treated effluent (changes to aquatic environment). For all options, the area immediately around the mining activity would not be available for Indigenous land and resource use activities during operations for safety reasons. Perceived suitability of land and resources for safe use expected to be similar for all options.	More preferred compared to options 2 and 4 because of smaller potential changes in resource availability linked to: 1. smaller footprint (and changes to terrestrial environment) and 2. lower volume of treated effluent (and changes to aquatic environment). For all options, the area immediately around the mining activity would not be available for Indigenous land and resource use activities during operations for safety reasons. Perceived suitability of land and resources for safe use expected to be similar for all options.	Less preferred compared to options 3 and 5 because of larger potential changes in resource availability linked to: 1. Larger footprint (changes to terrestrial environment) and 2. Higher volume of treated effluent (changes to aquatic environment). For all options, the area immediately around the mining activity would not be available for Indigenous land and resource use activities during operations for safety reasons. Perceived suitability of land and resources for safe use expected to be similar for all options.	More preferred compared to options 2 and 4 because of smaller potential changes in resource availability linked to: 1. smaller footprint (changes to terrestrial environment) and 2. lower volume of treated effluent (changes to aquatic environment). For all options, the area immediately around the mining activity would not be available for Indigenous land and resource use activities during operations for safety reasons. Perceived suitability of land and resources for safe use expected to be similar for all options.
		Heritage Resources	Less preferred compared to options 3 and 5. Larger area of surface disturbance increases potential interaction with archaeological resources.	More preferred compared to options 2 and 4. Smaller area of surface disturbance reduces potential interaction with archaeological resources.	Less preferred compared to options 3 and 5. Larger area of surface disturbance increases potential interaction with archaeological resources.	More preferred compared to options 2 and 4. Smaller area of surface disturbance reduces potential interaction with archaeological resources.
	Quality of Life	Cultural Expression	No appreciable difference was identified between alternatives for changes to knowledge transmission and traditional diet, including perceived changes in the suitability and safety of resources that support a traditional diet.			
		Community Well-being	No appreciable difference was identified between alternatives for change in income of local workers and community cohesion.			
		Infrastructure and Services	No appreciable difference was identified between alternatives for changes in traffic, community infrastructure and services.			
	Economics	Economy	No appreciable difference was identified between alternatives for changes in participation in the traditional economy.			

Other Evaluation Factors					
Criteria		Option 2: Jet Boring	Option 3: Surface Boring	Option 4: Micro Tunnel Boring	Option 5: ISR
Technical Factors	Complexity of design, construction, operation, and decommissioning	Potential advantages: technology currently in use in Canadian uranium industry; mine layouts do not require development at or above the unconformity; remote system – safe for radiological risks. Potential technical weaknesses: Long duration development timeline; low production rate with limited ability to increase; currently used at only one mine with limited experience outside of that operation; may require extensive research and development; high technical risk including underground operating risks, inflow risk, design and operating risk; may require bulk freezing approach versus perimeter freeze design as assumed in the PEA. This would increase freeze cost and time significantly.	Potential advantages: technology in widespread use in oil and gas industry; reduced safety and environmental risks with elimination of underground excavations; completely remote system – safe for radiological risks; reduced number of employees on site; short timeframe to production (weeks); good production rate with scalability; similar technique under evaluation in Canadian uranium industry (Orano's SABRE mining method). Potential technical weaknesses: Drilling accuracy is paramount and needs additional testing; not currently in use in Canadian uranium industry.	Potential advantages: technology in widespread use in civil / municipal applications; remote system – safe for radiological risks under normal operating conditions; self-supported tunnels, thus risk of ground failure or inflow in tunnels reduced; simple concept and operation, variety of knowledgeable contractors/personnel; moderate production rate (approximately 4M lbs/yr per machine); ability to apply multiple units (scalability). Potential technical weaknesses: Recovery of ore may be limited to 90% at best due to configuration of the tunnels; congested working space in the launch stations; not currently in use in Canadian uranium industry.	Potential advantages: technology in widespread use in international uranium operations (USA, Kazakhstan, Australia); reduced safety and environmental risks with elimination of underground excavations; completely remote system – safe for radiological risks; reduced number of employees on site; short timeframe to production (months); reduced technical risk with majority of remaining risks tested during feasibility stage; toll milling not required. Potential technical weaknesses: Not currently in use in Canadian uranium industry; mining solution permeability requires additional testing to increase confidence; low production rate – based on production rate at US operations (future testing may allow for higher production rates).

Other Evaluation Factors					
Criteria		Option 2: Jet Boring	Option 3: Surface Boring	Option 4: Micro Tunnel Boring	Option 5: ISR
Cost Factors	Capital, operating, and decommissioning costs	Option 2 has high operating cost relative to the grade of the ore body, high capital costs and long duration development timeline, although the technology is in use at an existing uranium operation in Canada.	Option 3 has low capital and operating costs compared to jet boring.	Option 4 has the lowest ore recovery and high capital costs and long duration development timeline. Technology is commonly used in civil engineering.	Option 5 has low capital and operating costs. The technology is in widespread use at international uranium operations. ISR mining operations often have comparatively low capital and operating costs, as well as shorter timelines to first production and greater flexibility to allow production to be scaled to meet market demands.

Input received from Interested Parties:

Denison discussed potential mining methods early in the engagement process. As part of the engagement program for the Project, Denison organized a series of in-person workshops with Indigenous and non-Indigenous communities of interest (COI) and other Interested Parties in 2018. The workshops gathered community and student input in relation to potential mining methods for the Phoenix deposit. Given the history of uranium mining in the Athabasca Basin, there is a wealth of knowledge on various mining methods, and Denison sought input for which method would be best suited to efficiently and safety mining the Phoenix deposit.

The following mining methods were evaluated for effectiveness in mining the Phoenix deposit at the Project: Jet Boring, Surface Boring, Micro Tunnel Boring and In Situ Recovery. There was no specific engagement data collected related to surface boring or micro tunnel boring. Workshop participants noted that while jet boring was a relatively well-known method of mining, the high economic costs may make it undesirable for the Phoenix deposit (18-EN-VPL-2.38) (18-EN-ERFN-5.44). ISR mining is new to northern Saskatchewan and Canada. Some workshop participants were unsure how to evaluate the potential benefits and/or drawbacks of this mining method (18-EN-VILX-3.69), however other participants were confident in the method, saying they know it works in other locations, there are minimal waste streams, and method is more economically feasible than other methods (18-EN-VILX-3.68). A participant in the Village of Beauval workshop preferred the small footprint and lesser environmental impacts of ISR and viewed this method as a new opportunity for northern Saskatchewan (18-EN-VB-4.51). New opportunities are welcomed in the area, as they can support local businesses, provide training and learning opportunities, and keep money within the local economy (16-EN-MLA-109.26).

Selected alternative for mining method = Option 5: ISR

Rationale: Mining methods were evaluated through an increasingly rigorous process and considered factors such as: safety, environment, production rates, capital costs, operating costs, schedule, operational flexibility, and risk. The top four mining methods considered for the Phoenix deposit were: jet boring, surface boring, micro tunnel boring, and ISR. Independent preliminary economic assessment or class 5 level assessments were completed on each of these four options in 2017. The parameters evaluated included safety, environmental impacts, radiological safety, capital cost, operating cost, development timeframe, production rate, economic results (net present value, internal rate of return), regulatory risk, technology risk, equipment and contractor availability, and operating flexibility; this information has been summarized above in the alternatives means assessment cells. In addition, workshops were held in local Indigenous and non-Indigenous communities to capture community input into the selection of a preferred mining method once the options were narrowed down. Ultimately, based on the alternatives evaluated and feedback from Communities of Interest, Denison included the ISR method in the prefeasibility study (PFS; Denison 2018) and this mining method was selected as the basis for the EA.

Less Preferred	Neutral	More preferred

Table 2.10-4: Summary of Alternative Means Carried Forward into the Environmental Assessment

Project Component		Reference to Detailed Alternative Means Assessment Table in Appendix 2-C	Alternative Means						
			Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
Mining	Method	Table 6	~~Open pit~~	Jet Boring	Surface Boring	Micro Tunnel Boring	**ISR**		
	Freeze design for tertiary containment of mining solution	Table 7	Freeze dome	**Freeze wall**					
	Permeability enhancement	Table 8	**Hydraulics**	**Propellant**	**Mechanical**				
	Mining solution	Not applicable. Option 1 basic solution was deemed not technically feasible, economically feasible, and passed the land use screening are carried forward in the evaluation.	~~Basic solution~~	**Acidic solution**					
Processing	Location of processing	Table 9	Off-site processing at an existing mill	**On-site processing in purpose built processing plant**					
	On-site processing method	Table 10	Ion exchange	Solvent extraction	**Direct precipitation**				
Water management	Freshwater supply	Table 11	**Groundwater**	**Surface water**					
	Drinking water	Table 12	Truck drinking water to site	**Generate drinking water on site with a potable water treatment plant**					

Project Component		**Reference to Detailed Alternative Means Assessment Table in Appendix 2-C**	**Alternative Means**						
			Option 1	**Option 2**	**Option 3**	**Option 4**	**Option 5**	**Option 6**	Option 7
	Treated effluent discharge location	Table 13	To groundwater	**To surface water**					
	Treated effluent discharge locations for surface water	Table 14	Kratchkowsky Lake (LA-7)	Whitefish Lake north (LA-6)	**Whitefish Lake south (LA-5)**	McGowan Lake (LA-1)	Russell Lake	~~Mardoc Lake (LA-4)~~	~~Williams Lake LB-3~~
Waste management	Organic waste disposal	Table 15	On-site disposal using an incinerator	On-site disposal in domestic landfill	**On-site composting**				
	Process precipitate disposal	Table 16	On-site permanent disposal	**Off-site reprocessing and final disposal**					
	Domestic waste disposal	Table 17	Collection and disposal off site by a third-party contractor	**Collection and disposal in an on-site domestic landfill**					
Access and transportation	Access road alignment	Table 18	Direct route	Direct route to reduce cut volumes	**Follows part of the existing exploration access road**				
	Stream crossing structures	Table 19	Culverts	**Clear span bridges**					
	Worker transportation	Table 20	Ground transport	**Air transport to existing airstrip at nearby Cameco operations**	**Air transport to new airstrip constructed and operated by Denison**				
Power	Primary power supply	Table 21	Liquefied natural gas power plant	~~Solar photovoltaic power plant~~	Diesel generators	**Provincial power grid**			

Project Component		Reference to Detailed Alternative Means Assessment Table in Appendix 2-C	Alternative Means						
			Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
Support facilities	Camp location optimization	Table 22	First location - Prefeasibility	Second location – Reduce fill volumes	**Third location - Southwest from second location**				

Selected alternative

~~Strikethrough~~ option was eliminated at an earlier step due to technical, economic, or land use factors (see Appendix 2-C)

Attachment: IR-28

Number	IR-28
Dept.	CNSC
Project effects link	Current use of lands and resources for traditional purposes
Reference to EIS, appendices, or supporting documentation	Section 4, IER and engagement appendices, including: • Appendix 2-A • Appendix 6-B • Appendix 7-B • Appendix 8-A • Appendix 9-A • Appendix 10-B • Appendix 11-A • Appendix 12-A • Appendix 13-A • Appendix 14-B
Context and Rationale	**Context:** The summary of issues tables do not appear to include all of the key issues identified by the Indigenous Nations and communities. For example, some Indigenous Nations and communities have shared concerns with respect to accident prevention and overall safety on the Key Lake road (Highway 914) due to increased traffic, impacts on treaty rights and section 35 rights due to cumulative impacts, and decommissioning, that were not captured in the issues and concerns and summary tables in Section 4.3.2 and in the IER. The tables in the engagement appendices include a column titled "Response (From Denison)". The "Response" column does not include responses, but instead points the reader to where this comment or concern was considered. When navigating to the sections referenced, it is often unclear how this information was considered or influenced the assessment. **Rationale:** Additional detail is required in order to ensure the key issues are all identified and to understand the status of validation for each issue raised and the response provided.
Information Requirement	1) Update the summary of issues and concerns tables to include all relevant issues and concerns raised by each of the Indigenous Nations and communities to date, including concerns raised in the Indigenous Knowledge studies provided, additional engagement, and Draft EIS comments.

	2) Please include a column in the issues and concerns tables to clearly articulate the specific mitigation/monitoring measures that Denison have committed to, or any other measures, in order to address the concerns raised by each Indigenous Nation and community during the engagement process to date. 3) Denison must demonstrate that each Indigenous Nation and community has validated that the summary of issues and concerns table reflects their understanding or agreement, and/or a path forward to complete the validation throughout the EIS and the updated IER. Validation must be complete by the time the technical review is complete, prior to submission of a final EIS. Should Denison not be able to fully address issues, concerns or feedback raised by any Indigenous Nation or community, through mitigation and monitoring measures, this should be documented, and a rationale provided. 4) Update the response column of the Engagement tables to describe how these were considered in the sections referenced. Consider renaming this column to reflect the nature of the content (i.e., how the information was considered).

Response:

This response has broken up information into two sections – the information requirement in relation to Section 4 and the associated related sections in the Indigenous Engagement Report (IER), and the engagement appendices that are associated with various sections of the EIS.

Section 4 and the IER: Context

Engagement with Indigenous and non-Indigenous Communities of Interest and Other Communities has been ongoing since 2016 and has evolved over time. Some changes have occurred from the beginning of engagement activities in 2016 to today, such as:

- early engagement occurring with the Northern Village of Pinehouse Lake, to the current state where Kineepik Métis Local #9 (KML) now generally represents the interests of the Métis citizens of the Northern Village of Pinehouse Lake together, along with general non-Indigenous residents;
- the Duty to Consult delegated to the Métis Nation – Saskatchewan from the A La Baie Métis Local #21, the Sipishik Métis Local #37, Patuanak Métis Local #82, and the Sled Lake / Dore Lake Métis Local #67; and
- interest expressed in the Project by Peter Ballantyne Cree Nation, who had not been previously identified by Denison, the CNSC nor the Province of Saskatchewan as having potential interests in the Project.

Section 4 and the IER: Interests, Issues and Concerns

Denison has worked to adapt to the changes as they have arisen. As such, we recognize that some of the *Interests, Issues and Concerns* tables ("Issues Tables") can be further updated with new information about potential issues that have arisen in relation to the Project, of which both the issue and Denison's response to the issue will be further subject to validation by the Indigenous Nation or community.

It is important to note that not all issue or concern raised by an Indigenous nation or community will necessarily have a specific mitigation measure and/or monitoring associated with Denison's response—but mitigation and monitoring measures will be included where it makes sense to do so.

In respect of understanding and enhancing the identification of issues by an Indigenous nation or community, we can advise the CNSC that presently we have:

1) reviewed each Issues Table to determine any engagement data gaps evident as presented in the draft EIS, which may have occurred due to the changing nature of engagement over time as specified above;
2) updated each Issues Table with the key issues raised by the Indigenous Nation and community as a result of comments made on the draft EIS;
3) have developed a plan for validation and positive resolution of the Issues Table with each Indigenous Nation and community and are presently seeking confirmation with each group accordingly; and
4) (in the near future) seek confirmation on acceptable path forward in relation to validation of issues and/or resolution, where it is mutually agreed upon. Where it is not mutually agreed upon, Denison will identify a proposed rationale for potential next steps.

As an important note on this, Denison received permission to use three Indigenous Knowledge reports in the EIS, to provide additional comprehensive information in relation to the relationship to the land and connection to the environment from the Indigenous nations who shared this information. Information from these reports was used accordingly in the draft EIS to inform the environmental assessment and methodology. At the request of these Indigenous nations, these reports have been provided to the regulators under confidential cover. Denison did not carry forward items into the draft EIS that were outside the scope of the agreed-upon nature of the information exchange between Denison and the Indigenous nation. As such, at the time, Denison did not bring forward concerns raised in these reports through to Section 4 of the draft EIS.

Each of the Indigenous nation for whom these reports were prepared has now provided publicly available comments on the draft EIS where they have summarized their own issues and concerns about the Project, *some* of which arise from the confidential materials they have provided to the regulator. As such, Denison can now confidently update the Issues Table with these comments provided on the public record, which will enable a transparent accounting of issues from the worldview.

Section 4 and the IER: Clear Documentation in Issues Tables

Denison understands the importance of demonstrating to the CNSC how issues and concerns raised by Indigenous nations and communities have been resolved, or where this has not been achieved, how Denison can demonstrate its efforts towards doing so and/or rationale for where agreement has not been reached.

We can advise that the steps identified above have been successfully achieved with KML, and as such, Appendix A to this submission includes the Issues Table that will be inserted into the final EIS for KML (Table 4.3-3: Key Issues and Concerns from Kineepik Métis Local #9 [and corresponding table in the IER]) and serves as an example of the Issues Table that will be generated for all the other Indigenous nations and communities.

In this table Denison has added additional information in relation to *How Comment was Addressed / Considered in the Draft EIS* as requested by the CNSC, including any specific mitigation and/or monitoring measures pertinent if appropriate. Additionally, the *Status* column includes whether the issue is complete or ongoing, and the *Justification of Status* column now includes the evidence to support the status conclusion, and if necessary, additional details are provided in the *Ongoing Resolution of Concerns (if Required)* column. The *Ongoing Resolution of Concerns* column will outline the planned process to be followed with the Indigenous nation or community in respect of validation and/or resolution of the issue.

It is Denison's objective to successfully validate and resolve concerns with Indigenous nations and communities prior to the finalization of the EIS. As per Denison's outlined engagement strategy, a focussed approach will occur, first with respect to Indigenous and non-Indigenous Communities of Interest, and then with other Interested Parties.

Where Denison is unable to demonstrate that positive validation and resolution have been attained, clear information will be provided in the relevant table for the Indigenous nation or community in Section 4 of the final EIS (and if required, the IER) outlining the efforts undertaken to do so, planned next steps, or clear rationale for why a positive resolution has not be found to date.

Section 4 and the IER: Planned Engagement and Next Steps

Denison understands the importance of outlining to the CNSC the planned engagement activities to occur with Indigenous nations and communities. As identified above, part of engagement activities is in relation to positive validation and resolution of key issues. Additionally, Denison will be undertaking additional engagement activities that are outlined as follows as of June 30, 2023.

English River First Nation ("ERFN")
Interests, Issues and Concerns:
1) Denison has reviewed ERFN comments provided on the draft EIS.
2) Issues Table from Section 4 of draft EIS will be revised according to the example found in Appendix A of this IR and updated with summarized draft EIS comments–for the final EIS.
3) Discussions are actively occurring with ERFN regarding a process to resolve issues and concerns raised about the draft EIS, as well as successful validation of Denison's responses to historical issues and concerns raised since engagement commenced 2016. Items of interest raised by regulators will be included as part of this process.
4) Status of successful validation by ERFN of Denison responses to Issues Table–**in progress.**

Engagement activities
1) Site tour is planned for summer 2023 with ERFN Leadership, Technical team and Members.
2) Community and Leadership engagement–planned for fall 2023 to discuss:
    a. mitigation, monitoring and residual effects
    b. forthcoming licensing actions

Future Documentation in updated EIS and updated IER
1) All records per the above will be updated in Section 4 of the EIS and the associated section in the IER.

Kineepik Métis Local #9 (“KML”)
Interests, Issues and Concerns:
1) Denison has reviewed KML comments provided on the draft EIS.
2) Issues, Interests and Concerns table from Section 4 of draft EIS was revised according to Appendix A of this IR to be updated with summarized draft EIS comments–for the final EIS.
3) Discussions actively occurring with KML regarding process to resolve issues and concerns raised about the draft EIS, as well as successful validation of Denison's responses to historical issues and concerns raised since engagement commenced 2016. Items of interest raised by regulators were included as part of this process.
4) On June 10, 2023, Denison received positive validation that Denison’s responses to KML issues, as described in the Issues Table, were acceptable to KML.
5) Status of successful validation by KML of Denison responses to KML Issues Table–**complete.**

****It is important to note that KML and the Northern Village of Pinehouse are working on the above matters together as a collective****

Engagement activities
1) Site tour is planned for summer 2023 with KML Leadership, Technical team and Citizens.
2) Community and Leadership engagement–planned for fall 2023 to discuss:
    c. mitigation, monitoring and residual effects
    d. forthcoming licensing actions

Future Documentation in updated EIS and updated IER
1) All records per the above will be updated in Section 4 of the final EIS and the IER.

Ya’thi Nene Lands and Resources Office (“YNLR”) (Representing the Athabasca Basin First Nations and the Athabasca Basin Communities)
Interests, Issues and Concerns:
1) Denison has reviewed YNLR comments provided on the draft EIS.
2) Issues Table from Section 4 of the draft EIS will be revised according to the example found in Appendix A of this IR and updated with summarized draft EIS comments–for the final EIS.
3) Discussions are actively occurring with YNLR regarding the process to resolve issues and concerns raised about the draft EIS, as well as successful validation of Denison's responses to historical issues and concerns raised over time.
4) Status of successful validation by YNLR of Denison responses to YNLR Issues, Interests and Concerns–**in progress.**

Engagement activities
1) Undertook in-person community meetings in January 2023 in coordination with the YNLR in Black Lake, Fond du Lac, Hatchet Lake and Uranium City.
2) Coordinating process for additional engagement with YNLR for fall 2023 as they deem appropriate to discuss:
    a) mitigation, monitoring and residual effects
    b) forthcoming licensing actions

Future Documentation in updated EIS and updated IER
1) All records per the above will be updated in Section 4 of the final EIS and the IER.

Métis Nation – Saskatchewan (“MN-S”)
Interests, Issues and Concerns:
1) Denison has reviewed MN-S comments provided on the draft EIS.
2) Issues Table from Section 4 of the draft EIS will be revised according to the example found in Appendix A of this IR and updated with summarized draft EIS comments–for the final EIS.

3) Denison has offered to meet to discuss the process toward resolution of draft EIS comments with MN-S as well as successful validation of Denison's responses to historical issues and concerns raised over time.
4) MN-S and Denison met on June 12, 2023, to provide a status update on completion of deliverables with respect to Capacity Funding Agreement, and in particular, the Métis Knowledge Study. MN-S outlined steps being followed in respect of this work. Denison indicated its willingness to meet regularly to support the efforts of MN-S in this regard. A tentative meeting has been set for the week of June 26-29, 2023.
5) Status of successful validation by MN-S of Denison responses to MN-S Issues, Interests and Concerns–**in progress.**

Engagement activities

1) Undertook in-person community NR1 and NR3 meetings in February 2023, as coordinated and led by MN-S.
2) Will take direction from MN-S about coordinating additional meetings with MN-S as they deem appropriate to discuss matters of interest.

Future Documentation in updated EIS and updated IER

1) All records per the above will be updated in Section 4 of the final EIS and the IER.

Birch Narrows Dene Nation ("BNDN")

Interests, Issues and Concerns:

1) Denison has reviewed BNDN comments provided on the draft EIS.
2) Issues Table from Section 4 of the draft EIS will be revised according to the example found in Appendix A of this IR and updated with summarized draft EIS comments–for the final EIS.
3) Denison has requested the BNDN traditional territory map along with relevant land and occupancy information in relation to the Wheeler River Project, as indicated by BNDN as existing. To facilitate this, Denison has shared a proposed confidentiality agreement with BNDN to facilitate the sharing of such information.
4) Discussions are actively occurring with BNDN regarding the process to resolve issues and concerns raised about the draft EIS, as well as successful validation of Denison's responses to historical issues and concerns raised over time.
5) Status of successful validation by BNDN of Denison responses to BNDN Issues, Interests and Concerns–**in progress.**

Engagement activities

1) Denison had a meeting with BNDN on February 14, 2023, to provide an overview of the Wheeler River Project. During the meeting, BNDN indicated they would share a traditional territory map and land and occupancy information in relation to the Wheeler River Project subject to reaching suitable confidentiality provisions.
2) On April 25, 2023, Denison shared a draft confidentiality agreement with BNDN.
3) On May 10, 2023, Denison met with BNDN, to discuss the process going forward. During the meeting, Denison was advised that BNDN had proposed revisions to the confidentiality agreement, which they would provide to Denison. Also identified in the meeting was that Denison's access to data BNDN has referenced regarding land use activities in and around the Wheeler River Project would be limited and subject to additional funding from Denison to BNDN. Denison continued to request the available site-specific information to better understand the potential for adverse impacts to rights from the Wheeler River Project to BNDN to potentially adjust engagement approaches with BNDN.

4) On May 11, 2023, Denison was advised to communicate directly with the Chief of BNDN and was provided additional information from BNDN that BNDN would connect with Denison in the future to determine next steps together.
5) On June 16, 2023, BNDN contacted Denison to request a meeting toward the latter part of July 2023. Denison responded positively to this request and will be following up with BNDN accordingly.
6) Subject to process set between Denison and BNDN as identified above, engagement process to be determined.

Future Documentation in updated EIS and updated IER

1) All records per the above will be updated in Section 4 of the final EIS and the IER.

Peter Ballantyne Cree Nation ("PBCN")

Interests, Issues and Concerns:

1) Denison has reviewed PBCN comments provided on the draft EIS.
2) Issues Table from Section 4 of the draft EIS will be revised according to the example found in Appendix A of this IR and updated with summarized draft EIS comments–for the final EIS.
3) Denison has requested PBCN traditional territory map along with relevant land and occupancy information in relation to the Wheeler River Project.
4) To facilitate this, PBCN has directed Denison to access the traditional territory map in a confidential fashion from the CNSC.
5) On May 30, 2023, Denison has made this request of the CNSC.
6) Per below, Denison intends to provide materials to PBCN responding to the concerns raised in the EIS.
7) Status of successful validation by PBCN of Denison responses to PBCN Issues, Interests and Concerns–**in progress.**

Engagement activities

1) Denison had a meeting with PBCN on May 16, 2023, to provide an overview of the Wheeler River Project. During the meeting, PBCN indicated they would share a traditional territory map and had land and occupancy information in relation to the Wheeler River Project. PBCN indicated they desired another meeting to discuss their interests in the Wheeler River Project further. During this meeting Denison and PBCN acknowledged the challenges of meeting immediately, but committed to doing so.
2) As of June 30, 2023, Denison and PBCN have not met, but have intent to do so. Generally, the purpose of the next meeting would be for PBCN to provide more detail on their interests in the Wheeler River Project, and Denison would provide responses to the high-level issues raised by PBCN in their draft EIS comments.

Future Documentation in updated EIS and updated IER

1) All records per the above will be updated in Section 4 of the final EIS and the IER.

Lac La Ronge Indian Band ("LLRIB")

Interests, Issues and Concerns:

1) Denison has reviewed comments provided on the draft EIS.
2) Issues Table from Section 4 of the draft EIS will be revised according to the example found in Appendix A of this IR and updated with summarized draft EIS comments–for the final EIS:
    a) Denison has confirmed that the Wheeler River Project is not located within the Lac La Ronge Indian Band Traditionally Occupied Territory as described in https://pubsaskdev.blob.core.windows.net/pubsask-prod/86730/86730-English.pdf (page 84) (email to Ty Roberts, LLRIB - date February 14, 2023).

   b) Denison has confirmed that the Trapping furblock in which the Wheeler River Project is located is N-18 (ERFN) (email to Ty Roberts, LLRIB - date February 14, 2023).
3) Per below, Denison is providing materials to LLRIB responding to the concerns raised on the Project in relation to the draft EIS.
4) Status of successful validation by LLRIB of Denison responses to LLRIB Issues, Interests and Concerns–**in progress**

Engagement activities

1) Denison will send correspondence to LLRIB regarding the issues raised in the letter sent to the CNSC on the draft EIS in the coming months. In this correspondence, Denison will reiterate its interest in participating in a meeting of the LLRIB Land and Resources Board at a time that is mutually convenient. Denison has also requested the information from the LLRIB that indicates there is some trapping activity near the Project, to better understand the nature of these activities in relation to the Project.
2) As of June 30, 2023, Denison and LLRIB have not met, but have intent to do so at a mutually convenient time.

Future Documentation in updated EIS and updated IER

1) All records per the above will be updated in Section 4 of the final EIS and the IER.

Prince Albert Grand Council ("PAGC")

Interests, Issues and Concerns:

1) Denison has reviewed comments provided on the draft EIS.
2) Issues Table from Section 4 of the draft EIS will be revised according to the example found in Appendix A of this IR and updated with summarized draft EIS comments–for the final EIS.
3) Per below, Denison is providing materials to PAGC responding to the concerns raised on the Project in relation to the draft EIS.
4) Status of successful validation by PAGC of Denison responses to PAGC Issues, Interests and Concerns–**in progress.**

Engagement activities

1) Denison will be sending correspondence to PAGC regarding the issues raised in the draft EIS with a response to issues raised by PAGC.
2) Based on the outcome of the effort above, Denison will undertake next steps accordingly.

Future Documentation in updated EIS and updated IER

1) All records per the above will be updated in Section 4 of the final EIS and the IER.

Northern Village of Beauval & Northern Village of Ile a la Crosse ("NVB" & "NVILX")

Interests, Issues and Concerns:

1) No comments were received on the draft EIS by these Interested Parties.
2) The format of the Issues Tables for NVB and NVILX will be formatted according to Appendix A of this IR–for the final EIS.
3) Denison will develop a process with NVB and NVILX in relation to the Issues Tables for each of these Interested Parties to seek successful validation by NVB and NVILX of Denison responses to NVB and NVILX Issues, Interests and Concerns.
4) Status of successful validation by NVB and NVILX of Denison responses to NVB and NVILX Issues, Interests and Concerns–**in progress.**

Engagement activities

1) Community and Leadership engagement–planned for fall 2023 to discuss:
   a) mitigation, monitoring and residual effects

b) forthcoming licensing actions

****NVILX subject to discussions with MN-S****

Future Documentation in updated EIS and updated IER

1) All records per the above will be updated in Section 4 of the final EIS and the IER.

Section 4 and the IER: Updates Planned for the Final EIS

The following will be updated for the final EIS:

- Section 4 general updates since submission of the draft EIS, including updates to clarify the purpose of the Key Issues and Concerns tables and the Engagement Database Summary tables in various appendices
- Table 4.3-2: Key Issues and Concerns from English River First Nation (and corresponding table in the IER)
- Table 4.3-3: Key Issues and Concerns from Kineepik Métis Local #9 (and corresponding table in the IER)
- Table 4.3-4: Key Issues and Concerns from Sipishik Métis Local #37 (and corresponding table in the IER)
- Table 4.3-5: Key Issues and Concerns from Patuanak Métis Local #82 (and corresponding table in the IER)
- Table 4.3-6: Key Issues and Concerns from Birch Narrows Dene Nation (and corresponding table in the IER)
- Table 4.3-7: Key Issues and Concerns from Lac La Ronge Indian Band (and corresponding table in the IER)
- Table 4.3-8: Key Issues and Concerns from A La Baie Métis Local #21 (and corresponding table in the IER)
- Table 4.3-9: Key Issues and Concerns from Métis Nation – Saskatchewan (and corresponding table in the IER)
- Table 4.3-10: Key Issues and Concerns from Ya'thi Néné Lands and Resources Office (and corresponding table in the IER)
- Table 4.4-1: Key Issues and Concerns from the Northern Village of Pinehouse
- Table 4.4-2: Key Issues and Concerns from the Northern Village of Beauval
- Table 4.4-3: Key Issues and Concerns from the Northern Village of Île-à-la-Crosse

A new table will also be included for Peter Ballantyne Cree Nation in the final EIS and in the IER.

Engagement Database Summary Tables in Various Appendices: Context

Denison's overall approach to respecting the information shared with Denison, as a result of engagement interactions from 2016 onwards, was to aspire to interweave the data outcomes throughout the entire assessment, rather than providing a single summary chapter in the draft EIS. To do this, Denison's Subject Matter Experts reviewed the over 2,000 lines of engagement data collected from 2016 onwards, and determined what and which information could meaningfully inform their assessment approach. This resulted in engagement data being reflected throughout the entire draft EIS, informing almost all aspects of the assessment. To make sure the reviewer could reasonably understand the context in which the engagement data was collected, Denison created an Engagement Database Summary Table as an Appendix item for each section of the draft EIS where engagement data were used. Each Engagement Database Summary Table identifies the *Unique ID* referenced in the chapter, the *Record of Contact* ("ROC") number that can be used to look up the original source materials in the EIS Appendix 4-A: Supporting Materials, the *Event Type*, the *Date*, the *Event Summary*, the *Interested Parties* with which the engagement occurred, the *Comment* made, and the *Response* from Denison. Denison has now added a final column called *Context*, which provides specifics about how the comment was used in the section.

It is important to note that not all issues or concern raised by an Indigenous nation or community will necessarily have a specific mitigation measure and/or monitoring associated with Denison's response, but mitigation and monitoring measures will be included where it makes sense to do so.

It is also important to note that these engagement data are not intended to be representative of the Indigenous nation or community perspective, as the comment may have been made by an individual from the Indigenous nation or community, and not specifically by the leadership. The Issues Tables (as discussed in this IR) are those Tables that summarize the collective interests, issues and concerns by the leadership, which Denison has identified will be subject to the validation process as outlined above. These appendices are simply intended to provide transparency around the engagement data points that had been used in the draft EIS in some manner, and are, therefore, not part of the validation process designed for Indigenous nations and communities.

Engagement Database Summary Tables in Various Appendices: Updates Planned for the Final EIS

Please see Appendix B to this IR for an example of the new format for the Engagement Appendices. The following in the EIS will be updated:

- Section 2 Project Description – Appendix 2-A: Engagement Database Summary Table for Project Description
- Section 6 Atmospheric and Acoustic Environment – Appendix 6-B: Engagement Database Summary Table for Project Description
- Section 7 Geology and Groundwater – Appendix 7-B: Engagement Database Summary Table for Geology and Groundwater
- Section 8 Aquatic Environment – Appendix 8-A: Engagement Database Summary Table for Aquatic Environment
- Section 9 Terrestrial Environment – Appendix 9-A: Engagement Database Summary Table for Terrestrial Environment
- Section 10 Human Health – Appendix 10-B: Engagement Database Summary Table for Human Health

- Section 11 Land and Resource Use – Appendix 11-A: Engagement Database Summary Table for Land and Resource Use
- Section 12 Quality of Life – Appendix 12- A: Engagement Database Summary Table for Quality of Life
- Section 13 Economics – Appendix 13-A: Engagement Database Summary Table for Economics
- Section 14 Accidents and Malfunctions – Appendix 14-B: Engagement Database Summary Table for Accidents and Malfunctions
- Section 15 Effects of the Environment – Appendix 15-A: Engagement Database Summary Table for Effects of the Environment on the Project

Topic	Summary of the Issue, Interest, or Concern	Reference	Denison Response & How Comment was Addressed/Considered in the Draft EIS	Status	Justification of Status	Ongoing Resolution of Concerns (if required)
Monitoring	Interest in information and direct participation in monitoring baseline and effects. Concern that project should have independent monitoring for the Project and that information from this be shared with communities.	ROC 2 ROC 105 ROC 444	An Environmental Protection Program will be established to provide an overarching framework for key environmental monitoring and management plans and to ensure a means to demonstrate compliance with applicable environmental regulatory requirements and other performance targets that Denison may set. The program would be developed in a manner that aligns with the ISO 14001 EMS Standard. Aspects of the Environmental Protection Plan will include: -Management and Monitoring of Emissions -Liquid Effluent Monitoring Plan - Air Emissions Monitoring Plan - Groundwater Monitoring Plan - Environmental Monitoring Plan - Woodland Caribou Management Plan As the Indigenous Community of Interest with a residential community most proximal to the Project, Denison has committed to collaborating with Kineepik Métis Local on a community specific monitoring regime, suited to their interests and needs in order to provide transparent information to discourage avoidance of the area and alleviate perceived concerns about potential impacts. As part of this program, Denison and KML will be sharing information in an agreed-upon fashion, about agreed-upon species of interest. Denison expects that important country foods harvested for food and cultural purposes (i.e moose, fish species, etc), surface water quality, and other areas of interest will form part of this monitoring program, including the potential to report on wildlife-vehicle mortality or other such areas of potential concern as they evolve over time. See Section 16 for a summary of monitoring and follow-up programs.	**Complete** (based on KML acceptance of Response)	• Draft table sent by email from Denison on **June 7, 2023** • Confirmation of positive validation by KML received by email on **June 10, 2023**	N/A General discussions to continue as part of ongoing dialogue
Economics	Concern and interest in economic opportunities associated with Project and education and training to facilitate access and participation by community members.	ROC 62 ROC 105 ROC 388 ROC 444 ROC 620 ROC 623	Denison has estimated a workforce of 300 during the two-year Construction phase and 180 during the Operation phase. Mineral sector positions are typically considered to be higher paying than many other industrial positions. Residents and communities in the LSA (ERFN (including Indian Reserve Wapachewunak 192D and Indian Reserve La Plonge 192) and Patuanak, Northern Hamlet (Patuanak); Pinehouse Lake, Northern Village; and Beauval, Northern Village) will	**Complete** (based on KML acceptance of Response)	• Draft table sent by email from Denison on **June 7, 2023**	N/A General discussions to continue as part of ongoing dialogue

Topic	Summary of the Issue, Interest, or Concern	Reference	Denison Response & How Comment was Addressed/Considered in the Draft EIS	Status	Justification of Status	Ongoing Resolution of Concerns (if required)
			be given first priority for employment, training, and business opportunities, followed by residents and communities in the RSA (Northern Saskatchewan Administrative District). Mitigation and enhancement measures will be implemented by Denison to enhance the positive effects of the Project on employment and training, income, traditional economy, and business opportunities and minimize adverse effects including: -A Human Resource Development Plan to initially prioritize Indigenous and non-Indigenous communities in the LSA in terms of employment and training opportunities; -Establishment of a procurement approach through all phases of the Project, focusing on businesses based within the LSA communities, followed by Indigenous and / or businesses in the RSA; -Negotiation with the Province of Saskatchewan to develop the Project's Surface Lease Agreement and Human Resource Development Agreement. The Agreement negotiated between Denison and KML outlines specific commitments for KML participation in economic opportunities associated with the Project, including in relation to ongoing education and training as deemed appropriate by KML. See Section 13 for a summary on local, provincial, and federal Project benefits and Denison's approach to employment, training, and business participation opportunities for communities. See Section 13 for information regarding employment, employment opportunities, and career growth for community members.		• Confirmation of positive validation by KML received by email on **June 10, 2023**	
Economics	Interest with potential contracts and business opportunities for northern Indigenous companies.	ROC 105 ROC 114 ROC 118 ROC 444	The Project will create employment and business opportunities and increase income for workers and businesses in the LSA, RSA, and beyond the RSA during all phases of the Project. Denison has estimated a workforce during the two-year Construction period of 300 people and during the Operation phase 180 people are expected to be employed to operate the ISR wellfield and processing plant, including	**Complete** (based on KML acceptance of Response)	• Draft table sent by email from Denison on **June 7, 2023**	N/A General discussions to continue as part of ongoing dialogue

Topic	Summary of the Issue, Interest, or Concern	Reference	Denison Response & How Comment was Addressed/Considered in the Draft EIS	Status	Justification of Status	Ongoing Resolution of Concerns (if required)
			supporting activities. Mineral sector positions are typically considered to be higher paying than many other industrial positions. Residents and communities in the LSA will be given first priority for employment and training and business opportunities, followed by Indigenous and / or other communities in the RSA. The Agreement negotiated between Denison and KML outlines specific commitments for KML participation in economic opportunities associated with the Project, including business opportunities as deemed appropriate by KML. See Section 13 for a summary of local, provincial, and federal Project benefits and Denison's approach to employment, training, and business participation opportunities for communities.		• Confirmation of positive validation by KML received by email on **June 10, 2023**	
Engagement	Interest in implementation of appropriate engagement process activities. Concern was raised over the approach to consultation with others (other communities) and questions raised on whether a Collaborative Agreement was possible during operations.	ROC 106 ROC 114 ROC 118 ROC 135 ROC 388 ROC 444	Denison has identified key objectives respecting Indigenous engagement associated with the Project: -Build and maintain authentic relationships based on a foundation of trust, good faith, and transparency. -Create a respectful dialogue process that promotes communication and collaboration among Denison and Indigenous communities, in a timely and accurate fashion. -Understand how the proposed development of the Project may affect the interests of Indigenous peoples (including Indigenous and/or Treaty Rights), and work with Indigenous peoples to avoid, mitigate, or otherwise address effects, while also collaborating to maximize potential positive effects. Engagement activities for the Project can and will evolve over time, as information is gathered that is pertinent to Denison's understanding of the Interested Parties and their relationship to, and interest in, the Project. At present, Denison has an Exploration Agreement with KML and continues to engage with KML and NVP with respect to the Wheeler River Project.	**Complete** (based on KML acceptance of Response)	• Draft table sent by email from Denison on **June 7, 2023** • Confirmation of positive validation by KML received by email on **June 10, 2023**	N/A General discussions to continue as part of ongoing dialogue

Topic	Summary of the Issue, Interest, or Concern	Reference	Denison Response & How Comment was Addressed/Considered in the Draft EIS	Status	Justification of Status	Ongoing Resolution of Concerns (if required)
			The Agreement negotiated between Denison and KML is demonstrative of Denison's responsiveness to the request from KML for such an agreement. See Section 4 for additional information on the consultation process.			
Cumulative Effects	Concern was expressed over cumulative effects in the region.	ROC 105	Denison conducted a cumulative effects assessment, which included the Highway 914 extension project, on categories: -The Atmospheric and Acoustic Environment. -Geology and Groundwater. -The Aquatic Environment. -The Terrestrial Environment. -Human Health. -Land and Resource Use. -Quality of Life. -Economics. Denison respects and understands KML's concern about the cumulative effects in the region, particularly in relation to access to traditional lands and resources in correlation with industrial and mining developments. The residual effects of the Project are expected to interact with the residual effects of other projects and activities in the ILRU RSA, resulting in potential cumulative effects to Indigenous land use activity in the area. This is largely due to the proposed Highway 914 extension project. See Section 16 for a summary of the cumulative effects assessments for each category above.	**Complete** (based on KML acceptance of Response)	• Draft table sent by email from Denison on **June 7, 2023** • Confirmation of positive validation by KML received by email on **June 10, 2023**	N/A General discussions to continue as part of ongoing dialogue
Project Description	Interest in information about current market conditions and overall viability of the Project.	ROC 105	Denison has identified that there is current and future market demand for uranium, the primary raw material for nuclear fuel generation. The Project can address gaps in annual global uranium supply and the use of uranium in nuclear power plants can contribute to net-zero goals, and this can be achieved while making a meaningful contribution to the Canadian economy. The Project was considered in relation to technical feasibility, economic feasibility, and l and use criteria to determine viability of the Project.	**Complete** (based on KML acceptance of Response)	• Draft table sent by email from Denison on **June 7, 2023** • Confirmation of positive	N/A General discussions to continue as part of ongoing dialogue

Topic	Summary of the Issue, Interest, or Concern	Reference	Denison Response & How Comment was Addressed/Considered in the Draft EIS	Status	Justification of Status	Ongoing Resolution of Concerns (if required)
			See Section 2 for information about Project components and purpose.		validation by KML received by email on **June 10, 2023**	
Project Description	Feedback on mining options and technical questions were asked on the different methods of mining. The community provided comments on the different on-site road options.	ROC 2	Project components include: ISR, Drilling, Freeze Wall, Wellfield, Processing, Water Management, Waste Management, Access and Transportation, Power, Support Facilities, Project Area, Project Activities, Ancillary Projects, GHG Emissions, Project Schedule, Project Benefits, Project Design Features, Management System, and Project Alternatives. Through an alternative means assessment, Denison considered options in relation to access and transportation. The access road alignment will follow part of the existing exploration access road, stream crossing structures will use clear span bridges, and worker transportation will be air transport to a) nearby Cameco operations or, b) a new airstrip constructed and operated by Denison. Denison incorporated the feedback provided on road options select the **current** road alignment for the Project. See Section 2 for information and technical detail pertaining to Project Components and Project alternatives.	**Complete** (based on KML acceptance of Response)	• Draft table sent by email from Denison on **June 7, 2023** • Confirmation of positive validation by KML received by email on **June 10, 2023**	N/A General discussions to continue as part of ongoing dialogue
Project Description	Interest for information about type and how chemicals and other hazardous products would be transported, and whether an emergency response team would be ready to respond.	ROC 444	Denison will establish a Transportation of Dangerous Good Program, intended to provide for the safe transport of goods by conforming to all applicable laws, regulations, company policies, and procedures. The Transportation of Dangerous Goods Program applies to all modes of transport and all locations where Denison assumes care and control of the materials. Denison will establish an Emergency Preparedness and Response Program to identify how the Project will prepare for and addresses emergencies that may affect the health and safety of persons, the environment, and the protection of property. Emergency	**Complete** (based on KML acceptance of Response)	• Draft table sent by email from Denison on **June 7, 2023** • Confirmation of positive validation by KML received by	N/A General discussions to continue as part of ongoing dialogue

Topic	Summary of the Issue, Interest, or Concern	Reference	Denison Response & How Comment was Addressed/Considered in the Draft EIS	Status	Justification of Status	Ongoing Resolution of Concerns (if required)
			Preparedness and Response Program would be developed consistent with guidance provided by CNSC in REGDOC-2.10.1, Nuclear Emergency Preparedness and Response (CNSC 2016). Increased pressure on emergency services is most likely to stem from an accident or malfunction on Highways 914 or 165. The extent to which these changes could affect any given community would depend on the nature of the accident or malfunction. Accidents and malfunctions for the Project were determined to (generally) have a highly unlikely to unlikely probability of occurrence, with an overall risk rating of low to moderate; however, the severity of accidents and malfunctions was determined to be minor to major. If such an event were to occur, local resources may be called upon to provide support, which may result in a call to fire, RCMP, or ambulance services depending on the nature of the event. Denison will provide any necessary training and/or equipment to local first responders to make sure they are sufficiently prepared to deal with an unlikely accident or malfunction. Denison's objective is to utilize existing emergency response teams from other operations prior to drawing on community-based resources. In the unlikely event that this were to occur, and KML resources were drawn upon, the Agreement negotiated between provides the foundation for discussions in respect of such incidents. See Section 2 for information pertaining to the above programs.		email on **June 10, 2023**	
Land and Resource Use	Russell Lake was noted of particular importance for recreational/commercial fishing.	ROC 2 ROC 620	Denison noted the importance of Russell Lake and considered Russell Lake in the LSA in terms of recreational/commercial fishing. Negligible aquatic habitat loss is predicted in LA-5 (also known as Whitefish Lake) due to the installation of a discharge pipeline and diffuser configuration. The total area of the lake substrate that would be overprinted by the pipeline is expected to be approximately 135 m2, which will constitute less than 0.05% of the lake's surface area. No other alteration, disruption, or destruction of aquatic habitat in the aquatic environment LSA is expected. Project-induced changes to the	**Complete** (based on KML acceptance of Response)	• Draft table sent by email from Denison on **June 7, 2023** • Confirmation of positive validation by KML received by	N/A General discussions to continue as part of ongoing dialogue

Topic	Summary of the Issue, Interest, or Concern	Reference	Denison Response & How Comment was Addressed/Considered in the Draft EIS	Status	Justification of Status	Ongoing Resolution of Concerns (if required)
			abundance and distribution of fish is, therefore, not expected. The effect, if any, is expected to undetectable to fishers. The Agreement negotiated between Denison and KML outlines specific commitments for KML participation in environmental monitoring associated with the Project, including the potential for monitoring fish species harvested by and important to, KML. See Section 11 for information on how the Project will interact with land and resources including how potential effects will be mitigated.		email on **June 10, 2023**	
Indigenous and Local Knowledge	The community has pre-existing Indigenous Knowledge and will work with Denison on this.	ROC 106	In 2018, KML approached Denison to support a land use mapping initiative in the Project area. The 2018 study builds on existing land use maps, completed in 2011. A verification meeting was held in late 2018 to make sure no geographic data gaps existed and that the results speak for the whole community. In 2022, KML prepared a document to voice their perspectives on Project VCs and to provide a record for EIS development. Based on 12 community engagement sessions and review of the land use maps, KML explained their unique social, cultural, and historical context, expressed a general consensus of support for the Project, and described issues and concerns. See Section 3 for information on IK and LK and how this information was integrated throughout the EIS.	**Complete** (based on KML acceptance of Response)	• Draft table sent by email from Denison on **June 7, 2023** • Confirmation of positive validation by KML received by email on **June 10, 2023**	N/A General discussions to continue as part of ongoing dialogue
Project Description	Questions and clarifications on ISR mining methodology, including freeze wall technology and Project power requirements.	ROC 62 ROC 604 ROC 620 ROC 623	Project components include: ISR, Drilling, Freeze Wall, Wellfield, Processing, Water Management, Waste Management, Access and Transportation, Power, Support Facilities, Project Area, Project Activities, Ancillary Projects, GHG Emissions, Project Schedule, Project Benefits, Project Design Features, Management System, and Project Alternatives. See Section 2 for information and technical detail pertaining to Project Components and Project alternatives.	**Complete** (based on KML acceptance of Response)	• Draft table sent by email from Denison on **June 7, 2023** • Confirmation of positive validation by KML received by email on	N/A General discussions to continue as part of ongoing dialogue

Topic	Summary of the Issue, Interest, or Concern	Reference	Denison Response & How Comment was Addressed/Considered in the Draft EIS	Status	Justification of Status	Ongoing Resolution of Concerns (if required)
			Engagement activities for the Project can and will evolve over time, as information is gathered that is pertinent to Denison's understanding of the Interested Parties and their relationship to, and interest in, the Project. At present, Denison has an Exploration Agreement with KML continues to engage with KML and NVP with respect to the Wheeler River Project. See Section 4 for additional information on the consultation process.		**June 10, 2023**	
Economics and Local Capacity Building	Expressed a need for building capacity locally in terms of training and education, emergency response, waste management, and additionally expressed a want of local procurement and industry supporting infrastructure.	Draft EIS Comments	As outlined in Denison's Indigenous Peoples Policy, Denison recognizes the critical necessity of advancing reconciliation with Indigenous peoples in Canada and the important role of Canadian business in the reconciliation process. Denison is committed to providing Indigenous people and businesses with sustainable economic opportunities and benefits and sharing the economic benefits of Denison's business activities. The Agreement negotiated between Denison and KML outlines specific commitments for KML participation in economic opportunities associated with the Project, including commitments for ongoing education and training as deemed appropriate by KML, support to the vision of local industry supporting infrastructure. In terms of building capacity locally for emergency response and waste management, Denison supports KML's vision on these items where it makes sense and is possible. The Agreement provides a framework for future possibilities such as these.	**Complete** (based on KML acceptance of Response)	• Draft table sent by email from Denison on **June 7, 2023** • Confirmation of positive validation by KML received by email on **June 10, 2023**	N/A General discussions to continue as part of ongoing dialogue
Access and Transport	Expressed a need for industrial grade improvements between Highway 2 and the Key Lake Gate to support the increase in heavy traffic.	Draft EIS Comments	Highway improvements are not within Denison's jurisdiction and are not considered in the EIS for the Wheeler River Project. However, Denison notes KML's perspective of increased traffic volumes and subsequent desire for highway improvements. On Highway 914 between Key Lake and Pinehouse, Denison anticipated that road users would see an increase between 16% and	**Complete** (based on KML acceptance of Response)	• Draft table sent by email from Denison on **June 7, 2023** • Confirmation of positive validation by	N/A General discussions to continue as part of ongoing dialogue

Topic	Summary of the Issue, Interest, or Concern	Reference	Denison Response & How Comment was Addressed/Considered in the Draft EIS	Status	Justification of Status	Ongoing Resolution of Concerns (if required)
			40% over the life of the mine. Trucks travelling on this section of highway will increase from 35 to 53 at peak operational times. Denison's vision in respect of this concern is that Denison and KML work together as partners in discussions about highways with the Provincial Government. However, in respect of actions Denison can undertake regarding traffic along the road at times important for the undertaking of cultural activities, Denison commits to: 1) Assisting KML with the clear identification of the forthcoming culture camp along highway 914 (clear signage 2) Having Project vehicle slow down to 40km/hr from mid-August to mid-October, during the times when KML members may be using the portion of the road near the culture camp. To be specific, this includes 2.5km before the entry into the culture camp, and 2.5km after the entry into the culture camp. See Section 2, Appendix 2-B for more detail pertaining to traffic volumes.		KML received by email on **June 10, 2023**	

Section 9: Engagement Database Summary Table – Vegetation and Ecosystems

Examples

Unique ID	ROC	Event Type	Date	Event Summary	Interested Parties	Comments (from interested party)	Response (from Denison)	Context
18-EN-VILX-3.32	3	Workshop	2018-01-17	As part of the engagement program for the Wheeler River Project, Denison organized a workshop in Ile a la Crosse for community and A La Baie Métis members to attend. The workshop gathered community and student input in relation to road alignment options, treated effluent discharge locations, and mining methods.	Village of Ile a la Crosse	Need to understand impact on groundwater and lakes.	Denison considered this in section: Assessment of Project Related Effects, Potential Project Related Effects, Change in Areal Extent of Habitat Types, Number of Listed Plants, and Areal Extent of Wetlands And in section: Assessment of Project Related Effects, Potential Project Related Effects, Change in the Concentrations of Constituents of Potential Concern in Vegetation	**How comment was used in this section:** The context in which this comment was used within the terrestrial section of the EIS serves as a local perspective, documented as coming from an individual who attended workshop in Ile a la Crosse in the year 2018, which reiterates the importance of groundwater and lakes, thereby providing further validity to the inclusion of water quality and water quantity as a potential pathway of influence in terms of areal extent of habitat types, number of listed plants, the areal extent of wetlands, and changes in the concentrations of constituents of potential concern in vegetation. **How comment would be answered through EIS information:** Groundwater impacts were assessed in Section 7 titled Geology and Groundwater. Impacts to lakes were assessed in Section 9 titled Aquatic Environment. Section 7 and 9 provide details to support the conclusion that there is no significant impact in terms of groundwater or lakes.
20-LK-LEASESUR- 267.67	267	Survey	2020-02-01	Denison sent all known local cabin and lodge leaseholders a survey in the mail to be completed regarding their interests in Wheeler River. Denison received 6 responses from the survey, which has informed it's understanding of leaseholder uses in the area and interests regarding elements to be assessed as part of the environmental assessment.	Leaseholder, Wheeler River Lodge	Concerns over fishing and hunting pressure [from the mine and people accessing the area].	Denison considered this in section: Cumulative Effects, Potential Cumulative Effects	**How comment was used in this section:** The context in which this comment was used within the terrestrial section of the EIS serves as a local perspective, documented as coming from a leaseholder who completed a survey in in the year 2020, which reiterates the importance of land use activities, thereby providing further validity to the inclusion of increased access to the terrestrial RSA as a potential pathway for cumulative effects in terms of invasive plant introduction and increased dust deposition. **How comment would be answered through EIS information:** Both fishing and hunting were assessed in Section 11 titled Land and Resource Use. The assessment considers both terrestrial and aquatic resource availability, as well as the health and abundance of resource, in terms of both Indigenous Land and Resource Use and Other Land and Resource Use. The assessment in Section 11 additionally incorporates increased access owing to the extension of highway 914 as part of the cumulative effects assessment while existing projects were captured and assessed within baseline conditions. Section 11 provides details to support the conclusion that there is no significant impact in terms of fishing and hunting.

Section 11: Engagement Database Summary Table – Indigenous Land and Resource Use

Examples

Unique ID	ROC	Event Type	Date	Event Summary	Interested Parties	Comments (from interested party)	Response (from Denison)	Context
18-EN-ERFN-5.1	5	Workshop	2018-05-03	As part of the engagement program for the Wheeler River Project, Denison organized a workshop for ERFN at their Patuanak Reserve location for ERFN and Patuanak members to attend. The workshop aimed to gather community input in relation to road alignment options, treated effluent discharge locations, and mining methods. The meeting had been delayed many times, and was held in the Health Clinic because there was a regional power outage.	English River First Nation	I always come from the elders' perspective. Since 1906, the area where you're working has been Treaty 10 land. Those lands were the primary area of ERFN and contain burial sites and birth sites of ERFN members. The Dené name of the Wheeler River, Russell Lake and Cree Lake all come from the Denésuliné of English River. The elders have always expressed that it's a primary area of EFRN. One of our late elders was born north of there in 1922. Our traditional gathering place is there.	Denison considered this in section: Existing Environment, Contemporary Indigenous Land and Resource Use in the Region, English River / Patuanak	**How comment was used in this section:** The context in which this comment was used within the land and resource use section of the EIS serves as a local perspective, documented as coming from a member of English River First Nation who attended a workshop in the year 2018. Existing conditions are based on available information and are accompanied by supporting information including available IK, LK, and results of engagement activities of specific relevance to the particular VC/KI. As such, the direct quote was incorporated into the characterization of the existing environment as it relates to occupancy, cultural sites, and navigation pertinent to English River First Nation. **How comment would be answered through EIS information:** English River First Nation is categorized as an Indigenous Community of Interest. Detail on Indigenous COI criteria is provided in detail in EIS Section 4 titled Engagement. Consideration of ERFN territory, as well as ERFN perspectives, has been interwoven throughout the EIS wherever pertinent. Potential impacts to heritage resources were assessed in Section 11 in the subsection titled Heritage Resources. Section 11 provides details to support the conclusion that there is no significant impact in terms of heritage resources. This section also provides detail on the Heritage Resource Management Plan.

Section 13: Engagement Database Summary Table – Economics

Examples

Unique ID	ROC	Event Type	Date	Event Summary	Interested Parties	Comments (from interested party)	Response (from Denison)	Context
21-EN-VPL-444.16	444	Virtual Meeting	2021-02-11	Denison hosted a virtual meeting for the municipality of Pinehouse Lake. The public meetings were focused on the Project generally, and did not seek input or comments on the distinct interests of the Métis in respect of the Project or Métis land use. This was expressly stated at the outset of each of the public meetings. Included in the discussion was an overview on the Valued Components for the Wheeler River Project, with a request to provide feedback to Denison via an online survey with specific questions pertaining to Valued Components.	Village of Pinehouse Lake	Will there be opportunities for people from Pinehouse to be employed?	Denison considered this in section: Existing Environment, Key Indicator: Employment and Training, Employment Rate	**How comment was used in this section:** The context in which this comment was used within the economics section of the EIS serves as a local perspective, documented as coming from a resident of Pinehouse Lake who attended a virtual meeting in the year 2021, which reiterates the importance of employment, thereby providing further validity to the inclusion of employment and training as a key indicator and additionally providing substance to the characterization of local perspectives on the existing environment as it relates to an emphasis on employment. **How comment would be answered through EIS information:** Denison has estimated a workforce of 300 during the two-year Construction phase and 180 during the Operation phase. Mineral sector positions are typically considered to be higher paying than many other industrial positions. Residents and communities in the LSA (ERFN (including Indian Reserve Wapachewunak 192D and Indian Reserve La Plonge 192) and Patuanak, Northern Hamlet (Patuanak); Pinehouse Lake, Northern Village; and Beauval, Northern Village) will be given first priority for employment, training, and business opportunities, followed by residents and communities in the RSA (Northern Saskatchewan Administrative District). Employment was assessed in Section 13 which provides detail related to all facets of the Economic assessments including detail on how the Project will create employment opportunities and increase income for workers and businesses in the LSA, RSA and beyond the RSA during all phases of the Project.

Attachment: IR-35

Number	IR-35
Dept.	CNSC
Project effects link	Change to an environmental component due to hazardous contaminants
Reference to EIS, appendices, or supporting documentation	Section 6, Chemicals of Potential Concern
Context and Rationale	**Context:** The use of petroleum products (e.g., propane, gasoline, and diesel) at the Denison Mines Wheeler River site is associated with vehicles and periodic operational testing of emergency generators as well as stationary pumps for emergency power or fire water systems. Thus, the air emissions will contain acrolein. **Rationale:** This chemical of potential concern (COPC) poses potential risks to human health via inhalation, but acrolein appears to have been missed or deemed insignificant. However, its consideration in the assessment will provide information on the significance of the associated risk.
Information Requirement	Please consider acrolein in the assessment or provide a rationale for its exclusion.

Response:

The air quality assessment in the draft EIS considered combustion emissions (i.e., NOx, SO_2, CO, and fine particulate matter) from diesel-powered equipment/vehicles and the standby diesel generators. While acrolein is a component of diesel exhaust, it was not identified as a contaminant of potential concern (COPC) given that the use of diesel equipment/vehicles and generators at the Wheeler River Project will be limited. To demonstrate this, a quantitative screening level assessment of acrolein emissions from diesel combustion was carried out here to address this IR. Because there is no acrolein criterion or standard in Saskatchewan, Ambient Air Quality Criteria (AAQC) from Ontario were used. These criteria have also been adopted in Alberta. The screening level assessment is described in the following text.

Using the nitrogen oxide (NOx) results from the air quality modelling assessment in Appendix 6-A, 1-hour and 24-hour dispersion factors (i.e., µg/m³ per g/s emitted) were calculated for each assessment scenario. A dispersion factor was calculated for both the worker camp receptor, and the off-property receptor with the highest predicted NOx concentration. These dispersion factors were then applied to estimates of acrolein emissions to predict 1-hour and 24-hour concentrations of acrolein at both locations. The acrolein emission rate from the standby diesel generators were estimated using fuel flow rates from manufacturer's specifications and emission factors from Chapters 3.3 and 3.4 of the U.S. EPA AP-42 Compilation of Emission Factors, depending on the generator size. For mobile equipment and vehicles, a ratio of acrolein to non-methane hydrocarbons (NMHC) was applied to the total HC emission factors (see Section A.9 and A.10 of Appendix 6-A), conservatively assuming total HC equals NMHC. The ratio of acrolein to NMHC was obtained from the U.S. EPA document "*Speciation Profiles and Toxic Emission Factors for Non-road Engines in MOVES3*" (2022) and assumed Tier II engines. The site-wide emission rates for acrolein were estimated to be 1.89E-03 g/s for Construction, 1.04E-03 g/s for Operation, and 1.53E-03 g/s for Decommissioning. In all scenarios, the generators were assumed to operate 24-hours per day and increased equipment usage during Construction and Decommissioning resulted in higher acrolein emissions compared to the Operation scenario.

The results of the screening level assessment are outlined in the table below. Calculated acrolein concentrations are compared against Ontario AAQC, which are based on health as the limiting effect. As can be seen in the table, acrolein concentrations are expected to be well below the applicable criteria for all scenarios. The highest estimated concentrations will occur for the Decommissioning scenario and are 6.7% of the 24-hour AAQC, and 1.8% of the 1-hour AAQC at the worker camp. At the maximum off-property receptor, the estimated acrolein concentrations for Decommissioning are predicted to be 0.9% and 2.0% of the 1-hour and 24-hour AAQC, respectively.

Based on the results of the screening level assessment, acrolein is not considered a COPC.

Calculated Dispersion Factors and Resulting Acrolein Concentrations

Scenario	Averaging Period	Ontario AAQC (μg/m³)	Emission Rate (g/s)	Dispersion Factor [1] (μg/m³ per g/s)		Concentration [2] (μg/m³)		% of Ontario AAQC	
				Camp Receptor	Max Off-Property Receptor	Camp Receptor	Max Off-Property Receptor	Camp Receptor	Max Off-Property Receptor
Construction	1-hour	4.5	1.89E-03	25.5	24.9	4.84E-02	4.71E-02	1.1%	1.0%
	24-hour	0.4		9.2	5.0	1.75E-02	9.56E-03	4.4%	2.4%
Operations	1-hour	4.5	1.04E-03	37.5	23.6	3.91E-02	2.47E-02	0.9%	0.5%
	24-hour	0.4		12.9	5.3	1.35E-02	5.55E-03	3.4%	1.4%
Decomm.	1-hour	4.5	1.53E-03	54.1	26.2	8.29E-02	4.01E-02	1.8%	0.9%
	24-hour	0.4		17.4	5.2	2.66E-02	8.02E-03	6.7%	2.0%

Notes:
[1] Based on the incremental NOx predictions at the worker camp receptor and the off-property receptor where maximum NOx concentrations were predicted.
[2] Concentrations are incremental and do not include the addition of a background. Background is expected to be negligible.

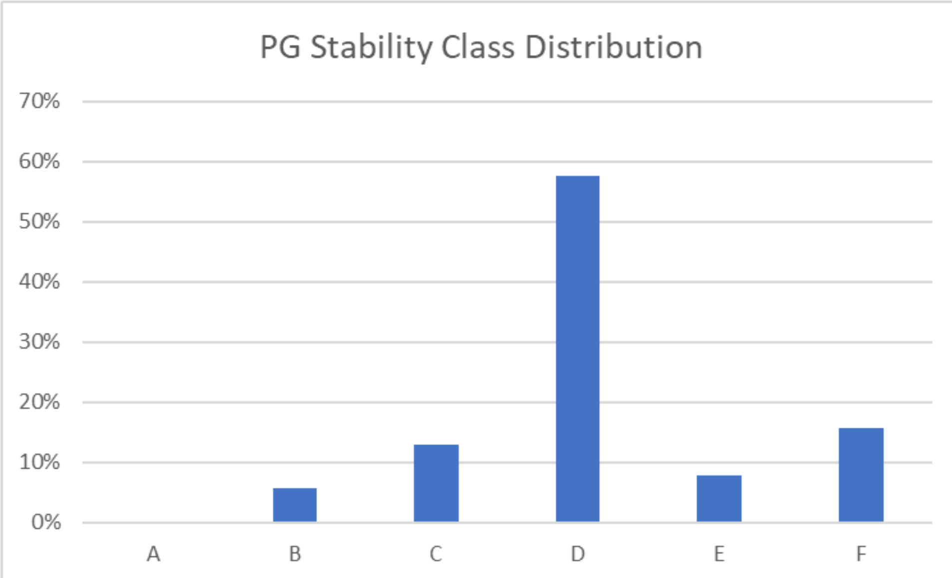
Attachment: IR-39

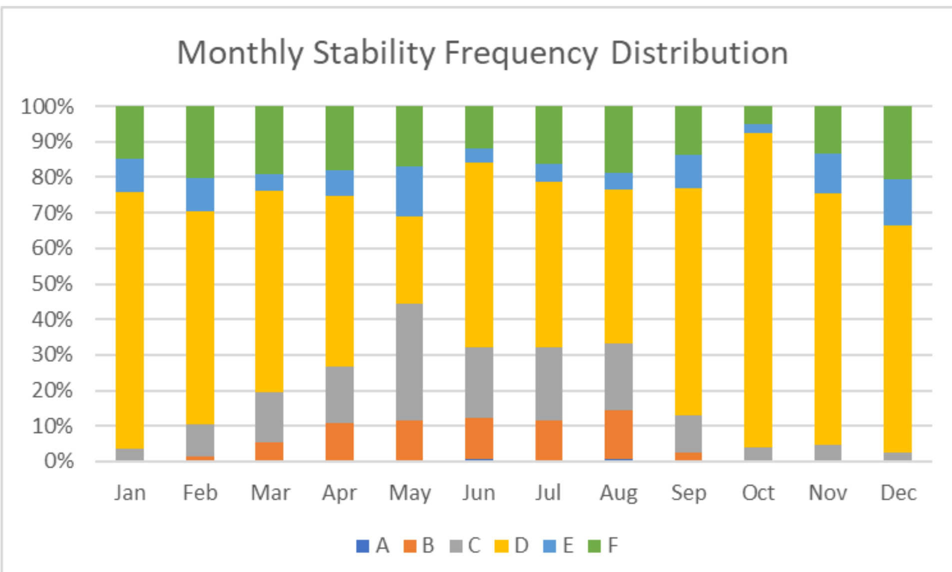
Number	IR-39
Dept.	ECCC
Project effects link	Change to an environmental component due to hazardous contaminants
Reference to EIS, appendices, or supporting documentation	Section 6.1.4.2, Potential Project- Related Effects
Context and Rationale	**Context**: In this section, the Proponent discusses the approach taken for air dispersion numerical modelling. Using their CALMET data set, the Proponent's CALPUFF model runs indicated exceedances for 24- hour total suspended particulates, 24-hour particulate matter (PM10), 1-hour nitrogen dioxide, and 24-hour uranium concentrations. However, there is no mention of possible diurnal and seasonal occurrences of the exceedances. **Rationale**: Adequate assessment of the modelling results requires knowledge of the temporal characteristics for the exceedances. For example, wintertime exceedances may be due to strong temperature inversions, especially during the overnight to morning hours. These strong inversions are challenging for numerical models to capture. Exceedances during warmer months may be due to specific wind directions, which transport emissions directly to downwind receptors.
Information Requirement	Provide additional information on any diurnal and seasonal influences of the modelled exceedances.

Response:

The draft EIS aggregated the total number of exceedances predicted over the one-year CALMET data set to determine the maximum frequency of exceedances. While information on diurnal and seasonal patterns of exceedances is useful for developing air emissions management and monitoring plans, the total number of exceedances was required to identify and evaluate potential residual effects in the EIS.

Information regarding the presence of inversions in the CALMET data set was presented during the Meteorology Technical Meeting held on January 27, 2023. As shown in the figures below, stable conditions (PG stability class categories E and F) occur about 24% of the time and are most prominent during December (33% of the time).



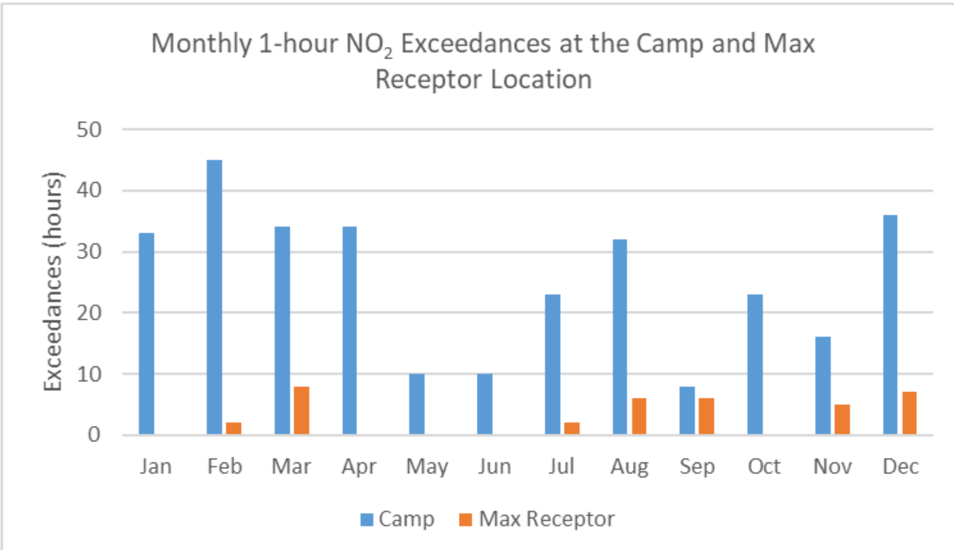


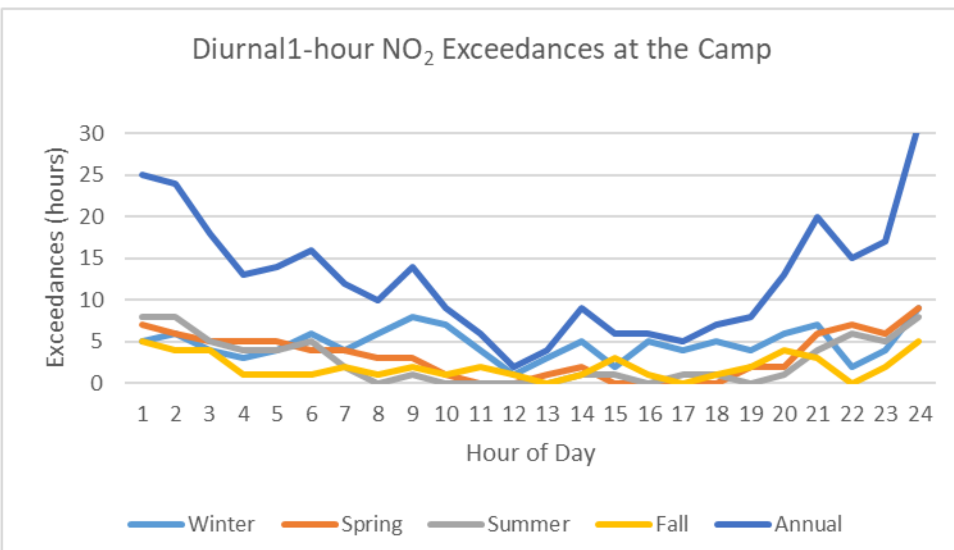
In addition to the previous information, the temporal patterns of the predicted exceedances for 1-hour NO_2, and 24-hour TSP, PM_{10}, and uranium for each of the assessment scenarios have been evaluated at the camp receptor and at the receptor with the maximum predicted concentration. The results of this analysis are presented in a series of figures below. While NO_2 exceedances are limited (i.e., < 5% of the time), some temporal patterns do emerge. Namely, 1-hour NO_2 exceedances are primarily expected to occur during the coldest months (January, February, and December) and during the morning and overnight hours when inversions are more likely to occur. For 24-hour TSP and PM_{10}, exceedances are predicted to be most frequent during the May to October period, corresponding to higher emission rates compared to the November to April period (see Section 4.0 of Appendix 6-A). Being that there are so few 24-hour uranium exceedances, no obvious temporal pattern was identified, but the months with the highest number of exceedances at the camp receptor are expected to be April, October, and

December and only one exceedance is predicted from May to September. This suggests that exceedances of the 24-hour uranium criteria are more likely to occur during the colder months, possibly due to the increased presence of inversions.

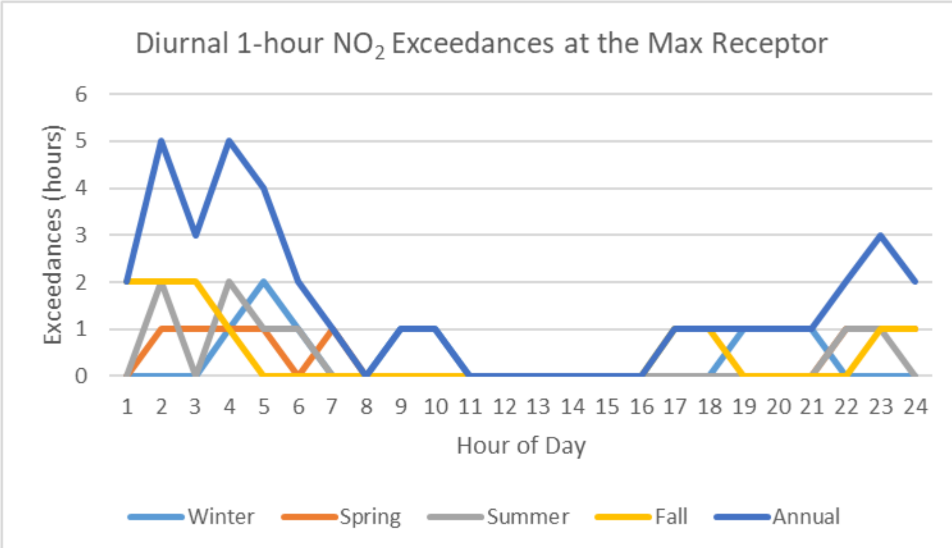
The aforementioned information will be considered as mitigation and monitoring plans are developed.

Figures for Construction Exceedances

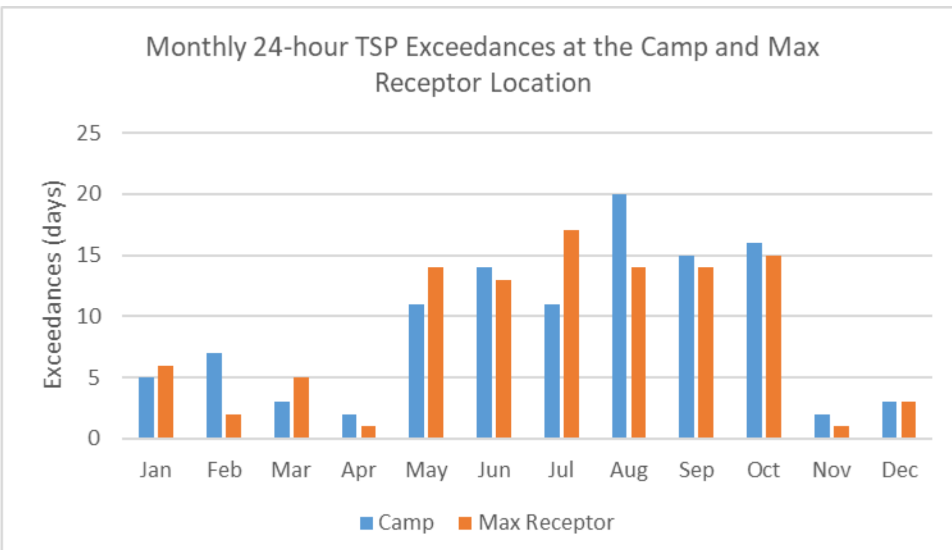




Note: Winter =Jan, Feb, Dec; Spring = Mar, Apr, May; Summer = Jun, Jul, Aug; Fall = Sep, Oct, Nov



Note: Winter =Jan, Feb, Dec; Spring = Mar, Apr, May; Summer = Jun, Jul, Aug; Fall = Sep, Oct, Nov



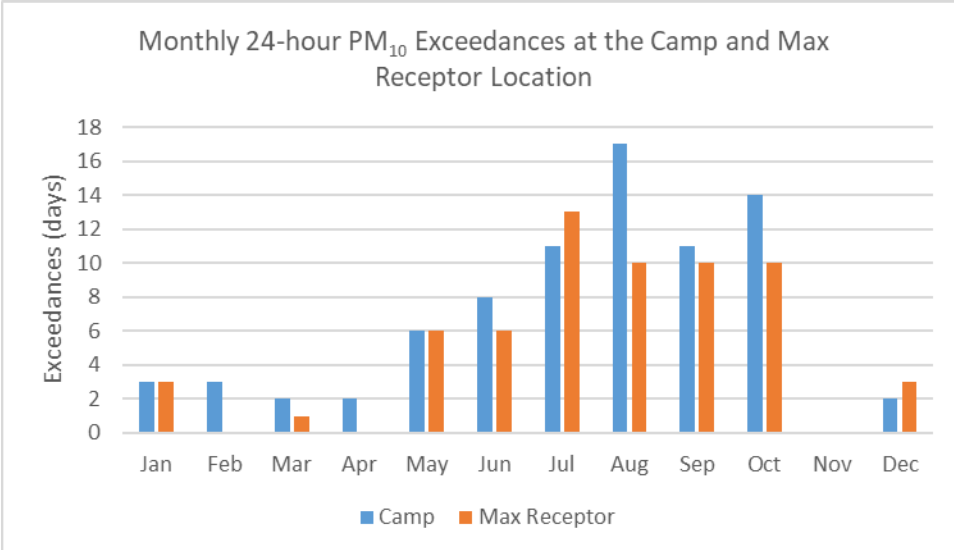
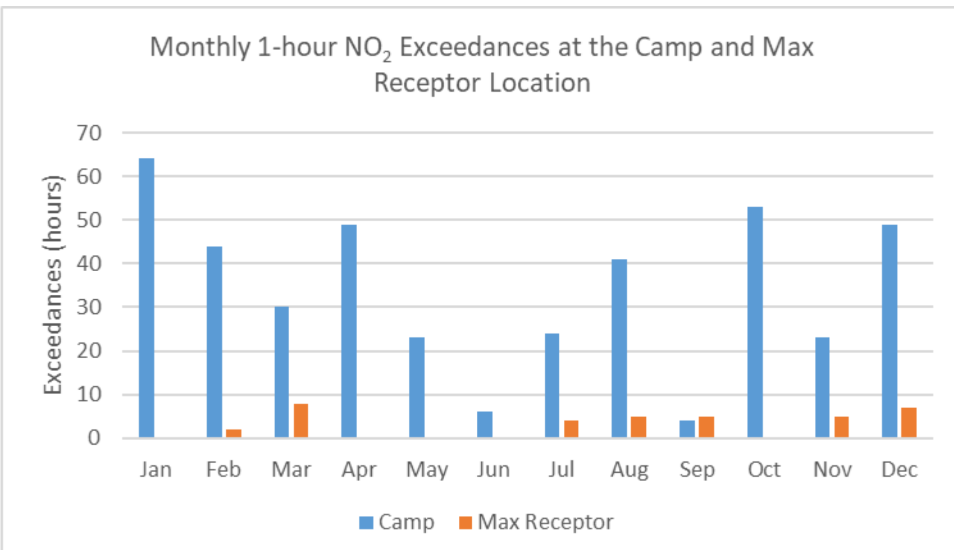
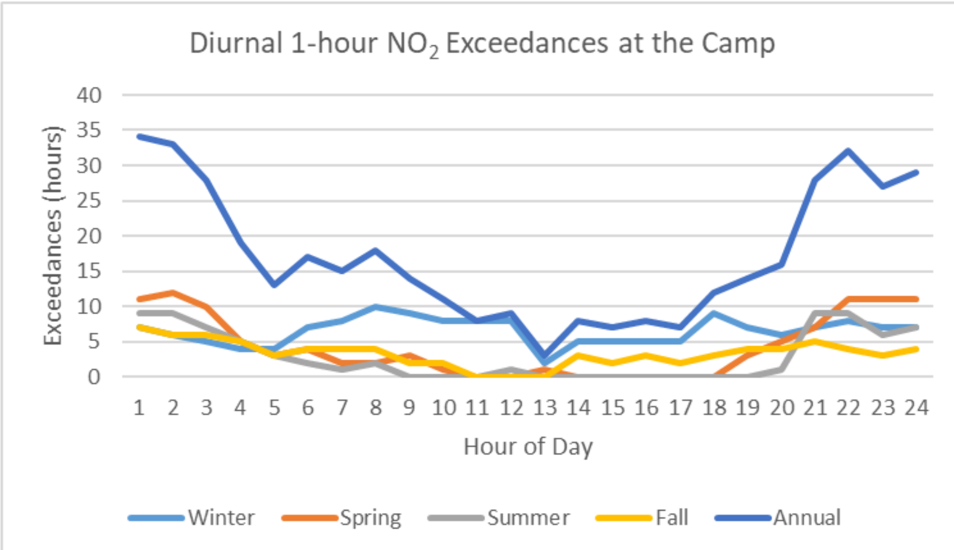
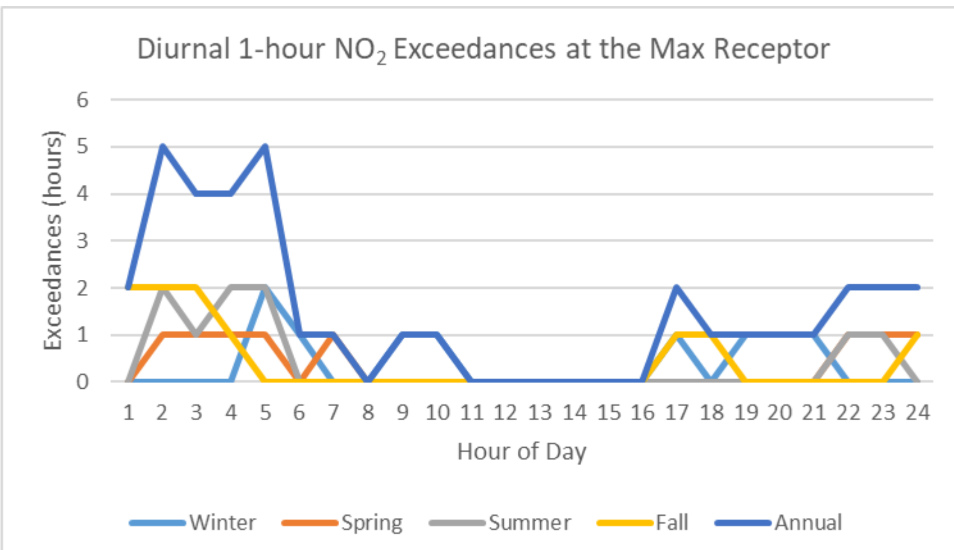


Figure for Operation Exceedances

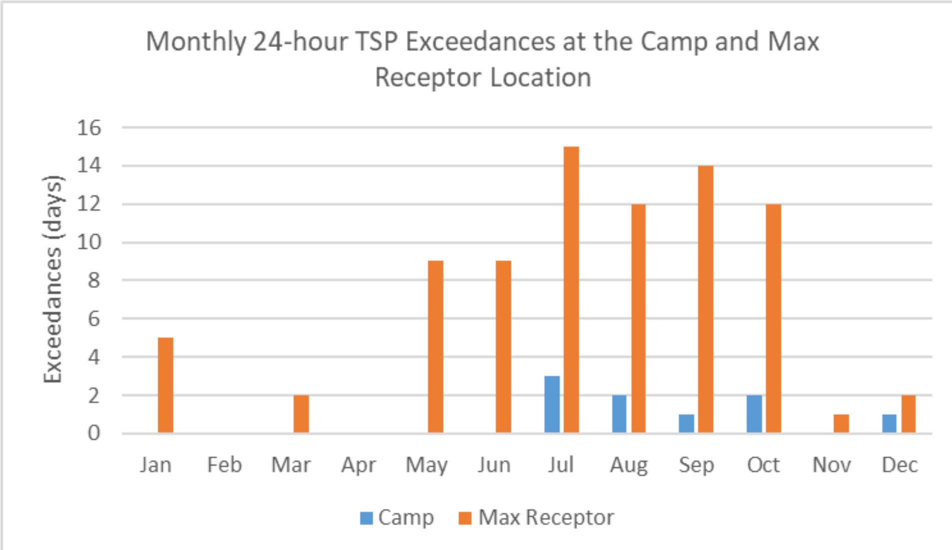


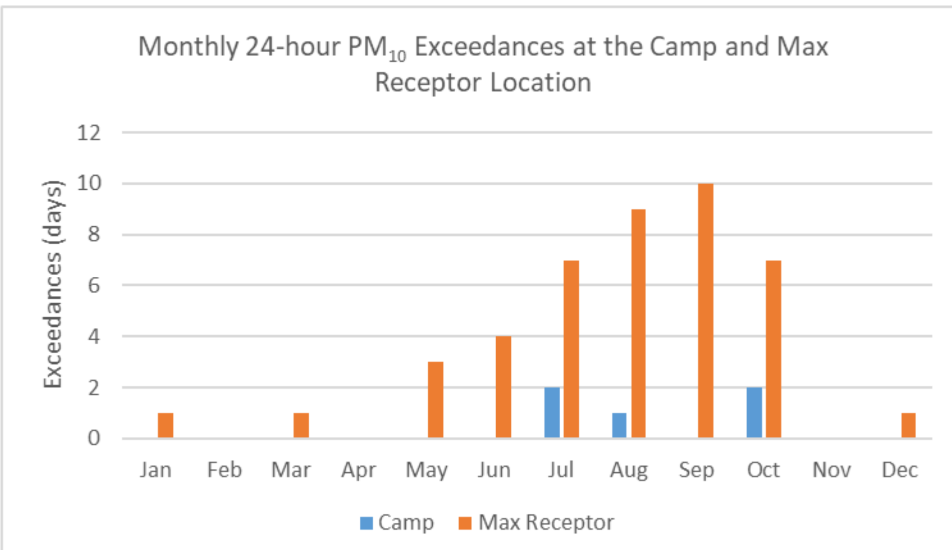


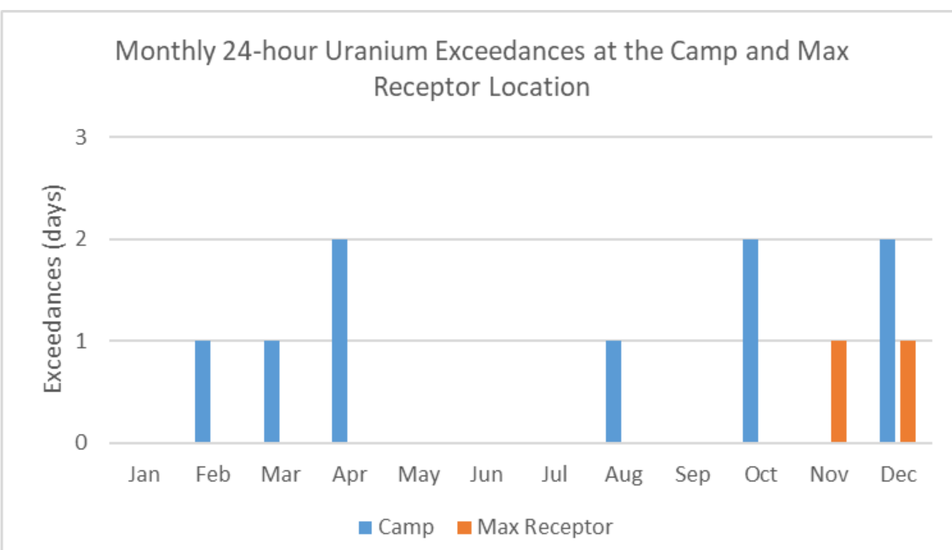
Note: Winter =Jan, Feb, Dec; Spring = Mar, Apr, May; Summer = Jun, Jul, Aug; Fall = Sep, Oct, Nov



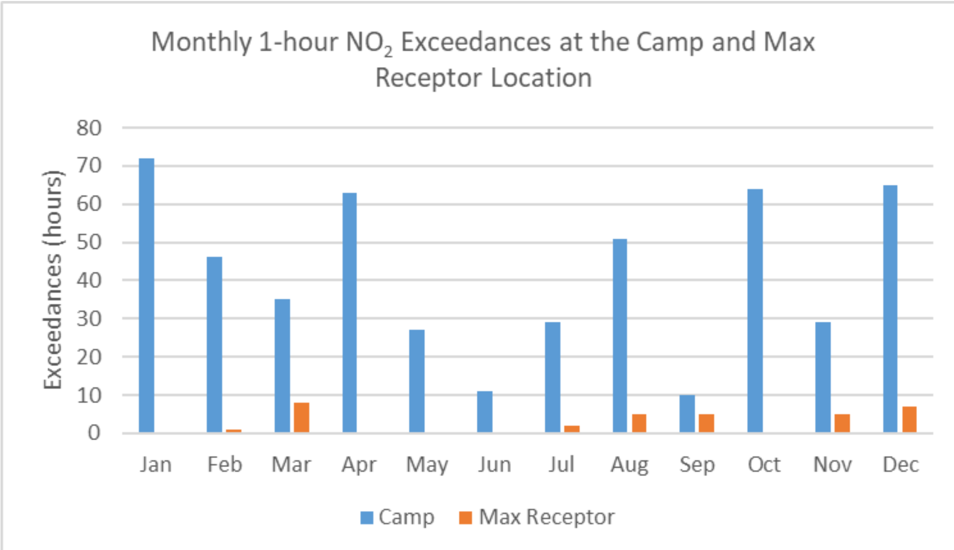
Note: Winter =Jan, Feb, Dec; Spring = Mar, Apr, May; Summer = Jun, Jul, Aug; Fall = Sep, Oct, Nov

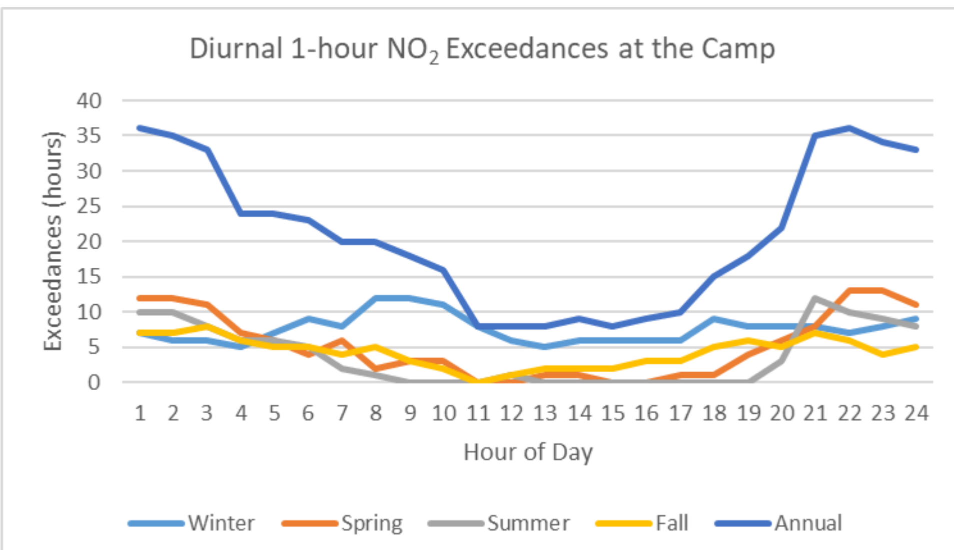

Monthly 24-hour TSP Exceedances at the Camp and Max Receptor Location
Exceedances (days)
0
2
4
6
8
10
12
14
16
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Camp
Max Receptor


Monthly 24-hour PM_{10} Exceedances at the Camp and Max Receptor Location
Exceedances (days)
0
2
4
6
8
10
12
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Camp
Max Receptor

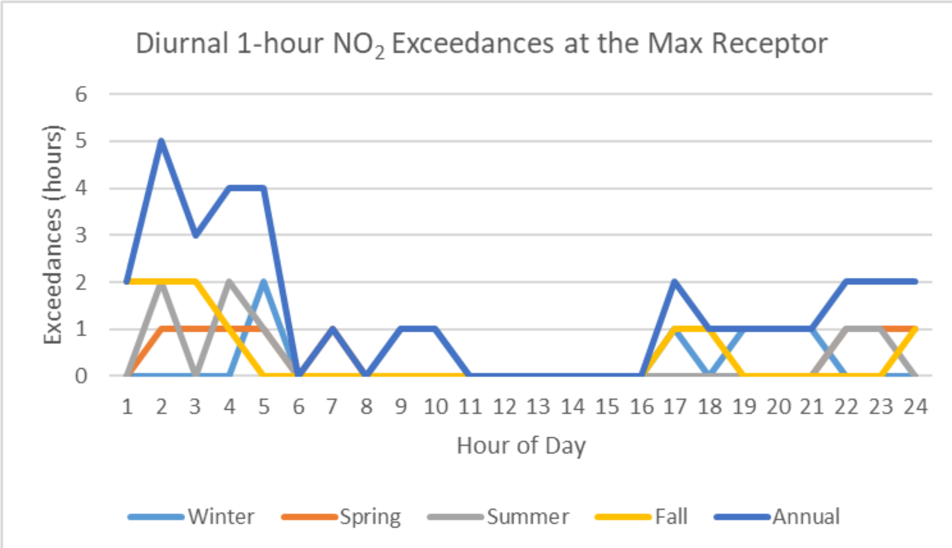

Monthly 24-hour Uranium Exceedances at the Camp and Max Receptor Location
Exceedances (days)
0
1
2
3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Camp
Max Receptor

Figures for Decommissioning Exceedances

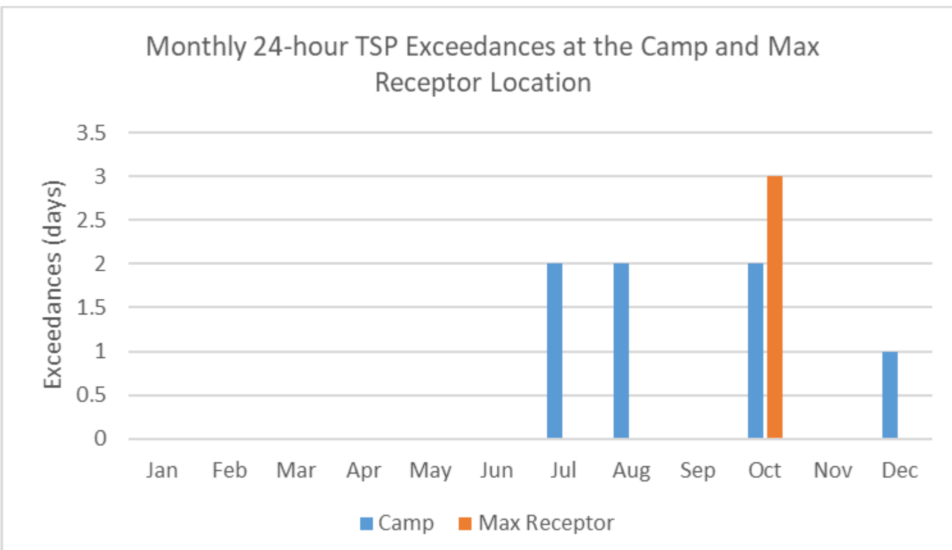


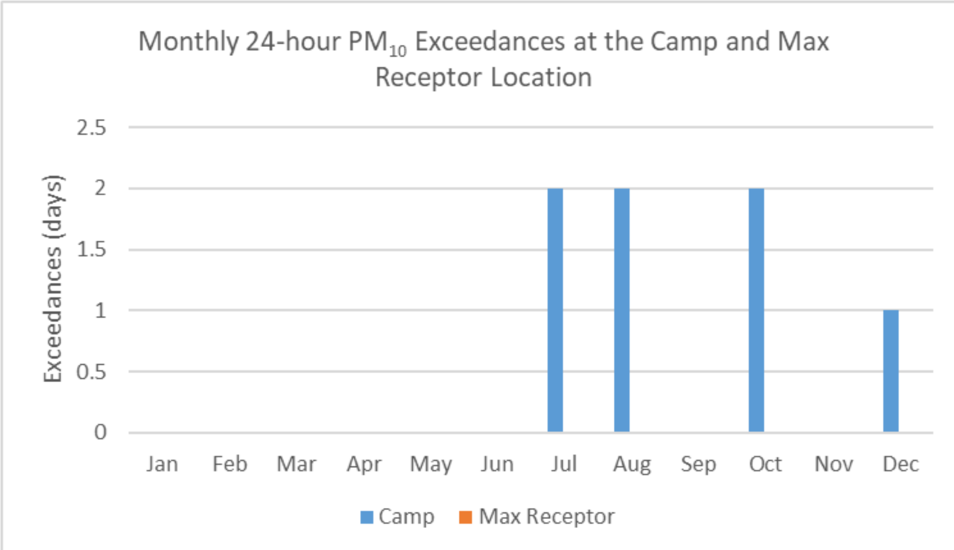


Note: Winter =Jan, Feb, Dec; Spring = Mar, Apr, May; Summer = Jun, Jul, Aug; Fall = Sep, Oct, Nov



Note: Winter =Jan, Feb, Dec; Spring = Mar, Apr, May; Summer = Jun, Jul, Aug; Fall = Sep, Oct, Nov





Note: There were no exceedances predicted at the maximum off-property receptor in the Decommissioning Scenario

Attachment: IR-45

Number	IR-45
Dept.	HC
Project effects link	Change to an environmental component due to hazardous contaminants
Reference to EIS, appendices, or supporting documentation	Section 6 Air Quality Technical Supporting Document Section 6.3.1
Context and Rationale	The carcinogenic risks of diesel exhaust from the project should be assessed. Context: Section 6.3.1 discusses modelled predictions of exceedances for Particulate Matter (PM). TSD p. 22 states: "concentrations of 24-hour PM2.5 are also elevated around the standby generators at the freeze plant, which emit fine particulate matter from combustion of diesel fuel". However, diesel particulate matter is not evaluated for the whole project in the air quality model or the air quality assessment. Rationale: Health Canada has determined that diesel exhaust is carcinogenic in humans which is consistent with the conclusion of the International Agency for Research on Cancer (IARC), and that diesel exhaust is associated with significant population health impacts in Canada. To characterize the carcinogenic risk of diesel exhaust from a project, HC has published a report (2022)[1] which provides a quantitative assessment of the relationship between ambient PM2.5 exposure and lung cancer risk. Specifically, this report quantifies the increase in risk of lung cancer mortality (over the baseline rate in the Canadian population) due to PM2.5 exposure. This quantitative assessment is considered appropriate to characterize risks from diesel PM given the contribution of diesel exhaust to ambient PM2.5 in Canada, and that the carcinogenicity of diesel exhaust has generally been evaluated based on the respirable PM fraction[1,2,3]. References: [1] HC. 2022. Lung Cancer and Ambient PM2.5 in Canada: A Systematic Review and Meta-analysis. Available at: https://publications.gc.ca/site/eng/9.907038/publication.html [2] HC. 2016. Human Health Risk Assessment for Diesel Exhaust. Available at: http://publications.gc.ca/collections/collection_2016/sc-hc/H129-60-2016-eng.pdf [3] IARC. 2013. IARC monographs on the evaluation of carcinogenic risks to humans. Volume 109. Outdoor air pollution. https://publications.iarc.fr/Book-And-Report Series/Iarc-Monographs-On-The-IdentificationOf-Carcinogenic-Hazards-To-Humans/Outdoor Air-Pollution-2015

Information Requirement	1. Evaluate the carcinogenic risk of all potential diesel exhaust from the project based on the approach proposed by Health Canada (2022). Additional guidance ("Additional Lung Cancer Mortality from PM2.5: Recommended Approach and Sample Calculation") is provided as an appendix to this comment table.[i]

[i] Additional Lung Cancer Mortality from PM2.5: Recommended Approach and Sample Calculation
Health Canada, Water and Air Quality Bureau, October 2022
Health Canada (2022) provides a quantitative estimate of the risk of lung cancer associated with exposure to PM2.5 in Canada. The pooled hazard ratio (HR) for lung cancer mortality in the Canadian population is 1.127 (95% CI: 1.085, 1.170) per 10 µg/m^3 increase in long-term exposure to ambient PM2.5. The slope coefficient (β) for this relationship is 0.01196, as derived below:
$e^{(\beta \times 10\ \mu g/m^3)} = pooled\ hazard\ ratio\ per\ 10\ \mu g/m^3$ $e^{(\beta \times 10\ \mu g/m^3)} = 1.127$ $\beta \times 10\ \mu g/m^3 = \ln 1.127$ $\beta = (\ln 1.127)/(10\ \mu g/m^3)$ \` $\beta = 0.01196$
The additional lung cancer mortality (over the baseline rate) from PM2.5 derived from a given source can be determined using the equation below, based on the attributable fraction or (HR-1)/HR (Greco et al. 2020):
$ALCM = \left[\left(e^{\beta \cdot Exposure} - 1\right) / e^{\beta \cdot Exposure} \right] \cdot Baseline\ rate \cdot Years$
ALCM = additional lung cancer mortality cases per 100,000 population
β = 0.01196 (slope coefficient from meta-analysis in Health Canada (2022))
Exposure = estimated PM2.5 exposure concentration from the relevant source(s) (µg/m3) (does not include baseline PM2.5 exposure)
Baseline rate = 45.5 per 100,000 (current Canadian Age Standardized Mortality Rate (ASMR) for lung cancer from Canadian Cancer Statistics Advisory Committee 2021); the Canadian baseline rate is appropriate as the slope coefficient was derived from Canada-wide studies and an updated ASMR of Canada (if available) would be appropriate for use in the calculation
Years = years of project or project phase
<u>Sample calculation:</u>

		Project estimates an exposure from relevant source(s) of 0.067 µg/m3 over 50 years of operation
		$$ALCM = \left[{(e^{\beta \cdot Exposure} - 1)} / {e^{\beta \cdot Exposure}} \right] \cdot Baseline\ rate \cdot Years$$ $$ALCM = \left[{(e^{0.01196 \cdot 0.067} - 1)} / {e^{0.01196 \cdot 0.067}} \right] \cdot 45.5 \cdot 50$$
		ALCM = 1.8 additional lung cancer mortality cases per 100,000
		References:
		[1] Canadian Cancer Statistics Advisory Committee in collaboration with the Canadian Cancer Society,
		Statistics Canada and the Public Health Agency of Canada. Canadian Cancer Statistics 2021. Toronto, ON:
		Canadian Cancer Society; 2021. Available at: cancer.ca/Canadian-Cancer-Statistics-2021-EN
		[2] Greco, S.L., MacIntyre, E., Young, S. et al. An approach to estimating the environmental burden of cancer
		from known and probable carcinogens: application to Ontario, Canada. BMC Public Health 20, 1017
		(2020). https://doi.org/10.1186/s12889-020-08771-w
		[3] Health Canada. Lung cancer and ambient PM2.5 in Canada: a systematic review and meta-analysis.
		[4] Health Canada, 2022. Available online at: https://publications.gc.ca/site/eng/9.907038/publication.html

Response:

Sources of Diesel Emissions from the Project

The Project-related atmospheric releases considered in the Environmental Risk Assessment (ERA) in the draft EIS Appendix 10-A were consistent with the air emissions inventory detailed in the Air Quality Assessment (draft EIS Section 6 and Appendix 6-A). The emissions will vary over time based on the schedule of Project activities and the air quality assessment scenarios were developed based on the year with the maximum activity occurring in each Project phase. There are several combustion sources at the site, which would be expected to contribute diesel emissions during the relevant phases of the Project. Combustion sources at the site include:

- diesel generators;
- propane heaters; and
- diesel and gasoline combustion associated with construction equipment and vehicles utilizing the on-site roads.

These combustion sources would contribute particulate matter (PM_{10} and $PM_{2.5}$), NO_x, SO_2 and CO to the atmospheric environment. Concentrations of these parameters were predicted in the Air Quality TSD

(Appendix 6-A) at several receptor locations within the Local Study Area and were used as surrogates for diesel emissions from the Project. It is important to note that scoping of the air quality assessment followed a conservative approach. For instance, and of relevance to this IR, although Denison expects the site will be powered by the provincial grid during Operations, the air quality assessment conservatively assumed that the back-up diesel generators would run continuously (24/7) during Operation and Decommissioning in order to predict worst-case concentrations and bound the evaluation of Project residual effects.

Assessment of Diesel Emissions in the ERA

Particulate matter, of which diesel particulate matter would be a subset and in particular a subset of or associated with the $PM_{2.5}$ fraction, was assessed in the ERA in Appendix 10-A based upon predicted concentrations at receptor locations as documented in the Air Quality Assessment (EIS Section 6 and Appendix 6-A). As discussed in Section 3.2.1.3.2 of the ERA (Appendix 10-A), predicted concentrations of particulate matter (including TSP and $PM_{2.5}$) during Construction, Operation, and Decommissioning all met their respective annual screening values of 60 µg/m³ for TSP and 8.8 µg/m³ for $PM_{2.5}$. Exceedances were predicted for TSP and PM_{10} of the 24 hour screening values in all Project Phases, attributable to fugitive dust from earthworks and unpaved roads and not operation of generators. There were, however, no exceedances of the 24 hour screening value for $PM_{2.5}$, the fraction of particulate matter most likely to be associated with diesel emissions.

Assessment of Diesel Emissions using HC New Approach

The method recommended by HC in this IR was used to calculate the additional lung cancer mortality (ALCM) over the baseline rate from $PM_{2.5}$ using the predicted $PM_{2.5}$ concentrations presented in the EIS. The same human receptor locations assessed in the ERA (Risk2 through Risk5, Table 3-7 in Appendix 10-A) were considered including the residency times for each receptor type consistent with Table 4-2 in Appendix 10-A, and shown in Table IR45-1 below.

Table IR45-1: Summary of Human Receptor Locations and Residency Assumptions

Receptor ID	Receptor Location Description	Receptor Type	Residency Assumption
Risk2	Human Location Trapper	Fisher/Trapper	50% at Risk2, 50% at Risk5
Risk3	Human Location Camp Worker	Camp Worker	50% at Risk3, 50% at Risk5
Risk4	Human Location Seasonal Resident	Seasonal Resident	30% at Risk2, 70% at Risk5

Baseline concentrations for $PM_{2.5}$ are 3.1 µg/m³. The following equation (Greco et al., 2020) was used to calculate the ALCM.

$$ALCM = \left[\left(e^{\beta \cdot Exposure} - 1\right) / e^{\beta \cdot Exposure} \right] \cdot Baseline\ rate \cdot Years$$

Where β = 0.01196

Exposure = estimated $PM_{2.5}$ exposure concentration with background removed

Baseline rate = 45.5 per 100,000

Years = years of project or project phase (construction = 2 years, operation = 15 years, decommissioning = 5 years)

The exposure concentrations for $PM_{2.5}$ were scaled to consider the fraction attributable to diesel sources, consistent with Section 4.0 in Appendix 6-A (Construction = 22.8%, Operation = 26.8%, and Decommissioning = 36.2%). Considering these assumptions, the following table provides the ALCM for each project phase:

Table IR45-2: Summary of Additional Lung Cancer Mortality Rates at Human Receptor Locations

Receptor ID	Construction	Operation	Decommissioning
Risk2	0	0	0
Risk3	0	0	0
Risk4	0	0	0

Note: Results are interpreted per 100,000 people.

As shown above, the risks for the general public at Risk2, Risk 3 and Risk4 demonstrate that no additional lung cancer mortality cases are expected per 100,000 population as a result of exposure to diesel particulate matter (using $PM_{2.5}$ as a surrogate) due to the Project. Therefore, there is unlikely to be an increased incidence of lung cancer mortality due to exposure to diesel particulate matter generated by the Project activities.

Mitigation measures to limit diesel emissions and exposure

Various mitigation measures will be implemented to control or reduce the impacts to the atmospheric environment from the Project. These include administrative and physical controls based on best industry practices, as listed below and outlined in the draft EIS Section 6 and Appendix 6-A and in IR responses:

Administrative controls

- Create and implement a dust management plan, including the application of water and/or chemical suppressant to control fugitive dust, in addition to other operational strategies to assist in dust control;
- Planning vehicle and equipment routes to minimize travel distances, where possible; and
- Employ standard operating procedures and complete regular inspections of equipment machinery to ensure it is in good working order.
- Vehicles and equipment will be equipped with Tier 4 engines where feasible (IR-139).

Physical controls

- Avoid dust-generating activities (e.g., earthworks, material handling) during dry or high wind conditions;
- Avoid dropping material from height;

- Ensure all exhausts (e.g., mobile equipment, generators) are in good working condition;
- Turn off vehicles and equipment when not being used;
- Minimize or reduce vehicle and equipment speed by enforcing speed limits;
- Apply water at least twice per day to unpaved roads and surfaces; and
- Maintain unpaved road surfaces via grading or other maintenance practices to reduce the amount of silt (i.e., fines) present in the roadbed material.

Conclusions

Considering $PM_{2.5}$ as a surrogate for diesel particulate matter, the modelled concentrations of $PM_{2.5}$ are not expected to result in any additional lung cancer mortality cases per 100,000 at the receptor locations that are relevant for members of the public (i.e., hunters, trappers, fishers, recreational users, seasonal residents) and the camp worker. The overall risk is expected to be negligible; however, monitoring of particulate matter will be carried out throughout the Project and compared to risk-based criteria. Therefore, no further Project controls beyond those identified are proposed for the protection of human health due to diesel particulate matter.

References

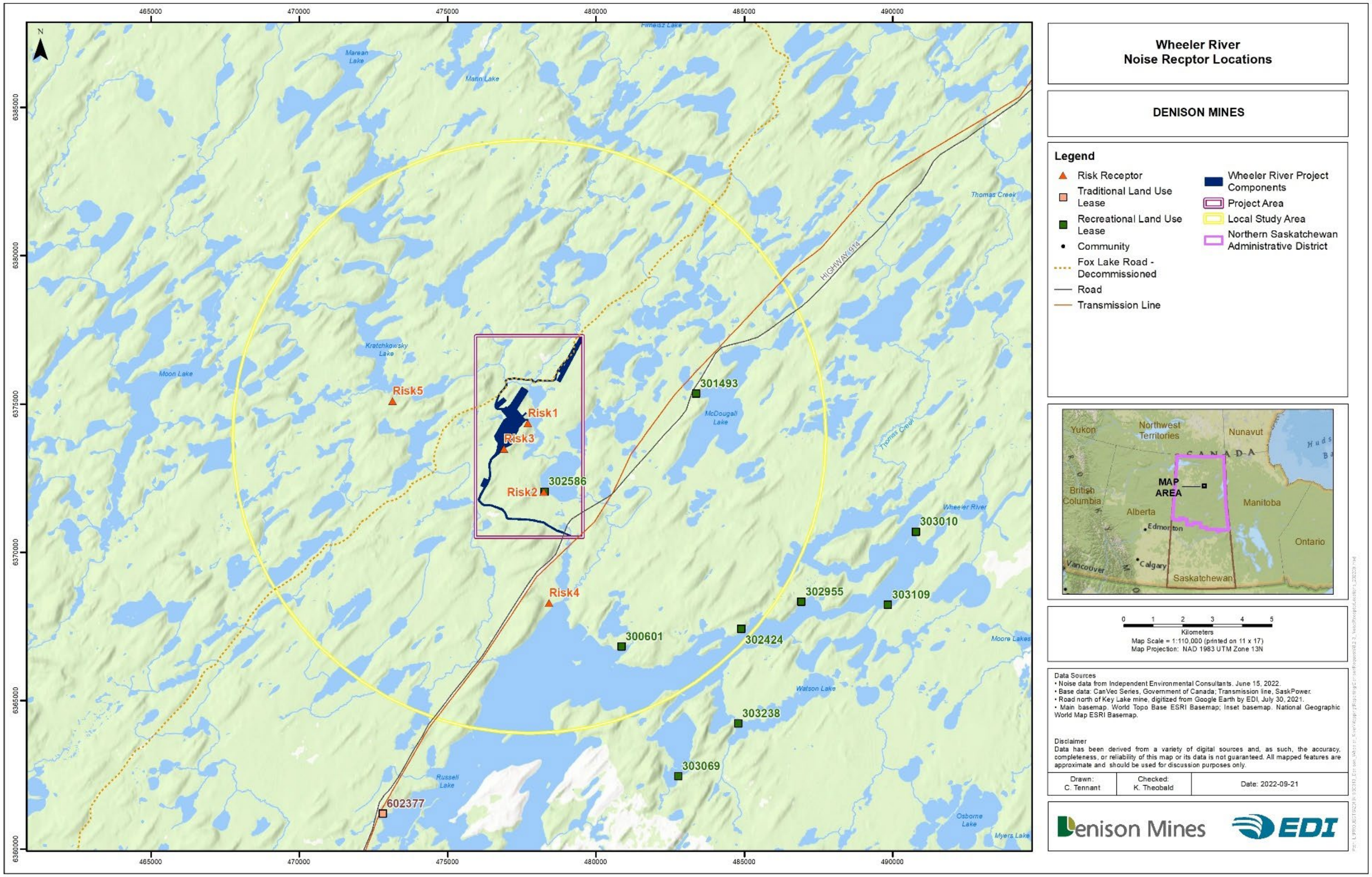
CCME (Canadian Council of Ministers of the Environment). 2023. Canadian Ambient Air Quality Standards. Last accessed online 2023/06/27 from https://ccme.ca/en/air-quality-report.

Greco, S.L., MacIntyre, E., Young, S. et al. 2020. An approach to estimating the environmental burden of cancer from known and probable carcinogens: application to Ontario, Canada. BMC Public Health 20, 1017

Attachment: IR-48

Number	IR-48
Dept.	HC
Project effects link	Physical stressors (noise and vibration)
Reference to EIS, appendices, or supporting documentation	Appendix 6-E, Figure 6.2.3, p. 6-57
Context and Rationale	Noise-sensitive receptors are not included on noise contour maps. Context: Noise-sensitive receptors are identified in the acoustic model report in Section 6 Appendix 6-E but not presented on any maps in the atmospheric and acoustic sections of the main report (Figure 6.2-3). Rationale: The noise assessment typically includes a map illustrating modelled noise levels from the project at receptor locations in the study area. Certainty regarding the presence of human receptors in the regional study area is also recommended in order to assess cumulative impacts.
Information Requirement	1. For more clarity, identify noise-sensitive receptors on Figure 6.2-3: Noise Assessment Study Area as well as on contour maps showing the baseline and predicted noise levels.

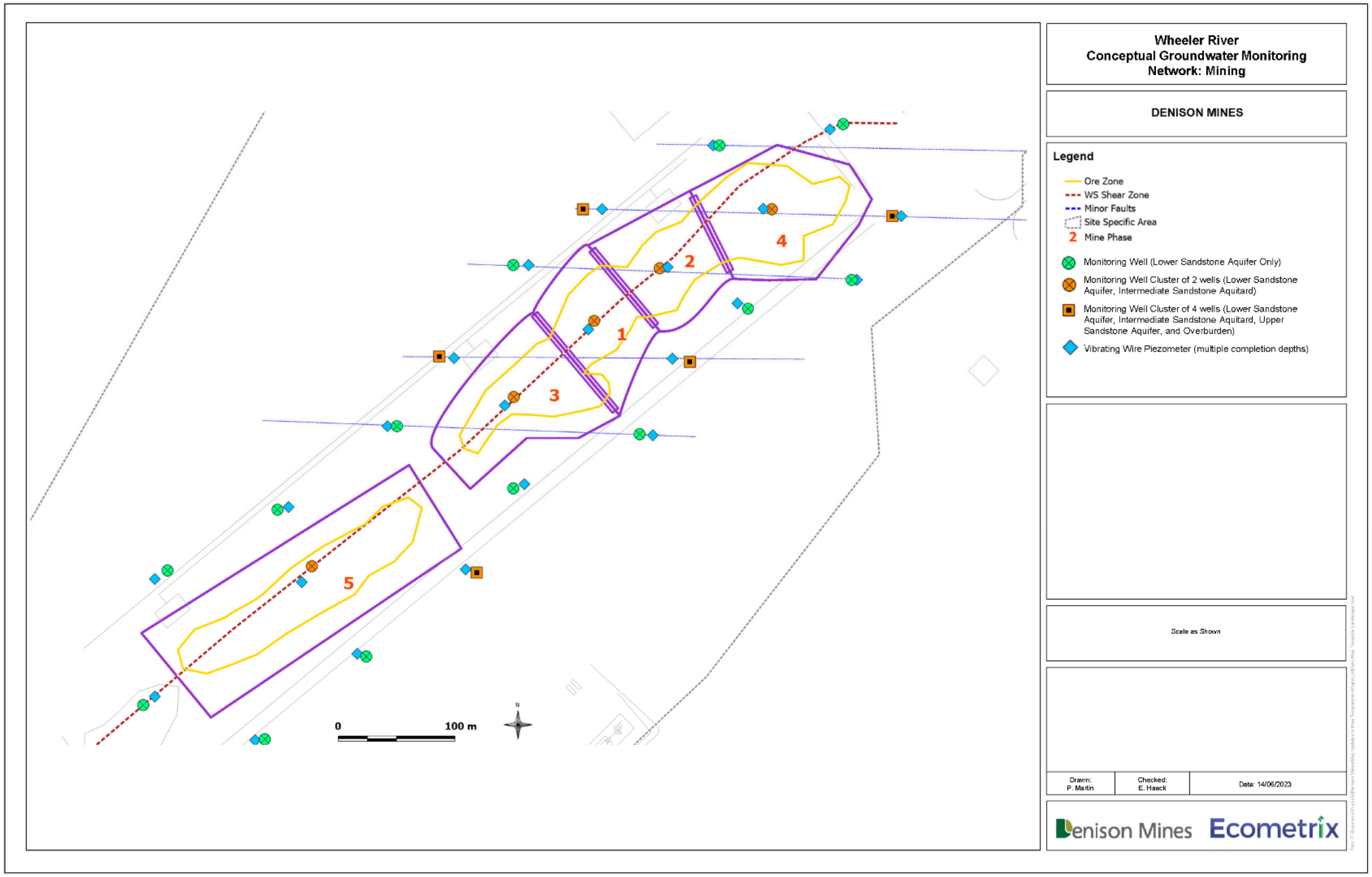
Supporting figure to the response provided in IR table:



Attachment: IR-51

Number	IR-51
Dept.	CNSC
Project effects link	Geology and Groundwater
Reference to EIS, appendices, or supporting documentation	Section 7, Figure 7.8-1 Appendix 7-C
Context and Rationale	**Context:** Figure 7.8-1 (p. 7-107, main EIS report) shows monitoring well cluster outside of the freeze wall. **Rationale:** It is not clear what the targeted hydro-stratigraphic units of each monitoring well cluster are. In addition, it is not clear how the establishment of the freeze wall and any leakage from the brine solution will be monitored. If there is any "window" within the freeze wall (i.e., the freeze wall is not continuous), is there any way to identify that?
Information Requirement	Please clarify the targeted hydro-stratigraphic units of each monitoring well cluster in Figure 7.8-1 (p. 7-107, main EIS report). Please clarify how the establishment of a continuous freeze wall will be monitored.

Supporting figure to the response provided in table:



Attachment: IR-57

Number	IR-57
Dept.	CNSC
Project effects link	Fish and fish habitat
Reference to EIS, appendices, or supporting documentation	Section 7.3.3.2 Appendix 7-A, Sections 3.1.2 and 3.7, Appendix 7-C, section 2.5.2
Context and Rationale	**Context**: The proponent's conceptual model of groundwater flow in the Local Study Area (EIS, sec 7.3.3, Figure 7.3-7) involves an unconfined Upper system hosted by overburden and the Upper sandstone aquifer, and a Lower confined system hosted by the Lower Sandstone Aquifer. The Intermediate Sandstone aquitard acts as a confining unit. Vertical heads gradients are directed downwards west of the Phoenix deposit and upwards beneath surface water receptors including Whitefish Lake (EIS, sec. 7.3.3.2). Using head data from nested monitoring wells (Appendix 7-A, sec. 3.1.2, Table 3-1) the proponent calculates upward gradients in cluster WR-607, between the Lower Sandstone aquifer and the Upper Sandstone aquifer. In cluster LA-5, an upward gradient is calculated between the Upper Sandstone and the overburden unit (Appendix 7-A, Table 3-5). In areas west and south-west of the Phoenix deposit, groundwater is estimated to flow downward under a vertical gradient of approximately 0.015 m/m (Appendix 7-A, p.3-15). **Rationale**: In NRCan's opinion, the proponent's interpretation of vertical head gradients in the LSA is not fully accurate. For the "Up-Gradient" monitoring well cluster, the tabulated head data (Appendix 7-A, Table 3-1) and data logger hydrographs (Appendix 7-A, Appendix B) indicate a downward gradient (0.014 m/m) from the overburden unit to the Intermediate Sandstone and an upward gradient (0.056 m/m) from the Lower Sandstone to the Intermediate Sandstone. Head data from the "NW" monitoring well cluster indicate a similar pattern of downward (0.016 m/m) and upward (0.014 m/m) gradients converging in the Intermediate Sandstone. In the "Downgradient" and "SE" monitoring well clusters, head observations and data logger hydrographs indicate downward gradients from the shallow aquifer system but essentially equal heads in the Intermediate and Lower Sandstones. This more complex picture of groundwater flow systems in the LSA does not appear to have been captured in the proponent's conceptual model. Given the importance of the baseline hydrogeological regime for predicting the transport and fate of COPCs in the post-decommissioning period, the proponent needs to demonstrate that the numerical groundwater flow model accounts for observed vertical head gradients.
Information Requirement	In section 2.5.2 of Appendix 7-C (Calibration Results), the proponent should demonstrate that the numerical groundwater flow model reproduces quantitatively or at least qualitatively the vertical head gradients calculated from observations in the nested monitoring well clusters (Appendix 7-A, Table 3-1).

Response:

Vertical gradients are presented in Table 3-5, Section 3.7 of Appendix 7-A, while Table 3-1 presents water levels observed at individual groundwater monitoring wells. Discussion of vertical gradients is limited to groups of wells which are close together (e.g., GWR-036 and GWR-037 which are approximately 10 m apart) rather than clusters of wells which are further apart (e.g., the upgradient cluster, where wells are approximately 400 m apart).

Vertical gradients are implicitly calculated as water levels from all observation wells are incorporated as calibration targets using their coordinates in 3D space. Recognizing that all water level observations are subject to human error, and as such values that are very close to one another (e.g., as observed at GWR-008 and GWR-009) are treated as essentially the same value.

As requested, the table below presents observed and simulated vertical gradients at the well clusters presented in Table 3-1, Appendix 7-A. Observed static water levels are presented as there were issues with the barometric pressure correction for transient water levels.

Cluster	Well	Unit	Observed Water Level (static)	Simulated Water Level	Screen mid-point Elevation	Observed Gradient	Simulated Gradient	Notes
NW	GWR-003	OVB	503.97	503.87	467.8			
	GWR-027	ISA	500.91	501.00	246.3	0.0065	0.0061	
	GWR-025	LSA	502.34	502.40	146.3	-0.0058	-0.0057	
SE	GWR-007	OVB	514.12	503.48	515.2			perched aquifer at GWR-007 impacts gradient calculation
	GWR-009	ISA	502.20	502.57	285.5	0.0231	0.0018	
	GWR-008	LSA	502.40	502.37	166.2	-0.0007	0.0007	
Up-gradient	GWR-006	OVB	514.70	515.81	504.75			
	GWR-028	ISA	511.00	510.40	241	0.0073	0.0107	
	GWR-029	LSA	514.80	515.07	172.25	-0.0158	-0.0194	
Down-gradient	GWR-005	OVB	501.99	500.94	382.55			
	GWR-014	ISA	501.60	501.21	348.05	0.0010	-0.0007	
	GWR-012	LSA	501.27	501.40	166.5	0.0009	-0.0005	

As indicated in this table, the model provides an excellent representation of the observed gradients estimated using these monitoring well clusters.

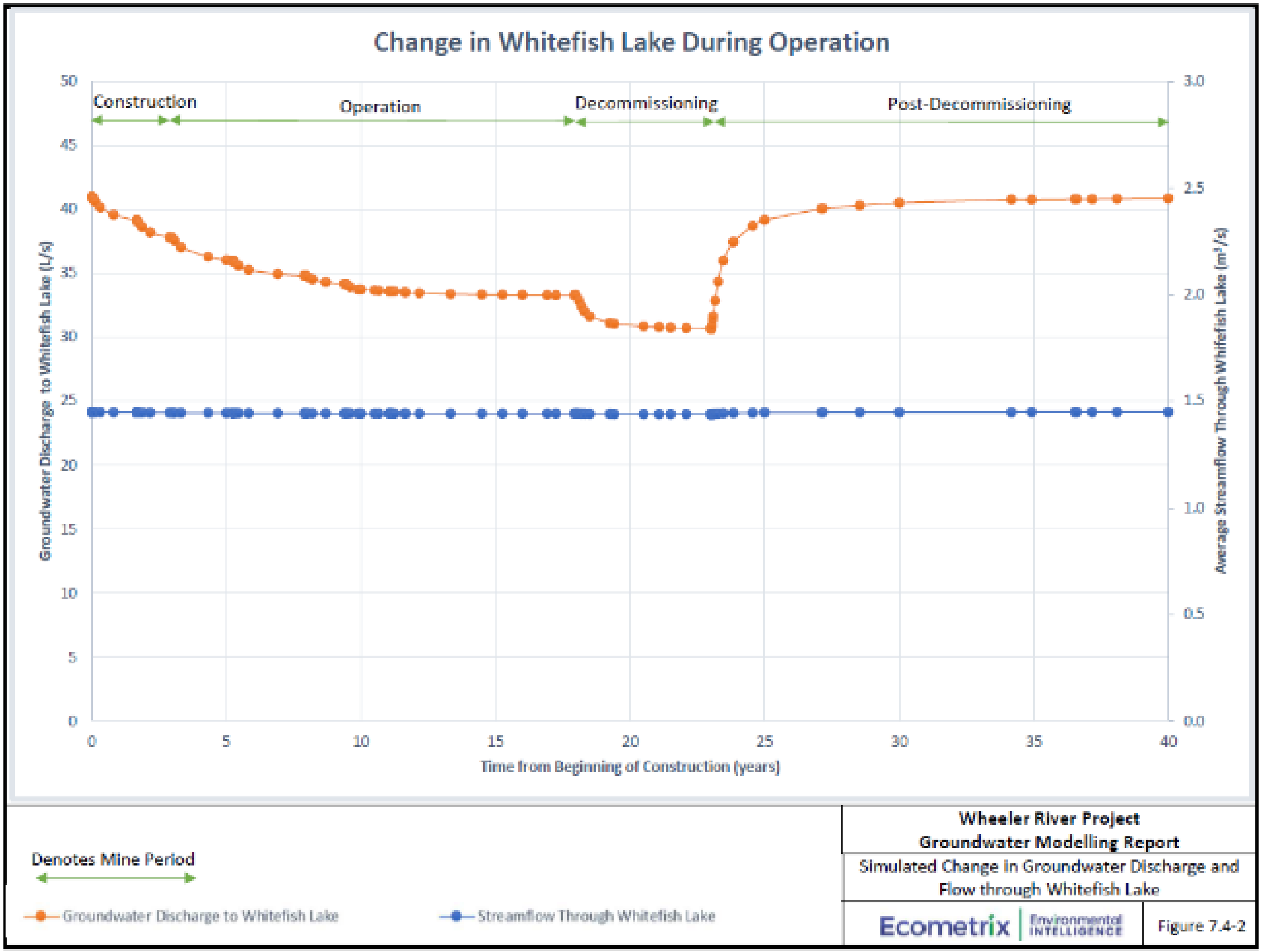
- At the northwest (NW) cluster, the observed and simulated gradients are virtually identical.
- At the southeast (SE) cluster, the gradient from the shallow overburden (OVB) to the intermediate sandstone aquitard (ISA) is under-estimated in the model, however the water level at GWR-007 is believed to be perched above the regional water table, and therefore not a good representation of vertical gradients; regardless both the model and observed data indicate a downward vertical gradient. The gradient between the ISA and the lower sandstone aquifer (LSA) is negligible, which is replicated by the model.
- At the up-gradient cluster, the observed are very well represented by the simulated gradients, including the flow directions.

- At the down-gradient cluster, the gradient between the ISA and the LSA is negligible, which is replicated by the model. The gradient between the OVB and ISA is observed to be downward but given the location of GWR-005 at the shore of Whitefish Lake, the natural hydraulic gradient is expected to generally be upward, as simulated.

Attachment: IR-59

Number	IR-59
Dept.	CNSC
Project effects link	Fish and fish habitat
Reference to EIS, appendices, or supporting documentation	Section 7.4 Assessment of Project-related Effects, Figure 7.4-2 (p. 7-56)
Context and Rationale	**Context:** Figure 7.4-2: Simulated Change in Groundwater Discharge and Flow through Whitefish Lake Over the Life of the Project appears to be missing information. **Rationale:** Legend is included below the image, but the Legend box is blank. The green dotted line is not represented by anything in the legend.
Information Requirement	Please update this Figure to ensure it is complete, and that features are properly indicated in the legend.

<ins>Supporting figure to the response provided in table:</ins>



Attachment: IR-63

Number	IR-63
Dept.	CNSC
Project effects link	Geology and groundwater
Reference to EIS, appendices, or supporting documentation	Section 7.4.2.1, Potential Effect #1: Groundwater Quantity – Construction to Decommissioning; Appendix 7-C, Section 2.7, Groundwater Conditions During Mine Operations
Context and Rationale	**Context**: The numerical groundwater model described was calibrated to observed water level and stream baseflow data. Table 7.4-3 in the EIS indicates that Denison recognizes the potential for freeze wall operation to impact groundwater quantity. To simulate this impact, the model was adapted to reduce recharge (to 50%) within the freeze wall area, reduce hydraulic conductivity associated with the vertical freeze walls, and simulate pumping within the freeze wall area. Recovery from pumping and effects on discharge to groundwater discharge to Whitefish Lake are discussed in the potential effects section. **Rationale:** Although this assessment considered drawdown of the water table and discharge to Whitefish Lake, the discussion did not address the potential effects of operating the freeze wall on the local and semi-regional groundwater regimes. What would the pathway be for groundwater to pass around the freeze wall? What is the basis for the parameters selected, e.g., 50% recharge and lower hydraulic conductivity for freeze well? These factors need to be considered when evaluating the potential impacts of freeze well operations on groundwater flow conditions and corresponding receptors.
Information Requirement	Please provide a more fulsome discussion on the impact of freeze wall operations on local and semi-regional groundwater regimes and potential receptors. Please provide the rationale for assumptions made for key model parameters (e.g., selection of 50% recharge, hydraulic conductivity value used to represent freeze wall). In addition, please discuss the potential pathways for groundwater flow around the freeze wall, complete with figures demonstrating these pathways.

Response:

The impact of the freeze wall on the local and semi-regional groundwater flow regimes is minor. The footprint of the freeze walled area represents < 0.04% of the area of the regional groundwater flow model, and as such the freeze walled area is a relatively small disruption to the regional groundwater flow system.

The effect of the freeze wall was simulated using the regional groundwater flow model, with results shown below. Hydraulic conductivity of the freeze wall was simulated as a reduction of the baseline hydraulic conductivity by four (4) orders of magnitude, which was consistent with expected hydraulic conductivity changes as reported by

Newmans (2020). The recharge reduction on top of the ore zone was estimated at 50% of the pre-development recharge based on the expected regrading and surface drainage at the site to accommodate all of the surficial operations. The simulated effect of the active freeze walls is illustrated through Figures 1 and 2, which illustrate the change in groundwater flow paths resulting from the freeze wall and operational groundwater pumping.

Figure 1 illustrates the pre-mining (and pre-pumping) groundwater flow paths toward Whitefish Lake. The particle traces shown were released at Whitefish Lake and tracked backward in time / space to their recharge area. The provide an understanding of the west-east groundwater flow toward Whitefish Lake, with local recharge creating the driving force for that groundwater flow. On this figure, the groundwater level contours are shown in black, while the flowlines (particle traces) are shown in blue. Note the flowlines closest to the pumping wells (red circles) and the ore body (light brown outline). The colours in the background reflect the shallow hydraulic conductivity zones, which help to explain inflections in the hydraulic head contours and flowlines.

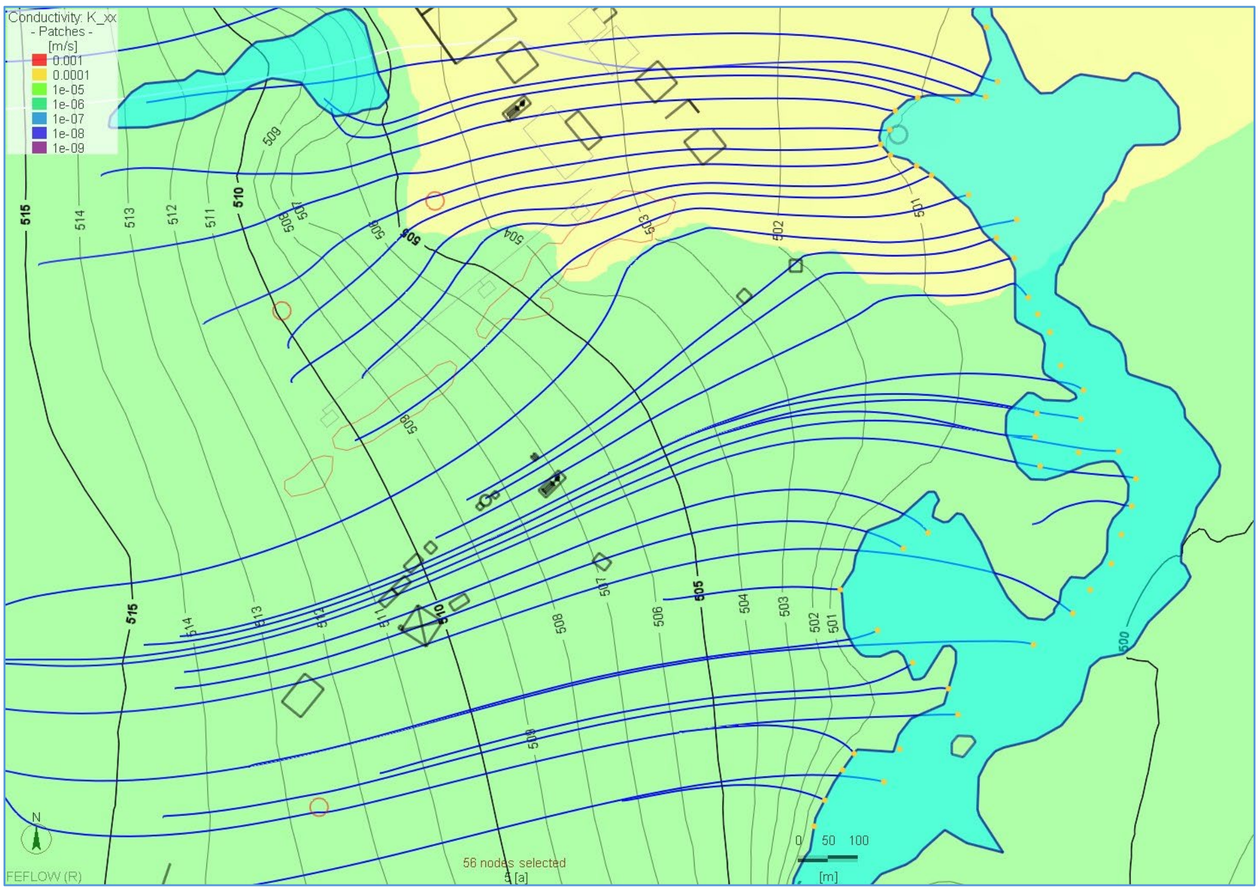


Figure 1: Groundwater Flow Paths Pre-Mining

Figure 2 illustrates the same groundwater flow paths toward Whitefish Lake during mining operations, while pumping was occurring (at red circles) and the freeze walls for phases 1 through 5 are in place.
From this figure, the effect of the freeze walls can be seen to be limited to the immediate area around the freeze walls. The addition of the freeze walls creates a cluster of water level contours consistent with the freeze wall locations, representing the change in water levels between the area inside and outside of the freeze wall. Note that the water levels outside the freeze wall are simulated to be relatively unchanged during freeze wall operations.

Also evident on this figure are the water level drawdown contours, which deflect around the pumping wells (3 red circles). Note the additional level of drawdown experienced at wells simulated to pump from the lower hydraulic conductivity zone (i.e., green area, as opposed to the yellow area).

The flowlines in Figure 2 indicate how the groundwater flow patterns will change due to the addition of the freeze wall and the onsite pumping. Flowlines are noted to travel around the freeze wall and in between the pumping wells to discharge at the lake. The pumping wells will capture water flowing from the west which would otherwise discharge to Whitefish Lake.

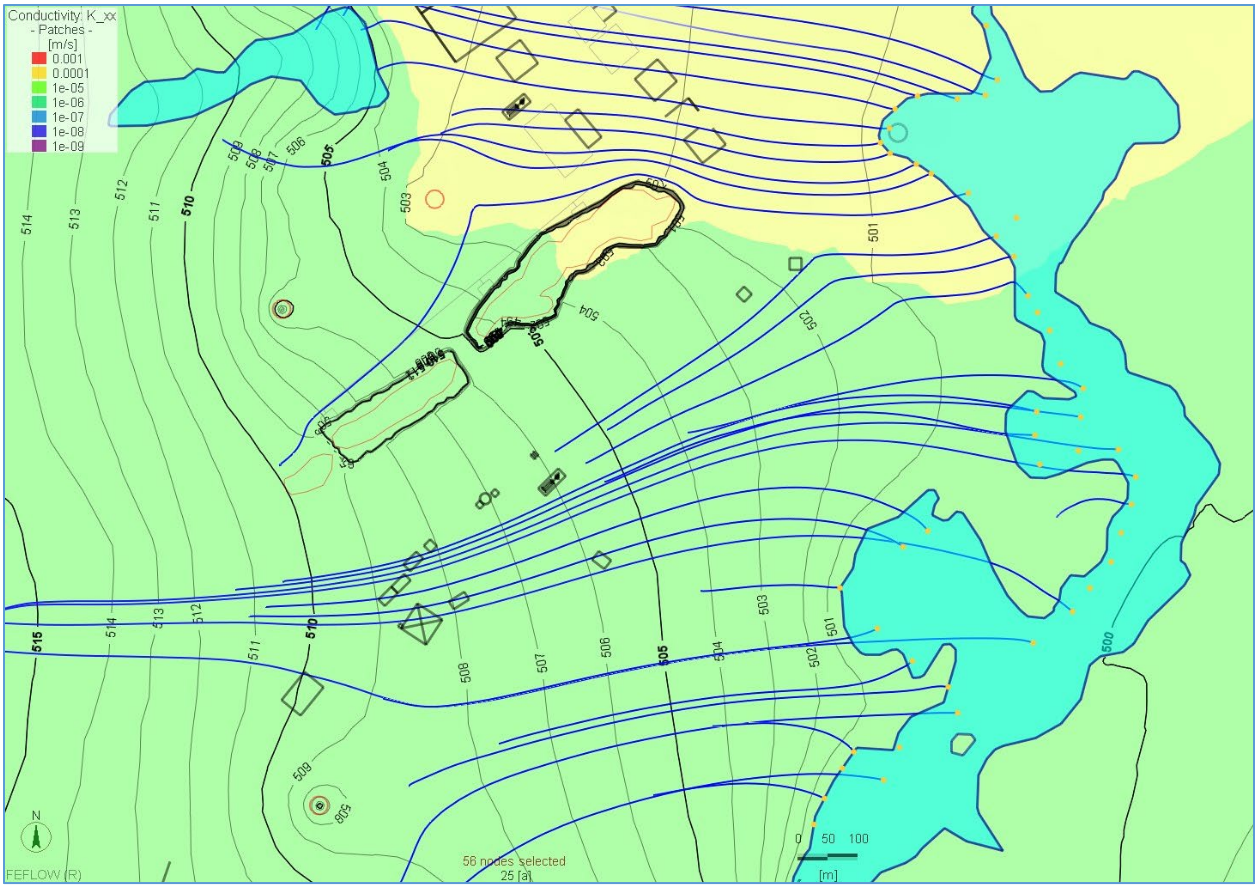


Figure 2: Groundwater Flow Paths During-Mining

Post mining, the groundwater flow path patterns would return to a condition similar to that simulated for pre-mining.

References

Newmans Geotechnique Inc. (2020). Wheeler River In-Situ Leach Surface Freezing Option Pre-Feasibility. Report to Denison Mines Ltd. August 2020.

Attachment: IR-68, IR-94, IR-97

Number	IR-68
Dept.	NRCan
Project effects link	Fish and fish habitat
Reference to EIS, appendices, or supporting documentation	Section 7.6.2.2.3 Appendix 7-C, sections 3.3, 4.1, 4.4.4 and 4.7
Context and Rationale	Context: Sources terms for the COPCs considered in 3D reactive transport modeling are given by the composition of "Restoration Solution #1", which the proponent believes is representative of groundwater quality in the ore zone after remediation at decommissioning (Appendix 7-C, sec. 3.3, Table 3-5; sec 4.0). The proponent considers COPC source terms as "initial conditions" for groundwater quality in the ore zone at the start of the model simulation period. During the simulation, no additional mass of COPCs is transferred to groundwater in the ore zone. Rationale: In NRCan's opinion, this representation of COPC sources is not conservative as it fails to account for various long-term slow mass release processes. These processes could include redissolution of secondary phases formed during ISR mining (e.g., radium-bearing gypsum or barite, jarosite, alunite) and migration of unrecovered lixiviant or restored solution from low-permeability regions or stagnant zones that were not fully swept during mining or remediation. NRCan notes that scenario #2 in the proponent's transport prediction uncertainty analysis (Appendix 7-C, sec. 4.7) does consider an extended source release period for protons (desorption from chlorite). However, in NRCan's opinion, additional modeling scenarios should consider extended-release periods for other COPCs as well.
Information Requirement	NRCan requests that the proponent's reactive transport prediction uncertainty analysis (Appendix 7-C, sec. 4.7) consider extended source release periods for additional COPCs.

Number	IR-94
Dept.	CNSC
Project effects link	Geology and Groundwater
Reference to EIS, appendices, or supporting documentation	Appendix 7-C, Numerical modelling: post-decommissioning evaluation, Section 3.5.5, Subsurface Conditions Incorporated
Context and Rationale	**Context:** It is reported in this section the assumed subsurface conditions that were applied in the geochemical site conceptual models. Critical phenomenon of pH tail was mentioned. Inclusion and exclusion of corresponding geochemical reactions were discussed briefly. **Rationale:** It was reported that the residual reduced minerals of uraninite and pyrite were not included in the modelling of the remediated mining area. The argument was based on consideration of the upstream groundwater, passing through the mined zone, will not be oxidizing and groundwater conditions are expected to be similar to pre-mine conditions. However, this ignores the pH tail effect that releases proton H+ sorbed to solid surface during ISR flooding. By ignoring this process, there is a potential risk of underestimating the source terms for some key COPCs. Exclusion of uraninite and pyrite in remediated mining

	area modelling is contradictory to pH-tail effect. The justification is not sufficient in the current form.
Information Requirement	Please provide additional evidence to justify the approach for excluding uraninite and pyrite from the analysis of remediated mining area. This may require the results from additional modelling.

Number	IR-97
Dept.	ECCC
Project effects link	Fish and fish habitat
Reference to EIS, appendices, or supporting documentation	Appendix 7-C, Figures 4-6, 4-7a, 4-7b, 4-8a, 4-8b, 4-9a, 4-9b
Context and Rationale	Context: Appendix 7, Figures 4-6, 4-7a, 4-7b, 4-8a, 4-8b, 4-9a, 4-9b present contaminant transport simulations of chloride, selenium, cadmium, and uranium. All simulations use initial condition concentrations at t=0 (or end of mining operations. In the 3D FEFLOW contaminant transport model it is not clear why initial condition concentrations were chosen rather than a constant concentration boundary. It is also unclear if mining activities will cause mobilization of the contaminants beyond the end of operations. Rationale: The choice of boundary conditions may impact the predicted transport of contaminants that reach Whitefish Lake through groundwater, which may have impacts to aquatic life.
Information Requirement	1. Explain and clarify if mining operations will mobilize contaminants beyond operations? 2. Clarify if the source of contamination, (e.g., uranium, selenium) will cease after operations? 3. For the 3D model please provide the rationale for using initial concentrations rather than constant concentration boundary conditions for contaminant concentrations.

Response IR-68, IR-94 and Questions 1-3 for IR-97:

In general, the ISR mining process will be sufficiently aggressive, chemically and through permeability enhancement, to access and remove most dissolvable mineral phases within the ore deposit during the mining operation. Metallurgical testing indicates that the mineralogy of the ore zone post-remediation (see IR-67 response) is made up of clay minerals, unreacted sulfide minerals (including pyrite, galena and chalcopyrite) and a small number of secondary mineral phases, discussed further below.

The decision made in the EIS to model geochemical reactive transport of the restored solution in the pore water of the mining zone post-remediation (i.e., initial conditions) and not a long-term contributions of COPCs from the ore zone for the following reasons:

- Uraninite that is not accessible to the mining process will represent residuals in very low permeability zones that will, likewise, have limited contact with groundwater in the future.

- As was discussed in the draft EIS (page 3.30 of Appendix 7-C), groundwater from the Athabasca sandstone that will flow through the ore zone following removal of the freeze wall will not be oxidizing (groundwater is anoxic and free of oxidants (e.g., O_2, Fe^{3+}), and thus, further oxidative dissolution of the reduced, low-solubility uraninite and sulphide minerals is not expected.
- Diffusion of UBS (containing U, Se and other COPCs), and lixiviant into the rock matrix may occur. However, the process of diffusion into the matrix will be limited over the relatively short timespan of mining in each zone (<10 years). Back-diffusion from the matrix of COPCs will be a slow process and will have a low mass flux rate.

The use of initial conditions in the model continues to be considered as sufficiently bounding for evaluation of potential effects in the EIS.

<u>Secondary Minerals – Response to IR-68</u>

The metallurgical testing to date suggests that secondary minerals may form in the ore zone during the operation, including jarosite ($KFe_3(SO_4)_2(OH)_6$), gypsum ($CaCO_4 \bullet 2H_2O$), barite ($BaSO_4$; which could be Ra-bearing) and anglesite ($PbSO_4$), with XRD evidence for these mineral phases in metallurgical testing at the end of the leaching period, and being flushed out of the mining areas as particulates in the UBS (see details in response to IR-67). Jarosite, gypsum and barite, however, were not identified in a QEMSCAN quantitative analysis on similar materials in the 2022 column leach tests that were designed to inform the understanding of mineralogy and solution composition in the mining area with remediation. Anglesite was present in quantifiable concentrations as mineral phase in the solid-phase residuals of those column tests.

Dissolution of anglesite has the potential to be a longer-term source of Pb from the ore zone, post-decommissioning. Testwork is ongoing to refine understanding of expected concentrations and distribution of Pb phases – meaning anglesite and galena – post-mining and post-remediation. Information from that test work will then be used to direct testing and monitoring during the operational phases.

Beyond the bounding scenario presented in the EIS, additional modelling of a Pb source over the long-term is not considered warranted at this time, for the following reasons:

1. Pb has a high affinity to sorb to clay minerals and iron oxide phases along the transport path. The assimilative capacity of the system, as modelled, will mitigate against maximum Pb concentrations at Whitefish Lake above those modelled in the EIS scenario.
2. Without further understanding of the reactivity of the anglesite – meaning, kinetic factors that may affect dissolution to solubility limits, modelling anglesite dissolution to thermodynamic equilibrium is expected to be overly conservative.
3. Mineral phases in the ore zone, including clay minerals and Fe oxides have the potential to sorb Pb mobilized from anglesite dissolution. Ongoing analysis of the results of the metallurgical testing and further test work will support refinement of that sorptive capacity and understanding of the potential for a long-term source of Pb from the remediated ore zone.

Attachment: IR-80

Number	IR-80
Dept.	CNSC
Project effects link	Geology and groundwater
Reference to EIS, appendices, or supporting documentation	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit
Context and Rationale	Context: This section provides data for groundwater samples collected during the Cigar Lake analogue study and Millennium Project for further regional context. The previous studies are heavily referenced to support interpretations made for the conceptual site model. Rationale: The Piper Plots in Figure 26 are difficult to interpret (many overlapping circles with variegated colors), and Cigar Lake samples plot predominantly as Na/K-Cl/SO4 groundwater facies. Conversely, samples collected as part of the Phoenix Project (current), plot either as Ca-HCO3 or Ca-SO4/Cl groundwater facies. No explanation is provided for the observed hydrogeochemical differences between groundwater from the Phoenix project and the Cigar Lake analogue study/Millenium Project.
Information Requirement	Please provide additional clarity to and interpretation of Figure 26 in Appendix 7-A, including a revision to the Figure to allow for easier interpretation. This could include clear identification of end members, as well as arrows indicating proposed evolution of groundwater chemistry. Further discussion should be provided describing observed differences between groundwater chemistry at the Phoenix project compared to Millenium/Cigar Lake.

Response to #1

Figure 26 of the draft EIS was presented as two panels (panel "a" and panel "b") in Appendix 7-A to the EIS. To support visual clarity and additional interpretation, Figure 26 has been split into two figures:

> Figure 26: Hydrochemical Type: Groundwaters for the Wheeler River Project
>
> Figure 27: Hydrochemical Type: Groundwaters for the Wheeler River, Cigar Lake and Millennium Projects

The figure numbering in Appendix 7-A of the draft EIS will be updated accordingly.

The revised Figures 26 and 27 are provided below. The figures have been updated to include visual support on the Piper plots to the interpretations of groundwater chemistry that are detailed in Section 4.3.3 of Appendix 7-A of the EIS. In addition, the text in Section 4.3.3. of Appendix 7-A of the ESI will be updated to provide additional clarity on the interpretations shown in the Piper plots. The new text is provided herebelow with additions shown in blue. .

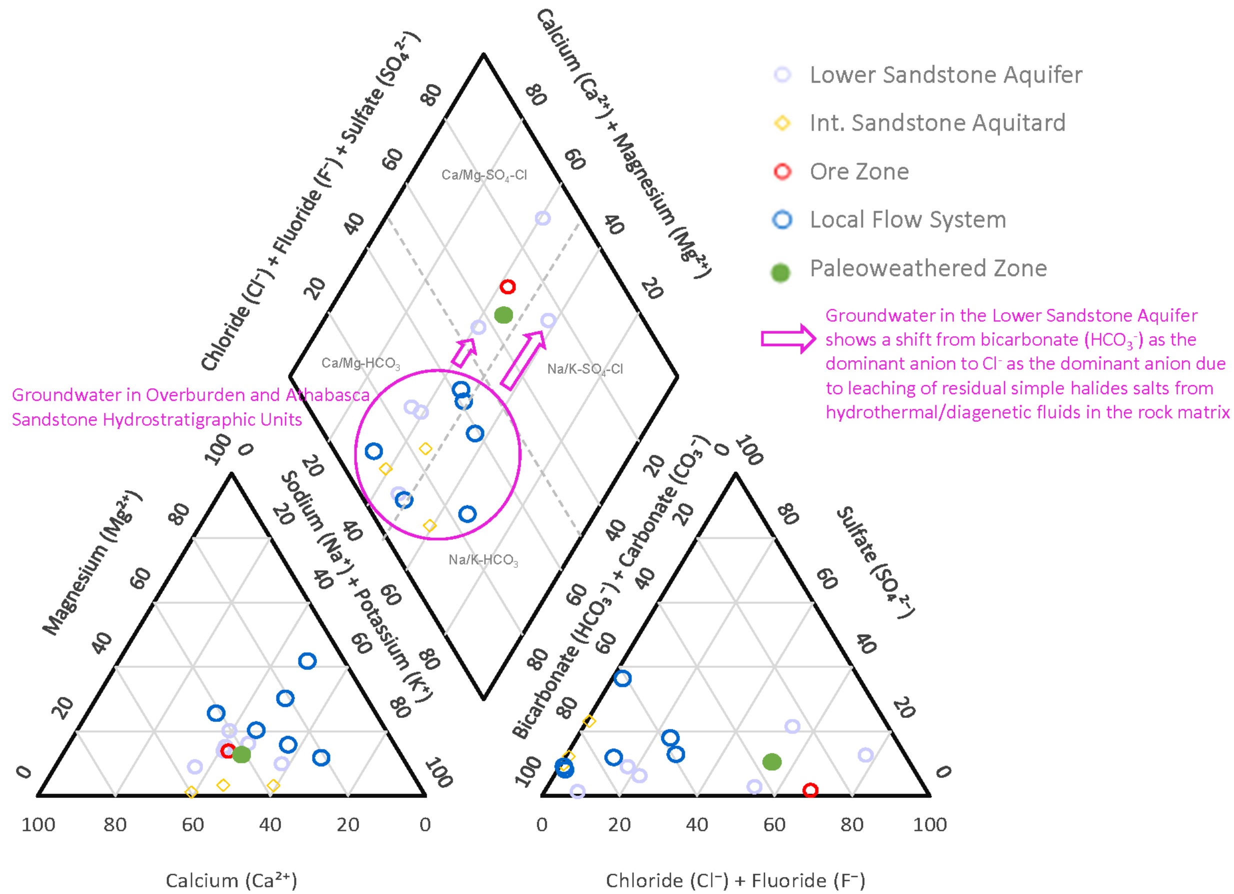
On page 4-21… The Lower Sandstone Aquifer is characterized by two distinct hydrochemical types. The first is groundwater with low mineralization. The second groundwater type is much more highly mineralized water that has Cl- as a dominant anion. The distinct nature of the two groundwater types is shown in Figure 25 through comparison of Stiff diagrams for GWR-029 and GWR-012. The mineralization at GWR-012 is much higher than that at GWR-029, and Cl-, versus HCO3-, is the dominant anion. The mineralization and groundwater major ion composition of GWR-029 is much more similar to overburden well GWR-006 (shown in Figure 24) than to GWR-012. In the Piper plot shown in Figure 26, the distinct geochemical types are evidenced by:

- clustering of groundwater for 3 wells in the Lower Sandstone aquifer with samples from the Intermediate Sandstone Aquitard and local groundwater flow system. This hydrochemical type (dominantly in the Ca/Mg-HCO3 quadrant of the central diamond of the Piper Plot) is shown within the purple circle; versus
- the other three wells from Lower Sandstone Aquifer, that show a higher relative dominance of Cl- as an anion. This shifts the hydrochemical type of the groundwater to the upper portion of the central diamond in the Piper plot, as shown by the purple arrows in Figures 26. This represents the contribution of leaching of halide salts into the groundwater as it moves along the flow path.

These same two distinct hydrochemical types were also observed in the MFa at Cigar Lake.

On page 4.18 - 4.19…. The higher mineralization groundwater with Cl- as the dominant anion was observed at Cigar Lake in groundwater collected from a monitoring well located within the zone of thermal alteration and in the inferred downgradient direction of the ore zone. This sample is shown in Figure 27 as "CL-LS-Out" and is of Na-Cl-HCO_3 type. The reasons for the hydrochemical type observed in that monitoring well, and specifically for the source of chloride to the water, was evaluated in some detail in the Cigar Lake studies. One possible explanation explored was that the groundwater reflected mixing of groundwater in the MFa with groundwater from the basement rock. Groundwater in the basement rock is known to be of Na-Cl type, and this is shown in Figure 27 by samples collected from monitoring wells installed in the Basement at Millennium ("Millennium-Bsmt"). This sample represents one endmember hydrochemical type for the basement rock of Na-Cl type. However, the potential for the relatively elevated chloride proportion of anions in groundwater in the MFa to be a result of mixing with groundwater from the basement rocks was ruled out at Cigar Lake as groundwater flow conditions in the MFa were identified as dominantly horizontal, with a component of downward flow to the altered basement.

On page 4.21… The paleoweathered zone was sampled at Cigar Lake; analytical results are provided in Appendix J, as samples 199B and 199D. Sample 199D has been referred to in Figure 27 as "CL-Alt-Bsmt". The hydrochemical type of the Cigar Lake paleoweathered zone is Na-Cl-HCO_3 and of GWR-031 for the Phoenix deposit is a more mixed hydrochemical type (Na-Ca-Mg-Cl-HCO3-SO4). In the Cigar Lake study, the hydrochemistry of the sample in the paloeweathered zone was explained by recharge of the basement waters from the overlying flow regime in the Lower Athabasca Sandstones. Evolution of the groundwater chemistry in the paleoweathered zone is aligned with this flow path. The groundwater quality in the paleoweathered zone represents an intermediate along the hydrochemical evolution of groundwater from the hydrochemical type of the Athabasca Group Sandstone hydrogeological units (Ca-Na-HCO3 to Na-Ca-HCO3 type) to one endmember in basement rock (NaCl type). This evolution is a result of water-rock interactions within basement aquitard (including the paleoweathered zone) and is most clearly visualized in the Piper plot by shifts in relative abundance of anions, shown with gold arrows in Figure 27. The difference in hydrochemical types between groundwater from the paleoweathered zone at Cigar Lake (Na-Cl-HCO3 type) and associated with the Phoenix deposit (Na-Ca-Mg-Cl-HCO3-SO4) is likely due to the screened interval of the well, which spans the ore zone, and the paleoweathered zone (Appendix A). Groundwater chemistry in GWR-031 is likely influenced by the hydrochemistry of the ore zone.



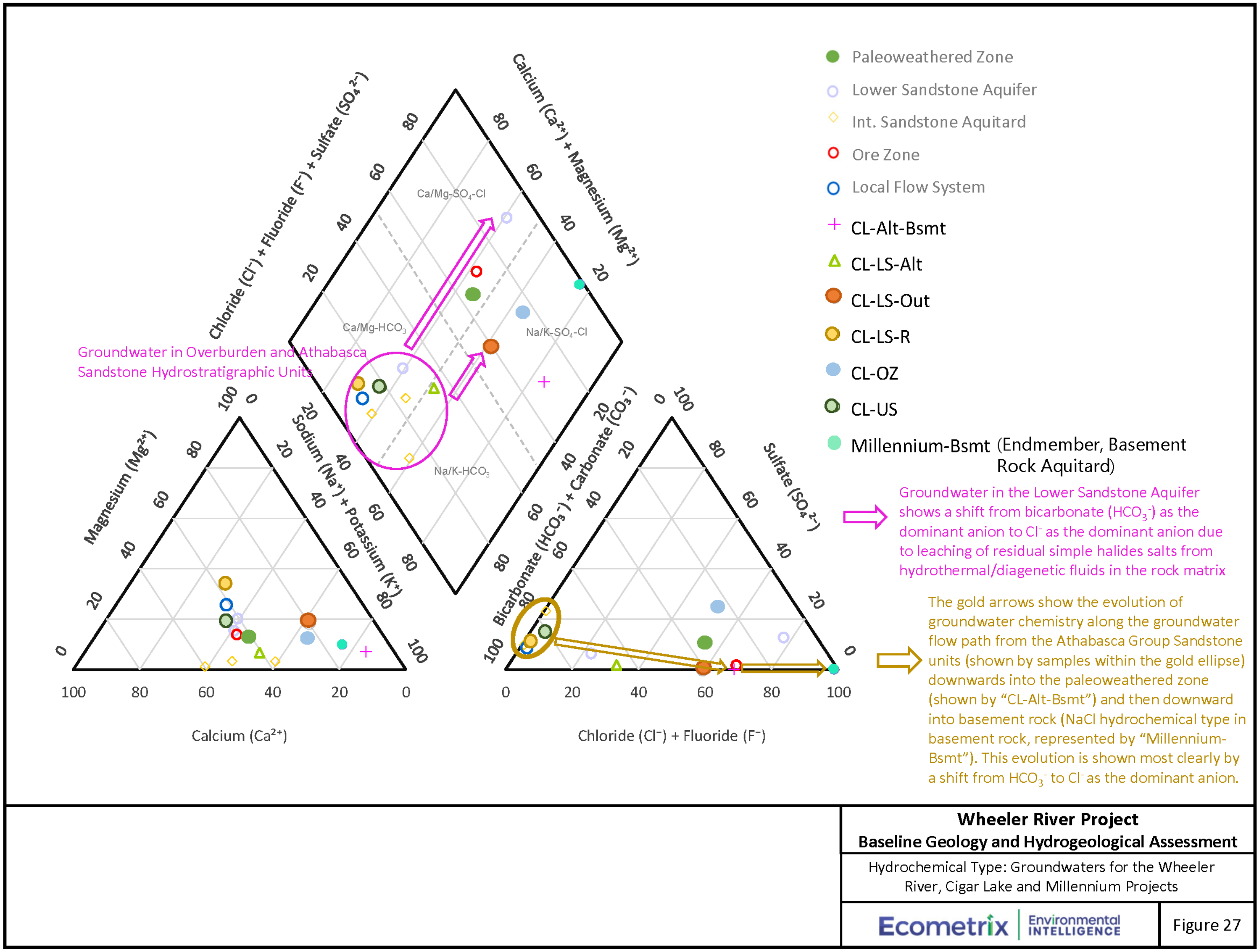
Wheeler River Project
Baseline Geology and Hydrogeological Assessment

Hydrochemical Type: Groundwaters for the Wheeler River Project

Based on (Project) 2020 Groundwater Quality

Ecometrix Environmental Intelligence

Figure 26


Paleoweathered Zone
Lower Sandstone Aquifer
Int. Sandstone Aquitard
Ore Zone
Local Flow System
CL-Alt-Bsmt
CL-LS-Alt
CL-LS-Out
CL-LS-R
CL-OZ
CL-US
Millennium-Bsmt (Endmember, Basement Rock Aquitard)
Ca/Mg-SO4-Cl
Ca/Mg-HCO3
Na/K-SO4-Cl
Na/K-HCO3
Calcium (Ca2+) + Magnesium (Mg2+)
Chloride (Cl-) + Fluoride (F-) + Sulfate (SO42-)
Magnesium (Mg2+)
Sodium (Na+) + Potassium (K+)
Calcium (Ca2+)
Bicarbonate (HCO3-) + Carbonate (CO3-)
Sulfate (SO42-)
Chloride (Cl-) + Fluoride (F-)
Groundwater in Overburden and Athabasca Sandstone Hydrostratigraphic Units
Groundwater in the Lower Sandstone Aquifer shows a shift from bicarbonate (HCO3-) as the dominant anion to Cl- as the dominant anion due to leaching of residual simple halides salts from hydrothermal/diagenetic fluids in the rock matrix
The gold arrows show the evolution of groundwater chemistry along the groundwater flow path from the Athabasca Group Sandstone units (shown by samples within the gold ellipse) downwards into the paleoweathered zone (shown by "CL-Alt-Bsmt") and then downward into basement rock (NaCl hydrochemical type in basement rock, represented by "Millennium-Bsmt"). This evolution is shown most clearly by a shift from HCO3- to Cl- as the dominant anion.
Wheeler River Project
Baseline Geology and Hydrogeological Assessment
Hydrochemical Type: Groundwaters for the Wheeler River, Cigar Lake and Millennium Projects
Ecometrix Environmental Intelligence
Figure 27

Attachment: IR-81

Number	IR-81
Dept.	CNSC
Project effects link	Geology and Groundwater
Reference to EIS, appendices, or supporting documentation	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit
Context and Rationale	The report states in the description of hydrochemistry of the Lower Sandstone Aquifer that, "On the basis of groundwater chemistry and tritium values in that groundwater, the authors (of the Cigar Lake analogue study in 1994) concluded that the groundwater reflected a younger water component that had penetrated to depth along hydraulically active fractures/faults. The same conclusion is made here (in the Wheeler River EIS) for the Phoenix study area – meaning that fracture/fault conditions are such that some areas of the MFa are characterized by younger/recharge groundwaters". Rationale: Tritium results for most wells in the Lower Sandstone Aquifer (MFa) reported in Table 4-1 of Appendix 7-A exhibit tritium concentrations <15 Bq/L for the 2020 sample, and 0.1 or <0.1 Bq/L for the 2021 sample. Tritium in modern precipitation typically varies from 1 – 3 Bq/L. Conclusions made in the text are not supported by data, especially given that tritium values are not reported in the EIS for local precipitation or surface water. This is important in reinforcing the assumption from the conceptual model that modern meteoric water circulates at depth in the Lower Sandstone Aquifer.
Information Requirement	Provide a further discussion on the interpretation of tritium in groundwater, rather than echoing conclusions from the Cigar Lake analogue study. Consideration should be given to the assertion that modern meteoric water circulates at depth in the Lower Sandstone Aquifer. Collection and analysis of stable isotope (e.g., δ2H, δ18O) samples is a cost-effective solution which would greatly improve understanding of groundwater hydrology and support the development of a conceptual model.

Response:

δ2H, δ18O Isotopes in Groundwater

Analysis of δ2H, δ18O Isotopes in groundwater was not performed for the Wheeler River Project baseline work at Ecometrix's recommendation. Based on our review of the sampling and analysis of isotope data from neighbouring sites, our interpretation was that similar additional sampling at the Wheeler River Project would not add sufficient value. Other projects in the region including Cigar Lake (AECL, 1994) and Millenium (Devine, 2016) analyzed δ2H, δ18O isotopes in groundwater. At Cigar Lake, stable isotopes of water were measured in all Athabasca Group Sandstone units ("upper", "lower", "altered sandstone"), the ore zone, and the altered basement. The results were (quoted from AECL, 1994):

- "The waters from the glacial overburden all plot on or near the Cigar Lake meteoric water line…indicating their meteoric origin";

- "deep groundwaters also plot entirely within the envelope, suggesting that the variations in the isotopic signatures observed for the groundwaters result entirely from variation in meteoric water compositions. The simplest explanation for these isotopic trends is that they reflect (moving) averaged meteoric water compositions of the Cigar Lake area"; and
- "[W]aters from the three [groundwater flow] regimes [in the Athabasca Sandstone group units], basement and mineralization have similar low temperature meteoric δ2H, δ18O values"

Devine, 2016 analyzed stable isotopes in groundwater for shallow groundwater (of depth < 50 m; groundwater in overburden and upper MFd) at the Millenium and McArthur River Projects. It was concluded that "Oxygen and H isotope compositions reveal that the groundwater sampled was meteoric water and has the same δ18O and δ2H as Saskatoon precipitation".

The potential for analysis of stable isotopes in groundwater to add value to the development of the CSM for the Pheonix project was, as such, considered low.

Tritium in Groundwater

The potential for tritium to support development of the CSM for the Wheeler River program was evaluated using the available information. The conclusion was that, beyond alignment between some samples in the overburden and the upper sandstone aquifer, tritium concentrations in groundwater do not provide a robust means of ageing groundwater in the subsurface at the Site. The reasons for this, and information supporting that conclusion are presented below.

Two tables have been presented in this IR to support the discussion below.

a) Table IR-81-1: Provides tritium concentrations in precipitation over time since the 1950s. The source of the tritium data for Canadian locations, including Churchill, Fort Smith and Ottawa, was from the International Atomic Energy Agency Global Network of Isotopes in Precipitation database (GNIP; https://nucleus.iaea.org/wiser). Tritium concentrations over time due to radioactive decay were calculated for examination against tritium concentrations in groundwater concentrations for the Wheeler River Project.
b) Table IR-87-2: Provides tritium concentrations measured in groundwater under baseline conditions for the Wheeler River Project. The tritium concentrations highlighted in yellow/orange were analyzed at the André E. Lalonde AMS Laboratory, University of Ottawa. The detection limit of < 15 Bq/L at the Saskatchewan Research council does not support interpretation of tritium concentrations with respect to groundwater flow conditions, considering the discussion below. The detection limit at the University of Ottawa is 0.8 TU (0.095 Bq/L). Tritium values measured in groundwater samples in 2021 at the University of Ottawa were examined further in the context of ageing groundwater for the Project.

Tritium concentrations in groundwater measured for the Wheeler River Project must consider several factors. These include:

a) Tritium concentrations in groundwater can be used to identify recharge to mostly granular aquifers in the last approximately 68-70 years, since the early 1950s (Cherry et al., 2004); water recharged prior to that time will have tritium values below analytical detection limits. This is shown in Table IR-81-1, where groundwater recharged prior to 1952, extrapolated out more than 60 years, has tritium values that are below the analytical detection limit of 0.1 Bq/L.

b) Maximum tritium concentrations in the precipitation, associated with "bomb tritium" were observed in the early 1960s. At the present time, tritium concentrations in groundwater recharged at that time would be in the range of 14 Bq/L to 53 Bq/L. Values this high were not observed in groundwater at the Wheeler River Project in 2021, and only in one instance in 2020, which is discussed further below.
c) Tritium concentrations in precipitation have stabilized from historically high "bomb tritium" values to values of approximately 9-25 Tritium Units (TU), equivalent to 1.1 – 3.0 Bq/L, in the last approximately 20 years (as noted by the CNSC review).
d) Tritium concentrations may reflect the influence of drilling fluids, which is generally other groundwater from the site.
e) Tritium is produced within the uranium ore deposits of the Athabasca region; this is evidenced by tritium concentrations at GWR-032 (Table IR-87-1) that were measured to be 950 Bq/L (2020) and 1800 Bq/L (2021) and are higher than can be explained by "bomb tritium" (Table IR-87-3). Tritium production in the ore zone is primarily by neutron capture by ^{6}Li (AECL, 1994). The groundwater sample from the paleoweathered zone (GWR-031; 910 Bq/L) are also considered to be reflecting tritium generation associated with the deposit.

It is our opinion, based on the above considerations and the discussion that follows, that measurement and analysis of tritium data at the Wheeler River Project is limited in value to conceptual model development, and the current data suggests it raises more questions than can be answered. Tritium concentrations in groundwater will continue to be measured as part of the routine groundwater sampling, to further evaluate the usefulness of this approach for refining the conceptual site model developed for the Wheeler River Project.

Table IR-81-2: Calculated Tritium Concentrations in Groundwater based on time period of recharge

Time Periods of Interest for recharge	Tritium concentrations in precipitation		Half-Lives of Tritium				
			1	2	3	4	5
			Years Elapsed				
			12.3	24.6	36.9	49.2	61.5
	TU	Bq/L[a]	Tritium concentration measured in Groundwater (Bq/L)[b,c]				
Recharged Prior to 1952 (Clark and Fritz, 1997)	8.2E+00	9.8E-01	4.9E-01	2.4E-01	1.2E-01	*6.1E-02*	*3.1E-02*
1953, annual average, Ottawa	2.7E+01	3.3E+00	1.6E+00	8.1E-01	4.1E-01	2.0E-01	1.0E-01
1956, annual average, Ottawa	1.5E+02	1.7E+01	8.7E+00	4.3E+00	2.2E+00	1.1E+00	5.4E-01
1959, annual average, Ottawa	5.4E+02	6.4E+01	3.2E+01	1.6E+01	8.0E+00	4.0E+00	2.0E+00
1963, monthly maximum, Fort Smith (NWT)	7.1E+03	8.5E+02	4.3E+02	2.1E+02	1.1E+02	5.3E+01	2.7E+01
1963, annual average, Fort Smith (NWT)	3.8E+03	4.6E+02	2.3E+02	1.1E+02	5.7E+01	2.9E+01	1.4E+01
1969, annual average, Fort Smith (NWT)	4.0E+02	4.8E+01	2.4E+01	1.2E+01	6.0E+00	3.0E+00	1.5E+00
1979, annual average, Ottawa	4.8E+01	5.8E+00	2.9E+00	1.4E+00	7.2E-01	3.6E-01	1.8E-01
1992 Average (Churchill, MB)	1.8E+01	2.1E+00	1.1E+00	5.3E-01	2.6E-01	1.3E-01	*6.6E-02*
2000-2019, Maximum annual average, Ottawa	2.3E+01	2.7E+00	1.3E+00	6.7E-01	3.4E-01	1.7E-01	*8.4E-02*
2000-2019, Minimum annual average, Ottawa	9.7E+00	1.2E+00	5.8E-01	2.9E-01	1.4E-01	*7.2E-02*	*3.6E-02*
Snow (AECL, 1994) (6 TU)	6.0E+00	7.1E-01	3.6E-01	1.8E-01	*8.9E-02*	*4.5E-02*	*2.2E-02*

Notes

a Tritium concentrations in TU were converted to Bq/L using the conversion factor of 0.1191 used by the André E. Lalonde AMS Laboratory at the University of Ottawa

b Yellow Highlighting indicates calculated concentration at approximate present-day (2019-2021)

c The detection limit for tritium at the André E. Lalonde AMS Laboratory, University of Ottawa in the water samples is 0.8 TU (0.095 Bq/L); *Values shown in italics are below the detection limit*

Table IR-81-1: Summary of Tritium Concentrations Measured in Groundwater for the Wheeler River EIS

Groundwater Well	Hydrostratigraphic Unit	Sampling Date	Tritium Concentration (Bq/L)
GWR-006	OB	2020-08-22	<15
GWR-006		2021-04-14	0.1
GWR-029	LSA	2020-08-30	<15
GWR-029		2021-04-12	0.1
GWR-003	OB	2020-08-16	<15
GWR-003		2021-04-18	1.1
GWR-025	LSA	2020-08-22	<15
GWR-025		2021-04-17	0.4
GWR-008	LSA/DSZ	2020-09-06	<15
GWR-008		2021-04-09	0.5
GWR-009	ISA/DSZ	2020-09-14	16
GWR-009		2021-04-10	1.2
GWR-033	LSA	2020-11-03	<15
GWR-033		2021-05-25	0.5
GWR-034	ISA	2020-10-30	<15
GWR-034		2021-05-24	1.2
GWR-035	USA	2020-11-03	<15
GWR-035		2021-05-24	0.80
GWR-005	OB	2020-08-29	<15
GWR-005		2021-05-22	<0.1
GWR-014	ISA/DSZ	2020-08-29	19
GWR-014		2021-05-21	0.13
GWR-012	LSA/DSZ	2020-08-29	<15
GWR-012		2021-05-23	<0.1
GWR-036	OB	2020-11-05	<15
GWR-036		2021-04-08	0.8
GWR-037	USA/DSZ	2020-10-24	<15
GWR-037		2021-04-09	0.1
GWR-031	PWZ	2020-08-09	<15
GWR-031		2021-06-04	910
GWR-011	LSA/DSZ	2020-08-08	<15
GWR-011		2021-06-01	0.13
GWR-013	ISA/DSZ	2020-08-09	<15
GWR-013		2021-06-02	0.78
GWR-032	OZ	2020-11-01	-
GWR-032		2020-08-08	950
GWR-032		2021-06-04	1800
GWR-046	ISA	9/14/2021	<40
GWR-047	ISA/DSZ	9/10/2021	<40
GWR-048	LSA	9/10/2021	<40

Overburden and Groundwater Wells in the uppermost Upper Sandstone Aquifer

There are there three wells monitored as part of the baseline program that are installed in overburden materials: GWR-006, GWR-003 and GWR-005. Two other wells are installed in the uppermost Athabasca Sandstone Group unit (MFd) immediately beneath the overburden. These wells are GWR-036, GWR-035. Tritium values in groundwater wells installed in the overburden and upper sandstone ranged from <0.1 Bq/L to 1.1 Bq/L. Tritium concentrations were 1.1 Bq/L in GWR-003, 0.8 Bq/L in GWR-036 and 0.8 Bq/L in GWR-035. These tritium concentrations in groundwater sampled in these wells is considered to have been recharged in the last 12-25 years. To check alignment between these results and the 3D hydrogeological model, particle tracking was done to estimate minimum groundwater residence times (in years) at each well cluster location. For the overburden unit, the particle tracking results indicated minimum residence times of between 0.5 and 20 years.

Tritium concentrations were at or below the detection limit of 0.1 Bq/L at GWR-006 and GWR-005. Monitoring well GWR-006 is very shallow (screened from 9-15 mbgs), whereas GWR-005 is the deepest of the overburden wells, with a screened interval from 117-123 mbgs. It is considered plausible that the low tritium values reflects the potential for longer residence groundwater times due to heterogeneity in hydraulic conductivities of till material in the overburden. However, tritium concentrations in snow are also lower than in precipitation (AECL, 1994). Thus, it is possible that in the localized areas to those groundwater monitoring wells, materials are lower hydraulic conductivity, and the tritium concentrations are relatively more influenced by snowmelt. Longer residence times in the overburden materials in wells GWR-006 and GWR-005 is supported by higher specific conductance in those wells GWR-003 and GWR-036. Field-measured specific conductance values in GWR-006 and GWR-005 were approximately 150 µS/cm in 2021, whereas values at GWR-003 and GWR-036 were < 75 u µS/cm in 2021 (Table 3-2 of Appendix 7-A to the EIS).

Deeper Groundwater

Interpretation of tritium values for "ageing" of groundwater was considered inappropriate beyond the shallowest units at the Site. This is because of the relatively low values of tritium in the groundwater in all but the ore zone, and the numerous confounding factors/complexities. Several tritium concentrations are within 1-3 times the analytical detection limits and are thus considered at the limits of interpretability.

One possible confounding factor at low tritium concentrations is contamination of the sample with drilling fluids. Influence is drilling fluids is possibly a factor in the tritium concentrations observed in groundwater well GWR-014. In that well, tritium values in 2020 were measured as 16 Bq/L at SRC. This is the highest value of tritium detected in groundwater in the Athabasca Sandstone hydrogeologic units and was not reproduced when the well was sampled in 2021; the tritium concentration felll significantly to 0.13 Bq/L. The higher relative concentration of tritium in that well is not considered to reflect "bomb tritium" because of the significant change upon resampling, and it is considered possible that the groundwater quality in that well was influenced by drilling fluids/well construction materials, which was also noted for this well in terms of groundwater quality in the Baseline Report (Appendix 7-A of the EIS). Influence of drilling fluids is also considered the likely explanation for the tritium concentration of 1.2

Bq/L in monitoring well GWR-034. As was noted in the Baseline Report, the water quality in GRW-034 is considered to reflect influence from drilling fluids and additives and is not considered reliable.

Tritium concentrations in groundwater will continue to be measured as part of the routine groundwater sampling, to further evaluate the usefulness of this approach for refining the conceptual site model developed for the Wheeler River Project.

References

AECL (Atomic Energy of Canada Ltd.), 1994. Final Report for the AECL/ SKB Cigar Lake Analog Study. Report No. AECL-10851. July.

Cherry, J.A., Parker, B.L., Bradbury, K.R., Eaton, T.T., Gotkowitz, M.G., Hart, D.J., and Borchardt, M.A., 2004, Role of aquitards in the protection of aquifers from contamination: a “state of the science” report: Awwa Research Foundation, Denver, Colorado.

Clark, I.D., and Fritz P. 1997. Environmental isotopes in hydrogeology. Lewis Publishers: New York. 328pp.

Devine, 2016. Sources and Pathways of Radiogenic Elements in Surface Media Above the Millennium and McArthur River Uranium Deposits in the Athabasca Basin, Saskatchewan, Canada. Ph.D. Thesis, Department of Earth Sciences, Faculty of Science, University of Ottawa.

Attachment: IR-82

Number	IR-82
Dept.	CNSC
Project effects link	Geology and groundwater
Reference to EIS, appendices, or supporting documentation	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit Appendix 7-C, Section 3.5
Context and Rationale	Context: A. In-field measurements of Oxidation-Reduction Potential (ORP) for three (3) out of twenty-six (26) groundwater samples are presented in Table 4-1 of Appendix 7-A. Although sparse, these values are also used to characterize redox conditions for representative groundwaters in Table 3-5 of Appendix 7-C. B. In Section 3.5.5 of Appendix 7-C it is stated that groundwaters in the PHREEQC model were allowed to equilibrate with atmospheric concentrations of oxygen, resulting in oxidizing subsurface conditions. In Section 3.7 of Appendix 7-C it states that input files for 3D reactive transport were generated based on outcomes for PHREEQC modelling. However, in reading Section 4 of Appendix 7-C, it is unclear whether this assumption (equilibration with atmospheric oxygen) was carried forward for the 3D model. C. As per p. 3.49 of Appendix 7-C, "A small amount of reactive pyrite was assumed for the first 500 m of transport away from the ore zone in the model, primarily in the desilicified sediments of the Lower Sandstone Aquifer, and deeper portion of the Intermediate Sandstone Aquitard". Rationale: A. Given the importance of redox conditions for U mobilization and precipitation/dissolution of minerals (e.g., pyrite/metal oxyhydroxides) and the corresponding influence on contaminant transport from both a modelling and monitoring perspective, these should be further characterized. It should also be noted that the measurement of Oxidative-Reductive Potential (ORP) in natural waters can be complex and difficult due to the variability and disequilibrium of natural systems and issues inherent to electrode calibration (e.g., Schuring et al., 2000). Measurements of redox couples (e.g., As(III)/As(V); Fe(II)/Fe(III); S(-II)/S(VI)) are typically recommended to accurately characterize redox conditions in natural waters (Schuring et al., 2000). B. The assumptions regarding redox conditions for the 3D solute transport model should be clarified. C. The amount of pyrite (e.g., % by weight) assumed for the purposes of modelling should be clarified, given the potential role of pyrite as a reducing agent in limiting the transport of COPCs. Reference: [1] Schuring J.; Schulz, H. D.; Fischer, W.R.; Bottcher, J.; and Duijnisveld, M.H.W. 2000. Redox: Fundamentals, Processes and Applications. Springer: Berlin.
Information Requirement	1. Provide further discussions and information (i.e., ORP measurements or analytical data for redox couples) on redox conditions at the Phoenix site. Particular focus should be given to the spatial heterogeneity of redox processes. Tools such as the reference provided [2]

	below provide an example of simplified framework for characterizing redox conditions in aquifers. 2. Clarify assumptions regarding initial redox conditions for the 3D solute transport model. 3. Provide the % reactive pyrite by weight assumed for models in the text. Justification for proportions used, such as analytical data, should also be provided. Reference: [2] Jurgens, B.C., McMahon, P.B., Chapelle, F.H., and Eberts, S.M., 2009, An Excel workbook for identifying redox processes in ground water: U.S. Geological Survey Open-File Report 2009–1004 8 p.

Response to #1

Redox conditions within the different hydrostratigraphic units at the site, which addresses spatial heterogeneity, was provided as part of Section 4.3.3 of Appendix 7-A of the draft EIS. As was noted by the CNSC reviewer in this IR (IR-82), the measurement of ORP in the system is qualitative at best, and this is also true of field-measured dissolved oxygen, which, upon exposure of groundwater to the atmosphere will quickly equilibrate with atmospheric oxygen. For the project, where concentrations of nitrate are low in all hydrostratigraphic units, the primary indicators of redox conditions are dissolved iron and sulphate concentrations. At the circumneutral pH range observed in groundwater in all hydrostratigraphic units at the site, concentrations of dissolved iron in groundwater above approximately 0.1 mg/L indicate definitively that the system is anoxic. Ferric oxyhydroxide solid control dissolved ferric iron (Fe^{3+}) concentrations to values less than 0.1 mg/L in near neutral pH water, whereas ferrous iron (Fe^{2+}) is very soluble and mobile in groundwater that is anoxic. The presence of sulphate and qualitative absence of detectable sulphide (based on absence of odour; $H_2S_{(g)}$ can typically be detected by odour down to 10 µg/L) in the groundwater is also an indicator that the system is not currently highly reducing. Sulphate reduction is typically tied to organic matter oxidation and the system does not appear to have organic carbon sources at this time.

As discussed in Section 4.3.3. of Appendix 7A of the draft EIS, the exception to the above is within the ore zone, where more reducing conditions are evidenced by the mineralogy and the persistence of sulphide minerals and uraninite for more than 1 billion years. In this zone, any oxidant will be scavenged by pyrite, maintaining a reducing environment. This is reflected qualitatively by the ORP measurements in the ore zone which was measured to be -265 mV (page 4.20 of Appendix 7A of the draft EIS).

The technical team acknowledges that there are other redox pairs or species, and specifically As(V)/As(III) and the measurement of dissolved reduced sulphur species sulphide species, that may support the interpretation of redox in groundwater. Holm (1989) concluded on the basis of his work calculating redox potentials from As(V)/As(III), Fe(III)/Fe(II) that the arsenic redox pairs provides supplementary information to that provided by dissolved iron, but is considered qualitative in nature. For the As(V)/As(III) pair, the solution phase speciation of the arsenic ions also has to be considered and may affect the accuracy of calculation of redox potentials from their analytical quantification in groundwater.

It is generally understood that groundwaters are typically not at redox equilibrium (e.g., Lindberg and Runnells, 1984). Thus, in this work, our primary reliance on the concentrations of dissolved iron and sulphate in the groundwater, as well as the mineralogy of the system was considered adequately robust for interpretation of baseline redox conditions in the hydrostratigraphic units for the Wheeler River project. Use of tools like the Jurgen et al., (2009) excel spreadsheet referenced by the CNSC reviewer requires careful consideration and qualification of the results provided, as it based on measured redox indicator ion concentrations and empirical relationships between them. The tool was applied to the available data on groundwater and returns interpretation that is aligned with what was discussed in the draft EIS and herein.

<u>Response to #2</u>

The redox conditions assumed for the 3D modelling, using PiChem, were the same for all scenarios as in the 1D modelling in PHREEQC. This includes the equilibration of the groundwater with atmospheric concentrations of oxygen for most of the modelling scenarios. The one exception was the “Redox Scenario” (page 3.48 of Appendix 7-C of the EIS), in which the solution was equilibrated with pyrite, resulting in reducing conditions controlled by the iron sulphide mineral.

It is noted that this equilibration of the groundwater solutions with atmospheric concentrations of oxygen affects only the speciation of elements that are redox sensitive and is a modelling approach that is used to force redox sensitive species to be in their most oxidized form. As noted above, groundwaters are seldom at equilibrium with respect to the speciation of redox sensitive species and thus, using thermodynamic considerations alone can results in elements being present in the model as species that are not observed in the environment. This was mitigated by forcing the conditions in the model to oxidized conditions. As was discussed in Appendix 7-C of the draft EIS (page 3.29), this is a conservative approach because the important redox-active constituents of concern are more mobile in their oxidized forms, including uranium as U(VI).

<u>Response to #3</u>

The “Redox” scenario model (page 3.48 of Appendix 7-C of the draft EIS) was run iteratively to evaluate the minimum amount of pyrite that would be required to reduce dissolved-phase U(VI) associated with remediation of the mining zone (i.e., the restored solutions). As was outlined on page 3.49 of Appendix 7-C of the draft EIS, the information available included quantification of total iron through wet chemical extraction in core samples, and observations recorded by Denison personnel during core logging. Specifically, pyrite was observed associated with hydrothermally altered materials between an approximate depth interval of 240-390 mbgs (page 3.49 of Appendix 7-C of the draft EIS).

Total (wet chemical) extraction of iron content of the core materials does not provide speciation of iron. The maximum, minimum, and median total iron concentration, expressed as Fe_2O_3 weight %, in the MFa are provided in Table 3-2 of Appendix 7-C of the draft EIS. Not indicated in that table is that these statistics are based on 10,436 elemental analyses of core samples. (*Noted is that as part of the response to IR-92, Table 3-2 is being updated to indicate the total number of samples from which the statistics were derived*).

A sample from the MFa downgradient of the mining zone was recently submitted to the Saskatchewan Research Council (SRC) for analysis of total iron and mineralogy by XRD. The sample was taken from location GWR-062 (located within Phase 1 of mining) at a depth of 398.7 mbgs in sandstone and was named "Altered Pyrite". The total iron content of the sample was determined in the whole rock assay (by lithium metaborate fusion) to be 13% by weight; the analytical results are provided in Appendix A. The certification of analysis for the whole rock assay is attached to this IR. Pyrite and marcasite were identified as the iron phases in the sample by XRD; the XRD results are attached to this IR in Appendix A.

Pyrite Content Assumed in the "Redox Scenario"

In the numeric model for the sensitivity "Redox Scenario", the total iron content was considered was the median value in the MFA. The Median total iron value in the MFA is 1.4 wt % (1.4 g) of Fe_2O_3 per kg of sediment/rock, which is equivalent to 0.0175 moles of Fe per kg of soil. Because of the stoichiometry of pyrite (FeS_2), this is equivalent to 0.0175 moles of pyrite per kg of soil. This value was then converted to moles of Fe per litre of water, as is the convention for PHREEQC. To do this conversion, it was assumed that the groundwater flow was predominantly through the desilicified/hydrothermally altered portion of the MFa, with a porosity of 0.2 and a bulk density of 2.12 g/cm^3. The total moles of pyrite per litre of soil was calculated as 0.186 moles/L.

Determined through the reactive transport modelling in PHREEQC was that only 0.0001 moles of pyrite per litre of water was required to oxidize the mass of U(VI) transported from the mining zone. This amount of pyrite represents 0.054% of the median total moles of iron present in the MFa.

The pyrite content measured in the "Altered pyrite" sample by XRD, presented herein, exceeds that assumed in the reactive transport modelling.

<u>References</u>

Holm, T.R. and Curtiss, C.D., 1989. A comparison of oxidation-reduction potentials calculated from the As(V)/As(III) and Fe(III)/Fe(II) couples with measured platinum-electrode potentials in groundwater. J. Contam. Hydrol., 5: 67-81.

Jurgens, B.C., McMahon, P.B., Chapelle, F.H., and Eberts, S.M., 2009, An Excel workbook for identifying redox processes in ground water: U.S. Geological Survey Open-File Report 2009–1004 8 p.

Lindberg, R.D. and Runnells, D.D., 1984. Ground water redox reactions: an analysis of equilibrium state applied to Eh measurements and geochemical modeling. Science, 225:925 927.

Attachment IR-82 Appendix A

SRC Mineral Processing
Attention: Jack Zhang
PO #/Project: 15475
Samples: 3

SRC Geoanalytical Laboratories
2901 Cleveland Avenue, Saskatoon, Saskatchewan, S7K 8A9
Tel: (306) 933-8118 Fax: (306) 933-5656 Email: geolab@src.sk.ca

Report No: G-2023-1281

Date of Report: Jun 28, 2023

ICP Whole Rock Assay
Lithium Metaborate Fusion

Column Header Details

Aluminum in wt % (Al2O3)
Calcium in wt % (CaO)
Iron in wt % (Fe2O3)
Potassium in wt % (K2O)
Magnesium in wt % (MgO)

Manganese in wt % (MnO)
Sodium in wt % (Na2O)
Phosphorus in wt % (P2O5)
Titanium in wt % (TiO2)
SiO2 by ICP in wt % (SiO2)

Barium in ppm (Ba)
Chromium in ppm (Cr)
Scandium in ppm (Sc)
Strontium in ppm (Sr)
Yttrium in ppm (Y)

Zirconium in ppm (Zr)
Loss on Ignition in wt % (LOI)
SUM in (SUM)

Sample Number	Al2O3 wt %	CaO wt %	Fe2O3 wt %	K2O wt %	MgO wt %	MnO wt %	Na2O wt %	P2O5 wt %	TiO2 wt %	SiO2 wt %	Ba ppm	Cr ppm	Sc ppm	Sr ppm	Y ppm	Zr ppm	LOI wt %	SUM
SY5	14.5	7.16	10.6	4.23	3.27	0.13	4.18	2.05	1.82	49.9	6410	147	13	3130	57	743	N/R	97.84
ALTERED PYRITE	2.23	0.02	13.0	0.05	0.41	<0.01	0.04	0.05	0.08	67.5	9	49	<2	151	37	176	16.9	100.58
ALTERED PYRITE R	2.16	0.02	13.0	0.05	0.40	<0.01	0.04	0.04	0.10	67.2	9	48	<2	148	36	178	17.5	100.50

Whole Rock Analysis: A 0.1 gram pulp is fused at 1000 C with lithium metaborate then dissolved in dilute HNO3.
The standard is SY5.

altered pyrite

FILE: [Altered Pyrite.raw] altered pyrite*
SCAN: 4.0/70.0537/0.01997/49.7(sec), Cu(40kV,40mA), I(p)=130072, 06/27/23 09:26a
PROC: [WPF Control File]

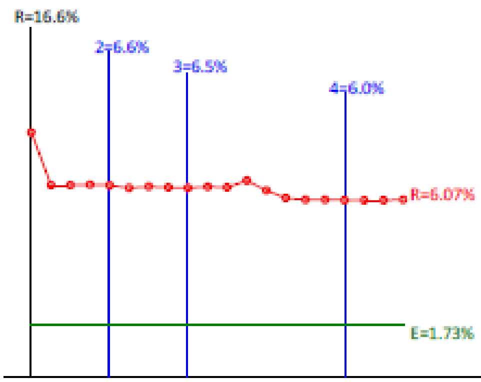
- ☑ K-alpha2 Peak Present
- ☑ Allow Negative Isotropic B
- ☑ Allow Negative Occupancy
- ☑ Apply Anomalous Scattering

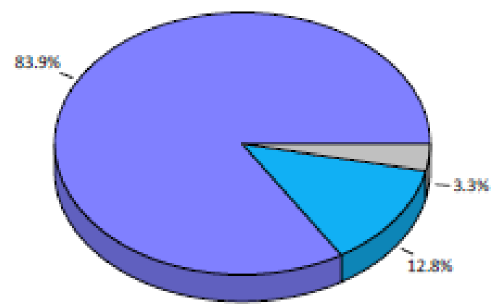
[Diffractometer LP] Two-Theta Range of Fit = 10.0 - 70.1(deg)

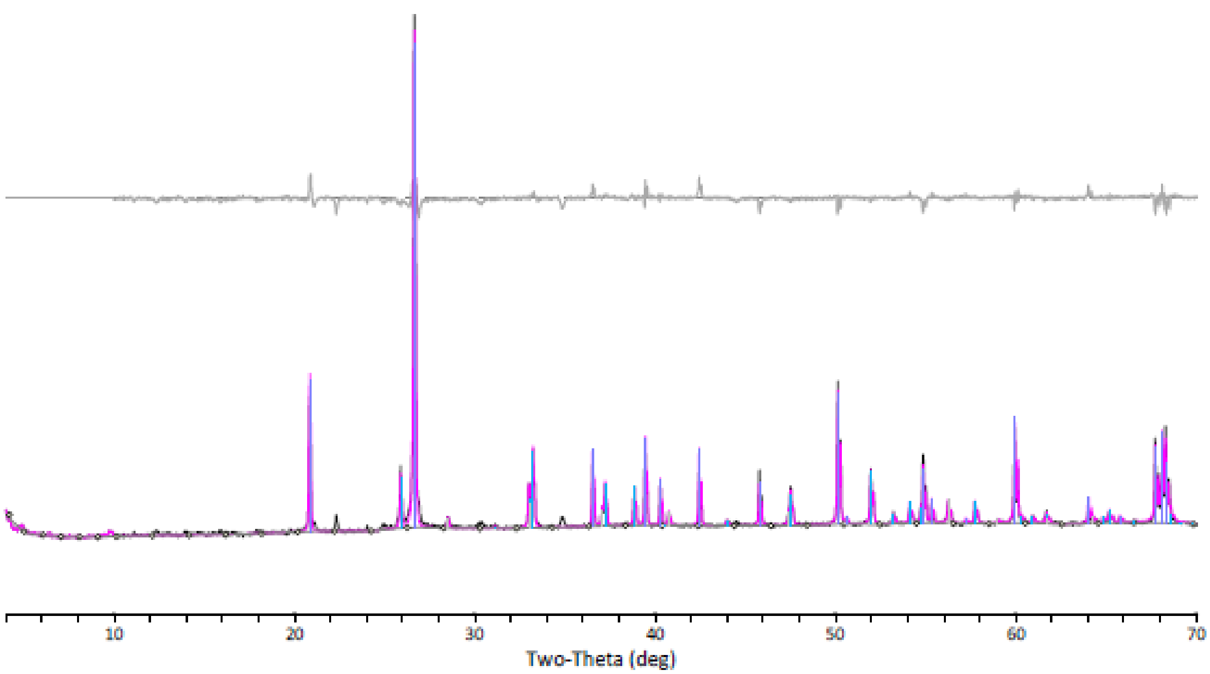
- ☑ Specimen Displacement - Cos(Theta) = 0.009851(0.000625)
- ☐ Monochromator Correction for LP Factor = 1.0
- ☐ K-alpha2/K-alpha1 Intensity Ratio = 0.5

Profile Shape Function (PSF) for All Phases: Pearson-VII, Fixed-BG, Lambda=1.54059Å (Cu/K-alpha1)

Phase ID (3)	Source	I/Ic	Wt%	#L
Quartz - SiO_2	PDF#98-091-4803	4.48(5%)	83.9 (5.5)	18
Marcasite - FeS_2	PDF#98-091-1215	2.28(5%)	12.8 (0.9)	24
Pyrite - FeS_2	PDF#98-091-4417	2.62(5%)	3.3 (0.3)	11



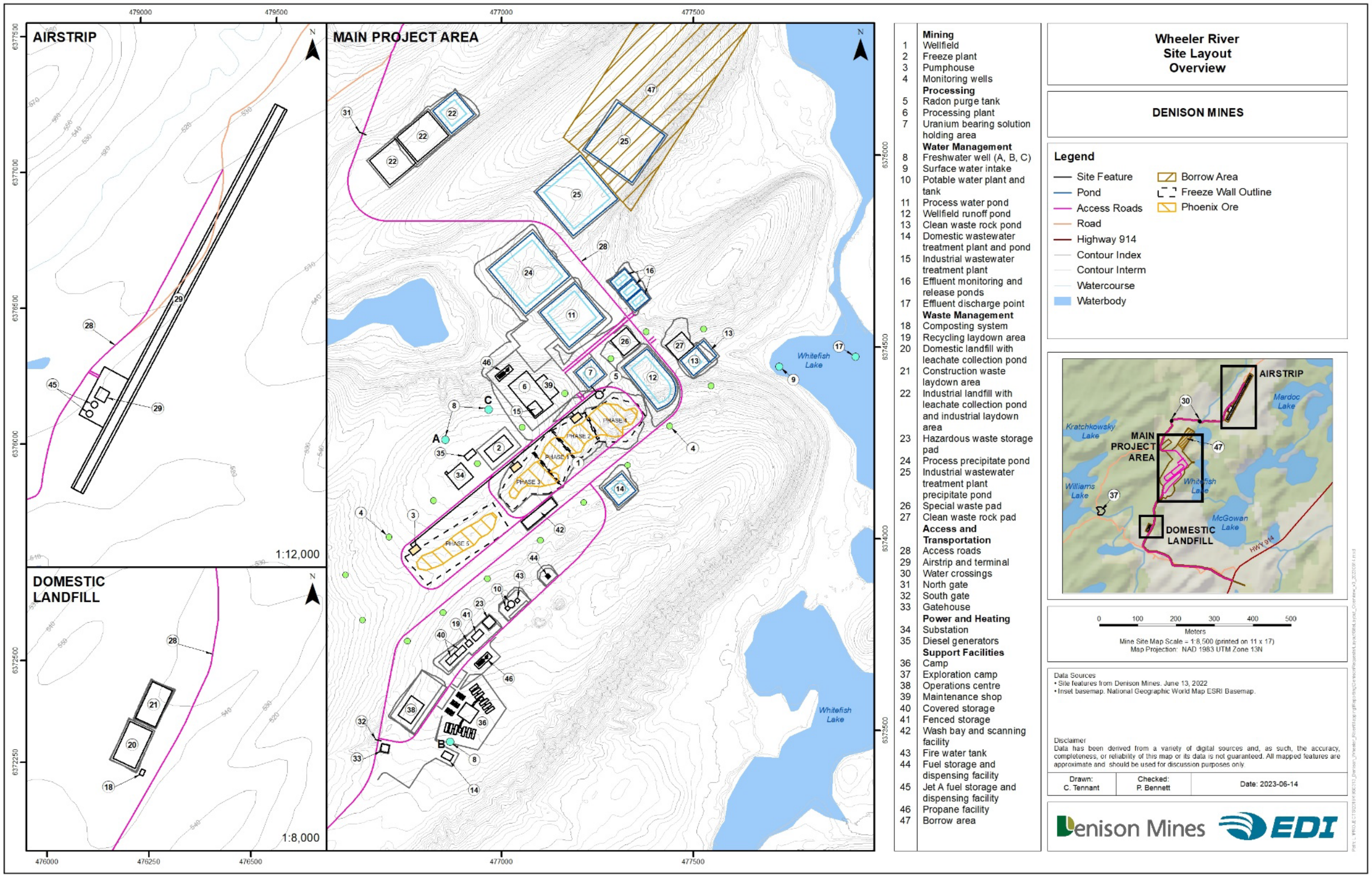




Attachment: IR-85

Number	IR-85
Dept.	CNSC
Project effects link	Geology and Groundwater
Reference to EIS, appendices, or supporting documentation	Appendix 7-C
Context and Rationale	Context: Section 2.7.3 (Appendix 7-C) mentions Wells A, B and C, and Figure 2-17 (p. 2.43, Appendix 7-C) illustrates the predicted drawdown ranges at Well B and Well C. Rationale: It is not clear where Well A, Well B and Well C are located.
Information Requirement	Please provide the locations of Well A, Well B and Well C illustrated in a Figure.

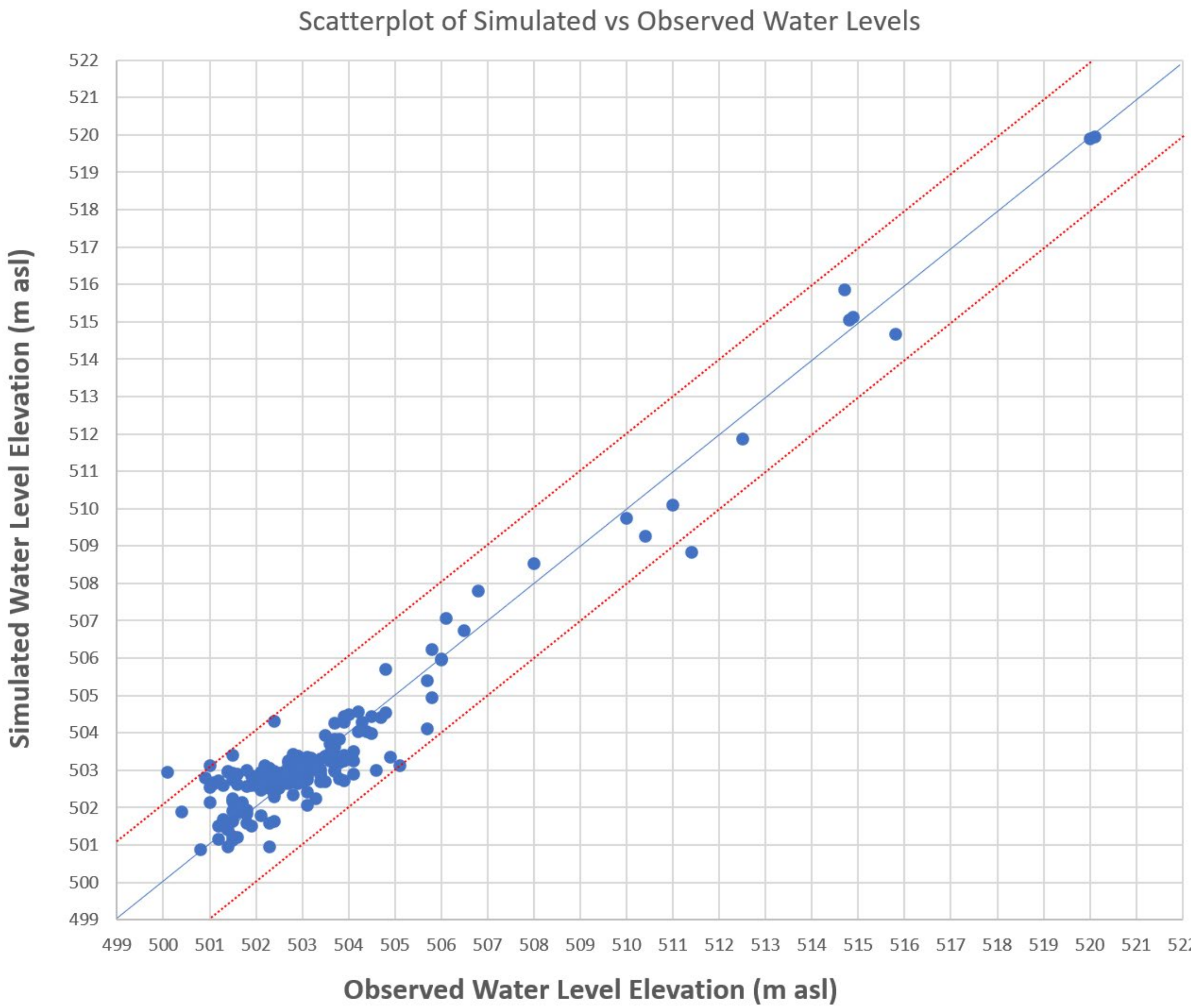
Supporting figure to the response provided in table:



Attachment: IR-91

Number	IR-91
Dept.	NRCan
Project effects link	Fish and fish habitat
Reference to EIS, appendices, or supporting documentation	Appendix 7-C, section 2.5.2
Context and Rationale	Context: The numerical model calibration quality plot (Appendix 7-C, sec. 2.5.2.1, Figure 2-13) contains a small error. The vertical (simulated heads) and horizontal (observed heads) axes do not have the same scales (499 to 521 masl versus 499 to 522 masl). Therefore, the line of ideal fit is offset. Rationale: As a result, NRCan notes that observed heads in the 510-512 masl range are underpredicted by the model. NRCan also notes that the calibration statistics (Appendix 7-C, sec.2.5.2.3) are highly leveraged by two data points from open boreholes south of Kratchkowsky Lake where simulated values are largely controlled by the nearby constant-head boundary in the Lower Sandstone aquifer (520 masl).
Information Requirement	The proponent should correct the scales on the axes of Figure 2-13 in Appendix 7-C. The proponent should also comment on the effect on calibration of the clustering of most observation wells in the ore zone.

Supporting figure to the response provided in table:



Attachment: IR-92

Number	IR-92
Dept.	CNSC
Project effects link	Geology and Groundwater
Reference to EIS, appendices, or supporting documentation	Appendix 7-C, Section 3.2.1, Mineralogical Composition
Context and Rationale	Context: Table 3-2 summarizes the clay content of the Athabasca Group sandstones and the Paleoweathered Zone. Although minimum, maximum and median values are provided, the number of samples and variability of the dataset are not. Rationale for incorporating illite into reactive transport modelling and excluding kaolinite/dichlorite is provided in the text. From p. 3.29 in Appendix 7-C: "The illite content was based on the normative clay composition determined from site-specific corehole elemental analysis (median illite by mass is 7.68%; Table 3-2) and using portable infra-red mineral analysis indicating median illite content by mass is 13.1% (data not shown)" From p. 3.30 in Appendix 7-C: "Using the minor amount of illite compared to the more dominant chlorite is conservative in that not all sorptive capacity of the clays is accounted for in the simulated paleoweathered zone". This conservative assumption appears contrary to assumptions for the desilicified zone (DSZ) and Athabasca Group sandstones "Illite was used to represent the total clay content, which varies from 1.74% to 5.85% by mass in the hydrostratigraphic units within the Athabasca Group sandstones and Desilicified Zone". Rationale: Information is missing in the EIS regarding the clay composition of hydrostratigraphic units. Results from infrared mineral analysis are not reported. The assumption for the solute transport model is that all clays in the downgradient DSZ are illite. However, clay content in the Read Formation (Lower Sandstone Aquifer) downgradient of the ore zone is low in illite (0.42%) compared to kaolinite (0.52%) and dichlorite (1.18%). A value of 3.9% illite clay by weight is used for the DSZ, but Table 3-2 indicates median content is 2.42% illite. It is not clear why illite was used to represent total clay content for the DSZ, as opposed to the conservative assumptions used for the Paleoweathered Zone, nor has any basis or justification been given.
Information Requirement	1. Please provide in Table 3- the number of samples and variability of the datasets used to estimate the clay content of hydrostratigraphic units for the model. Include results from infrared mineral analysis in the text if the information is used to support assumptions for modelling. 2. Please provide further information/discussion within the EIS relating to the assumptions of clay content in hydrostratigraphic units for modelling. Provide further justification and rationale as to why total clay content in the Athabasca Group sandstones and Desilicified Zone is assumed to be illite, and how this assumption is

	conservative. This discussion could include a comparison of the properties (cation exchange capacity, surface area) of illite vs. kaolinite vs. dichlorite for the anticipated range of subsurface conditions (pH, redox, U concentrations, etc.).

Response to #1

Table 3-2 in Appendix 7C of the draft EIS has been updated to indicate the number of samples analyzed and arithmetic average and (one) standard deviation values as a measure of sample variability, in addition to the maximum, median and minimum values that had already been provided. Results from Portable Infrared Mineral Analyzer (PIMA) have also been included for the paleoweathered zone. The updated Table 3-2 is included on the next page.

Note that in Table 3-2 in Appendix 7C of the draft EIS, the normative clay content for kaolinite, illite and ditrichlorite in the paleoweathered zone had been entered erroneously as the % of total clay and had not been converted to wt% in the sediment/rock. This was corrected and the updated values represent wt% of kaolinite, illite and ditrichlorite in the sediment/rock.

Response to #2

Unlike the iron oxide minerals goethite and ferrihydrite and gibbsite, for which there is an existing compilation of thermodynamic surface complexation constants for sorption of metals, metalloids, and anions to a single, laboratory-produced mineral phase (Dzombak and Morel, 1991; Mathur and Dzombak, 2006; Karamalidis and Dzombak, 2006), such a compilation does not exist for clay minerals. Rather, to develop the database of surface complexation constants for metals and metalloids to illite clay for the modelling work presented in Appendix 7-C of the draft EIS took an extensive review of the literature to make decisions on the most defensible constants to include in the work. For kaolinite, a similarly comprehensive databased could have been developed, but not for chlorite, where the number of studies identified in the literature for sorption characteristics is much more limited.

The decision was made to use illite to represent the clays present in the Athabasca Sandstone group units because:

- for the reasons give above and the discussion provided below, it was not practicable to develop a database of surface complexation constants for more than one clay mineral phase;
- using the updated Table 3-2 provided as part of this IR response, the median illite content (weight %, based on normative clay calculations) of the Athabasca Sandstone Group units is, with only one exception, always more than twice (2x) the median kaolinite content, and three times (3x) the median chlorite content. The exception is the “MFa in downgradient DSZ”, where the median illite content is lower, than the median kaolinite and chlorite contents.

In the model, the choice was made to represent the clays assemblage as a whole as 3.9% illite/kg of sediments/rock (wt %, based on normative clay calculations). Median normative clay contents in the Athabasca Sandstone Units (MFa, MFb, MFc, and MFd) and overburden materials ranged from 1.74-5.85 wt %, and for the locations downgradient of the mining zone (“Downgradient Desilicified Zone, All Units”) was 4.14 %. The robustness of selection of illite to represent the clay assemblage is discussed here below using CEC as an important characteristic of the sorption behaviour of the clays present in the system (illite, kaolinite and chlorite).

Updated Table 3-2 in Appendix 7-C of the draft EIS: CaO, Fe Oxide and Clay Contents of the Athabasca Group Sandstones and Paleoweathered Zone

Lithologic Unit	Number of Samples (CaO and Fe2O3, %)	Number of Samples (Clay %)	Statistic	Elemental Analysis (wt % in sediment/rock)		Normative Clay (wt % in sediments/rock)[b]					PIMA (% of total clay content)[c]			
				CaO (%, Total)	Fe2O3 (%, Total)[a]	Clays (%)	Kaolinite (%)	Illite (%)	Dichlorite (%)	Dravite (%)	Illite (%)	Chlorite (%)	Kaolinite (%)	Dravite1 (%)
Overburden	8	84	Max	0.21	0.38	6.7	3.63	5.23	2.17	0.62	Data Not Collected			
			Min	0.005	0.03	0.20	0.00	0.06	0.00	0.01				
			Median	0.165	0.28	1.74	0.29	1.06	0.04	0.03				
			Average	0.14	0.26	1.94	0.47	1.22	0.25	0.08				
			Standard Deviation	0.063	0.10	1.23	0.52	0.94	0.47	0.11				
MFd	3077	3556	Max	0.71	1.7	39.6	17.2	24.4	15.2	8.03				
			Min	0.005	0.02	0.02	0.00	0.00	0.00	0.00				
			Median	0.005	0.05	2.05	0.32	1.45	0.00	0.28				
			Average	0.009	0.085	2.27	0.47	1.49	0.30	0.45				
			Standard Deviation	0.014	0.120	1.45	0.76	1.20	0.66	0.53				
MFc	8532	9065	Max	1.44	9.1	60.5	18.9	46.1	27.8	16.3				
			Min	0.005	0.02	0.03	0.00	0.00	0.00	0.00				
			Median	0.01	0.29	3.76	0.44	2.60	0.08	0.30				
			Average	0.02	0.52	4.08	0.84	2.73	0.49	0.66				
			Standard Deviation	0.02	0.60	2.50	1.23	1.96	1.17	0.99				
MFb	6086	7115	Max	2.48	7.23	64.3	32.61	31.95	52.59	21.60				
			Min	0.005	0.04	0.03	0.00	0.00	0.00	0.00				
			Median	0.02	0.89	5.85	0.95	4.17	0.00	0.17				
			Average	0.02	1.10	6.23	1.56	4.24	0.41	0.51				
			Standard Deviation	0.06	0.87	3.28	1.99	2.20	2.12	1.07				
MFa	10436	10817	Max	3.74	25.8	68.0	34.2	38.2	63.7	45.0				
			Min	0.005	0.01	0.03	0.00	0.00	0.00	0.00				
			Median	0.01	0.14	3.53	0.67	1.74	0.20	0.33				
			Average	0.021	0.52	4.76	1.16	2.67	0.93	1.00				
			Standard Deviation	0.056	1.08	4.73	1.94	2.95	2.79	2.03				
MFa in Downgradient DSZ	510	542	Max	0.28	5.77	41.3	28.8	17.0	20.9	9.22				
			Min	0.005	0.03	0.40	0.00	0.00	0.00	0.01				
			Median	0.02	0.09	2.62	0.51	0.42	1.18	0.15				
			Average	0.021	0.30	3.96	0.78	1.66	1.52	0.52				
			Standard Deviation	0.022	0.64	3.95	1.70	2.55	1.89	1.23				
Downgradient Desilicified Zone, All Units	1376	1459	Max	0.28	6.73	41.3	28.8	17.0	20.9	9.2				
			Min	0.005	0.03	0.30	0.00	0.00	0.00	0.01				
			Median	0.02	0.23	4.14	0.47	2.42	0.64	0.17				
			Average	0.019	0.58	4.63	0.79	2.94	0.90	0.47				
			Standard Deviation	0.017	0.78	3.05	1.28	2.60	1.36	0.89				
Paleoweathered Zone	109	109	Max	10.1	23.598	67.1	17.9	36.0	65.3	43.3	98.5	95.4	21.1	11.1
			Min	0.1	0	2.81	0.00	0.00	0.00	0.06	0	1.5	0	0
			Median	0.29	2.05	47.1	0.00	9.20	35.5	0.97	13.1	69.5	NC[d]	NC[e]
			Average	0.61	3.4	48.5	1.70	10.10	36.7	1.67	28.1	64.5	NC[d]	NC[e]
			Standard Deviation	1.51	4.2	10.4	3.60	7.60	12.60	4.10	33.2	30	NC[d]	NC[e]

Notes

[a] Iron oxide content for the paleoweathered zone is % Hematite (vs. total iron as Fe_2O_3)

[b] Normative clay values for predominantly basement-hosted paleoweathered zone may be erroneous due to variable host lithology chemistry

[c] The number of samples analyzed by PIMA for the paleoweathered zone was 9 (i.e., n= 9)

[d] Kaolinite was only detected in 3 samples in the paleoweathered zone using PIMA, and was "0" in all other samples. A. Median, average and standard deviation values were not calculated.

[e] Dravite was only detected in 1 sample in the paleoweathered zone using PIMA, and was "0" in all other samples. A. Median, average and standard deviation values were not calculated.

Cation Exchange Capacity (CEC) in the Overburden and Athabasca Sandstone Group Units

Literature ranges for cation exchange capacity for kaolinite, illite and chlorite are shown below in Table IR-92-1. Because there is a range of CEC values for each clay mineral in the literature, the maximum and minimum CEC value in the range provided in the literature was used to evaluate the CEC of the overburden and Athabasca Sandstone Group units for the Wheeler River Project. The range of calculated CECs based on the clay mineral assemblage in each sample is given in Table IR-92-2. Note that the number of samples used for each of the lithologic units is the same as that provided in the updated Table 3-2.

In Table IR-92-2, the “Kaolinite+Illite+Dichlorite CEC – Minimum” and “Kaolinite+Illite+Dichlorite CEC-Maximum” were calculated in the following way, to estimate the range of CEC that may be expected by lithologic unit.

$$Kaolinite + Illite + Dichlorite\ CEC - Minimum = \frac{wt\%\ kaolinite\ (\frac{kg}{kg})}{100} * 10\frac{meq}{kg} + \frac{wt\%\ illite\ (\frac{kg}{kg})}{100} * 100\frac{meq}{kg} + \frac{wt\%\ dichlorite\ (\frac{kg}{kg})}{100} * 14\ meq/kg$$

$$Kaolinite + Illite + Dichlorite\ CEC - Maximum = \frac{wt\%\ kaolinite\ (\frac{kg}{kg})}{100} * 150\frac{meq}{kg} + \frac{wt\%\ illite\ (\frac{kg}{kg})}{100} * 400\frac{meq}{kg} + \frac{wt\%\ dichlorite\ (\frac{kg}{kg})}{100} * 100\ meq/kg$$

This was then compared to the CEC used in the reactive transport modelling presented in Appendix 7-C of the draft EIS. The CEC of illite assumed was 225 meq/kg (Baeyans and Bradbury, 2009), which is a value intermediate to range in the literature sources (Table IR-92-1). At 3.9% illite, which was the illite content assumed in the base case of the modelling scenarios, the CEC assumed for the overburden and Athabasca Sandstones was (3.9 wt % (kg/kg)/100 * 225 meq/kg = 8.87 meq/kg of sediments/bedrock). In the modelling sensitivity analysis, 1/10 of the reactive phases, including illite, were assumed to be accessible to solution, so that the CEC of the bedrock/sediments was assumed to be 0.887 meq/kg.

The CEC values evaluated in the modelling (0.887 and 8.87 meq/kg) are within the range of median CECs that are represented for the lithologic units for the project. Because groundwater movement from the mining zone is understood the be preferentially through the desilicified zone (DSZ), as presented in Appendix 7-C of the draft EIS, it is important that the CEC assumed in the model is reflective of conditions in that unit. The calculated CEC for the “Downgradient Desilicified Zone, All Units” ranged from 2.7-11.8 meq/kg (Table IR-92-2). The CEC value assumed in the base case of the model (8.87 meq/kg) is intermediate to this range, and the sensitivity analysis value of 0.887 meq/kg is reflective of not all cation exchange sites being accessible for reaction with constituents in groundwater.

Further, three core samples from the desilicified zone at depth were submitted for CEC analysis. Details of the samples, the normative clay content, and the measured CEC using the ammonium-saturation method are provided in Table IR-92-3.

Table IR-92-1: CEC values from the Literature

	Cation Exchange Capacity (meq/kg)		
Clay Mineral	Kaolinite	Illite	(DiTri)Chlorite
Minimum CEC Applied	10	100	14
Maximum CEC Applied	150	400	100
Ranges in Literature (meq/kg)			
Drever (1982)	10-100	100-400	<100
Bain et al., (1994)	30-150	100-400	100-400
Zazzi, 2009	-	-	14-40
Bradbury and Baeyens (2009)		225	

(Highlighted cells:) Applied for geochemical reactive transport modelling in Appendix 7-C of the draft EIS

Table IR-92-2: Calculated CEC ranges for the Lithologic Units for the Wheeler River Project

Lithologic Unit	Statistic	Clays (%)	Kaolinite (%)	Illite (%)	Dichlorite (%)	Dravite1 (%)	Kaolinite+Illite +Dichlorite CEC - Minimum	Kaolinite+Illite +Dichlorite CEC - Maximum
Overburden	Max	6.7	3.63	5.23	2.17	0.62	5.4	22.2
	Min	0.20	0.00	0.06	0.00	0.01	0.076	0.39
	Median	1.74	0.29	1.06	0.04	0.03	1.1	4.9
MFd	Max	39.6	17.2	24.4	15.2	8.03	26.6	112.9
	Min	0.02	0.00	0.00	0.00	0.00	0	0
	Median	2.05	0.32	1.45	0.00	0.28	1.5	6.3
MFc	Max	60.5	18.9	46.1	27.8	16.3	48.1	198.7
	Min	0.03	0.00	0.00	0.00	0.00	0	0
	Median	3.76	0.44	2.60	0.08	0.30	2.8	11.7
MFb	Max	64.3	32.61	31.95	52.59	21.60	34.9	149.2
	Min	0.03	0.00	0.00	0.00	0.00	0	0
	Median	5.85	0.95	4.17	0.00	0.17	4.4	18.6
MFa	Max	68.0	34.2	38.2	63.7	45.0	38.8	157.1
	Min	0.03	0.00	0.00	0.00	0.00	0	0
	Median	3.53	0.67	1.74	0.20	0.33	2.0	9.0
MFa in Downgradient DSZ	Max	41.3	28.8	17.0	20.9	9.22	19.6	92.3
	Min	0.40	0.00	0.00	0.00	0.01	0.11	0.64
	Median	2.62	0.51	0.42	1.18	0.15	0.7	3.9
Downgradient Desilicified Zone, All Units	Max	41.3	28.8	17.0	20.9	9.2	19.6	92.3
	Min	0.30	0.00	0.00	0.00	0.01	0.11	0.64
	Median	4.14	0.47	2.42	0.64	0.17	2.7	11.8

Table IR-92-3: Normative Clay and Measured CEC for Desilicified Zone Samples

Sample Name	Corehole Location	Normative Clay Content					CEC (meq/kg)
		Clays (wt %)	Kaolinite (wt %)	Illite (wt %)	DiTriChlorite (wt %)	Dravite (%)	
DS-1	GWR-054	10.16	0.14	9.5	0.49	0.24	21
DS-2	GWR-059	5.74	0.40	6.2	3.6	0.743	26
DS-3	GWR-060	12.12	0.89	6.7	2.6	0.312	25
DS-Feed	Composite of DS-1, DS-2, DS-3	7.91	0.61	7.4	2.2	0.404	21

The Paleoweathered Zone

Conceptually, the paleoweathered zone mineral assemblage was made up of 9% clay by mass, as illite, and 25% quartz, as was described on page 3-29 of Appendix 7-C of the draft EIS. For the paleoweathered zone, there is a smaller dataset and the normative clay content in this unit can be inaccurate due to the host (basement) mineralogy. This is because the normative clay percentages for kaolinite, illite, dravite and chlorites are calculated from the bulk total geochemical composition of the sandstones using an in-house set of linear equations that govern the distribution of oxides into minerals of interest. Key oxide inputs are Al_2O_3, Fe_2O_3, K_2O, and MgO in percent and B in ppm. Unlike the sandstones, that contain little parent basement rock material, calculation of clay content in samples from the paleoweathered zone – because this unit is basement-hosted – can be influenced by the presence of parent rock material that has the same/similar chemical composition. In the paleoweathered zone, portable infrared mineral analysis (PIMA) was used to support the information from the normative clay content in terms of the relative abundance of the clay mineral phases. PIMA does not quantify the total clay in the rock sample (i.e., clay as a wt% of rock), but it does provide the relative abundances of the clay minerals present.

The conceptualization of the paleoweathered zone with respect to reactive mineral phases in the numeric modelling presented in Appendix 7-C of the draft EIS is considered conservative and robust based on the alignment of the following:

- The normative clay content, which as shown in the updated Table 3-2 presented above in this IR has a median value of 47.1 wt % clay content, with median illite and chlorite contents of 9.20 wt %, and 35.3 wt %, respectively.

- The PIMA results, presented in the updated Table 3-2. The PIMA results support the normative clay content results in that the dominant clay is chlorite (median of 69.5% relative abundance) followed by illite (median 13.1% relative abundance).
- Characteristics of the paleoweathered zone have been discussed for the Cigar Lake program (AECL, 1994) and for other study areas in the Athabasca Basin by Macdonald (1980) and by Wilson (1986). Macdonald (1980) studied the Precambian regolith in areas of the Athabasca Basin that were not mineralized – meaning away from areas of hydrothermal alteration. The mineralogy of the regolith depended on the depth in the regolith and on the specific parent basement rock (Meta-arkose, meta-semipelite, and meta-pelite). The quartz content of the regolith ranged from 5-40 volume % with values generally close to 25 volume %.

- In Wilson (1996), the author identifies zones of hydrothermal alteration overprinting the regolith that are dominated by quartz, illite, and kaolinite.

- In the Cigar Lake study (AELC, 1994) the paleoweathered zone beneath the ore body is described in the following way: "*A noticeable feature is the funnel-shaped zone of hydrothermally altered basement rock which also overprints the older regolithic alteration immediately underneath the unconformity. This hydrothermal alteration is characterized by a weakening of the rock strength through shearing and foliation dominated by clay-mineral development".*

Support from CEC and XRD Analyses

Using the same calculation method as above, the CEC of the paleoweathered materials would be 20.25 meq/kg assuming 9% wt% illite.

Recently, a composite sample of 4 core samples taken from the paleoweathered zone ('PW-Feed") was analyzed by XRD for mineralogy and the CEC was measured. Details of the samples included in the "PW-Feed" sample are provided below in Table IR-92-4. The CEC for PW-Feed is also included in that table, and was 72 meq/kg, and is aligned with a higher content of illite in the PW-Feed sample than is assumed for the numerical modelling and suggests a contribution to the CEC from the chlorite. The XRD results are provided as Appendix A of this IR response. The results indicate that the mineralogical makeup of PW-feed is: 24.4 wt% quartz (which aligns very well with the assumptions of 25 wt% in the conceptualization), 31.4 wt% illite, and 40.5 wt% chlorite. There is also a small amount of basement rock/parent material present in the sample (3.7wt% biotite).

The measured CEC was substantively (~3x) higher than assumed in the numeric model. It was understood in representing the clay mineral phases in the paleoweathered zone by 9% illite that the sorptive capacity may be underestimated. The decision was made to take a conservative approach because the dataset of surface complexation constants developed for the project was for illite, and it was considered inappropriate to apply the same sorptive reactivity to the much larger relative content of chlorite in this zone. The results of the XRD and the measured CEC provide support to the approach in the reactive transport modelling of assuming illite as the sorptive clay mineral as a conservative one.

Table IR-92-4: Measured CEC for PW-Feed Sample

Sample Name	Corehole Location	CEC (meq/kg)
PW-1	GWR-054	-
PW-2	GWR-061	-
PW-3	GWR-057	-
PW-4	GWR-060	-
PW-Feed	Composite of PW-1 through PW-4	72

Changes to the draft EIS text

To reflect the discussion above and updates to Table 3-2 of Appendix 7-C of the draft EIS, the following changes will be made to the text on page 3.29-3.20 of Appendix 7-C of the EIS.

Conceptually, the paleoweathered zone mineral assemblage was made up of 9% clay by mass, as illite, and 25% quartz. The illite content was based on the normative clay composition determined from site-specific corehole elemental analysis (median illite by mass is 9.20%; Table 3-2). Portable infra-red mineral analysis supported the normative clay content in that chlorite is the dominant clay mineral (69.5% relative abundance) followed by illite (median 13.1% relative abundance). The quartz content was based on a regional study by Macdonald (1980) evaluating the mineralogical composition of the weathered bedrock/saprolite regionally. The mineral composition of the paleoweathered zone was conceptualized in this manner because the data set for the project with respect to clay minerals was for the sorptive properties of illite. Using the relatively smaller illite content of the paleoweathered zone compared to the more dominant chlorite content is conservative in that not all sorptive capacity of the clays is accounted for in the simulated paleoweathered zone.

References

AECL (Atomic Energy of Canada Ltd.), 1994. Final Report for the AECL/ SKB Cigar Lake Analog Study. Report No. AECL-10851. July.

Bain, D. C. Smith, B.F. L., Wilson, M. J., Ed. 1994. Clay Mineralogy: Spectroscopy and Chemical Determinative Methods, Champman and Hall New York, USA. p. 300.

Drever, J. I., 1982. The Geochemistry of Natural Waters. PrenticeHall, Englewood Cliffs, N.J., p. 388.

Dzombak, D.A., Morel, F.M.M., 1991. Surface Complexation Modeling: Hydrous Ferric Oxide. Wiley.

Karamalidis A.K. and Dzombak D.A., 2010. Surface Complexation Modeling: Gibbsite, John Wiley & Sons, New York, New York, pp. 312, ISBN: 0470587687

Macdonald, C.C., 1980. Mineralogy and geochemistry of a precambrian regolith in the Athabasca Basin. Master's Thesis Submitted to the University of Saskatchewan.

Mathur, S.S., Dzombak, D.A., 2006. Surface Complexation: Goethite, in: Surface Complexation Modelling. Elsevier, p. 443.

Wilson, J.A., 1986, Geology of the basement beneath the Athabasca Basin in Alberta. Bulletin 55. Geological Survey Department, Alberta Research Council, Edmonton, Alberta, Canada.

Attachment IR-92 Appendix A

Note the following on the XRD results for the PW-Feed sample:

a) Chlinochlore is part of the chlorite group of minerals.
b) The diffraction patterns for illite and muscovite are nearly identical, and thus, muscovite is interpreted as illite in this sample.

PW-Feed

FILE: [PW-Feed.raw] PW-Feed*
SCAN: 4.0/70.0537/0.01997/49.7(sec), Cu(40kV,40mA), I(p)=51894, 03/28/23 10:41a
PROC: [WPF Control File]

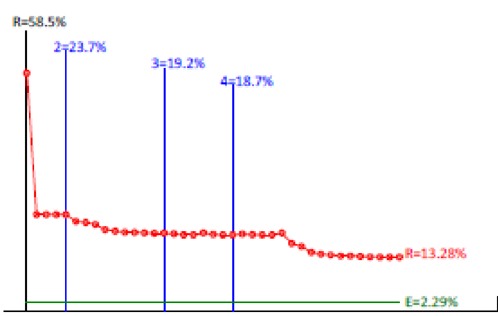
- ☑ K-alpha2 Peak Present
- ☑ Allow Negative Isotropic B
- ☑ Allow Negative Occupancy
- ☑ Apply Anomalous Scattering

[Diffractometer LP] Two-Theta Range of Fit = 5.0 - 70.1(deg)

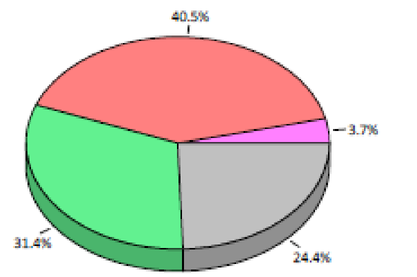
- ☑ Specimen Displacement - Cos(Theta) = 0.000934(0.002162)
- ☐ Monochromator Correction for LP Factor = 1.0
- ☐ K-alpha2/K-alpha1 Intensity Ratio = 0.5

Profile Shape Function (PSF) for All Phases: Pearson-VII, Fixed-BG, Lambda=1.54059Å (Cu/K-alpha1)

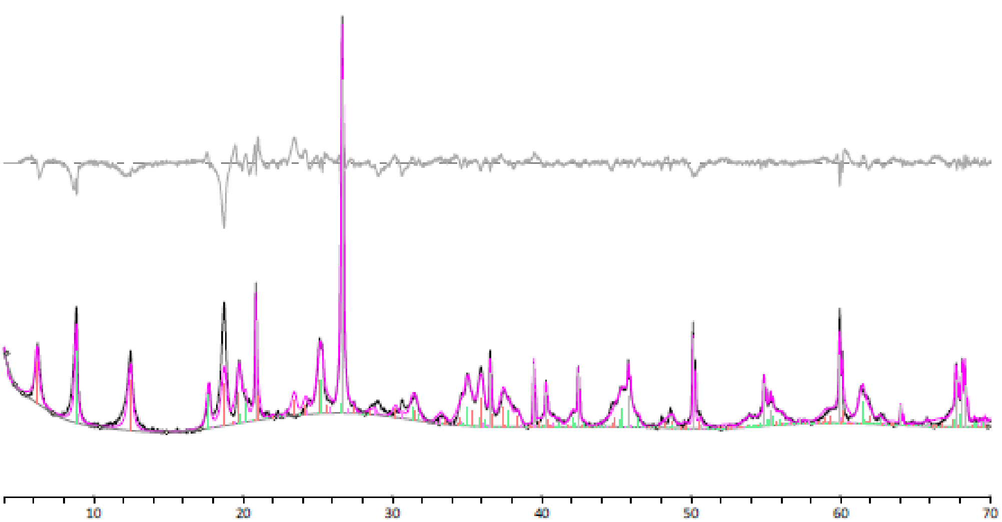
Phase ID (4)	Source	I/Ic	Wt%	#L
Biotite - $Mg_{2.001}Al_{1.999}KSi_3O_{12}H_2$	PDF#98-090-2546	0.60(5%)	3.7 (0.6)	116
Clinochlore - $Mg_5Al_2Si_3O_{18}D_8$	PDF#98-090-4186	0.53(5%)	40.5 (2.5)	158
Muscovite - $Al_{1.94}Si_{3.86}K_{.86}(O_{12}H_2)$	PDF#98-091-2053	1.20(5%)	31.4 (2.0)	198
Quartz - SiO_2	PDF#98-091-4802	4.48(5%)	24.4 (1.5)	18



Refinement Iterations



Wt%



Attachment: IR-93

Number	IR-93
Dept.	CNSC
Project effects link	Geology and Groundwater
Reference to EIS, appendices, or supporting documentation	Appendix 7-C, Table 3-10: Properties of Adsorbing Mineral Phases
Context and Rationale	**Context:** In Appendix 7-C, section 3.5.6.2.2 Ion Exchange and Surface Complexation, the consideration of ion exchange and surface complexation and the corresponding parameters and chemical reaction are discussed. **Rationale:** The site density of sorbent Geothite was reported in Table 3-10 to be 1.6E3 mol/kg. Taking into account the specific surface area of 60 m2/g, this equals to 1600/6E4 mol/m2, or 0.0266 mol/m2, 1.6e4 sites/nm2. This value largely overestimates the site density of goethite, which is reported to be in the range of 2~6 sites/nm2. The reference used in the EIS report indicates the similar range of variation for this specific parameter. There are plenty of similar studies on SCM of iron oxides in literature. It is suggested to consult with more than one single study to enhance the reliability of model parameters. The overestimation of sorption site density will directly result in underestimation of the affected COPCs' concentrations in pore fluid. This will result in underestimation of COPC transport plume in the affected underground space, and potentially the dissolved concentrations in the hydrogeological sink.
Information Requirement	Please provide additional evidence to justify the model parameter of site density for goethite, applied to the numerical model. If necessary, the reactive transport modelling should be re-run to update the contents presented in the EIS report.

<u>Response:</u>

The value provided in Table 3-10 for site density on goethite was a typographical error. The correct value for the density of reactive sites for goethite is 0.203 moles/kg. This value is derived below.

Equation for site density on goethite per kg of goethite:

$$Site\ Density\left(\frac{mole\ sites}{kg\ Goethite}\right) = Site\ Density\left(\frac{mole\ sites}{mole\ Fe}\right) x\ MW\ Goethite\left(\frac{g}{mol}\right) x\ 1000(\frac{g}{kg})$$

$$Site\ Density\ \left(\frac{mole\ sites}{kg\ Goethite}\right) = 0.018\ \left(\frac{mole\ sites}{moles\ Fe}\right) x\ 88.8517\ \left(\frac{g}{mol}\right)\ x\ 1000\ (\frac{g}{mol})$$

$$Site\ Density\ \left(\frac{mole\ sites}{kg\ Goethite}\right) = 0.203\ (\frac{mol}{kg})$$

The values for site density of 0.018 mole sites/mole Fe and the was given by Mathur and Dzombak (2006). The formula of goethite is FeOOH (also given by Mathur and Dzombak, 2006) and has a molecular weight ("MW") of 88.8517 g/mol.

The corrected table 3-10 is provided here below. Noted is that the value for site density for quartz has also been corrected. Please see the discussion below.

Table 3-10: Properties of Adsorbing Mineral Phases

Sorbent Phase	Site Density (mol/kg)	Specific Area (m2/g)	Reference
Goethite (FeOOH)	0.203	60	Mathur and Dzombak, 2006
Quartz (SiO_2)	0.00118	0.31	Prikryl et al., 2001
Illite	Strong Sites: 0.002 (metals and protons sorb); Weak Sites; 0.04 (protons only sorb)	97	Bradbury and Baeyans, 2009

Properties of Sorbent Phases used in PHREEQC/piChem modelling

The erroneous values reported in Table 3-10 were not used in the modelling. Below, example calculations are given for goethite to derive the total number of binding sites, in moles, for the mineral phase. The total number of sites for the clay, quartz and goethite were provided in the example PHREEQC file given in Appendix E of Appendix 7C of the EIS.

In PHREEQC, the default assumption is that a reaction occurs within 1L of the aqueous phase. This aqueous phase is pore water in the calculations of geochemical reactive transport through rocks and soils. Thus, the total moles of reactive sites associated with goethite (and other reactive phases) is expressed as that which is present in contact with 1L of pore water.

For total density of reactive sites on the goethite surface in the model, the following information was used:

- Site density: 0.018 mole of sites/mole Fe
- Fe_2O_3 content of sediment/rock: 0.29 wt % in whole rock (from rock core) (equivalent to 2.9 g/kg in whole rock)
- MW of Fe_2O_3 159.6882
- MW of FeOOH (goethite) 88.8517
- Specific Area of goethite 60 m^2/g
- (Rock) Effective Porosity 0.2 (Desilicified Zone; Appendix 7C, Table 2-4)
- Bulk Density of sediment/rock 2.12 g/cm^3 (calculated) (equivalent to 2.12 kg/L)
- Density of quartz 2.65 g/cm^3

Step 1: Total moles of reactive sites on goethite per kg of soil

$$Total\ moles\ reactive\ sites\ on\ geothite\ per\ kg\ of\ soil$$
$$= mass\ Fe2O3\left(\frac{g}{kg\ soil}\right) \div MW\ Fe2O3\left(\frac{g}{mol}\right) x\ 2\left(\frac{mole\ Fe}{mole\ Fe2O3}\right) x\ 0.018\ (\frac{mole\ reactive\ sites}{mole\ Fe})$$

$$Total\ moles\ reactive\ sites\ on\ geothite\ per\ kg\ of\ soil = 2.9\left(\frac{g}{kg\ soil}\right) \div 159.6882\left(\frac{g}{mol}\right) x\ 2\ (\frac{mole\ Fe}{mole\ Fe2O3})$$

$$Total\ moles\ reactive\ sites\ on\ geothite\ per\ kg\ of\ soil = 0.000654\ (\frac{moles\ reactive\ sites}{kg\ soil})$$

Step 2: Bulk Density of the sediment/soil

Quartz is the predominant mineral present in the Athabasca Sandstones. Thus, the bulk density of the sediment/rock was first calculated for the modelling purposes using the density of quartz, for a given effective porosity.

Density of Quartz (ρ_{quartz}) = 2.65 kg/L (Appelo and Postma)

Effective porosity (ε) = 0.2 (Desilificied zone, as above)

$$Bulk\ Density\ of\ Soil\ \left(\frac{kg}{L}\right) = \frac{(1-\varepsilon)}{(\frac{1}{\rho_{quartz}\left(\frac{kg}{L}\right)})}$$

$$Bulk\ Density\ of\ Soil\ \left(\frac{kg}{L}\right) = \frac{1 - 0.2\ (unitless)}{\frac{1}{2.65(\frac{kg}{L})}}$$

$$Bulk\ Density\ of\ soil = 2.12\ kg/L$$

Step 3: Reactive sites per 1L of aqueous solution (groundwater)

$$Total\ moles\ reactive\ sites\ on\ geothite\ per\ 1L\ porewater = Total\ moles\ of\ reactive\ sites\ on\ goethite\ per\ kg\ of\ soil\ \left(\frac{moles}{kg}\right) x\ soil\ bulk\ density\ \left(\frac{kg}{L}\right) \div soil\ effecftive\ porosity\ (unitless)$$

$$Total\ moles\ of\ reactive\ sites\ on\ goethite\ per\ 1L\ porewater = 0.000654\ \left(\frac{moles\ reactive\ sites}{kg\ soil}\right) * 2.12\ \div 0.2$$

$$Total\ moles\ of\ reactive\ sites\ on\ goethite\ per\ 1L\ pore\ water = 0.00693\ moles/L$$

This is the value for reactive sites on goethite provided in the example PHREEQC File "**#PHREEQC Input File_Transport_PWZ_DSZ and Sediments2_Chlorite2.phr"** provided in Appendix E of Appendix 7-C of the EIS. Goethite in the model was indicated by "Hfo_". The values "60" and "32.4" are the specific surface area of goethite (60 m2/g) and mass of goethite in contact with 1 L of porewater, respectively. The specific area and mass of goethite are not used in the model calculations, as the reactive sites are provided as the absolute number of moles (0.00693 moles reactive sites per 1 L of porewater).

(Excerpted from the PHREEQC input file provided)

```
Surface 56-145 #Mineral Assemblage, reactive sites, Desilicified zone
-equilibrate with solution 96-145
Hfo_      0.00693 60        34.2
-no_edl

Hao_s     0.0008268         97        413.4
Hao_w     0.0165
Hao_ww              0.0165
-no_edl

QOH       0.0119  0.31      10017
-no_edl
```

References

Appelo, C.A.J, and Postma, D. Geochemistry, groundwater and pollution, 2nd edition. CRC Press, Boca Raton, Florida. 649 pages.

Attachment: IR-95

Number	IR-95
Dept.	CNSC
Project effects link	Geology and Groundwater
Reference to EIS, appendices, or supporting documentation	Appendix 7-C, Table 3-11
Context and Rationale	**Context:** The Table 3-11 reported the Solid-Phase Concentrations and Partitioning Constants for COPCs. Data were both measured and simulated. Rationale: It is unclear how the partition coefficients of various COPCs upon desilicified and paleoweathered rocks were obtained. It was not reported at what pH were these Kd analyzed. Sorption of chemicals on solid phase is known to be pH dependent. It is unclear whether pH influence was considered in the measurement and analysis of apparent partition coefficients. In addition, uptake of metals on clay is highly nonlinear, and always has a maximum capacity. Even with a very strong affinity towards specific metal ions, the sorption will be saturated at elevated concentrations. Therefore, assuming a linear correlation needs to be cautious of the concentration range of target COPC species, and the applicable sorption capacity of the clay mineral. In the current model, only the linear form of sorption is considered, although with discussion of Kd value selection. Additional rationale is needed to justify if the applied methodology is sufficient for assessment.
Information Requirement	Please justify the choice of applying a linear form partition coefficient for the modelling and assessment, and whether it provides a conservative approach to the assessment results. Clarity around the experimental conditions during the measurement of partitioning coefficient of various COPCs on the target rocks may help support this assumption.

Response:

Solid-liquid partition coefficients (K_d values) were not used in the geochemical reactive transport modelling for groundwater except for the lake bottom sediments of Whitefish Lake, as described in Appendix 7-C, Sections 4.5.1 and 4.5.6.2.3 of the draft EIS. The lake bottom sediments are encountered only at the very end of the (much longer; approximately 1000 m) transport pathway from the mining area to Whitefish Lake and were conceptualized as a 1 m zone between the overburden soils and the lake (page 4.6 of Appendix 7-C of the draft EIS).

For reactive transport of groundwater through all subsurface hydrogeologic units (paleoweathered zone, Athabasca Group Sandstone units, and overburden materials), the geochemical code PHREEQC was incorporated for geochemical reactive transport modelling, and sorption reactions included cation exchange and adsorption of constituents from solution to reactive sites at the surface of mineral phases as surface complexes (i.e. using the Surface Complexation Model). The Surface Complexation Model accounts for:

- non-linear sorption of metals and other constituents

- competition amongst these constituents for reactive sites at mineral surfaces
- pH-dependent sorption.

K_d values were presented in Appendix 7-C, Section 3.5.6.2.3 of the draft EIS as a check on the reasonableness of the modelled. COPC adsorption that was conceptualized in the model as occurring at quartz, illite and goethite mineral surfaces. It was important, ***as a check***, to demonstrate that modelled sorption to these surfaces was not overpredicting COPC concentrations in the solid phase under initial/baseline conditions. To do this, measured concentrations of COPCs in core material were compared to predicted solids concentrations in the model. Further, using concentrations of COPCs in representative groundwater, K_d values were calculated from both the measured COPC concentrations and those modelled.

Supplemental Information – calculation of K_ds

Information supplemental to the response above is presented herein to detail how the K_d values provided in Appendix 7-C, Section 3.5.6.2.3 and Table 3-11 of the draft EIS were calculated.

The K_d (L/kg) is calculated as the solid phase concentration of an element, divided by the dissolved-phase concentration of that element.

Measured Solid-Phase COPC Concentrations:

- "Desilicified Zone" refers to solid phase elemental concentrations in core from wells indicated in Figure 3-1 of Appendix 7-C of the draft EIS. Elemental concentrations were measured on total and partial digestions. The total number of samples used in the calculation of the maximum, minimum and median values of the solid phase concentrations was 1,459 for samples for which total digestion results were presented. This includes all elements presented other than arsenic (As) and selenium (Se). For these elements, only partial digestion results were available. The total number of samples used to calculate maximum, minimum and median solid phase concentrations for As and Se was 843.
- Elemental Analysis for the Paleoweathered Zone represents a total of 108 samples, as provided in Appendix E of Appendix 7C, Table E-1.

Measured Solution-Phase Concentrations: Representative groundwater concentrations of COPCs were those used in the model, and are presented in Appendix 7-C, Table 3-5.

An example K_d calculation is provided here below for chromium in the Desilicified Zone, using the measured median solid-phase concentration and the Cr concentration in groundwater:

Kd (L/kg) = Median Solid phase Cr concentration (total digestion; mg/kg) ÷ Solution Phase Concentration of Cr in Representative Solution for Desilicified Zone (mg/L)

Kd (L/kg) = 8 mg/kg ÷ 0.0005 mg/L

Kd (L/kg) = 1.6×10^4 L/kg

Calculating K_d values in this way is appropriate because it is calculated using measured data. Thus, no assumptions were made with respect to pH. The pH of groundwater in the system is circumneutral (i.e., pH = 6-7) and the measured solid-phase concentrations are from rock material that was in equilibrium with the groundwater when collected and analyzed.

In the PHREEQC and, likewise, piChem models, solid phase concentrations are yielded by assuming equilibrium occurs between the solution phase concentrations of COPCs, which are the inputs to the model, and the sorbing phases. As is described in Appendix 7C, Section 3.5.6.2.3, within the model the solid sorbent phases (quartz, illite and goethite) are "pre-loaded" (pre-equilibrated) with COPCs to bring the solid phase concentrations into equilibrium with the dissolved phase, groundwater, concentrations before the transport simulation is started. Outside of the model, an "Apparent K_d" was then calculated by dividing the modelled solid phase concentration for each COPC by its solution phase concentration. These K_d values are referred to as "apparent" because they are modelled and because they are derived from the modelled concentrations metals sorbed to mineral surfaces and the modelled solution phase concentrations of those metals; they do not account, for example, for metals that are present within the crystal structure of the minerals in the bedrock.

The K_ds derived from the core and groundwater data were compared to the Apparent K_ds. For the majority of the COPCs and for both the Desilicified and paleoweathered zones, the modelled solid phase concentrations and apparent K_d values were below those measured, and calculated from measured values, respectively. This indicates that the model is not overpredicting solid-phase concentrations based on sorption, nor are the apparent K_d values exceeding those reported in the literature."

It was noted that there a few were minor transcription errors in the results presented for the Desilicified Zone in Table 3-11 of Appendix 7-C. None of the corrections affect the interpretation above. The corrected table is given here (below), and will be updated in the final EIS.

Table 3-11: Solid-Phase Concentrations and Partitioning Constants for COPCs, measured and simulated (Updated)

Desilicified Zone													
	Units	As (Partial)	Cd	Co	Cr	Cu	Mo	Ni	Pb	Se (Partial)	U	V	Zn
Solid Phase Concentration - Maximum	mg/kg	8.46E+00	7.00E-01	2.25E+01	1.09E+02	1.09E+02	4.51E+00	1.58E+02	7.33E+01	4.00E-01	2.13E+02	3.71E+02	9.30E+01
Solid Phase Concentration - Minimum	mg/kg	9.00E-02	5.00E-02	1.20E-01	2.00E+00	2.00E-01	4.00E-02	1.00E+00	7.80E-01	1.00E-01	5.00E-01	1.40E+00	5.00E-01
Solid Phase Concentration - Median	mg/kg	5.60E-01	1.00E-01	4.90E-01	8.00E+00	2.00E+00	1.70E-01	6.00E+00	2.95E+00	1.00E-01	1.77E+00	7.70E+00	3.00E+00
Concentration in Representative Groundwater	mg/L	1.30E-03	1.00E-05	1.00E-04	5.00E-04	1.80E-03	4.20E-03	1.00E-04	1.00E-04	1.00E-04	7.00E-04	1.00E-04	1.20E-02
K_d - maximum value	L/kg	6.51E+03	7.00E+04	2.25E+05	2.18E+05	6.06E+04	1.07E+03	1.58E+06	7.33E+05	4.00E+03	3.04E+05	3.71E+06	7.75E+03
K_d - minimum value	L/kg	6.92E+01	5.00E+03	1.20E+03	4.00E+03	1.11E+02	9.52E+00	1.00E+04	7.80E+03	1.00E+03	7.14E+02	1.40E+04	4.17E+01
K_d - median value	L/kg	4.30E+02	1.00E+04	4.90E+03	1.60E+04	1.11E+03	4.05E+01	6.00E+03	2.95E+04	1.00E+03	2.53E+03	7.70E+04	2.50E+02
Modelled Solids Concentration **Base Case**	mg/kg	7.70E-03	1.11E-04	5.62E-03	1.90E+00	3.57E+00	5.51E-07	1.30E-02	8.68E-02	6.60E-06	7.25E-02	3.90E-07	1.37E+00
Apparent K_d value in the **Base Case** model	(L/kg)	5.92E+00	1.11E+01	5.62E+01	3.81E+03	1.98E+03	1.31E-04	1.30E+02	8.68E+02	6.60E-02	1.04E+02	3.90E-03	1.14E+02
Apparent K_d value in the model; **1/10 reactive sites**	(L/kg)	5.92E-01	1.11E+00	5.62E+00	3.81E+02	1.98E+02	1.31E-05	1.30E+01	8.68E+01	6.60E-03	1.04E+01	3.90E-04	1.14E+01
Paleoweathered Zone													
	Units	As (Partial)	Cd	Co	Cr	Cu	Mo	Ni	Pb	Se (Partial)	U	V	Zn
Solid Phase Concentration - Maximum	mg/kg	5.66E+02	8.00E+00	4.23E+02	4.41E+02	5.24E+04	3.93E+03	5.88E+02	5.15E+03	2.00E+02	5.56E+04	6.05E+03	1.58E+03
Solid Phase Concentration - Minimum	mg/kg	5.00E-01	1.00E-01	6.00E+00	6.00E+00	5.00E+00	5.00E-01	4.40E+01	1.00E+00	5.00E-01	9.00E+00	2.20E+01	7.00E+00
Solid Phase Concentration - Median	mg/kg	2.40E+01	1.00E+00	2.80E+01	1.55E+02	2.28E+02	5.00E+00	1.67E+02	4.60E+01	1.00E+00	4.03E+02	3.10E+02	3.10E+01
Concentration in Representative Groundwater	mg/L	5.00E-02	1.00E-05	1.00E-02	4.50E-03	5.00E-03	1.28E-02	1.50E-02	1.00E-04	1.00E-04	1.24E-02	1.00E-04	4.25E-03
K_d - maximum value	L/kg	1.13E+04	8.00E+05	4.23E+04	9.80E+04	1.05E+07	3.07E+05	3.92E+04	5.92E+07	2.00E+06	4.49E+06	6.05E+07	3.72E+05
K_d - minimum value	L/kg	1.00E+01	1.00E+04	6.00E+02	1.33E+03	1.00E+03	3.91E+01	2.93E+03	7.00E+04	5.00E+03	7.26E+02	2.20E+05	1.65E+03
K_d - median value	L/kg	4.80E+02	1.00E+05	2.80E+03	3.44E+04	4.56E+04	3.91E+02	1.11E+04	8.30E+05	1.00E+04	3.25E+04	3.10E+06	7.29E+03
Modelled Solids Concentration **Base Case**	mg/kg	1.87E-01	9.80E-05	4.69E-01	0.00E+00	5.30E+00	0.00E+00	2.34E+00	6.34E-02	2.87E-06	3.63E-01	0.00E+00	4.41E-01
Apparent K_d value in the **Base Case** model	(L/kg)	3.74E+00	9.80E+00	4.69E+01	0.00E+00	1.06E+03	0.00E+00	1.56E+02	6.34E+02	2.87E-02	2.93E+01	0.00E+00	1.04E+02
Apparent K_d value in the model; **1/10 reactive sites**	(L/kg)	3.74E-01	9.80E-01	4.69E+00	0.00E+00	1.06E+02	0.00E+00	1.56E+01	6.34E+01	2.87E-03	2.93E+00	0.00E+00	1.04E+01
Literature K_d values (mean value and range)[a,b]	L/kg	550 (25-3000)	15 (2.0-250)	1.9×10^3 (29-99,000)	18 (1.0-1600)	530 (760-2700)	40 (7-130)	58 (7.0-1100)	2000 (25-130,000)	56 (4-1600)	740 (2.6 - 6.2×10^4)	1.1-2.7	1.6×10^3 (6.2-30,000)

Notes

[a] Literature K_d values are for pH values ranging from 5-8 from IAEA, 2010. These values show mean values (and range). Value for Cd is for soils with pH < 6.5. Where pH dependent K_d values were not available, the mineral soil texture values were obtained. Where a K_d was not available for mineral soil, the value for "All soil" texture or "Sand" was used.

[b] Literature range of K_d values for Vanadium taken from US EPA, 2005

[c] Literature value of maximum K_d for pH values ranging from 5-7 from IAEA, 2010.

Attachment: IR-96

Number	IR-96
Dept.	CNSC
Project effects link	Geology and Groundwater
Reference to EIS, appendices, or supporting documentation	Appendix 7-C, Section 4.4.4, Sub-Domain Model Transport Boundary Conditions
Context and Rationale	**Context:** From the text, "Transport parameters were specified for diffusion (1x10-9 m2/s), longitudinal dispersivity (10 m along the plume trajectory), and transverse dispersivity (5 m)". The source of this information is not provided in Appendix 7-C. It is unclear if the values used are defaults in the modelling software, from literature, from small-scale laboratory tests, or are site-specific values determined through tracer tests. **Rationale:** The use of a calibrated flow model does not imply that the solute transport model is calibrated. The transport parameters (such as effective porosity, dispersivity and reactive transport parameters) can only be calibrated by matching simulated and observed spatial and/or temporal distributions of a solute. Sensitivity analysis indicates that decreasing longitudinal and transverse dispersivities by a factor of two resulted in exceedances of groundwater criteria for both selenium (Se) and cobalt (Co). Given the clear influence of these values on contaminant transport, it is important that transfer parameter values are justified in the solute transport model. In addition, the influence of large-scale heterogeneity on dispersion and solute transport predictions should be discussed, to identify any uncertainty in the model predictions, and provide confidence that the applied model is adequately representing groundwater flow and solute transport. Further guidance on solute transport modelling can be found in BC MOE (2012) [1]. Reference: [1] British Columbia Ministry of the Environment (BC MOE). 2012. Guidelines for Groundwater Modelling to Assess Impacts of Proposed Natural Resource Development Activities. Report no. 194001, 385 p.
Information Requirement	1. Please provide the source of the numerical value used for diffusion and longitudinal and transverse dispersivity, and provide justification if default values by the model code were used. 2. Please provide a discussion on the influence of large- scale heterogeneity on dispersion and solute transport predictions in the modelling report. See also related: IR-89

Response Part 1:

The transport parameters applied in the model were not calibrated and that is why they were: a) selected to be conservative, and b) why more conservative parameters were selected for prediction uncertainty analyses.

Diffusion rates are unknown, as is commonly the case at most sites, and so a representative literature value was selected. Matrix diffusion of mass into lower permeability zones is considered the most relevant area for diffusion; migration to Whitefish Lake is advection-dominated such that diffusion along the flow path would not appreciably enhance transport timing. Matrix diffusion was accounted for is the set-up of transport simulation parameters using PHREEQC.

Longitudinal and transverse dispersivity rates can vary greatly and are generally scale dependent. Literature references for dispersivity are noted below and used to estimate longitudinal and transverse dispersivity rates for the plume, which is estimated to have a length of 0.9 to 1.7 km. Graphic representation of the values suggested by the literature are appended.

- Gelhar et al. (1992), as quoted in the B.C. guidance (BC MOE, 2012), suggests a representative longitudinal dispersity of approximately 40 m (with a range from 10 to 150 m), and a transverse dispersivity of 5 m.
- Neuman (1995) suggests a "best fit" longitudinal dispersivity of 350 m to be consistent with field observed valued (note the range of model-calibrated values was 10 to 350 m).
- Schulze-Makuch (2005), suggests a best fit value for sandstone units of 10 to 20 m.
- Chapman et al (2014) found a longitudinal dispersivity for a site in a similar fractured sandstone environment to be 10 m for a plume 1.2 km in length. Martin et al. (2019) found the equivalent longitudinal dispersivity appropriate under dual porosity and EPM simulations was 10.7 m for the same site.

Recognizing all of this, the longitudinal dispersivity applied (i.e., 10 m) is considered reasonable, and the more conservative value of 5 m represents a reasonable lower bounding limit. Similarly, the literature supports the transverse dispersity value of 5 m applied. It was be noted that minor exceedances were noted under the lower dispersivity simulations; however, these simulations more importantly also contain conservative geochemical assumptions, such that we feel such breakthrough is unlikely.

Response Part 2:

As noted in the literature (e.g., Neuman et al., 2003; Neuman, 2006) dispersivity is expected to increase as a plume encounters heterogeneities of increasing length-scales. This is the foundation of scale-dependent dispersivity. As such, large-scale heterogeneity will enhance dispersion of the plume, and reduction of solute concentrations, as the plume gets larger and encounters heterogeneities of increasing length-scales. At the Pheonix site, and example of such large-scale features is the desilicified zone, wherein dispersion is simulated to play a role in reducing transported solute concentrations. The dispersion of solute concentrations is coupled with geochemical reactions along the plume trajectory. The plume dispersion exposes concentrations to a greater surface area of the geologic materials, which enhances the ability of geochemical processes to curtail plume migration.

References

British Columbia Ministry of the Environment (BC MOE). 2012. Guidelines for Groundwater Modelling to Assess Impacts of Proposed Natural Resource Development Activities. Report no. 194001, 385 p.

Chapman, S.W., B. Parker, J. Cherry, P. Martin, D. Abbey, S.D. McDonald. 2014. Combined EPM-DFN Modelling Approach for Plume in Sedimentary Bedrock Aquifers. DFNE 2014-236.

Gelhar, L.W., Welty, C., & Rehfeldt, K.R. (1992). A critical review of data on field-scale dispersion in aquifers. Water Resources Research 28, no. 7, 1955-1974.

Martin, P.J., B. Parker, S. Chapman, and K. Walton. 2019. Utilizing the DFN-M Framework to Inform Transport Modelling. Presentation to the American Geophysical Union (AGU).

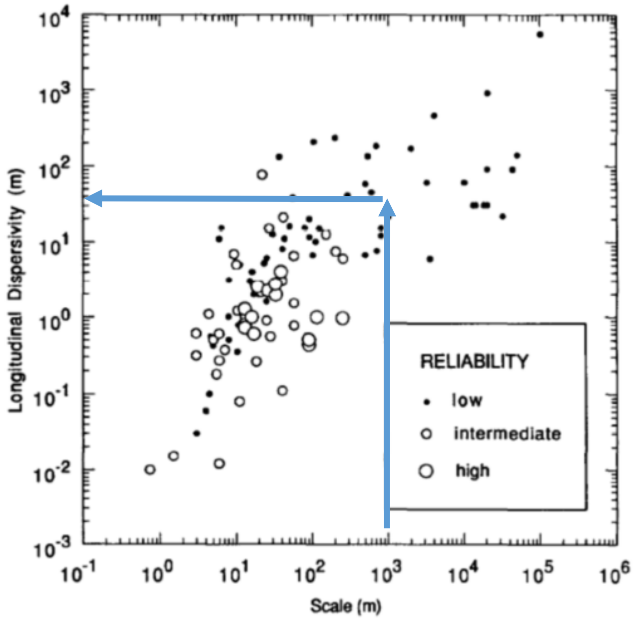
Neuman, S.P. 1990. Universal scaling of hydraulic conductivities and dispersivities in geologic media. Water Resources Research 26, no. 8: 1749–1758.

Neuman, S.P. 1995. On advective dispersion in fractal velocity and permeability fields. Water Resources Research 31, no. 6: 1455–1460.

Neuman, S.P., and V. Di Federico. 2003. Multifaceted nature of hydrogeologic scaling and its interpretation. Reviews of Geophysics 41, no. 3: 1014.

Neuman, S.P. 2006. Response to paper: Longitudinal Dispersivity Data and Implications for Scaling Behavior. GROUND WATER 44, no. 2: 139–141.

Schulze-Makuch, D. 2005. Longitudinal Dispersivity Data and Implications for Scaling Behavior. GROUND WATER 43, no. 3: 443–456.



(b)

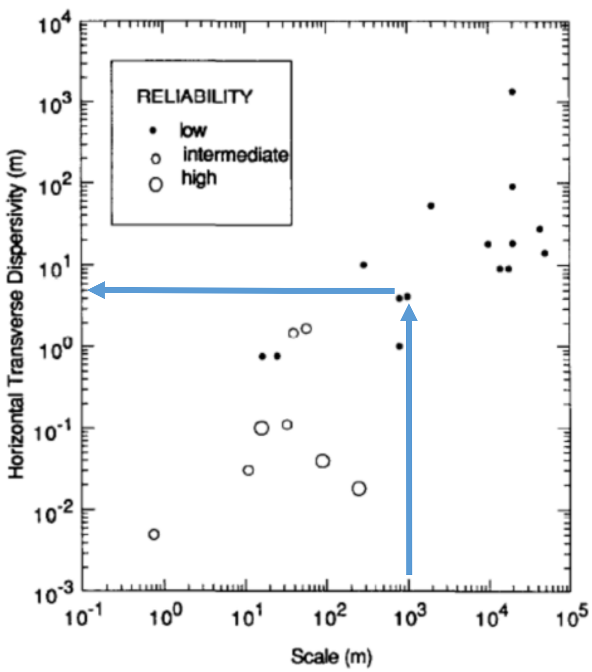


Figure 9-5: (a) Longitudinal dispersivity versus scale with data classified by reliability and (b) horizontal transverse dispersivity as a function of observation scale (from Gelhar et al., 1992).

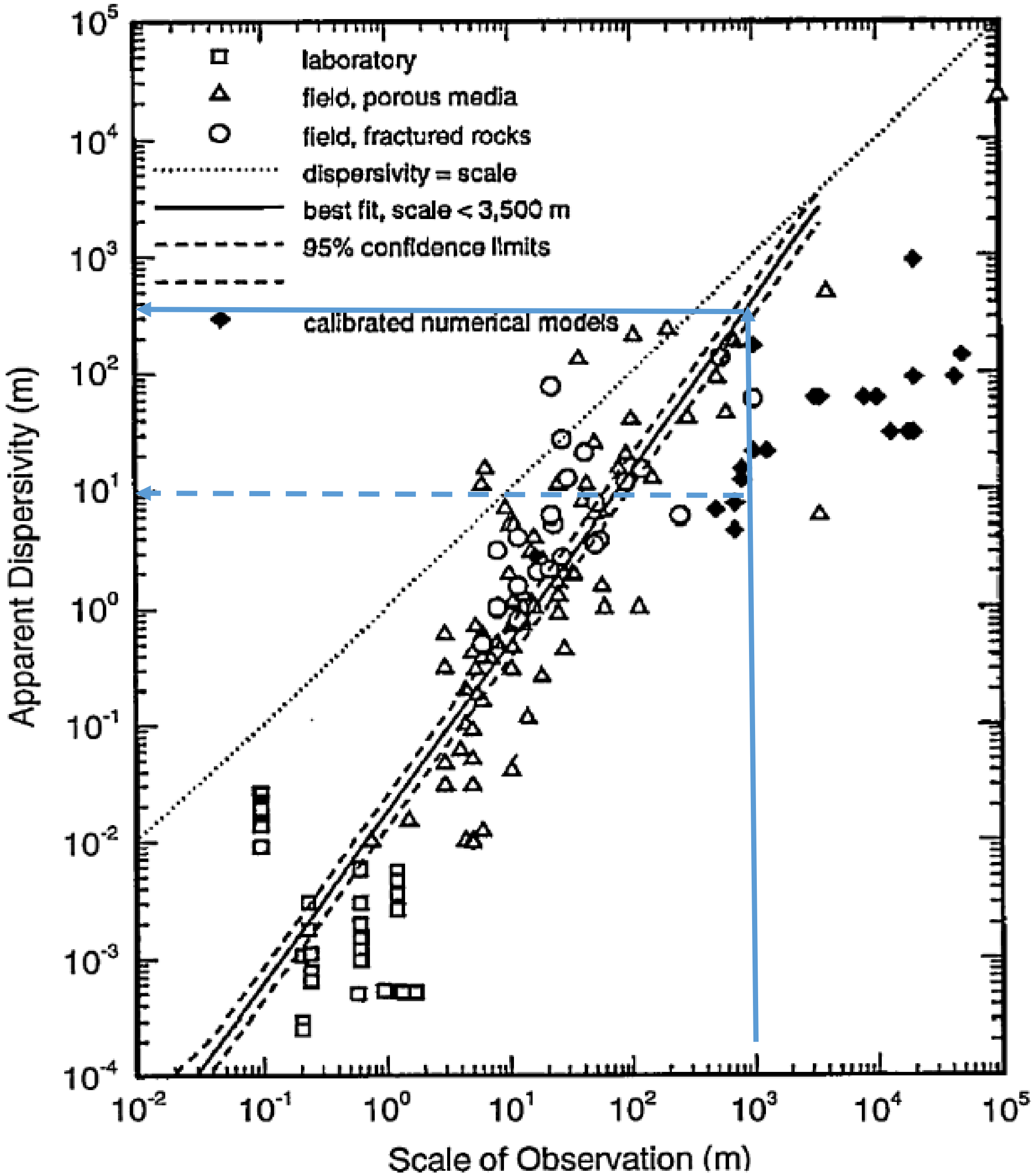


Figure 1. Apparent longitudinal dispersivities vs. scale of observation based on worldwide tracer studies (after Neuman 1995).

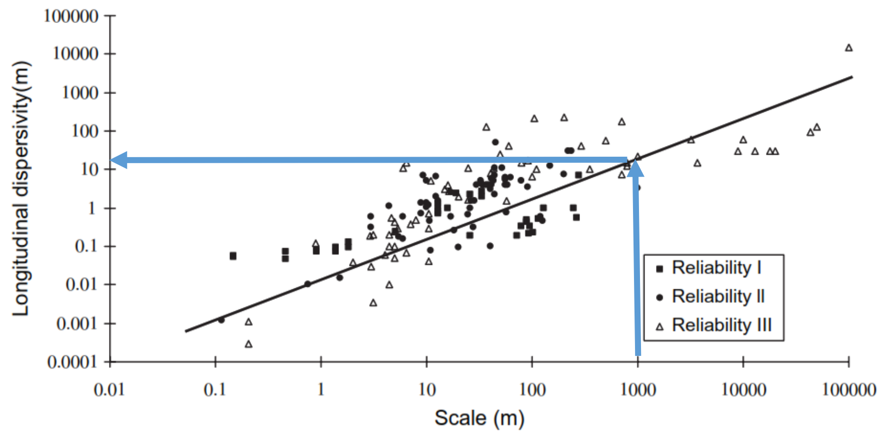


Figure 1. Relationship of longitudinal dispersivity to scale of measurement for unconsolidated sediments. The line represents the regression line for all data points (regardless of assigned reliability class) with a scaling exponent of 0.81 and a *c* value of 0.085 m.

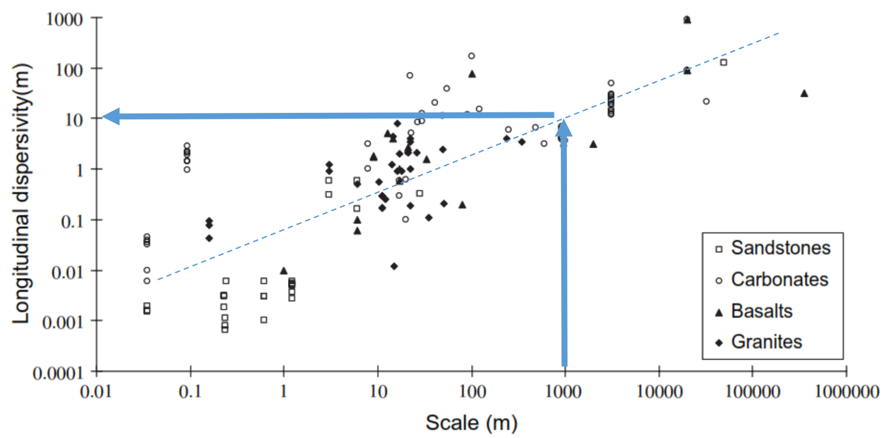


Figure 2. Relationship of longitudinal dispersivity to scale of measurement for various rock types. The scaling behavior for each rock type is quantified in Table 3.

Attachment: IR-99

Number	IR-99
Dept.	CNSC
Project effects link	Aquatic environment
Reference to EIS, appendices, or supporting documentation	Section 8, Water Quality, Table 8.2-13
Context and Rationale	Context: Table 8.2-13 shows the maximum concentration of hazardous and radiological COPC's in surface water throughout the local study area. However, the concentration for all constituents is stated as mg/L. Rationale: It is unusual for radiological COPC's to be displayed in mg/L, radiological constituents are typically displayed in Bq/L.
Information Requirement	Please use Bq/L when displaying concentration of radiological COPC's. If this was a typographical error in the table, please indicate as such and revise the table to indicate values are indeed in Bq/L. Please also review other tables displaying concentrations of radiological constituents to ensure this error is not repeated in other tables.

Revised Table 8.2-13 to support response in IR table:

Table 8.2-13: Maximum Concentration of Surface Water Constituents of Potential Concern in Surface Water (Updated)

Location	Maximum Concentration (mg/L) of Non-radionuclides in Surface Waters During Project Phases										
	Arsenic	Cadmium	Chloride	Cobalt	Chromium	Copper	Molybdenum	Sulphate	Selenium	Uranium	Zinc
Kratchkowsky Lake	1.19E-04	2.38E-05	3.22E-01	1.01E-04	5.30E-04	6.22E-04	1.07E-04	6.87E-01	3.35E-05	3.12E-05	7.00E-04
Whitefish Lake North	1.10E-04	2.34E-05	3.22E-01	1.01E-04	5.24E-04	6.20E-04	1.07E-04	6.87E-01	3.28E-05	3.05E-05	6.89E-04
Whitefish Lake Middle	1.46E-04	3.97E-05	6.53E+00	1.29E-04	7.46E-04	8.22E-04	2.43E-02	5.80E+01	4.33E-04	5.74E-04	1.06E-03
Whitefish Lake South	1.49E-04	3.86E-05	6.50E+00	1.28E-04	7.30E-04	8.17E-04	2.39E-02	5.78E+01	4.12E-04	5.46E-04	1.03E-03
McGowan Lake	1.26E-04	3.27E-05	4.46E+00	1.19E-04	6.53E-04	7.50E-04	1.57E-02	3.89E+01	2.58E-04	3.37E-04	9.00E-04
Icelander River	1.26E-04	3.26E-05	4.42E+00	1.19E-04	6.52E-04	7.48E-04	1.56E-02	3.85E+01	2.56E-04	3.33E-04	8.98E-04
Russell Lake Inlet	1.22E-04	3.01E-05	3.46E+00	1.14E-04	6.17E-04	7.17E-04	1.18E-02	2.97E+01	1.95E-04	2.51E-04	8.40E-04

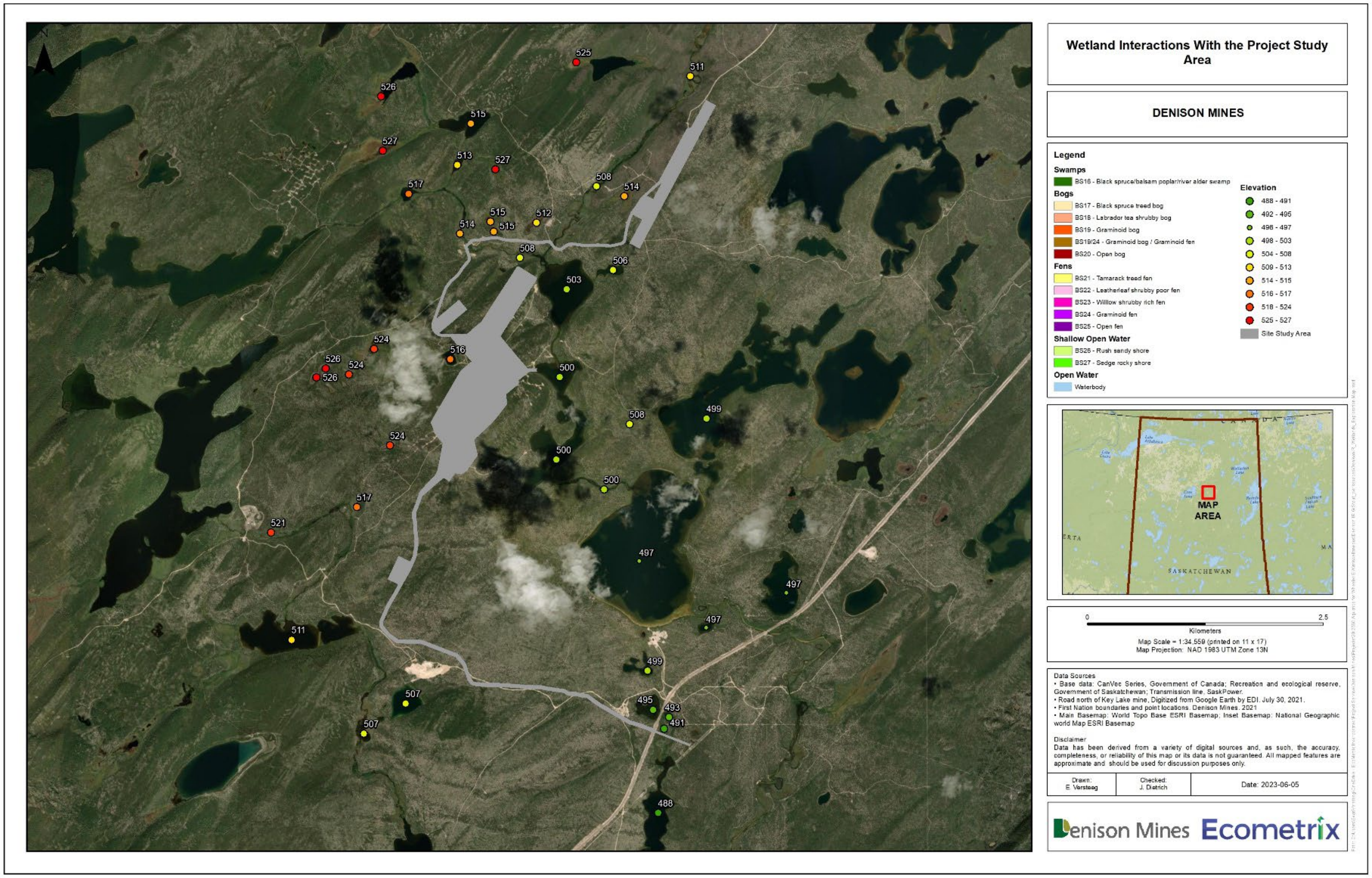
Location	Maximum Concentration (Bq/L) of Radionuclides in Surface Waters During Project Phases					
	Uranium-238	Uranium-234	Thorium-230	Radium-226	Lead-210	Polonium-210
Kratchkowsky Lake	3.85E-04	3.85E-04	1.01E-02	5.70E-03	6.22E-03	6.33E-03
Whitefish Lake North	3.77E-04	3.77E-04	1.01E-02	5.63E-03	5.68E-03	5.78E-03
Whitefish Lake Middle	7.05E-03	7.05E-03	1.87E-02	6.87E-03	8.35E-03	6.71E-03
Whitefish Lake South	6.71E-03	6.71E-03	1.85E-02	6.73E-03	8.25E-03	7.22E-03
McGowan Lake	4.14E-03	4.14E-03	1.57E-02	6.32E-03	6.68E-03	6.23E-03
Icelander River	4.10E-03	4.10E-03	1.56E-02	6.32E-03	6.66E-03	6.20E-03
Russell Lake Inlet	3.08E-03	3.08E-03	1.43E-02	6.14E-03	6.41E-03	6.16E-03

Attachment: IR-101

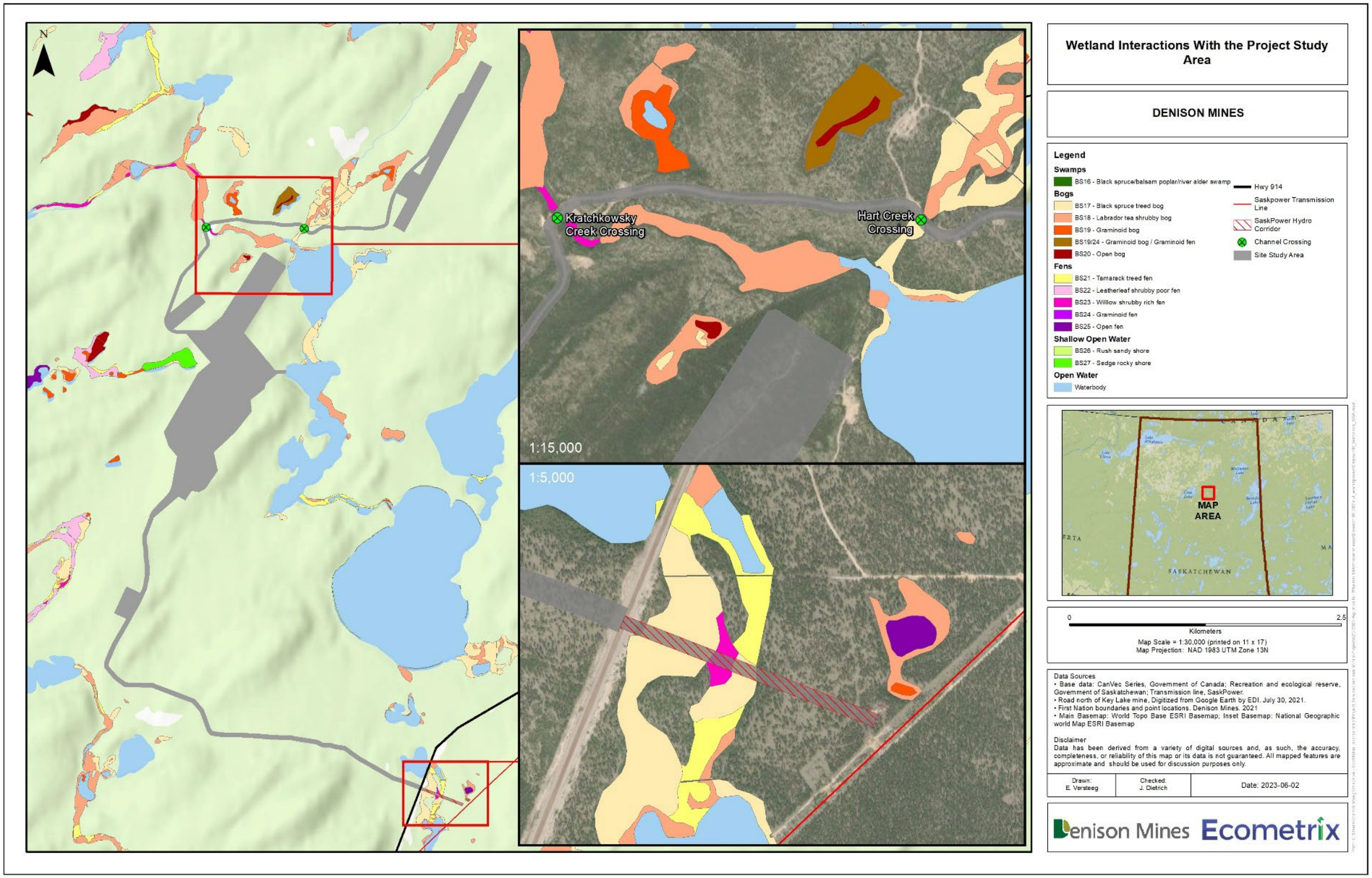
Number	IR-101
Dept.	ECCC
Project effects link	Fish and fish habitat
Reference to EIS, appendices, or supporting documentation	Section 8.1.1.3, Section 8.2.1.3 Aquatic Environment
Context and Rationale	**Context:** In Section 8.1.1.3 Spatial and Temporal Boundaries the Project Area, Local Study Area (LSA) and Regional Study Area (RSA) are established as they pertain to surface water quantity. The same is done in Section 8.2.1.3 for surface water quality. In Section 8.1.1.3 Figure 8.1-4, the locations of the Project Area, LSA, RSA and surface water features and monitoring stations are provided. However, the locations of wetlands located near the Project area and within the LSA and RSA have not been provided. The location of wetlands within or near the Project footprint, as well as the other wetlands existing within the LSA can be confirmed from Part II_S9 Terrestrial Environment, Section 9.2.3.3 Figure 9.2.-8, including the wetland classifications. There appears to be at least one shallow open water wetland and several bogs located within the Project Area. There is no consideration of wetlands or potential effects to wetland hydrology, surface water or sediment quality throughout the aquatic environment assessments. There is no baseline information regarding wetlands and their status as fish habitat and ecological function, or assessment of potential effects to flow rates, water levels, water quality, sediment quality, or biota. **Rationale:** There is currently not enough information provided for ECCC to provide advice on the potential risks of the proposed Project to wetland hydrology, surface water and sediment quality within the LSA. This pathway of effects is important to assess in terms of potential effects to wetland habitat availability and quality due to changes in flow rates, water levels, water quality, sediment transport, sediment quality and potential effects to terrestrial and aquatic receptors. It is necessary to evaluate if changes in groundwater and surface water runoff flows and routing will affect water levels and habitat availability within wetlands. Potential effects from COPCs and radionuclides to surface water and sediment, or potential effects to ecological receptors within wetlands have not been evaluated.
Information Requirement	1) Provide baseline information regarding wetland characterization within the Project Area and LSA, including: locations, wetland type, size, water surface elevation, depth, water flow pathways, and the presence of

	wildlife receptors including presence of fish/fish habitat within the Aquatic Environment section of the draft EIS. If this information is available in annexes or baseline studies, summarize it within the main body of the Aquatic Environment section of the draft EIS with references to respective documents for review. 2) Provide baseline information on wetland surface water and sediment quality characterization for wetlands within the Project footprint. 3) Provide an assessment of potential effects to wetlands within the LSA and potential effects to ecological receptors during all phases of the proposed Project. 4) Provide further information on mitigation measures and monitoring that would be applied for the protection of wetlands.

Supporting figures to the response provided in table:



Attachment IR-101 Figure 1 – Elevations of Wetland Features in the LSA.



Attachment IR-101 Figure 2: Denison Wheeler River Project SSA and Wetland Feature Distribution

Attachment: IR-102

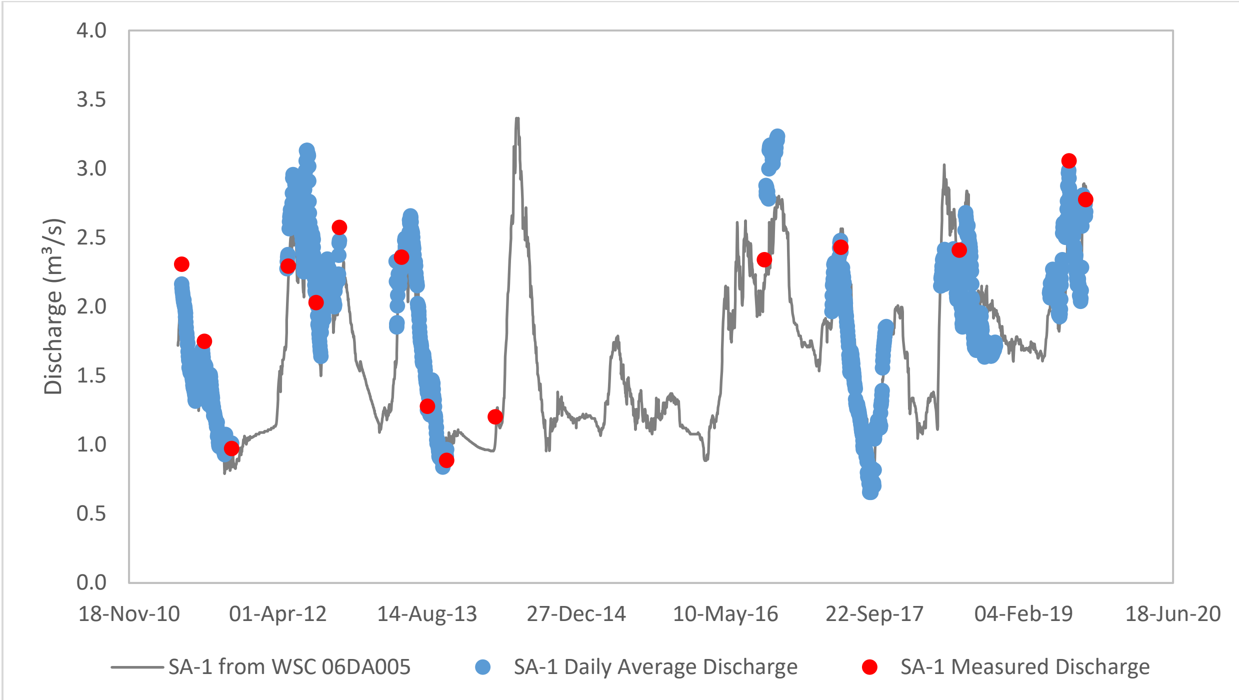
Number	IR-102
Dept.	ECCC
Project effects link	Fish and fish habitat
Reference to EIS, appendices, or supporting documentation	8.1.3.1 Appendix 8-C, including Appendix II, Table 1 (p. 2)
Context and Rationale	**Context:** Only one measured-results dataset for baseline stream flow exists that is relevant to the Project data from the Water Survey of Canada (WSC) station for Wheeler River (06DA005), and the Proponent used constructed records. The Proponent states that data from 06DA005 was used to extend local hydrometric station records and calculate baseline water quantity metrics. However, this was done through a complex combination of daily data correlation or monthly unit area runoff relationship, with or without offset, where some stations were based off constructed records instead of the real long-term dataset at 06DA005 (see Section 8.1.3.1 and Appendix II of Appendix 8-C, Table 1, p.2 (PDF p. 569)). Appendix 8-C references previous reports in its own appendices, but no equations are shown and there is no description of the accuracy of the fit, or explanation for not referring back to the one dataset (WSC station). Subsequent statistics calculated from these constructed records (e.g., 7Q10 needed for SK water licenses) would be affected by this uncertainty. **Rationale:** Fish habitat can be altered by changes to depositional and erosional patterns in streams. Confidence in the Proponent's estimate of baseline water quantity, and by extension Project effects to fish habitat, cannot be established without a complete description of the method applied, as well as a discussion of its accuracy.
Information Requirement	1. Provide more information on the extension of Project hydrometric station data using WSC station 06DA005. 2. Discuss the accuracy of any correlations/relationships and justify any deviations from simple unit area runoff relationships in the estimation of baseline water quantity values for the Project hydrometric stations. Constructing records from records that are themselves constructed is not recommended. 3. If baseline water quantity metrics need to be revised, discuss (if any) resulting changes to the effects assessment.

Supporting information to the response provided in table:

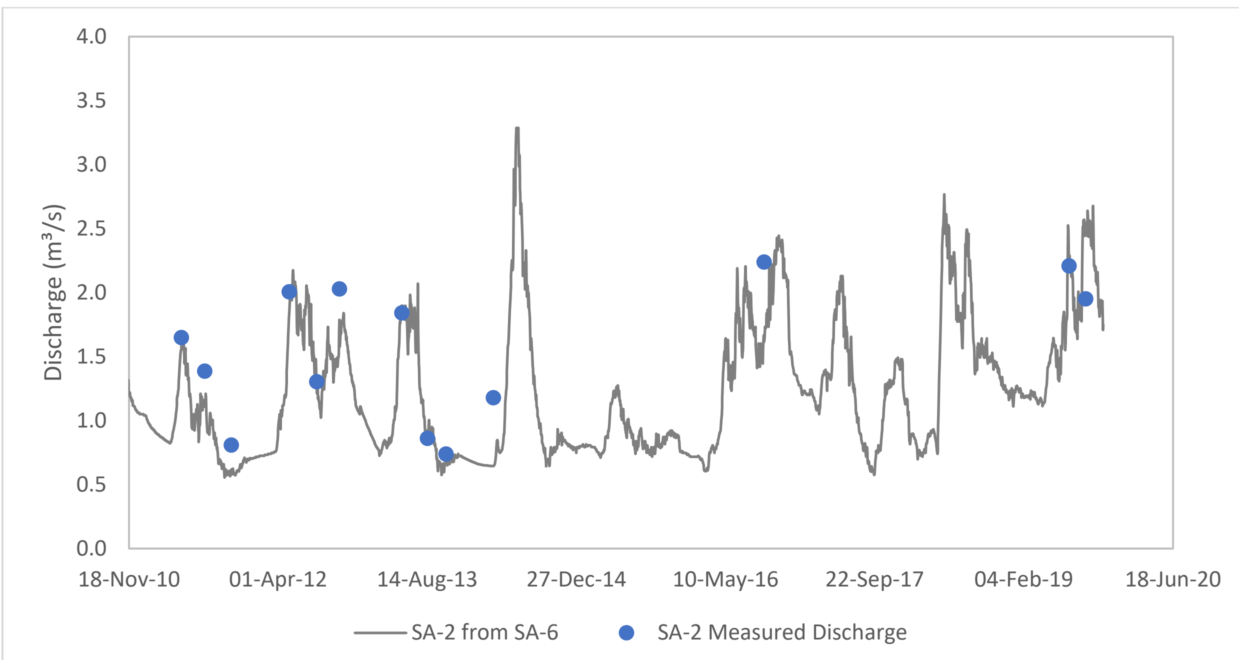
Attachment IR-102 Table 1: Record Extension Variables

Assessment Node (AN)	Assessment Node Drainage Area (km²)	Source Station (SS)	Source Station Drainage Area (km²)	Extension Method	Equation Parameters: QAN = A(B+C(QSS+D)E)				
					A	B	C	D	E
SA-1	280.55	06DA005	3030	Correlation	7.1250E-01	0.0000E+00	1.3029E-01	0.0000E+00	1.0599E+00
SA-2	257.36	SA-6	251.69	Unit Area Runoff with Scaling and Offset	1.0000E+00	-6.2600E-02	1.0708E+00	0.0000E+00	1.0000E+00
SA-3	15.537	SA-1	280.55	Unit Area Runoff with Scaling	1.0000E+00	0.0000E+00	2.3453E-01	0.0000E+00	1.0000E+00
SA-4	80.498	SA-6	251.69	Correlation	7.6738E-01	0.0000E+00	3.4997E-01	0.0000E+00	9.0494E-01
SA-5	167.32	SA-6	251.69	Unit Area Runoff	6.6479E-01	0.0000E+00	1.0000E+00	0.0000E+00	1.0000E+00
SA-6/LA-6	251.69	SA-1	280.55	Correlation	8.0221E-01	3.3463E-01	2.1528E-01	5.3078E-01	2.0643E+00
SB-3	24.869	SA-1	280.55	Unit Area Runoff	8.8644E-02	0.0000E+00	1.0000E+00	0.0000E+00	1.0000E+00
LA-1	277.52	SA-1	280.55	Unit Area Runoff	9.8920E-01	0.0000E+00	1.0000E+00	0.0000E+00	1.0000E+00
LA-5	257.18	SA-2	257.36	Unit Area Runoff	9.9930E-01	0.0000E+00	1.0000E+00	0.0000E+00	1.0000E+00

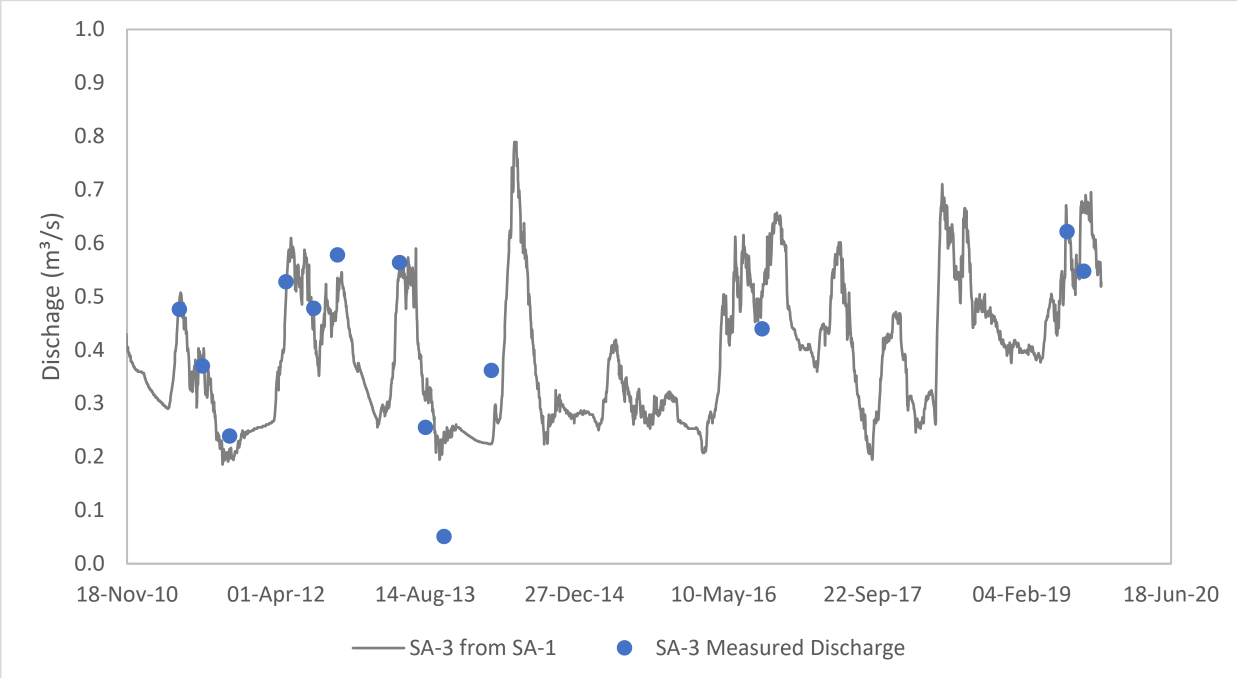
Attachment IR-102 Figure 1: SA-1 from WSC 06DA005



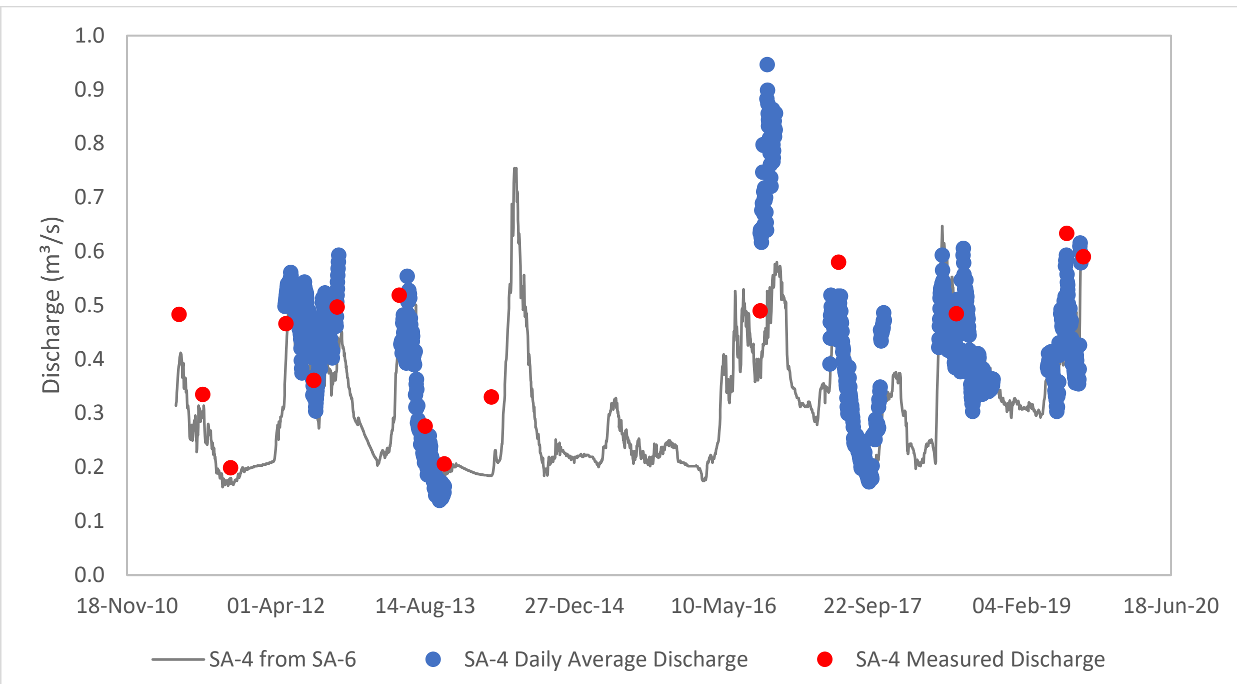
Attachment IR-102 Figure 2: SA-2 from SA-6



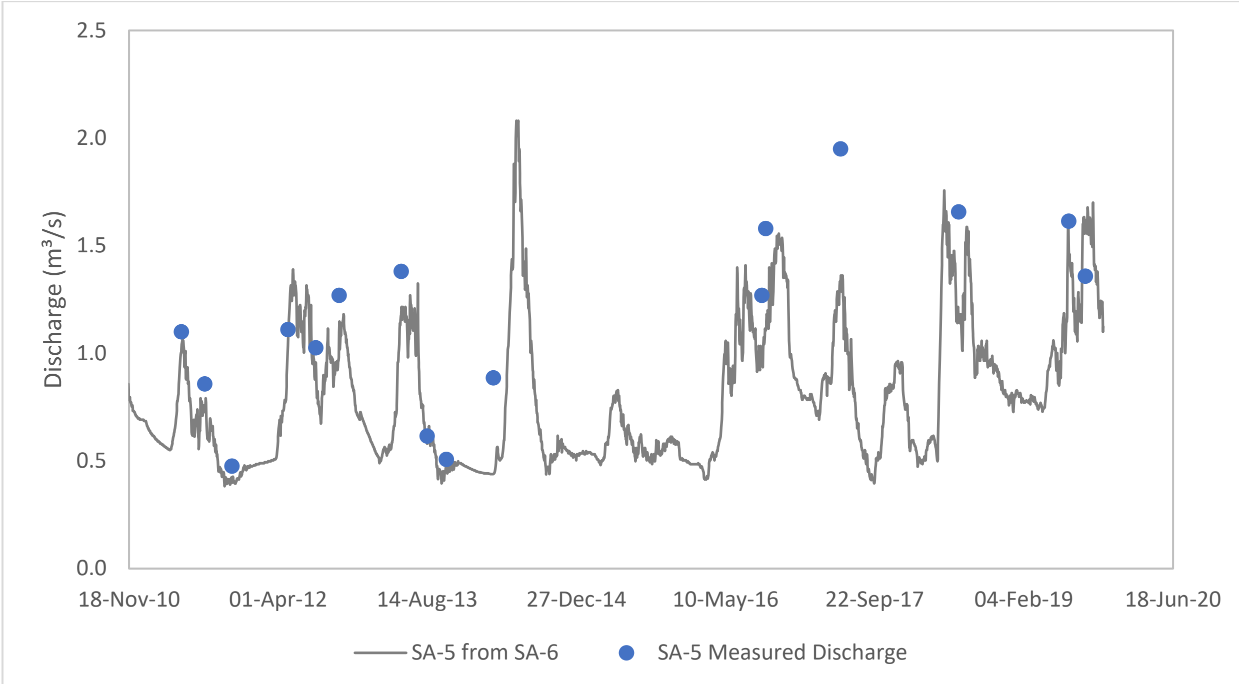
Attachment IR-102 Figure 3: SA-3 from SA-1



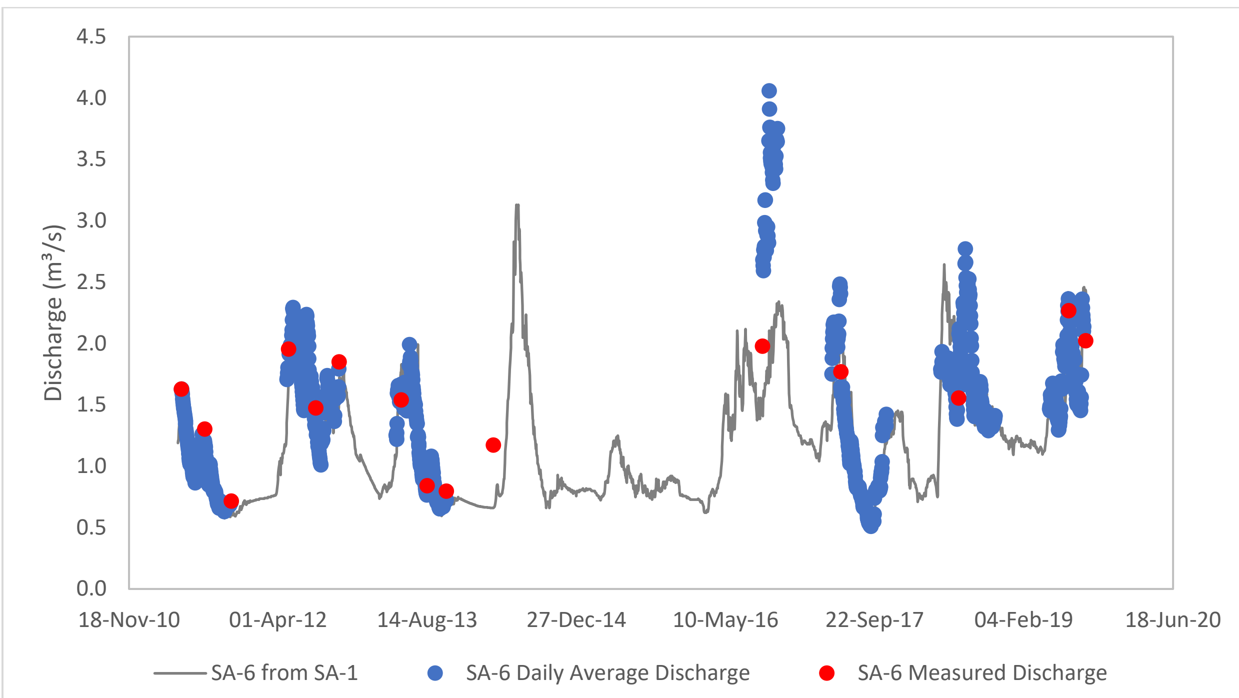
Attachment IR-102 Figure 4: SA-4 from SA-6



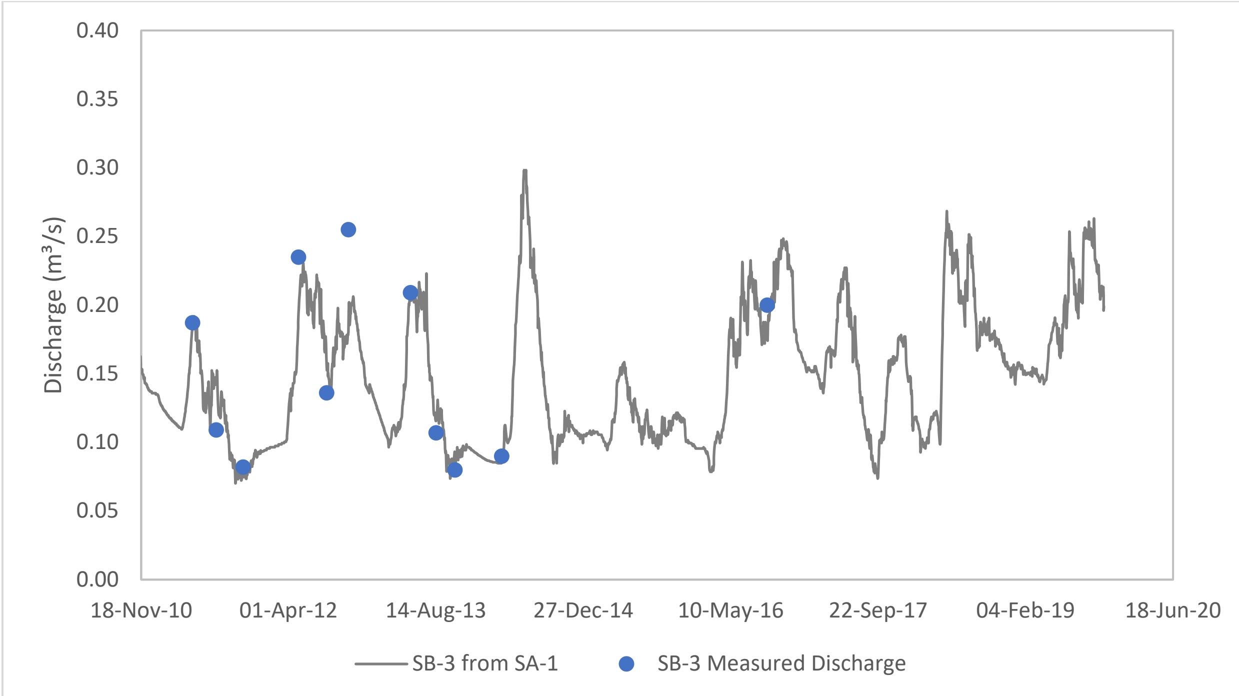
Attachment IR-102 Figure 5: SA-5 from SA-6



Attachment IR-102 Figure 6: SA-6 from SA-1



Attachment IR-102 Figure 7: SB-3 from SA-1



Attachment: IR-108

Number	IR-108
Dept.	ECCC
Project effects link	Fish and fish habitat
Reference to EIS, appendices, or supporting documentation	Section 8.2.3.3 Aquatic Environment
Context and Rationale	Context: Tables 8.2-2 and 8.2-3 provide summaries of the baseline surface water quality in the LSA. No justifications for the selection of water quality guidelines have been provided. COPCs that require calculations based on other parameters such as hardness, pH, or temperature to derive guidelines (i.e., ammonia, cobalt, zinc, etc.) should be indicated within the table, with a note specifying the parameter values used in the calculations, so that thresholds may be confirmed. No baseline data for un-ionized ammonia has been provided, which is a Schedule 4 substance requiring monitoring under the MDMER. For cobalt, manganese, and vanadium, Federal Environmental Quality Guidelines (FEQGs) and/or CCME Canadian Water Quality Guidelines (CWQGs) for the Protection of Aquatic Life have not been included. A guideline of 26 mg/L has been provided for molybdenum as a Saskatchewan Environmental Quality Guidelines (SEQG), however the actual SEQG is 31 mg/L and the CCME CWQG is 0.073 mg/L. Rationale: In order to assess potential changes to surface water quality from Project related activities, ECCC requires that data on all parameters that require MDMER effluent and receiving environment monitoring be provided for assessment, including accurate water quality guidelines where available.
Information Requirement	1. Update Tables 8.2-2 and 8.2-3 to include all COPCs that require effluent characterization and receiving environment monitoring under the MDMER. 2. Update Tables 8.2-2 and 8.2-3 to include missing or corrected water quality guidance thresholds, and information on values used to derive thresholds for COPCs that are dependent on general parameters.

Response:

Tables 8.2-2 and 8.2-3 will be updated in the final EIS to include 1) all COPCs that require effluent characterization and receiving environment monitoring under the MDMER and 2) missing or corrected water quality guidance thresholds, and information on values used to derive thresholds for COPCs that are dependent on general parameters. The updated EIS tables are provided below for completeness.

Table 8.2-2: Baseline Surface Water Quality in Local Study Area Lakes and Russell Lake (Updated)

Parameter	Units	Benchmark		McGowan Lake (LA-1)			Whitefish Lake South (LA-5)			Whitefish Lake North (LA-6)		
		Value	Reference	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Alkalinity	mg/L			2	10	6	3	13	7.7	3	38	15
Aluminum	mg/L	0.005	SEQG	0.001	**0.0051**	0.0034	0.0048	**0.0078**	**0.0061**	0.005	**0.073**	**0.0201**
Ammonia as N	mg/L	5.7	SEQG	<0.01	0.09	0.0266	<0.01	0.07	0.043	<0.01	0.05	0.026
Ammonia, *unionized	ug/L	19	CWQG	*0.008*	*0.072*	*0.0229*	*0.013*	*0.105*	*0.0543*	0.005	0.036	0.0164
Antimony	mg/L			<0.0002	<0.0002	<0.0002	<0.0002	0.0003	0.000233	<0.0002	<0.0002	<0.0002
Arsenic	mg/L	0.005	SEQG	<0.0001	<0.0001	<0.0001	0.0001	0.0001	<0.0001	0.0001	0.0001	<0.0001
Barium	mg/L			0.0023	0.0038	0.003	0.0021	0.0032	0.0027	0.0024	0.0051	0.00328
Beryllium	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bicarbonate	mg/L			2	12	7.8	4	16	9.3	4	46	13.4
Boron	mg/L	1.5	CWQG	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	mg/L	0.00004	CWQG	<0.00001	0.00003	0.000015	<0.00001	0.00002	0.000013	<0.00001	0.00004	0.000016
Calcium	mg/L			1.1	1.7	1.35	1.2	1.6	1.4	1.1	1.5	1.24
Carbonate	mg/L			<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloride	mg/L	120	CWQG	0.4	0.5	0.43	0.3	0.4	0.33	0.3	0.4	0.32
Chromium	mg/L	0.001	CWQG	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Cobalt	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Copper	mg/L	0.002	CWQG	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0004	0.00024
DOC	mg/L			2	2.6	2.23	2	2.5	2.2	2	2.5	2.22
Diss. Phosphorus	mg/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoride	mg/L	0.12	CWQG	<0.01	0.08	0.03166	0.02	0.07	0.037	0.02	0.08	0.042
Hardness	mg/L			5	6	5.5	5	6	5.3	5	5	5
Hydroxide	mg/L			<1	<1	<1	<1	<1	<1	<1	<1	<1
Iron	mg/L	0.3	SEQG	0.037	0.27	0.12	0.04	0.19	0.11	0.031	0.21	0.1064
Lead	mg/L	0.001	CWQG	<0.0001	0.0004	0.00015	<0.0001	<0.0001	<0.0001	<0.0001	**0.0012**	0.00032
Lead-210	Bq/L			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Magnesium	mg/L			0.3	0.5	0.42	0.4	0.4	0.4	0.2	0.4	0.36

Parameter	Units	Benchmark		McGowan Lake (LA-1)			Whitefish Lake South (LA-5)			Whitefish Lake North (LA-6)		
		Value	Reference	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Manganese	mg/L			0.0039	0.029	0.016	0.0046	0.02	0.0142	0.0024	0.019	0.01232
Mercury	mg/L	2.60E-05	CWQG	1.00E-07	1.00E-05	6.00E-06	1.00E-06	1.00E-05	7.00E-06	1.00E-07	1.00E-05	6.00E-06
Molybdenum	mg/L	26	SEQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	0.025	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0004	0.00016
Nitrate	mg/L	13.29	SEQG	<0.04	0.49	0.18	<0.04	0.26	0.15	<0.04	0.31	0.1725
P. Alkalinity	mg/L			<1	<1	<1	<1	<1	<1	<1	<1	<1
pH	units	6.5–9	CWQG	6.52	6.94	6.77	6.6	7	6.8	**5.71**	6.79	6.502
Phosphorus	mg/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Polonium-210	Bq/L			<0.005	<0.005	<0.005	<0.005	0.008	0.006	<0.005	<0.005	<0.005
Potassium	mg/L			0.2	0.5	0.37	0.2	0.4	0.33	0.2	0.4	0.32
Radium-226	Bq/L	0.11	SSWQO	<0.005	<0.005	<0.005	<0.005	0.01	0.0076667	<0.005	<0.005	<0.005
Selenium	mg/L	0.001	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Silver	mg/L	0.0001	CWQG	<0.00005	<0.00005	<0.00005	0.00005	0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Sodium	mg/L			1.4	1.8	1.5	1.4	1.7	1.5	1.4	1.8	1.52
Conductivity	µS/cm			9	24	16.8	16	22	19	9	21	15.2
Strontium	mg/L			0.012	0.016	0.014	0.012	0.015	0.013	0.011	0.014	0.0126
Sulphate	mg/L	128	SEQG	0.7	0.8	0.75	0.6	0.7	0.63	0.5	0.7	0.64
Sum of Ions				6	18	12.5	8	22	14	8	51	18
Thallium	mg/L	0.0008	CWQG	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Thorium-228	Bq/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium-230	Bq/L			<0.01	<0.01	<0.01	<0.01	0.02	0.0133	<0.01	<0.01	<0.01
Thorium-232	Bq/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tin	mg/L			<0.0001	0.0013	0.0004	<0.0001	0.0008	0.00033	<0.0001	0.0011	0.0003
Titanium	mg/L			<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
TDS	mg/L			18	26	22.167	22	29	24	14	29	22.2
TKN	mg/L			0.17	0.38	0.27333	0.14	0.34	0.22	0.24	0.43	0.306
TOC	mg/L			2.2	2.6	2.3667	1.9	4.3	2.8	2.2	2.9	2.36
TSS	mg/L			<1	4	2.5	<1	4	2.66	<1	4	2

Parameter	Units	Benchmark		McGowan Lake (LA-1)			Whitefish Lake South (LA-5)			Whitefish Lake North (LA-6)		
		Value	Reference	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Uranium	mg/L	0.015	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Zinc	mg/L	0.03	CWQG	<0.0005	0.001	0.00058	<0.0005	<0.0005	<0.0005	<0.0005	0.02	0.00474

Table 8.2-2 (Continued)

Parameter	Units	Benchmark		Russell Lake (LAB-1)			Russell Lake (LAB-2)			LB-2		
		Value	Reference	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Alkalinity	mg/L			2	14	7.7	8	8	8	7	12	9.5
Aluminum	mg/L	0.005	SEQG	0.0023	0.0025	0.0024	0.0029	0.0029	0.0029	**0.0067**	**0.0096**	**0.0082**
Ammonia as N	mg/L	5.7	SEQG	<0.01	0.05	0.0233	<0.01	<0.01	<0.01	<0.01	0.04	0.025
Ammonia, *unionized	ug/L			0.016	0.055	0.0303	0.033	0.033	0.033	0.011	0.028	0.0195
Antimony	mg/L			<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic	mg/L	0.005	SEQG	0.0001	0.0001	<0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Barium	mg/L			0.0033	0.0039	0.0036	0.0034	0.0034	0.0034	0.0033	0.0046	0.004
Beryllium	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bicarbonate	mg/L			2	17	9	10	10	10	8	15	12
Boron	mg/L	1.5	CWQG	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	mg/L	0.00004	CWQG	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Calcium	mg/L			2.7	3.9	3.5	3.5	3.5	3.5	1.3	1.8	1.6
Carbonate	mg/L			<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloride	mg/L	120	CWQG	<0.1	0.5	0.3333333	0.4	0.4	0.4	0.2	0.2	0.2
Chromium	mg/L	0.001	CWQG	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Cobalt	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Copper	mg/L	0.002	CWQG	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
DOC	mg/L			2.1	2.5	2.3	2.2	2.2	2.2	2.6	3.5	3.1
Diss. Phosphorus	mg/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	0.02
Fluoride	mg/L	0.12	CWQG	0.02	0.07	0.04	0.03	0.03	0.03	<0.01	0.07	0.04

Parameter	Units	Benchmark		Russell Lake (LAB-1)			Russell Lake (LAB-2)			LB-2		
		Value	Reference	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Hardness	mg/L			9	13	11	12	12	12	5	6	5.5
Hydroxide	mg/L			<1	<1	<1	<1	<1	<1	<1	<1	<1
Iron	mg/L	0.3	SEQG	0.056	0.08	0.070667	0.039	0.039	0.039	0.15	0.15	0.15
Lead	mg/L	0.001	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Lead-210	Bq/L			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Magnesium	mg/L			0.5	0.7	0.6	0.7	0.7	0.7	0.4	0.4	0.4
Manganese	mg/L			0.029	0.064	0.045	0.019	0.019	0.019	0.0094	0.037	0.0232
Mercury	mg/L	2.60E-05	CWQG	1.00E-06	1.00E-05	7.00E-06	1.00E-07	1.00E-07	1.00E-07	1.00E-06	1.00E-05	5.50E-06
Molybdenum	mg/L	26	SEQG	0.0003	0.0013	0.00077	0.0011	0.0011	0.0011	<0.0001	<0.0001	<0.0001
Nickel	mg/L	0.025	CWQG	0.0001	0.0001	<0.0001	0.0003	0.0003	0.0003	0.0001	0.0002	0.00015
Nitrate	mg/L	13.29	SEQG	0.05	0.44	0.25	0.05	0.05	0.05	<0.04	0.66	0.35
P. Alkalinity	mg/L			<1	<1	<1	<1	<1	<1	<1	<1	<1
pH	units	6.5–9	CWQG	6.7	7	6.9	7.2	7.2	7.2	6.7	6.8	6.8
Phosphorus	mg/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Polonium-210	Bq/L			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Potassium	mg/L			0.3	0.6	0.5	0.8	0.8	0.8	0.2	0.4	0.3
Radium-226	Bq/L	0.11	SSWQO	<0.005	0.006	0.0053333	0.007	0.007	0.007	<0.005	0.008	0.0065
Selenium	mg/L	0.001	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Silver	mg/L	0.0001	CWQG	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Sodium	mg/L			1.7	2	1.8	1.7	1.7	1.7	1.4	1.6	1.5
Conductivity	µS/cm			30	47	38	42	42	42	20	22	21
Strontium	mg/L			0.017	0.018	0.017	0.016	0.016	0.016	0.013	0.016	0.0145
Sulphate	mg/L	128	SEQG	3.7	8.1	6.5	8.3	8.3	8.3	0.5	0.8	0.65
Sum of Ions				18	28	23	25	25	25	12	21	16.5
Thallium	mg/L	0.0008	CWQG	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Thorium-228	Bq/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium-230	Bq/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium-232	Bq/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Parameter	Units	Benchmark		Russell Lake (LAB-1)			Russell Lake (LAB-2)			LB-2		
		Value	Reference	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Tin	mg/L			<0.0001	0.001	0.0004	<0.0001	<0.0001	<0.0001	<0.0001	0.0008	0.00045
Titanium	mg/L			<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
TDS	mg/L			30	35	32	35	35	35	19	30	24.5
TKN	mg/L			0.14	0.22	0.17	0.29	0.29	0.29	0.13	0.35	0.24
TOC	mg/L			2.2	2.6	2.4	2.2	2.2	2.2	2.7	3.6	3.2
TSS	mg/L			1	1	<1.0	4	4	4	<1	<1	<1
Uranium	mg/L	0.015	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Zinc	mg/L	0.03	CWQG	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0018	0.00115

Notes:

Green-highlighted cells indicate values that fall below the analysis detection limit.

Bold values indicate metrics that exceed benchmark values.

Italicized values include a temperature point estimated from an adjacent water body taken in the same season

Blank cells in the "benchmark" column indicate parameters without a prescribed benchmark at this time

SEQG – Saskatchewan Environmental Quality Guidelines – Water Quality Guidelines for Freshwater Aquatic Life.

CWQG – Canadian Council of Ministers of the Environment – Canadian Water Quality Guidelines for the Protection of Aquatic Life.

SSWQO – Saskatchewan Surface Water Quality Objectives.

DOC – Dissolved organic carbon.

TDS – Total dissolved solids.

TKN – Total Kjeldahl Nitrogen.

TOC – Total organic carbon.

TSS – Total suspended solids.

Table 8.2-3: Baseline Surface Water Quality in Local Study Area Watercourses (Updated)

Parameter	Units	Benchmark		Icelander River (SA-1)			SA-2			SA-3	
		Value	Reference	Min	Max	Mean	Min	Max	Mean	Min	Max
Alkalinity	mg/L			2	13	5.5	2	11	6.75	1	23
Aluminum	mg/L	0.005	SEQG	0.0022	**0.0056**	0.0037	0.0039	**0.081**	**0.015**	0.0013	**0.006**
Ammonia as N	mg/L	5.7	SEQG	<0.01	0.04	0.014	<0.01	0.04	0.01375	<0.01	0.04
Ammonia, *unionized	ug/L	19	CWQG	0.005	0.036	0.0143	0.006	0.024	0.013	0.004	0.036
Antimony	mg/L			<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic	mg/L	0.005	SEQG	<0.0001	<0.0001	<0.0001	0.0001	0.0001	<0.0001	0.0001	0.0001
Barium	mg/L			0.0022	0.0035	0.00267	0.0019	0.0041	0.0026625	0.0025	0.004
Beryllium	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bicarbonate	mg/L			2	16	6.7	2	13	8.125	1	28
Boron	mg/L	1.5	CWQG	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	mg/L	0.00004	CWQG	<1.0E-05	0.00002	0.000012	<1.0E-05	0.00002	0.0000125	1.00E-05	0.00002
Calcium	mg/L			1.3	1.7	1.4	1.2	1.7	1.3375	1.5	1.9
Carbonate	mg/L			<1	<1	<1	<1	<1	<1	<1	<1
Chloride	mg/L	120	CWQG	0.4	0.6	0.45	0.2	0.4	0.3125	0.5	0.7
Chromium	mg/L	0.001	CWQG	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Cobalt	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Copper	mg/L	0.002	CWQG	<0.0002	<0.0002	<0.0002	<0.0002	0.0008	0.000275	<0.0002	<0.0002
DOC	mg/L			1.7	2.4	2.13	1.9	2.5	2.225	1.7	2.6
Diss. Phosphorus	mg/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoride	mg/L	0.12	CWQG	0.01	0.07	0.026	0.01	0.03	0.01625	<0.01	0.07
Hardness	mg/L			5	6	5.3	4	6	4.75	5	7
Hydroxide	mg/L			<1	<1	<1	<1	<1	<1	<1	<1
Iron	mg/L	0.3	SEQG	0.031	**0.31**	0.1215	0.041	0.11	0.073875	0.036	0.13
Lead	mg/L	0.001	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	0.0003	0.000125	<0.0001	<0.0001
Lead-210	Bq/L			<0.02	<0.02	<0.02	<0.02	0.05	0.02375	<0.02	0.03
Magnesium	mg/L			0.3	0.7	0.43	0.3	0.6	0.375	0.4	0.5

Parameter	Units	Benchmark		Icelander River (SA-1)			SA-2			SA-3	
		Value	Reference	Min	Max	Mean	Min	Max	Mean	Min	Max
Manganese	mg/L			0.0041	0.025	0.01467	0.0044	0.017	0.010325	0.0066	0.023
Mercury	mg/L	2.60E-05	CWQG	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
Molybdenum	mg/L	26	SEQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	0.025	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nitrate	mg/L	13.29	SEQG	<0.04	0.26	0.0714286	<0.04	0.31	0.094	<0.04	0.26
P. Alkalinity	mg/L			<1	<1	<1	<1	<1	<1	<1	<1
pH	units	6.5–9	CWQG	**6.34**	6.99	6.75	6.58	7.01	6.7775	**6.42**	7.02
Phosphorus	mg/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Polonium-210	Bq/L			<0.005	0.01	0.0054999	<0.005	<0.005	<0.005	<0.005	0.01
Potassium	mg/L			0.2	0.5	0.36	0.1	0.4	0.3375	0.3	0.5
Radium-226	Bq/L	0.11	SEQG	<0.005	0.009	0.0061	<0.005	0.01	0.006125	<0.005	0.01
Selenium	mg/L	0.001	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Silver	mg/L	0.0001	CWQG	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Sodium	mg/L			1.4	1.7	1.53	1.2	1.8	1.45	1.4	1.8
Conductivity	µS/cm			16	22	18.2	14	22	17	18	24
Strontium	mg/L			0.011	0.015	0.0127	0.011	0.015	0.012125	0.013	0.018
Sulphate	mg/L	128	SSWQO	0.4	0.9	0.71	<0.2	0.7	0.5875	0.4	0.8
Sum of Ions				6	22	11.5	6	19	12.5	6	33
Thallium	mg/L	0.0008	CWQG	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Thorium-228	Bq/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium-230	Bq/L			<0.01	<0.01	<0.01	<0.01	0.02	0.01125	<0.01	<0.01
Thorium-232	Bq/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tin	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium	mg/L			<0.0002	<0.0002	<0.0002	<0.0002	0.0015	0.000375	<0.0002	<0.0002
TDS	mg/L			18	25	21.7	13	30	21.25	17	26
TKN	mg/L			0.11	0.3	0.241	<0.05	0.31	<0.195	0.13	0.3
TOC	mg/L			1.8	2.6	2.25	2.1	2.4	2.2875	1.8	2.6
TSS	mg/L			<1	3	2.2	1	3	1.5	<1	2

Parameter	Units	Benchmark		Icelander River (SA-1)			SA-2			SA-3	
		Value	Reference	Min	Max	Mean	Min	Max	Mean	Min	Max
Uranium	mg/L	0.015	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Zinc	mg/L	0.03	CWQG	<0.0005	0.0028	0.00074	<0.0005	0.0096	0.001675	<0.0005	0.0011

Table 8.2-3 (Continued)

Parameter	Units	Benchmark		SA-4			SA-5			SA-6	
		Value	Reference	Min	Max	Mean	Min	Max	Mean	Min	Max
Alkalinity	mg/L			2	15	7.5	2	8	5.2222	3	13
Aluminum	mg/L	0.005	SEQG	0.0025	**0.0099**	**0.0053**	0.004	**0.014**	**0.0065**	0.0032	**0.02**
Ammonia as N	mg/L	5.7	SEQG	<0.01	0.05	0.015	<0.01	0.05	0.01444	<0.01	0.04
Ammonia, *unionized	ug/L	19	CWQG	0.007	0.065	0.0194	0.002	0.04	0.0137	0.006	0.04
Antimony	mg/L			<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic	mg/L	0.005	SEQG	0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0001
Barium	mg/L			0.0021	0.0032	0.0025625	0.0021	0.0031	0.0025556	0.0023	0.0032
Beryllium	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bicarbonate	mg/L			2	18	9.125	2	10	6.2222	4	16
Boron	mg/L	1.5	CWQG	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	mg/L	0.00004	CWQG	1.00E-05	**0.00007**	0.0000175	1.00E-05	0.00004	1.44E-05	1.00E-05	**0.00005**
Calcium	mg/L			1.3	2	1.5625	1.2	1.4	1.2444	1.2	1.8
Carbonate	mg/L			<1	<1	<1	<1	<1	<1	<1	<1
Chloride	mg/L	120	CWQG	0.4	0.6	0.45	0.2	0.3	0.23333	0.3	0.5
Chromium	mg/L	0.001	CWQG	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Cobalt	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Copper	mg/L	0.002	CWQG	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
DOC	mg/L			2	2.4	2.275	1.8	2.5	2.2667	1.9	2.5
Diss. Phosphorus	mg/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoride	mg/L	0.12	CWQG	0.01	0.07	0.02625	0.01	0.08	0.0233	<0.01	0.07

Parameter	Units	Benchmark		SA-4			SA-5			SA-6	
		Value	Reference	Min	Max	Mean	Min	Max	Mean	Min	Max
Hardness	mg/L			5	7	5.625	4	5	4.56	4	6
Hydroxide	mg/L			<1	<1	<1	<1	<1	<1	<1	<1
Iron	mg/L	0.3	SEQG	0.034	0.13	0.077375	0.03	0.11	0.071222	0.036	0.16
Lead	mg/L	0.001	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Lead-210	Bq/L			<0.02	0.03	0.02125	<0.02	<0.02	<0.02	<0.02	<0.02
Magnesium	mg/L			0.4	0.6	0.4375	0.2	0.4	0.33333	0.3	0.5
Manganese	mg/L			0.0029	0.019	0.010625	0.0025	0.018	0.0083333	0.0037	0.029
Mercury	mg/L	2.60E-05	CWQG	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
Molybdenum	mg/L	26	SEQG	<0.0001	0.0002	0.00011	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	0.025	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nitrate	mg/L	13.29	SEQG	<0.04	0.35	0.112	<0.04	0.31	0.093	<0.04	0.35
P. Alkalinity	mg/L			<1	<1	<1	<1	<1	<1	<1	<1
pH	units	6.5–9	CWQG	6.58	7.16	6.8488	**6.17**	6.97	6.7233	**6.48**	7.07
Phosphorus	mg/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Polonium-210	Bq/L			<0.005	0.007	0.0052	<0.005	<0.005	<0.005	<0.005	0.006
Potassium	mg/L			0.2	0.6	0.375	0.2	0.4	0.32222	0.2	0.4
Radium-226	Bq/L	0.11	SEQG	<0.005	0.009	0.00625	<0.005	0.007	0.00544	<0.005	<0.005
Selenium	mg/L	0.001	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Silver	mg/L	0.0001	CWQG	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Sodium	mg/L			1.4	2.1	1.63	1.3	1.6	1.41	1.3	1.9
Conductivity	µS/cm			17	25	19.375	14	20	16.111	14	23
Strontium	mg/L			0.012	0.018	0.0141	0.011	0.013	0.0113	0.011	0.016
Sulphate	mg/L	128	SSWQO	0.4	0.7	0.525	0.4	0.8	0.63333	0.3	0.8
Sum of Ions				7	25	14.125	6	14	10.667	8	22
Thallium	mg/L	0.0008	CWQG	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Thorium-228	Bq/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium-230	Bq/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium-232	Bq/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Parameter	Units	Benchmark		SA-4			SA-5			SA-6	
		Value	Reference	Min	Max	Mean	Min	Max	Mean	Min	Max
Tin	mg/L			<0.0001	0.0002	0.0001125	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium	mg/L			<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0003
TDS	mg/L			21	32	25	13	28	20	15	28
TKN	mg/L			0.13	0.3	0.215	0.11	0.29	0.213	0.15	0.41
TOC	mg/L			2	2.6	2.325	1.9	2.7	2.3111	1.9	2.6
TSS	mg/L			1	3	2	<1	3	1.89	1	6
Uranium	mg/L	0.015	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Zinc	mg/L	0.03	CWQG	<0.0005	0.0012	0.0006	<0.0005	0.0017	0.0007445	<0.0005	0.0006

Table 8.2-3 (Continued)

Parameter	Units	Benchmark		SB-3			SB-5		
		Value	Reference	Min	Max	Mean	Min	Max	Mean
Alkalinity	mg/L			<1	24	<6.7778	3	13	7.375
Aluminum	mg/L	0.005	SEQG	**0.0052**	**0.012**	**0.0089**	0.0016	**0.0086**	**0.0054**
Ammonia as N	mg/L	5.7	SEQG	<0.01	0.04	0.01333	<0.01	0.04	0.0138
Ammonia, *unionized	ug/L			0.003	0.024	0.012	0.005	0.032	0.0134
Antimony	mg/L			<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Arsenic	mg/L	0.005	SEQG	<0.0001	<0.0001	<0.0001	0.0001	0.0001	<0.0001
Barium	mg/L			0.0025	0.0041	0.0031111	0.0026	0.004	0.0030625
Beryllium	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bicarbonate	mg/L			<1	29	<8.3333	4	16	9
Boron	mg/L	1.5	CWQG	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	mg/L	0.00004	CWQG	<1.0E-05	0.00002	1.11E-05	<1.0E-05	0.00004	0.000016
Calcium	mg/L			1.1	1.7	1.3778	1.2	1.7	1.3625
Carbonate	mg/L			<1	<1	<1	<1	<1	<1
Chloride	mg/L	120	CWQG	0.1	0.2	0.17778	<0.1	0.2	<0.175

Parameter	Units	Benchmark		SB-3			SB-5		
		Value	Reference	Min	Max	Mean	Min	Max	Mean
Chromium	mg/L	0.001	CWQG	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Cobalt	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Copper	mg/L	0.002	CWQG	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
DOC	mg/L			2.2	3.4	3.0222	2.6	3.2	2.975
Diss. Phosphorus	mg/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoride	mg/L	0.12	CWQG	0.01	0.07	0.023333	0.01	0.07	0.02375
Hardness	mg/L			4	6	5.11	4	6	4.88
Hydroxide	mg/L			<1	<1	<1	<1	<1	<1
Iron	mg/L	0.3	SEQG	0.042	0.22	0.095111	0.036	0.16	0.098375
Lead	mg/L	0.001	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Lead-210	Bq/L			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Magnesium	mg/L			0.3	0.5	0.38889	0.2	0.5	0.375
Manganese	mg/L			0.0053	0.02	0.010633	0.0071	0.016	0.010325
Mercury	mg/L	2.60E-05	CWQG	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05	<1.0E-05
Molybdenum	mg/L	26	SEQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	0.025	CWQG	0.0001	0.0002	0.00011	<0.0001	<0.0001	<0.0001
Nitrate	mg/L	13.29	SEQG	<0.04	0.4	0.115	<0.04	0.4	0.13
P. Alkalinity	mg/L			<1	<1	<1	<1	<1	<1
pH	units	6.5–9	CWQG	**6.18**	6.99	6.7044	**6.47**	6.99	6.7288
Phosphorus	mg/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Polonium-210	Bq/L			<0.005	0.008	0.0058	<0.005	<0.005	<0.005
Potassium	mg/L			0.2	0.5	0.33333	0.2	0.5	0.3625
Radium-226	Bq/L	0.11	SEQG	<0.005	0.01	0.0059	<0.005	0.006	0.0051
Selenium	mg/L	0.001	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Silver	mg/L	0.0001	CWQG	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Sodium	mg/L			1.2	1.7	1.4	1.3	1.7	1.44
Conductivity	µS/cm			15	22	16.778	15	23	17.25
Strontium	mg/L			0.011	0.015	0.0124	0.011	0.015	0.0119

Parameter	Units	Benchmark		SB-3			SB-5		
		Value	Reference	Min	Max	Mean	Min	Max	Mean
Sulphate	mg/L	128	SSWQO	0.3	0.9	0.68889	0.5	1	0.725
Sum of Ions				4	34	12.667	8	22	13.375
Thallium	mg/L	0.0008	CWQG	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Thorium-228	Bq/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium-230	Bq/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium-232	Bq/L			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tin	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium	mg/L			<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
TDS	mg/L			14	26	20.556	16	26	20.125
TKN	mg/L			0.16	0.34	0.256	0.18	0.33	0.27
TOC	mg/L			2.4	3.6	3.1111	2.7	3.2	3
TSS	mg/L			<1	4	2.56	<1	3	1.875
Uranium	mg/L	0.015	CWQG	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	mg/L			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Zinc	mg/L	0.03	CWQG	<0.0005	0.0012	0.00059	<0.0005	0.0016	0.00065

Notes:

Green-highlighted cells indicate values that fall below the analysis detection limit.

Bold values indicate metrics that exceed benchmark values.

Italicized values include a temperature point estimated from an adjacent water body taken in the same season

Blank cells in the "benchmark" column indicate parameters without a prescribed benchmark at this time

SEQG – Saskatchewan Environmental Quality Guidelines – Water Quality Guidelines for Freshwater Aquatic Life.

CWQG – Canadian Council of Ministers of the Environment – Canadian Water Quality Guidelines for the Protection of Aquatic Life.

SSWQO – Saskatchewan Surface Water Quality Objectives.

DOC – Dissolved organic carbon.

TDS – Total dissolved solids.

TKN – Total Kjeldahl Nitrogen.

TOC – Total organic carbon.

TSS – Total suspended solids.

Attachment: IR-114

Number	IR-114
Dept.	ECCC, CNSC
Project effects link	Fish and Fish Habitat
Reference to EIS, appendices, or supporting documentation	Section 8.2.4.2.3 and Section 8.2.4.2.4
Context and Rationale	Context: Tables 8.2-9, 8.2-10 and 8.2-13 demonstrate predicted maximum effluent concentrations of COPCs and maximum predicted receiving environment concentrations in the near- and far-field. General parameters such as temperature, pH, conductivity, etc. that would require Project thresholds and monitoring under the MDMER have not been provided in this table. Lead, nickel, TSS and un-ionized ammonia were not provided, despite all being Schedule 4 substances with maximum monthly concentrations under the MDMER. Aluminum, iron, nitrate, thallium, and manganese have not been provided despite being required parameters under Schedule 5 Section 4 of the MDMER for effluent characterization. For zinc, it is unclear how guidelines have been calculated when CCME thresholds can only be derived with hardness values <250 mg/L. Additionally, water quality thresholds appear to have been calculated using estimated effluent concentrations rather than receiving environment baseline concentrations. Mercury has been identified as a COPC of interest to Indigenous groups for the proposed Project. Table 8.2-8 indicates that background concentrations of mercury in LA-5 are low, and predicted effluent concentrations are also low. However, no information has been provided on background methylmercury concentrations or expected atmospheric deposition of mercury from Project related emissions. Predicted effluent concentrations of 3915 mg/L of sulphate are quite high, and sulphate is known to increase mercury methylation rates in aquatic environments. Rationale: A review of all modelling results for all COPCs under the MDMER will assist ECCC in understanding the potential risks to the receiving environment. ECCC recommends the use of the most stringent guidelines for the protection of aquatic biota. All water quality thresholds should be derived from receiving environment parameters to determine any baseline receiving environment and effluent COPC exceedances of water quality thresholds.

	Increased sulphate availability can lead to increased methylation rates of mercury and methylmercury in sediment and surface water. Methylmercury is a toxin that can bioaccumulate within the food chain and present risks to aquatic biota and wildlife consuming aquatic biota. Potential changes to methylmercury concentrations in water quality, sediment and fish tissues should be assessed due to the proposed sulphate loadings in effluent. Additionally, in accordance with the MDMERs, Denison will be required to demonstrate that their effluent quality meets the limits in the MDMER. Denison is expected to provide the predicted effluent quality for lead, nickel, and un-ionized ammonia to demonstrate compliance with the MDMERs.
Information Requirement	1. Update all tables to include all COPCs with required monitoring under the MDMER including acute and chronic thresholds. 2. Ensure all selected water quality thresholds are derived using baseline receiving environment concentrations and use water quality guidelines that are protective of aquatic biota. 3. Provide baseline data on the concentrations of methylmercury in surface water, sediment and fish tissues (i.e., large- bodied sports fish and small-bodied forage fish) in the LSA and RSA receiving environment to establish a baseline prior to potential Project impacts. 4. Provide an assessment of risk from methylmercury to ecological receptors due to changes in sulphate concentrations in effluent, and potential deposition of mercury from Project related atmospheric emissions in the receiving environment.

Response:

1) Please see updated Tables 8.2-9 and 8.2-10 from the draft EIS below. Water quality predictions for the well mixed portion of LA-5 for each of the three flow scenarios (described in Section 8.2.4.2.3 and Table 8.2-7 of the draft EIS) are provided in the updated Table 8.2-10 below. Predicted site discharge concentrations that exceed respective receiver WQOs are bolded. Chloride, sulphate, TDS, arsenic, cadmium, chromium, cobalt, copper, selenium, and uranium, thorium-230, radium-226, lead-210, and polonium-210 predicted discharge concentrations are above receiver WQOs. However, under all three flow scenarios, the predicted water quality for all constituents is below respective WQOs within the well mixed portion of LA-5, indicating that sufficient dilution is present within LA-5 to meet objectives. Updated Table 8.2-13 is provided below. Water quality predictions have been added for MDMER constituents listed under Schedule 4 and Schedule 5. There are no predicted exceedances of water quality guidelines for any of the COPCs during Construction, Operation, or Decommissioning

2) The predictive water quality analysis considered the effects of toxicity modifying factors, such as hardness, on water quality. Specifically, the analysis considered induced hardness - that is hardness that is derived from or includes contributions from on site sources and in this case discharge from the IWWTP. It is a reasonable in this case to utilize induced hardness since the water quality assessment directly considers the potential effect of IWWTP discharge on the receiving environment. The hardness added to the receiver from the discharge represents a constant source during periods of discharge. The

effluent hardness value used in the analysis was derived from bench scale testing and is considered to be a reasonable estimate of expected hardness in effluent. With that in mind, the predictive water quality analysis reflects the water quality conditions that are anticipated to prevail in the receiver and therefore presents an appropriate platform on which to base the effects assessment.

3) The table below (IR-114 Table 1) shows a summary of baseline concentrations of total mercury in surface water within the LSA. Sediment was not analyzed for mercury during previous baseline surveys. Baseline water quality in the LSA and RSA showed no indication of total mercury present above detectable limits and as such, the potential for methyl-mercury to be detected was unlikely. Generally, 60 to 95% of total mercury concentrations in fish muscle tissues are present in the form of methyl-mercury. Table 8.5-2 of Section 8.5 of the EIS provides a full summary of tissue constituent concentrations for key species from the Icelander River and Russell Lake. A conservative approach of assuming 95% of mercury in the tissues is present in the methylated form could be used for comparative purposes. These data supplemented with more current baseline data for water, sediment and fish tissues specific to total and methyl-mercury prior to the onset of site development will provide a robust database for comparative purposes during the subsequent development and operation on site.

4) Consistent with CSA N288.1-20, Clause 5.1.5, atmospheric depositions to large water bodies such as lakes, are considered negligible; therefore, the air to surface water pathway has been excluded for the ecological risk assessment. The rationale for exclusion of atmospheric deposition to lakes and rivers is explained in detail in Section G9, Appendix G of the COG DRL Guidance Document (Hart, 2019). Typical transfer parameters from source to air and source to water are on a similar magnitude to each other. The transfer parameter from air to water is orders of magnitude lower indicating that atmospheric deposition to the lake would have a negligible effect. Rationale on the exclusion of the air to water pathway can be included in the ERA in Appendix 10-A. The following statement will be added to Section 2.2 in Appendix A to Appendix 10-A "Atmospheric deposition to Whitefish Lake is considered negligible. This is consistent with the COG DRL guidance (COG, 2019) which shows (assuming a modest flow rate for a lake of 0.1 m/s and an assumed water depth of 10 m) that the transfer of constituents from the atmosphere to large bodies of water (including lakes and rivers) is considered negligible."

As baseline surface water did not identify measurable concentrations of total mercury in the LSA or RSA (See IR-114 Table 1 below) and deposition to large water bodies such as lakes is not likely to contribute to the methyl mercury concentration in the Wheeler River receiving waters, it is most reasonable to conclude that changes in total and methyl mercury can be adequately monitored in relation to sulphate inputs. Denison will undertake monitoring of total and methyl mercury as it relates to the discharge of sulphate to Whitefish Lake.

References:

Hart, D. 2019. Derived Release Limits Guidance. COG-06-3090R4-I

Table 8.2-9: Predicted Effluent Water Quality (Updated to include MDMER Constituents)

Constituent	Unit	Discharge Concentration (max predicted)
Chloride	mg/L	**600**
Sulphate (Hardness)	mg/L	**3915**
Sulphate	mg/L	**3915**
TDS	mg/L	**6420**
TSS	mg/L	6
Arsenic	mg/L	**0.006**
Cadmium	mg/L	**0.0018**
Chromium	mg/L	**0.025**
Cobalt	mg/L	**0.0030**
Copper	mg/L	**0.022**
Lead	mg/L	0.0003
Molybdenum	mg/L	2.5
Nickel	mg/L	0.014
Selenium	mg/L	**0.042**
Uranium	mg/L	**0.057**
Vanadium	mg/L	0.059
Zinc	mg/L	0.042
Mercury	mg/L	0.000001
Ammonia (as N)	mg/L	3.9
Un-ionized Ammonia*	mg/L	0.0078
Phosphorus	mg/L	N/A
Thorium-230	Bq/L	**0.9**
Radium-226	Bq/L	**0.15**
Lead-210	Bq/L	**0.419**
Polonium-210	Bq/L	**0.15**

Note:

* - Calculated value

Table 8.2-10: Near-field Receiving Water Quality Results (Updated to include MDMER Constituents)

Constituent	Unit	Screening Concentration	Source of Screening Concentration	Predicted Site Discharge Concentration	LA-5 Well Mixed (7Q10)	LA-5 Well Mixed (Monthly Low)	LA-5 Well Mixed (Average)
Chloride	mg/L	120	SEQG/CCME	**600**	10.06	6.18	4.69
Sulphate (Hardness)	mg/L	429	BC MOE*	**3915**	63.83	38.51	28.76
Sulphate	mg/L	128	BC MOE	**3915**	63.83	38.51	28.76
TDS	mg/L	500	SEQG	**6420**	131.41	90.06	74.13
TSS	mg/L	15	Schd 4 - MDMER	6	3.9	3.9	3.9
Arsenic	mg/L	0.01	SEQG/CCME	**0.006**	0.00020	0.00016	0.00014
Cadmium	mg/L	0.0003	SEQG/CCME*	**0.0018**	0.00005	0.00004	0.00003
Chromium	mg/L	0.001	SEQG/CCME	**0.025**	0.00090	0.001	0.00068
Cobalt	mg/L	0.0003	FEQG	**0.0030**	0.00015	0.00013	0.00012
Copper	mg/L	0.004	SEQG/CCME*	**0.022**	0.00055	0.00041	0.00036
Lead	mg/L	0.005	CCME	0.0003	0.0001	0.0001	0.0001
Molybdenum	mg/L	0.07	WHO	2.5	0.040	0.024	0.018
Nickel	mg/L	0.07	WHO	0.014	0.0003	0.0002	0.0002
Selenium	mg/L	0.001	SEQG/CCME	**0.042**	0.0008	0.001	0.0004
Uranium	mg/L	0.02	SEQG/CCME	**0.057**	0.0010	0.0006	0.0005
Vanadium	mg/L	0.12	FEQG	0.059	0.0011	0.0007	0.0005
Zinc	mg/L	0.1	FEQG**	0.042	0.0018	0.0015	0.0014
Mercury	mg/L	0.000026	SEQG/CCME	0.000001	0.00001	0.00001	0.00001
Ammonia (as N)	mg/L	5.74	SEQG/CCME	3.9	0.13	0.11	0.10
Un-ionized Ammonia	mg/L	1.00	MDMER Sched 4	0.0078	0.00008	0.00006	0.00006
Phosphorus	mg/L	0.015	BC MOE	N/A	0.01	0.01	0.01
Thorium-230	Bq/L	0.6	HC	**0.9**	0.024	0.019	0.016
Radium-226	Bq/L	0.11	SEQG	**0.15**	0.008	0.007	0.007
Lead-210	Bq/L	0.2	HC	**0.419**	0.026	0.024	0.023
Polonium-210	Bq/L	0.1	HC	**0.15**	0.007	0.006	0.006

Notes

Constituent	Unit	Screening Concentration	Source of Screening Concentration	Predicted Site Discharge Concentration	LA-5 Well Mixed	LA-5 Well Mixed	LA-5 Well Mixed
					(7Q10)	(Monthly Low)	(Average)
(1) **Bolded values** are those that exceed the screening concentrations Un-ionized ammonia calculated value * Hardness induced guideline, assuming hardness >250 mg/L ** Hardness induced guideline, assuming hardness >250 mg/L, pH=7.0, DOC = 5.26 mg/L							

Table 8.2-13: Maximum Concentration of Surface Water Constituents of Potential Concern in Surface Water (Updated to include available MDMER Constituents)

Constituent	Unit	Kratchkowsky Lake (LA-7)	Whitefish Lake North (LA-6)	Whitefish Lake Middle (LA-5 North)	Whitefish Lake South (LA-5 South)	McGowan Lake (LA-1)	Icelander River	Russell Lake Inlet	Screening Concentration	Source of Screening Concentration
Chloride	mg/L	0.32	0.32	6.14	6.11	4.20	4.16	3.26	120	SEQG/CCME
Sulphate	mg/L	0.69	0.69	38.66	38.49	26.03	25.75	19.88	128	BC MOE
Arsenic	mg/L	0.00012	0.00011	0.00015	0.00015	0.00013	0.00013	0.00012	0.01	SEQG/CCME
Cadmium	mg/L	0.000024	0.000023	0.000040	0.000039	0.000033	0.000033	0.000030	0.0003	SEQG/CCME*
Chromium	mg/L	0.000530	0.0005	0.0007	0.0007	0.0007	0.0007	0.0006	0.001	SEQG/CCME
Cobalt	mg/L	0.000101	0.000101	0.000129	0.000128	0.000119	0.000119	0.000114	0.0003	FEQG
Copper	mg/L	0.00062	0.00062	0.00082	0.00082	0.00075	0.00075	0.00072	0.004	SEQG/CCME*
Lead	mg/L	0.000124	0.000114	0.000118	0.000130	0.000114	0.000114	0.000116	0.005	CCME
Molybdenum	mg/L	0.0001	0.0001	0.0243	0.0240	0.0158	0.0156	0.0118	0.07	WHO
Nickel	mg/L	0.00039	0.00038	0.00051	0.00050	0.00046	0.00046	0.00044	0.07	WHO
Selenium	mg/L	0.000034	0.00003	0.00043	0.00041	0.00026	0.00026	0.00020	0.001	SEQG/CCME
Uranium	mg/L	0.00003	0.00003	0.00057	0.00055	0.00034	0.00033	0.00025	0.02	SEQG/CCME
Vanadium	mg/L	0.00017	0.00015	0.00067	0.00056	0.00033	0.00033	0.00027	0.12	FEQG
Zinc	mg/L	0.00070	0.00069	0.00106	0.00103	0.00090	0.00090	0.00084	0.1	FEQG**
Ammonia (as N)	mg/L	0.01463	0.01463	0.05232	0.05215	0.03978	0.03950	0.03368	5.74	SEQG/CCME
Un-ionized Ammonia	mg/L	0.0000086	0.0000086	0.0000309	0.0000308	0.0000235	0.0000233	0.0000199	1.00	MDMER Sched 4
Thorium-230	Bq/L	0.01014	0.01012	0.01868	0.01854	0.01569	0.01563	0.01430	0.6	HC
Radium-226	Bq/L	0.0057	0.0056	0.0069	0.0067	0.0063	0.0063	0.0061	0.11	SEQG
Lead-210	Bq/L	0.0062	0.0057	0.0084	0.0083	0.0067	0.0067	0.0064	0.2	HC
Polonium-210	Bq/L	0.0063	0.0058	0.0067	0.0072	0.0062	0.0062	0.0062	0.1	HC
Mercury	mg/L	No background information or effluent concentration to model								
Aluminum		Monitoring required under MDMER Schedule 5 - no criteria stipulated under this regulation								MDMER Sched 5

Constituent	Unit	Kratchkowsky Lake (LA-7)	Whitefish Lake North (LA-6)	Whitefish Lake Middle (LA-5 North)	Whitefish Lake South (LA-5 South)	McGowan Lake (LA-1)	Icelander River	Russell Lake Inlet	Screening Concentration	Source of Screening Concentration
TSS		Will be mitigated through design and treatment and monitored as per CCME and MDMER Sched 4 criterion								MDMER Sched 4
Iron		Monitoring required under MDMER Schedule 5 - no criteria stipulated under this regulation								MDMER Sched 5
Thallium		Monitoring required under MDMER Schedule 5 - no criteria stipulated under this regulation								MDMER Sched 5
Manganese		Monitoring required under MDMER Schedule 5 - no criteria stipulated under this regulation								MDMER Sched 5
Phosphorus		Monitoring required under MDMER Schedule 5 - no criteria stipulated under this regulation								MDMER Sched 5

Notes

(1) Bolded values are those that exceed the screening concentrations

* Hardness induced guideline, assuming hardness >250 mg/L

** Hardness induced guideline, assuming hardness >250 mg/L, pH=7.0, DOC = 5.26 mg/L

Un-ionized ammonia represented by calculated values

IR-114 Table 1: Total and Dissolved Mercury Concentrations in the LSA and RSA

Parameter	Total Mercury, Dissolved	Total Mercury
Units	mg/L	mg/L
Total Count	40	59
Count (<RDL)	39	46
Minimum	<1.00E-05	<1.00E-07
5th Percentile	<1.00E-05	<8.20E-07
50th Percentile	<1.00E-05	<1.00E-05
95th Percentile	<1.00E-05	<1.00E-05
Maximum	<1.00E-05	<1.00E-05
Arithmetic Mean	<1.00E-05	<7.63E-06
StdDev	2.76E-12	3.70E-06
Std Error	0	4.81E-07
Geometric Mean	<1.00E-05	<5.38E-06
Geometric StdDev	1.	3.281

Notes:

1. The summary time is between 01-Jan-2010 and 31-Dec-2021.

2. The reporting locations are: "LA-1", "LA-1-Bottom", "LA-5", "LA-6", "LAB-1", "LAB-2", "SA-1", "SA-2", "SA-3", "SA-6".

Attachment: IR-115

Number	IR-115
Dept.	ECCC
Project effects link	Fish and Fish Habitat
Reference to EIS, appendices, or supporting documentation	Section 8.2.4.2.3 Aquatic Environment Appendix 10-A (ERA), Section 3.1.1.1
Context and Rationale	Context: Table 8.2-8 demonstrates baseline concentrations of COPCs in LA-5 South Whitefish Lake, their respective water quality guidelines from applicable sources, and proposed Project thresholds. General parameters such as temperature, pH, conductivity, etc. that would require Project thresholds and monitoring under the MDMER have not been provided in this table. Lead, nickel, Total Suspended Solids (TSS) and un-ionized ammonia were not provided, despite all being Schedule 4 substances with maximum monthly concentrations under the MDMER. Aluminum, iron, nitrate, thallium, and manganese have not been provided despite being required parameters under Schedule 5 Section 4 of the MDMER for effluent characterization. Water quality thresholds appear to have been calculated using estimated effluent concentrations rather than receiving environment baseline concentrations. The water quality objective selected for molybdenum is the 31 mg/L SEQG rather than the CCME guideline of 0.073 mg/L. Rationale: ECCC recommends the use of guidelines that will ensure the protection of aquatic biota. All water quality thresholds should be derived from receiving environment parameters to determine any baseline receiving environment and effluent COPC exceedances of water quality thresholds.
Information Requirement	1. Update Table 8.2-8 to include all COPCs with required monitoring under the MDMER. 2. Ensure all selected water quality thresholds are derived using baseline receiving environment concentrations and are at levels protective of aquatic life. 3. Provide additional information to justify the use of the selected water quality guideline for molybdenum.

<u>Table to support response:</u>

Table 8.2-8 has been updated and provided below.

Constituent	Unit	LA-5 Background Concentration (95th percentile)	Screening Concentration	Source of Screening Concentration
Chloride	mg/L	0.39	120	SEQG/CCME
Sulphate (Hardness)	mg/L	0.69	429	BC MOE*
Sulphate	mg/L	0.69	128	BC MOE
TDS	mg/L	28.3	500	SEQG
TSS	mg/L	3.9	15	Schd 4 - MDMER
Arsenic	mg/L	0.0001	0.01	SEQG/CCME
Cadmium	mg/L	0.000019	0.0003	SEQG/CCME*
Chromium	mg/L	<0.0005	0.001	SEQG/CCME
Cobalt	mg/L	<0.0001	0.0003	FEQG
Copper	mg/L	<0.0002	0.004	SEQG/CCME*
Lead	mg/L	<0.0001	0.005	CCME
Molybdenum	mg/L	<0.0001	0.07	WHO
Nickel	mg/L	<0.0001	0.07	WHO
Selenium	mg/L	<0.0001	0.001	SEQG/CCME
Uranium	mg/L	<0.0001	0.02	SEQG/CCME
Vanadium	mg/L	<0.0001	0.12	FEQG
Zinc	mg/L	0.0011	0.1	FEQG**
Mercury	mg/L	<0.00001	0.000026	SEQG/CCME
Ammonia (as N)	mg/L	0.068	5.74	SEQG/CCME
Phosphorus	mg/L	<0.01	0.015	BC MOE
Thorium-230	Bq/L	<0.01	0.6	HC
Radium-226	Bq/L	<0.0059	0.11	SEQG
Lead-210	Bq/L	<0.02	0.2	HC
Polonium-210	Bq/L	<0.005	0.1	HC

Notes
* Hardness induced guideline, assuming hardness >250 mg/L
** Hardness induced guideline, assuming hardness >250 mg/L, pH=7.0, DOC = 5.26 mg/L

Attachment: IR-116

Number	IR-116
Dept.	ECCC
Project effects link	Change to an environmental component due to hazardous contaminants
Reference to EIS, appendices, or supporting documentation	Section 8.2.4.2.5, Section 8.4.4.2.5 and Section 8.5.4.2.3
Context and Rationale	Context: Tables 8.2-14, 8.4-9 and 8.5-5 demonstrate predicted mass flux (in mg/s) of COPCs in groundwater during the future centuries scenario. The table does not provide any information on actual surface water concentrations of COPCs or accumulation in concentrations over time. It is not possible to determine what the COPC concentrations in surface water and sediment will be during the future centuries scenario with the current information. Additionally, only a subset of parameters have been provided in this table based on parameters that were elevated in effluent after treatment. Groundwater may have a variety of different COPCs with elevated concentrations as it will migrate directly from the ore body area and not receive treatment. Rationale: It is not possible for ECCC to assess the predicted concentrations of COPCs in surface water and sediment, and therefore risk to aquatic biota during the future centuries scenario with the provided information.
Information Requirement	Information Requirement: 1. Provide the predicted water and sediment quality concentrations of COPCs in the receiving environment for the future centuries scenario. 2. Include data for a greater suite of COPCs that were assessed as having potential to be at elevated concentrations in groundwater.

Response:

1) The maximum concentrations of COPCs in surface water and sediment during the Future Centuries period are provided in IR-116 Table 1 and IR-116 Table 2, respectively.

2) The suite of COPCs that are provided in IR-116 Table 1 and IR-116 Table 2 are generally inclusive of those that have the potential for elevated concentrations in groundwater. However, estimates for pH, iron and manganese have not currently been modelled. These three parameters were identified in

Section 7.6.2.2.3 and Appendix 7-C as having the potential to be present in groundwater above the groundwater quality screening criteria (see Table 7.6-1 in the EIS and Table 3-4 in Appendix 7-C [existing conditions groundwater quality]).

During future centuries, groundwater that may reach Whitefish Lake is estimated to have a pH ranging from 6.39 to 6.47, which is slightly below the screening criteria of 6.5 to 9. However, the range predicted is within the range of the local groundwater flow system of 5.9 to 7.5 (median of 6.5, as provided in Table 3-4 of Appendix 7-C). Therefore, no change from the current existing conditions is expected during future centuries.

During future centuries, groundwater that may reach Whitefish Lake is estimated to have an iron concentration ranging from 0.0065 mg/L and 2.91 mg/L. The upper range of concentrations will exceed the Groundwater quality guideline of 0.3 mg/L. However, the range predicted is within the range of dissolved iron concentrations measured for groundwater in the local groundwater flow system, of 0.01 mg/L to 4.8 mg/L (median of 0.41). Therefore, no change from the current existing conditions is expected.

During future centuries, groundwater that may reach Whitefish Lake is estimated to have a manganese concentration ranging from 0.279 mg/L and 0.289 mg/L. The range of predicted concentrations will exceed the Groundwater quality guideline of 0.230 mg/L. However, the range predicted is only marginally above that of the local groundwater flow system of 0.04 mg/L and 0.2 mg/L (median of 0.1) and within a similar magnitude.

Arsenic concentrations in sediment have also been predicted based on mass-flux in a conservative manner and indicate potential exceedance of the CCME ISQG.

The modelled predictions of the future centuries groundwater are highly conservative. Continued monitoring of groundwater through the period of construction and initial operation will allow for refinement of the predictions for the future centuries scenario, thereby providing information for adaptive management.

IR-116 Table 1: Maximum Concentration of Surface Water Constituents of Potential Concern in Surface Water During Future Centuries

Constituent	Unit	Kratchkowsky Lake (LA-7)	Whitefish Lake North (LA-6)	Whitefish Lake Middle (LA-5 North)	Whitefish Lake South (LA-5 South)	McGowan Lake (LA-1)	Icelander River	Russell Lake Inlet	Screening Concentration	Source of Screening Concentration
Chloride	mg/L	0.32	0.32	0.41	0.41	0.39	0.39	0.38	120	SEQG/CCME
Sulphate	mg/L	0.69	0.69	0.72	0.72	0.71	0.71	0.71	128	BC MOE
Arsenic	mg/L	0.000103	0.000103	0.000107	0.000107	0.000105	0.000105	0.000104	0.01	SEQG/CCME
Cadmium	mg/L	0.0000232	0.0000232	0.0000233	0.0000233	0.0000233	0.0000233	0.0000232	0.0003	SEQG/CCME*
Chromium	mg/L	0.00052	0.00052	0.00053	0.00053	0.00052	0.00052	0.00052	0.001	SEQG/CCME
Cobalt	mg/L	0.00010	0.00010	0.00011	0.00011	0.00011	0.00010	0.00010	0.0003	FEQG
Copper	mg/L	0.00062	0.00062	0.00063	0.00063	0.00062	0.00062	0.00062	0.004	SEQG/CCME*
Lead	mg/L	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011	0.005	CCME
Molybdenum	mg/L	0.00011	0.00011	0.00012	0.00012	0.00011	0.00011	0.00011	0.07	WHO
Nickel	mg/L	0.00038	0.00038	0.00041	0.00041	0.00040	0.00040	0.00039	0.07	WHO
Selenium	mg/L	0.00003	0.00003	0.00004	0.00004	0.00004	0.00004	0.00004	0.001	SEQG/CCME
Uranium	mg/L	0.00003	0.00003	0.00004	0.00004	0.00003	0.00003	0.00003	0.02	SEQG/CCME
Vanadium	mg/L	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.12	FEQG
Zinc	mg/L	0.00068	0.00068	0.00074	0.00074	0.00072	0.00072	0.00071	0.1	FEQG**
Ammonia (as N)	mg/L	0.01463	0.01463	0.01463	0.01463	0.01463	0.01463	0.01463	5.74	SEQG/CCME
Un-ionized Ammonia	mg/L	0.000035	0.000035	0.000035	0.000035	0.000035	0.000035	0.000035	1.00	MDMER Sched 4
Thorium-230	Bq/L	0.01010	0.01010	0.01036	0.01036	0.01030	0.01030	0.01025	0.6	HC
Radium-226	Bq/L	0.00557	0.00557	0.00639	0.00637	0.00615	0.00614	0.00600	0.11	SEQG
Lead-210	Bq/L	0.00527	0.00527	0.00605	0.00592	0.00557	0.00556	0.00545	0.2	HC
Polonium-210	Bq/L	0.00536	0.00536	0.00615	0.00602	0.00566	0.00564	0.00553	0.1	HC
Mercury	mg/L	No background information or effluent concentration to model								
Aluminum		Monitoring required under MDMER Schedule 5 - no criteria stipulated under this regulation								MDMER Sched 5
TSS		Will be mitigated through design and treatment and monitored as per CCME and MDMER Sched 4 criterion								MDMER Sched 4
Iron		Monitoring required under MDMER Schedule 5 - no criteria stipulated under this regulation								MDMER Sched 5
Thallium		Monitoring required under MDMER Schedule 5 - no criteria stipulated under this regulation								MDMER Sched 5

Constituent	Unit	Kratchkowsky Lake (LA-7)	Whitefish Lake North (LA-6)	Whitefish Lake Middle (LA-5 North)	Whitefish Lake South (LA-5 South)	McGowan Lake (LA-1)	Icelander River	Russell Lake Inlet	Screening Concentration	Source of Screening Concentration
Manganese		Monitoring required under MDMER Schedule 5 - no criteria stipulated under this regulation								MDMER Sched 5
Phosphorus		Monitoring required under MDMER Schedule 5 - no criteria stipulated under this regulation								MDMER Sched 5

Notes
(1) Bolded values are those that exceed the screening concentrations
* Hardness induced guideline, assuming hardness >250 mg/L
** Hardness induced guideline, assuming hardness >250 mg/L, pH=7.0, DOC = 5.26 mg/L

IR-116 Table 2: Predicted Maximum Sediment Quality during Future Centuries

Constituent	Unit	Kratchkowsky Lake (LA-7)	Whitefish Lake North (LA-6)	Whitefish Lake Middle (LA-5 North)	Whitefish Lake South (LA-5 South)	McGowan Lake (LA-1)	Russell Lake InLet	Sediment Quality Guidelines					
								Burnett-Seidel and Liber		Thompson et al.		CCME	
								REF	NE2	LEL	SEL	ISQG	PEL
Chloride	mg/kg(dw)	2.81	2.81	3.62	3.61	3.43	3.29	--	--	--	--	--	--
Sulphate	mg/kg(dw)	6.00	6.00	6.29	6.29	6.22	6.17	--	--	--	--	--	--
Arsenic	mg/kg(dw)	**8.35**	**8.35**	**8.66**	**8.62**	**8.48**	**8.43**	21	522	9.8	346.4	5.9	17
Cadmium	mg/kg(dw)	0.34	0.34	0.34	0.34	0.34	0.34	--	--	--	--	0.6	3.5
Chromium	mg/kg(dw)	5.86	5.86	5.94	5.93	5.91	5.90	31.5	26.2	47.6	115.4	37.3	90
Cobalt	mg/kg(dw)	0.25	0.25	0.27	0.26	0.26	0.26	--	--	--	--	--	--
Copper	mg/kg(dw)	1.85	1.85	1.87	1.87	1.87	1.86	9.1	11.3	22.2	268.8	35.7	197
Lead	mg/kg(dw)	10.21	10.21	10.34	10.31	10.26	10.24	16.3	19.7	36.7	412.4	35	91.3
Molybdenum	mg/kg(dw)	0.34	0.34	0.37	0.37	0.36	0.35	23	245	13.8	1,239	--	--
Nickel	mg/kg(dw)	3.32	3.32	3.53	3.52	3.47	3.43	21	326	23.4	484	--	--

Constituent	Unit	Kratchkowsky Lake (LA-7)	Whitefish Lake North (LA-6)	Whitefish Lake Middle (LA-5 North)	Whitefish Lake South (LA-5 South)	McGowan Lake (LA-1)	Russell Lake InLet	Sediment Quality Guidelines					
								Burnett-Seidel and Liber		Thompson et al.		CCME	
								REF	NE2	LEL	SEL	ISQG	PEL
Selenium	mg/kg(dw)	0.62	0.62	0.83	0.82	0.76	0.72	3.6	30	1.9	16.1	--	--
Uranium	mg/kg(dw)	0.58	0.58	0.71	0.70	0.66	0.64	97	2,296	104.4	5,874	--	--
Zinc	mg/kg(dw)	9.93	9.93	10.79	10.76	10.52	10.37	--	--	--	--	123	315
Total Ammonia (N)	mg/kg(dw)	0.13	0.13	0.13	0.13	0.13	0.13	--	--	--	--	--	--
Thorium-230	Bq/kg(dw)	23.19	23.19	23.80	23.79	23.64	23.54	--	--	--	--	--	--
Radium-226	Bq/kg(dw)	65.14	65.14	74.67	74.39	71.82	70.13	--	--	600	14,400	--	--
Lead-210	Bq/kg(dw)	373.84	373.84	428.83	419.39	394.66	386.43	--	--	900	20,800	--	--
Polonium-210	Bq/kg(dw)	380.31	380.31	436.25	426.65	401.49	393.07	--	--	800	12,100	--	--
Mercury	mg/kg(dw)	No background information or effluent concentration to model											
Aluminum	mg/kg(dw)	Monitoring required in effluent under MDMER Schedule 5 - no criteria stipulated under this regulation											
Iron	mg/kg(dw)	Monitoring required in effluent under MDMER Schedule 5 - no criteria stipulated under this regulation											
Thallium	mg/kg(dw)	Monitoring required in effluent under MDMER Schedule 5 - no criteria stipulated under this regulation											
Manganese	mg/kg(dw)	Monitoring required in effluent under MDMER Schedule 5 - no criteria stipulated under this regulation											
Phosphorus	mg/kg(dw)	Monitoring required in effluent under MDMER Schedule 5 - no criteria stipulated under this regulation											

Note:
bolded values indicate exceedance of the CCME ISQG

Attachment: IR-123

Number	IR-123
Dept.	ECCC
Project effects link	Change to an environmental component due to radiological contaminants
Reference to EIS, appendices, or supporting documentation	Section 8.4.3.2.3, Aquatic Environment Appendix 8-D, Table 3-5
Context and Rationale	**Context:** Table 8.4-3 provides a summary of the baseline concentrations of COPCs in sediments in the LSA. Sediment quality thresholds and justification for the selection of those thresholds have not been provided. Table 3-5 in Appendix 8-D does provide benchmarks but the selection of benchmarks is not discussed, and the most stringent guidelines are not used for some COPCs. Additionally, there is no data provided for sediment concentrations of mercury, which is a COPC that requires surface water quality monitoring and effluent characterization under the MDMER. Rationale: Further information should be provided regarding any exceedances of sediment quality thresholds in baseline concentrations of COPCs, which should be recommended for further assessment of risk due to effluent discharges.
Information Requirement	1. Provide sediment quality thresholds and justification for the selection of those thresholds for comparison against measured baseline COPC concentrations in the LSA. 2. Provide data on baseline concentrations of mercury in sediment. 3. Identify any COPCs with baseline concentrations that exceed sediment quality thresholds in the LSA.

Table 1 is provided below to support the text response to IR-123 in the IR table:

Table 1: Baseline Sediment Quality Summary

Category	Parameter	Units	Total Count	Count (<RDL)	Min	5th Percentile	50th Percentile	95th Percentile	Max	Arithmetic Mean	StdDev	Std Error	Geometric Mean	Geometric StdDev	Sediment Quality Guidelines					
															Burnett-Seidel and Liber		Thompson et al.		CCME	
															REF	NE2	LEL	SEL	ISQG	PEL
Physical Tests	Moisture	%	22	0	24.59	28.934	94.81	96.858	97.24	74.715	31.256	6.6637	66.042	1.7444						
Total Metals	Aluminum	ug/g	22	0	920	1144	4645	9110.	9300	4391.82	2321.67	494.98	3723.16	1.8908	n/d	n/d	n/d	n/d	n/d	n/d
	Antimony	ug/g	22	17	<0.2	0.2	0.2	0.295	0.3	<0.20909	0.029425	0.0062733	<0.20751	1.1267	n/d	n/d	n/d	n/d	n/d	n/d
	Arsenic	ug/g	22	0	0.4	0.505	3.35	5.695	7.2	3.1909	2.0128	0.42913	2.3379	2.5249	21	522	9.8	346.4	5.9	17
	Barium	ug/g	22	0	19	21.25	42.5	70.45	100	43.727	17.694	3.7723	40.761	1.4647	n/d	n/d	n/d	n/d	n/d	n/d
	Beryllium	ug/g	22	7	<0.1	<0.1	0.3	0.395	0.5	<0.24545	0.11434	0.024377	<0.21531	1.747	n/d	n/d	n/d	n/d	n/d	n/d
	Boron	ug/g	22	7	<1	<1	5.5	11	12	<5.0455	3.5787	0.76299	<3.5672	2.5755	n/d	n/d	n/d	n/d	n/d	n/d
	Cadmium	ug/g	22	2	<0.1	<0.1	0.4	0.595	**0.7**	<0.35909	0.16521	0.035223	<0.31108	1.8383	n/d	n/d	n/d	n/d	0.6	3.5
	Chromium	ug/g	22	3	<0.5	<0.5	8.15	14.9	16	<7.55	4.7699	1.017	<5.0365	3.1656	31.5	26.2	47.6	115.4	37.3	90
	Cobalt	ug/g	22	5	<0.2	0.2	1.65	2.68	3.8	<1.4591	1.0051	0.21428	<0.96852	2.9677	n/d	n/d	n/d	n/d	n/d	n/d
	Copper	ug/g	22	7	<0.5	<0.5	1.65	4.565	5	<1.9136	1.3981	0.29807	<1.4281	2.2783	9.1	11.3	22.2	268.8	35.7	197
	Iron	ug/g	22	0	1410	1590.5	12650	32699.99	91300	16020	18960.23	4042.33	9545.32	3.0244	n/d	n/d	n/d	n/d	n/d	n/d
	Lead	ug/g	22	0	1	1	7.3	10	13	6.0545	3.6694	0.78232	4.4383	2.5369	16.3	19.7	36.7	412.4	35	91.3
	Manganese	ug/g	22	0	22	22.55	195	388.5	1270	237.41	253.54	54.056	159.75	2.6446	n/d	n/d	n/d	n/d	n/d	n/d
	Molybdenum	ug/g	22	2	<0.1	0.1	0.65	11.95	13	<2.4455	4.1007	0.87428	<0.83873	4.1956	23	245	13.8	1,239	n/d	n/d
	Nickel	ug/g	22	3	<0.1	<0.1	5.6	11.895	12	<5.1	3.6738	0.78327	<2.7847	4.651	21	326	23.4	484	n/d	n/d
	Selenium	ug/g	22	7	<0.1	<0.1	0.8	1.49	1.6	<0.73182	0.49989	0.10658	<0.4781	3.0508	3.6	30	1.9	16.1	n/d	n/d
	Silver	ug/g	22	11	<0.1	<0.1	<0.1	0.68	2	<0.25455	0.41142	0.087714	<0.16407	2.1254	n/d	n/d	n/d	n/d	n/d	n/d
	Strontium	ug/g	22	0	16	17	26.5	39.75	42	26.545	7.076	1.5086	25.66	1.3072	n/d	n/d	n/d	n/d	n/d	n/d
	Thallium	ug/g	22	22	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0	0	<0.2	1	n/d	n/d	n/d	n/d	n/d	n/d

Radionuclides	Tin	ug/g	22	7	<0.1	<0.1	0.2	0.4	0.4	<0.19091	0.10193	0.021731	<0.16863	1.6518	n/d	n/d	n/d	n/d	n/d	n/d
	Titanium	ug/g	22	0	31	31.25	200	446.5	480	205.36	139.5	29.741	147.31	2.5607	n/d	n/d	n/d	n/d	n/d	n/d
	Uranium	ug/g	22	0	0.2	0.2	0.7	1.395	1.5	0.67727	0.38537	0.08216	0.56276	1.9464	97	2,296	104.4	5,874	n/d	n/d
	Vanadium	ug/g	22	0	1.2	1.3	18	26.75	30	14.223	9.3994	2.004	8.7761	3.4375	35.1	31.8	35.2	160	n/d	n/d
	Zinc	ug/g	22	5	<0.5	<0.5	24	43.3	62	<19.85	16.079	3.4281	<8.2122	6.2729	n/d	n/d	n/d	n/d	123	315
	Lead-210	Bq/g	22	7	<0.04	<0.04	0.415	0.725	0.75	<0.35273	0.24914	0.053116	<0.21687	3.3521	n/d	n/d	0.9	20.8	n/d	n/d
	Polonium-210	Bq/g	22	1	<0.01	0.02	0.41	0.678	0.76	<0.35136	0.25533	0.054436	<0.17468	4.8038	n/d	n/d	0.8	12.1	n/d	n/d
	Radium-226	Bq/g	22	6	<0.01	<0.01	0.03	0.0495	0.05	<0.025909	0.012968	0.0027649	<0.0225	1.7702	n/d	n/d	0.6	14.4	n/d	n/d
	Thorium-228	Bq/g	22	20	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	3.81E-09	8.13E-10	<0.02	1	n/d	n/d	n/d	n/d	n/d	n/d
	Thorium-230	Bq/g	22	20	<0.02	<0.02	<0.02	<0.02	0.03	<0.020455	0.002132	0.00045455	<0.020372	1.0903	n/d	n/d	n/d	n/d	n/d	n/d
	Thorium-232	Bq/g	22	22	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	3.81E-09	8.13E-10	<0.02	1	n/d	n/d	n/d	n/d	n/d	n/d

Notes:

1. The summary time is between 01-Jan-2010 and 31-Dec-2021.

2. The reporting locations are: "LA-1-1", "LA-1-2", "LA-1-3", "LA-5-1", "LA-5-2", "LA-5-3", "LA-5-4", "LA-5-5", "LA-6-1", "LA-6-2", "LA-6-3", "LA-6-4", "LA-6-5", "LAB-1-1", "LAB-1-2", "LAB-1-3", "LAB-2-1", "LAB-2-2", "LAB-2-3", "LAB-2-CORE".

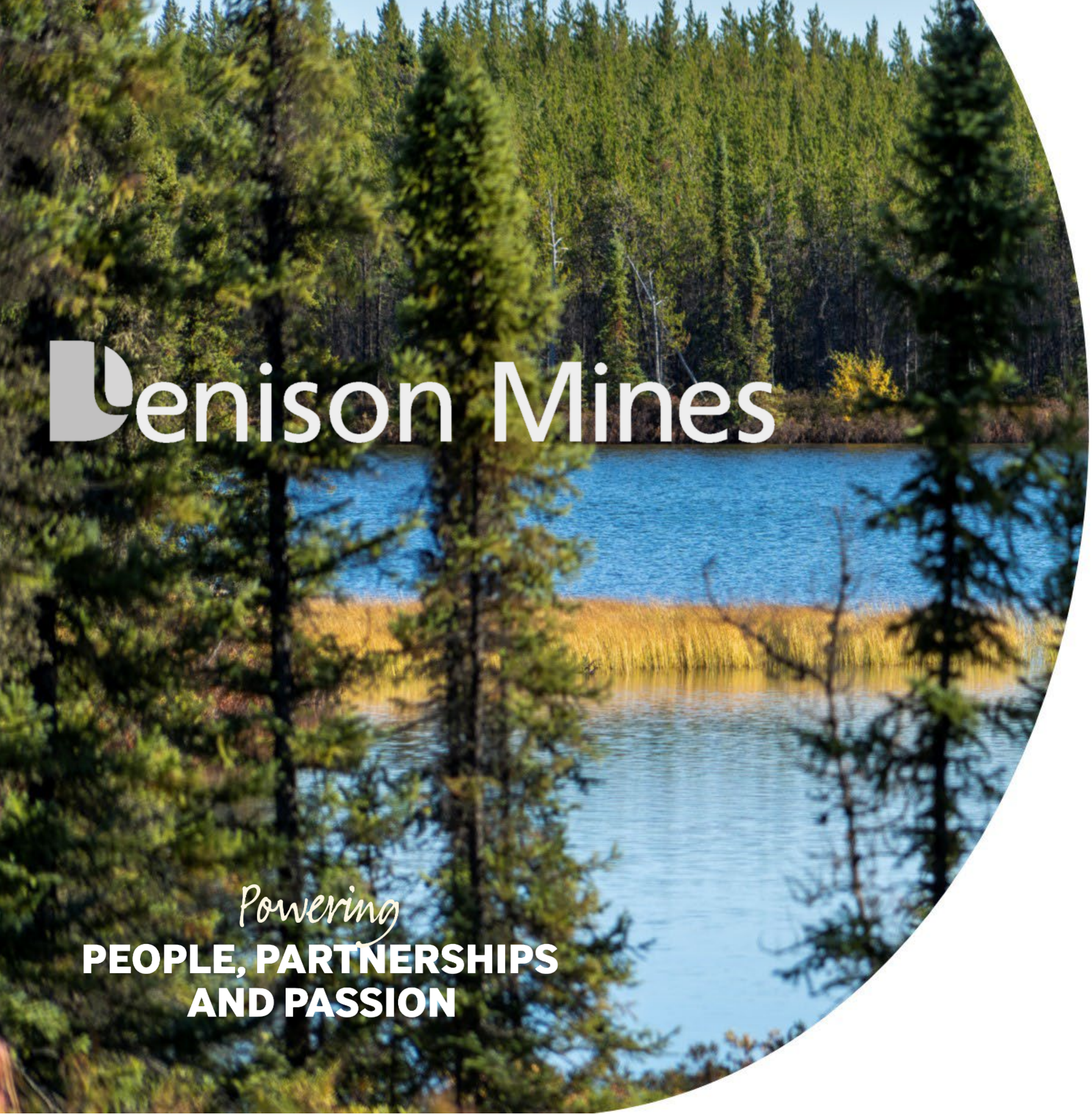
0.7	indicates exceedance of CCME ISQG

Attachment: IR-131

Number	IR-131
Dept.	CNSC
Project effects link	Migratory birds, Wildlife and Wildlife Habitat
Reference to EIS, appendices, or supporting documentation	Section 9, Terrestrial Environment
Context and Rationale	Context and Rationale: As per the requirement outlined in Section 79 of the Species at Risk Act (SARA): The person must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plans. This is accomplished by ensuring that the Proponent has identified, avoided, lessened and will monitor effects to species at risk. As per the CNSC's Generic Guidelines for the Preparation of an EIS pursuant to the Canadian Environmental Assessment Act, 2012: "The EIS will then describe mitigation measures that are specific to each environmental effect identified. Measures will be written as specific commitments that clearly describe how the proponent intends to implement them and the environmental outcome the mitigation is designed to address. The EIS will describe mitigation measures in relation to species and/or critical habitat listed under the Species at Risk Act (SARA). These mitigation measures will be consistent with any SARA permit, applicable recovery strategy and/or action plan". The draft EIS neither lists the adverse effects to all listed schedule 1 SARA species, nor outlines the measures that will be taken to avoid or lessen these effects. The Proponent references that additional species-specific mitigations will be detailed in environmental management plans but has not provided those plans for review.
Information Requirement	Identify all species at risk listed on Schedule 1 of the Species at Risk Act and their critical habitat that are likely to be affected by the Project and describe how they may be adversely affected by the Project. Describe what measures will be taken to avoid or lessen the effects of each Project activity and stage, and how these effects will be monitored to ensure they are avoided or minimized.

<u>Response:</u>

A new appendix to the final EIS (Appendix 9-D Species At Risk) is included below.


Denison Mines
Powering
PEOPLE, PARTNERSHIPS
AND PASSION

Denison Mines Corp.

Appendix 9-D Wildlife Species At Risk

New Appendix to final EIS, Section 9

Version 1

July 2023

Table of Contents

Tables

Acronyms and Abbreviations

Term	Definition
BBS	Breeding Bird Survey
BC	British Columbia
CEA	Cumulative effects assessment
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
EMS	Environmental Management System
FIRT	Federal-Indigenous Review Team
IRs	Information requests
ISR	In situ recovery
KI	Key Indicator
LSA	Local Study Area
Project	Wheeler River Project
QP	Qualified Professional
RSA	Regional Study Area
SAR	Species at risk
SARA	*Species at Risk Act*
SARGSS	Saskatchewan Activity Restriction Guidelines for Sensitive Species
SKCDC	Saskatchewan Conservation Data Centre
VC	Valued Component

1 Introduction

1.1 Background

On October 21, 2022, Denison Mines Corp. (Denison) submitted a draft Environmental Impact Statement (EIS) for the proposed Wheeler River Project (the Project). Based on their initial review, the Canadian Nuclear Safety Commission indicated that the submission contained the required information to proceed with the Federal-Indigenous Review Team (FIRT) technical review of the draft EIS. On March 20, 2023, the FIRT provided Denison with a list of information requests (IRs) for Denison to respond to and eventually submit a final EIS document.

This Appendix provides additional information to address several IRs provided by Environment and Climate Change Canada (ECCC) as part of the initial round of Federal Indigenous Review Team (FIRT) comments. These IRs were related to 16 wildlife species at risk (SAR) listed under Schedule 1 of the federal *Species at Risk Act* (SARA). The draft EIS approach was conservative in that it considered appropriate representative species as Valued Components (VCs) and Key Indicators (KIs) in sections 9.3 Ungulates, Furbearers, and Woodland Caribou and 9.4 Raptors, Migratory Breeding Birds, and Bird SAR. Of the 16 wildlife SAR listed in Table 1.1, seven had been included as VCs or KIs in the EIS after a thorough scoping process (refer to Section 1.2 for additional information).

Nine of the sixteen were not included as individual VCs or KIs but are considered important from a regulatory perspective. The SARA-listed species identified by ECCC are listed in Table 1.1. Those noted in bold font indicate those for which further assessment is provided in this appendix.

Table 1.1 Wildlife Species at Risk Listed by Environment and Climate Change Canada

Common Name	Scientific Name	Discussed in the draft EIS
Nine-spotted lady beetle	***Coccinella ovemnotata***	**No**
Transverse lady beetle	***Coccinella transversoguttata***	**No**
Yellow-banded bumble bee	***Bombus terricola***	**No**
Northern leopard frog	***Lithobates pipiens***	**No**
Little brown myotis	***Myotis lucifugus***	**No**
Northern myotis	***Myotis septentrionalis***	**No**
Wolverine	*Gulo gulo*	Yes
Woodland caribou	*Rangifer tarandus caribou*	Yes
Bank Swallow	***Riparia riparia***	**No**
Barn Swallow	***Hirundo rustica***	**No**
Common Nighthawk	*Chordeiles minor*	Yes
Horned Grebe	***Podiceps auritus***	**No**
Olive-sided Flycatcher	*Contopus cooperi*	Yes
Rusty Blackbird	*Euphagus carolinus*	Yes

Common Name	Scientific Name	Discussed in the draft EIS
Short-eared Owl	*Asio flammeus*	Yes
Yellow Rail	*Coturnicops noveboracensis*	Yes

Of the 16 species listed in Table 1.1, seven had been included as VCs or KIs in the EIS after a thorough scoping process, as summarized below.

1.2 Valued Component Selection

The VCs considered in the effects assessment for the Project are aspects of the biophysical and human environments that were considered to be likely to be affected (adversely or positively) by the Project. The VCs reflect identified scientific, local knowledge, and Indigenous Knowledge, and community interests regarding the Project and its potential effects. The potential effects are typically identified early in the environmental assessment process as a result of questions and concerns raised through engagement with Indigenous and community groups, government departments and agencies, and the general public.

Denison reviewed and considered all received input to develop a VC list that reflects the key environmental, socio-economic, heritage, and human health components and interests to appropriately focus the EA.

The initial VCs selected to represent bird SAR in the habitat-based assessment that were provided in the Terms of Reference (Denison 2019) were evaluated, consolidated, and organized to allow for the logical assessment of Project effects, and are presented in Table 1.2 and Table 1.3, which formed the basis for the subsequent VC-specific assessment.

Table 1.2 Wildlife Species at Risk Valued Component and Rationale for their Inclusion in the Habitat-based Environmental Assessment for the Denison Wheeler River Project

Valued Component	Rationale
Biophysical Environment	
Terrestrial Environment	
Furbearers	Project activities and infrastructure may affect local furbearer populations, including species at risk (SAR), resulting in non-compliance with permit conditions (e.g., *Species at Risk Act* [SARA; Government of Canada 2022], *The Wildlife Act 1998* [Government of Saskatchewan 2020]).
Woodland Caribou	Project activities and infrastructure may affect woodland caribou populations, resulting in non-compliance with permit conditions (e.g., SARA [Government of Canada 2022], *The Wildlife Act, 1998* [Government of Saskatchewan 2020]).
Bird Species at Risk	Project activities and infrastructure may affect bird SAR (specifically disturbance and/or destruction of eggs, young, and adults) resulting in non-compliance with regulatory requirements (e.g., SARA [Government of Canada 2022], *Migratory Birds Convention Act 1994* [Government of Canada 2017], *Saskatchewan Activity Restriction Guidelines for*

Valued Component	Rationale
	Sensitive Species [Government of Saskatchewan 2017], *The Wildlife Act 1998* [Government of Saskatchewan 2020]).

Table 1.3 Valued Components, Key Indicators, and Measurable Parameters for the Wildlife Component included in the Habitat-based Environmental Assessment for Denison Wheeler River Project

Valued Component	Key Indicator	Measurable Parameter
Furbearers	Wolverine	Amount of habitat (km^2) (not necessarily occupied) that may be altered or lost relative to its availability in the Regional Study Area (RSA). The number of wolverine mortalities directly or indirectly attributable to the Project.
Woodland Caribou	Woodland caribou	Amount of habitat (km^2) (not necessarily occupied) that may be altered or lost relative to its availability in the RSA. The number of woodland caribou mortalities directly or indirectly attributable to the Project.
Bird Species at Risk	Common Nighthawk	Percentage of habitat for Common Nighthawk altered/lost directly or indirectly as a result of Project activities. The number of Common Nighthawk mortalities directly or indirectly attributable to the Project.
	Rusty Blackbird	Percentage of habitat for Rusty Blackbird altered/lost directly or indirectly as a result of Project activities. The number of rusty blackbird mortalities directly or indirectly attributable to the Project
	Olive-sided Flycatcher	Percentage of habitat for Olive-sided Flycatcher altered/lost directly or indirectly as a result of Project activities. The number of Olive-sided Flycatcher mortalities directly or indirectly attributable to the Project
	Short-eared Owl	Percentage of habitat for Short-eared Owl altered/lost directly or indirectly as a result of Project activities. The number of Short-eared Owl mortalities directly or indirectly attributable to the Project.
	Yellow Rail	Percentage of habitat for Yellow Rail altered/lost directly or indirectly as a result of Project activities. The number of Yellow Rail mortalities directly or indirectly attributable to the Project.

The five bird species identified in Table 1.3 were selected as SAR VCs for the habitat-based EA in consideration of information/responses received during extensive Indigenous and community engagement completed by Denison, and they represent wildlife species of local importance. For these five species, additional information is not be provided in this Appendix. Rather, the reader is referred to the applicable sections in the EIS where appropriate information on existing conditions (Section 9.4.3.3), potential project-related effects (Section 9.4.4), mitigation measures (Section 9.4.5), residual effects and their significance (Section 9.4.6), and cumulative effects (Section 9.4.7) is provided.

2 Supplemental Information

As requested by ECCC, the following subsections provide supplemental information for the remaining nine species listed in Table 2.1 that were not included as VCs or KIs in the EIS. For these nine species, a brief overview of life history requirements (existing environment), a discussion on the effects assessment and mitigation measures, and a summary of residual and cumulative effects are included.

Table 2.1 Wildlife Species At Risk Considered in the Wheeler River Project Environmental Impact Statement

Common Name	Scientific Name	Provincial Status	Federal Status[1]	Preferred Habitat	Documented Occurrence in the Local Study Area[2]	Reference in the Environmental Impact Statement (EIS)
Arthropods						
Nine-spotted lady beetle	*Coccinella novemnotata*	S4	Endangered	Habitat generalist – uses a diverse range of habitats and consumes a variety of prey. See Section 2.1.1 for further details.	~~Unlikely~~ Local Study Area (LSA) is located within COSEWIC range; no observations in SKCDC and no Project-specific observations to date.	Not included as a Valued Component (VC) in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.
Transverse lady beetle	*Coccinella transversoguttata*	S4	Special Concern	Habitat generalist – uses a diverse range of habitats and consumes a variety of prey. See Section 2.1.2 for further details.	~~Unlikely~~ LSA is located within COSEWIC range; no observations in SKCDC and no Project-specific observations to date.	Not included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.
Yellow-banded bumble bee	*Bombus terricola*	S4	Special Concern	Habitat generalist – uses a variety of habitats and consumes nectar and pollen from many different flowering plants. See Section 2.1.3 for further details.	~~Unlikely~~ LSA is located within COSEWIC range; no observations in SKCDC and no Project-specific observations to date.	Not included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.
Amphibians						
Northern leopard frog	*Lithobates pipiens*	S3	Special Concern	Three district habitats: (1) overwintering waterbodies that are cold, well oxygenated, and do not freeze to bottom; (2) breeding and larval waterbodies with	LSA is located within COSEWIC range; no observations in SKCDC and no Project-specific	Not included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.

Common Name	Scientific Name	Provincial Status	Federal Status[1]	Preferred Habitat	Documented Occurrence in the Local Study Area[2]	Reference in the Environmental Impact Statement (EIS)
				shallow, open habitats, neutral pH, and no fish; and (3) summering areas in shallow marshes, moist upland meadows where grass height is less than 1 m. See Section 2.2.1 for further details.	observations to date. Amphibian nocturnal call and visual search surveys were completed in the LSA and Regional Study Area (RSA) as part of the baseline program; however, only boreal chorus frogs (*Pseudacris maculata*) were detected (Appendix 9-C).	
Bats						
Little brown myotis	*Myotis lucifugus*	S4B, S4N	Endangered	Seasonal habitat requirements: (1) overwintering hibernacula that are sufficiently cool and humid and (2) summering areas that provide foraging areas and suitable locations for roosting and maternity colonies. See Section 2.3.1 for further details.	Documented during the acoustic bat surveys as part of the baseline field program as present in the LSA and RSA, and previously observed in the RSA (SKCDC 2023).	Not included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.
Northern myotis	*Myotis septentrionalis*	S3	Endangered	Seasonal habitat requirements: (1) overwintering hibernacula that are sufficiently cool and humid and (2) summering areas that provide foraging areas and suitable locations for roosting and maternity colonies. See Section 2.3.2 for further details.	Documented during the acoustic bat surveys as part of the baseline field program as present in the LSA and RSA (Appendix 9-C).	Not included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.

Common Name	Scientific Name	Provincial Status	Federal Status[1]	Preferred Habitat	Documented Occurrence in the Local Study Area[2]	Reference in the Environmental Impact Statement (EIS)
Terrestrial Wildlife Species						
Wolverine	*Gulo gulo*	S2	Special Concern	See Section 9.3.3.2 of the EIS for details.	LSA is located within COSEWIC range; no observations in SKCDC and no Project-specific observations to date.	Included as a Key Indicator (KI) of the Furbearer VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Woodland caribou	*Rangifer tarandus caribou*	S3	Threatened	See Section 9.3.3.3 of the EIS for details.	Documented within the RSA during the baseline field program (Appendix 9-C)	Included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Avian Species						
Bank Swallow	*Riparia riparia*	S4B, S5M	Threatened	Nesting colonies are typically characterized by steep embankments with a sand, silt, or clay substrate that can be easily excavated for burrows. They are often adjacent to slow-moving or still waterbodies and may occur in natural habitats or in anthropogenic features. Bank Swallows are aerial insectivores that forage over a variety of open habitats. See Section 2.4.1 for further details.	LSA is located within COSEWIC range; no historical observations documented by the SKCDC (2023) and no Project-specific observations to date.	Not included as a KI of the Bird Species at Risk (SAR) VC in the EIS (Common Nighthawk was used as a surrogate species). A review of life history requirements and discussion on effects assessment are included in this Appendix. Any new species-specific mitigation measures identified in this appendix will be added to the final EIS (Section 9.4.5).
Barn Swallow	*Hirundo rustica*	S4B	Threatened	Breeding habitat typically requires a suitable nesting site with a vertical or horizontal surface underneath a roof of	Documented during the breeding bird surveys as part of the baseline field	Not included as a KI of the Bird SAR VC in the EIS (Common Nighthawk was used as a surrogate species). A review of life history

Common Name	Scientific Name	Provincial Status	Federal Status[1]	Preferred Habitat	Documented Occurrence in the Local Study Area[2]	Reference in the Environmental Impact Statement (EIS)
				some sort, open areas for foraging, and a waterbody with mud for nest building. Anthropogenic features such as barns, houses, bridges, and culverts are commonly used nesting sites. See Section 2.4.2 for further details.	program as present in the LSA (Appendix 9-C), and previously observed in the RSA (SKCDC 2023)	requirements and discussion on effects assessment are included in this Appendix. Any new species-specific mitigation measures identified in this appendix will be added to the final EIS (Section 9.4.5).
Common Nighthawk	*Chordeiles minor*	S4B	Special Concern	See Section 9.4.3.3 of the EIS for details.	Documented during the baseline field program as present in the LSA (Appendix 9-C), and previously observed in the RSA (SKCDC 2023)	Included as a KI of the Bird SAR VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Horned Grebe	*Podiceps auritus*	S5B	Special Concern	Breeding habitat consists of small to medium-sized freshwater lakes, ponds, and marshes that are shallow with open water (at least 40%), emergent vegetation, anchorage for nests, and concealment for nests and young. See Section 2.4.3 for further details.	Documented during the baseline field program as present in the LSA (Appendix 9-C).	Not included as a KI of the Bird SAR VC in the EIS (Yellow Rail was used as a surrogate species). A review of life history requirements and discussion on effects assessment are included in this Appendix. Any new species-specific mitigation measures identified in this appendix will be added to the final EIS (Section 9.4.5)..
Olive-sided Flycatcher	*Contopus cooperi*	S4B	Special Concern	See Section 9.4.3.3 of the EIS for details.	Documented during the baseline field program as present in the LSA (Appendix 9-C), and previously observed in the RSA (SKCDC 2023)	Included as a KI of the Bird SAR VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.

Common Name	Scientific Name	Provincial Status	Federal Status[1]	Preferred Habitat	Documented Occurrence in the Local Study Area[2]	Reference in the Environmental Impact Statement (EIS)
Rusty Blackbird	*Euphagus carolinus*	S3B, SUN	Special Concern	See Section 9.4.3.3 of the EIS for details.	LSA is located within COSEWIC range; no historical observations documented by the SKCDC (2023) and no Project-specific observations to date.	Included as a KI of the Bird SAR VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Short-eared Owl	*Asio flammeus*	S3B, S2N	Special Concern	See Section 9.4.3.3 of the EIS for details.	LSA is located within COSEWIC range; no historical observations documented by the SKCDC (2023) and no Project-specific observations to date.	Included as a KI of the Bird SAR VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Yellow Rail	*Coturnicops noveboracensis*	S3B	Special Concern	See Section 9.4.3.3 of the EIS for details.	LSA is located within COSEWIC range; no historical observations documented by the SKCDC (2023) and no Project-specific observations to date.	Included as a KI of the Bird SAR VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.

Note: shaded rows indicate SAR was included as a VC or KI in the draft EIS

1 Schedule 1 under the *Species at Risk Act*.

2 Potential for Occurrence – based on known species occurrence data from Saskatchewan Conservation Data Centre (2023), Omnia (Appendix 9-C), Birds of Saskatchewan (2019), and Atlas of Saskatchewan Birds (Smith 1996) and/or presence of suitable habitat.

2.1 Arthropods

2.1.1 Nine-Spotted Lady Beetle

Source: COSEWIC (2016a).

The nine-spotted lady beetle is a small beetle species found across southern Canada and the continental United States (COSEWIC 2016a). Its northern range limit in Saskatchewan is reported to occur near Lake Athabasca (COSEWIC 2016a). Based on records provided by the Saskatchewan Conservation Data Centre Hunting, Angling and Biodiversity of Saskatchewan (HABISask) database (SKCDC 2023), there are no historical observations of this species documented in the Regional Study Area (RSA).

The nine-spotted lady beetle is a habitat generalist that uses a diverse range of habitats (e.g., open to semi-open forests, grasslands, riparian areas) and consumes a variety of prey (e.g., many species of arthropods [particularly aphids], sap, nectar and pollen) (COSEWIC 2016a). Being a habitat generalist allows the nine-spotted lady beetle to exploit seasonally available prey sources, with prey availability influencing the species' distribution more than habitat availability (COSEWIC 2016a).

The nine-spotted lady beetle has four life stages (i.e., egg, larva, pupa, and adult) and may produce two generations per year (i.e., spring and fall) depending on regional climate conditions (COSEWIC 2016a). Lady beetles, in general, are highly mobile and may undertake short (few hundred metres) and long-distance (18 to 120 km) movements (COSEWIC 2016a). The nine-spotted lady beetle is not migratory nor does it display strong site fidelity (COSEWIC 2016a). The nine-spotted lady beetle overwinters in aggregations in well-ventilated habitats (e.g., in rock crevices, grass tussocks, or leaf litter, or under stones or tree bark), becoming active in the early spring when temperatures start to increase (COSEWIC 2016a).

The nine-spotted lady beetle is federally listed under Schedule 1 of SARA as Endangered (Government of Canada 2023) and is designated as an S4 species in Saskatchewan (i.e., Apparently Secure) (Saskatchewan Conservation Data Centre 2023). The species has undergone significant population declines in Canada since 1975, going from one of the more common lady beetles collected to being rarely collected relative to other lady beetles, despite comprehensive and targeted surveys (COSEWIC 2016a). Reasons for these population declines are currently unknown but are thought to be driven by competition, predation, and introduced diseases from non-native species (including non-native lady beetles), agricultural pesticide use to control aphids, habitat loss via urban expansion, and other human disturbances (COSEWIC 2016a).

2.1.2 Transverse Lady Beetle

Source: COSEWIC (2016b).

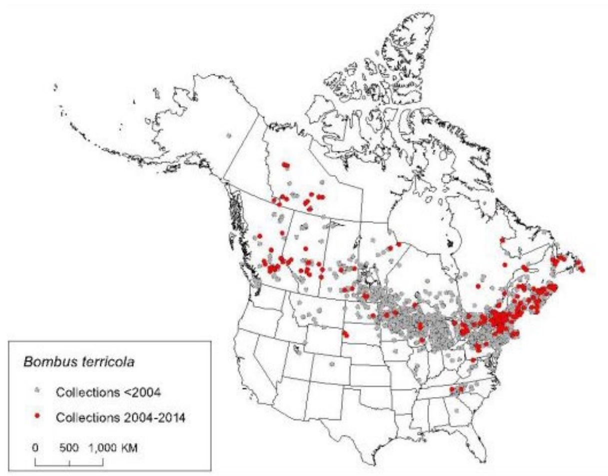
The transverse lady beetle is a small beetle species found across the United States and Canada, including all provinces and territories (COSEWIC 2016b). The species is a habitat generalist and uses similar habitat types and consumes similar prey as the nine-spotted lady beetle, which means it is also able to exploit seasonally available prey sources (COSEWIC 2016b). According to the information from the HABISask database, there are no historical observations of this species documented in the RSA.

The transverse lady beetle has four life stages (i.e., egg, larva, pupa, and adult) and may produce two generations per year (i.e., spring and fall) depending on regional climate conditions (COSEWIC 2016b). Lady beetles in general are highly mobile and may undertake short (few hundred metres) and long-distance (18 to 120 km) movements (COSEWIC 2016b). The transverse lady beetle is not migratory nor does it display strong site fidelity (COSEWIC 2016b). The transverse lady beetle overwinters in aggregations in well-ventilated habitats (e.g., in rock crevices, grass tussocks, or leaf litter, or under stones or tree bark), becoming active in the early spring when temperatures start to increase (COSEWIC 2016b).

The transverse lady beetle is federally listed under Schedule 1 of SARA as Special Concern (Government of Canada 2023) and is designated as an S4 species in Saskatchewan (i.e., Apparently Secure) (Saskatchewan Conservation Data Centre 2023). The species was once abundant across its range in Canada and was one of the most common lady beetles collected; however, since 1986, the species is now absent, below detection limits, or present in low numbers in many parts of its range (COSEWIC 2016b). The transverse lady beetle has not been detected in Saskatchewan since 2001 (COSEWIC 2016b). Reasons for these population declines are currently unknown but are thought to be driven by the same factors listed for the nine-spotted lady beetle in Section 2.1.1.

2.1.3 Yellow-banded Bumble Bee

The yellow-banded bumble bee is a medium-sized bumble bee species found throughout eastern North America, from eastern British Columbia (BC) to Newfoundland and Labrador and from the northern United States up to the southern portion of the territories (COSEWIC 2015). The species is a habitat generalist (e.g., boreal habitats, mixed woodlands, montane meadows) and consumes nectar and pollen from many different flowering plants (COSEWIC 2015). According to the information from the HABISask database, there are no historical observations of this species documented in the RSA.



Source: COSEWIC (2015).

The yellow-banded bumble bee has four life stages (i.e., egg, larva, pupa, and adult) and produces one generation per year, with mated queens establishing new colonies each year (COSEWIC 2015). After overwintering underground in loose soil or decomposing organic material, the mated queens emerge in the spring and search for potential nest sites, which are typically located underground in existing cavities (e.g., abandoned rodent burrows, rotten logs, openings in dead wood, and grassy hummocks) (COSEWIC 2015). Once a queen has found a suitable nest site, she forages for nectar and pollen and then returns to her nest site to lay eggs, which will develop into her future workers (i.e., unmated daughters that do not typically reproduce) (COSEWIC 2015). After the initial eggs hatch and the larva and pupa develop into adult workers, the workers take over nest and brood care, foraging duties, and colony protection while the queen continues to lay eggs (COSEWIC 2015). Males and potential queens are produced by late summer once the colony reaches maximum worker production, at which point they leave the colony and mate (COSEWIC 2015). All males and workers die by fall while the mated queens hibernate through the winter in suitable overwintering sites (COSEWIC 2015).

The yellow-banded bumble bee is federally listed under Schedule 1 of SARA as Special Concern (Government of Canada 2023) and is designated as an S4 species in Saskatchewan (i.e., Apparently Secure)

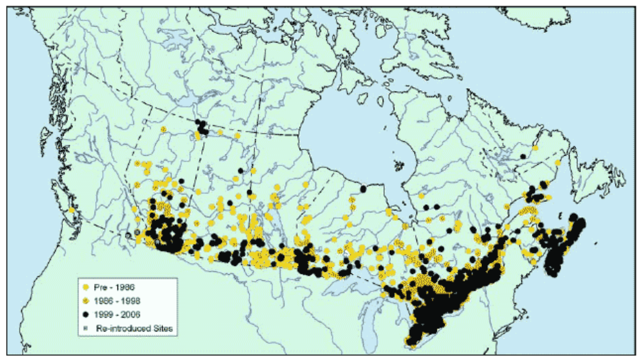
(Saskatchewan Conservation Data Centre 2023). Prior to the 1990s, the yellow-banded bumble bee was one of the more common bumble bees collected in eastern and boreal Canada (COSEWIC 2015, Environment and Climate Change Canada 2022a). Population declines started to occur in the early 1990s, with an average rate of decline of 66.5% in proportional abundance across central and southern Canada between 1992 and 2011 (COSEWIC 2015, Environment and Climate Change Canada 2022a). The species is no longer found at several historical collection sites (COSEWIC 2015).

The status of the yellow-banded bumble bee in boreal habitats and Arctic regions is unknown (COSEWIC 2015, Environment and Climate Change Canada 2022a). Reasons for these population declines are currently unknown but are thought to be driven by introduced diseases from managed bumble bee species, agricultural pesticide use, habitat loss via urban and agricultural expansion, and climate change (COSEWIC 2015).The species' unique type of sex determination, where colonies must reach maximum worker production to produce males and potential queens, has been identified as a limiting factor (COSEWIC 2015, Environment and Climate Change Canada 2022a).

2.2 Amphibians

2.2.1 Northern Leopard Frog

The northern leopard frog is found across most of west-central and northeastern North America (COSEWIC 2009a). The species is widespread in Canada, ranging from southeastern BC to Labrador, and from southcentral Northwest Territories (COSEWIC 2009a, NCC 2023).



Source: COSEWIC (2009a).

Three district habitats are used by the northern leopard frog on an annual basis: (1) overwintering waterbodies that are cold, well oxygenated, and do not freeze to bottom (e.g., rivers, streams, deep lake ponds and creeks, and spillways below dams); (2) breeding and larval waterbodies with shallow, open habitats (e.g., ponds, lakeshores, marshes, and slow-moving streams; may be permanent or semi-permanent), neutral pH, well vegetated, and no fish; and (3) summering areas in shallow marshes, moist upland meadows, forests and grasslands where grass height is less than 1 m (COSEWIC 2009a, NCC 2023). These habitats must be in proximity with suitable dispersal corridors interconnecting them (e.g., riparian areas and waterways) as the species is not capable of long-distance movements (COSEWIC 2009a, Environment Canada 2013).

Northern leopard frogs emerge from their overwintering waterbodies in early spring shortly after ice off (COSEWIC 2009a). The breeding season extends from mid-April to June, with exact timing dependent on location and latitude (COSEWIC 2009a). Females lay several thousand eggs, attaching them to submerged vegetation, which develop into tadpoles within two weeks depending on water temperatures (COSEWIC 2009a). The tadpoles in turn develop into small frogs over a two-to-three-month period, after which they migrate to their summering areas and forage on a variety of arthropods, worms, and snails, sometimes preying on small birds and smaller frogs (COSEWIC 2009a).

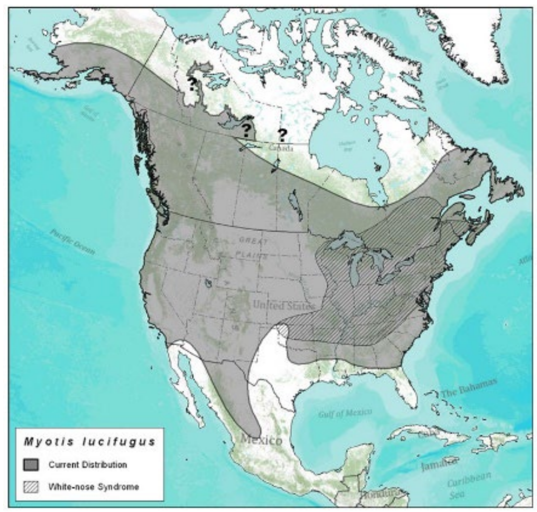
Three populations are recognized for the northern leopard frog in Canada: the Rocky Mountain, the Western Boreal/Prairie, and the Eastern (COSEWIC 2009a, NCC 2023). The Western Boreal/Prairie population is found in Alberta, Saskatchewan, Manitoba, and the Northwest Territories (COSEWIC 2009a, NCC 2023). The Western Boreal/Prairie population is federally listed under Schedule 1 of SARA as Special Concern (Government of Canada 2023) and is designated as an S3 species in Saskatchewan (i.e., Vulnerable) (Saskatchewan Conservation Data Centre 2023).

Population data are limited for the northern leopard frog in Canada (COSEWIC 2009a, Environment Canada 2013). Large-scale population declines occurred in the early 1970s, with populations in western Canada (i.e., BC and Alberta) most dramatically affected (COSEWIC 2009a). Information is lacking on the current status of northern leopard frog populations in Saskatchewan (COSEWIC 2009a, Environment Canada 2013).

Threats to the northern leopard frog include emerging diseases (e.g., *Chytridiomycosis*), introduced non-native species, habitat loss and fragmentation, environmental contamination, and increased frequency and severity of droughts (COSEWIC 2009a). The species' specific habitat requirements and vulnerability to diseases and prolonged periods of drought have been identified as limiting factors (Environment Canada 2013).

2.3 Bats

2.3.1 Little Brown Myotis



Source: COSEWIC (2013a).

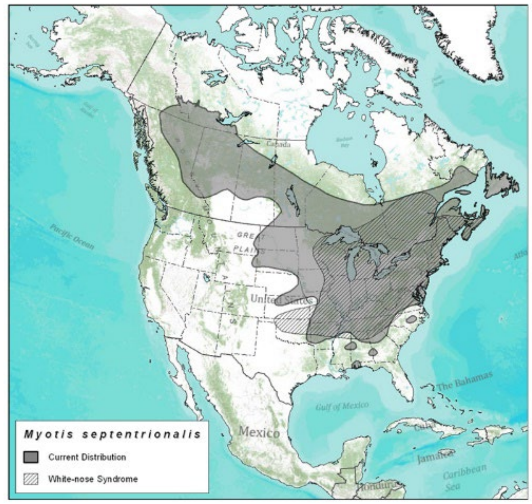
The little brown myotis is a small bat species found across North America, including across Canada south of the treeline (COSEWIC 2013a). The species is considered a short-distance regional migrant between its summer and winter ranges, with the distance travelled dependent on the location of suitable overwintering hibernacula (COSEWIC 2013a).

Habitat for the little brown myotis is composed of (1) overwintering hibernacula that are sufficiently cool and humid and (2) summering areas that provide foraging areas and suitable locations for roosting and maternity colonies (COSEWIC 2013a). Hibernacula and maternity sites are the main limiting habitat features for this species (COSEWIC 2013a). Hibernacula occur in parts of caves, mines, and buildings that have stable and specific temperature (-4 to 13°C) and humidity (>80%) conditions (COSEWIC 2013a). Maternity sites occur in large-diameter trees, rock crevices, buildings, and bat houses that offer warm and relatively stable microclimate conditions that allow females to avoid going into torpor so they can focus on caring for their young (COSEWIC 2013a, Slough and Jung 2020). Males are more versatile in their summer roosting requirements and use tree cavities, raised bark, foliage, rock crevices, buildings, and bridges with a broader range of microclimate conditions (COSEWIC 2013a, Johnson et al. 2019). Foraging areas for the little brown myotis include a variety of habitats situated close to roosting and maternity sites, including over water (e.g., wetlands, lakes, ponds, and rivers), along riparian areas and forest edges, and in forest gaps (COSEWIC 2013a).

The little brown myotis is federally listed under Schedule 1 of SARA as Endangered (Government of Canada 2023) and is designated as an S4B, S4N species in Saskatchewan (i.e., Apparently Secure breeding population, Apparently Secure non-breeding population) (Saskatchewan Conservation Data Centre 2023).

The current size of the little brown myotis population in Canada is unknown. Prior to the arrival of White-nose Syndrome in 2010, the population in Canada was estimated to be over one million individuals (COSEWIC 2013a, Environment and Climate Change Canada 2018). White-nose Syndrome is a disease the causes high rates of mortality among hibernating bats, and it has been identified as the main threat for bat populations in Canada (COSEWIC 2013a). Other threats to the little brown myotis include habitat loss, colony eradication, chemical contamination, and wind turbines (COSEWIC 2013a).

2.3.2 Northern Myotis



Source: COSEWIC (2013a).

The northern myotis is a small bat species found across North America, including across Canada south of the treeline (COSEWIC 2013a). The species is considered a short-distance regional migrant between its summer and winter ranges, with the distance travelled dependent on the location of suitable overwintering hibernacula (COSEWIC 2013a).

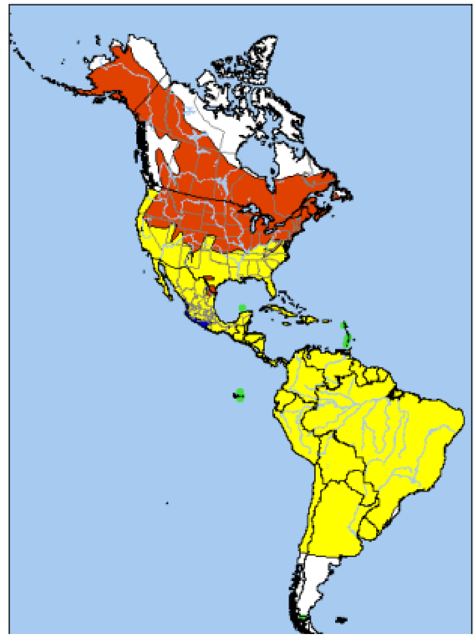
Habitat for the northern myotis is composed of (1) overwintering hibernacula that are sufficiently cool and humid and (2) summering areas that provide foraging areas and suitable locations for roosting and maternity colonies (COSEWIC 2013a). Hibernacula and maternity sites are the main limiting habitat features for this species (COSEWIC 2013a). Hibernacula occur in parts of caves, mines, and buildings that have stable and specific temperature (0.6 to 14°C) and humidity (>80%) conditions (COSEWIC 2013a). Summer roosting trees are typically found in mature to old-growth forests, swamps, and riparian areas, although retained older trees and snags in younger forests may occasionally provide suitable roosting habitat (Environment and Climate Change Canada 2018). Females strongly prefer tall, large-diameter trees (both living and dead, typically deciduous) with early- to mid-decay for maternity sites (COSEWIC 2013a, Environment and Climate Change Canada 2018). Anthropogenic features (e.g., barns) may occasionally be used as maternity sites in fragmented landscapes with few potential roost trees (Environment and Climate Change Canada 2018). Maternity sites that maintain warm and relatively stable microclimate conditions are important to reproductive females and young as they allow more energy to be directed toward growth and development (Caceres and Barclay 2000, COSEWIC 2013a). Males are more versatile in their summer roosting requirements; they most frequently roost under exfoliating, raised bark but may also roost in the cavities and crevices of trees and snags with early- to mid-decay (Jung et al. 2004, COSEWIC 2013a).

The northern myotis is well adapted to flying in areas of dense or structurally complex vegetation where it catches flying insects on the wing or feeds by gleaning prey from foliage (Caceres and Barclay 2000, Henderson and Broders 2008). The species typically forages within the interior of mature to old-growth deciduous and mixedwood forests, but may also forage in forest gaps, along forest edges and riparian areas, and over rivers (Henderson and Broders 2008, COSEWIC 2013a).

The northern myotis is federally listed under Schedule 1 of SARA as Endangered (Government of Canada 2023) and is designated as an S3 species in Saskatchewan (i.e., Vulnerable) (Saskatchewan Conservation Data Centre 2023). The current size of the northern myotis population in Canada is unknown. Prior to the arrival of White-nose Syndrome in 2010, the population in Canada was estimated to be over one million individuals (COSEWIC 2013a, Environment and Climate Change Canada 2018). White-nose Syndrome has been identified as the main threat for northern myotis populations in Canada (COSEWIC 2013a). . Other threats to the northern myotis include habitat loss, colony eradication, chemical contamination, and wind turbines (COSEWIC 2013a)

2.4 Avian Species

2.4.1 Bank Swallow



Source: COSEWIC (2013b).

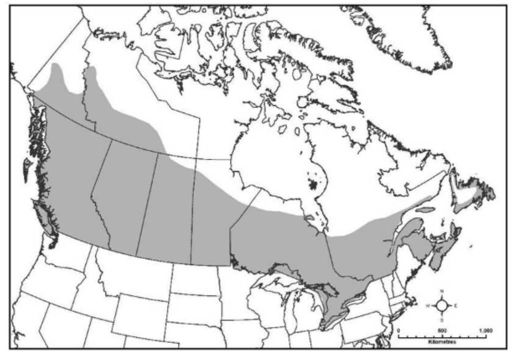
The Bank Swallow is a small songbird that occurs on every continent (except Antarctica and Australia), breeds throughout Canada, and winters primarily in South America (COSEWIC 2013b). Nesting colonies are typically characterized by steep embankments with a sand, silt, or clay substrate that can be easily excavated for burrows (COSEWIC 2013b, Government of Canada 2019a). These steep sand, silt, or clay embankments are frequently subject to erosion or slumping (COSEWIC 2013b, Garrison and Turner 2020).

Nesting colonies are often adjacent to slow-moving or still waterbodies (e.g., low gradient rivers or lakes) and may occur in natural habitats or in anthropogenic features (e.g., quarries or road cuts) (COSEWIC 2013b, Government of Canada 2019a, Garrison and Turner 2020). Colony size can range from less than half a dozen burrows to hundreds or thousands of burrows (COSEWIC 2013b, Government of Canada 2019a). Individual burrows within colonies may be recolonized in subsequent years if the integrity of the colony remains intact (i.e., does not erode and collapse) (Garrison and Turner 2020). Bank Swallows are aerial insectivores that forage over a variety of open habitats such as lakes, ponds, rivers, wetlands, grasslands, and agricultural areas (COSEWIC 2013b, Garrison and Turner 2020).

The Bank Swallow is federally listed under Schedule 1 of SARA as Threatened (Government of Canada 2023) and is designated as an S4B, S5M species in Saskatchewan (i.e., Apparently Secure breeding population, Secure aggregating transient population [migrants]) (Saskatchewan Conservation Data Centre 2023). The most recent breeding population estimate for Canada is 2.4 million individuals (Environment and Climate Change Canada 2022b). Based on Breeding Bird Survey (BBS) data collected between 1970 and 2019, the Bank Swallow population in Canada has declined at a rate of 5.3% per year, for an overall decline of 98.0% (Environment and Climate Change Canada 2022b). The long-term population decline appears to be driven by several threats acting cumulatively, including loss of nesting and foraging habitats, incidental take during anthropogenic activities (e.g., aggregate extraction and erosion control), large-scale declines in aerial insect populations, and climate change (COSEWIC 2013b). Bank Swallows are also particularly vulnerable to collisions with vehicles partly due to the attraction of individuals to intraspecific carcasses; one swallow hit by a vehicle could attract several individuals to a road, potentially resulting in subsequent collisions and large mortality events (COSEWIC 2013b, Garrison and Turner 2020).

Although colonial nesting may provide advantages (e.g., predation protection and assistance with thermoregulation), it has been identified as a limiting factor for the Bank Swallow, potentially making them more vulnerable to natural events or anthropogenic activities, which may result in mass mortality events (Environment and Climate Change Canada 2022b).

2.4.2 Barn Swallow

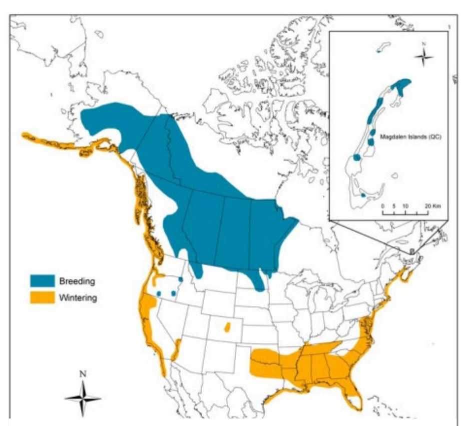


Source: COSEWIC (2021).

The Barn Swallow is a medium-sized songbird that occurs on every continent (except Antarctica), breeds throughout Canada, and winters in the southern United States, Mexico, and southwards (COSEWIC 2021). Breeding habitat typically requires a suitable nesting site with a vertical or horizontal surface underneath a roof of some sort, open areas for foraging (e.g., grasslands, fields, wetlands, and shorelines), and a waterbody with mud for nest building (Government of Canada 2019b, Brown and Brown 2020, COSEWIC 2021). Historically, suitable nesting sites were likely provided by caves, cliff faces, rock leges, tree branches, and hollow trees (Brown and Brown 2020, COSEWIC 2021). Today, nesting sites are usually located within agricultural and rural areas, and along roads and highways (Brown and Brown 2020, COSEWIC 2021). Anthropogenic features such as barns, houses, bridges, and culverts are commonly used for nesting sites (COSEWIC 2021). Barn Swallows nest in colonies or independently and typically return to the same nesting sites each year and may reuse old nests (Government of Canada 2019b, Brown and Brown 2020, COSEWIC 2021).

The Barn Swallow is federally listed under Schedule 1 of SARA as Threatened (Government of Canada 2023) and is designated as an S4B species in Saskatchewan (i.e., Apparently Secure breeding population) (Saskatchewan Conservation Data Centre 2023). An estimated 6.4 million individuals currently breed in Canada, with over 60% of the population breeding throughout the prairie provinces (COSEWIC 2021). Based on BBS data collected between 1970 and 2019, the Barn Swallow population in Canada has declined at a rate of 2.34% per year, for an overall decline of 68.6% (COSEWIC 2021). Intensification of agriculture, loss of nesting sites, large-scale declines in aerial insect populations, and climate change are cited as the most imminent threats for the Barn Swallow, and its dependence on aerial insects for prey and low post-fledging survival rates are cited as limiting factors for the species (COSEWIC 2021). The repeated use of anthropogenic features for nesting makes Barn Swallows vulnerable to incidental take, especially if the anthropogenic features require routine maintenance. In addition, their frequent use of anthropogenic features for nesting makes Barn Swallows vulnerable to entrapment (e.g., buildings, pipes, vents, other enclosed spaces) as they search for potential locations to build a nest (COSEWIC 2021).

2.4.3 Horned Grebe



Source: COSEWIC 2009b

The Horned Grebe is a small waterbird that occurs in North America and Eurasia (COSEWIC 2009b). Within North America, the species breeds across western Canada from BC and Yukon across to the Magdalen Islands in Quebec and winters along the Pacific and Atlantic coasts (COSEWIC 2009b).

Breeding habitat for the Horned Grebe consists of small to medium-sized freshwater lakes, ponds, and marshes that are shallow with open water (at least 40%), emergent vegetation, anchorage for nests, and concealment for nests and young (COSEWIC 2009b, Stedman 2020). Horned Grebes use a range of waterbody sizes for breeding, but typically prefer waterbodies between 0.3 and 2.0 ha in size (COSEWIC 2009b). Most pairs are solitary, but loose colonies of up to 20 pairs have been found on larger waterbodies with abundant food resources (COSEWIC 2009b, Stedman 2020). Nests are typically located in shallow water near shore on a floating or emerging mass of vegetation (COSEWIC 2009b). Horned Grebes are diving birds that feed on a variety of aquatic arthropods and fish (COSEWIC 2009b, Stedman 2020).

The Western population of the Horned Grebe is federally listed under Schedule 1 of SARA as Special Concern (Government of Canada 2023) and is designated as an S5B species in Saskatchewan (i.e., Secure breeding population) (Saskatchewan Conservation Data Centre 2023). An estimated 200,000 to 500,000 individuals occur in the Western population, with most breeding in southern Alberta and Saskatchewan (COSEWIC 2009b, Environment and Climate Change Canada 2022c). Based on BBS data collected between 1970 and 2019, the Western population of the Horned Grebe in Canada has declined at a rate of 1.7% per year, for an overall decline of 57.0% (Environment and Climate Change Canada 2022c). The reasons for this population decline are unknown. Probable threats include permanent habitat loss, temporary loss of habitat during droughts, eutrophication and degradation of habitat due to fertilizers, predator expansion on the prairies, Type E botulism in the Great Lakes, entanglement in commercial fishing gear, climate change and extreme weather, and oil spills on wintering grounds (COSEWIC 2009b).

3 Mitigation Measures

The Project will require the construction, operation, and decommissioning of several components (as described in Section 2 of the EIS). Expected interactions between these Project components and activities and the wildlife VCs and their associated KIs are summarized by Project phase and activity in Tables 9.3-6 and 9.4-5 of the EIS. Based on the timing and nature of interactions identified in Tables 9.3-6 and 9.4-5 of the EIS, the following adverse effects on the wildlife VCs, including SAR, are likely to occur during the lifetime of the Project:

- alteration and/or loss of habitat; and
- change in mortality.

These potential effects apply to Wildlife SAR as well. The potential effects are described in Sections 9.3.4.2 and 9.4.4.2 of the EIS for each Project phase as they may affect the wildlife VCs and associated KIs.

Mitigation in this EIS is defined as the elimination, reduction, or control of potential adverse effects of the Project on the environment throughout all Project phases. Project-specific mitigation measures include: Project design; implementation of best management practices; development of management plans; implementation of emergency response programs; and provision of training, education and awareness (Denison 2020). Mitigation measures for each potential effect are described in Sections 9.3.5 and 9.4.5 of the EIS. The following subsections summarize mitigation measures that will be implemented to avoid or minimize adverse effects on the Wildlife SAR.

3.1 Project Design Measures

Potential adverse effects on Raptors, Migratory Breeding Birds, and Bird SAR VCs will be avoided or minimized to the extent practical through Project design. All of the Project design measures listed here are consistent with those presented in Section 9 of the EIS (i.e., there are no new Project design measures proposed in this appendix):

- The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent practicable resulting in reduced habitat disturbance and noise propagation.
- Much of the proposed footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance.
- The powerline to the main substation at the site is relatively short (i.e., approximately 7 km) and will be constructed from the existing provincial power line adjacent to Highway 914.
- During Operation, progressive reclamation activities will be completed where possible, and the progress and success of these activities will be assessed annually.
- Cleared brush will be stockpiled when possible, to be used in progressive reclamation.
- Ongoing decommissioning of Project components will be completed when possible.
- Dust deposition on vegetation and waterbodies (including potential deposition of trace metals and radionuclides) will be reduced by:
    - directing processing plant exhaust from drying and packaging areas through a stack prior to release outside of the building;
    - designing the stack height based on results of air dispersion modelling to be an appropriate height for optimal dispersion;

  - controlling access to the property with both a north and south security gate (the north gate is on a decommissioned road and the south gate is manned);
  - making a wash bay available to clean items, equipment and vehicles that may have been in contact with potentially contaminated materials. Contaminated water from the wash bay will be collected in a sump tank and routed to the water treatment plant for treatment and discharge;
  - conducting radiological clearance scanning as required for any items, equipment, and vehicles leaving the Project Area; and.
  - watering and traffic controls on roads.

- Battery-powered light vehicles and mobile equipment, and an AC powered dual rotary drill for ISR wellfield development instead of a traditional diesel-powered unit, will be employed, where practical, to reduce air emissions and noise levels and improve energy efficiency.
- The main sources of noise will be related to transport of people and goods, drilling of holes for the freeze wall and wellfield, operation of the batch plant, operation of the processing plant, and operation of the pumphouses. The use of high-quality, low sound emission equipment and regular maintenance will reduce noise associated with Project activities.
- Bulk storage tanks for processing chemicals such as sulphuric and/or hydrochloric acid, sodium hydroxide, and hydrogen peroxide will sit inside appropriately designed and sized secondary containment basins, physically separated from the containment basins for other chemical systems.
- Surface pipelines will be designed to have secondary containment or catchment and have leak detection systems in place at key locations.
- A freeze wall will be established around the uranium deposit to reduce groundwater disturbance.
- Mining solution and process water will be reused throughout the mining process, reducing water use requirements to the extent feasible and reducing the volume of treated effluent requiring discharge. Make-up water will be preferentially sourced from site runoff where possible.
- Double-walled, high-density polyethylene or equivalent piping will be used in the wellfields and will be freeze protected and secured to minimize pipe movement.
- Contaminated wastes (e.g., mineralized drill cuttings, solid impurities removed from mining solution, dewatered reject solids) will be properly contained on a double lined waste pad with leak detection capabilities and an associated monitoring program. An adjacent pond will be used to collect runoff from the pad and water in the waste pond will be piped to the water treatment plant. Such waste will be disposed of either on site or off site at an approved facility.
- The ISR wellfield and processing plant will be designed to re-use most of the solutions inside each circuit; any excess water will be released to a surface water body once acceptable water quality is achieved. All treated effluent released to surface water will meet federal and provincial regulatory discharge limits.
- All contaminated areas, such as waste ponds and pads, and the domestic landfill will be fenced to avoid contact with workers and wildlife. Fences will be monitored and maintained.

3.2 General Mitigation Measures for Wildlife Species at Risk

Mitigation measures specific to the Wildlife SAR, in accordance with the *Migratory Birds Convention Act* and tailored to Project features will be incorporated into various Project management and monitoring plans such as the erosion and sediment controls, soil and vegetation monitoring, wildlife monitoring, the Decommissioning Plan, air quality monitoring, Spill Response Plan, Radiation Protection Plan, surface water and effluent monitoring and Waste Management Plan.

The management plans within the Environmental Management System (EMS) will provide specific mitigation measures based on proven and accepted mitigation measures following standard industry guidelines and best management practices. The EMS will provide guidance to avoid or minimize potential adverse effects of the Project on avian species and their habitat, including monitoring and follow-up programs, as appropriate. It will be in place during all phases of the Project and will be subject to ongoing review and revision as required. If monitoring identifies a need for additional or revised mitigation measures, a process of adaptive management (as described in the plan) will be triggered. The Project management plans provide direction on monitoring and adaptive management so that responses are timely and effective.

The following subsections provides a description of the mitigation measures that will be applicable during all Project phases and expected to be effective immediately following implementation. Additional mitigation measures specific to the Wildlife SAR that were not included or that were revised from what was described in the draft EIS are provided in **bold text**.

3.2.1 Work Timing Windows and Habitat Disturbance

- Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the nesting season, when practical. **The nesting season for many Wildlife SAR in Saskatchewan spans a period from March 15 to August 31; however, the dates differ for certain species. The Wildlife Management Plans within the EMS will provide details on nesting windows for avian species, as well as other sensitive time periods (e.g., caribou calving periods) occurring in the Terrestrial RSA based on the Saskatchewan Activity Restriction Guidelines for Sensitive Species (SARGSS), which were established to support the avoidance of sensitive species' habitats during sensitive periods (SK MOE 2017).**
- **Prior to commencing any site clearing (i.e., vegetation clearing and/or soil disturbance) during the nesting and breeding season, pre-disturbance wildlife clearance surveys will be conducted a by a Qualified Professional (QP) at that location within the Project Area to identify sensitive species and habitat features (e.g., nests as well as roosts and hibernacula used by bat species).**
- **Active and/or suspected breeding and roosting locations identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) in accordance with the level of the disturbance and species until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations). If guidelines cannot be met, due to safety or operational concerns, SK MOE will be contacted for advice on the appropriate response to the situation.**

3.2.2 Wildlife Education and Awareness

- Employees and contractors will be provided with wildlife education and awareness training, including education about potential Wildlife SAR issues on site and training on the mitigation measures to avoid or minimize potential adverse Project effects on Wildlife SAR and their habitats.
- Employees and contractors will be educated on waste management policies that limit human-avian interactions.
- Designated employees will be trained in appropriate avian deterrent techniques to minimize avian interactions with the Project.
- **Employees and contractors will be requested to report avian observations on site, injured or dead birds (which will be reported to SK MOE). Avian encounters and outcomes will be monitored, and logbooks will be used to record observations. Logbooks and reports will be available to employees.**

3.2.3 Wildlife and Habitat Protection

- Personal firearms will be prohibited for employees and contractors within the Project Area to prevent hunting activities.
- If any individual were seeking access around the Project area to undertake Aboriginal and/or Treaty Rights, Denison staff would facilitate this, provided it were safe to do so given activities in the area.
- Policies will be implemented prohibiting employees and contractors from feeding, approaching, or harassing avian species within the Project Area.
- To support habitat regeneration, progressive reclamation and ecosystem-based revegetation will be conducted on disturbed areas as soon as practicable in accordance with the Reclamation and Closure Plan.

3.2.4 Wildlife Deterrence and Prevention of Wildlife Entrapment

- **Buildings and other Project infrastructure will be designed and maintained to exclude birds (e.g., barn swallows) and bats as much as possible. This would include installing solid barriers (e.g., corner slope panels, wooden panels) or flexible barriers (e.g., netting, tarps or geotextiles) under roof eaves or other exterior surfaces.**
- **Physical, visual, and/or auditory deterrents will be used to discourage bird and bat use of buildings and other Project infrastructure (e.g., water or waste treatment ponds) for refuge, shelter, breeding, and roosting, and to deter birds and bats from potentially becoming entrapped.**
- **Noise emitting Project activities will be managed to minimize sensory disturbance of wildlife SAR species, especially during sensitive time periods (i.e., breeding and nesting).**
- Low sound emission equipment, regular maintenance of equipment, and the use of silencers or mufflers (whenever practical) will be used to reduce noise associated with Project activities, to the extent practical.
- **Directed lighting or light shielding, rather than broad lighting, will be implemented to minimize sensory disturbance on the wildlife SAR, and lighting will be focused on work sites and not surrounding areas.**

- Dust generation and subsequent deposition on vegetation and in waterbodies (including potential deposition of trace metals and radionuclides) will be limited through dust suppression techniques such as road watering and traffic management.

3.2.5 Road and Traffic Management

- Traffic and access control measures will be implemented will include reducing traffic volume by scheduling truck convoys, using high-volume haul trucks, and restricting public access to the Project site and roads (e.g., private vehicles, snowmobiles, all-terrain vehicles, and foot traffic). It is important to note that if any individual were seeking access around the Project area to undertake Aboriginal and / or Treaty Rights, Denison staff would facilitate this, provided it were safe to do so given activities in the area.
- Appropriate road signage will be installed (e.g., speed limits) along Project roads to raise awareness and minimize the potential for wildlife SAR-vehicle collisions.
- Wildlife will have the right-of-way on Project roads, unless it is unsafe to stop (i.e., if a collision is imminent). Vehicles will not be used to encourage wildlife to move off Project roads.
- Processes will be implemented for employees and contractors to slow down and/or stop vehicles/equipment to allow animals to move away or off the road before resuming normal road speeds for the area.
- Employees and contractors will report and communicate the location and circumstances of any roadkill observed on or alongside Project roads. Large-bodied wildlife carcasses found will be reported to SK MOE and disposed of as directed to discourage avian scavengers.
- **Vegetation management, such as mowing and brush cutting, will be implemented along Project roads to reduce site attractiveness for wildlife SAR and maintain appropriate sightlines for drivers to minimize wildlife-vehicle collisions.**
- Alternative measures on Project roads for de-icing and winter traction (e.g., sand, gravel) or dust suppression (e.g., water) will be implemented, whenever practicable.
- Appropriately sized gaps in the roadside snowbanks during winter will be maintained to facilitate wildlife crossing and escape thereby reducing the risk of wildlife-vehicle collisions.
- New Project site and access roads will be designed to minimize sightlines for predators, whenever practicable, while still maintaining general road safety.
- Ditches and culverts along Project roads will be designed and maintained to minimize pooling of water. Roadside pools that form may attract wildlife.

3.2.6 Waste and Hazardous Materials Management

- A "no littering policy" for employees and contractors will be implemented within the Project Area.
- **Vegetation management will be incorporated in the vicinity of waste ponds to discourage wildlife SAR use of potentially affected vegetation.**
- Waste will be collected and temporarily stored in wildlife-proof containers to avoid attracting scavengers and with that increase the risk for human-wildlife interact.
- The wildlife-proof containers will be inspected regularly for evidence of avian presence (e.g., gull species) or access to waste disposal facilities. If evidence of avian presence or access to waste disposal facilities is detected, modified systems will be implemented and/or off-site waste disposal frequencies will be increased.
- The use of hazardous materials will be limited as much as possible.

- Hazardous materials will be handled, stored, and disposed of appropriately and in accordance with a Waste Management Plan to avoid attracting avian scavengers (e.g., wildlife-proof containers, exclusion fencing).
- Physical deterrents (e.g., fencing) will be employed around contaminated areas (e.g., waste ponds and waste pads), the domestic landfill, or hazardous materials storage areas to discourage wildlife use.
- Appropriate hazardous materials management practices will be implemented in accordance with industry guidelines and a Waste Management Plan to minimize the risk of accidental spills or leakage.
- Appropriate spill response kits will be positioned adjacent to areas where hazardous materials are stored in accordance with the Spill Response Plan.
- A minimum 100 m distance from any waterbody will be maintained for fuel storage, refueling activities, or equipment servicing in accordance with the Spill Response Plan.
- Appropriate fuel, chemical, and materials management practices will be followed in accordance with the Spill Response Plan to minimize the risk of accidental spills or leakage of diesel fuel, other hydrocarbons, and other hazardous materials.
- Air emissions will be reduced to the extent practical through implementation of an air quality monitoring plan within the EMS.
- All vehicles and equipment will be equipped with industry-standard emission control systems; unnecessary idling of vehicles will be prohibited.
- Vehicles and equipment will be maintained in good working condition (e.g., no leaks) and furnished with industry-standard spill response kits.
- Mitigation measures to reduce the potential for dispersion of radiological contaminants of potential concern to vegetation will be implemented in accordance with the Radiation Protection Plan.
- Education on and enforcement of proper waste and hazardous materials management practices will be provided to employees and contractors.

3.3 Species-Specific Mitigation Measures for Wildlife Species at Risk

The following provides a summary of the species-specific mitigation measures that will be implemented during Project activities. Mitigation measures specific to the Wildlife SAR that were not included or that were revised from what was described in the draft EIS are provided in **bold text**. These will be added to the final EIS.

3.3.1 Arthropod Species

- Mitigation measures designed for the Soil and Organic Matter / Peat (Section 9.1.5) and Vegetation and Ecosystems (Section 9.2.5) VCs are expected to mitigate adverse effects on the arthropod species that are considered SAR (i.e., nine-spotted lady beetle, transverse lady beetle, and yellow-banded bumble bee) primarily related to limiting the loss and/or disruption of suitable habitat for these species. These include:
    - The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation.

- Much of the proposed Project Footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance.
- During Operation, progressive reclamation will be completed where possible, and the progress and success of these activities will be assessed annually.

- **Herbicide use as part of vegetation management will be limited to the immediate Project Footprint and applied by licensed professional applicators, when necessary, to limit the potential for adverse effects on arthropod species.**

3.3.2 Amphibian Species

- Mitigation measures designed for the Wetlands VC (Section 9.2.5) are expected to mitigate adverse effects on the northern leopard frog primarily related to limiting the loss and/or disruption of suitable habitat for these species. These include:
  - The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation.
  - Much of the proposed Project Footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance.
  - During Operation, progressive reclamation will be completed where possible, and the progress and success of these activities will be assessed annually.
- **Pre- disturbance wildlife clearance surveys will be conducted to identify site-specific habitat features (e.g., amphibian breeding ponds) and implement the setbacks and/or timing windows (that will be defined in the Wildlife Management Plan).**
- **Locations of site-specific habitat features used by amphibians will be communicated to Project personnel and the requirement to limit disturbance in these areas will be implemented.**
- **Appropriate setback and buffer distances from wetland features where amphibians are known to occur will be implemented and maintained under the direction of a wildlife QP.**
- **Vehicle traffic and construction activities will be restricted to the approved access routes and work areas and will not cross or enter a watercourse or wetland**.

3.3.3 Bat Species

- Vegetation clearing activities will occur outside of roosting periods, when practical.
- **Pre- disturbance wildlife clearance surveys will be completed to identify site-specific habitat features such as maternal rooting sites and hibernacula used by bat species. If features are identified in the Project Footprint, appropriate setbacks and/or timing windows will be implemented in accordance with the SARGSS (SK MOE 2017 (that will also be defined in the Wildlife Management Plan).**
- **In the event a maternal roosting site is identified on the Project Footprint, exclusionary methods (e.g., installing a one-way bat exit) will be implemented following the summer maternity roost season. This installation would allow for bats to leave but not the ability to re-enter the roosting site.**

- **Locations of these site-specific habitat features used by bats will be communicated to the appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.**
- **Specific exclusion methods will be added as mitigation measures (Section 9.4.5 of the final EIS) to prevent access to buildings and other infrastructure.**

3.3.4 Avian Species

- Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the nesting season, when practical. The breeding and nesting season for most avian species in Saskatchewan typically spans a period from March 15 to August 31; however, the dates differ for certain species.
- **In the event Project activities such as vegetation clearing and/or soil disturbance are required during the breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of avian SAR and/or their nests.**
- **Active and/or suspected breeding and roosting locations identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) for other grebe species (as there is currently no activity restriction guidelines for horned grebe in Saskatchewan) in accordance with the level of the disturbance and species until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).**
- **Locations of nesting sites used by bank swallows, barn swallows, and horned grebe will be communicated to appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.**
- **Deterrents designed to discourage or prevent barn swallows from using buildings and other Project infrastructure have been described in Section 3.2.4 of the EIS.**
- **Buildings and other Project infrastructure will be designed and maintained to exclude birds (e.g., barn swallows) and bats as much as practical. This would include installing solid barriers (e.g., corner slope panels, wooden panels) or flexible barriers (e.g., netting, tarps or geotextiles) under roof eaves or other exterior surfaces.**

4 Residual and Cumulative Effects Summary

The approach to assessing residual Project effects on wildlife VCs followed the methodology outlined in Section 5.8 of the EIS, which included a habitat-based approach. For each VC and associated KI, each residual effect was assessed in the context of the Project activities that will occur within each Project phase. Each residual effect was then characterized based on the combined predicted residual effect for all phases. See Sections 9.3.6 and 9.4.6 of the EIS for specific details regarding the residual effects assessment for wildlife VCs (i.e., residual effect characterization and significance determination). A summary of the environmental assessment considerations and determination for predicted residual effects for Wildlife SAR is provided in Table 4.1. Mitigation measures specific to the Wildlife SAR that were not included or that were revised from what was described in the draft EIS are provided in bold text. These will be added to the final EIS.

The cumulative effects assessment (CEA) followed standard methodology as per provincial (e.g., Guidelines for an Environmental Assessment under the [Saskatchewan] *Environmental Assessment Act* 1980) and federal (e.g., Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act 2012*) guidance, and is discussed in detail in Section 5.9 of the EIS. Similar to the residual effects assessment, the CEA included a habitat-based approach. See Sections 9.3.7 and 9.4.7 of the EIS for specific details regarding the CEA for wildlife VCs. A summary of the significance determination of the cumulative effects on Wildlife SAR is provided in Table 4.2.

Table 4.1 Summary of the Environmental Assessment Considerations and Determination for Predicted Residual Effects for Wildlife Species At Risk

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
Terrestrial Environment	Nine-spotted lady beetle Transverse lady beetle Yellow-banded bumble bee	Amount of habitat that is altered or lost relative to its availability in the Terrestrial Regional Study Area (RSA).	• Development of access roads and air strip. • Site preparation and earthworks; clearing, levelling, and grading of the Project Area. • Waste management (composting, domestic and industrial landfill operation, recycling). • Water management (including treatment). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	• The proposed mitigation measures outlined in the EIS, particularly those designed for the Valued Components (VCs) Soil and Organic Matter / Peat (Section 9.1.5) and Vegetation and Ecosystems (Section 9.2.5), adequately and appropriately address potential for adverse effects on these species, primarily related to limiting the loss and/or disruption of suitable habitat. These include the following: - The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation. - Much of the proposed Project Footprint will be developed within previously disturbed areas, including	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, and fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for the arthropod SAR within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• Water withdrawal from groundwater or surface water body. • Management of surface water (including seepage and site runoff). • Water release to groundwater and/or surface water body. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			

[1] Mitigation measures specific to the Wildlife SAR that were not included or that were revised from what was described in the draft EIS are provided in bold text.

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
			• Site water management, treatment, and release • Process water treatment and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning	roads currently used for exploration activities, thereby minimizing additional habitat disturbance. - During Operation, progressive reclamation will be completed where possible, and the progress and success of these activities will be assessed annually. • **Herbicide use as part of vegetation management will be limited to the immediate Project Footprint applied by licensed professional applicators when necessary to limit the potential for adverse effects on arthropod species.**		
		Mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, levelling, and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction		Change in mortality: predicted to be low magnitude, local in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of the arthropod SAR to the point where they are not sustainable or available to contribute to ecological functions.
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
Terrestrial Environment	Northern leopard frog	Amount of habitat that is altered or lost relative to its availability in the Terrestrial RSA.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, leveling and grading of the Project Area. • Water management (including treatment and site runoff). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials.	Construction	• The proposed mitigation measures outlined in the EIS, particularly those designed for the Wetlands VC (Section 9.2.5), adequately and appropriately address potential adverse effects on northern leopard frogs, primarily related to limiting the loss and/or disruption of suitable habitat for this species. These include the following: - The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation. - Much of the proposed Project Footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance.	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for northern leopard frog within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• Water withdrawal from groundwater or surface water body. • Management of surface water (including seepage and site runoff). • Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials.	Operation			
			• Site water management, treatment, and release. • Process water treatment and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
		Mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials.	Construction	- During Operation, progressive reclamation will be completed where possible, and the progress and success of these activities will be assessed annually. • **Pre- disturbance wildlife clearance surveys will be conducted to identify site-specific habitat features (e.g., amphibian breeding ponds) and implement the setbacks and/or timing windows (that will be defined in the Wildlife Management Plan).** • **Locations of site-specific habitat features used by amphibians will be communicated to Project personnel and the requirement to limit disturbance in these areas will be implemented.** • **Appropriate setback and buffer distances from wetland features where amphibians are known to occur will be implemented and maintained under the direction of a wildlife QP.**	Change in mortality: predicted to be low magnitude, local in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of northern leopard frog to the point where they are not sustainable or available to contribute to ecological functions
			• Water withdrawal from groundwater or surface water body. • Management of surface water (including seepage and site runoff). • Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials	Operation			
			• Site water management, treatment, and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • Reclamation of disturbed areas). • On-site and off-site operation of vehicles and transport of materials.	Decommissioning			

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
					• **Vehicle traffic and construction activities will be restricted to the approved access routes and work areas and will not cross or enter a watercourse or wetland.**		
Terrestrial Environment	Little brown myotis Northern myotis	Amount of habitat that is altered or lost relative to its availability in the Terrestrial RSA.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	• **Vegetation clearing activities will occur outside of roosting periods, when practical.** • **Pre- disturbance wildlife clearance surveys will be completed to identify site-specific habitat features such as maternal rooting sites and hibernacula used by bat species. If features are identified in the Project Footprint, appropriate setbacks and/or timing windows will be implemented in accordance with the SARGSS (SK MOE 2017 (that will also be defined in the Wildlife Management Plan).** • **In the event a maternal roosting site is identified on the Project Footprint, exclusionary methods (e.g., installing a one-way bat**	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for bat species within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
		Mortalities directly or indirectly	• Development of access roads and air strip.	Construction		Change in mortality: predicted to be low	The predicted residual effect of

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
		attributable to the Project.	• Site preparation and earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.		**exit) will be implemented following the summer maternity roost season. This installation would allow for bats to leave but not the ability to re-enter the roosting site.** • **Locations of these site-specific habitat features used by bats will be communicated to appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.** • **Specific exclusion methods will be added as mitigation measures (Section 9.4.5 of the final EIS) to prevent access to buildings and other infrastructure.**	magnitude, local in geographical extent, long-term duration, infrequent, and fully reversible.	change in mortality is not expected to alter the integrity of the regional populations of the bat species to the point where they are not sustainable or available to contribute to ecological functions
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
Terrestrial Environment	Bank Swallow Barn Swallow Common Nighthawk Horned Grebe Olive-sided Flycatcher Rusty Blackbird	Amount of habitat that is altered or lost relative to its availability in the Terrestrial RSA.	• Development of access roads and air strip. • Site preparation an earthworks; clearing, leveling and grading of the Project Area. • Water management (including treatment and site runoff). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials.	Construction	• Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the nesting season, when practical. The breeding and nesting season for most avian species in Saskatchewan typically spans a period from March 15 to	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for the avian SAR within the Terrestrial RSA to the

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
	Short-eared Owl Yellow Rail		• Air transportation for workers.		August 31; however, the dates differ for certain species. • **In the event Project activities such as vegetation clearing and/or soil disturbance are required during the breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted a by a QP at that location within the Project Area before activities commence to identify the presence of avian SAR and/or their nests.** • **Active and/or suspected breeding and roosting locations identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) for other grebe species (as there is currently no activity restriction guidelines for horned grebe in Saskatchewan) in accordance with the level of the disturbance**		point where it is not sustainable or available to contribute to ecological functions.
			• Management of surface water (including seepage and site runoff). • Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Site water management, treatment, and release. • Process water treatment and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
		Mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation an earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction		Change in mortality: predicted to be low magnitude, regional in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of the avian SAR to the point where they are not sustainable or available to
			• On-site and off-site operation of vehicles and transport of materials.	Operation			

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
			• Air transportation for workers.		**and species until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).** • **Locations of nesting sites used by bank swallows, barn swallows, and horned grebe will be communicated to appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.** • **Deterrents designed to discourage or prevent barn swallows from using buildings and other Project infrastructure have been previously described in Section 3.2.4 of the EIS.** • **Buildings and other Project infrastructure will be designed and maintained to exclude birds (e.g., barn swallows) and bats as much as practical. This would include installing solid barriers (e.g., corner slope panels, wooden panels) or flexible**		contribute to ecological functions.
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
					barriers (e.g., netting, tarps or geotextiles) under roof eaves or other exterior surfaces • **Minimize height of salvaged soil stockpiles and avoid vertical slopes to deter bank swallows from creating nesting cavities.**		

Table 4.2 Summary of Significance of the Cumulative Effects on Wildlife Species At Risk

Component	Valued Component	Key Indicator	Cumulative Effects	Summary of Significance of the Cumulative Effects
Terrestrial Environment	Wildlife Species at Risk	• Nine-spotted lady beetle • Transverse lady beetle • Yellow-banded bumble bee • Northern leopard frog • Little brown myotis • Northern myotis • Bank Swallow • Barn Swallow • Common Nighthawk • Horned Grebe • Olive-sided Flycatcher • Rusty Blackbird • Short-eared Owl • Yellow Rail	Alteration and/or loss of habitat.	**Not significant:** The cumulative effect of alteration and/or loss of habitat is not expected to alter the integrity of the Wildlife Species at Risk habitat within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			Change in mortality.	**Not significant:** The cumulative effect of change in mortality is not expected to alter the integrity of the regional populations to the point where they are not sustainable or available to contribute to ecological functions.

5 References

Brown, M.B. and Brown, C.R. 2020. Barn Swallow (*Hirundo rustica*), version 1.0. In Birds of the World (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. (https://birdsoftheworld.org/bow/species/barswa/cur/introduction). Accessed May 30, 2023.

Caceres, M.C. and Barclay, R.M.R. 2000. *Myotis septentrionalis*. Mammalian Species (634):1–4. DOI: 10.2307/0.634.1

COSEWIC. 2009a. COSEWIC assessment and update status report on the Northern Leopard Frog *Lithobates pipiens*, Rocky Mountain population, Western Boreal/Prairie populations, and Eastern populations, in Canada. Committee on the Status of Endangered Widllife in Canada, Ottawa. vii + 69 pp.

COSEWIC. 2009b. COSEWIC assessment and status report on the Horned Grebe, *Podiceps auritus*, Western population and Magdalen Islands population, in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. vii + 42 pp.

COSEWIC. 2013a. COSEWIC assessment and status report on the Little Brown Myotis *Myotis lucifugus*, Northern Myotis *Myotis septentrionalis*, and Tri-colored Bat *Perimyotis subflavus* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. xxiv + 93 pp.

COSEWIC. 2013b. COSEWIC assessment and status report on the Bank Swallow *Riparia riparia* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. xi + 48 pp.

COSEWIC. 2015. COSEWIC assessment and status report on the Yellow-banded Bumble Bee *Bombus terricola* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. ix + 60 pp.

COSEWIC. 2016a. COSEWIC assessment and status report on the Nine-spotted Lady Beetle *Coccinella novemnotata* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. x + 57 pp.

COSEWIC. 2016b. COSEWIC assessment and status report on the Transverse Lady Beetle *Coccinella transversoguttata* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. xi + 57 pp.

COSEWIC. 2021. COSEWIC assessment and status report on the Barn Swallow *Hirundo rustica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 60 pp.

Environment and Climate Change Canada. 2018. Recovery Strategy for the Little Brown Myotis (*Myotis lucifugus*), the Northern Myotis (*Myotis septentrionalis*), and the Tri-colored Bat (*Perimyotis subflavus*) in Canada. Environment and Climate Change Canada, Ottawa. ix + 172 pp.

Environment and Climate Change Canada. 2022a. Management Plan for the Yellow-banded Bumble Bee (*Bombus terricola*) in Canada [Proposed]. *Species at Risk Act* Management Plan Series. Environment and Climate Change Canada, Ottawa. iv + 46 pp.

Environment and Climate Change Canada. 2022b. Recovery Strategy for the Bank Swallow (*Riparia riparia*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. ix + 125 pp.

Environment and Climate Change Canada. 2022c. Management Plan for the Horned Grebe (*Podiceps auritus*), Western population, in Canada. *Species at Risk Act* Management Plan Series. Environment and Climate Change Canada, Ottawa. v + 49 pp.

Environment Canada. 2013. Management Plan for the Northern Leopard Frog (*Lithobates pipiens*), Western Boreal/Prairie Populations, in Canada. *Species at Risk Act* Management Plan Series. Environment Canada, Ottawa. iii + 28 pp.

Garrison, B.A. and Turner, A. 2020. Bank Swallow (*Riparia riparia*), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. (https://birdsoftheworld.org/bow/species/banswa/cur/introduction). Accessed May 30, 2023.

Government of Canada. 2019a. Description of Residence for Bank Swallow (*Riparia riparia*) in Canada. (https://species-registry.canada.ca/index-en.html#/species/1233-894#residence_description)

Government of Canada. 2019b. Description of Residence for Barn Swallow (*Hirundo rustica*) in Canada. (https://species-registry.canada.ca/index-en.html#/species/1147-790#residence_description)

Government of Canada. 2023. Species at risk public registry. (https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html). Accessed May 31, 2023.

Henderson, L.E. and Broders, H.G. 2008. Movements and Resource Selection of the Northern Long-Eared Myotis (*Myotis septentrionalis*) in a Forest - Agriculture Landscape. Journal of Mammalogy 89(4):952–963. DOI: 10.1644/07-MAMM-A-214.1

Johnson, J.S., Treanor, J.J., Slusher, A.C., and Lacki, M.J. 2019. Buildings provide vital habitat for little brown myotis (*Myotis lucifugus*) in a high-elevation landscape. Ecosphere 10(11):e02925. DOI: 10.1002/ecs2.2925

Jung, T.S., Thompson, I., and Titman, R.D. 2004. Roost site selection by forest-dwelling male *Myotis* in central Ontario, Canada. Forest Ecology and Management (202):325–335.

Nature Conservancy Canada (NCC). 2023. Northern Leopard Frog. (https://www.natureconservancy.ca/en/what-we-do/resource-centre/featured-species/reptiles-and-amphibians/northern-leopard-frog.html).

Saskatchewan Conservation Data Centre. 2023. Saskatchewan Conservation Data Centre. (http://biodiversity.sk.ca/). Accessed May 30, 2023.

Slough, B.G. and Jung, T.S. 2020. Little Brown Bats Utilize Multiple Maternity Roosts Within Foraging Areas: Implications for Identifying Summer Habitat. Journal of Fish and Wildlife Management 11(1):311–320.

Smith, A.R. 1996. Atlas of Saskatchewan Birds. Special Publication No. 22. Saskatchewan Natural History Society (Nature Saskatchewan). Regina, Saskatchewan. 456 pp.

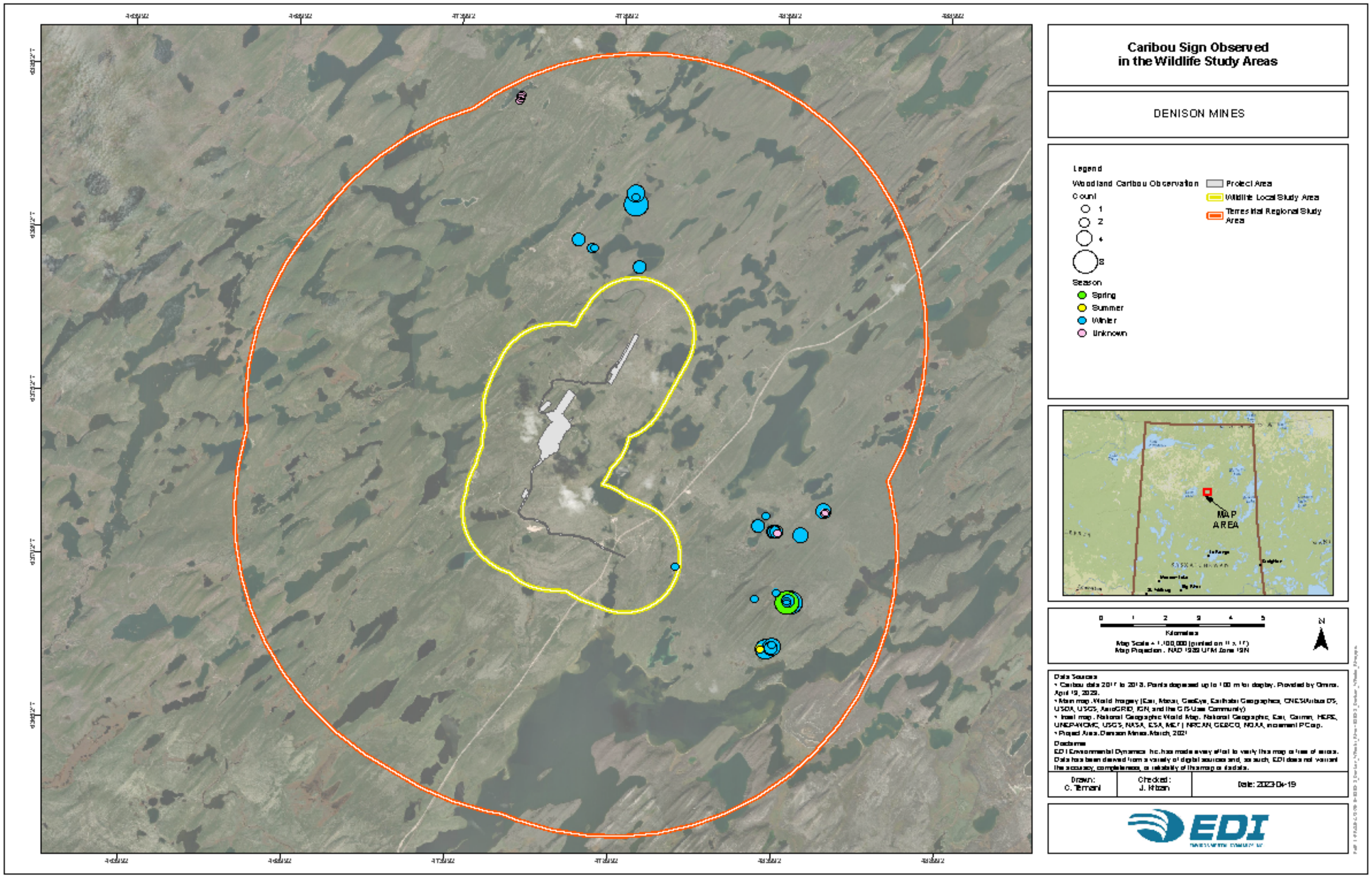
Smith, A.R., C.S. Houston, and J.F. Roy. 2019. Birds of Saskatchewan. Special Publication No. 38. Nature Saskatchewan. Regina, Saskatchewan. 765 pp.

Stedman, S.J. 2020. Horned Grebe (Podiceps auritus), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. (https://birdsoftheworld.org/bow/species/horgre/cur/introduction). Accessed May 30, 2023.

Attachment: IR-143

Number	IR-143
Dept.	ECCC
Project effects link	Wildlife and Wildlife habitat
Reference to EIS, appendices, or supporting documentation	Section 9.3.3.3, Baseline Studies
Context and Rationale	**Context and Rationale:** The baseline caribou data is insufficient to understand potential Project impacts to this species. Presence/absence detection was provided by camera traps, incidental observations, winter track and pellet survey. Additional information and analyses on caribou use of the landscape during all life stages of the Project area is required to assess impacts and to determine significance of impact from the Project to caribou.
Information Requirement	Provide details on the baseline caribou data including: • Revision of map 9.3-8 to include all observations, categorized by type, season and year (see also IR-145); and • Description of seasonal use of the LSA, RSA and caribou range. • Description of Project areas used by caribou. • Description of future studies planned to assess habitat use by caribou. Include specific details on how many additional years of aerial surveys will be completed to assess the caribou baseline conditions. Utilizing additional data noted above and specified in IR-145, explain how caribou use of the area could be affected by the Project throughout all seasons and life stages (e.g., calving, post-calving, rutting, wintering). See also related: IR-152.

Supporting figure to the response provided in table: revised Figure 9.3-8



Attachment IR-143 Figure 9.3-8 Caribou Sign Observations in the Wildlife Study Areas (updated)

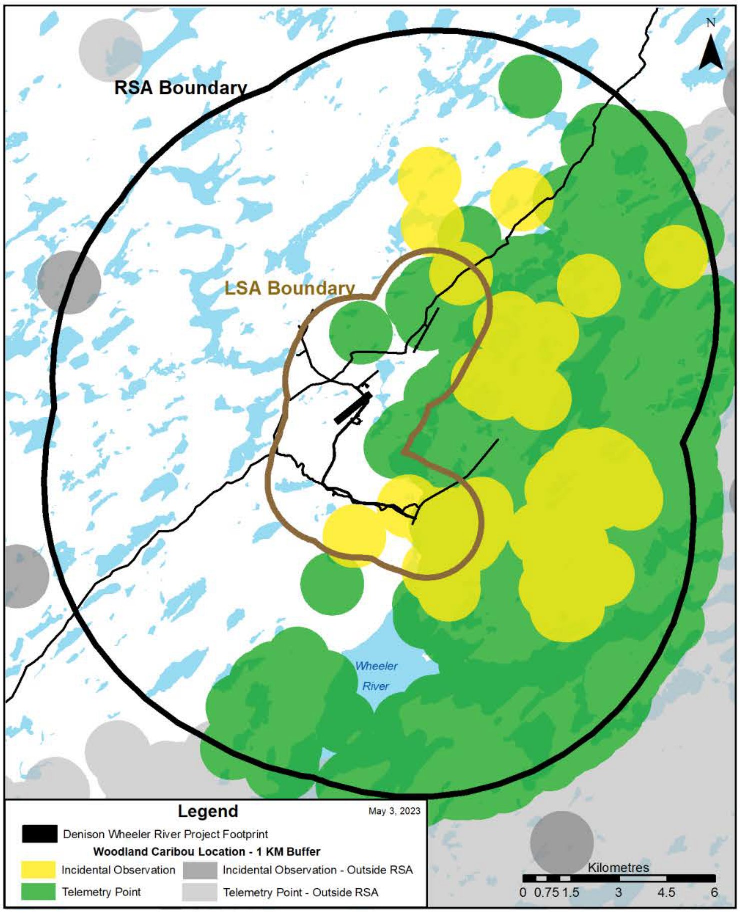
Attachment: IR-145

Number	IR-145
Dept.	ECCC
Project effects link	Wildlife and Wildlife habitat
Reference to EIS, appendices, or supporting documentation	Section 9.3.3.3, Woodland Caribou
Context and Rationale	Context and Rationale: The Proponent has not provided sufficient information on how caribou use the landscape, including identification of areas for different life stages of caribou (calving, post-calving, rutting and wintering). The University of Saskatchewan published a report entitled Population and habitat ecology of boreal caribou and their predators in the Saskatchewan Boreal Shield. This report contains information on habitat types that are used during different life stages. Additionally, Appendix H of the Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 20202 [1] details habitat characteristics required by boreal caribou to carry out life processes necessary for survival and recovery. The scientific literature review (Section 9.3.3.3.1) on Woodland Caribou states: "While calving areas have not been documented within the SK1 range, it is recognized that caribou may use open fen and treed bog habitat types for calving during the spring/summer period. In Saskatchewan, caribou habitat used during the calving season in the SK2 range demonstrated a strong selection for treed muskegs, but avoidance of jack pine, mixed hardwood stands, and roads (Dyke 2008)." ECCC is not able to verify the Proponent's effects assessment without sufficient information on important habitat or biophysical attributes for caribou within the study areas. [1] https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/recovery-strategies/woodland-caribou-boreal-2020.html#toc0

Information Requirement	1. Provide, based off existing literature or available data and the Amended Recovery Strategy for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada: • information on known important habitat features or biophysical attributes in Project areas for different caribou life stages (calving, post-calving, rutting, wintering), • a map(s) of the type and spatial extent of important caribou habitat features or biophysical attributes of the study areas as defined in Appendix H of the Recovery Strategy, • mapping should be at the RSA/LSA level as well as larger-scale mapping at the scale of the Project footprint. 2. Assess the potential direct and indirect effects based on additional information on caribou from bullet A above. See also related IRs: IR-143 and IR-152.

<u>Supporting figure to the response provided in table:</u>

Denison-Wheeler Study Area - Woodland Caribou Location Data



RSA Boundary		
Data Type	**Years**	**Number of Locations**
Incidental Observation	1987, 2017 – 2022	89
Telemetry Point*	2013 – 2016	3,848

*Data from 15 individual woodland caribou cows

LSA Boundary		
Data Type	**Years**	**Number of Locations**
Incidental Observation	2017 – 2022	19
Telemetry Point*	2013, 2015 – 2016	62

*Data from 4 individual woodland caribou cows

NOTE: Absence of data does not mean absence of woodland caribou.

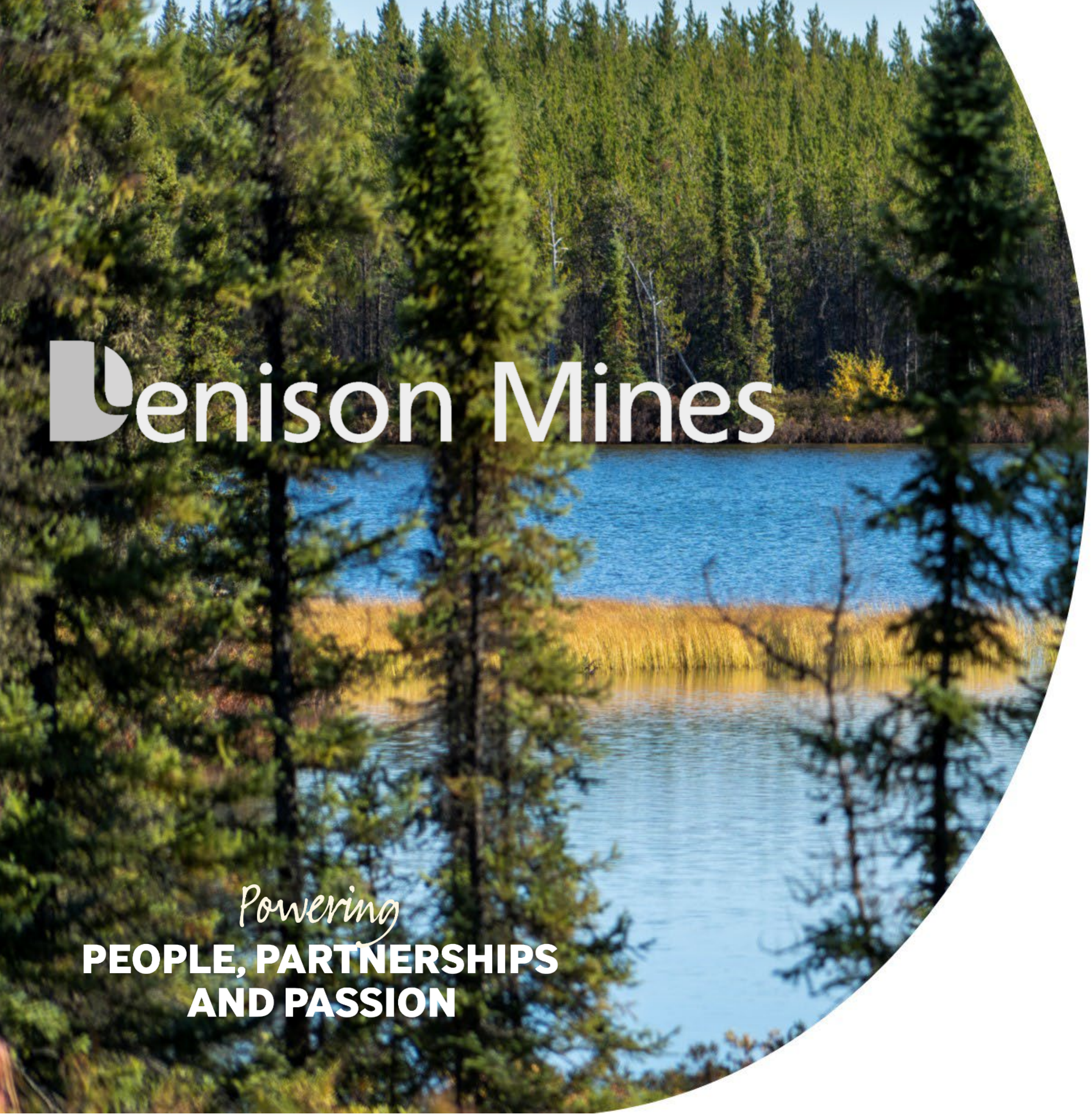
Attachment: IR-149

Number	IR-149
Dept.	ECCC CNSC
Project effects link	Wildlife and Wildlife habitat
Reference to EIS, appendices, or supporting documentation	Section 9.3.5.2, Additional Wildlife- specific Mitigation Measures
Context and Rationale	**Context:** The EIS describes that ongoing research is performed to inform the development of a Woodland Caribou Management Plan. This includes studies on the effectiveness of linear disruption features on predator/prey movements, and a field program for long-term reclamation planning. Moreover, it is stated that the Plan will include a detailed assessment of the need for habitat offsets. The draft EIS Section 9.3.5.2 states: "A wildlife monitoring plan and a Woodland Caribou Management Plan will be developed to address wildlife-specific mitigation measures based on proven and accepted mitigation following standard industry guidelines and BMPs. The plans will provide guidance to avoid or minimize potential adverse effects of the Project on wildlife and wildlife habitat, including monitoring and follow-up programs, as appropriate. It will be in place during all phases of the Project and will be subject to ongoing review and revision as required. If monitoring identifies a need for additional or revised mitigation measures, a process of adaptive management (as described in the plan) will be triggered." **Rationale**: The draft EIS does not present sufficient species-specific mitigation measures for boreal caribou. ECCC is not able to assess potential residual impacts to caribou without specific mitigations. Since the Woodland Caribou Management Plan is still under development, it is difficult to judge whether the measures will be adequate to mitigate and/or offset potential project effects on Woodland caribou and its critical habitat.
Information Requirement	Provide the Woodland Caribou Management Plan, to demonstrate effective mitigation of potential project effects, along with wildlife-specific mitigation measures for review. The Plan should be informed by and consistent with the Boreal Caribou Recovery Strategy and demonstrate that avoidance and minimization measures will be applied to mitigate for predicted Project effects to boreal caribou and its critical

	habitat prior to considering offsetting measures. That is, the Plan should follow the mitigation hierarchy and information should be provided as outlined below: 1. AVOID: Describe all measures that will be taken to avoid effects to boreal caribou and avoid the destruction or alteration boreal caribou critical habitat. 2. MINIMIZE: Describe all measures that will be taken to minimize the effects to boreal caribou and minimize the destruction of boreal caribou critical habitat. 3. RESTORE ON-SITE: describe the measures that will be taken to restore disturbed areas of the project, related to construction, operation and maintenance, on boreal caribou critical habitat, remaining after considering the avoidance and minimization measures. 4. Characterize the risk of the adverse effects that are likely to result from the project on boreal caribou and its critical habitat after avoidance minimization, and onsite restoration measures have been considered. 5. OFFSET: Describe the measures that will be implemented outside the Designated Project area to mitigate adverse effects, destruction or alteration of boreal caribou critical habitat by the Designated Project during construction and operation. 6. Characterize the risk of the adverse effects that are likely to result from the project on boreal caribou and its critical habitat after avoidance, minimization, onsite restoration, and offset measures have been considered. Describe all relevant uncertainties on the effectiveness of the measures to address adverse effects on boreal caribou and the rationale for the selected measure, in light of the mitigation hierarchy. See also related IRs: IR-149 and IR-157.

Response:

Conceptual Caribou Mitigation Plan is included below.


Denison Mines
Powering
PEOPLE, PARTNERSHIPS
AND PASSION

Denison Mines Corp.

Conceptual Caribou Mitigation Plan

Version 1

June 2023

Revision History

Version	Date	Description of Revision
1	June 30, 2023	Conceptual plan to support provincial and federal review of the draft environmental impact statement

Table of Contents

Tables

Figures

Acronyms and Abbreviations

Term	Definition
Anthropogenic	Caused or produced by humans
BSCs	biological soil crusts
Boreal Caribou	The boreal ecotype of woodland caribou occurs within the boreal forest of Canada. These non-migratory caribou form small aggregations throughout the year and disperse for solitary calving.
Committee on the Status of Endangered Wildlife in Canada (COSEWIC)	A committee made up of experts from academic, government and non-government organizations that assess the conservation status of wildlife species that may be at risk of extinction in Canada.
Critical Habitat	The habitat that is necessary for the survival of a listed wildlife species and is identified as the species critical habitat in the recovery strategy or action plans for the species.
DERT Project	Developing Eco-Restoration Together Project
Disturbed habitat (per ECCC 2020)	Habitat showing: i) anthropogenic disturbance visible on Landsat at a scale of 1:50,000, including habitat within a 500 m buffer of the anthropogenic disturbance; and/or ii) fire disturbance in the last 40 years, as identified in data from each provincial and territorial jurisdiction (without buffer).
ECCC	Environment and Climate Change Canada
EA	environmental assessment
EIS	environmental impact statement
EMS	environmental management system
ENV	Saskatchewan Ministry of Environment
ha	hectare
Local Populations (ECCC 2020)	Group of boreal caribou occupying a defined area distinguished spatially from areas occupied by other groups of boreal caribou. Local population dynamics are driven primarily by local factors affecting birth and death rates, rather than immigration or emigration among groups. In this recovery strategy, “local population” refers to a group of boreal caribou occupying any of the three types of boreal caribou ranges (i.e., conservation unit, improved conservation unit, local population unit).

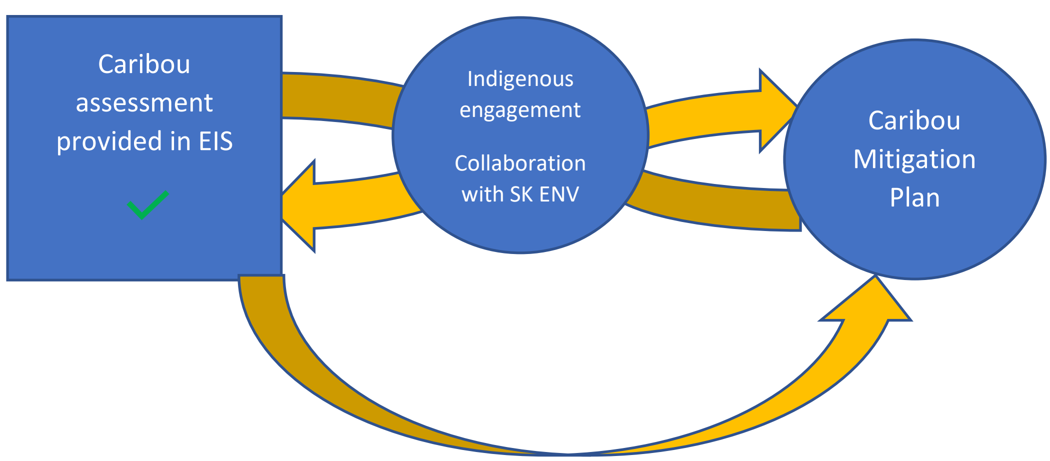
Plan	Conceptual Caribou Mitigation Plan
Project	Wheeler River Project
Range (per ECCC 2020)	The geographic area occupied by a group of individuals that are subject to similar factors affecting their demography and used to satisfy their life history processes (e.g., calving, rutting, wintering) over a defined time frame. Environment and Climate Change Canada (2011) identified three types of boreal caribou ranges categorized based on the degree of certainty in the delineated range boundaries (i.e., conservation unit, improved conservation unit, local population unit).
Recovery strategy	A planning document that identifies what needs to be done to stop or reverse the decline of a species.
SARA	Species at Risk Act
Self-sustaining local population (ECCC 2020)	A local population of boreal caribou that on average demonstrates stable or positive population growth over the short-term (≤20 years) and is large enough to withstand stochastic events and persist over the long-term (≥50 years), without the need for ongoing active management intervention.
Threatened species	A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
Undisturbed habitat (per ECCC 2020)	Habitat not showing any: i) anthropogenic disturbance visible on Landsat at a scale of 1:50,000, including habitat within a 500 m buffer of the anthropogenic disturbance; and/or ii) fire disturbance in the last 40 years, as identified in data from each provincial and territorial jurisdiction (without buffer). Disturbance within the 500 m buffer would result in a reduction of the undisturbed habitat.

1 Introduction

The Wheeler River Project (the Project) environmental impact statement (EIS) evaluates and assesses potential Project-related effects on the Boreal population of woodland caribou (*Rangifer tarandus caribou*; referred to herein as caribou or boreal caribou) following standard environmental assessment (EA) methodology. The assessment of potential effects considered both direct (i.e., habitat loss) and indirect effects (i.e., habitat alteration) on caribou and their habitat, while assuming that caribou were present year-round and during all of their life stages (i.e., calving, rearing, mating, over wintering). In this way, the EIS took a precautionary or conservative approach to understanding/addressing the likely residual effects (i.e., effects remaining after mitigation measures were considered) of the Project on caribou and their habitat and is using this approach as a planning tool to inform/support future Project-related regulatory approvals processes and follow-up monitoring. The EIS has demonstrated that the Project, as proposed and assessed, is predicted to minimize the potential for environmental adverse effects on caribou and their habitat before any Project specific construction occurs. The conclusions of the assessment predicted that the likely residual effects of the Project on caribou were not significant.

This Conceptual Caribou Mitigation Plan (the Plan), developed proactively by Denison, has a different objective than the EIS. The Plan builds on the assessment of potential Project effects and commitments to mitigate such effects made in the EIS and is expected to be advanced with ongoing consultation with the Saskatchewan Ministry of Environment (ENV), as ENV finalize the caribou range plan for SK1. The EIS is a conservative planning tool, whereas the Plan is a practical, living document designed to define management works associated with caribou. The Plan is not a requirement for EA determination but is provided as a guidance document to help Denison proactively describe and inform the development and implementation of appropriate mitigation measures related to caribou and their habitat.

The Plan is an evergreen document. It will be consistent with the management goals of ENV for the SK-1 caribou conservation unit, and will be developed/refined in consultation with local communities including English River First Nation and Kineepik Métis Local in Pinehouse and regulators (e.g., ENV). As noted above, the boreal caribou range plan for SK-1 is under development and it is understood that this Plan will be updated as more information becomes available. The conceptual nature of the Plan is in part due to the absence of range plan priorities and reflects Denison's commitment to continue to work with the province to meet the management objectives and management strategies for the SK1 range.



2 Guidance and Regulatory Framework

A brief review highlighting federal and provincial considerations of boreal caribou is provided below for reference.

2.1 Federal

Boreal caribou have been designated as *threatened* under the federal *Species at Risk Act* (SARA). Environment and Climate Change Canada (ECCC) released amended recovery strategy for woodland caribou in 2020 (ECCC 2020). A recovery strategy is a planning document that identifies what should be done to stop or reverse the decline of a species.

The Project is located in the Boreal Shield West ecoregion of the Boreal Shield ecozone. The Boreal Shield West ecoregion stretches from Alberta to Ontario (Figure 2-1).

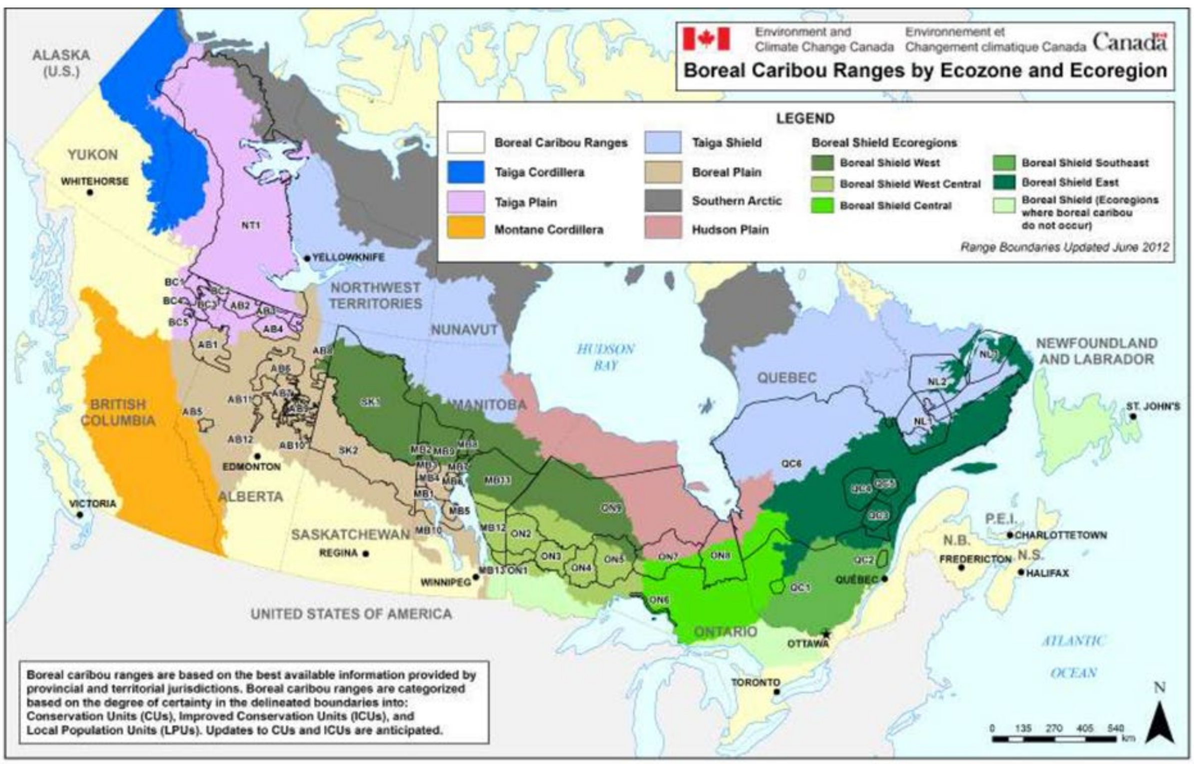


Figure 2-1: Boreal Caribou Distribution Across Ecozones and Ecoregions in Canada (source: ECCC 2020)

The SK1 range comprises more than 18,000,000 hectares (ha) and is characterized by high fire disturbance and low anthropogenic disturbance (ECCC 2020). The likelihood of caribou self-sustainability in the boreal shield range in SK1 is "likely" (ECCC 2020). For SK1, the amended recovery strategy (ECCC 2020) identifies 40% undisturbed habitat in the range as the disturbance management threshold, which provides a measurable probability (71%) for the local population to be self-sustaining. This threshold is considered a minimum threshold because at 40% undisturbed habitat there remains a risk (29%) that the SK1 local population cannot be self-sustaining. Disturbed habitat (ECCC 2020) is habitat showing: i) anthropogenic disturbance visible on Landsat at a scale of 1:50,000, including habitat within a 500 m buffer of the anthropogenic disturbance; and/or ii) fire disturbance in the last 40 years, as identified in data from each provincial and territorial jurisdiction (without buffer). Undisturbed habitat (ECCC 2020) is habitat not showing any: i) anthropogenic disturbance visible on Landsat at a scale of 1:50,000, including habitat within a 500 m buffer of the anthropogenic disturbance; and/or ii) fire disturbance in the last 40 years, as identified in data from each provincial and territorial jurisdiction (without buffer). Disturbance within the 500 m buffer would result in a reduction of the undisturbed habitat.

Studies (e.g., McLoughlin et al. 2019) indicate that the SK1 local caribou population is likely self-sustaining at current levels of disturbance (60% total disturbance), with a 71% probability of persistence. Environment and Climate Change Canada's analyses also indicate that the SK1 local population is sensitive to small increases anthropogenic disturbance and sensitive to small decreases in adult survival. For these reasons, a higher probability of persistence was selected for critical habitat identification in SK1 (71%) than was selected for the other 50 ranges across Canada (60%) (ECCC 2019).

The precise location of the 40% undisturbed habitat within the range is expected to vary over time. The habitat within the SK1 range should exist in an appropriate spatial configuration such that boreal caribou can move throughout the range and access required habitat when needed. The key to this habitat delineation is achieving and maintaining an overall, ongoing range condition that allows for the dynamic habitat supply system, containing the biophysical attributes upon which caribou depend, to remain sustainable. It is this dynamic habitat supply system within the SK1 range that is the habitat condition considered to be necessary for the caribou.

2.2 Provincial

The responsibility for woodland caribou management lies with the Province of Saskatchewan. Broadly, the province is responsible for developing range plans or management plans which build on the federal recovery strategy by setting goals and objectives for maintaining sustainable population levels.

The Saskatchewan Conservation Data Centre (SK-CDC) is responsible for evaluating and assigning a conservation rank to each taxon, resident or transient, found in the province. Woodland caribou's subnational or S-rank conservation rank is S3. This ranking indicates that, provincially, the species is vulnerable/rare to uncommon which is associated with a moderate risk of extinction or extirpation due to a restricted range, relatively few populations, recent and widespread declines, threats, or other factors. Currently, the caribou population in SK-1 is stable (ENV 2023) and the range plan is under development. Engagement is a key component of the range plan process and will be completed with representatives from First Nation, Métis, industry, non-governmental organizations, and communities.

The provincial goal is to sustain and enhance woodland caribou populations, and maintain the ecosystems they require, throughout their current range (ENV 2013). Through the woodland caribou range assessment and range planning program, the province is:

- Gaining a better understanding of woodland caribou ecology;
- Working toward meeting objectives identified in provincial and federal strategies; and
- Improving how the province manages the species and related habitat.

The province's woodland caribou range assessment and range planning program incorporates two key components:

- Woodland caribou range assessment, which enhances the understanding of woodland caribou populations and their interactions with the environment; and
- Woodland caribou range planning, which provides a framework, strategies and objectives that allow for better decisions involving habitat management and self-sustaining caribou populations.

Although the management objectives and management strategies for caribou in SK1 are not yet defined, Denison is committed to working with ENV as the range plan is developed. The Plan will be updated as the Project advances so that it aligns with the conservation objectives as determined by the province as the primary steward of caribou in the province.

3 SK 1 Caribou Population – Background Information

Background information concerning the condition of the SK 1 caribou population is provided below.

3.1 Population Trends

The SK1 Boreal Shield management unit contains high-quality conifer-dominated caribou habitat with greater than 40-year-old stands of jack pine and black spruce forests suitable for lichen colonization, black spruce swamps, and open muskegs supporting relatively high densities of caribou, at 36.9 caribou/1,000 km^2 or approximately 4,000 caribou across the SK1 Boreal Shield Woodland Caribou Management Unit (McLoughlin et al. 2019).

Research has shown that up to 70% of the year-round diet of caribou may consist of ground and arboreal lichens. If the quantity of available lichen forage is low, caribou can exist without relying entirely on lichens (McLoughlin et al. 2019). Due to their physiology, lichens are resilient to periods of drought and cold temperatures, but because of their slow growth rate, exhibit a slow recovery time after depletion and fire events. In the SK1 range, McLoughlin et al. (2019) found that stand types with the highest potential for adequate lichen biomass for caribou are jack pine and poorly drained black spruce sites.

McLoughlin et al. (2019) observed that, from 2014 to 2018, the caribou population exhibited a high average adult female survival rate and moderate recruitment (0.192 calves per cow in March), ranging from a low of 0.134 calves/cow in March 2016 to 0.244 calves/cow in March 2018. These demographic parameters led the authors to assess the SK1 Boreal Shield caribou population as being stable at the time of their study (McLoughlin et al. 2019).

While calving areas have not been documented within the SK1 range, it is recognized that caribou may use open fen and treed bog habitat types for calving during the spring/summer period. In Saskatchewan, caribou habitat used during the calving season in the SK2 range demonstrated a strong selection for treed muskegs, but avoidance of jack pine, mixed hardwood stands, and roads (Dyke 2008).

Neufeld et al. (2021) summarized results from aerial surveys over a period of eight years in an 87,193 km^2 study area in the Athabasca Plain and Churchill River Upland ecoregions in the north, that are inclusive of the Terrestrial RSAs that were used in the EIS. During 11 of 16 aerial caribou surveys conducted between 2008 and 2015, woodland caribou were detected in the surveyed areas. The average density of the 16 surveys was estimated at 36.9 caribou/1,000 km^2) (95% CI = 26.7 to 47.2 caribou/1,000 km^2). Across the Neufeld et al. (2021) study area and all years, estimated caribou densities were higher in comparison to averages reported for most other boreal woodland caribou ranges in Canada (i.e., caribou density reported in other areas ranged 4.3 to 18.7/1,000 km^2) indicating that caribou can tolerate natural disturbance. One exception to the relatively high caribou densities in northern Saskatchewan was noted: the 2,285 km aerial the Millennium Project in March 2014, 10 km west of the Terrestrial RSA, resulted in lower woodland caribou densities at 5 caribou/1,000 km2 (Neufeld et al. 2021).

Eight of the sixteen caribou surveys reported the ratios of male to female and calf to female in their results with the average male:female ratio calculated at 0.571 (95% CI = 0.444 to 0.699) and calf:female at 0.195 (0.158 to 0.232). Again, the 2014 Millennium survey reported a different male:female ratio, outside the reported range (1.6), concurring with the reported low caribou densities.

3.2 Predation

In addition to relatively low predator densities in their study area, McLoughlin et al. (2019) found some spatial separation between caribou and wolves. Caribou did not seem to avoid existing linear features (such as roads, trails, and transmission lines) in the area, while wolves established their territories away from linear features. Unlike caribou, who preferred mature conifer stands, wolves selected for wetlands and patches of deciduous-mixed forest, avoiding stands of mature conifers. Other prey species, such as moose, also occurred at relatively low densities (i.e., 45.7 moose/1,000 km^2) (McLoughlin et al. 2019).

McLoughlin et al. (2019) observed that mortality of adult caribou occurred mostly during the snow-free season and only 1 of 94 collared caribou was harvested by a hunter during the four years of the study.

While predation is believed to be a key limiting factor for woodland caribou (Bergerud 1974; Stuart-Smith et al. 1997, DeMars et al. 2011 from ECCC 2020), Neufeld et al. (2021) suggested that habitat- or disturbance-mediated apparent competition only plays a minor role in the Saskatchewan woodland caribou population. Habitat- or disturbance-mediated apparent competition occurs when natural (e.g., forest fires) and anthropogenic (e.g., human development or activities) disturbances increase the abundance of other ungulates, which in turn may increase predator densities, which then increases predation risk to caribou. Neufeld et al. (2021) concluded that Northern Shield and Taiga ecoregions are of low productivity where caribou may compete with only one ungulate species (i.e., moose) and therefore, caribou and wolf dynamics do not follow general habitat- or disturbance-mediated apparent competition models.

3.3 Harvest

Indigenous peoples in Saskatchewan have an inherent right to harvest woodland caribou for subsistence purposes (ENV 2013). No other harvest of woodland caribou is currently permitted. Under provincial and federal recovery planning and effective species management, self-sustaining caribou populations will support long-term subsistence use of the species and protect treaty rights. Subsistence harvest levels are assumed to be low but actual numbers are not available because most communities or Indigenous groups are not collecting and/or publishing this information.

4 No Net Loss and Mitigation Hierarchy

A generic biodiversity mitigation hierarchy (OECD 2016) to achieve no net loss is provided in Figure 4-1. As shown in the hierarchy, an offset can be used to achieve no net loss if residual effects remain following efforts to avoid, minimize, and restore potential project effects. This generic hierarchy is generally consistent with the approach of ENV to manage effects on caribou and their habitat.

The balance of Section 4 of this Plan outlines Denison's approach to avoid, minimize, and restore caribou habitat per commitments made in the draft EIS associated with the Wheeler River Project.

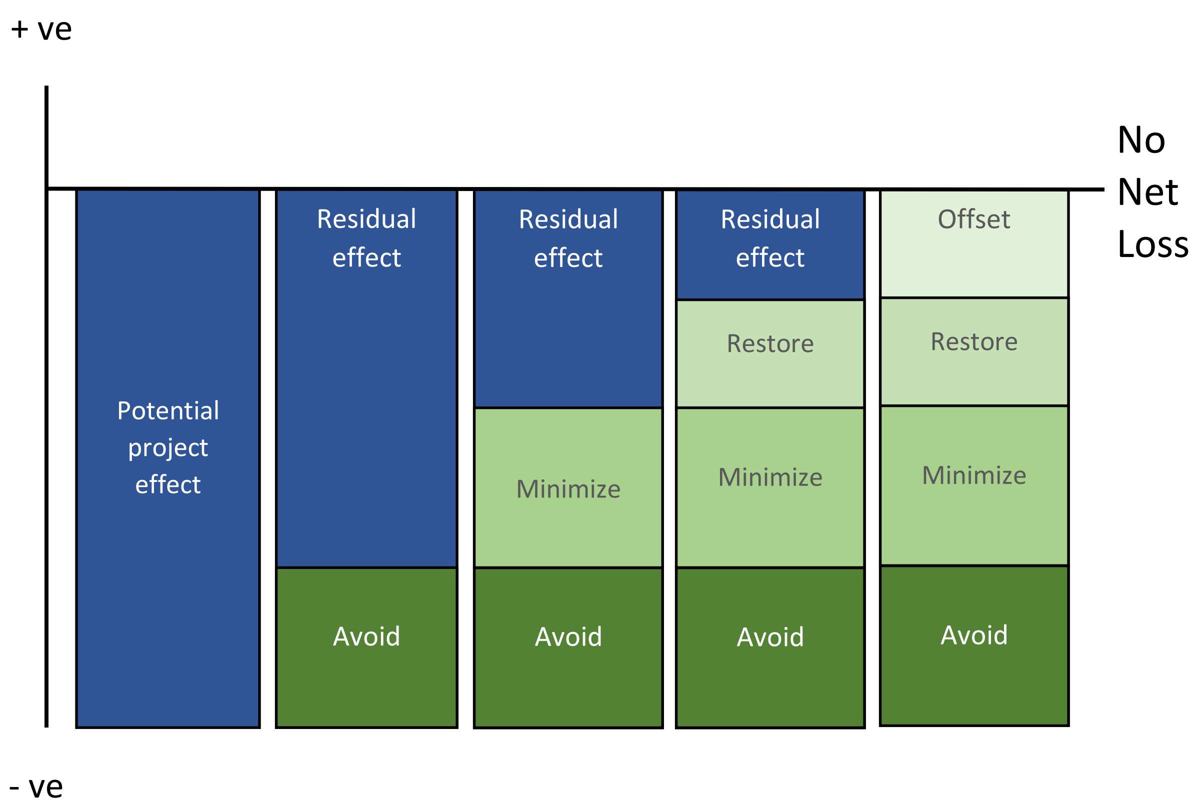


Figure 4-1: Generic No Net Loss and Mitigation Hierarchy (modified from OECD 2016)

4.1 Avoid

Potential adverse effects on the caribou have been avoided to the extent possible through Project design, including:

- Selection of in-situ recovery (ISR) mining avoids some direct and indirect effects compared to conventional underground or open-pit mining methods . ISR mining avoids the need for spatially expansive infrastructure such as waste rock piles and tailings management facilities reducing the Project footprint (i.e., avoids direct effects on caribou and their habitat). ISR mining also reduces the potential for interactions between caribou and Project components / activities as it concerns sensory disturbance as it is inherently a less intensive form of mining with reduced noise/light/vibration generation (i.e., avoids indirect effects on caribou and their habitat).

- Site clearing and other works that involve disturbance of vegetation and/or soil will be completed during least-risk timing windows for caribou (for example, outside of wintering/calving period from April 1-July 31, per ENV 2013), where practical, to avoid disturbance during sensitive time periods.
- Pre-disturbance wildlife surveys will be completed to identify caribou presence and work will be postponed if caribou are present.

4.2 Minimize

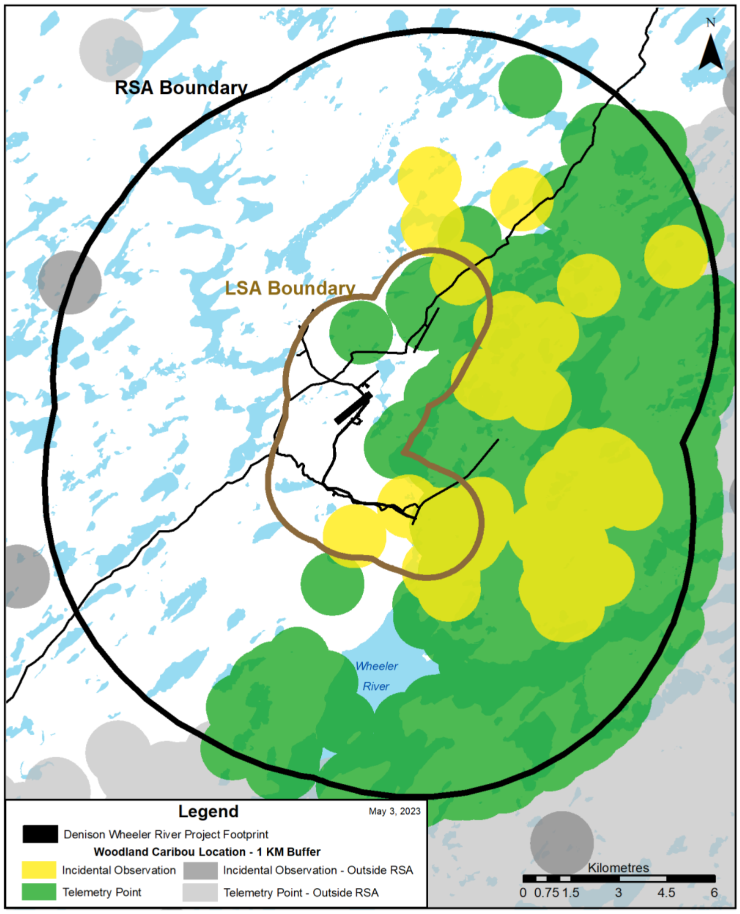
Additional mitigation measures to minimize effects on caribou and their habitat and tailored to Project features have been incorporated into the various Project management and monitoring plans within the Environmental Management System (EMS) including but limited to erosion and sediment controls, soil and vegetation monitoring, Decommissioning Plan, air quality monitoring, fuel spill control and response, Radiation Protection Plan, surface water and effluent monitoring, and Waste Management Plan.

The Project's EMS plans provide direction on monitoring and adaptive management so that issues are identified and mitigation measures are developed and implemented in a timely and effective manner. Mitigation measures specific to caribou are applicable during all Project phases, within all seasons and expected to be effective following appropriate implementation. Examples of the measures to minimize Project effects on wildlife in general, and caribou in particular, are highlighted below.

4.2.1 Disturbance Footprint

- Siting Project components in close proximity to the ISR mining area minimizes indirect effects on caribou and their habitat. The Project components are also west of the known home range of woodland caribou (based on tracking data received by the Ministry of Environment; Figure 4-2), although the absence of data does not mean the absence of caribou and Denison has observed caribou in the area. . Appropriate siting is anticipated to minimize the potential for interactions with woodland caribou and Project activities.
- The Project footprint (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable, resulting in limited/minimal habitat loss/disturbance and noise propagation.
- Portions of the proposed Project footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance.

Denison-Wheeler Study Area - Woodland Caribou Location Data



RSA Boundary		
Data Type	**Years**	**Number of Locations**
Incidental Observation	1987, 2017 – 2022	89
Telemetry Point*	2013 – 2016	3,848

*Data from 15 individual woodland caribou cows

LSA Boundary		
Data Type	**Years**	**Number of Locations**
Incidental Observation	2017 – 2022	19
Telemetry Point*	2013, 2015 – 2016	62

*Data from 4 individual woodland caribou cows

NOTE: Absence of data does not mean absence of woodland caribou.

Figure 4-2 Saskatchewan Ministry of Environment Woodland Caribou Location Data Provided to Denison

4.2.2 Wildlife and Habitat Protection

- Project activities have been assessed for their potential to disturb or remove wildlife and/or wildlife habitat (e.g., site clearing, soil disturbance) to determine potential effects on wildlife and wildlife habitat and the assessment, including proposed mitigation measures, for the Project will guide Project activities.
- Pre-disturbance wildlife clearance surveys will be conducted within the Project Area; results of the clearance surveys will inform the development and implementation of appropriate mitigation (e.g., delay of work) to address the identified issue (e.g., presence of caribou).
- Personal firearms for employees and contractors will be prohibited within the Project Area to prevent hunting activities.
- Policies will be implemented prohibiting employees and contractors from feeding, approaching, or harassing wildlife species within the Project Area.
- To support wildlife habitat regeneration, progressive restoration including ecosystem-based revegetation will be conducted on disturbed areas as soon as practicable in accordance with the Decommissioning Plan.

4.2.3 Wildlife Deterrence and Prevention of Wildlife Entrapment

- In addition to installing secure fencing around all contaminated areas to prevent accidental contaminant exposure, buildings and other Project components will be designed and maintained to exclude wildlife from using buildings for refuge or shelter, and to deter wildlife from potentially becoming entrapped.

4.2.4 Sensory Disturbance

- Noise emitting Project activities will be managed to minimize sensory disturbance of wildlife, especially during sensitive time periods, such as calving. This would include:
    - locating excessive noise generating activities such as the concrete batching operation as far away from sensitive wildlife locations as possible;
    - directing the generator discharge openings away from sensitive locations; and
    - making use of available on-site obstructions to control sound exposure at sensitive areas (i.e., locate sources behind buildings).
- The main sources of noise will be related to transport of people and goods, drilling of holes for the freeze wall and wellfield, operation of the batch plant, operation of the processing plant, and operation of the pumphouses. Low sound emission equipment and the use of silencers or mufflers (whenever practical) will be used to reduce noise associated with Project activities. There will be regular maintenance of equipment to ensure it is in proper working order and not emitting noise unduly.

- Lighting will be focused on work sites and not surrounding areas, to minimize light trespass and other light-related pollution sources.
- Facilities will be illuminated only to meet standards set for the protection of workers to avoid over-illumination.
- Battery-powered, light vehicles and mobile equipment, and an AC powered dual rotary drill will be used for ISR wellfield development instead of a traditional diesel-powered unit, where practical, to reduce air emissions and noise levels and improve energy efficiency.
- Fugitive dust sources that could lead to deposition of dust on vegetation and waterbodies (including potential deposition of trace metals and radionuclides) will be reduced by:
    - dust suppression techniques on site roadways, such as road watering and traffic management;
    - directing processing plant exhaust from drying and packaging areas through a stack prior to release outside of the building;
    - designing the stack height based on results of air dispersion modelling to be an appropriate height for optimal dispersion;
    - making a wash bay available to clean items, equipment, and vehicles that may have been in contact with potentially contaminated materials. Contaminated water from the wash bay will be collected in a sump tank and routed to the water treatment plant for treatment and discharge; and,
    - conducting radiological clearance scanning as required for any items, equipment, and vehicles leaving the Project Area.

4.2.5 Road and Traffic Management

- Traffic and access control measures will be implemented, including managing traffic volume by scheduling truck convoys, using high-volume haul trucks, and restricting public access (e.g., private vehicles, snowmobiles, all-terrain vehicles, and foot traffic) to the Project site and roads with both north and south security access gates. It is important to note that if any individual were seeking access around the Project area to undertake Aboriginal and / or Treaty Rights, Denison staff would facilitate this, provided it was safe to do so given Project activities in the area.
- Appropriate road signage will be installed (e.g., speed limits, identification of wildlife crossings and areas of high activity) along Project roads to minimize the risk of wildlife-vehicle collisions.
- Speed limits will be implemented to reduce the risk of wildlife-vehicle collisions.
- Wildlife will have the right-of-way on Project roads, unless it is unsafe to stop (i.e., if a collision is imminent). Vehicles will not be used to encourage caribou to move off Project roads and processes will be implemented for employees and contractors to slow down and/or stop vehicles/equipment to allow caribou to move away or off the road before resuming normal road speeds for the area.

- Road watering and regular road maintenance to limit dust dispersion.
- Employees and contractors will report and communicate the location and circumstances of any roadkill observed on or alongside Project roads. Large-bodied wildlife carcasses found will be promptly reported to ENV and disposed of as directed to prevent scavenging.
- Vegetation along Project roads will be managed to reduce attractiveness to wildlife (e.g., forage plants) and maintain appropriate sightlines for drivers to minimize wildlife-vehicle collisions.
- Alternative measures on Project roads for de-icing and winter traction (e.g., sand, gravel) or dust suppression (e.g., water) will be implemented, whenever practicable, to limit the use of specialty chemicals and potential exposure of wildlife including caribou to them.
- Appropriately sized gaps in the roadside snowbanks during winter will be maintained to facilitate caribou crossing and escape and, with that, reducing their risk of vehicle collisions.
- New Project site and access roads will be designed to minimize sightlines for predators, whenever practicable, while still maintaining general road safety.
- Ditches and culverts along Project roads will be designed and maintained to minimize pooling of water as roadside pools may attract caribou.

4.2.6 Water Management, Waste Management, Emissions, and Hazardous Materials Management

- Education on and enforcement of proper water, waste, emissions and hazardous materials management practices will be provided to employees and contractors.
- A freeze wall will be established around the uranium deposit to reduce potential for groundwater disturbance or contamination mitigating the likelihood of exposure of caribou to contaminants in local areas of groundwater discharge to surface.
- The ISR wellfield and processing plant will be designed to re-use most of the solutions inside each circuit, reducing water use requirements to the extent feasible. Make-up water will be preferentially sourced from site runoff (instead of freshwater) where possible.
- Contaminated wastes (e.g., mineralized drill cuttings, process precipitates) will be temporarily stored on double lined pads with leak detection capabilities and an associated monitoring program until final disposal at an approved facility. An adjacent pond will be used to collect contact water from these pads.
- All contact water will be routed to the Industrial Wastewater Treatment Plant for treatment and eventual release to the environment. All treated effluent released to surface water will meet federal and provincial regulatory discharge limits. This will mitigate exposure of caribou to Project-related contaminants released to the environment.

- Surface pipelines will be designed to have secondary containment or catchment and have leak detection systems in place at key locations to mitigate the likelihood of the release of such chemicals to the environment that could result in exposure of caribou to the chemicals.
- Double-walled high-density polyethylene (HDPE) or equivalent piping will be used in the wellfields and will be freeze protected and secured to minimize pipe movement to mitigate the likelihood of the piping failure and the associated release of wellfield chemicals to the environment that could result in exposure of caribou to the chemicals.
- Denison is proposing to segregate and compost organic wastes on site in a composting system, reducing the volume of material in the domestic landfill generating odours and thereby minimizing wildlife attractants.
- Domestic waste will be collected and temporarily stored in wildlife-proof containers to avoid attracting wildlife and reduce the risk for human-wildlife interactions. The wildlife-proof containers will be inspected regularly for evidence of wildlife presence or access to waste disposal facilities. If evidence of wildlife presence or access to waste disposal facilities is detected, modified systems will be implemented and/or off-site waste disposal/incineration frequencies will be increased.
- A "no littering policy" for employees and contractors will be implemented within the Project Area.
- Air emissions will be reduced to the extent practical through implementation of the development of air emissions management and monitoring plans within the EMS.
- All vehicles and equipment will be equipped with industry-standard emission control systems; unnecessary idling of vehicles will be prohibited to reduce emissions.
- The use of hazardous materials will be limited as much as possible.
- Appropriate hazardous materials management practices will be implemented in accordance with industry guidelines to minimize the risk of accidental spills or leakage. This will mitigate the likelihood of release to the environment that could result in exposure of caribou to the hazardous materials.
- Hazardous materials will be handled, stored, and disposed of appropriately and in accordance to avoid attracting wildlife (e.g., wildlife-proof containers, exclusion fencing) to mitigate the likelihood of exposure of caribou to hazardous materials.
- Physical deterrents (e.g., fencing) will be employed around contaminated areas (e.g., waste ponds and waste pads), the domestic landfill, or hazardous materials storage areas to discourage wildlife use / interaction. The deterrents will be monitored and maintained .
- Appropriate spill response kits will be positioned adjacent to areas where hazardous materials are stored in accordance with the Spill Response Plan to mitigate the likelihood of

the release of hazardous material to the environment that could result in exposure of caribou to the material.

- A minimum 100 m distance from any waterbody will be maintained for fuel storage, refueling activities, or equipment servicing in accordance with the Spill Response Plan. This will mitigate the likelihood of a fuel spill to water that could result in exposure of caribou to fuel.
- Appropriate fuel, chemical, and materials management practices will be followed in accordance with the Spill Response Plan to minimize the risk of accidental spills or leakage of diesel fuel, other hydrocarbons, and other hazardous materials and mitigate the likelihood of exposure of caribou to such chemicals.
- All vehicles and equipment will be maintained in good working condition (e.g., no leaks) and furnished with industry-standard spill response kits.

4.2.7 Wildlife Education

- Employees and contractors will be provided with wildlife education and awareness training, including education about potential caribou issues on site and training on the mitigation measures summarized with the EMS and specifically in this Plan to avoid or minimize potential Project effects on caribou and caribou habitat.
- Employees and contractors will be educated on waste and hazardous waste management practices / policies that limit human-wildlife interactions and the potential exposure of wildlife to those wastes.
- Designated employees will be trained in appropriate wildlife deterrent techniques to minimize wildlife interactions with the Project.
- Employees and contractors will be requested to report wildlife observations, including prompt reporting of caribou observations and immediate communication to on-site staff. Wildlife encounters and outcomes will be monitored, and logbooks will be used to record wildlife observations. Logbooks and reports will be available to employees. Incidental observations recorded by staff will be entered into Species Detection Loadforms and submitted to the Saskatchewan Conservation Data Centre annually.

4.3 Restore

The temporal bounds for the Project as stated in the EIS are years 1 to 3 for construction, years 3 to 18 for operation, years 18 to 23 for decommissioning, and fifteen years of post-decommissioning monitoring and inspections from years 23 to 38. Importantly, during physical decommissioning the majority of Project components are scheduled to be removed from site which is expected to facilitate restoration activities. Also, because of the selected ISR mining method, there are no large, permanent Project components, such as waste rock piles or tailings management facilities, for which large scale and potentially complex restoration strategies are needed.

Denison's decommissioning commitment is to return the land back to the Province of Saskatchewan for unrestricted surface land use post-closure. The Project's Conceptual Decommissioning Plan (CDP) is included in the draft EIS. The details of decommissioning and restoration will be refined over time as the Project proceeds. A Preliminary Decommissioning Plan (PDP) will be developed by Denison to support licensing and permitting applications. Prior to executing decommissioning activities, Denison will prepare and submit a Detailed Decommissioning Plan (DDP) to regulators for their review and acceptance, which builds on the PDP.

The CDP outlines plans for physical decommissioning (mining area remediation; asset removal; and decontamination, demolition, and disposal), followed by restoration. A summary of the CDP is provided here.

- Ongoing decommissioning of Project components will be completed when possible.
- Denison has committed to progressively restore areas no longer necessary to support/facilitate Operations to limit the amount of disturbance at any given time. Restoration of inactive areas will take place when/as these areas become available. The progress and success of these activities will be assessed regularly at a schedule commensurate with the expectations of the activities per the decommissioning plan. Progressive restoration including ecosystem-based revegetation will be conducted on disturbed areas as soon as safely and logistically practicable with the use of suitable/appropriate native species and in accordance with the decommissioning plan.
- Once the asset removal, decontamination, demolition, and disposal are completed, and the site has been cleared and leveled, restoration activities, including planting, will take place. Currently this would largely be with jack pine seedlings, but the mix of plants will depend on location and available species. Restoration activities monitored until it is deemed self-sustaining and viable wildlife habitat.
- Future discussions will be held with Indigenous and general public Interested Parties to determine the amount of access to the area they wish to maintain in the future (post-decommissioning). Based on results of these discussions, transportation corridors including roads or trails associated with the Project site that are no longer needed will be graded, scarified, and vegetated with native, self-sustaining species as required. Access to facilitate safe post-closure monitoring or requested by appropriate Interested Parties (e.g., to facilitate land use) may be left in place. Access to the site may be restricted by gates and/or berms.
- Laydown areas will be scarified, covered with 0.5 to 1.0 m of stockpiled overburden, and vegetated with native, self-sustaining species. The footprints of other infrastructure, such as the camp, will be scarified and vegetated with native, self-sustaining species as required. The topsoil and brush stockpiled during pre-construction activities will be used during restoration.
- Lessons learned from progressive decommissioning and any site-specific restoration studies will be incorporated into the DDP. Additionally, information from other northern Saskatchewan mine

sites will be examined to help Denison select the restoration tools, including revegetation options, that will contribute towards decommissioning success.

Closure of the entire Project will be completed in accordance with provincial and federal regulations and guidance documents with the fundamental considerations being to confirm physical and chemical stability of the site to protect human health and the environment.

Progressive decommissioning and restoration will be completed throughout the life of the Project, whenever feasible, and reported to the regulatory agencies as part of the annual reporting requirements throughout Operation. Associated activities will focus on the decontamination, demolition, and disposal of unused buildings and infrastructure, as well as the removal of unused equipment and machinery. Progressive decommissioning and restoration are expected to continue and result in positive effects as revegetation is continued and regeneration occurs. Following decommissioning and restoration, wildlife habitat is expected to recover to baseline conditions.

5 Habitat Loss Calculation

5.1 Habitat Loss in Context of the Disturbance Management Threshold for SK1

To support the Plan with respect to the calculation of habitat loss, a mapping exercise was completed to provide context on the Project-related habitat loss in consideration of the woodland caribou range (SK1) disturbance management threshold (ECCC 2020).

5.1.1 Approach

First the Project infrastructure footprint area was delineated and estimated to be 80 ha. Next, a 500 m buffer was applied to the Project footprint, resulting in a total potential disturbance area of 1,350 ha. This is consistent with the approach for determining direct and indirect effects, as outlined in ECCC (2020).

Finally, an analysis was undertaken to quantify the amount of caribou habitat that is currently disturbed within the Project footprint + 500 m buffer. According to ECCC (2020), there are two contributors to disturbed habitat in SK1: 1. anthropogenic disturbance + 500 m buffer and 2. fire disturbance in the last 40 years, without a buffer. The two factors for disturbed habitat were considered as follows:

1. Existing anthropogenic disturbance + 500 m: For anthropogenic disturbance calculations to inform the Plan, mapping was completed and evaluated to determine the existing anthropogenic disturbance. Although the EIS considered anthropogenic disturbances on IKONOS imagery at the 1:5,000 scale, the mapping exercise to support habitat loss calculations in the Plan used anthropogenic disturbances visible on Landsat at the 1:50,000 scale, to be consistent with the definitions of disturbed habitat from the amended recovery strategy (ECCC 2020).

2. Fire disturbance in the last 40 years, without buffer: To determine ecosites that were in a regenerating phase or having experienced fire disturbance in the last 40 years, the ecosites BS3/BS7-Jack pine-blueberry/Black spruce-blueberry/lichen were used, based on previous ecosite classification work completed to support the EIS.

5.1.2 Results

As shown in Table 5-1 and Figure 5-1, the proposed Project footprint + 500 m buffer is almost entirely located within existing, buffered anthropogenic disturbance. This means the Project footprint + 500 m buffer is located within already disturbed habitat, according to ECCC (2020). Additionally, the mapping exercise shows that approximately half of the Project footprint + 500 m buffer is located within regenerating forest, i.e., forest burned less than 40 years ago (Figure 5-2).

Table 5-1: Existing Disturbed Habitat within Buffered Project Footprint

	Area within Project Footprint + 500 m buffer (1,350 ha)
Existing anthropogenic disturbance (+ 500 m buffer)	1,298 ha
Regenerating forest (fire disturbance in the last 40 years; no buffer)	730 ha

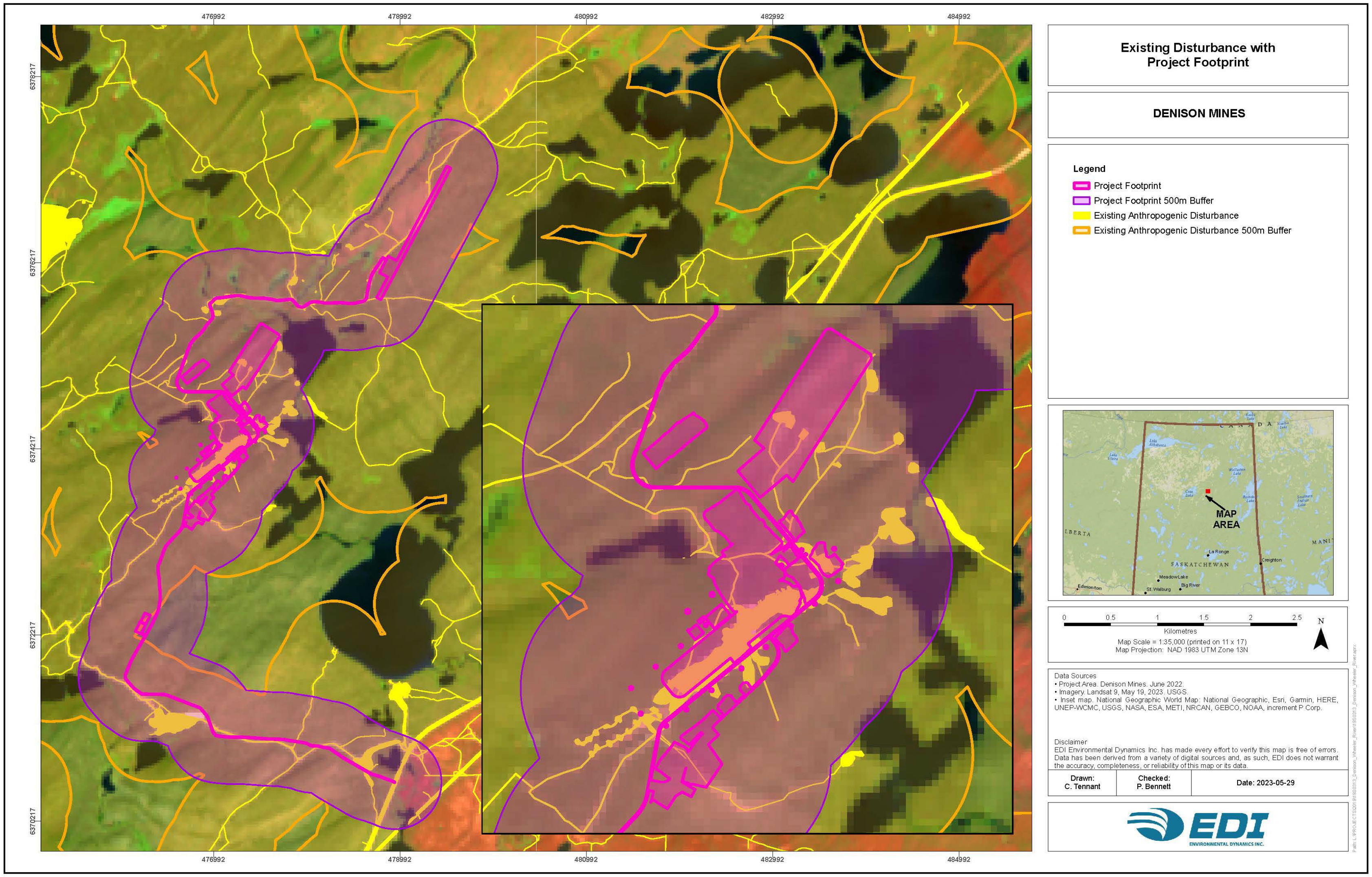


Figure 5-1: Proposed Project Footprint (+ 500 m buffer) with Existing Anthropogenic Disturbance (+ 500 m buffer) Visible on Landsat at 1:50,000

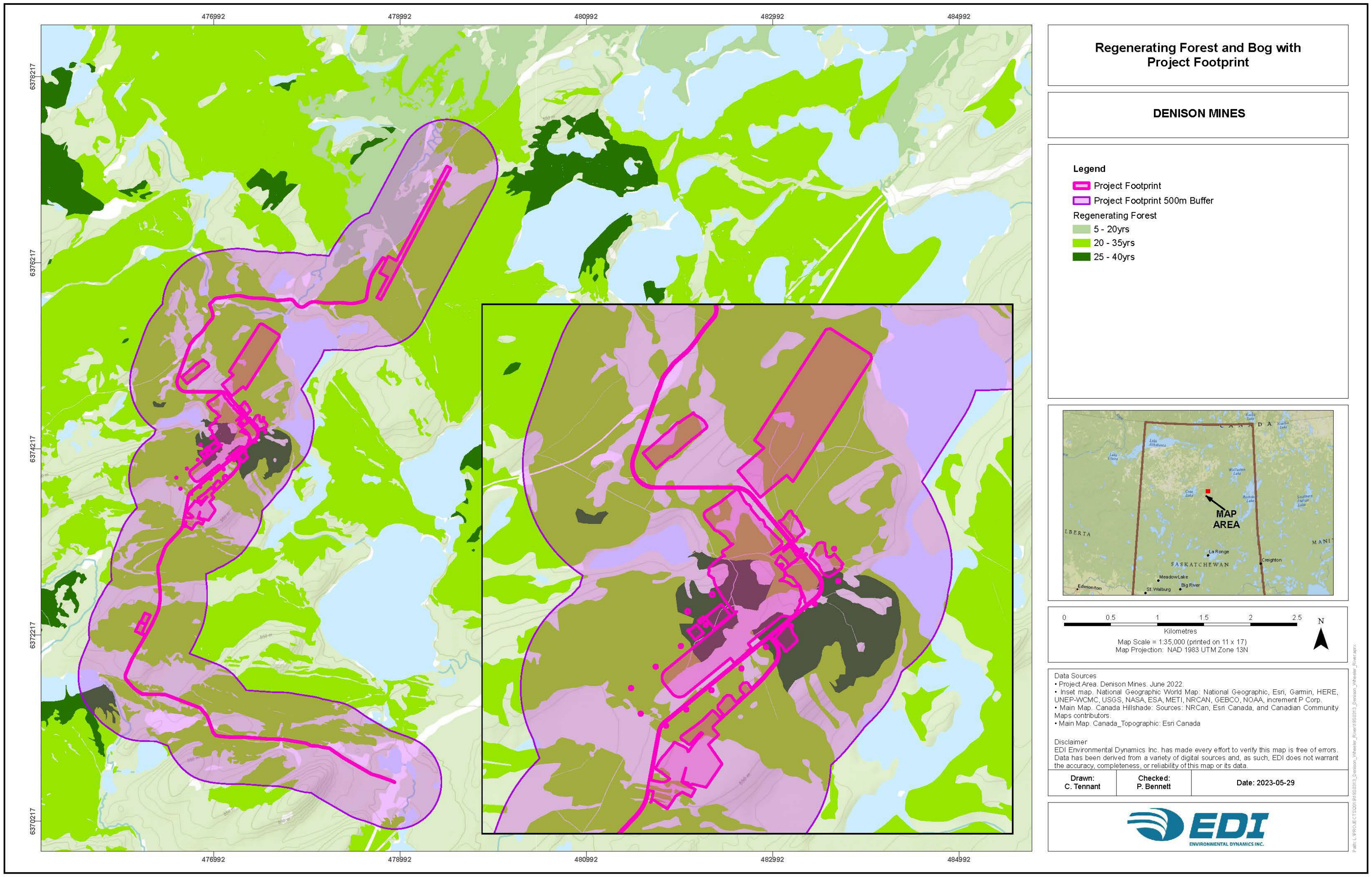


Figure 5-2: Proposed Project Footprint (+ 500 m buffer) with Regenerating Forest

Based on the above analysis using ECCC (2020) criteria, should the Project proceed, the disturbance management threshold for SK1 range would remain unchanged.

Additionally, ECCC (2020) identified the caribou population in the SK1 range as being self-sustaining at a threshold of 40% undisturbed habitat and recommended that total anthropogenic disturbance in the SK1 Boreal Shield range should not exceed 5% with the remainder (i.e., 55%) being attributed to natural disturbance (while maintaining a minimum of 40% undisturbed habitat in the range). ECCC (2020) calculated that approximately 58% of the SK1 Boreal Shield range is currently affected by past forest fires and 3% of the range is affected by anthropogenic disturbances. For additional context, the size of the SK1 Boreal Shield range is estimated at 18,034,870 ha (ECCC 2020). The Project footprint + 500 m buffer (1,350 ha) would represent an estimated Project-related disturbance of 0.007% at the scale of the SK1 Boreal Shield Woodland Caribou Management Unit.

5.2 Direct Loss Calculation

The Project infrastructure footprint has been delineated and the area was determined to be 80 ha. Of this area, 12 ha are comprised of previously disturbed land resulting from past activities (e.g., access, exploration camp and laydown areas). The remainder of the Project footprint is comprised of regenerating forest (forest less than 40 years old) habitat which is typically considered to be low quality habitat for caribou (Figure 5.3).

Table 5-2: Land Cover Types within the Project Footprint

	Total Area
Project footprint	80 ha
Existing anthropogenic disturbance	12 ha
Regenerating forest habitat (i.e., low quality caribou habitat)	68 ha

Denison understands that the Project will likely result in a limited residual effect on caribou and their habitat within the RSA; however, these effects are considered to be small in a relative sense when considered in the context of the SK1 range, as described in Section 5.1.

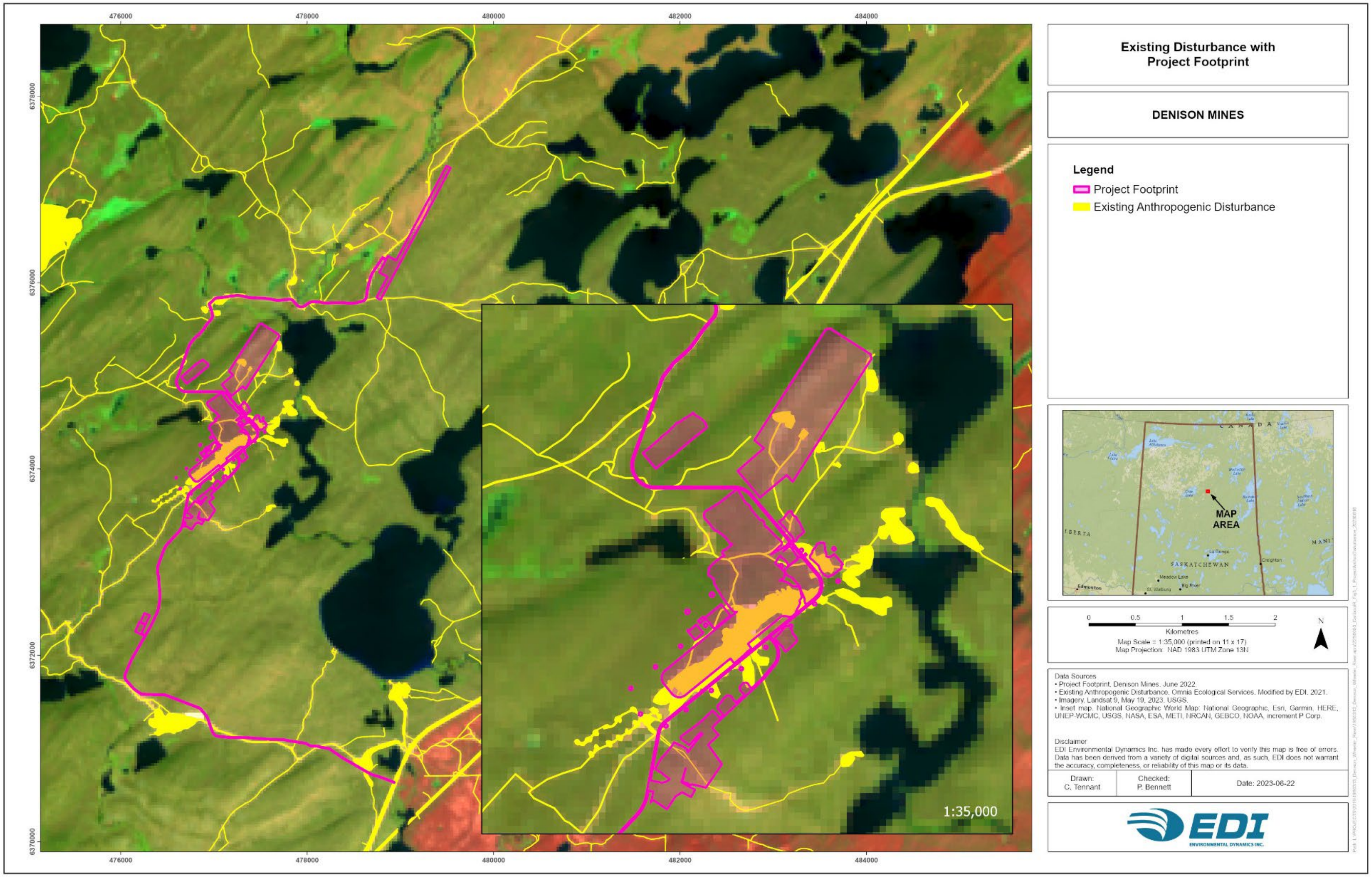


Figure 5-3: Proposed Project Footprint with Existing Anthropogenic Disturbance Visible on Landsat at 1:50,000

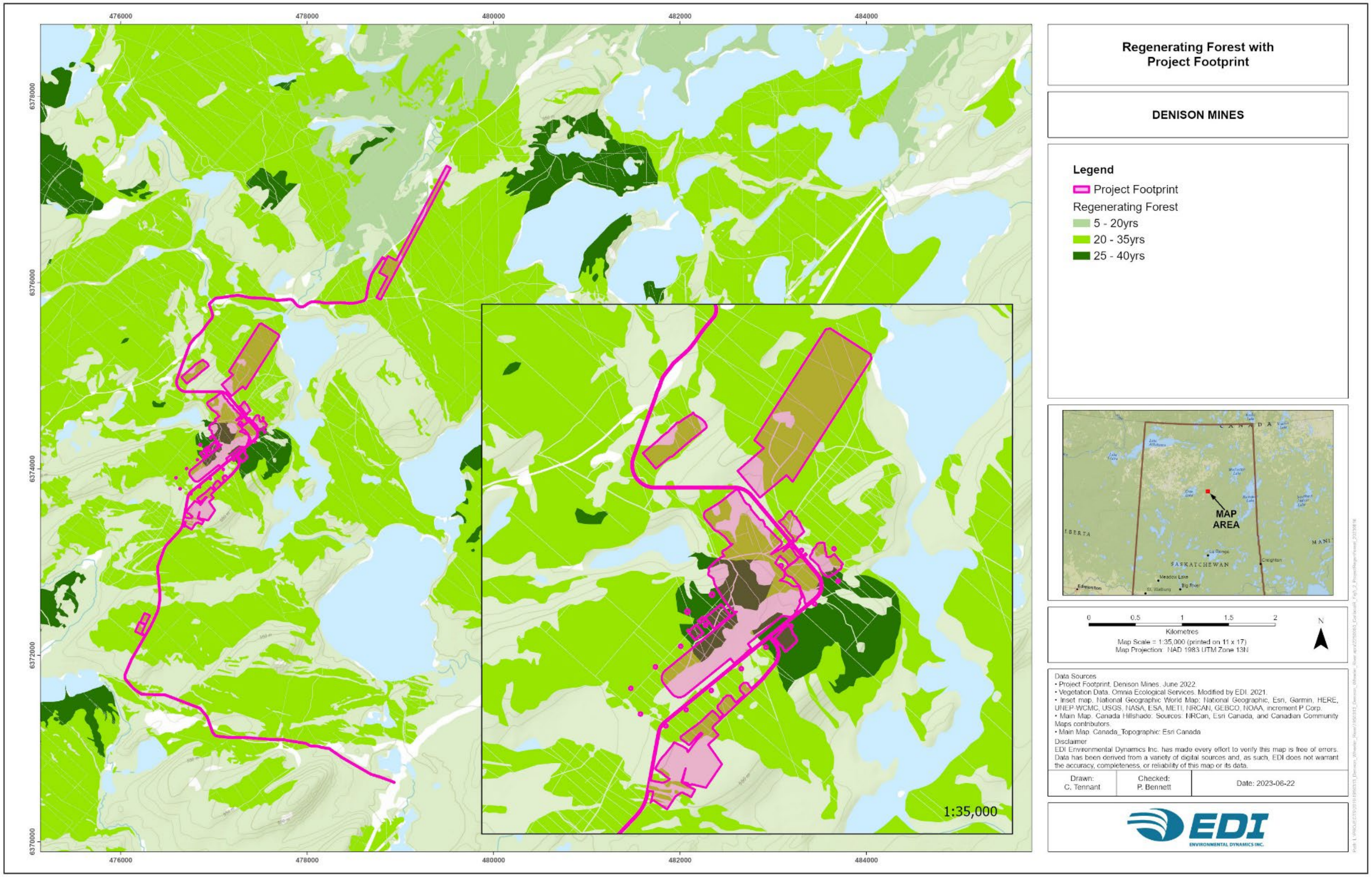


Figure 5-4: Proposed Project Footprint with Regenerating Forest

It is Denison's understanding that currently there are no provisions/requirements for caribou habitat offset by the ENV for projects within the SK1 range. Denison recognizes the importance of woodland caribou to Indigenous groups, the general public, other Interested Parties in Saskatchewan, and Canada. As such, as part of this Plan, Denison is proposing to continue to work with ENV to determine an appropriate offset based on the habitat loss as a result of the Project. Denison expects that the proposed offset calculations would likely include aspects of additionality, temporal considerations, spatial considerations, and other aspects, depending on the expectations/requirements of the caribou habitat offset process that the ENV is currently refining/finalizing. The proposed offset calculations are expected to be refined through ongoing communications with ENV to appropriately address issues at the provincial level related to caribou and habitat.

Future versions of the Plan will include detailed options to develop and advance restoration work and initiatives to provide responsible, proactive environmental stewardship. These offsets (Figure 5-5) are expected to be further refined/defined through Plan updates as the Project proceeds and consultations with ENV advance. Some initial options are presented at a conceptual level in Section 6.

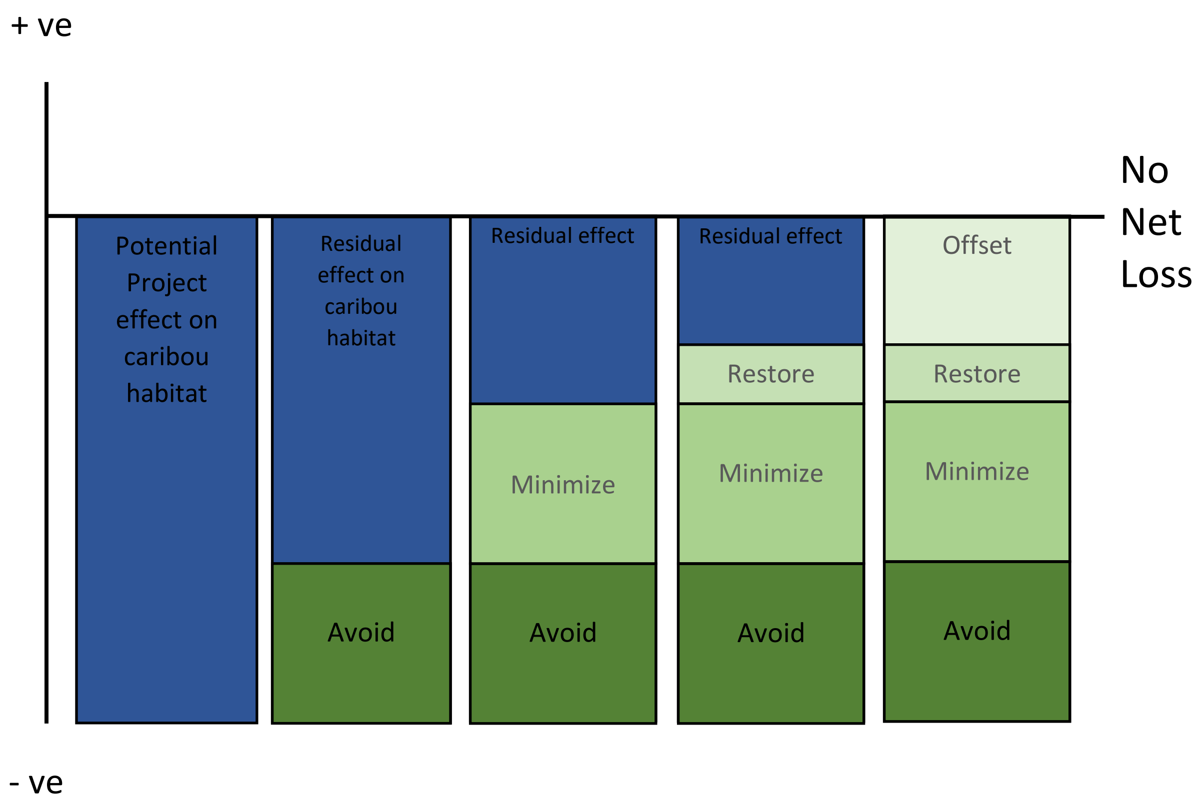


Figure 5-5: Wheeler River Project Conceptual Caribou Mitigation Plan to Achieve No Net Loss

6 Offset Framework

This section provides a discussion on offset options will become more defined as the Plan advances, in consultation with ENV. This is expected to offset residual effects over the life-of-the-Project and enhance the restoration activities occurring within the Project footprint to result in no net loss of habitat within the RSA as a result of the Project.

6.1 Conceptual Offset Opportunities

An opportunity that Denison has proactively identified is a combined linear feature mitigation and restoration option. Denison has implemented a practical and experimental pilot study to investigate the design, implementation, testing, and monitoring of several functional and structural habitat mitigation options. This opportunity involves two components: 1) applying treatments to address (i.e., reduce) lines-of-sight and discourage linear feature use by both caribou and their predators, and 2) restoration focused on re-establishing terrestrial lichen communities co-established with a biological soil crust (BSC) component.

Importantly, to complete this pilot program, Denison has partnered with the University of Saskatchewan and Northwest Communities Environmental Services (an Indigenous-owned environmental company) under the Developing Eco-Restoration Together (DERT) program. This unique project aims to co-create ecological restoration practices that centre Indigenous peoples, worldviews, and values while also braiding knowledge from the land, Indigenous knowledge, and western science. The project is supported by the three partners but is ultimately guided by the Indigenous Project Advisory Board, and the Community Liaison/Education Coordinator. Through restoration trials, community engagement, and various planting techniques, Denison, with their partners are seeking to return ecosystem functions in areas where they have been previously disturbed (e.g., exploration cutlines). Through collaboration with community members, University of Saskatchewan, industry partners, two graduate students, and local youth, this project is expected to ultimately inform the creation of a framework for effective restoration practices in northern Saskatchewan that centre on caribou and Indigenous communities.

6.1.1 Caribou Trail Study

Wildlife, particularly bears, wolves, and woodland caribou, are using anthropogenic linear features to move throughout their habitat with greater ease. This can result in increased chance encounters between predators and prey and could contribute to the reduction in woodland caribou populations (Omnia 2022). Denison is conducting research on the use of linear features predators and prey in the Athabasca Basin to collect relevant data to inform an effective plan designed to disrupt the current risk related to predator/prey movements/interactions.

Currently, ENV has no guidelines or protocols for assessing the status of disturbance features or for evaluating the need for linear feature mitigation. Denison proactively initiated research to collect field-based findings on the effectiveness of linear disruption features on predator/prey movements in the vicinity of the Project. This field program was designed and implemented to deploy and monitor the effectiveness of five linear feature treatments across nine locations. Treatment types include, seeding and/or planting of jack pine, spreading coarse woody debris, tree tipping, constructing biodegradable fencing, and earth/debris mounding. Methods vary by location but have a common goal: to discourage prolonged disturbance and encourage new growth in areas of disturbance (Omnia 2022). Each treatment area is monitored by game cameras year-round to determine how wildlife interact with the created physical and visual barriers. All treatments are temporary and biodegradable with the purpose of reducing trail use in the near-term so that the forest can regenerate naturally.

Preliminary results are encouraging and indicate that bear use of treated lines was reduced by 43% compared to untreated lines, caribou use was reduced by 95%, and wolf and moose use was reduced by approximately 94%. Overall, use of treated lines by species of interest was reduced by approximately 83% when compared to baseline monitoring rates. These successful preliminary results will guide future work to define potential offset options associated with linear feature mitigation and restoration.

6.1.2 Biological Soil Crust Research

To support restoration planning, additional research will be designed to investigate BSCs and conducted by a soil science graduate student at the University of Saskatchewan. This research is expected to contribute to the goals of the Developing Eco-Restoration Together Project. BSCs are communities of lichen, bryophytes, cyanobacteria, and microorganisms found in the top layer of the soil (Heindel et al. 2019). These surface soil mats are rich in diversity, and play an important role in the broader ecosystem, especially in locations with extreme climate, little moisture, and nutrient-poor soil (Cowden et al., 2022). Research on BSCs has been focused on desert regions, and this research provides insight to BSC's role in boreal ecosystems, specifically in northern Saskatchewan. By gaining a better understanding of how to support BSC establishment and growth, it is expected that the findings can inform restoration activities that would ultimately benefit caribou.

Sampling of BSCs within the region will be based on a fire chronosequence. This is expected to provide a foundation to better understand the functions and species present in BSCs, and how they develop post-disturbance (Coxson and Marsh 2001). Understanding how these communities develop and interact is important, especially considering the gap in knowledge on soil microbial communities, non-vascular species, and their role in restoration techniques.

A critical element in supporting caribou populations is the consideration of caribou forage lichens. Due to the slow-growing nature of lichens, it can be difficult to include them in restoration activities (McMullin and Rapai 2020). Denison is planning to focus on caribou forage, primarily through transplanting and propagation of the appropriate lichen species. Natural regrowth of lichen communities after fires takes place in a complex setting, where BSCs and bryophyte communities stabilize soil surfaces, providing habitats where lichen propagules can establish and grow (Coxson and Marsh 2001). Denison hypothesizes that reestablishment of terrestrial lichen communities will have a better chance of success where these supporting BSC components can be co-established at the same time. The findings from the BSC research within post-fire environments is expected to support lichen communities, restoration activities for the DERT project, and ultimately caribou and caribou habitat within the Wheeler River Project area.

7 Monitoring and Adaptive Management Framework

An adaptive management framework will be developed to support the implementation of this Plan (Figure 7-1). In this context the adaptive management framework provides the means for the integration of Plan scope, management, and monitoring to systematically evaluate assumptions to adapt and learn. In practical terms the framework will consider the outcomes of actions taken/implemented, whether they have been successful and, if not, how can such actions be adapted to increase the likelihood of success. Outcomes of the Plan would be measured by establishing performance indicators as the way to define and measure progress toward achieving the objectives.

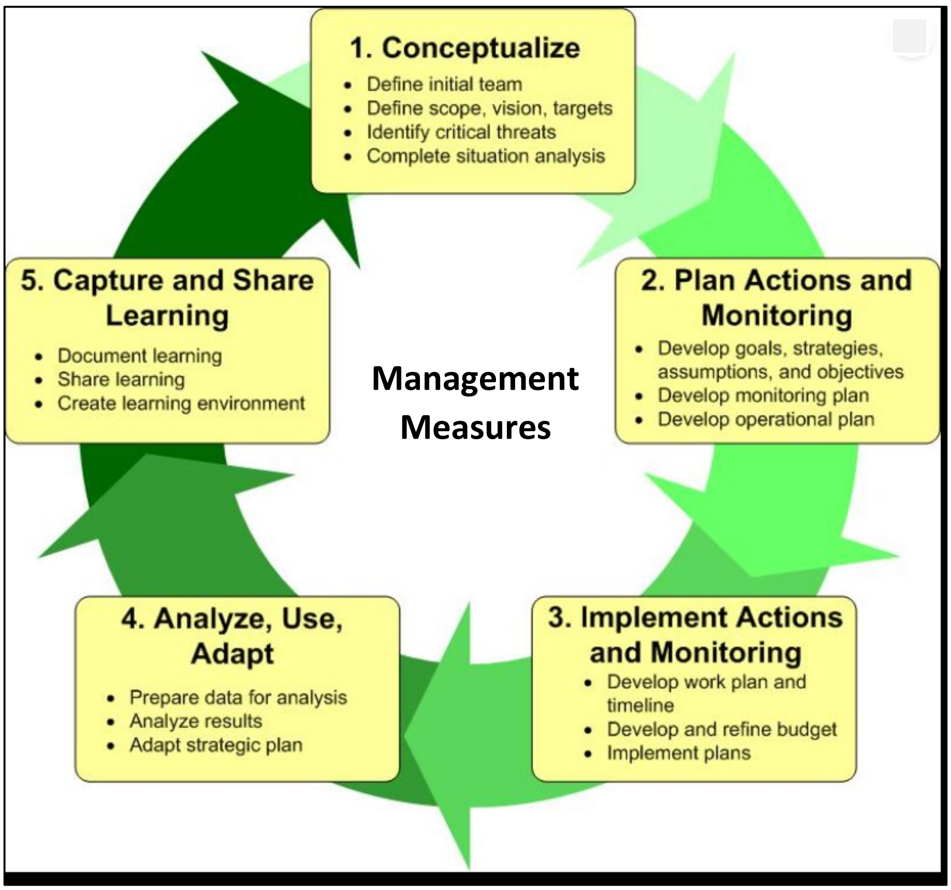


Figure 7-1: Adaptive Management Cycle

8 References

Cowden, P., Hanner, R., Collis, B., Kuzmina, M., Conway, A., Ivanova, N., & Stewart, K. (2022). Early successional changes in biological soil crust community assembly and nutrient capture in mining impacted landscapes. Soil Biology and Biochemistry, 175. doi.org/10.1016/j.soilbio.2022.108841

Coxson, D., and J. Marsh. 2001. Lichen chronosequences (postfire and postharvest) in lodgepole pine (Pinus contorta) forests of northern interior British Columbia. Canadian Journal of Botany. https://doi.org/10.1139/b01-127

Environment Canada. 2011. Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada: 2011 Update. Ottawa, ON. 102pp. plus appendices.

Environment and Climate Change Canada (ECCC). 2019. Boreal Caribou Science to Inform Recovery: Science Summary Sheet #1. Ottawa, Ontario, Canada. 10p.

Environment and Climate Change Canada (ECCC). 2020. Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada. Species at Risk Act Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. xiii + 143pp.

Heindel, R. C., Governali, F. C., Spickard, A. M., & Virginia, R. A. (2019). The Role of Biological Soil Crusts in Nitrogen Cycling and Soil Stabilization in Kangerlussuaq, West Greenland. Ecosystems, 22(2), 243–256. https://doi.org/10.1007/s10021-018-0267-8

McLoughlin, P. D., C. Superbie, K. Stewart, P. Tomchuk, B. Neufeld, D. Barks, T. Perry, R. Greuel, C. Regan, A. Truchon-Savard, S. Hart, J. Henkelman, and J. F. Johnstone. 2019. *Population and habitat ecology of boreal caribou and their predators in the Saskatchewan Boreal Shield*. Final Report. Department of Biology, University of Saskatchewan, Saskatoon. 238 pp.

McMullin, R. T., & Rapai, S. (2020). A review of reindeer lichen (Cladonia subgenus Cladina) linear growth rates. Rangifer, 40(1), 15–26. https://doi.org/10.7557/2.40.1.4636

Neufeld, B., C. Superbie, R. J. Greuel, T. Perry, P. A. Tomchuk, D. Fortin, and P. D. McLoughlin. 2021. Disturbance-Mediated Apparent Competition Decouples in a Northern Boreal Caribou Range. *The Journal of Wildlife Management* 85(2): 254–270.

Omnia Biological Services (Omnia). 2022. Denison Mines Corporation Wheeler River Project, Linear Feature Mitigation Trial Project Update Report. April 2022 Update.

OECD. 2016. Biodiversity Offsets: Effective Design and Implementation. OECD Publishing, Paris. https://doi.org/10.1787/9789264222519-en

Saskatchewan Ministry of Environment (ENV). 2013. Conservation Strategy For Boreal Woodland Caribou (Rangifer tarandus caribou) in Saskatchewan. Saskatchewan Ministry of Environment. Fish and Wildlife Technical Report 2014.

Saskatchewan Ministry of Environment (ENV). 2023. Wildlife Species At Risk – Woodland Caribou. https://www.saskatchewan.ca/business/environmental-protection-and-sustainability/wildlife-and-conservation/wildlife-species-at-risk/woodland-caribou (accessed May 2023).

Attachment: IR-150

Number	IR-150
Dept.	ECCC
Project effects link	Wildlife and Wildlife habitat
Reference to EIS, appendices, or supporting documentation	Section 9.3.5.2.1, Best Management Practices for working in Boreal Woodland Caribou Range in Saskatchewan
Context and Rationale	**Context and Rationale:** In the draft EIS Section 9.3.5.2.1, the Proponent states: "Denison proactively initiated research to provide field-based findings on the effectiveness of linear disruption features on predator/prey movements." "Results will help the development of proactive and meaningful restoration strategies as an ongoing part of the overall Project (Omnia 2022). Additionally, the 2023 field program will support a program that uses the results from the 2021/2022 Caribou Trail Study in long-term reclamation planning. The program will be led by the University of Saskatchewan and is funded by Denison, an Indigenous-owned environmental company, the Northwest Communities Environmental Services (Métis owned), Mitacs, and the Natural Science and Engineering Research Council of Canada through an alliance grant. The Caribou Trail Study and the reclamation plan will culminate with the development of a Woodland Caribou Management Plan." ECCC is available to support the Proponent through review of study programs should those programs be made available during the review process. ECCC requests to see the 2021/2022 study to further our review of caribou use in the Project area.
Information Requirement	Provide the report for 2021/2022 Caribou Trail study for long-term reclamation planning for ECCC review.

<u>Response:</u>

The requested report titled *Pilot Program: Linear Feature Mitigation Interim Report- Status Update and Preliminary Results* is included below.

Denison Mines Corporation
Wheeler River Project

Pilot Program: Linear Feature Mitigation
Interim Report- Status Update and Preliminary Results

Prepared for:

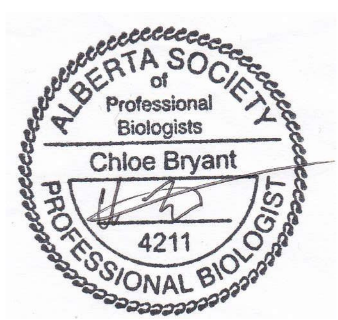
Denison Mines
345 4th Avenue South
Saskatoon, SK, S7K 1N3

Jennifer Skilnick, Environmental Coordinator
Janna Switzer, Environmental Manager

Prepared by:

Omnia Ecological Services
6244 Silver Ridge Drive NW
Calgary, AB, T3B 3S7

Chloe Bryant, P.Biol
Hans Skatter, P.Biol



November 2022
Omnia Project ID: 2103-01

BACK

TABLE OF CONTENTS

BACK

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Federal and provincial planning documents and woodland caribou (*Rangifer tarandus caribou*) population assessments have indicated that much of the Saskatchewan woodland caribou population is at risk from landscape-level disturbance. There exist no guidelines for evaluating reclamation requirements or outlining what the criteria for reclamation are. Omnia Ecological Services (Omnia) has been engaged by Denison Mines Corporation (Denison) to continue to support the project application (e.g., assessment of impacts and regional mapping/inventory) with respect to reclamation/offset planning to assist with developing potential woodland habitat reclamation selection and criteria protocol through the use of cost effective and practical functional habitat restoration/mitigation options. If successful, these mitigation techniques could be deployed at a larger scale within the SK Boreal Shield and may assist government in developing mitigation/reclamation criteria.

A pilot project of potential mitigation options to disrupt predator-prey movement patterns on linear features by creating a physical, visual, and/or line-of sight barriers has been deployed at 12 sites within the Wheeler River study area (Figure 1). Detailed background information and full details of site-specific treatments, including preliminary planning and consultation, can be accessed in Omnia (2022). Also included in that report are preliminary findings from the first five months of monitoring.

The objectives of this interim report are to outline preliminary results gathered from monitoring data thus far (year 1) and outline program follow-up requirements and recommendations for future consideration.

2 MONITORING

A site visit was completed in May 2022 as part of the planned bi-annual inspection/data collection with the following objectives:

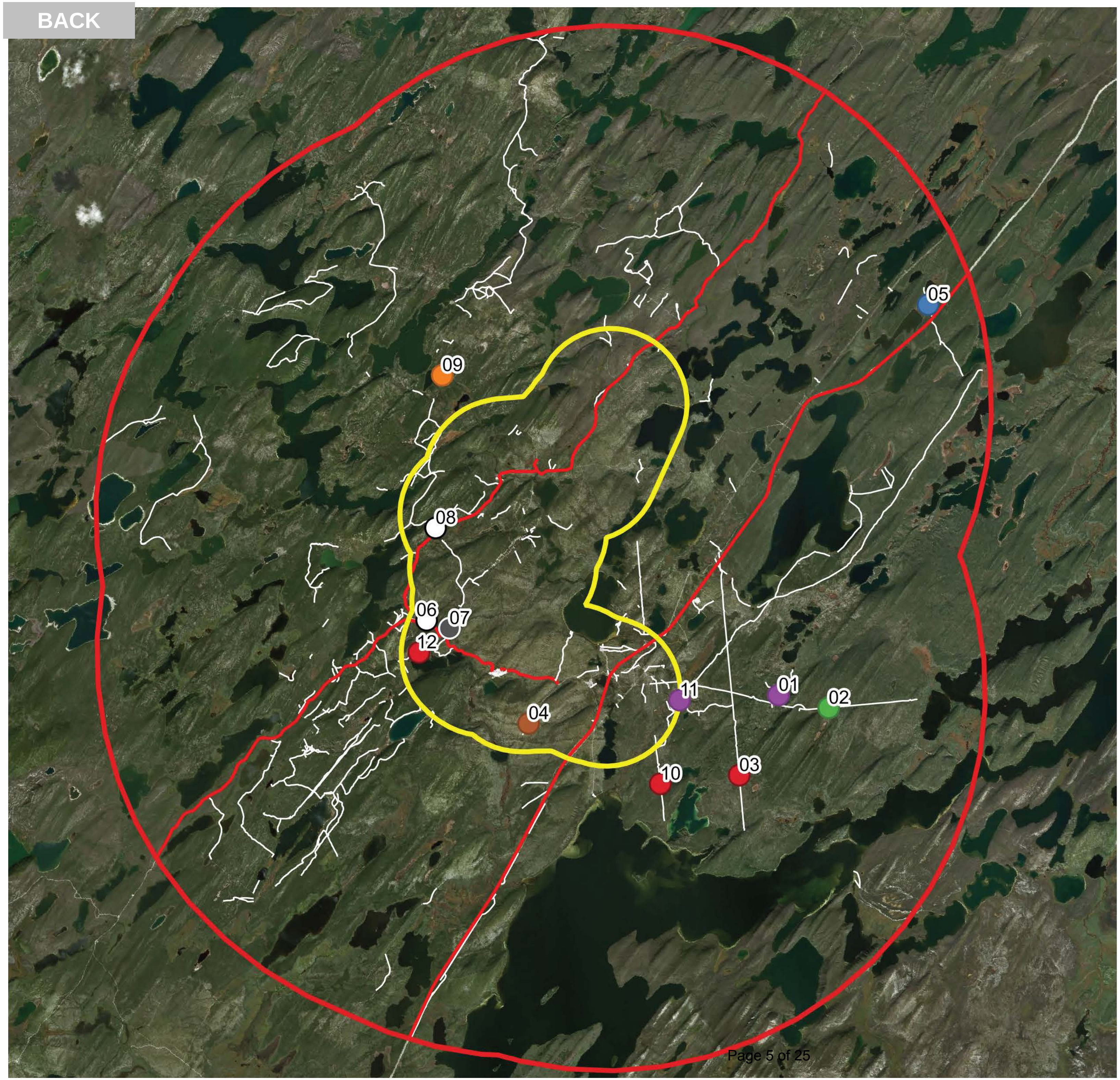
- Revisit and check the status of all 12 treatment sites.
- Make any repairs or modifications as required.
- Remove and replace covert camera memory cards to collect wildlife use data collected since deployment.
- Replace covert camera batteries to support ongoing monitoring.
- Measure height and assess health status of planted Jack pine seedlings.

2.1 Methods

The linear feature mitigation sites were visited from May 24-25, 2022. Photographs were taken at each site and notes were taken on overall conditions of the installation, durability, effect of snow cover/melt, issues encountered, and modifications or repairs conducted. Any signs of wildlife use in the area were also noted (i.e., tracks, pellets). Covert camera cards were replaced and camera setups were adjusted where required to prevent unnecessary false trigger events (such as from burlap flapping in the wind). All camera batteries were replaced. Camera photographs were retrieved and analyzed for wildlife use along the 12 treated linear features (LFs) and six reference/untreated parallel linear features.

BACK

Figure 1. Installed mitigation features for the linear feature reclamation and mitigation trial. - Denison Wheeler River Project



Legend

- Local Study Area (LSA)
- Regional Study Area (RSA)

Disturbance Type
- Road
- Rough Road
- Trail

Treatment Type
- Burlap fence
- Coarse Woody Debris + Planting
- Coarse Woody Debris + Planting + Burlap Fence
- Tree Tip / Wood Structure
- Tree Tip / Wood Structure + Planting
- Tree Tip / Wood Structure + Planting + Burlap Fence
- Trench Pile + Planting
- Trench Pile + Planting + Burlap Fence

N W E S

0 2 4 6 km

1:120,000

August, 2021
Omnia Project # 2103-01
www.omniaeco.ca

OMNIA ECOLOGICAL SERVICES

For treated and untreated LFs, each wildlife trigger event was characterized as a “use” event if the animal appeared to be travelling on the line and/or displaying non-avoidance behavior, such as approaching/interacting with the burlap or other treatment features. Behavior such as crossing the LF, traveling in the adjacent forest, or paralleling the LF was characterized as “non-use” of the LF. Cameras were programmed to take five photographs per trigger event, often allowing for movement trajectory to be determined. However, if field of view was limited, body language and movement cues of the animals were used to best determine appropriate categorization, such as angle of head/body, no assumption of sharp turns, etc. Photograph analysis findings were compared to results gathered from multi-year baseline linear feature camera monitoring across the project area, and between treated and reference sites. Effects of treatments on wildlife use of LFs was then analyzed across all species of interest and between individual species types.

Each seedling that was planted when treatments were installed in July 2021 was measured for height, and a relative health score was assigned to each seedling: 1=healthy, 2=average, 3=poor 4=dead/missing. Evidence of browsing events by wildlife were also recorded.

2.2 Results

2.2.1 Treatment Visits

Table 1 summarizes the overall status of the treatment types, wildlife sign observations and modifications completed. Coarse woody debris (CWD) treatments maintained reasonable coverage and withstood snow pack/snowmelt (Photograph 1). Tree hinging/structures treatments were holding up very well and only a few structures/tree hinges had fallen over and needed reinforcing (Photograph 2). Needles on the trees that were hinged were yellowing but remained intact (Photograph 3). Trench and pile treatments were holding up very well and didn’t appear compressed following the winter snow (Photographs 4). Burlap installations, both on their own and when combined with other treatment types, required minimal repairs (Photograph 5).

Repairs consisted of:

- Replacement of ripped/ deteriorating burlap panels
- Replacing wooden lath ripped off by a bear (Site 10, Photograph 6)
- Adding screws and staples to reinforce, where required

2.2.2 Wildlife Photograph Analysis

Overall

Photographs were analyzed from 18 different cameras totaling 4,861 camera days. One hundred-ninety-four (194) detections were recorded of 13 different species, averaging four detections per 100 cameras nights. The most commonly detected species from all cameras, treatment and reference, was snowshoe hare with 56 detections, followed by woodland caribou with 44 detections, and black bear with 25 detections (Table 2). Table 2 summarizes the detections rates of species of interest (caribou, moose, black bear, wolf) by treatment type / reference linear feature. Detection rates of species of interest and human (ATV) use were compared with baseline covert camera results from multi-year linear feature monitoring conducted in the Denison Wheeler

River study area (Table 2a). Results were separated into desired non-use and use of linear feature type (treated versus untreated monitoring/reference trails). The results for trails (approximately 5m wide) were included for direct comparison and data from hand-cut lines and roads were excluded. A similar comparison was completed for treatments where no burlap was present, either on its own or in combination with other blocking techniques (Table 2b). This was to assess for trends without the potential wildlife attractant effects of the burlap. When treatments including burlap were included in the analysis, detection rates of all species of interest on treated lines are less than those of multi-year linear feature monitoring in the area. Bear use of treated lines was reduced with 61% compared with untreated lines, moose use was reduced with a 92%, and caribou use was reduced with 94% (Table 2a). No wolves were detected using treated lines. Overall use of treated lines by species of interest was reduced by approximately 85% when compared to monitoring rates. When installations including burlap are excluded from analysis, the reduction in detection rates along the treated sites are even more pronounced. No bears or wolves were observed using treated lines, while only a single caribou and moose were detected using treated lines.

Treatment Sites

Figures 2 and 3 highlight the relative effectiveness of the individual treatment types on wildlife species of interest detections and their use of the treated linear features. Non-use of the treated line by wildlife via travel in the adjacent forest, crossing, or paralleling the line was the desired effect and was therefore rated as positive. Use of a treated LF via traveling down the line/interacting with the treatment features was an undesired effect and was therefore rated as negative.

Figure 2 shows the results of the treatments for all species of interest combined. CWD treatment sites had the most wildlife detections (20) of three species, (bear, caribou and moose) and all interactions were positive (non-use of the line). Tree hinging/structures had ten detections of bear and caribou, 92% of these interactions were rated as positive. Trench and pile treatments had three moose detections; two thirds positive. Trench and pile + burlap had a split response between bears (all use) and moose (all non-use). CWD + burlap and burlap only had all negative interactions.

Figure 3 shows the results of the treatments for each species of interest. Caribou showed positive interactions (avoidance) with CWD and tree hinging/structures (100% and 83% of detections, respectively) and a negative interaction with burlap (100% of detections). Moose response to CWD and trench and pile + burlap was 100% positive, and was two-thirds positively associated with trench and pile. Black bears responded positively to CWD and tree hinging/structures, and negatively to CWD + burlap, trench and pile + burlap, and burlap only. Wolf responded negatively to burlap.

BACK

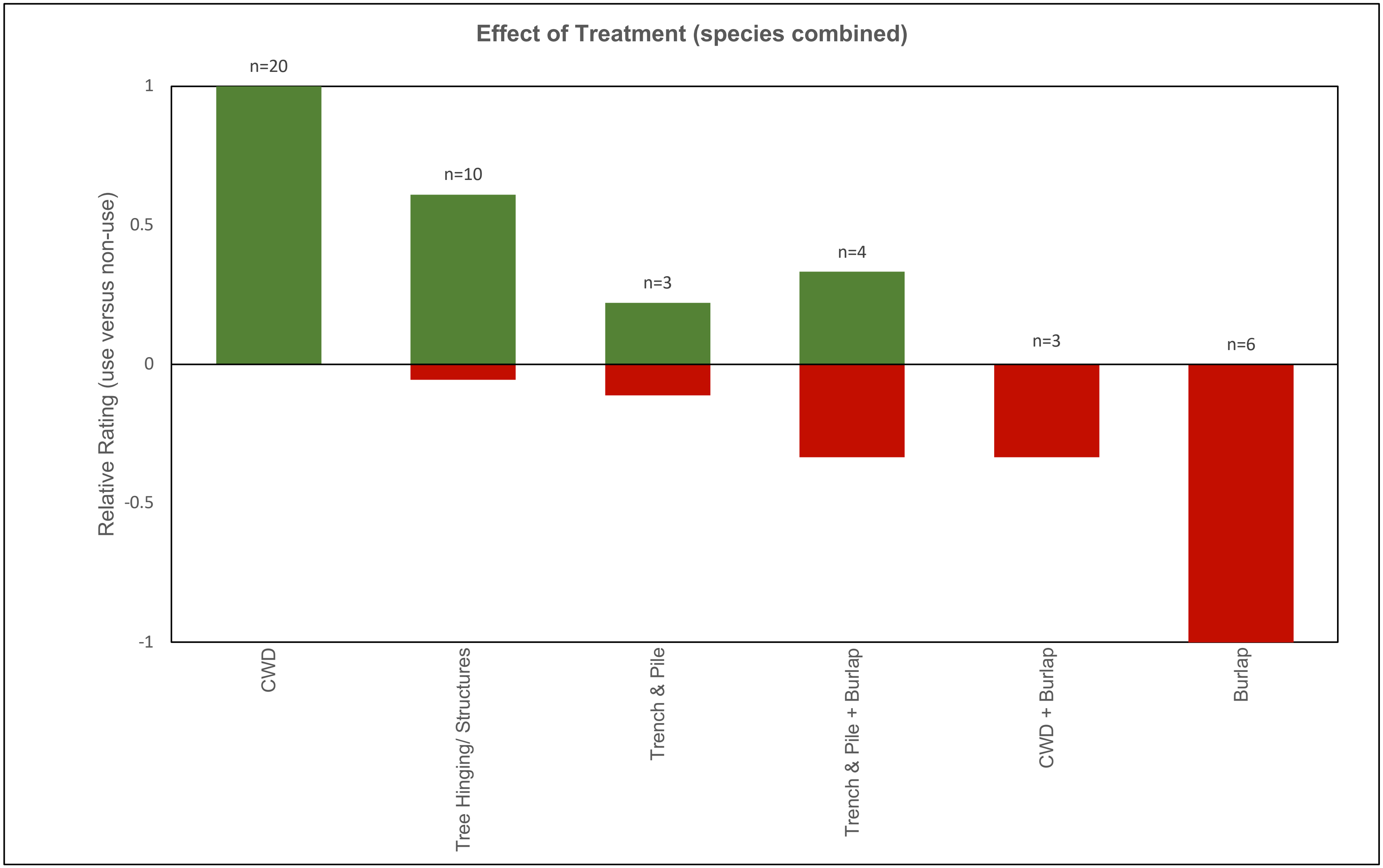


Figure 2. Wildlife detections by treatment type, all species combined (caribou, moose, black bear and wolf). Green/positive indicates desired avoidance of the treated LF; red/negative indicates undesired use of treated LF.

BACK

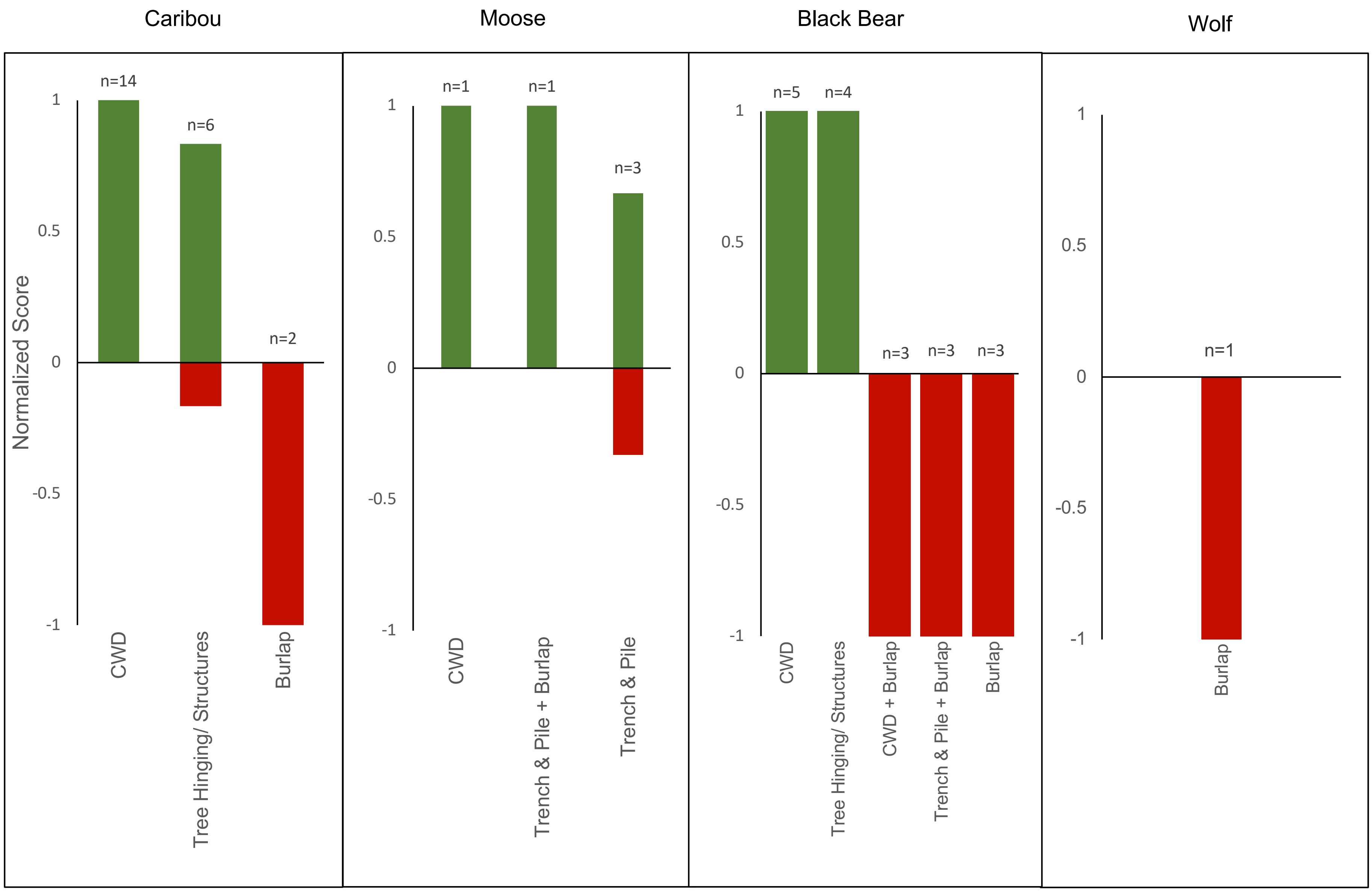


Figure 3. Caribou, moose, black bear and wolf detections by treatment type. Green/positive indicates desired avoidance of the treated LF; red/negative indicates undesired use of treated LF.

2.2.3 Seedling Health Assessment

A total of 476 seedlings were counted and measured, out of the initial 500 planted. Seedling height averaged 15cm (range 12-18cm) when planted and average height when measured in May 2022 was 18.8 cm (Table 4.). Average health status was 1.8. Photograph 7 illustrates representative examples of each health status, ranging from 1-4, healthy, average, poor, and dead, respectively. Mortality/loss averaged 4.8%.

3 SUMMARY PRELIMIARY CONCLUSIONS – Year 1

- Detection rates of all species of interest on treated lines (including burlap) are less than those of multi-year linear feature monitoring in the area (bears 61% reduction, moose 92% reduction and caribou 94% reduction; no wolves). When burlap is removed from analysis, the frequency of detection on treated lines is further reduced (no bears or wolves; only 1 caribou and 1 moose)
- CWD, tree hinging/structures, and trench & pile treatments elicited all/mostly positive avoidance responses from species of interest.
- Burlap, when used alone or in combination with other treatments, elicited the most negative responses from species of interest. Although preliminary, early results indicate that burlap may act as an unwanted attractant for curious wildlife or is not perceived as a barrier to species movement (Photograph 8).
- Burlap remains the most labor-intensive treatment in terms of maintenance and repairs required.
- Overall planted seedling health was strong and growth progression is promising.

4 NEXT STEPS

- Continuation of multi-annual site visits to monitor the status of treatment types, make repairs or adjustments as necessary.
- Continuation of multi-annual inspection/service and data collection of covert cameras and analysis of covert camera photographs.
- Assess potential impacts of a 2022 forest fire on several treatment locations/cameras and determine suitability for continued monitoring and/or redeployment.
- Analysis of potential snow depth/weather effects on wildlife activity over time are anticipated as more winter data is collected.
- Evaluate seedling status once again in 2023 to ensure status.
- Verify tree-hinge/structure counts to ensure replicability at other sites.
- Quantify coarse woody debris (CWD) stem counts and volume estimates to ensure replicability at other sites.
- Monitoring is ongoing and an increased monitoring period, and associated sample size, will facilitate further analysis, including potential use of statistics.

BACK

TABLES

Table 1. Summary of treatment status, observations, and modifications.

Treatment	# Linear Features	Overall	Wildlife Sign	Modifications
CWD	2	Holding up well after snow melt, minor compression	Faint caribou tracks at start of treatment, appear to deflect away from treatment; other caribou tracks on edge	none
CWD + Burlap	1	CWD holding up well, burlap corners lifted	none	reinforced burlap
Tree Hinging/ Structures	3	In great shape; needles on tree hinges yellowing but intact	none	Lifted/ reinforced a few structures/hinges that had fallen
Trench & Pile	2	Holding up very well, no compression	moose tracks avoid treatment and stay on parallel trail	none
Trench & Pile + Burlap	1	Trenches in good shape, burlap had a few holes	none	replaced 2 burlap panels
Burlap	3	Repairs made in December 2021 held up well, minor repairs needed	none	reinforced stakes pulled off by a bear, added more screws/ fixed burlap holes where needed

BACK

Table 2. Wildlife detection results by treatment type/ reference.

Treatment	# Linear Features	Camera Days	Detections/ 100 Camera Nights												ATV	Comments
			Bear			Caribou			Wolf			Moose				
			Non-Use	Use	Total	Non-Use	Use	Total	Non-Use	Use	Total	Non-Use	Use	Total		
CWD	2	613	0.82	0	0.82	2.28	0	2.28	0	0	0	0.16	0	0.16	0	-
CWD + Burlap	1	306	0	0.98	2.27	0	0	0	0	0	0	0	0	0	0	-
Tree Hinging/ Structures	3	745	0.54	0	0.54	0.67	0.13	0.81	0	0	0	0	0	0	0	-
Trench & Pile	2	610	0	0	0	0	0	0	0	0	0	0.33	0.16	0.49	0	-
Trench & Pile + Burlap	1	305	0	0.98	0.98	0	0	0	0	0	0	0.33	0	0.33	0	-
Burlap	3	622	0	0.48	0.48	0	0.32	0.32	0	0.16	0.16	0	0	0	0	-
TOTAL Treatments	**12**	**3201**	**0.28**	**0.28**	**0.56**	**0.59**	**0.09**	**0.69**	**0**	**0.03**	**0.03**	**0.12**	**0.03**	**0.16**	**0**	**-**
TOTAL Reference	**6**	**1660**	**0.24**	**0.18**	**0.42**	**0.60**	**0.72**	**1.33**	**0**	**0.18**	**0.18**	**0**	**0.12**	**0.12**	**1.02**	removed site 6 reference camera Dec2021

BACK

Table 3a. Comparison of caribou mitigation trial covert camera wildlife detections with baseline linear feature wildlife use inventory results.

Denison Program	Associated Feature	Total Camera Days	Bear		Caribou		Wolf		Moose		Species of Interest (bear, caribou wolf, moose)		All Animals*		ATV	
			Total	/100 cam days	Total	/100 cam days	Total	/100 cam days	Total	/100 cam days	Total	/100 cam days	Total	/100 cam days	Total	/100 cam days
Caribou Mitigation Trial	Treatment- Non-Use	3201	9	0.28	19	0.59	1	0.03	4	0.12	33	1.03	89	2.78	0	0.00
	Treatment- Use		9	0.28	3	0.09	0	0.00	1	0.03	13	0.41	39	1.22	0	0.00
Covert Camera Monitoring 2019-2021 + Reference Cameras	Trail- Use	6115	44	0.72	95	1.55	18	0.29	22	0.36	179	2.93	509	8.32	122	2.00

*includes mesocarnivores, small mammals, hares, birds, etc

Table 3b. Comparison of caribou mitigation trial covert camera wildlife detections with linear feature monitoring results, all burlap installations excluded.

Denison Program	Associated Feature	Total Camera Days	Bear		Caribou		Wolf		Moose		Species of Interest (bear, caribou wolf, moose)		All Animals*		ATV	
			Total	/100 cam days	Total	/100 cam days	Total	/100 cam days	Total	/100 cam days	Total	/100 cam days	Total	/100 cam days	Total	/100 cam days
Caribou Mitigation Trial	Treatment- Non-Use	1837	9	0.49	19	1.03	1	0.05	3	0.22	32	1.74	83	4.52	0	0.00
	Treatment- Use		0	0.00	1	0.05	0	0.00	1	0.05	2	0.11	19	1.03	0	0.00
Covert Camera Monitoring 2019-2021 + Reference Cameras	Trail- Use	6115	44	0.72	95	1.55	18	0.29	22	0.36	179	2.93	509	8.32	122	2.00

*includes mesocarnivores, small mammals, hares, birds, etc.

BACK

Table 4. Seedling health assessment results.

Plot ID	Treatment	# Planted July 2021	# Seedlings May 2022	Average Height (cm)	Average Status [a]	% browsed	% Missing / Dead	Comments
1	CWD	65	61	19.9	1.5	36.1	6.2	
2	Tree Hinging/Structures	70	67	12.3	2.4	97.0	4.3	
4	CWD + Burlap	65	62	17.9	1.9	14.5	4.6	
6	Trench & Pile	60	57	22.2	1.54	33.3	5.0	
7	Trench & Pile + Burlap	60	60	21	1.2	1.7	0.0	
8	Trench & Pile	60	59	22.3	1.3	32.2	1.7	
9	Tree Hinging/Structures	60	53	12.7	2.2	88.7	11.7	lost ~5 due to burlap log being cut down and landing on seedlings
11	CWD	60	57	21.8	2	75.4	5.0	
Total / Average		**500**	**476**	**18.8**	**1.8**	**47.4**	**4.8**	

a: 1= healthy, 2=average, 3=poor, 4=dead

BACK

REFERENCES

Omnia Ecological Services. 2022. Linear Feature Mitigation Trial. Project Update Report. Prepared for Denison Mines Corporation. 58pp.

BACK

FIELD PROGRAM PHOTOGRAPHS

BACK

Photograph 1. Status of CWD treatment May 2022.

Consulting - Telemetry - Research
www.omniaeco.ca

BACK

Photograph 2. Status of tree hinge/structures treatment May 2022.

BACK

Photograph 3. May 2022 status of needles on tree that was hinged.

BACK

Photograph 4. Status of trench & pile treatment May 2022.

Consulting - Telemetry - Research
www.omniaeco.ca

BACK

Photograph 5. Burlap repairs May 2022, before and after.

Consulting - Telemetry - Research
www.omniaeco.ca

BACK

Photograph 6. Wooden lath removed by bear.

Consulting - Telemetry - Research
www.omniaeco.ca

Photograph 7. Seedling health assessment examples 1-4, left to right, respectively.

BACK

Photograph 8. Burlap challenges with wildlife.

Consulting - Telemetry - Research
www.omniaeco.ca

Attachment: IR-165

Number	IR-165
Dept.	CNSC ECCC
Project effects link	Birds (all species)
Reference to EIS, appendices, or supporting documentation	Section 9.4.4.2.2 Section 9.4.5.2.4, Avian Deterrence and Prevention of Entrapment Appendix 10-A (ERA)
Context and Rationale	**Context:** On p. 9-364 of the EIS, it is stated that exposure to hazardous materials through contact with contaminated waste ponds could affect avian health and contribute to mortality. However, the ERA places the avian receptors only in waterbodies and locations outside of the Project area (see Figure 5-2 in the ERA), i.e., Whitefish Lake, McGowan Lake, the inlet to Russell Lake, and Kratchkowsky Lake. Further, there are insufficient details on the potential effects of the water quality in the water management and treatment facilities on birds, species at risk, and other wildlife, including the risk of bioaccumulation of contaminants. The Proponent should assess potential effects of water quality from these areas using applicable CCME guidelines. **Rationale:** It is unclear whether the ecological risk assessment based on the chosen exposure locations is protective and conservative for avian species potentially exposed to contaminated waste ponds on the Project site. While mitigation measures such as physical, visual, and/or auditory deterrents are proposed in Section 9.4.5.2.4, the possibility of avian species coming into contact with waste ponds cannot be excluded based on the available information in the EIS. The possibility of birds, species at risk, and other wildlife accessing the water management and treatment facilities for drinking water or other purposes is not discussed in the draft EIS.
Information Requirement	Please perform an ecological risk assessment with avian receptors located at the contaminated waste ponds, including:

	1. Describe and analyze the possibility of birds, species at risk and other wildlife using the water or waste management facilities and provide an analysis to determine if there is a risk to wildlife that may access these areas. 2. Identify the potential toxicity of water management ponds to aquatic migratory birds and species at risk (SAR). 3. Describe what measures will be taken if the waters are found to be toxic to migratory birds and SAR. Suggestions for mitigation and follow-up measures: CNSC recommends that Denison ensure adequate mitigation measures are implemented to minimize the potential for avian exposure to pond waters.

Response:

Water Management Context and Risk of Exposure

Details on water management and treatment facilities are provided in Section 2 Project Description, Section 2.2.3 Water Management. Importantly, the Project does not include a tailings management facility because of the nature of the proposed mining and processing methods. A summary of water management plans is provided herein; please refer to the marked-up Figure 2.2-15 below.

Clean, non-contact runoff will be diverted around Project components where possible. Contact water will be collected in various ponds and routed to the process water pond (shown in yellow in figure below). These contact water management ponds have been designed to manage event driven runoff and are not intended to be “wet” ponds. That is, the contact water ponds are not designed to hold standing water for long periods of time; rather, they would contain / manage runoff volumes up to the design event and subsequently be pumped down to ensure ongoing management capacity. As a result, the quality of water in these ponds is expected to be relatively good as it would largely comprise precipitation and runoff from natural surfaces.

Additionally, given the design basis of the contact water management ponds (i.e., they are not wet ponds that are meant to hold water at all times), birds and wildlife are not likely to interact with them in a material fashion from a contaminant exposure perspective.

Considering the Project design, the ponds with potential to contain water for any period of time in consideration of potential temporary use by avian species are:

- the process water pond, and the
- effluent monitoring and release ponds.

Process water pond

The process water pond can hold up to 30,000 m^3 of water. It will be a central pond collecting water from a variety of areas, including:

- water from the wash bay (shown in green in figure below),

- water from the domestic wastewater treatment plant,
- water from the dewatering of IWWTP precipitates (non-radioactive, gypsum type material), and
- precipitation-related contact water (shown in yellow in figure below; includes water from the wellfield runoff pond, clean waste rock pond, process precipitate pond, and landfill leachate collection [which is expected to be primarily surface contact water during the Operation phase]).

Water in the process water pond can be used directly in the processing plant or be directed to the industrial wastewater treatment plant (IWWTP) for treatment prior to release to Whitefish Lake. The majority of the flows into the process water pond during Operation (approximately 61% or 10.7 m^3/hour out of total 17.5 m^3/hour) are contact waters. As noted above, the quality of the contact water is expected to be relatively good given its sources. As such, a screening was conducted to evaluate the main non-contact water input to the pond, namely the water from the IWWTP precipitate pond. This input represents about 20% of the expected inflow to the process water pond and using this as an estimate for quality of the entire pond is considered conservative.

Effluent monitoring and release ponds

The effluent monitoring and release ponds will receive treated water from the IWWTP. Each of the three ponds will have capacity for 3,300 m^3 of water and a composite liner system. The ponds have been designed to hold effluent for a period of 80 hours for testing before discharge to the environment. Having three ponds allows for increased operational flexibility, as one pond can be undergoing maintenance when required. A minimum of two ponds are required to be operational at all times to make sure all effluent released to surface water meets federal and provincial discharge limits. Each pond will be operated with the following stages: 1) filling, 2) holding while awaiting quality confirmation; and 3) releasing to Whitefish Lake once water quality is confirmed to meet discharge limits. There is potential for wildlife to be in contact for short periods of time with the ponds during the holding stage. Table 2.2-1 outlines the upper bound effluent quality proposed for the Project.

In addition to the above that considers where exposure to water management facilities could reasonably occur on the Project site, the following is also relevant as it concerns the likelihood that such exposure would occur. During construction and operations, bird and other wildlife species are expected to avoid the Project Area and Local Study Area (LSA) because of sensory disturbance from project activities that generate noise, artificial light, vibration, dust, etc. and the presence of workers (Adams et al. 2019, Habib et al., 2007; Narins, 1990). While some habituation to sensory disturbance is anticipated that could result in individuals of some species returning to the LSA, generally it is expected that many individuals will be displaced into available habitat elsewhere outside the LSA in the Regional Study Area (RSA). The LSA is not within a major flyway and the LSA currently provides limited waterfowl habitat relative to the neighbouring parts of the RSA. Overall, based on these considerations we characterize the likelihood of bird and other wildlife species exposures to water management facilities on the site as low.

Potential Toxicity to Aquatic Migratory Birds and Species at Risk (SAR)

A comparison of the expected water quality from the IWWTP precipitate pond, a conservative representation of the process water pond, to the Canadian Council of Minsters of the Environment (CCME) water quality guidelines (WQG) for the protection of livestock and considered protective of animals potentially exposed to contaminated waste ponds on the Project site was completed. This comparison shows that the expected IWWTP precipitate pond water quality was below the CCME WQG for the protection of livestock for most constituents except selenium (**Table IR 165-1**), and as such, risks to birds, species at risk and other wildlife that may contact or ingest this water are not expected for those constituents below the CCME WQG protective of livestock.

Oviparous birds and fish are the most sensitive to selenium in aquatic environments with toxicity to birds and fish being associated with organic selenium primarily in the diets and tissues of exposed biota.[3] Selenium toxicity to these organisms is manifested through the maternal transfer of selenium which may cause embryotoxicity and teratogenicity[4]. Considering the mitigation measures described below to deter avian use of the ponds, including vegetation management such as managing areas around the waste ponds being free of vegetation to limit the attraction of waterfowl and other wildlife to these areas for foraging and/or breeding, potential risks to avian birds exposed to selenium at this pond would be low.

A CCME WQG protective of livestock was not available for antimony, barium, iron, manganese, silver, strontium, tin and titanium. Potential risks to avian species are unlikely for silver and titanium as these parameters were not detected in the IWWTP precipitate pond. Avian species and wildlife are not expected to be at increased risk for antimony, barium, iron, manganese, strontium and tin because the IWWTP precipitate pond water concentrations for these parameters represents about 20% of the expected inflow to the process, and the mitigation measures, discussed below, to deter avian species and wildlife from these ponds, will reduce the receptor's exposure to these constituents.

Table IR165-1: Comparison of Expected IWWTP precipitate pond Water Quality to the CCME WQGs for the Protection of Livestock

Constituent	Unit	C1-ETS2-SN	CCME Protection of Livestock
Aluminum, dissolved	mg/L	0.018	5
Antimony, dissolved	mg/L	0.0007	NV
Arsenic, dissolved	ug/L	0.4	25
Barium, dissolved	mg/L	0.097	NV
Beryllium, dissolved	mg/L	<0.0001	0.1
Boron, dissolved	mg/L	0.36	5
Cadmium, dissolved	mg/L	0.00045	0.08
Chromium, dissolved	mg/L	0.0064	0.05
Cobalt, dissolved	mg/L	0.0002	1
Copper, dissolved	mg/L	0.0021	0.5[a]
Iron, dissolved	mg/L	0.001	NV
Lead, dissolved	mg/L	<0.0001	0.1
Manganese, dissolved	mg/L	0.0012	NV

[3] Young , T.F., Finley, K., Adams, W., Besser, J., Hopkins, W.A, Jolley, D., McNaughton, E., Presser, T.S., Shaw, D.P, & Unrine J.(2010). What You Need to Know about Selenium. In: P.M. Chapman, W.J. Adams, M.L. Brooks, C.G. Delos, S.N. Luoma, W.A. Maher, H.M. Ohlendorf, T.S. Presser & D.P. Shaw (Eds.), Ecological Assessment of Selenium in the Aquatic Environment. Boca Raton (FL): CRC. p 7–45.
[4] Ibid

Constituent	Unit	C1-ETS2-SN	CCME Protection of Livestock
Molybdenum, dissolved	mg/L	0.018	0.5
Nickel, dissolved	mg/L	0.0004	1
Selenium, dissolved	mg/L	0.19	**0.05**
Silver, dissolved	mg/L	<0.00005	NV
Strontium, dissolved	mg/L	4.1	NV
Thallium, dissolved	mg/L	0.0007	1
Tin, dissolved	mg/L	0.0044	NV
Titanium, dissolved	mg/L	<0.0002	NV
Uranium, dissolved	ug/L	25	200
Vanadium, dissolved	mg/L	0.0064	0.1
Zinc, dissolved	mg/L	0.0027	50

Notes:
NV – no CCME WQG
a- lowest value between the sheep, cattle, swine and poultry value
Bold indicates that the predicted water quality exceeds the CCME WQG for protection of livestock.

A comparison of the proposed effluent quality in Table 2.2-1 of the EIS to the CCME WQG for the protection of livestock was also completed. This comparison shows that the proposed effluent quality was below the CCME WQG protective of livestock for most constituents except molybdenum and sulphate (**Table IR 165-2**). As such, birds, species at risk and other wildlife that may contact or ingest the proposed effluent quality are not expected to be at increased risk for those constituents below the CCME WQG protective of livestock.

Table IR165-2: Comparison of Proposed Effluent Quality to the CCME WQGs for the Protection of Livestock

Constituent	Unit	Proposed Effluent Quality	CCME Protection of Livestock
General Chemistry			
Chloride	mg/L	600	NV
Sulphate	mg/L	3915	**1000**
Total Dissolved Solids	mg/L	6420	NA
Metals and Metalloids (Dissolved)			
Arsenic	mg/L	0.006	0.025
Cadmium	mg/L	0.0018	0.08
Chromium	mg/L	0.025	0.05
Cobalt	mg/L	0.003	1
Copper	mg/L	0.022	0.5[a]
Molybdenum	mg/L	2.5	**0.5**
Selenium	mg/L	0.042	0.05
Uranium	mg/L	0.057	0.2
Zinc	mg/L	0.042	50
Radionuclides			

Constituent	Unit	Proposed Effluent Quality	CCME Protection of Livestock
Uranium-238	Bq/L	0.7	0.2[b]
Uranium-234	Bq/L	0.7	95[b]
Thorium-230	Bq/L	0.9	22[b]
Radium-226	Bq/L	0.15	13.5[b]
Lead-210	Bq/L	0.419	8[b]
Polonium-210	Bq/L	0.15	7[b]

Notes:
NV – no CCME WQG
NA- not applicable.
a - lowest value between the sheep, cattle, swine and poultry value
b - US DOE Standard (2019) for aquatic biota, including riparian animals
Bold indicates that the proposed effluent quality exceeds the CCME WQG for protection of livestock.

For molybdenum and sulphate increased risks to avian species and wildlife exposed to effluent in the ponds are not expected as the mitigation measures, discussed below, to deter avian species and wildlife from the ponds, will reduce the potential receptor's exposure to these constituents.

A CCME WQG protective of livestock was not available for chloride and for the radionuclides. Avian species and wildlife are not expected to be at increased risk to those constituents without a CCME WQG protection of livestock because the mitigation measures, discussed below, to deter avian species and wildlife from the ponds, will reduce the receptor's exposure to these constituents.

A comparison of the proposed effluent quality for radionuclides to the US Department of Energy (DOE) Standard[5] for *a graded approach for evaluating radiation doses to aquatic and terrestrial biota* (Table IR165-2), that is protective of wildlife exposed to radionuclides, suggests that wildlife are not expected to be at increased risks to these radionuclides, as the proposed effluent quality for these radionuclides were below the US DOE Standard. As such, increased risk are not expected to avian species, species at risk and other wildlife exposed to constituents in contaminated waste ponds on the Project site.

Mitigation Measures

Mitigation measures outlined in the draft EIS to minimize the potential for avian exposure to pond water include:

- Employees and contractors will be provided with wildlife education and awareness training, including education about potential avian issues on site and training on the mitigation measures to avoid or minimize potential adverse Project effects on avian species and their habitat.
- Employees and contractors will be educated on waste management policies that limit human-avian interactions.
- Designated employees will be trained in appropriate avian deterrent techniques to minimize avian interactions with the Project.

[5] US Department of Energy. 2019. DOE Standard: A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota. U.S. Department of Energy, Washington, DC. DOE-STD-1153-2019.

- Employees and contractors will be requested to report avian observations on site, injured or dead birds (which will be reported to SK MOE). Avian encounters and outcomes will be monitored, and logbooks will be used to record observations. Logbooks and reports will be available to employees.
- Physical, visual, and/or auditory deterrents and exclusion measures will be employed around hazardous materials to discourage avian use, as required.
- Vegetation management will be incorporated in the vicinity of waste ponds to discourage avian use of potentially affected vegetation.

Adaptive management will be a component of the wildlife management plan which will be developed to support licensing. If birds are observed on site ponds, additional deterrent techniques could be employed. Examples of other deterrent options to dissuade birds from landing on ponds under an adaptive management framework are provided here:

- Visual deterrents: Reflective tape/flagging could be properly and appropriately installed on infrastructure and/or over the ponds. Predator decoys (i.e., plastic hawks, owls) could be strategically installed on visible high points, such as building roofs and fence posts. Brightly coloured flags flown from posts and/or inflatable tube dancers could be installed along the perimeter of the ponds and/or on the facilities, as appropriate. Inflatable tube dancers are similar to scarecrows, but determined to be more effective (Lukas et al. 2020[6]) likely resulting from the constant motion caused by the wind. A combination of the above visual deterrents would be expected to provide the best results.
- Auditory deterrents: Ultrasonic deterrent systems create a “net” that has been shown to repel birds from an area (Ezeonu et al. 2012[7]). Propane cannons are another effective method shown to deter birds. The use of propane cannons has been more widely studied and are recommended over ultrasonic deterrent systems. Propane cannons have been shown to be more effective when paired with a radar-activated on-demand system that fires cannons when birds are entering the area (Ronconi and Cassady St. Clair, 2006[8]), as birds can habituate to a timely, consistent firing/noise event.

[6] Lukas, S, Clark, L, Davis, A, Sanchez, D, Brewer, L. 2020. Nonlethal Bird Deterrent Strategies: Methods for reducing fruit crop losses in Oregon. Oregon State University Extension Service.
[7] Exeonu, SO, Amaefule, DO, Okonkwo, GN. 2012. Construction and Testing of Ultrasonic Bird Repeller. Journal of Natural Sciences Research 2(9): 8-17.
[8] Ronconi, RA, St. Clair, CC. 2006. Efficacy of a radar-activated on-demand system for deterring waterfowl from oil sands tailings ponds. Journal of Applied Ecology 43: 111-119

WHEELER RIVER PROJECT DRAFT EIS – OCTOBER 2022

Denison Mines

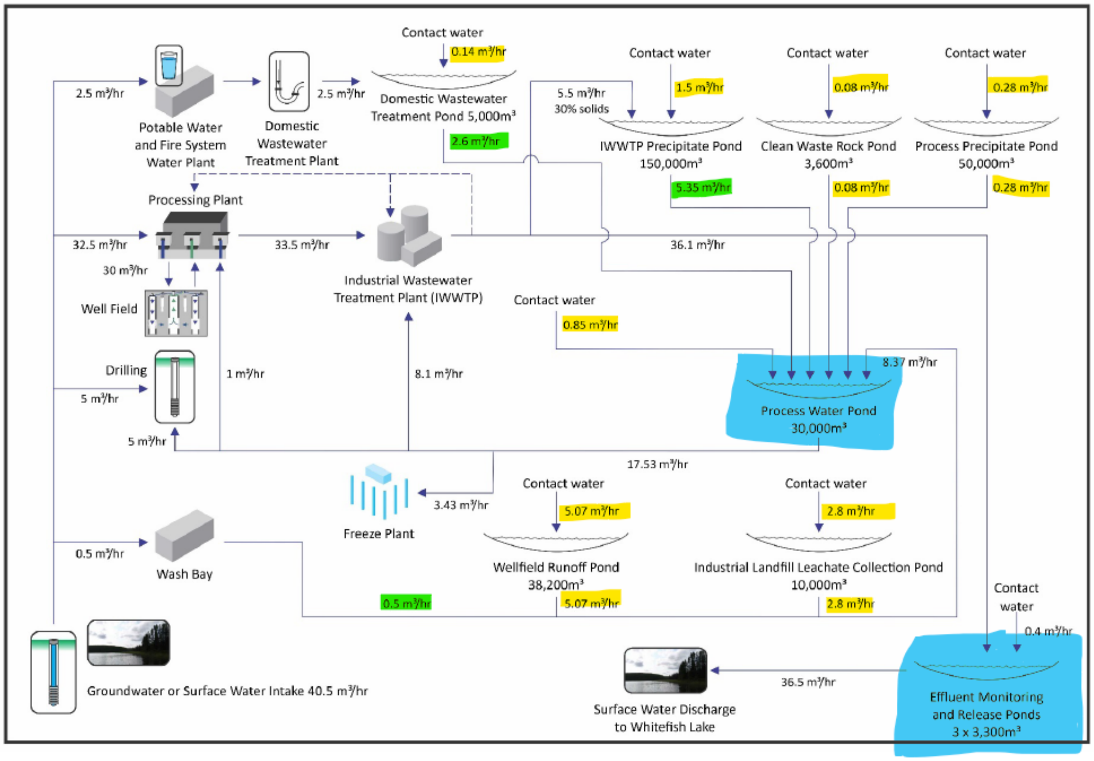


Figure 2.2-15: Operation Water Balance for the Project

PROJECT DESCRIPTION PAGE 2-32

References

Adams, C. A., A. Blumenthal, E. Fernández-Juricic, E. Bayne, and C. C. St. Clair. 2019. Effect of anthropogenic light on bird movement, habitat selection, and distribution: a systematic map protocol. Environmental Evidence 8(S1): 1–16.

Habib, L., E.M. Bayne and S. Boutin. Chronic industrial noise affects pairing success and age structure of ovenbirds Seiurus aurocapilla. Journal of Applied Ecology, 44: 176–184.

Narins, P.M. 1990. Seismic communication in anuran amphibians. Bioscience 40 (4):268-274

Attachment: IR-183 to 187

Number	IR-183
Dept.	CNSC
Project effects link	Human Health with respect to radiation exposure
Reference to EIS, appendices, or supporting documentation	Section 10.2 Appendix 10-C
Context and Rationale	Context: Exposure scenarios for workers have been identified and high-level summaries of the assumptions and resultant dose estimates have been provided. However, the detailed dose calculations have not been provided. Rationale: The method used to estimate effective, equivalent and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data, for at least the most dose significant scenarios.
Information Requirement	Provide the dose calculations for deriving the dose estimates for workers in all exposure scenarios, for at least the most dose significant scenarios.

Number	IR-184
Dept.	CNSC
Project effects link	Human Health with respect to radiation exposure
Reference to EIS, appendices, or supporting documentation	Section 10.2 Appendix 10-C, 2.0
Context and Rationale	Context: It is stated in Appendix 10-C, section 2.0 that: “In addition, the CNSC has proposed a 100 mSv 5-year equivalent dose to lens of eye, in accordance with recent recommendations of the International Commission for Radiological Protection (ICRP, 2012a). This implies an average annual equivalent dose to lens of 20 mSv/a and will be considered as an applicable dose limit for workers.” As per section 14 of the Radiation Protection Regulations, the equivalent dose limit for the lens of an eye for nuclear energy workers (NEWs), effective January 1, 2021, is 50 mSv in a one-year dosimetry period.

	Rationale: The reason of the requested change is to ensure consistency with the Radiation Protection Regulations.
Information Requirement	The EIS and Appendix 10-C should be aligned with the Radiation Protection Regulations regarding the equivalent dose limit for the lens of an eye for NEWs.

Number	IR-185
Dept.	CNSC
Project effects link	Human Health with respect to radiation exposure
Reference to EIS, appendices, or supporting documentation	Section 10.2.3.2 Appendix 10-C Table 3.10-3.12
Context and Rationale	Context: The Geometries for External Exposure Scenarios Modelled in MicroShield for Sources in various locations were provided in tables 3.10-3.12 in appendix 10-C. The doses from those scenarios were omitted. Rationale: The method used to estimate effective, equivalent, and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data.
Information Requirement	The proponent is asked to provide all the necessary information and assumptions required to perform the MicroShield calculations independently and to list the resulting calculated values from the listed scenarios.

Number	IR-186
Dept.	CNSC
Project effects link	Human Health with respect to radiation exposure
Reference to EIS, appendices, or supporting documentation	Section 10.2.3.2.4, Section 10.2.3.2.6, Section 10.2.4 Appendix 10-C, Section 3.2
Context and Rationale	Context: In sections 10.2.3.2.4 and 10.2.3.2.6, as well as section 3.2 of Appendix 10-C, the proponent has stated that workers in the drying and packaging areas of the processing plant will be required to wear powered air purifying respirators (PAPR) to reduce/eliminate inhalation exposure.

	Further in section 10.2.4, which elaborates mitigation measures, it is stated: "For the drying and packaging/loading areas of the ISR plant, use of PAPR has been assumed. It will be needed in these areas, and it has been planned in these areas to substantially reduce doses from inhalation of uranium dust. Dust levels in these areas will be monitored and kept ALARA." The use of respirators appears to be in contradiction of the requirements of section 13 of the Uranium Mines and Mills Regulations, which states: No licensee shall rely on the use of a respirator to comply with the Radiation Protection Regulations unless the use of the respirator (a) is for a temporary or unforeseen situation; and (b) is permitted by the code of practice referred to in the licence. The proponent is also reminded that respirators should not be the first choice for dose reduction in workplaces. They should only be used when the hierarchy of control (elimination, substitution, engineering, or administrative controls) is not possible. Rationale: At this stage of the project, the proponent is expected to identify design improvements to these areas of the ISR plant/processing plant following the hierarchy of control for the radiological protection of workers, as per regulatory requirements and as described in REGDOC-2.7.1, Radiation Protection.
Information Requirement	Provide the rationale for mandating the use of respirators by workers in the drying and packaging areas of the processing plant. Include the demonstration of the application of the hierarchy of control for radiological protection within the design of these areas of the processing plant. Justify that this approach complies with section 13 of the Uranium Mines and Mills Regulations.

Number	IR-187
Dept.	CNSC
Project effects link	Human Health with respect to radiation exposure
Reference to EIS, appendices, or supporting documentation	Section 10.2.3.2.4, Section 10.2.3.2.6 Appendix 10-C, Section 3.3, 6.0

Context and Rationale	Context: The exposure scenarios and assumptions for the workers in the drying area and the packaging/loading area of the processing plant include the wearing of PAPRs, which is assumed to provide a 1000-fold reduction in dust exposure. Further to reference IR-186, the use of a respirator as well as in worker dose predictions for the project, appears to contravene section 13 of the Uranium Mines and Mills Regulations, and does not follow the hierarchy of controls for radiological protection of workers as described in REGDOC-2.7.1, Radiation Protection. Rationale: At this stage of the project, the proponent is expected to identify design improvements to these areas of the ISR plant/processing plant following the hierarchy of control for the radiological protection of workers, as per regulatory requirements and as described in REGDOC-2.7.1, Radiation Protection.
Information Requirement	Modify the exposure scenarios and assumptions (i.e., remove the use of a respirator) for the workers in the drying area and the packaging/loading area of the processing facility. Assess the resultant exposures against CNSC regulatory dose limits and the ALARA principle. Identify mitigation measures as per the hierarchy of control for radiological protection.

Summary of IRs 183 to 187 and Responses:

IR-183 (CNSC): Provide the dose calculations for deriving the dose estimates for workers in all exposure scenarios, for at least the most dose significant scenarios.

Response: *Example dose calculations are provided in Appendix A of the Worker Dose Assessment, which is Appendix 10-C of the EIS. As noted in response to IRs 185, 186, and 187, some revisions to Appendix A are detailed in an attached memo.*

IR-184 (CNSC). As per section 14 of the Radiation Protection Regulations, the equivalent dose limit for the lens of an eye for nuclear energy workers (NEWs), effective January 1, 2021, is 50 mSv in a one-year dosimetry period. The EIS and Appendix 10-C should be aligned with the Radiation Protection Regulations regarding the equivalent dose limit for the lens of an eye for NEWs.

Response: *The text cited by the reviewer from Section 2.0 of Appendix 10-C about a proposed additional limit for 5-year equivalent dose to lens of eye will be deleted to be consistent with the Regulation.*

IR-185 (CNSC). The proponent is asked to provide all the necessary information and assumptions required to perform the MicroShield calculations independently and to list the resulting calculated values from the listed scenarios.

Response: *The source radiochemistries, geometries, and distance/time assumptions that are inputs to the external dose calculation are provided in the Worker Dose Assessment, which is Appendix 10-C of the EIS.*

The calculation of external dose is detailed in Appendix A (Table A.3) of the Worker Dose Assessment. This calculation uses dose rates at distance as output from MicroShield. As we have noticed several typos in Table A.3, and have changed inputs for drying and packaging in response to IR-186, a revised table is provided (see Table A.3 below).

IR-186 (CNSC). Provide the rationale for mandating the use of respirators by workers in the drying and packaging areas of the processing plant. Include the demonstration of the application of the hierarchy of control for radiological protection within the design of these areas of the processing plant. Justify that this approach complies with section 13 of the Uranium Mines and Mills Regulations.

Response: *We had used a very conservative dust level in drying and packaging areas (representing equipment sources of dust to the exhaust system). While the hazard cannot be eliminated or substituted, engineering controls will minimize the pathway. As a primary engineering control, the equipment and exhaust will be in a negative pressure enclosure. Under normal operation, workers will not be inside the enclosure. To support a more realistic exposure assessment for drying and packaging, a conservative design estimate for potential dust levels in the main room has been obtained. It is anticipated that workers in these areas will not require PAPR under normal circumstances. As an administrative control, dust levels in the room will be monitored, and individual worker exposures will be monitored and managed. PAPR will be available if needed as a control of last resort. The approach will respect the hierarchy of control and will comply with Section 13 of the Uranium Mines and Mills Regulations. A new worker exposure assessment has been completed for drying and packaging areas, using the design estimate for dust levels in the main room, a revised time spent in the area, and no routine use of PAPR (see revised Tables A.1 and A.3 below).*

IR-187 (CNSC). Modify the exposure scenarios and assumptions (i.e., remove the use of a respirator) for the workers in the drying area and the packaging/loading area of the processing facility. Assess the resultant exposures against CNSC regulatory dose limits and the ALARA principle. Identify mitigation measures as per the hierarchy of control for radiological protection.

Response: *As described in response to IR-186, a new worker exposure assessment has been completed for drying and packaging areas, using the design estimate for dust levels in the main room, a revised time spent in the area, and no routine use of PAPR (see revised Tables A.1 and A.3 below). The in-design engineering controls will include negative pressure enclosure of source equipment and exhaust, as well as ventilation controls in the main rooms (drying and packaging areas). Administrative controls will include area and individual monitoring and time-exposure management. It is shown that CNSC regulatory dose limits can be met without PAPR. This will be confirmed by air and dose monitoring during the commissioning phase as the control system is optimized. PAPR will be available as needed for non-routine situations, such as any necessary work within the enclosures.*

<u>Changes to the Worker Dose Calculations and Report:</u>

The Worker Dose Assessment (Appendix 10-C of the EIS) will be revised to reflect the information provided in Responses to IRs above. References to routine use of PAPR as an exposure control will be deleted. The primary engineering controls on dust exposure in the drying and packaging areas will be explained. Section 6.0 (Radiation Protection Strategies) will be updated to reflect the hierarchy of controls – elimination > substitution > engineering > administrative > PPE. Neither elimination nor substitution of the hazard are feasible controls for the Project, given its purpose to produce uranium concentrate, and given the radioactive nature of uranium. Elimination of an exposure pathway would typically involve engineering controls. Engineering controls will be utilized as a first line of defense.

As noted in the responses, a design estimate has been obtained for dust levels in the main room for the drying area and the packaging/loading area. This value of 0.5 mg/m^3 is a conservative representation of potential dust levels for workers under normal operations. It translates to a respirable dust value of 0.4 mg/m^3 and a U-238 activity of 3.9 Bq/m^3. This value has been used in revised calculations of the dust inhalation dose (presented herein). In addition, time spent in the room has been reduced from 8 to 4 hours per day. The revised dose calculations show that the CNSC regulatory dose limits can be met without use of PAPR.

Because the dust sources (dryer and calciner in the drying area; drum loader in the packaging area) will be fully enclosed under negative pressure, workers will not be in the enclosure, and time spent at 1 m from source will be zero. The time at distance allocation has been revised to:

0 h/d at 1 m, 3 h/d at 5 m, and 1 h/d at 10 m

This time at distance allocation is relevant to the external dose, which is a minor dose component for the drying and packaging/loading areas.

To accommodate these new assumptions, the worker dose calculations have been revised. In addition, several typos in the tables of the June 2022 Worker Dose Assessment have been corrected. For completeness, all the tables from the report that have any changes are provided below, including the example calculations from Appendix A of the Worker Dose Assessment. Any word or numeric value that has changed is shown in red font.

The revised effective dose from dust inhalation, in both drying and packaging areas, without use of PAPR, is calculated to be 11.7 mSv/a (Table 5.1 and Table A.1) well below the 5-year average effective dose limit of 20 mSv/a. Actual dust levels will be confirmed during the commissioning phase, using both area monitoring and sampling pumps worn by workers, and the control system will be optimized to ensure that doses are ALARA. Monitoring will continue through the operations phase, in accordance with the Radiation Protection Program.

Section 2.0 of the Worker Dose Assessment (on Regulatory Context) will be updated to align with the Radiation Protection Regulations, by deleting the following text:

"~~In addition, the CNSC has proposed a 100 mSv 5-year equivalent dose to lens of eye, in accordance with recent recommendations of the International Commission for Radiological Protection (ICRP, 2012a). This implies an average annual equivalent dose to lens of 20 mSv/a and will be considered as an applicable dose limit for workers.~~"

Section 6.0 of the Worker Dose Assessment (on Radiation Protection Strategies) will be updated to describe the planned mitigations, consistent with the hierarchy of controls. Text in this section relevant to dust exposure will be revised as follows:

"Doses to workers at the Wheeler River Project are expected to be maintained below the average annual dose limit of 20 mSv/a for NEWs. Several mitigations have been assumed and will be important in keeping doses ALARA. For the drying and packaging/loading areas of the ISR Plant, the engineering controls will include negative pressure enclosures around source equipment and exhaust, as well as ventilation controls in the main rooms (beyond enclosures). Administrative controls will include area and individual monitoring and time-exposure management. Actual dust levels will be confirmed during the commissioning phase and the control system will be optimized to ensure that doses are ALARA. ~~use of PAPR has been assumed. It will be needed in these areas, and it has been planned in these areas to substantially reduce dose from inhalation of uranium dust. Dust levels in these areas should be monitored and kept as low as reasonably achievable.~~"

"Powered Air Purifying Respirators (PAPR) should be available in these areas in case of need for any non-routine work that may involve high dust exposures. However, PAPR is a control of last resort. Under the Radiation Protection Program, a radiation work permit process will be in place for any non-routine work that may involve unusually high exposures, ensuring that risks are assessed and exposure controls are optimized in accordance with the ALARA principle. ~~protection factor of 1000 is provided by several types of respirators such as Powered Air-Purifying Respirators (PAPR) with a full facepiece or hood, and Supplied-Air Respirators (SAR) in positive-pressure mode or continuous flow mode. Alternatively, a Self-Contained Breathing Apparatus will provide protection factors over 10,000 if used in positive-pressure mode. It should be noted that Air-Purifying Respirators will not offer protection against radioactive gases such as radon.~~ "

"Dust inhalation is also a potentially significant component of dose at the core shack. ~~At this location, PAPR will not be required; however, dust levels should be monitored here too.~~ An administrative level of respirable dust equal to ¼ of the ACGIH TLV of 0.27 mg/m^3 has been assumed. Again, dust levels will be confirmed during the commissioning phase and the control system will be optimized to ensure that doses are ALARA. It may be possible to increase air exchange in the core shack, above the planned 6 exchanges per hour, should this be necessary. This would help also with radon exposure in the core shack."

Radiation Protection Program documents, now in preparation, to be completed during licensing, will provide more detail regarding radiation protection processes and procedures.

Tables of the Worker Dose Assessment (in Section 3, Section 5, and Appendix A) will be revised as discussed above. The revised tables are shown below.

Table 3.1: Exposure Locations and Sources

Location	Work Area	Source	Worker Function
Wellfield	Wellfield drilling	Cuttings in drum	Driller 1
	Pump houses	UBS in pump house piping	Wellfield Operator 1
	UBS Pond	UBS in storage pond	Wellfield Operator 1
	Wellfield piping	UBS in piping	Wellfield Operator 2 [a]
ISR Plant	Process Precipitate Removal Area	UBS feed tank	Plant Operator 1 [a]
		Totes of filter cake	
		Precipitate thickener	
	Yellowcake Precipitation Area	Yellowcake precipitation tank	Plant Operator 2 [a]
		Yellowcake conveyor	
		Yellowcake thickener	
	Water Treatment Area	WTP clarifier	Plant Operator 3 [a]
	Drying Area	Yellowcake	Plant Operator 4 [a]
	Packaging Loading Area	Yellowcake	Plant Operator 5 [a]
Site Ponds Pads	Special Waste Pad	Drill cuttings	Equipment Operator 1
	Contaminated Landfill	none	Equipment Operator 1
	Process Precipitate Pond	Process precipitate	Equipment Operator 1
Site infrastructure	Core Shack	3 cores	Geologist/Geotech Loggers

(a) Operator and Maintenance worker have the same exposure characteristics

Table 3.2: Concentrations in Dust and Occupancy in Work Area for the Indoor and Outdoor Dust Inhalation Scenarios

Work Area	Worker	Respirable Dust in Air (kg/m^3)	U-238 in Dust (Bq/kg)	Ra-226 in Dust (Bq/kg)	U-238 in Air (Bq/m^3)	Daily Occupancy h/d	Active months per year [d]
Wellfield	Driller 1	-	-		9.49E-04[a]	11	8
Wellfield	Wellfield Operator 1, 2	-	-		9.49E-04[a]	8	12
Process Precipitate Removal Area	Plant Operator 1	-	-		3.41E-03[a]	8	12
Yellowcake Precip Area	Plant Operator 2	-	-		3.41E-03[a]	8	12
Water Treatment Area	Plant Operator 3	-	-		3.41E-03[a]	8	12
Drying Area	Plant Operator 4	4.00E-07	9.74E+06		3.90E+00[b]	4	12
Packaging Loading Area	Plant Operator 5	4.00E-07	9.74E+06		3.90E+00[b]	4	12
Special Waste Pad	Equipment Operator 1	-	-		6.83E-03[a]	2	12
Process Precipitate Pond	Equipment Operator 1	-	-		9.95E-04[a]	4	12
Contaminated Landfill	Equipment Operator 1	-	-		4.25E-04[a]	3	12
Core Shack	Geologist/ Geotech Logger	6.75E-08	2.99E+06	2.06E+06	2.02E-01[c]	11	6

(a) U-238 (Bq/m^3) in air calculated from IEC (2022) μg/m^3 in outdoor air at each location, operations phase, with calciner
(b) U-238 in air shown for drying and packaging areas is an ambient concentration, based on a design value for dust in the main room of the drying area (0.5 mg/m^3 total)

(c) U-238 in air for core shack based on an administrative level for respirable dust equal to ¼ of the ACGIH Threshold Limit Value (TLV); U-238 concentration in dust from ore assays by R and D Enterprises (2018)
(d) Workers are assumed to work 20 days per month

Table 3.3: Concentrations of Radon and Occupancy in Work Area for the Indoor and Outdoor Radon Inhalation Scenarios

Work Area	Worker	Source	Rn-222 in Air (Bq/m^3)	Daily Occupancy h/d	Active months per year [b]
Wellfield	Driller 1	Outdoor	6.75E+01[a]	11	8
Wellfield	Wellfield Operator 1, 2	Outdoor	6.75E+01[a]	8	12
Process Precipitate Removal Area	Plant Operator 1	Outdoor	1.17E+02[a]	8	12
		Cake	2.72E+01		
		Thickener	7.35E+02		
Yellowcake Precip Area	Plant Operator 2	Outdoor	1.17E+02[a]	8	12
		Thickener	4.96E+02		
Water Treatment Area	Plant Operator 3	Outdoor	1.17E+02[a]	8	12
		Clarifier	1.28E+02		
Drying Area	Plant Operator 4	Outdoor	1.17E+02[a]	4	12
Packaging Loading Area	Plant Operator 5	Outdoor	1.17E+02[a]	4	12
Special Waste Pad	Equipment Operator 1	Outdoor	8.82E+02[a]	2	12
Process Precipitate Pond	Equipment Operator 1	Outdoor	9.03E+01[a]	4	12
Contaminated Landfill	Equipment Operator 1	Outdoor	2.97E+01[a]	3	12
Core Shack	Geologist/Geotech Logger	Outdoor	6.75E+01[a]	11	6
		Cores	1.18E+03		

(a) Rn-222 (Bq/m^3) in air taken from IEC (2022) value in outdoor air at each location, operations phase, with calciner
(b) Workers are assumed to work 20 days per month

Table 3.9: Exposure Factors for External Exposures.

Location	Source [a]	Worker Function	h/d in area	h/d at 1 m	h/d at 5 m	h/d at 10 m	active months per year
Wellfield	Cuttings in Drum	Driller 1	11	2	4	5	8
	UBS Solution in pump house piping	Wellfield Operator 1	4	2	1	1	12
	UBS solution in storage pond	Wellfield Operator 1	4	2	1	1	12
	UBS Solution in piping	Wellfield Operator 2	8	4	2	2	12
ISR Plant	UBS feed tank	Plant Operator 1	8	6	1	1	12
	Totes of filter cake						
	Precipitate Thickener						
	Yellowcake precipitation tank	Plant Operator 2	8	6	1	1	12
	Yellowcake conveyor						
	Yellowcake Thickener						
	WTP Clarifier	Plant Operator 3	8	6	1	1	12
	Drying Area, Dryer	Plant Operator 4	4	0	3	1	12
	Drying Area, Calciner						
	Packaging/Loading Area	Plant Operator 5	4	0	3	1	12
Site Ponds Pads	Special Waste Pad	Equipment Operator 1	2	0	2	0	12
	none	Equipment Operator 1	3	0	2	1	12
	Process Precipitate Pond	Equipment Operator 1	4	0	3	1	12

Core Shack	3 cores	Geologist/Geotech Loggers	11	2	8	1	6

(a) When there are several sources in one work area, the worker is assumed to divide his time roughly equally among those sources (see Appendix Table A.3).

Table 3.11: Geometries for External Exposure Scenarios Modelled in MicroShield for Sources in the ISR Plant

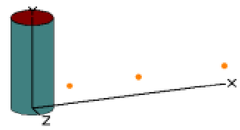
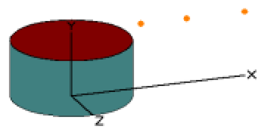
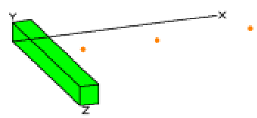
Source	Geometry	Source Type	MicroShield Geometry	Volume (m^3)	Shielding Thickness (mm)	Shielding material	Source form	Density (kg/m^3)
UBS Feed Tank	Height: 5.2m, diameter: 3.3m	UBS Feed		4.45E+01	6.35	Steel	Liquid	1.00E+03
Totes of Filter Cake	3 totes of filter cake, each 1m height, 1m diameter	Process Precipitates		3.00E+00	6.35	PET	Cake	1.88E+03
Precipitate Thickener	Height: 5m, Diameter: 10m, drum 1.7m above the floor	Process Precipitates		3.93E+02	6.35	Steel	Slurry	1.30E+03
Precipitation Tank	Height:5.2m, Diameter: 3.3m	Yellowcake Precipitation Solution		4.45E+01	6.35	Steel	Liquid	1.00E+03
Yellowcake in Screw conveyor	Height: 1m, Length: 10m, Width: 1m	UO_4		1.00E+01	6.35	Steel	Cake	2.40E+03

Table 3.11: Geometries for External Exposure Scenarios Modelled in MicroShield for Sources in the ISR Plant (continued)

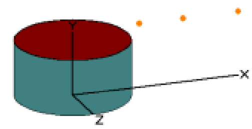
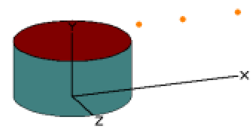
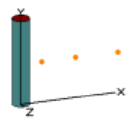
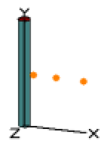
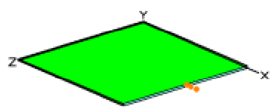
Source	Geometry	Source Type	MicroShield Geometry	Volume (m^3)	Shielding Thickness (mm)	Shielding material	Source form	Density (kg/m^3)
Yellowcake Thickener	Height: 5m, Diameter: 10m, drum 1.7m above the floor	UO_4		3.93E+02	6.35	Steel	Slurry	1.30E+03
WTP Clarifier	Height: 5m, Diameter: 10m, drum 1.7m above the floor	NA		3.93E+02	6.35	Steel	Slurry	1.00E+03
Dryer	Horizontal cylinder, Length: 10m, Diameter: 2m	UO_4		3.14E+01	6.35	Steel	powder	2.03E+03
Calciner	Horizontal cylinder, Length: 20m, Diameter: 2m	UO_4		6.28E+01	6.35	Steel	powder	2.03E+03
Drum Storage	350 barrels on a pad, each height: 0.89m, diameter: 0.58m	UO_4		1.08E+02	1.20	Steel	powder	1.71E+03

Table 5.1: Internal Annual Dose from Dust Inhalation

Work Area	Worker	Effective Dose from Inhalation U-238⁺ (mSv/a)	Effective Dose from Inhalation Ra-226⁺ (mSv/a)	Total Effective Dose (mSv/a)
Wellfield	Driller 1	5.21E-03	-	5.21E-03[a]
Wellfield	Wellfield Operator 1, 2	5.68E-03	-	5.68E-03[a]
Process Precipitate Removal Area	Plant Operator 1	2.04E-02	-	2.04E-02[a]
Yellowcake Precip Area	Plant Operator 2	2.04E-02	-	2.04E-02[a]
Water Treatment Area	Plant Operator 3	2.04E-02	-	2.04E-02[a]
Drying Area	Plant Operator 4	1.17E+01	-	1.17E+01[b]
Packaging Loading Area	Plant Operator 5	1.17E+01	-	1.17E+01[b]
Special Waste Pad	Equipment Operator 1	1.02E-02	-	1.02E-02[ac]
Process Precipitate Pond	Equipment Operator 1	2.98E-03	-	2.98E-03[ac]
Contaminated Landfill	Equipment Operator 1	9.54E-04	-	9.54E-04[ac]
Core Shack	Geologist/ Geotech Logger	5.63E+00	1.02E+00	6.65E-00[d]

(a) Based on outdoor concentration of U dust from IEC (2022); U-238⁺ DCF 2.60E-06 Sv/Bq from ICRP 137 includes U-238+U-234

(b) Based on indoor concentration of U dust, which dominates; U-238⁺ DCF 2.60E-06 Sv/Bq from ICRP 137 includes U-238+U-234

(c) Equipment Operator 1 frequents 3 locations; the 3 doses must be added for this worker

(d) Based on indoor concentration of ore dust, which dominates; U-238⁺ DCF 2.08E-05 Sv/Bq from ICRP 137 includes the entire U-238 series; doses shown for U-238⁺ and Ra-226⁺ reflect the portions from U-238 to Th-230, and from Ra-226 to Po-210, respectively.

Table 5.2: Internal Annual Dose from Radon Inhalation

Work Area	Worker	Source	Dose from Radon in Air (mSv/a)	Total Radon Dose for Worker (mSv/a)
Wellfield	Driller 1	Outdoor	9.44E-02[a]	9.44E-02
Wellfield	Wellfield Operator 1, 2	Outdoor	1.03E-01[a]	1.03E-01
Process Precipitate Removal Area	Plant Operator 1	Outdoor	1.78E-01[a]	2.27E+00
		Cake	7.47E-02[b]	
		Thickener	2.02E+00[b]	
Yellowcake Precip Area	Plant Operator 2	Outdoor	1.78E-01[a]	1.54E+00
		Thickener	1.36E+00[b]	
Water Treatment Area	Plant Operator 3	Outdoor	1.78E-01[a]	5.30E-01
		Clarifier	3.52E-01[b]	
Drying Area	Plant Operator 4	Outdoor	8.89E-02[a]	8.89E-02
Packaging Loading Area	Plant Operator 5	Outdoor	8.89E-02[a]	8.89E-02
Special Waste Pad	Equipment Operator 1	Outdoor	3.37E-01[a]	4.23E-01
Process Precipitate Pond	Equipment Operator 1	Outdoor	6.89E-02[a]	
Contaminated Landfill	Equipment Operator 1	Outdoor	1.70E-02[a]	
Core Shack	Geologist/	Outdoor	7.08E-02[a]	2.30E+00
	Geotech Logger	Cores	2.23E+00[b]	

(a) Based on outdoor concentration of radon from IEC (2022)
(b) Based on an indoor source of radon to indoor air

Table 5.3: Effective Dose and Equivalent Dose to the Lens of the Eye for Workers from External Exposure

			By Exposure Scenario		By Worker	
Work Area	**Worker**	**Source**	**External Dose (mSv/a)**	**Dose to Lens of Eye (mSv/a)**	**External Dose (mSv/a)**	**Dose to Lens of Eye (mSv/a)**
Wellfield	Driller 1	Cuttings	10.16	16.40	10.16	16.40
Wellfield	Wellfield Operator 2	Piping	0.05	0.07	0.05	0.07
	Wellfield Operator 1	Pump House Piping	0.24	0.34	0.53	0.81
		UBS Pond	0.29	0.47		
Process Precipitate Removal Area	Plant Operator 1	Feed Tank	0.24	0.39	12.59	20.40
		Cake	8.19	13.15		
		Thickener	4.16	6.86		
Yellowcake Precip Area	Plant Operator 2	Precip Tank	0.08	0.13	0.10	0.15
		Cake	0.02	0.02		
		Thickener	0.001	0.001		
Water Treatment Area	Plant Operator 3	Clarifier	1.70	2.61	1.70	2.61
Drying Area	Plant Operator 4	Dryer	0.002	0.002	0.004	0.004
		Calciner	0.002	0.002		
Packaging Loading Area	Plant Operator 5	Drums	0.009	0.009	0.009	0.009
Special Waste Pad	Equipment Operator 1	Waste Pad	<0.0001[a]	0.0001[a]	5.68	9.33
Process Precipitate Pond	Equipment Operator 1	Precip Pond	5.68	9.33		
Contaminated Landfill	Equipment Operator 1	No source	0.000	0.000		

Core Shack	Geologist/ Geotech Logger	Cores	2.02	3.25	2.02	3.25

(a) Dose to Equipment Operator 1 at the Special Waste Pad is mitigated by a 2m wide berm, which provides shielding.

Table 5.4: Total Dose from Internal and External Pathways for Workers

Work Area	Worker	Internal Dose (mSv/a)		External Dose (mSv/a)	Total Effective Dose (mSv/a)
		Dust	Radon		
Wellfield	Driller 1	5.21E-03	9.44E-02	10.16	10.26
Wellfield	Wellfield Operator 2	5.68E-03	1.03E-01	0.05	0.16
	Wellfield Operator 1	5.68E-03	1.03E-01	0.53	0.64
Process Precipitate Removal Area	Plant Operator 1	2.04E-02	2.27E+00	12.59	14.88
Yellowcake Precip Area	Plant Operator 2	2.04E-02	1.54E+00	0.10	1.66
Water Treatment Area	Plant Operator 3	2.04E-02	5.30E-01	1.70	2.25
Drying Area	Plant Operator 4	1.17E+00[a]	8.92E-02	0.004	11.77
Packaging Loading Area	Plant Operator 5	1.17E+00[a]	8.92E-02	0.009	11.78
Special Waste Pad	Equipment Operator 1	1.02E-02	3.37E-01	-[b]	6.11
Process Precipitate Pond	Equipment Operator 1	2.98E-03	6.89E-02	5.68	
Contaminated Landfill	Equipment Operator 1	9.54E-04	1.70E-02	-	
Core Shack	Geologist/	6.65E+00[a]	2.30E+00	2.02	10.97
	Geotech Logger				

(a) Dust exposures in work area to be monitored and kept ALARA.
(b) External dose mitigated by a berm around the Special Waste Pad, which provides shielding

Appendix A Example Calculations

Table A.1: Dust Inhalation Dose Calculation

Work Area	Worker	U-238 in Air (Bq/m^3)	Exposure Time (h/a)	DCF (Sv/Bq)	Total Effective Dose (mSv/a)
Wellfield	Driller 1	9.49E-04	1760	2.60E-06	5.21E-03
Wellfield	Wellfield Operator 1, 2	9.49E-04	1920	2.60E-06	5.68E-03
Precipitate Removal Area	Plant Operator 1	3.41E-03	1920	2.60E-06	2.04E-02
Yellowcake Precip Area	Plant Operator 2	3.41E-03	1920	2.60E-06	2.04E-02
Water Treatment Area	Plant Operator 3	3.41E-03	1920	2.60E-06	2.04E-02
Drying Area	Plant Operator 4	3.90E+00	960	2.60E-06	1.17E+01
Packaging Loading Area	Plant Operator 5	3.90E+00	960	2.60E-06	1.17E+01
Special Waste Pad	Equipment Operator 1	6.83E-03	480	2.60E-06	1.02E-02
Precipitate Pond	Equipment Operator 1	9.95E-04	960	2.60E-06	2.98E-03
Industrial Landfill	Equipment Operator 1	4.25E-04	720	2.60E-06	9.54E-04
Core Shack	Geologist/ Geotech Logger	2.02E-01	1320	2.08E-05	6.65E+00

Total Effective Dose (mSv/a) = Cair (Bq/m^3) x I (m^3/h) x ET (h/a) x DCF (Sv/Bq) x 1000 (mSv/Sv)

Notes:

Concentrations from indoor sources for Drying/Packaging and Core Shack
Concentrations in Drying and Packaging are respirable activity based on a design value for dust in the main room of the drying area (0.5 mg/m^3 total)
DCFs (Sv/Bq) from ICRP 137: U238+U234 (2.60E-6); U238 to Po-210 (2.08E-5)
Inhalation Rate (I) from ICRP 119 is 1.2 m^3/h

Table A.2: Radon Dose Calculation

Work Area	Worker	Source	Radon in Air (Bq/m^3)	Exposure Time (h/a)	Equilibrium Factor F	Radon Dose (mSv/a)	Total (mSv/a)
Wellfield	Driller 1	Outdoor	6.75E+01	1760	0.10	9.44E-02	9.44E-02
Wellfield	Wellfield Operator 1, 2	Outdoor	6.75E+01	1920	0.10	1.03E-01	1.03E-01
Process Precipitate Removal Area	Plant Operator 1	Outdoor	1.17E+02	1920	0.10	1.78E-01	2.27E+00
		Cake	2.72E+01	1920	0.18	7.47E-02	
		Thickener	7.35E+02	1920	0.18	2.02E+00	
Yellowcake Precip Area	Plant Operator 2	Outdoor	1.17E+02	1920	0.10	1.78E-01	1.54E+00
		Thickener	4.96E+02	1920	0.18	1.36E+00	
Water Treatment Area	Plant Operator 3	Outdoor	1.17E+02	1920	0.10	1.78E-01	5.30E-01
		Clarifier	1.28E+02	1920	0.18	3.52E-01	
Drying Area	Plant Operator 4	Outdoor	1.17E+02	960	0.10	8.89E-02	8.89E-02
Packaging Loading Area	Plant Operator 5	Outdoor	1.17E+02	960	0.10	8.89E-02	8.89E-02
Special Waste Pad	Equipment Operator 1	Outdoor	8.82E+02	480	0.10	3.37E-01	4.23E-01
Process Precipitate Pond	Equipment Operator 1	Outdoor	9.03E+01	960	0.10	6.89E-02	
Contaminated Landfill	Equipment Operator 1	Outdoor	2.97E+01	720	0.10	1.70E-02	
Core Shack	Geologist/ Geotech Logger	Outdoor	6.75E+01	1320	0.10	7.08E-02	2.30E+00
		Cores	1.18E+03	1320	0.18	2.23E+00	

Radon Dose (mSv/a) = (Cair (Bq/m^3)/3700 Bq/m^3 per WL) x F x (ET (h/a)/170 h per WL) * 5 (mSv/a per WL)

Table A.3: External Dose Calculation

			Exposure Time (h/d) at:			Max Effective Dose (mSv/h)			Max Lens Dose (mSv/h)				By Exposure Scenario	
Work Area	**Worker**	**Source**	**1m**	**5m**	**10m**	**1m**	**5m**	**10m**	**1m**	**5m**	**10m**	**Exp Days (d/a)**	**External Dose (mSv/a)**	**Dose to Lens of Eye (mSv/a)**
Wellfield	Driller 1	Cuttings	2	4	5	2.68E-02	1.86E-03	4.84E-04	4.33E-02	3.01E-03	7.82E-04	160	10.16	16.40
Wellfield	Wellfield Operator 2	Piping	4	2	2	4.91E-05	9.10E-06	3.40E-06	6.85E-05	1.26E-05	4.68E-06	240	0.05	0.07
	Wellfield Operator 1	Pump House Piping	2	1	1	4.74E-04	4.13E-05	1.08E-05	6.74E-04	5.81E-05	1.52E-05	240	0.24	0.34
		UBS Pond	2	1	1	4.63E-04	1.80E-04	8.75E-05	7.59E-04	2.94E-04	1.43E-04	240	0.29	0.47
Precipitate Removal Area	Plant Operator 1	Feed Tank	2.2	0.33	0.33	4.35E-04	8.51E-05	2.82E-05	7.13E-04	1.39E-04	4.60E-05	240	0.24	0.39
		Cake	1.6	0.33	0.33	2.08E-02	1.92E-03	5.06E-04	3.34E-02	3.09E-03	8.14E-04	240	8.19	13.15
		Thickener	2.2	0.33	0.33	7.17E-03	3.26E-03	1.43E-03	1.18E-02	5.34E-03	2.34E-03	240	4.16	6.86
Yellowcake Precip Area	Plant Operator 2	Precip Tank	2	0.33	0.33	1.63E-04	3.18E-05	1.05E-05	2.65E-04	5.17E-05	1.71E-05	240	0.08	0.13
		Cake	2	0.33	0.33	3.69E-05	7.89E-06	2.50E-06	3.69E-05	7.89E-06	2.50E-06	240	0.02	0.02
		Thickener	2	0.33	0.33	2.33E-06	1.87E-06	8.74E-07	2.33E-06	1.87E-06	8.74E-07	240	0.001	0.001
Water Treatment Area	Plant Operator 3	Clarifier	6	1	1	1.06E-03	5.03E-04	2.22E-04	1.63E-03	7.51E-04	3.30E-04	240	1.70	2.61
Drying Area	Plant Operator 4	Dryer	0	1.5	0.5	9.12E-06	4.37E-06	1.55E-06	1.51E-05	4.37E-06	1.55E-06	240	0.002	0.002
		Calciner	0	1.5	0.5	1.52E-05	5.10E-06	2.30E-06	1.52E-05	5.10E-06	2.30E-06	240	0.002	0.002
Packaging Loading Area	Plant Operator 5	Drums	0	3	1	5.91E-05	1.19E-05	3.79E-06	5.91E-05	1.19E-05	3.79E-06	240	0.009	0.009
Special Waste Pad	Equipment Operator 1	Waste Pad	0	2	0	1.02E-07	8.54E-08	5.86E-08	1.84E-07	1.55E-07	1.06E-07	240	4.10E-05	0.0001
Precipitate Pond	Equipment Operator 1	Waste Pond	0	3	1	1.49E-02	6.78E-03	3.31E-03	2.45E-02	1.12E-02	5.43E-03	240	5.68	9.33
Industrial Landfill	Equipment Operator 1	No source	0	3	0	-	-	-	-	-	-	240	0	0
Core Shack	Geologist/ Geotech Logger	Cores	2	8	1	6.59E-03	4.39E-04	1.12E-04	1.06E-02	7.09E-04	1.81E-04	120	2.02	3.25

External Dose (mSv/a) = [Σ ET (h/d) x Max Effective Dose (mSv/h)] x ED (d/a)

Dose to Lens (mSv/a) = [Σ ET (h/d) x Max Lens Dose (mSv/h)] x ED (d/a)

Notes:

Maximum dose rates at distance (mSv/h) are output from Microshield scenarios; highest value considering all possible orientations.
Skin dose was less than or equal to lens dose, depending on the scenario.

Attachment: IR-195

Number	IR-195
Dept.	ECCC
Project effects link	Change to an environmental component due to hazardous contaminants
Reference to EIS, appendices, or supporting documentation	Appendix 10-A (ERA), Section 3.1.2.1
Context and Rationale	**Context:** Figure 3-2 depicts modelled concentrations of COPCs in the receiving environment surface water during all Project phases. Effluent discharge rates during Operations and Decommissioning are not anticipated to differ significantly. However, COPC concentrations seem to decrease rapidly after the end of the operations period despite effluent releases continuing into the decommissioning phase. **Rationale:** There has been no information provided on predicted changes in effluent COPC concentrations and discharge rates during the decommissioning phase. It remains unclear how COPC concentrations would decrease so quickly following the end of operations.
Information Requirement	1. Provide further information on modelled maximum COPC concentrations for each individual Project phase with estimated timing for peak concentrations to appear in the receiving environment. 2. Provide further information on predicted effluent quality during the Project decommissioning phase. 3. Update ERA figures and conclusions as needed.

Figures and tables to support response in IR table:

Table IR195-1: Modelled Maximum COPC Concentrations in Water by Individual Project Phase

	Non-radionuclides during Operations Phase (mg/L)											
Location	**Arsenic**	**Cadmium**	**Chloride**	**Cobalt**	**Chromium**	**Copper**	**Molybdenum**	**Sulphate**	**Selenium**	**Uranium**	**Vanadium**	**Zinc**
Kratchkowsky Lake	1.19E-04	2.38E-05	3.22E-01	1.01E-04	5.30E-04	6.22E-04	1.07E-04	6.87E-01	3.35E-05	3.12E-05	1.67E-04	7.00E-04
Whitefish Lake North	1.10E-04	2.34E-05	3.22E-01	1.01E-04	5.24E-04	6.20E-04	1.07E-04	6.87E-01	3.28E-05	3.05E-05	1.55E-04	6.89E-04
Whitefish Lake Middle	1.46E-04	3.97E-05	6.53E+00	1.29E-04	7.46E-04	8.22E-04	2.43E-02	5.80E+01	4.33E-04	5.74E-04	6.70E-04	1.06E-03
Whitefish Lake South	1.49E-04	3.86E-05	6.50E+00	1.28E-04	7.30E-04	8.17E-04	2.39E-02	5.78E+01	4.12E-04	5.46E-04	5.64E-04	1.03E-03
McGowan Lake	1.26E-04	3.27E-05	4.46E+00	1.19E-04	6.53E-04	7.50E-04	1.57E-02	3.89E+01	2.58E-04	3.37E-04	3.28E-04	9.00E-04
Icelander River	1.26E-04	3.26E-05	4.42E+00	1.19E-04	6.52E-04	7.48E-04	1.56E-02	3.85E+01	2.56E-04	3.33E-04	3.26E-04	8.98E-04
Russell Lake Inlet	1.22E-04	3.01E-05	3.46E+00	1.14E-04	6.17E-04	7.17E-04	1.18E-02	2.97E+01	1.95E-04	2.51E-04	2.68E-04	8.40E-04
Location	**Non-radionuclides during Decommissioning Phase (mg/L)**											
Kratchkowsky Lake	1.19E-04	2.38E-05	3.22E-01	1.01E-04	5.30E-04	6.22E-04	1.07E-04	6.87E-01	3.35E-05	3.12E-05	1.67E-04	7.00E-04
Whitefish Lake North	1.10E-04	2.34E-05	3.22E-01	1.01E-04	5.24E-04	6.20E-04	1.07E-04	6.87E-01	3.28E-05	3.05E-05	1.55E-04	6.89E-04
Whitefish Lake Middle	1.46E-04	3.97E-05	6.14E+00	1.29E-04	7.46E-04	8.22E-04	2.43E-02	3.87E+01	4.33E-04	5.74E-04	6.70E-04	1.06E-03
Whitefish Lake South	1.49E-04	3.86E-05	6.11E+00	1.28E-04	7.30E-04	8.17E-04	2.40E-02	3.85E+01	4.12E-04	5.47E-04	5.64E-04	1.03E-03
McGowan Lake	1.26E-04	3.28E-05	4.20E+00	1.19E-04	6.54E-04	7.50E-04	1.58E-02	2.60E+01	2.59E-04	3.38E-04	3.28E-04	9.01E-04
Icelander River	1.26E-04	3.26E-05	4.16E+00	1.19E-04	6.52E-04	7.49E-04	1.56E-02	2.57E+01	2.56E-04	3.34E-04	3.26E-04	8.99E-04
Russell Lake Inlet	1.22E-04	3.01E-05	3.26E+00	1.14E-04	6.17E-04	7.17E-04	1.18E-02	1.99E+01	1.95E-04	2.52E-04	2.69E-04	8.40E-04

	Radionuclides during Operations Phase (Bq/L)					
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**
Kratchkowsky Lake	3.85E-04	3.85E-04	1.01E-02	5.70E-03	6.22E-03	6.33E-03
Whitefish Lake North	3.77E-04	3.77E-04	1.01E-02	5.63E-03	5.68E-03	5.78E-03

Whitefish Lake Middle	7.05E-03	7.05E-03	1.87E-02	6.87E-03	8.35E-03	6.71E-03
Whitefish Lake South	6.71E-03	6.71E-03	1.85E-02	6.73E-03	8.25E-03	7.22E-03
McGowan Lake	4.14E-03	4.14E-03	1.57E-02	6.32E-03	6.68E-03	6.23E-03
Icelander River	4.10E-03	4.10E-03	1.56E-02	6.32E-03	6.66E-03	6.20E-03
Russell Lake Inlet	3.08E-03	3.08E-03	1.43E-02	6.14E-03	6.41E-03	6.16E-03
Location	**Radionuclides during Decommissioning Phase (Bq/L)**					
Kratchkowsky Lake	3.85E-04	3.85E-04	1.01E-02	5.70E-03	6.22E-03	6.33E-03
Whitefish Lake North	3.77E-04	3.77E-04	1.01E-02	5.63E-03	5.68E-03	5.78E-03
Whitefish Lake Middle	7.05E-03	7.05E-03	1.87E-02	6.87E-03	8.36E-03	6.71E-03
Whitefish Lake South	6.72E-03	6.72E-03	1.85E-02	6.73E-03	8.25E-03	7.22E-03
McGowan Lake	4.15E-03	4.15E-03	1.57E-02	6.33E-03	6.68E-03	6.23E-03
Icelander River	4.11E-03	4.11E-03	1.56E-02	6.32E-03	6.66E-03	6.20E-03
Russell Lake Inlet	3.09E-03	3.09E-03	1.43E-02	6.14E-03	6.41E-03	6.16E-03

Table IR195-2: Modelled Maximum COPC Concentrations in Sediment by Individual Project Phase

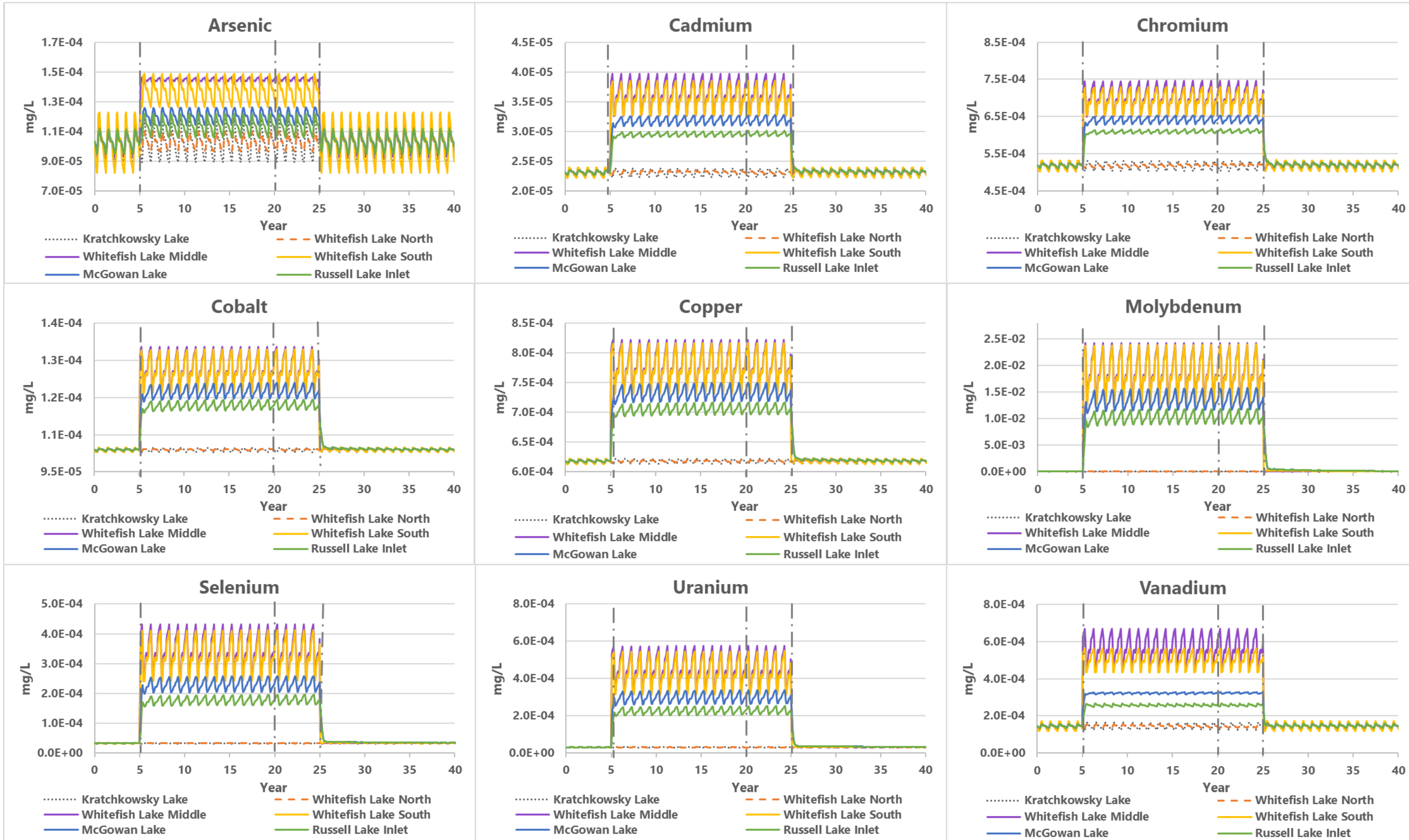
	Non-radionuclides during Operations Phase (mg/kg dw)										
Location	**Arsenic**	**Cadmium**	**Chloride**	**Cobalt**	**Chromium**	**Copper**	**Molybdenum**	**Selenium**	**Uranium**	**Vanadium**	**Zinc**
Kratchkowsky Lake	8.35E+00	3.38E-01	-	2.52E-01	5.86E+00	1.85E+00	3.37E-01	6.22E-01	5.78E-01	1.12E+01	9.93E+00
Whitefish Lake North	8.35E+00	3.38E-01	-	2.52E-01	5.86E+00	1.85E+00	3.37E-01	6.22E-01	5.78E-01	1.12E+01	9.93E+00
Whitefish Lake Middle	1.07E+01	4.79E-01	-	3.02E-01	7.41E+00	2.28E+00	5.40E+01	4.90E+00	6.39E+00	3.40E+01	1.32E+01
Whitefish Lake South	1.03E+01	4.73E-01	-	3.02E-01	7.35E+00	2.28E+00	5.30E+01	4.70E+00	6.12E+00	3.06E+01	1.31E+01
McGowan Lake	9.33E+00	4.30E-01	-	2.88E-01	6.90E+00	2.16E+00	3.88E+01	3.33E+00	4.26E+00	2.08E+01	1.21E+01
Russell Lake Inlet	8.95E+00	4.06E-01	-	2.80E-01	6.63E+00	2.09E+00	2.95E+01	2.60E+00	3.26E+00	1.73E+01	1.15E+01
Location	**Non-radionuclides during Decommissioning Phase (mg/kg dw)**										
Kratchkowsky Lake	8.35E+00	3.38E-01	-	2.52E-01	5.86E+00	1.85E+00	3.37E-01	6.22E-01	5.78E-01	1.12E+01	9.93E+00
Whitefish Lake North	8.35E+00	3.38E-01	-	2.52E-01	5.86E+00	1.85E+00	3.37E-01	6.22E-01	5.78E-01	1.12E+01	9.93E+00
Whitefish Lake Middle	1.10E+01	4.97E-01	-	3.05E-01	7.59E+00	2.31E+00	5.72E+01	5.48E+00	7.18E+00	3.72E+01	1.36E+01
Whitefish Lake South	1.05E+01	4.90E-01	-	3.04E-01	7.53E+00	2.30E+00	5.62E+01	5.26E+00	6.87E+00	3.33E+01	1.35E+01
McGowan Lake	9.47E+00	4.43E-01	-	2.90E-01	7.03E+00	2.18E+00	4.11E+01	3.71E+00	4.78E+00	2.22E+01	1.24E+01
Russell Lake Inlet	9.04E+00	4.15E-01	-	2.81E-01	6.73E+00	2.10E+00	3.13E+01	2.88E+00	3.64E+00	1.82E+01	1.17E+01

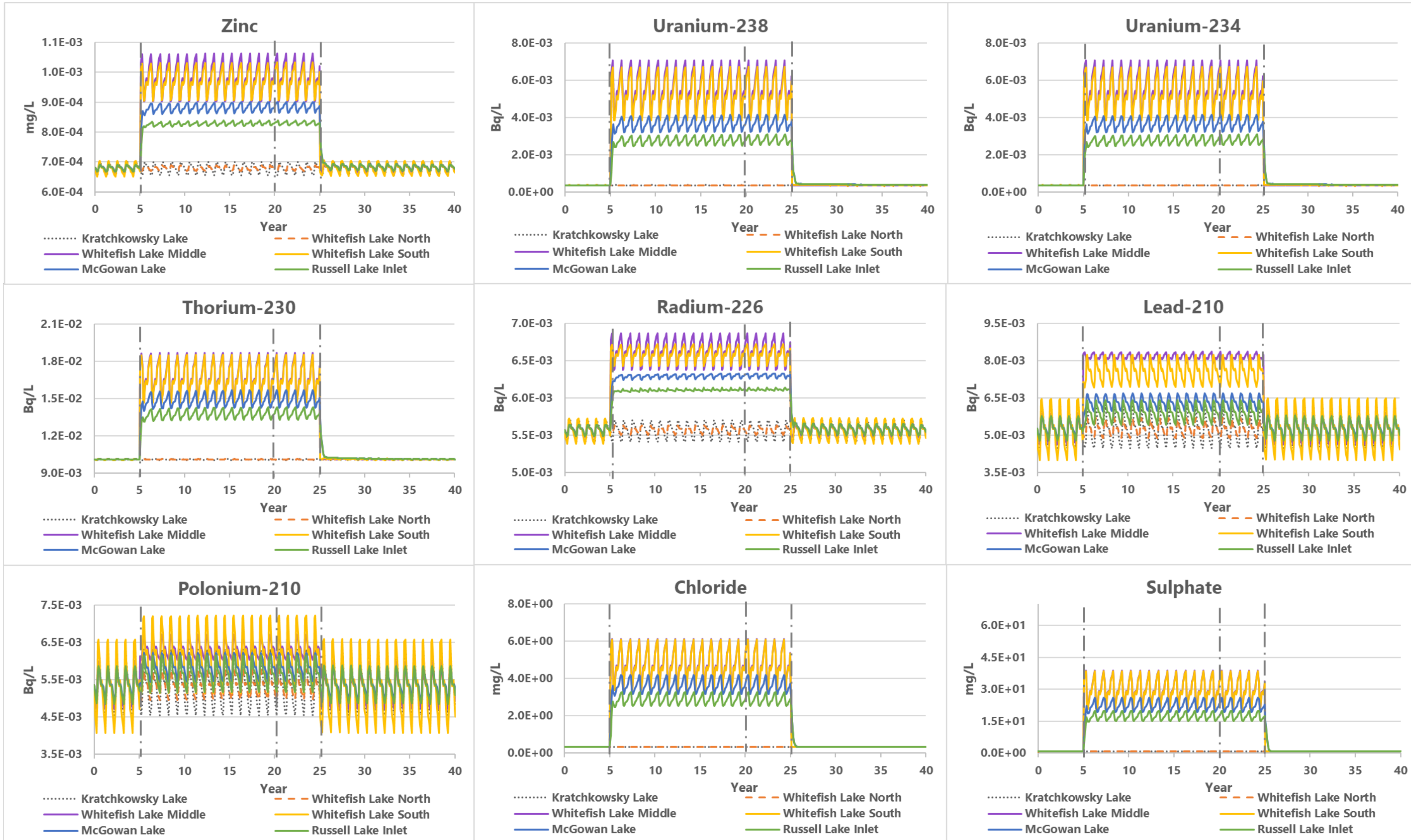
	Radionuclides during Operations Phase (Bq/kg dw)					
Location	**Uranium-238**	**Uranium-234**	**Thorium-230**	**Radium-226**	**Lead-210**	**Polonium-210**
Kratchkowsky Lake	7.14E+00	7.14E+00	2.32E+01	6.51E+01	3.74E+02	3.80E+02
Whitefish Lake North	7.14E+00	7.14E+00	2.32E+01	6.51E+01	3.74E+02	3.80E+02
Whitefish Lake Middle	7.85E+01	7.85E+01	3.77E+01	7.46E+01	5.41E+02	5.42E+02
Whitefish Lake South	7.51E+01	7.51E+01	3.75E+01	7.41E+01	5.07E+02	5.09E+02

McGowan Lake	5.23E+01	5.23E+01	3.36E+01	7.15E+01	4.36E+02	4.41E+02
Russell Lake Inlet	4.01E+01	4.01E+01	3.11E+01	6.98E+01	4.11E+02	4.16E+02
Location	**Radionuclides during Decommissioning Phase (Bq/kg dw)**					
Kratchkowsky Lake	7.14E+00	7.14E+00	2.32E+01	6.51E+01	3.74E+02	3.80E+02
Whitefish Lake North	7.14E+00	7.14E+00	2.32E+01	6.51E+01	3.74E+02	3.80E+02
Whitefish Lake Middle	8.82E+01	8.82E+01	3.83E+01	7.57E+01	5.57E+02	5.58E+02
Whitefish Lake South	8.44E+01	8.44E+01	3.80E+01	7.52E+01	5.19E+02	5.22E+02
McGowan Lake	5.87E+01	5.87E+01	3.41E+01	7.23E+01	4.42E+02	4.47E+02
Russell Lake Inlet	4.48E+01	4.48E+01	3.15E+01	7.04E+01	4.14E+02	4.20E+02

Table IR195-2: Summary of Effluent Quality for the Wheeler River Project during Operations and Decommissioning Phase

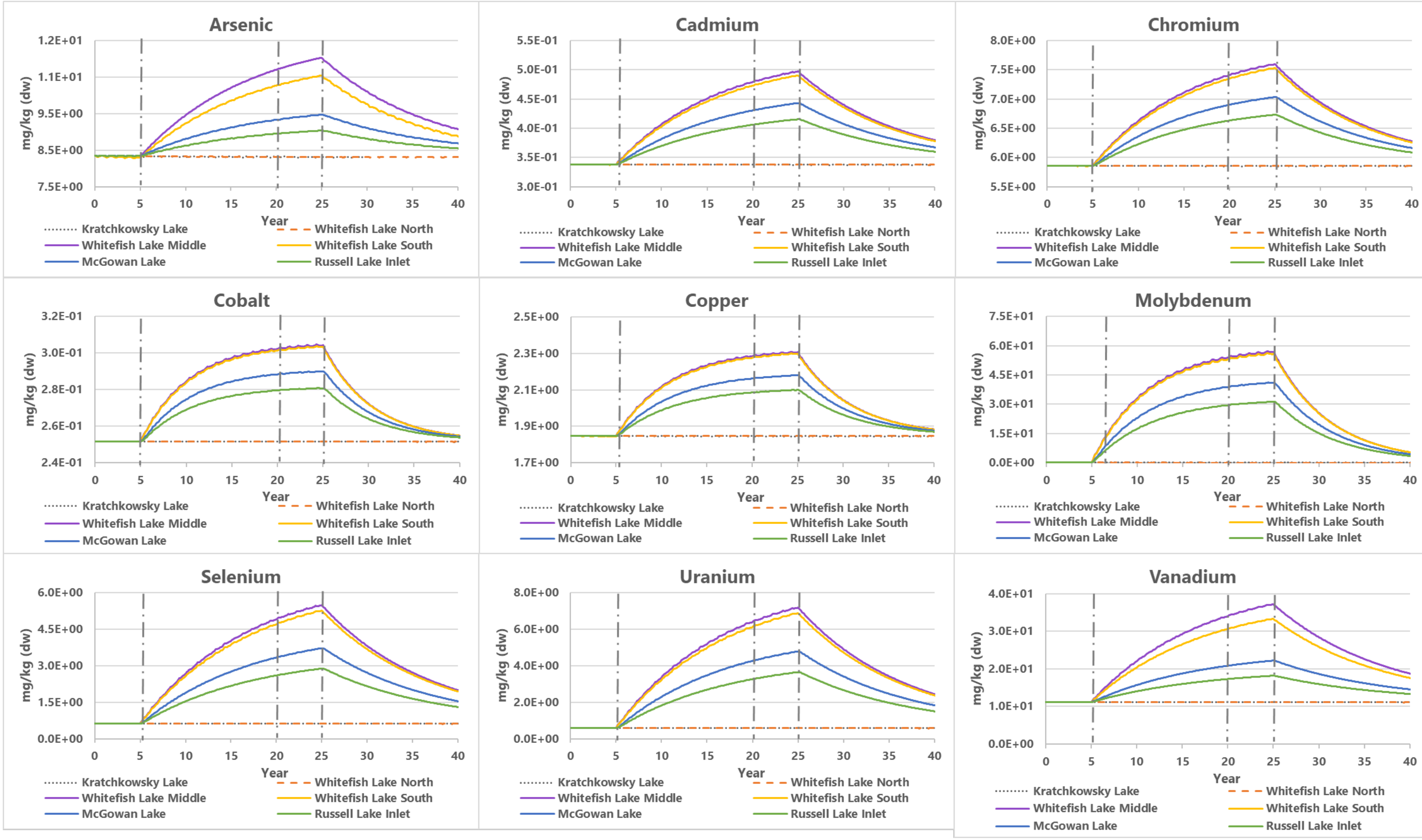
Constituent of Potential Concern (COPC)	**Unit**	**Effluent Quality**
General Chemistry		
Chloride	mg/L	600
Sulphate	mg/L	3915
Total Dissolved Solids	mg/L	6420
Metals and Metalloids		
Arsenic	mg/L	0.006
Cadmium	mg/L	0.0018
Chromium	mg/L	0.025
Cobalt	mg/L	0.003
Copper	mg/L	0.022
Molybdenum	mg/L	2.5
Selenium	mg/L	0.042
Uranium	mg/L	0.057
Vanadium	mg/L	0.059
Zinc	mg/L	0.042
Radionuclides		
Uranium-238	Bq/L	0.7
Uranium-234	Bq/L	0.7
Thorium-230	Bq/L	0.9
Radium-226	Bq/L	0.15
Lead-210	Bq/L	0.419
Polonium-210	Bq/L	0.15

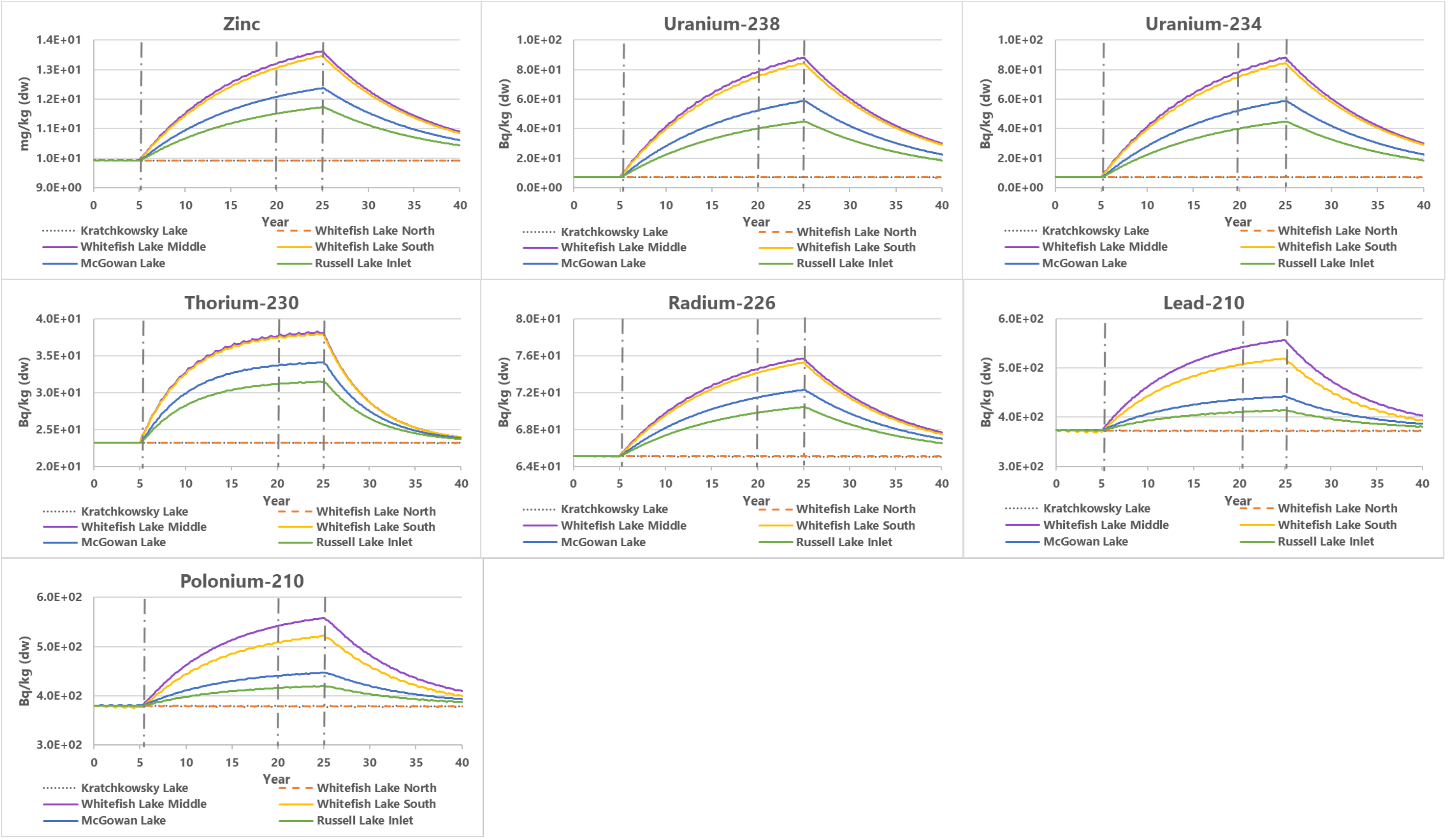

Arsenic
1.7E-04
1.5E-04
1.3E-04
1.1E-04
9.0E-05
7.0E-05
mg/L
0 5 10 15 20 25 30 35 40
Year
Cadmium
4.5E-05
4.0E-05
3.5E-05
3.0E-05
2.5E-05
2.0E-05
mg/L
0 5 10 15 20 25 30 35 40
Year
Chromium
8.5E-04
7.5E-04
6.5E-04
5.5E-04
4.5E-04
mg/L
0 5 10 15 20 25 30 35 40
Year
Cobalt
1.4E-04
1.3E-04
1.2E-04
1.1E-04
9.5E-05
mg/L
0 5 10 15 20 25 30 35 40
Year
Copper
8.5E-04
8.0E-04
7.5E-04
7.0E-04
6.5E-04
6.0E-04
mg/L
0 5 10 15 20 25 30 35 40
Year
Molybdenum
2.5E-02
2.0E-02
1.5E-02
1.0E-02
5.0E-03
0.0E+00
mg/L
0 5 10 15 20 25 30 35 40
Year
Selenium
5.0E-04
4.0E-04
3.0E-04
2.0E-04
1.0E-04
0.0E+00
mg/L
0 5 10 15 20 25 30 35 40
Year
Uranium
8.0E-04
6.0E-04
4.0E-04
2.0E-04
0.0E+00
mg/L
0 5 10 15 20 25 30 35 40
Year
Vanadium
8.0E-04
6.0E-04
4.0E-04
2.0E-04
0.0E+00
mg/L
0 5 10 15 20 25 30 35 40
Year
Kratchkowsky Lake
Whitefish Lake North
Whitefish Lake Middle
Whitefish Lake South
McGowan Lake
Russell Lake Inlet



Long dash dot lines separate the time periods of project phases: 3 years baseline; 2 years construction; 15 years operations; 5 years decommissioning; first 15 years post-decommissioning

Figure IR195-1: Modelled Concentrations of COPCs in Water during Project Phases


Arsenic
1.2E+01
1.1E+01
9.5E+00
8.5E+00
7.5E+00
mg/kg (dw)
0 5 10 15 20 25 30 35 40
Year
Kratchkowsky Lake
Whitefish Lake North
Whitefish Lake Middle
Whitefish Lake South
McGowan Lake
Russell Lake Inlet
Cadmium
5.5E-01
5.0E-01
4.5E-01
4.0E-01
3.5E-01
3.0E-01
mg/kg (dw)
0 5 10 15 20 25 30 35 40
Year
Kratchkowsky Lake
Whitefish Lake North
Whitefish Lake Middle
Whitefish Lake South
McGowan Lake
Russell Lake Inlet
Chromium
8.0E+00
7.5E+00
7.0E+00
6.5E+00
6.0E+00
5.5E+00
mg/kg (dw)
0 5 10 15 20 25 30 35 40
Year
Kratchkowsky Lake
Whitefish Lake North
Whitefish Lake Middle
Whitefish Lake South
McGowan Lake
Russell Lake Inlet
Cobalt
3.2E-01
3.0E-01
2.8E-01
2.6E-01
2.4E-01
mg/kg (dw)
0 5 10 15 20 25 30 35 40
Year
Kratchkowsky Lake
Whitefish Lake North
Whitefish Lake Middle
Whitefish Lake South
McGowan Lake
Russell Lake Inlet
Copper
2.5E+00
2.3E+00
2.1E+00
1.9E+00
1.7E+00
mg/kg (dw)
0 5 10 15 20 25 30 35 40
Year
Kratchkowsky Lake
Whitefish Lake North
Whitefish Lake Middle
Whitefish Lake South
McGowan Lake
Russell Lake Inlet
Molybdenum
7.5E+01
6.0E+01
4.5E+01
3.0E+01
1.5E+01
0.0E+00
mg/kg (dw)
0 5 10 15 20 25 30 35 40
Year
Kratchkowsky Lake
Whitefish Lake North
Whitefish Lake Middle
Whitefish Lake South
McGowan Lake
Russell Lake Inlet
Selenium
6.0E+00
4.5E+00
3.0E+00
1.5E+00
0.0E+00
mg/kg (dw)
0 5 10 15 20 25 30 35 40
Year
Kratchkowsky Lake
Whitefish Lake North
Whitefish Lake Middle
Whitefish Lake South
McGowan Lake
Russell Lake Inlet
Uranium
8.0E+00
6.0E+00
4.0E+00
2.0E+00
0.0E+00
mg/kg (dw)
0 5 10 15 20 25 30 35 40
Year
Kratchkowsky Lake
Whitefish Lake North
Whitefish Lake Middle
Whitefish Lake South
McGowan Lake
Russell Lake Inlet
Vanadium
4.0E+01
3.0E+01
2.0E+01
1.0E+01
0.0E+00
mg/kg (dw)
0 5 10 15 20 25 30 35 40
Year
Kratchkowsky Lake
Whitefish Lake North
Whitefish Lake Middle
Whitefish Lake South
McGowan Lake
Russell Lake Inlet



Long dash dot lines separate the time periods of project phases: 3 years baseline; 2 years construction; 15 years operations; 5 years decommissioning; first 15 years post-decommissioning

Figure IR195-2: Modelled Concentrations of COPCs in Sediment during Project Phases

Attachment: IR-196

Number	IR-196
Dept.	ECCC
Project effects link	Change to an environmental component due to hazardous contaminants
Reference to EIS, appendices, or supporting documentation	Appendix 10-A (ERA), Section 3.1.2.3
Context and Rationale	**Context:** Table 3-6 provides predicted maximum sediment concentrations of COPCs compared to sediment quality guidelines. Several selected sediment screening values are not the most stringent sediment quality guidelines, with no justification provided. Additionally, copper and lead appear to be missing guidelines that are available from the Burnett-Seidel and Liber (2013) study. **Rationale:** The most stringent guidelines should be used for the sediment quality risk assessment in the ERA. Use of the most stringent guidelines will allow the most protective assessment to analyze risks to the receiving environment, aquatic and terrestrial biota.
Information Requirement	1. Provide further information and justification for the selection of less stringent thresholds. 2. Update the ERA as needed.

Updated Appendix 10-A Table 3-6 below (red text indicates a change from the existing table in the draft EIS) to support response in IR table:

Table 3-6: Sediment Quality Screening for the Wheeler River Project

Constituent	Units	Maximum – Whitefish Lake (LA-5)	Sediment Quality Guidelines						Selected Sediment Screening Value	Is Concentration Greater than Selected Screening Value? (Y/N)
			Burnett-Seidel and Liber(b)		Thompson et al.(c)		CCME(d)			
			REF	NE2	LEL	SEL	ISQG	PEL		
Metals and Metalloids										
Arsenic	mg/kg dw	10.7	21	522	9.8	346	5.9	17	21	No
Cadmium	mg/kg dw	0.48	n/d	n/d	n/d	n/d	0.6	3.5	0.6	No
Chromium	mg/kg dw	7.41	31.5	26.2	47.6	115.4	37.3	90	31.5	No
Cobalt	mg/kg dw	0.3	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/a
Copper	mg/kg dw	2.28	9.1	11.3	22	268.8	35.7	197	9.1	No
Lead	mg/kg dw	10.23	16.3	19.7	37	412	35	91.3	16.3	No
Molybdenum	**mg/kg dw**	**53.99**	**23**	**245**	**14**	**1,239**	**n/d**	**n/d**	**23**	**Yes**
Nickel	mg/kg dw	4	21	326	23	484	n/d	n/d	21	No
Selenium	**mg/kg dw**	**4.9**	**3.6**	**30**	**1.9**	**16**	**n/d**	**n/d**	**3.6**	**Yes**
Uranium	mg/kg dw	6.39	97	2,296	104	5,874	n/d	n/d	97	No
Vanadium	mg/kg dw	34.03	35.1	31.8	35.2	160	n/d	n/d	35.1	No
Zinc	mg/kg dw	13.2	n/d	n/d	n/d	n/d	123	315	123	No
Radionuclides										
Uranium-234	Bq/kg dw	78.53	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/a
Uranium-238	Bq/kg dw	78.53	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/a
Thorium-230	Bq/kg dw	37.71	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/a
Radium-226	Bq/kg dw	74.55	n/d	n/d	600	14,400	n/d	n/d	600	No
Lead-210	Bq/kg dw	540.82	n/d	n/d	900	20,800	n/d	n/d	900	No
Polonium-210	Bq/kg dw	541.96	n/d	n/d	800	12,100	n/d	n/d	800	No

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

a) Sediment concentrations predicted based on release of aqueous source-terms to LA-5 and interaction with sediment. Modelling performed in IMPACT according to the equations outlined in Appendix A.

Attachment: IR-198

Number	IR-198
Dept.	HC
Project effects link	Change to an environmental component due to radiological contaminants
Reference to EIS, appendices, or supporting documentation	Appendix 10-A (ERA) Appendix B, Tables B.7 and B.8 Ref. 19-2638 Appendix 10-A (ERA), Table 4-3 Ref. 19-2638 (p. 4.17)
Context and Rationale	Context: Section 10 Appendix 10-A (ERA) contains Table 4-3 (p. 4.17), which lists ingestion rates for traditional foods and includes the category "organs" for Mammals. Tables B.7 and Table B.8 in Section 10 Appendix 10-A (ERA) Ref. 19-2638 provide the predicted concentrations of radionuclides for ecological receptors during the project phases and during future centuries, respectively. They list the concentrations of radionuclides in moose and in moose organs, which is presented as a single cumulative organ value. Other terrestrial and aquatic animals (such as the black bear and woodland caribou) that are a part of the traditional diet of nearby Indigenous communities have higher concentrations of radionuclides than moose, yet concentrations are not provided for organs of these species. Rationale: While Health Canada is not aware of transfer factors to individual organs, or to organs in animals that are not ruminants, it would be beneficial to have a better understanding of radionuclide concentrations in the organs of other animals that may be consumed by local Indigenous communities.
Information Requirement	1. Provide more clarification on how the mammalian organ ingestion rates are calculated (which animals and relative contribution percentages). 2. Provide a rationale for why concentrations of radionuclides were not assessed in organs of animals (other than moose) that are consumed as country foods by Indigenous people harvesting in the area.

Response:

1. Mammalian Organ Ingestion Rates

The derivation of the Traditional Foods diet is explained in detail in Section 4.2.4.2 of Appendix 10-A (ERA), which states: "*A dietary study was performed for residents of Patuanak and La Plonge to understand which traditional foods were consumed by each community and the approximate amounts consumed. The results of the survey were summarized in CanNorth (2017) by average daily intake in grams (fresh weight) of country foods by species and season, for Patuanak, La Plonge, and an average. A summary of the ERFN traditional food ingestion rates by food type is shown in Table 4-3 and the proportions of food types are shown in Figure 4-3.*"

As shown in Table 4-3 in Appendix 10-A the mammalian organ ingestion rate was 6.2 g/d for La Plonge, and 16.2 g/d for Patuanak, and the average was 12.8 g/d for both areas combined. A more detailed breakdown of organ types is provided in IR-198 Table 1 below which indicates that organs are consumed from moose, woodland caribou, and barren-ground caribou. As shown in IR-198 Table 1 below, the greatest contribution to the total organ ingestion rate is from moose organs. Looking at the total organ ingestion rate, approximately 80% of the contribution is from moose liver, kidney, and other parts (see IR-198 Figure 1 below); therefore, it was decided for the ERA to assign the total organ ingestion rate to moose organs.

2. Rationale for Concentrations of Radionuclides in Moose Organs Only

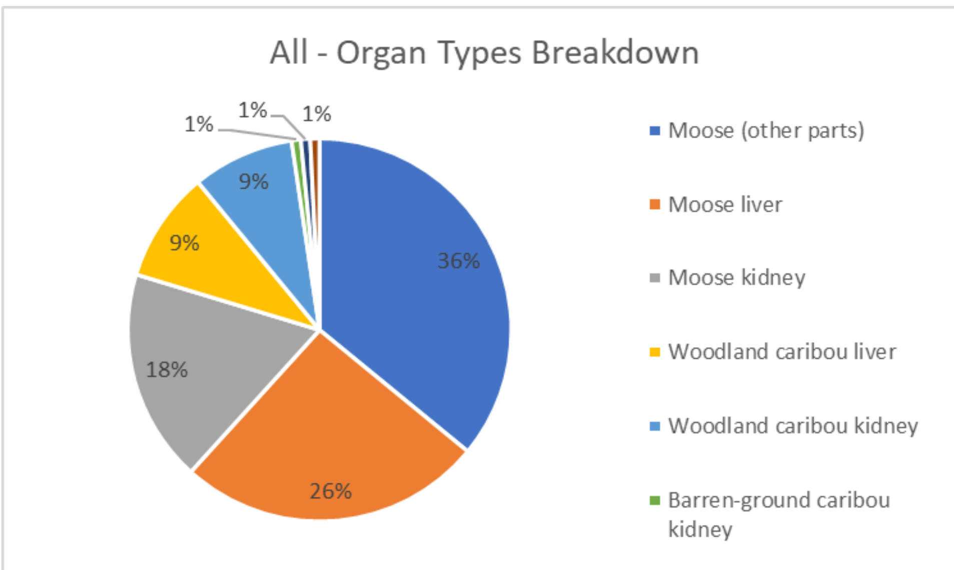
The reviewer also requested rationale for why concentrations of radionuclides are not provided for organs of animals other than moose. The reviewer acknowledges that they are “not aware of transfer factors to individual organs or to organs that are not ruminants, it would be beneficial to have a better understanding of radionuclide concentrations in the organs of other animals that may be consumed by local Indigenous communities.” The transfer factor for moose organs was scaled based on the beef organs transfer factor from CSA N288.1-20 (see Table 3-15 in Appendix A to Appendix 10-A). Limited literature data is available for transfer factors for organs. It was decided to represent organs with moose organs based on the results from the ERFN diet explained above.

Denison acknowledges that the ingestion transfer factors for woodland caribou organs would be higher than the transfer factors for moose. These ingestion transfer factors are summarized in IR-198 Table 2 below for the relevant radionuclides, and the resulting tissue concentrations based on predicted concentrations at McGowan Lake are summarized in IR-198 Table 3. The predicted tissue concentrations for woodland caribou organs ranges from about 0.6 to 6.9 times higher than the predicted tissue concentrations for moose organs for radionuclides in the U-238 decay chain. However, based on the breakdown of organ ingestion rates shown in IR-198 Table 1 below, the caribou organ intake rate is ¼ of the moose organ intake rate, which roughly offsets the higher concentrations in caribou organs. Therefore, representing the organ intake as 100% moose organs is a reasonable approximation.

No changes to the EIS or ERA (Appendix 10-A) were made based on the response to this IR.

IR-198 Table 1: Breakdown of Contribution of Organ Types to Total Organ Ingestion Rate

Organ Types	La Plonge g/d	Patuanak g/d	All g/d	La Plonge % of Organs	Patuanak % of Organs	All % of Organs
Moose (other parts)	2.4	5.7	4.6	39%	35%	36%
Moose liver	1.8	4.1	3.3	29%	25%	26%
Moose kidney	1.8	2.5	2.3	29%	15%	18%
Woodland caribou liver	0.1	1.7	1.2	2%	10%	9%
Woodland caribou kidney	0.05	1.7	1.1	1%	10%	9%
Barren-ground caribou kidney		0.2	0.1	0%	1%	1%
Barren-ground caribou liver		0.2	0.1	0%	1%	1%
Caribou (other parts)	0.02	0.1	0.1	0%	1%	1%
Total Organs	**6.2**	**16.2**	**12.8**	**100%**	**100%**	**100%**



IR-198 Figure 1: Breakdown of Organ Types for ERFN Traditional Foods Diet

IR-198 Table 2: Ingestion Transfer Factors (d/kg fw) for Mammalian Organs

Radionuclide	Beef Organs	Moose Organs	Woodland Caribou Organs
Body Weight (kg)	600	400	180
Uranium-238	6.90E-04	9.35E-04	1.70E-03
Uranium-234	6.90E-04	9.35E-04	1.70E-03
Thorium-230	6.30E-02	8.54E-02	1.55E-01
Radium-226	9.50E-04	1.29E-03	2.34E-03
Lead-210	2.20E-02	2.98E-02	5.43E-02
Polonium-210	5.00E-05	6.78E-05	1.23E-04

IR-198 Table 3: Estimated Tissue Concentrations of Moose Organs and Woodland Caribou Organs at McGowan Lake

Tissue Type	Units	U-238	U-234	Th-230	Ra-226	Pb-210	Po-210
Moose organs	mg/kg fw	7.84E-02	7.84E-02	3.04E+00	8.76E-02	7.15E+00	1.31E-02
Woodland caribou organs	mg/kg fw	3.31E-01	3.31E-01	3.30E+00	5.46E-02	4.94E+01	7.50E-02

Attachment: IR-213

Number	IR-217
Dept.	CNSC
Project effects link	Accidents and Malfunctions
Reference to EIS, appendices, or supporting documentation	Sections 14.6.1 and 14.6.2
Context and Rationale	**Context:** Highway 914 crosses the Wheeler River 10 km southwest of the access road junction. A vehicle accident, including a rollover, collision, or run off road, at or near the bridge could potentially result in a release of uranium concentrate and release of fuels and chemicals into the surface water at this location. Denison believes that a release of uranium concentrate and a release of fuels and chemicals at this location would bound the releases at any other water crossing along the transportation corridor. However, no information on what other water crossings along the transportation corridor exist and how bounding scenarios 1 and 2 would bound the risk of releasing uranium concentrate and fuels and chemicals at other crossings. **Rationale:** The release of uranium concentrate and fuels and chemicals at water crossings would contaminate the water body at the crossings and pose a risk to the environment and public health.
Information Requirement	Please provide information on all water crossings along the transportation corridor and justification why bounding scenarios 1 and 2 would bound the effects of the accidental releases of uranium concentrate and fuels and chemicals at these crossings.

<u>Table to support response in IR table:</u>

Table 3-2 in Appendix A of Appendix 14-A will be updated in the final EIS to include (new) Scenario 2.4 Well Casing Yield and/or Damage:

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
2.4	Scenario 2.4 Well Casing Yield and/or Damage	Co / Op	Loss of lixiviant into the groundwater within freeze wall containment	Occupational health and safety plan Personnel training and orientation Personal protection equipment Spill management and response Secondary containment via freeze wall	2	3	Low	Risk level is low, moderate consequence event (assume localized event to ground where clean up is possible), no further assessment

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

:

Attachment: IR-214

Number	IR-214
Dept.	CNSC
Project effects link	Accidents and Malfunctions
Reference to EIS, appendices, or supporting documentation	Section 14.5.3 Appendix 14-A, section 3.2.3
Context and Rationale	**Context**: Hazard scenarios were identified using a systematic approach that considered the existence of sources of hazards and initiating events for the Project in consideration of Project activities and components. Details for how each of these project components and activities are considered in the initial hazard scenario identification process are provided in the accidents and malfunctions TSD (see Appendix 14-A; Ecometrix 2022). However, in Table 3-1 to Table 3-14 in Appendix A of Appendix 14-A, the following inconsistencies were identified: i. consequences for the hazards ID# 1.1, 1.5, 1.7, 14.2 include occupational major injuries; however, the severity (S) is denoted as number 2 that appears to be inconsistent with consequence rating number in Figure 14.5-2 ii. Hazard ID# 1.5 has a L=2, but it is described as a highly unlikely event, which is inconsistent with the term in Figure 14.5-2 iii. Hazards ID# 3.6 and 3.7 have a L=1, but they are described as low probability event that is inconsistent with the term in Figure 14.5-2 iv. Hazards ID# 8.2, 8.3, 9.1, 10.1 to 10.5, 11.1, 11.5 have a L=1, but they are described as unlikely events, which are inconsistent with the term in Figure 14.5-2. Rationale needs to be provided how stockpile erosion is considered to have a L=1 v. Hazard ID# 12.1 has a L=2 and S=3, but it's risk ranking is moderate, which is inconsistent with the term in Figure 14.5-2 vi. Hazard ID# 13.3 has a L=2. Based on the operation experience in the similar projects in the northern Saskatchewan, ponds lining failure and leakage is a very likely event. Rationale needs to be provided to support L=2 or change the number for L. **Rationale**: Inconsistent or inaccurate/incorrect information was included in Accidents and Malfunctions assessment.

Information Requirement	Please clarify or correct all inconsistent and/or inaccurate information in Tables 3-1 to 3-14 in Appendix A of Appendix 14-A.

Tables to support response to IR-214:

The updated hazard screening tables on the following pages are provided in support of the response to IR-214.

It is noted that the revisions highlighted do not affect the outcome of the screening evaluation and do not necessitate consideration of additional bounding scenarios by way or more detailed analyses.

Site Works - Summary – Nine potential scenarios have been identified. Risks have been characterized as low to moderate as it concerns environmental risks. No scenarios carried forward for quantitative assessment.

Table 3-1: Hazard Identification Evaluation – Site Works

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
1.1	Fall / slip	Co / Op / De	Occupational major injuries	Occupational health and safety plan Personnel training and orientation Personal protection equipment	5	~~2~~3	ALARP, moderate	Best practice in worker health and safety program resulting in ALARP, no further assessment
1.2	Fall / slip	Co / Op / De	Occupational fatalities	Occupational health and safety plan Personnel training and orientation Personal protection equipment	2	5	ALARP, High	Best practice in worker health and safety program resulting in high but ALARP, no further assessment
1.3	Refuelling accident	Co / Op / De	Hydrocarbon release	Occupational health and safety plan Personnel training and orientation Personal protection equipment Spill management and response Secondary containment	4	2	Low	Overall r~~R~~isk level is low, ~~low~~ minor consequence event, no further assessment
1.4	Fuel storage failure	Co / Op / De	Hydrocarbon release	Occupational health and safety plan Personnel training and orientation Personal protection equipment Spill management and response Secondary containment	1	3	Low	Overall ~~Risk~~ risk level is low, highly unlikely event, no further assessment
1.5	Fuel storage and transfer fire and explosion	Co / Op / De	Occupational major injuries	Occupational health and safety plan Personnel training and orientation Personal protection equipment Fire safety plan and firefighting system	2	~~2~~3	Low	Overall r~~R~~isk level is low, ~~highly~~ unlikely event, no further assessment
1.6	Fuel storage and transfer fire and explosion	Co / Op / De	Occupational fatalities	Occupational health and safety plan Personnel training and orientation Personal protection equipment Fire safety plan and firefighting system	1	5	ALARP, moderate	Best practice in worker health and safety program resulting in ALARP, no further assessment
1.7	Vehicle and construction equipment accident	Co / Op / De	Occupational major injuries	Occupational health and safety plan Personnel training and orientation Preventive and routine maintenance Onsite traffic control (speed limits, signage)	4	2	ALARP, moderate	Best practice in worker health and safety program resulting in ALARP, no further assessment
1.8	Vehicle and construction equipment accident	Co / Op / De	Occupational fatalities	Occupational health and safety plan Personnel training and orientation Preventive and routine maintenance Onsite traffic control	2	5	ALARP, High	Best practice in worker health and safety program resulting in high but ALARP, no further assessment
1.9	Vehicle accident	Co / Op / De	Hazardous materials spill	Occupational health and safety plan Personnel training and orientation Preventive and routine maintenance Onsite traffic control (speed limits, signage) Spill management and response	4	2	Low	Overall r~~R~~isk level is low, minor consequence event~~s~~, no further assessment

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

EcoMetrix
Editorial changes made to make terminology consistent with the hazard risk analysis matrix.
@mention or reply

EcoMetrix
Per FIRT IR 214 updated severity to 3 (from 2) to reflect occupational injury. This change does not change the overall risk ranking of ALARP, moderate.
@mention or reply

EcoMetrix
Per FIRT IR 214 updated severity to 3 (from 2) to reflect occupational injury. This change does not change the overall risk ranking of ALARP, moderate.
@mention or reply

EcoMetrix
Updated severity to 3 (from 2) to reflect occupational injury. This change does not change the overall risk ranking of ALARP, moderate.
@mention or reply

Wellfield - Summary – Three potential scenarios have been identified. Risks have been characterized as low to moderate as it concerns environmental risks. No scenarios carried forward for quantitative assessment.

Table 3-2: Hazard Identification Evaluation – Drilling

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
2.1	Drilling mud spill	Co / Op	Material spill to ground, including contaminated drill muds	Occupational health and safety plan Personnel training and orientation Personal protection equipment Spill management and response Primary and secondary containment for drilling mud	4	2	Low	Overall rRisk level is low, ~~low~~ minor consequence event (assumes containment and clean up), no further assessment
2.2	Piping failure in the well field	Co / Op	Loss of lixiviant, UBS, and/or regents to ground	Occupational health and safety plan Personnel training and orientation Personal protection equipment Spill management and response Secondary containment via freeze wall	2	3	Low	Overall rRisk level is low, moderate consequence event (assume localized event to ground where clean up is possible prior to groundwater contamination), no further assessment
2.3	Surface flood	Co / Op	Potential for groundwater contamination	Lined collection points Site grading to collection areas Collection pond sized to accommodate PMP	2	2	Low	Overall rRisk level is low, ~~low~~ minor consequence event, no further assessment
2.4	Well casing yield and/or damage	Co / Op	Loss of lixiviant into the groundwater within freeze wall containment	Occupational health and safety plan Personnel training and orientation Personal protection equipment Spill management and response **Secondary containment via freeze wall**	2	3	Low	Overall risk level is low, moderate consequence event (assume localized event to groundwater where cleanup is possible), no further assessment

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

EcoMetrix
Editorial changes made to make terminology consistent with the hazard risk analysis matrix.
Note: Table includes new scenario 2,4 FIRT IR 213.
August 16, 2023, 8:23 AM
@mention or reply

Access Road / Land Transportation - Summary – Eight potential scenarios have been identified. Risks have been characterized as low to high as it concerns environmental risks. Two scenarios carried forward for quantitative assessment.

Table 3-3: Hazard Identification Evaluation – Access Road / Land Transportation (shaded rows are those recommended for further assessment)

ID#	Accident / Malfunction	Phase	Consequences	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
3.1	Vehicle accident including rollover, collision, run off road	Op	Aquatic release of radioactivity	Occupational health and safety plan Personnel training and orientation Traffic control measures Travel management plan Spill management and emergency response plan	3	5	High	Further Assessment Recommended
3.2	Vehicle accident including rollover, collision, run off road	Co / Op / De	Terrestrial release of radioactivity	Occupational health and safety plan Personnel training and orientation Traffic control measures Travel management plan Spill management and emergency response plan	3	4	ALARP, moderate	Best practice in terrestrial spill containment and cleanup resulting in ALARP, no further assessment
3.3	Vehicle accident including rollover, collision, run off road	Co / Op / De	Aquatic release of fuel, hazardous chemicals and reagents	Occupational health and safety plan Personnel training and orientation Traffic control measures Travel management plan Spill management and emergency response plan	3	5	High	Further Assessment Recommended
3.4	Vehicle accident including rollover, collision, run off road	Co / Op / De	Terrestrial release of fuel, hazardous chemicals and reagents	Occupational health and safety plan Personnel training and orientation Traffic control measures Travel management plan Spill management and emergency response plan	3	4	ALARP, moderate	Best practice in terrestrial spill containment and cleanup resulting in ALARP; Further Assessment Recommended to address interested party concerns (includes consideration of radioactivity)
3.5	Vehicle fire	Co / Op / De	Terrestrial release of hydrocarbons and fuel	Occupational health and safety plan Personnel training and orientation Travel management plan Spill and emergency response plan Spill management and emergency response plan	1	4	ALARP, moderate	Best practice in terrestrial spill containment and cleanup resulting in ALARP, no further assessment
3.6	Vehicle fire	Co / Op / De	Release of radioactivity to air	Occupational health and safety plan Personnel training and orientation Travel management plan Spill and emergency response plan Spill management and emergency response plan	1	4	ALARP, moderate	Overall moderate (ALARP) ~~Low~~ risk, ~~low probability~~highly unlikely event. Reversible and transient effect. No further assessment
3.7	Vehicle fire	Co / Op / De	Atmospheric release of particulate and combustion by-products	Occupational health and safety plan Personnel training and orientation Travel management plan Spill management and emergency response plan Fire safety plan and firefighting systems Ambient air monitoring	1	3	Low	Overall ~~Low~~ low risk, highly unlikely ~~low probability~~ event. Reversible and transient effect. No further assessment
3.8	Vehicle – Wildlife collision	Co / Op / De	Wildlife fatality	Occupational health and safety plan Personnel training and orientation Traffic control measures Travel management plan	4	2	Low	Overall low risk, Individual (not population) level minor effect, reversible and nonsignificant effect, no further assessment

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

Airstrip - Summary – Four potential scenarios have been identified. Risks have been characterized as low to moderate as it concerns environmental risks. No scenarios carried forward for quantitative assessment.

Table 3-4: Hazard Identification Evaluation – Airstrip

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
4.1	Fuel storage failure	Co / Op / De	Hydrocarbon release	Occupational health and safety plan Personnel training and orientation Storage inspection, maintenance Secondary containment Spill and emergency response plan	1	3	Low	Overall r~~R~~isk level is low, highly unlikely event, no further assessment
4.2	Refuelling accident	Co / Op / De	Hydrocarbon release	Occupational health and safety plan Personnel training and orientation Secondary containment Spill and emergency response plan	4	2	Low	Overall ~~Risk~~ risk level is low, ~~low~~ minor consequence event, no further assessment
4.3	Plane de-icing chemical release	Co / Op / De	Terrestrial release of reagent; possible aquatic release of reagent	Personnel training Containment Spill and emergency response plan	3	2	Low	Overall r~~R~~isk level is low, ~~low~~ minor consequence event, no further assessment
4.4	Air plane crash	Co / Op / De	Occupational major injuries / fatality Atmospheric release of particulate and combustion by-products Release of hydrocarbons and fuel Damage to mine infrastructure structure	Travel management plan Air traffic control Spill and emergency response plan Fire safety plan and firefighting systems Personnel training	1	5	ALARP, moderate	~~Low likelihood~~Highly unlikely event, best practice in air traffic control resulting in ALARP, no further assessment
4.5	Ground vehicle – air plane collision	Co / Op / De	Occupational major injuries / fatality Atmospheric release of particulate and combustion by-products Release of hydrocarbons and fuel Damage to mine infrastructure structure	Travel management plan Air traffic control Ground traffic control Spill and emergency response plan Fire safety plan and firefighting systems Personnel training	1	5	ALARP, moderate	~~Low~~ Highly unlikely~~likelihood~~ event, best practice in air / ground traffic control resulting in ALARP, no further assessment

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

EcoMetrix
Editorial changes made to make terminology consistent with the hazard risk analysis matrix.
@mention or reply

Freeze plant - Summary – Five potential scenarios have been identified. Risks have been characterized as low to high as it concerns environmental risks. One scenario is carried forward for quantitative assessment.

Table 3-5: Hazard Identification Evaluation – Freeze plant (shaded rows are those recommended for further assessment)

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
5.1	Ammonia storage and piping failure	Co / Op	Material spill	Occupational health and safety plan Personnel training and orientation Storage inspection, maintenance Secondary containment Spill and emergency response plan	3	2	Low	Overall r~~R~~isk level is low, ~~low~~ minor consequence event, no further assessment
5.2	Loss of freeze capacity	Op	Loss of freeze wall and secondary underground containment	Freeze wall monitoring Monitoring wells outside of the freeze wall – temp, pressure Back up gensets	1	5	Moderate	Loss of containment of lixiviant outside mining chamber - Further Assessment Recommended. Denison does not believe a leak would occur however public perception of a loss of containment is of high concern and should assessed. In practice, the mechanical failure of refrigeration system can be addressed and mitigated well before the thawing of the freeze wall which would take months.
5.3	Cooling line break	Co / Op	Release of brine below ground and potential for groundwater contamination	Occupational health and safety plan Personnel training and orientation Inspection and maintenance Remote monitoring system Spill and emergency response plan	2	4	ALARP, moderate	~~Low likelihood~~Unlikely event, best practice resulting in ALARP, no further assessment
5.4	Cooling line break	Co / Op	Release of brine on surface ~~-~~ – potential for ground and groundwater contamination	Occupational health and safety plan Personnel training and orientation Inspection and maintenance Remote monitoring system Pipes in trenches and secondary containment Spill and emergency response plan	2	2	Low	Overall ~~Risk~~ risk level is low, ~~low~~ minor consequence event with appropriate response and mitigation, no further assessment
5.5	Pumps failure	Co / Op	Release of brine on surface - potential for surface and groundwater contamination	Occupational health and safety plan Personnel training and orientation Inspection and maintenance Remote monitoring system No open drain from pumphouse Spill and emergency response plan	2	2	Low	Overall ~~Risk~~ risk level is low, ~~low~~ minor consequence event with appropriate response and mitigation, no further assessment

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

EcoMetrix
Editorial changes made to make terminology consistent with the hazard risk analysis matrix.
@mention or reply

Freeze wall - Summary – One potential scenario has been identified. Risks have been characterized as high as it concerns environmental risks. One scenario is carried forward for quantitative assessment.

Table 3-6: Hazard Identification Evaluation – Freeze wall

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
6.1	Failure of freeze wall due to seismic event / geotechnical instability	Op	Loss secondary underground containment and groundwater contamination	Freeze wall monitoring Redundancy in design Control of pump and injection wells	2	4	Moderate	Loss of containment of lixiviant outside mining chamber - Further Assessment Recommended

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

EcoMetrix
No changes needed.
@mention or reply

Production Plant - Summary – Seven potential scenarios have been identified. Risks have been characterized as low to high as it concerns environmental risks. Two scenarios are carried forward for quantitative assessment.

Table 3-7: Hazard Identification Evaluation – Production Plant (shaded rows are those recommended for further assessment)

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
7.1	Process vessel and piping system failure	Op	Release of sulphuric acid	Occupational health and safety plan Personnel training and orientation Inspection and maintenance Spill and emergency response plan Secondary containment Process sumps Production building is contained	3	2	Low	Overall low~~Moderate~~ risk, ~~low~~ minor consequence event, no further assessment
7.2	Process vessel and piping system failure	Op	Release of hydrogen peroxide and potential for fire	Occupational health and safety plan Personnel training and orientation Inspection and maintenance Spill and emergency response plan Secondary containment Process sumps Production building is contained	3	2	Low	Overall low ~~Moderate~~ risk, ~~low~~ minor consequence event, no further assessment
7.3	Process vessel and piping system failure	Op	Release of magnesium hydroxide	Occupational health and safety plan Personnel training and orientation Inspection and maintenance Spill and emergency response plan Secondary containment Process sumps Production building is contained	3	2	Low	Overall low ~~Moderate~~ risk, ~~low~~ minor consequence event, no further assessment
7.4	Process vessel and piping system failure, Thickener overflow	Op	Release of aqueous solution	Occupational health and safety plan Personnel training and orientation Inspection and maintenance Spill and emergency response plan Secondary containment Process sumps Production building is contained Detectable signs of exposure e.g., irritation	3	2	Low	Overall low ~~Moderate~~ risk, ~~low~~ minor consequence event, no further assessment. ALARP
7.5	Process vessel and piping system failure	Op	Release of acidic fume from storage tank	Occupational health and safety plan Personnel training and orientation Inspection and maintenance Availability of respirators Emergency response plan will implement medical response to acute exposure to acidic fumes. Ambient monitoring Building ventilation	3	2	Low	Overall low ~~Moderate~~ risk, ~~low~~ minor consequence event, no further assessment
7.6	Process vessel and piping system failure	Op	Release of radon from storage tank	Occupational health and safety plan Personnel training and orientation Inspection and maintenance Emergency response plan Ambient monitoring Building ventilation	3	3	Moderate	Overall m~~M~~oderate risk, moderate consequence event - Further Assessment Recommended
7.7	Facility fire / explosion	Op	Release of radioactivity and yellowcake powder to atmosphere	Occupational health and safety plan Personnel training and orientation Inspection and maintenance Fire safety plan and firefighting systems Emergency response plan Ambient air monitoring	2	5	High	Further Assessment Recommended. It is also noted that this scenario could be an outcome of many initiating events – the specific details associated with the event will be determined based on the most current inventory of combustible and flammable materials associated with the production plant when the analysis is completed.
7.8	Process containment and gas cleaning and filtration system failure	Op	Release of yellowcake powder to atmosphere	Inspection, testing, and maintenance program Ambient air monitoring	3	4	ALARP, moderate	The consequence is bounded by scenario 7.7.

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

EcoMetrix
Editorial changes made to make terminology consistent with the hazard risk analysis matrix.
@mention or reply

Clean Waste Rock Pads - Summary – Four potential scenarios have been identified. Risks have been characterized as low as it concerns environmental risks. No scenarios are carried forward for quantitative assessment.

Table 3-8: Hazard Identification Evaluation – Clean Waste Rock Pads

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
8.1	Stockpile slope failure	Co / Op /De	Release of material into surrounding environment	Personnel training and orientation Inspection and maintenance	~~2~~1	2	Low	Overall ~~L~~low risk, unlikely event due to small extent of stockpiles, no further assessment
8.2	Stockpile erosion	Co / Op /De	Release of materials into the environment	Personnel training and orientation Inspection and maintenance Single-lined pad Inspection and maintenance	~~1~~2	3	Low	Overall ~~Low~~ low risk, highly unlikely event, no further assessment
8.3	Uncontrolled leachate / seepage release through runoff	Co / Op /De	Release of materials into the surface water	Personnel training and orientation Single-lined pad Inspection and maintenance Ambient monitoring Surface water management Spill management	1	2	Low	Overall ~~Low~~ low risk, highly unlikely event, no further assessment
8.4	Uncontrolled leachate / seepage release through lining failure	Co / Op /De	Release of materials into the groundwater	Personnel training and orientation Single-lined pad Inspection and maintenance Groundwater monitoring Spill response plan	2	3	Low	Overall ~~L~~low risk, unlikely event, no further assessment

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

EcoMetrix
Editorial changes made to make terminology consistent with the hazard risk analysis matrix.
@mention or reply

EcoMetrix
Though not captured by the FIRT IR the Likelihood rating of Scenarios 8.1 and 8.2 were inadvertently reversed. That's has been corrected and the revised Likelihood rating for Scenario 8.1 is "highly unlikely", score 1 and the revised Likelihood rating for Scenario 8.2 is " "unlikely", score 2.
August 16, 2023, 9:11 AM
@mention or reply

EcoMetrix
Though not captured by the FIRT IR the Likelihood rating of Scenarios 8.1 and 8.2 were inadvertently reversed. That's has been corrected and the revised Likelihood rating for Scenario 8.1 is "highly unlikely", score 1 and the revised Likelihood rating for Scenario 8.2 is " "unlikely", score 2.

With Specific reference FIRT IR 214(IV) it is believed that that the revised scoring "unlikely" better reflects the event likelihood. Stockpile erosion may not be uncommon but stockpile erosion that would lead to an environmental release as envisioned by the scenario in consideration of the design basis is deemed unlikely.
August 16, 2023, 9:12 AM
@mention or reply

Special / Specialized Waste Containment - Summary – Two potential scenarios have been identified. Risks have been characterized as low to moderate as it concerns environmental risks. No scenarios are carried forward for quantitative assessment.

Table 3-9: Hazard Identification Evaluation –Special / Specialized Waste Rock Pads

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
9.1	Loss of containment from storage vessels (barrels) resulting in uncontrolled leachate release	Co / Op /De	Release of contaminants into the surface water	Personnel training and orientation Double lined with leak detection/collection Inspection and maintenance Ambient monitoring Surface water management Spill management	1	3	Low	Overall ~~Low~~ low risk, highly unlikely event, no further assessment
9.2	Loss of containment from storage vessels (barrels)resulting in uncontrolled leachate release	Co / Op /De	Release of contaminants into the groundwater	Personnel training and orientation Double lined with leak detection/collection Inspection and maintenance Groundwater monitoring Spill response plan	1	4	ALARP, moderate	Best management practice results in ALARP, highly unlikely event, no further assessment

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

EcoMetrix
Editorial changes made to make terminology consistent with the hazard risk analysis matrix.
@mention or reply

Gypsum (clean) Precipitates Disposal Area - Summary – Five potential scenarios have been identified. Risks have been characterized as low as it concerns environmental risks. No scenarios are carried forward for quantitative assessment.

Table 3-10: Hazard Identification Evaluation – Gypsum (clean) Precipitates Disposal Area

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
10.1	Precipitates erosion	Co / Op /De	Release of contaminants into surrounding environment	Personnel training and orientation Single-lined pad Inspection and maintenance	1	2	Low	Overall ~~Low~~ low risk, highly unlikely event, no further assessment
10.2	Uncontrolled leachate / seepage release through runoff	Co / Op /De	Release of contaminants into the environment	Personnel training and orientation Single-lined pad Inspection and maintenance Surface water monitoring Surface water management Spill management and response plan	1	2	Low	Overall ~~Low~~ low risk, highly unlikely event, no further assessment
10.3	Uncontrolled leachate / seepage release through lining failure	Co / Op /De	Release of contaminants into the surface water	Personnel training and orientation Single-lined pad Inspection and maintenance Surface water monitoring Surface water management Spill management and response plan	1	2	Low	Overall ~~Low~~ low risk, highly unlikely event, no further assessment
10.4	Uncontrolled leachate / seepage release through lining failure	Co / Op /De	Release of contaminants into the groundwater	Personnel training and orientation Single-lined pad Inspection and maintenance Groundwater monitoring Spill management and response plan	1	3	Low	Overall ~~Low~~ low risk, highly unlikely event, no further assessment
10.5	Wind erosion	Co / Op /De	Atmospheric release of contaminants	Personnel training and orientation Erosion control measures Inspection and maintenance Ambient air monitoring Response plan	1	3	Low	Overall ~~Low~~ low risk, highly unlikely event, no further assessment

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

EcoMetrix
Editorial changes made to make terminology consistent with the hazard risk analysis matrix.
@mention or reply

Iron (contaminated) Precipitates Disposal Area – Summary – Five potential scenarios have been identified. Risks have been characterized as low to moderate as it concerns environmental risks. No scenarios are carried forward for quantitative assessment.

Table 3-11: Hazard Identification Evaluation – Iron (contaminated) Precipitates Disposal Area

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
11.1	Precipitates erosion	Co / Op /De	Release of contaminants into surrounding environment	Personnel training and orientation Double lined with leak detection/collection Inspection and maintenance	1	3	Low	Overall ~~Low~~ low risk, highly unlikely event, no further assessment
11.2	Uncontrolled leachate / seepage release through runoff	Co / Op /De	Release of contaminants into the environment	Personnel training and orientation Double lined with leak detection/collection Inspection and maintenance Surface water monitoring Surface water management Spill management and response plan	1	5	ALARP, moderate	Best management practice results in ALARP, highly unlikely event, no further assessment
11.3	Uncontrolled leachate / seepage release through lining failure	Co / Op /De	Release of contaminants into the surface water	Personnel training and orientation Double lined with leak detection/collection Inspection and maintenance Surface water monitoring Surface water management Spill management and response plan	1	5	ALARP, moderate	Best management practice results in ALARP, highly unlikely event, no further assessment
11.4	Uncontrolled leachate / seepage release through lining failure	Co / Op /De	Release of contaminants into the groundwater	Personnel training and orientation Double lined with leak detection/collection Inspection and maintenance Groundwater monitoring Spill management and response plan	1	5	ALARP, moderate	Best management practice results in ALARP, highly unlikely event, no further assessment
11.5	Wind erosion	Co / Op /De	Atmospheric release of contaminants	Personnel training and orientation Erosion control measures Inspection and maintenance Ambient air monitoring Response plan	1	3	Low	Overall ~~Low~~ low risk, highly unlikely event, no further assessment

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

EcoMetrix
Editorial changes made to make terminology consistent with the hazard risk analysis matrix.
@mention or reply

Wastewater Treatment System - Summary – Three potential scenarios have been identified. Risks have been characterized as low to moderate as it concerns environmental risks. No scenarios are carried forward for quantitative assessment.

Table 3-12: Hazard Identification Evaluation – Wastewater Treatment System

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
12.1	Equipment / piping failure	Op / De	Contaminant and radioactivity release	Occupational health and safety plan Personnel training and orientation Piping design pressure higher than pumps shutoff pressure Inspection and maintenance Process monitoring Spill management and response	2	3	ALARP, ~~moderate~~low	Best management practice results in ALARP, containment of the piping within the ditches indicates no further assessment
12.2	Effluent clarifier overflow	Op / De	Contaminant and radioactivity release	Occupational health and safety plan Personnel training and orientation Inspection and maintenance Process monitoring Secondary containment Spill management and response	2	3	ALARP, ~~moderate~~low	Best management practice results in ALARP, no further assessment
12.3	Equipment and control system failure	Op / De	Release of reagents, Environmental contamination	Occupational health and safety plan Personnel training and orientation Inspection and maintenance Process monitoring Recirculation of off-spec water to the process Spill management and response	2	3	Low	Low risk, unlikely event, no further assessment

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

EcoMetrix
Changes made to make overall risk ranking consistent with the hazard risk analysis matrix. Originally, scenarios 12.1 and 12.2 were "moderate" but should have been ranked "low" based on L=2 and S=3.
August 16, 2023, 8:47 AM
@mention or reply

Ponds and Retention Berms - Summary – Five potential scenarios have been identified. Risks have been characterized as low to moderate as it concerns environmental risks. No scenarios are carried forward for quantitative assessment.

Table 3-13: Hazard Identification Evaluation – Ponds and Retention Berms

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
13.1	Pond overtopping	Op / De	Contaminant and radioactivity release	Personnel training and orientation Inspection and maintenance Surface water management Ponds designed for PMP/PMF Spill and emergency response plan Monitoring	2	3	Low	Overall l~~L~~ow risk, ~~low probability~~unlikely event, no further assessment
13.2	Ponds containment or embankment failure	Op / De	Contaminant and radioactivity release	Personnel training and orientation Inspection and maintenance Surface water management Ponds designed for PMP/PMF Spill and emergency response plan Monitoring	1	5	ALARP, moderate	Best engineering practice in maintenance and inspection of the containment systems and berms. No further assessment
13.3	Ponds lining failure and leakage	Op / De	Contaminant and radioactivity release to groundwater	Personnel training and orientation Inspection and maintenance Groundwater monitoring Response plan	~~2~~3	3	ALARP, moderate~~Low~~	Overall moderate~~Low~~ risk, ~~low probability~~likely event with moderate consequence. ~~,~~Overall risk considered ALARP given engineering design and other safeguards. ~~no~~ No further assessment recommended.
13.4	Surface flooding	Op / De	Contaminant and radioactivity release	Personnel training and orientation Inspection and maintenance Surface water management Ponds designed for PMP/PMF Spill and emergency response plan Monitoring	1	3	Low	Overall l~~L~~ow risk, ~~low probability~~highly unlikely event, no further assessment
13.5	Wildlife entering pond	Op/De	Exposure to contaminants, drowning	Wildlife management plan Inspection Fencing	1	2	Low	Overall ~~Low~~ low risk, ~~low probability~~highly unlikely event, no further assessment

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

EcoMetrix
Editorial changes made to make terminology consistent with the hazard risk analysis matrix.
@mention or reply

EcoMetrix
Per FIRT IR 214 the likelihood score has been revised from L=2 (unlikely) to L=3 (likely) and therefore overall risk has been updated to ALARP, moderate from Low.
Based on information received from manufactures and the project team's own experience it is thought the L=3 (≤1 occurrence in 10 years and >1 occurrence in 100 years)may better reflect liner performance, assuming the liner is installed based on appropriate design criteria and used as intended.
August 16, 2023, 10:34 AM
@mention or reply

Electrical System and Power Plant - Summary – Three potential scenarios have been identified. Risks have been characterized as low to moderate as it concerns environmental risks. No scenarios are carried forward for quantita assessment.

Table 3-14: Hazard Identification Evaluation – Electrical System and Power Plant

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
14.1	Substation transformer leak	Co / Op / De	Release of mineral oil and potential for groundwater contamination	Personnel training and orientation Inspection and maintenance Spill and emergency response plan Secondary containment	3	2	Low	Overall ~~l~~Low risk, ~~low~~ minor cons event, no further assessment
14.2	Transformer, turbine, generator fire / explosion	Co / Op / De	Occupational major injuries	Personnel training and orientation Occupational health and safety program Personal protection equipment Inspection and maintenance Emergency response plan Fire safety plan and firefighting systems	2	~~2~~3	ALARP, ~~moderate~~low	Best practice in worker health an program resulting in ALARP, no fu assessment
14.3	Transformer, turbine, generator fire / explosion	Co / Op / De	Occupational fatalities	Personnel training and orientation Occupational health and safety program Personal protection equipment Inspection and maintenance Emergency response plan Fire safety plan and firefighting systems	1	5	ALARP, moderate	Best practice in worker health an program resulting in ALARP, no fu assessment

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

EcoMetrix
Per FIRT IR 214, updated severity to 3 (from 2) to reflect occupational injury.

Also, originally the overall risk ranking was ALARP, moderate - this has been revised to ALARP, low consistent with the hazard analysis risk matrix.
August 16, 2023, 9:18 AM

@mention or reply

EcoMetrix
Editorial changes made to make terminology consistent with the hazard risk analysis matrix. Also, change made to make overall risk ranking consistent with the hazard risk analysis matrix. Originally, scenario14.2 was "moderate" but should have been ranked "low" based on L=2 and S=2.
August 16, 2023, 8:52 AM

@mention or reply

Fire Protection System - Summary – Two potential scenarios have been identified. Risks have been characterized as low as it concerns environmental risks. No scenarios are carried forward for quantitative assessment.

Table 3-15: Hazard Identification Evaluation – Fire Protection System

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
15.1	Failure of fire pump	Co / Op / De	Loss of firefighting capacity	Personnel training and orientation Occupational health and safety program Personal protection equipment Inspection and maintenance Redundancy Fire safety plan and firefighting systems (including and elevated fire water tank, and a gas-powered pump for at a groundwater well) Emergency response plan	1	3	Low	Overall Low risk, highly unlikely event, no further assessment
15.2	Loss or lack of fire water	Co / Op / De	Loss of firefighting capacity	Personnel training and orientation Occupational health and safety program Personal protection equipment Inspection and maintenance Fire safety plan and firefighting systems Emergency response plan	1	3	Low	Overall Low risk, highly unlikely event, no further assessment

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

EcoMetrix
Editorial changes made to make terminology consistent with the hazard risk analysis matrix.
@mention or reply

Hazardous Waste Management System - Summary – One potential scenario has been identified. Risks have been characterized as low as it concerns environmental risks. No scenarios are carried forward for quantitative assessment.

Table 3-16: Hazard Identification Evaluation – Hazardous Waste Management System

ID#	Accident / Malfunction	Phase	Consequence	Existing Safeguards / Design Features	L	S	RR / Significance	Screening Decision / Rationale
16.1	Hazardous waste spill	Co / Op / De	Potential for surface water and soil contamination	Personnel training and orientation Occupational health and safety program Personal protection equipment Inspection and maintenance Waste management plan Emergency response plan Onsite monitoring	2	2	Low	Overall lLow risk, ~~low~~ minor consequence event, no further assessment

Notes: "Co" is construction
"Op" is operations
"De" is Decommissioning
"L" is likelihood
"S" is severity
"RR" is risk ranking

EcoMetrix
Editorial changes made to make terminology consistent with the hazard risk analysis matrix.
@mention or reply

Attachment: IR-217

Number	IR-217
Dept.	CNSC
Project effects link	Accidents and Malfunctions
Reference to EIS, appendices, or supporting documentation	Sections 14.6.1 and 14.6.2
Context and Rationale	**Context:** Highway 914 crosses the Wheeler River 10 km southwest of the access road junction. A vehicle accident, including a rollover, collision, or run off road, at or near the bridge could potentially result in a release of uranium concentrate and release of fuels and chemicals into the surface water at this location. Denison believes that a release of uranium concentrate and a release of fuels and chemicals at this location would bound the releases at any other water crossing along the transportation corridor. However, no information on what other water crossings along the transportation corridor exist and how bounding scenarios 1 and 2 would bound the risk of releasing uranium concentrate and fuels and chemicals at other crossings. **Rationale:** The release of uranium concentrate and fuels and chemicals at water crossings would contaminate the water body at the crossings and pose a risk to the environment and public health.
Information Requirement	Please provide information on all water crossings along the transportation corridor and justification why bounding scenarios 1 and 2 would bound the effects of the accidental releases of uranium concentrate and fuels and chemicals at these crossings.

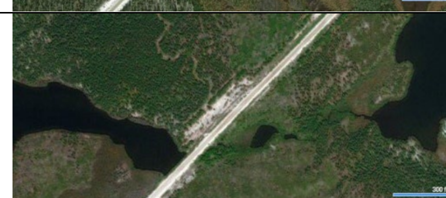
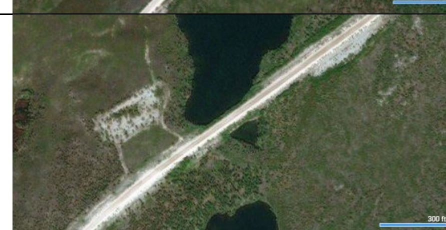
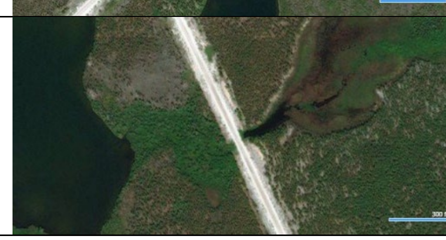
<u>Response:</u>

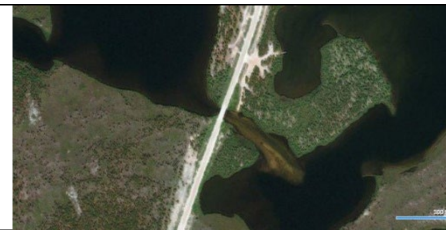
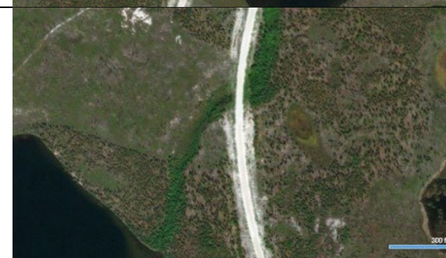
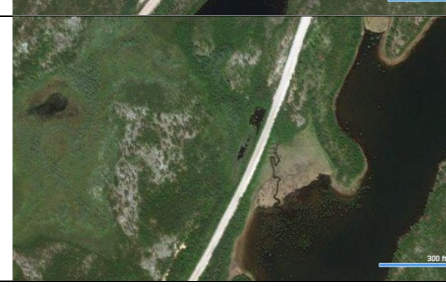
As recommended by the reviewer a review of water crossings associated with the transportation route have been identified. For reference, the analysis considers Hwy 914 south from the project site to its junction with Hwy 165. Hwy 165 was further considered east to Hwy 2 and west to Hwy 155. A total of 66 water crossings were identified as shown in Table IR-217-1, below. Coordinates (lat., long.; are provided for each of the crossings along with a basic description of each and a corresponding satellite image. For reference, in the table the designation “Highway 165W” means the location of the crossing is on Hwy 165 west of Hwy 914, beginning at the Hwy 165/155 and travelling east and the designation “Highway 165E” means the crossing is east of Hwy 914, travelling east toward Hwy 2. It is noted that most crossings are not identifiable by a specific name and are thus identified as “Unnamed creek”.

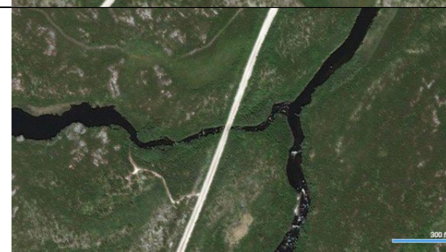
As noted by the reviewer, the potential aquatic environment release scenarios focused on the Wheeler River crossing location. This location was chosen as it represents an important location to resource users in the study area. The scenarios provide examples of the consequences of such releases to local receptors. That is, the results of the assessment of the releases at this location would be expected to be representative of crossings along the transport route since the key endpoint in the assessment is overall risk, as defined for the assessment process as probability multiplied by consequence. For reference, the crossing analysis reference above and presented in the technical memorandum has identified in excess of 100 water crossings along the transportation route as described. It is not practical to assess each of these crossings. While the specific conditions at these crossings may differ in size or nature, the results of the analysis presented can generally be applied more broadly as indicated above. The approach used is consistent with past practice for comparable assessments for uranium projects in the province.

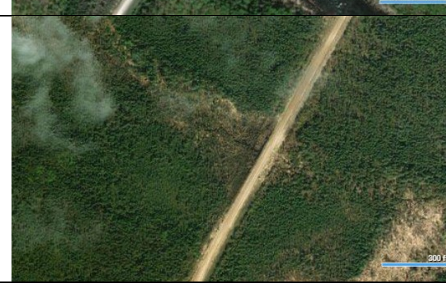
Table IR-217-1 – Water Crossings on the Wheeler River Project Transport Route

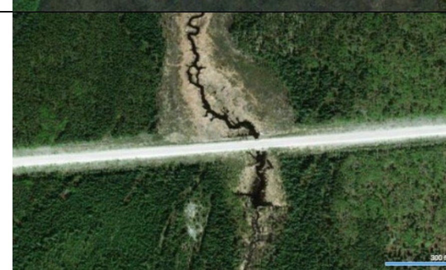
Crossing #	Hwy	Coordinates	Name	Feature	Feature Width (m)	Image
1	914	57.439217, -105.399002	Unnamed creek	Water crossing	10	
2	914	57.378448, -105.464859	Unnamed creek	Water crossing	<2	
3	914	57.354164, -105.485123	Russell Lake	Lake crossing	900	
4	914	57.285332, -105.570038	Unnamed creek	Water crossing	<2	

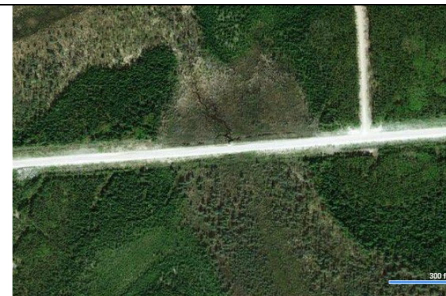
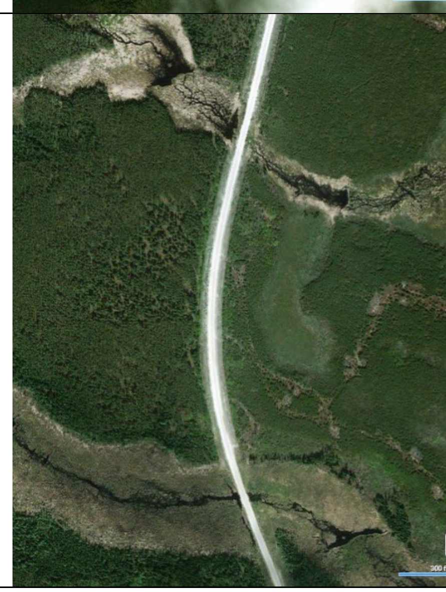
5	914	57.273514, -105.591202	Unnamed creek	Wetland complex	100	
6	914	57.220776, -105.685287	Unnamed creek	Water crossing	13	
7	914	57.053490, -105.983330	Unnamed creek	Wetland complex	35	
8	914	56.898136, -106.130302	Unnamed creek	Water crossing	50	
9	914	56.882645, -106.152107	Unnamed creek	Water crossing	60	
10	914	56.850391, -106.159187	Unnamed creek	Water crossing	10	

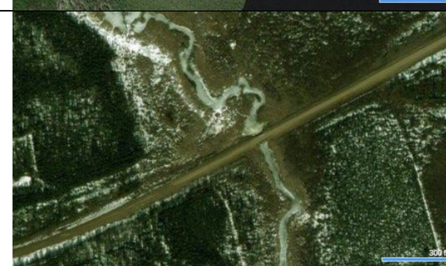
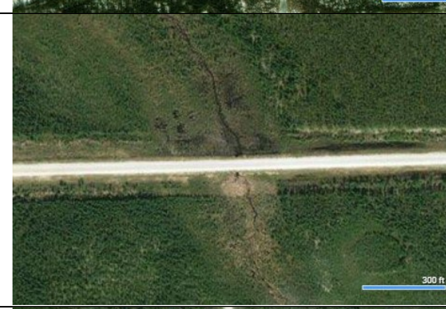
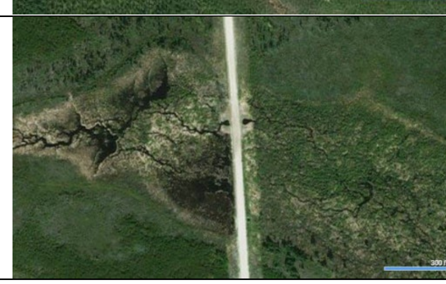
11	914	56.793152, -106.146248	Unnamed creek	Water crossing	15	
12	914	56.787197, -106.149460	Unnamed creek	Water crossing	<2	
13	914	56.722340, -106.165710	Unnamed creek	Water crossing	<2	
14	914	56.669765, -106.201149	Unnamed creek	Water crossing	10	
15	914	56.600300, -106.252251	Unnamed creek	Water crossing	<2	
16	914	56.572754, -106.281494	Unnamed creek	Water crossing	<2	

17	914	56.554306, -106.306236	Unnamed creek	Water crossing	<2	
18	914	56.539055, -106.330338	Unnamed creek	Water crossing	5	
19	914	56.444473, -106.401733	Unnamed creek	Water crossing	10	
20	914	56.388561, -106.512726	Unnamed creek	Water crossing	20	
21	914	56.353569, -106.565643	Unnamed creek	Water crossing	<2	
22	914	56.329689, -106.562004	Unnamed creek	Water crossing	10	

23	914	56.147633, -106.613579	Unnamed creek	Water crossing	35		
24	914	55.994797, -106.521835	Unnamed creek	Water crossing	10		
25	914	55.967976, -106.532318	Unnamed creek	Water crossing	30		
26	914	55.867905, -106.503120	Unnamed creek	Water crossing	<2		
27	914	55.733261, -106.565331	Churchill River	Water crossing	40		
28	914	55.660831, -106.585144	Unnamed creek	Water crossing	<2		

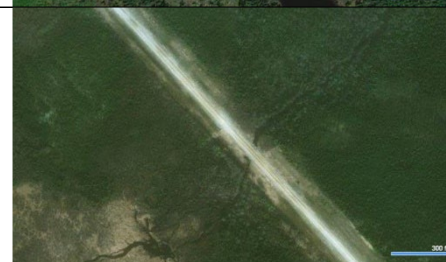
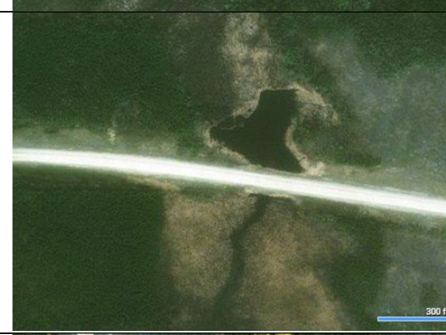
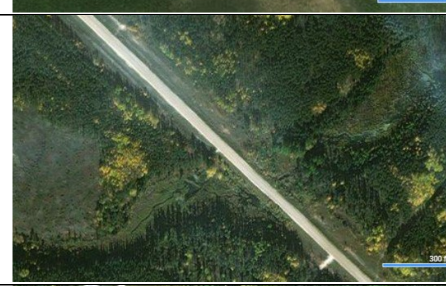
29	914	55.656418, -106.588326	Unnamed creek	Water crossing	<2	
30	914	55.568588, -106.603722	Unnamed creek	Water crossing	10	
31	914	55.494350, -106.646774	Unnamed creek	Water crossing	<2	
32	914	55.504215, -106.714218	Unnamed creek	Water crossing	7	
33	914	55.500674, -106.768551	Unnamed creek	Water crossing	5	
34	914	55.474350, -106.836800	Unnamed creek	Water crossing	20	

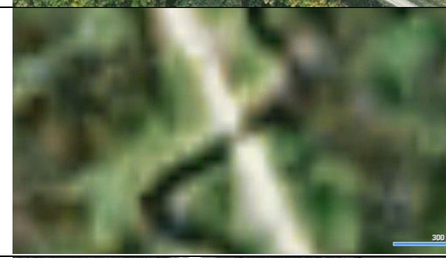
35	914	55.465046, -106.865280	Unnamed creek	Water crossing	<2	
36	914	55.434074, -106.842552	Unnamed creek	Water crossing	<2	
37	914	55.378868, -106.833595	Unnamed creek	Water crossing	10	
38	914	55.358044, -106.839149	Unnamed creek	Water crossing	<2	
39	914	55.282467, -106.815933	Unnamed creek	Water crossing (2x)	40	

40	165W	55.124847, -107.681786	Unnamed creek	Water crossing	15		
41	165W	55.153086, -107.597933	Beaver River	Crossing complex	750		
42	165W	55.219022, -107.403364	Unnamed creek	Water crossing (minor)	3		
43	165W	55.222092, -107.214650	Unnamed creek	Water crossing	18		
44	165W	55.240179, -106.869717	Unnamed creek	Water crossing (minor)	3		
45	165E	55.229849, -106.789293	Unnamed creek	Wetland complex	100		

46	165E	55.210766, -106.789518	Unnamed creek	Water crossing	6	
47	165E	55.190045, -106.755394	Unnamed creek	Water crossing (one side ponded)	60	
48	165E	55.178462, -106.686886	Unnamed creek	Crossing complex	13	
49	165E	55.164998, -106.635760	Unnamed creek	Water crossing (one side ponded)	25	
50	165E	55.147328, -106.569588	Unnamed creek	Water crossing (minor)	5	
51	165E	55.145846, -106.480813	Unnamed creek	Water crossing	10	

52	165E	55.148323, -106.465283	Unnamed creek	Water crossing (minor)	3	
53	165E	55.155644, -106.419692	Unnamed creek	Water crossing (minor)	3	
54	165E	55.160151, -106.391546	Unnamed creek	Wetland complex	25	
55	165E	55.156452, -106.340823	Unnamed creek	Water crossing	10	
56	165E	55.159666, -106.317084	Unnamed creek	Water crossing	5	
57	165E	55.166328, -106.259241	Unnamed creek	Water crossing (minor)	2	

58	165E	55.163412, -106.206745	Smoothstone River	Water crossing (major)	50	
59	165E	55.122788, -106.016421	Unnamed creek	Water crossing (minor)	5	
60	165E	55.103940, -105.963149	Unnamed creek	Water crossing (minor)	3	
61	165E	55.104002, -105.949567	Unnamed creek	Water crossing (ponded)	70	
62	165E	55.076830, -105.859303	Unnamed creek	Water crossing (minor)	3	
63	165E	55.059849, -105.821333	Unnamed creek	Water crossing (minor)	5	

64	165E	55.056275, -105.810201	Unnamed creek	Water crossing (minor)	3	
65	165E	54.884914, -105.748054	Montreal River	Water crossing (major)	20	
66	165E	54.811663, -105.671518	Unnamed creek	Water crossing (ponded)	38	

Attachment: IR-218

Number	IR-218
Dept.	CNSC
Project effects link	Accidents and Malfunctions
Reference to EIS, appendices, or supporting documentation	Sections 14.6.1.1 and 14.6.1.4
Context and Rationale	**Context:** Table 14.6-1 indicates that the average flow of Wheeler River south of Russel Lake is 17,340 L/s or 17.34 m3/s. This rate is used for uranium dissolution rate calculation. However, in section 14.6.1.4, it states that the average annual flow is 24.3 m3/s. In Table 14.6-3, the last two rows appear to be added wrongly. It also states that sediment quality results are shown in Table 14.6-5 for post-remediation conditions. During minimum flow conditions, the affected volume is expected to be smaller, resulting in a higher sediment concentration. In comparison, higher flow conditions are expected to result in a greater footprint and lower concentrations. However, in Table 14.6-5, the average sediments concentration and porewater concentration appear to be incorrect and switched between average flow and maximum flow. **Rationale:** Inconsistent/inaccurate information provided in the EIS.
Information Requirement	Please clarify and correct the inconsistent information on average flow rate of Wheeler River at the crossing and incorrect information in Table 14.6-3, and average sediment concentration and porewater concentration under average and maximum flow conditions in Table 14.6-5.

<u>Updated EIS tables to support response:</u>

Table 14.6-5 to be revised as shown below:

Flow	Affected Distance (m)	Average Sediment Concentration (µg/g)	Porewater Concentration (µg/L)
Minimum	21	3,461	12
Average	33	3,309~~2,535~~	12~~9~~
Maximum	47	2,535~~3,309~~	9~~12~~

Table 8-5 to be revised as shown below:

Flow	Affected Distance (m)	Average Sediment Concentration (µg/g)	Porewater Concentration (µg/L)
Minimum	21	3,461	12
Average	33	3,309~~2,535~~	12~~9~~
Maximum	47	2,535~~3,309~~	9~~12~~

Attachment: IR-236

Number	IR-236
Dept.	ECCC
Project effects link	Fish and fish habitat
Reference to EIS, appendices, or supporting documentation	Section 15.5.2, Expected Environmental Conditions
Context and Rationale	Context: It is stated that, "Table 15.5-1 and Table 15.5-2 summarize the predicted mean values of the climate variables for the Tomblin Lake regional grid unit…" As per the Proponent's description, Tomblin Lake was chosen as representative location for Wheeler when Climate Atlas was used as data source. Rationale: In those two tables, for the "Max 1-Day Precipitation (mm)" the historical average is given as 24.1mm. Local time series analysis for the climatic region in which Wheeler Project is located provide averages (for 1-day max precipitation) of approximately 30+ mm. It is the Proponent's responsibility to keep the required database current and up to date, because the length of the time series influences all derived statistics. Statistical analysis of extreme events is highly dependent of the mean with extreme values reaching values 3 to 4 times higher than the mean.
Information Requirement	1. Provide a clear explanation on how the historical mean for 1-Day Max Precipitation was calculated. 2. Compare the values obtained via various means (ex: copied from the internet, modeled via some online algorithm, derived from specialty literature), against time series analysis based on observations. Technical Discussion Required: Yes

<u>Response:</u>

During the EIS review by the FIRT, there were information requirements (IRs; mainly IR-235 and IR-236, and to a lesser extent IR-103 and IR-104) related to current and future climate precipitation, as well as the probable maximum precipitation. The information in Attachment IR-236 will be added as *Appendix D Summary of Precipitation Values Presented in the EIS* to Appendix 6-C in the final EIS. The Project design and site drainage plan are more closely linked to detailed design to support the licensing process and the precipitation information provided in the draft EIS to support an EA decision is adequate. This new appendix to Appendix 6-C serves to provide clarifications only.

The probable maximum precipitation (PMP) event used for feasibility engineering designs is 493 mm. The PMP value has been extrapolated from Key Lake data presented in the Canadian Climate Program

(1994). Denison reviewed the update to the Canadian Climate Program (1994) report provided in Atmospheric Environment Branch (1999) which shows PMP at the approximate Wheeler River Project location at 489.3 mm. Denison retained the higher of the two PMP values, i.e., 493 mm, for design purposes. As an example, during a PMP, water requiring management will report to the wellfield runoff pond which will be sized to accommodate a PMP event at the site. This pond has been sized to 38,200 m^3 (*excluding a freeboard of 1 meter*). From the wellfield runoff pond, water will then be sent to the process water pond for treatment if required. In EIS Section 2.8 Project Design Features, Denison notes that “Ponds will be designed to maintain a minimum freeboard of at least 1.0 m to allow for continued functioning during a probable maximum precipitation (PMP) event.”

Tables 1 to 4 below provide a summary of precipitation information for both current / existing climate and future climate under different emissions scenarios, in order to 1) summarize precipitation data from various sections of the EIS (Section 6 including Appendix 6-C, Section 8, and Section 15) and 2) provide context on the PMP of 493 mm in comparison to precipitation values (annual precipitation, maximum 1-day precipitation, and 1:100 year, 24 hour return).

Table 1: Precipitation - Existing Climate – Comparisons of Observed Annual Average Precipitation and Maximum 24-hour Precipitation to PMP

Precipitation-related metric	Value	Notes on Source of Data	Location in EIS and comment on how this information was used in the EIS	Commentary on metric compared to PMP (493 mm)
Annual average precipitation	456 mm	Recorded from Key Lake in the period from 2011-2020, ECCC station 4063753 Available at: climate.weather.gc.ca	Presented in 6.1.3.1.2 Precipitation and Appendix 6-C. Provides point of comparison for selected Project PMP.	***PMP is similar to annual precipitation***
Annual average precipitation	483 mm	Canadian Climate Normals 1981-2010 Station Data, Key Lake, Saskatchewan. Available at: climate.weather.gc.ca	Presented in 6.1.3.1.2 Precipitation and Appendix 6-C. Provides point of comparison for selected Project PMP.	***PMP is similar to annual precipitation***
Maximum 24-hour precipitation	45.9 mm	Occurred on August 8, 2020. Recorded from Key Lake in the period from 2011-2020, ECCC station 4063753 Available at: climate.weather.gc.ca	Presented in 6.1.3.1.2 Precipitation and Appendix 6-C. Provides point of comparison for selected Project PMP.	***24-hr event is 10.7 x lower than PMP***
Maximum 24-hour precipitation	72 mm	Occurred July 12, 1998. Canadian Climate Normals 1981-2010 Station Data, Key Lake, Saskatchewan. Available at: climate.weather.gc.ca	Presented in 6.1.3.1.2 Precipitation and Appendix 6-C. Provides point of comparison for selected Project PMP.	***24-hr event is 6.8 x lower than PMP***

Precipitation-related metric	Value	Notes on Source of Data	Location in EIS and comment on how this information was used in the EIS	Commentary on metric compared to PMP (493 mm)
1 in 100 year, 24 hour return	79.9 mm	Calculated using IDF_CC Tool for the Wheeler River Project. Available at: www.idf-cc-uwo.ca	8.1.3.4 Climate Change Influenced Extreme Events and Appendix 8-B. Provides point of comparison for water management design and understanding rainfall associated with 1:100-year storms.	***1:100 is 6.2 x lower than PMP***
1 in 100 year, 24 hour return	56.4 mm	Return Period Estimate based on data from the Key Lake Mine using the IDF_CC Tool (~32 km away from Wheeler River Project). Available at: www.idf-cc-uwo.ca	8.1.3.4 Climate Change Influenced Extreme Events and Appendix 8-B. Provides point of comparison for water management design and understanding rainfall associated with 1:100-year storms.	***1:100 is 8.7 x lower than PMP***

Table 2: Precipitation – Future Climate - Existing and Predicted Precipitation Data for Key Lake (provided in EIS, Appendix 6-C, Table 10)

Year	**Total Annual (mm)**				**Maximum 1-day (mm)**			
	Measured	RCP 2.6	RCP 4.5	RCP 8.5	Measured	RCP 2.6	RCP 4.5	RCP 8.5
2011-2020	455	518	509	508	48	29	27	27
2030		528	503	537		27	24	26
2040		487	498	514		28	29	24
2050		504	524	520		26	29	33
2060		513	515	523		26	33	26
2070		527	534	568		29	31	28
2080		539	551	547		30	33	28
2090		543	545	548		31	32	35
2100		546	535	559		23	25	28
Overall Increase:		28	26	51		-6	-2	1

Table 3: Precipitation – Future Climate - Historical and Future Precipitation Data (Total Annual and Maximum 1-day) for Tomblin Lake, Climate Atlas (provided in EIS, Section 15, Table 15.5-1 and 15.5-2)

Period	**Total Annual (mm)**			**Maximum 1-day (mm)**		
	Historical	RCP 4.5	RCP 8.5	Measured	RCP 4.5	RCP 8.5
Historical mean (1976-2005)	456			24.1		
Near Term (2021-2050)		484	487		25.9	25.9
Far Term (2051-2080)		500	509		26.7	27.5

Table 4: Precipitation – Future Climate - Predicted Precipitation (1:100 year, 24-hour return) for Key Lake and Wheeler River Project, 2020 to 2050 using IDF_CC Tool (provided in EIS Section 8)

Location	**1:100 year, 24-hour return**
Key Lake Mine	62.0
Wheeler River Project	88.6

References:

Canadian Climate Program. 1994. Point Probable Maximum Precipitation in Northern Saskatchewan. R.F. Hopkinson Scientific Services Regina Operations Building, Regina Airport. Regina, Saskatchewan. Report No. CSS – R94 – 01.

Atmospheric Environment Branch. 1999. Environment Canada Prairie and Northern Region – Point Probable Maximum Precipitation for the Prairie Provinces. Atmospheric Environment Branch, Atmospheric and Hydrologic Sciences Division. Regina, Saskatchewan. Report No. AHSD – R99 – 01.

Attachment: IR-237

Number	IR-237
Dept.	CNSC
Project effects link	EA follow-up and monitoring program
Reference to EIS, appendices, or supporting documentation	Appendix 16-C throughout, including Table 1.5-1: Wheeler River Monitoring and Follow-up Program Summary (p. 8-15)

Context and Rationale	**Context:** CNSC's Generic Guidelines for the Preparation of an EIS state: "The EIS should provide discussion on the follow-up program's requirements, and include:
	• objectives and structure of the follow-up program and the VCs targeted by the program
	• tabular summary and explanatory text of the main components of the program including:
	  ○ a description of each monitoring activity under that component
	  ○ which of the two generic program objectives the activity is relevant to (e.g., verify EA predictions, determine effectiveness of mitigation measures)
	  ○ the specific statement from the EA that goes along with that generic objective and will be the focus for that activity (e.g., program objective: verify predicted effects; environmental assessment effect: no potential adverse effects)
	  ○ the specific monitoring objective for that activity
	  ○ planned schedule
	• roles and responsibilities to be played by the proponent, regulatory agencies, Indigenous people, local and regional organizations and others in the design, implementation and evaluation of the program results
	• possible involvement of independent researchers
	• program funding sources
	• information management and reporting (reporting frequency, methods and format)
	• possible opportunities for the proponent to include the participation of the public and Indigenous groups, during the development and implementation of the program
	
	The follow-up program plan should be sufficiently described in the EIS to allow independent judgment as to the likelihood that it will deliver the type, quantity and quality of information required to reliably verify predicted effects (or absence of them) and confirm the effectiveness of mitigation measures." (Section 11)
	
	Rationale: The Summary of Monitoring and Follow-up Programs provided in Appendix 16-C contains very high-level information, and while some of the aspects detailed in the Generic EIS Guidelines are included, the aspects underlined are missing or appear incomplete.
	
	Further, all information from throughout the EIS should be incorporated into this Summary. For example, the EIS notes that: "Groundwater samples will be collected at least monthly and semi-annually in the wells within the freeze wall and on the freeze wall perimeter, respectively" (p. 7-109) and that "At least five to seven multi-well clusters are proposed across the mined area (Figure 7.8-2). Sampling will include KI parameters or the full suite of COPC at different times in the remediation process" (p. 7-111).
	
	These details (only examples) are not included in Appendix 16-C.

Information Requirement	It is recognized that this document will evolve over the planning process and be finalized prior to the EA Decision; however, as plans are developed and revised, CNSC staff expect that updates will be made to this document and provided with any future versions of the EIS. Appendix 16-C Summary of Monitoring and Follow-up Programs must include sufficient details to allow CNSC staff to determine the likelihood that it will deliver the type, quantity and quality of information required to reliably verify predicted effects (or absence of them) and confirm the effectiveness of mitigation measures. This includes concrete monitoring plans (sampling locations, frequency, etc.). Additionally, please incorporate any relevant information included in the EIS into this Summary.

Response:

Denison concurs that follow-up program documentation will evolve over the planning process and is committed to providing complete and up to date documentation as the EIS is finalized and prior to the EA Decision. Per the March 20, 2023 letter from the CNSC to Denison (Subject: Results of the Federal-Indigenous Review Team technical review of the October 21st, 2022 Draft Environmental Impact Statement Submission for the proposed Wheeler River Project), the company will be providing, as part of the final EIS documentation, a Commitments Report in order to capture all the mitigation measures, follow-up program measures and commitments that have been referenced in the EA documentation in a single location for completeness and traceability. The Commitments Report will be scoped so that it also fulfils the obligations of the commitments registry required by the Saskatchewan Ministry of Environment.

Notwithstanding the above, Denison believes that section 16-C, Summary of Monitoring and Follow-up Programs, in the draft EIS generally meets the requirements outlined in the EIS guidelines but agrees that some additional information can be provided to clarify select aspects. Specific notes per the EIS Guidelines are provided below to provide context the remainder of the response. For reference text in *italics* is taken from the EIS Guidelines; whereas text in **bold** is commentary provide by Denison. Additionally, bold text that is **underlined** indicates where Denison commits to revising or adding information into the EIS.

The EIS shall include a framework or preliminary program upon which EA follow-up actions will be managed throughout the life of the project. **Note from Denison – Table 1-5.1 in Appendix 16-C identifies a framework or preliminary program upon which EA follow-up actions will be managed, as well as all phases of the Project in which the proposed individual follow up programs will be executed.**

The EIS should provide discussion on the follow-up program's requirements, and include:

- *objectives and structure of the follow-up program and the VCs targeted by the program* - **Note from Denison - Table 1-5.1 in Appendix 16-C identifies the objectives of the proposed individual follow up programs, provides an overall program structure and identifies the VCs targeted by the program.**
- *tabular summary and explanatory text of the main components of the program including:*
  - *a description of each monitoring activity under that component* - **Note from Denison - Table 1-5.1 in Appendix 16-C identifies each proposed monitoring activity for the various technical disciplines within which the environment assessment has been organized.**
  - *which of the two generic program objectives the activity is relevant to (e.g., verify EA predictions, determine effectiveness of mitigation measures)* - **Note from**

Denison - Table 1-5.1 in Appendix 16-C generally identifies whether the proposed follow up activities are related to verifying EA predictions and/or determine effectiveness of mitigation measures (see column "Monitoring Program Objective(s)"; however, it is agreed that further clarity can be provided in this regard. <u>In the updated version of Table 1-5.1 a further column will be added to indicate specifically whether the proposed follow up activities are related to verifying EA predictions and/or determine effectiveness of mitigation measures with rational.</u>

- o *the specific statement from the EA that goes along with that generic objective and will be the focus for that activity (e.g., program objective: verify predicted effects; environmental assessment effect: no potential adverse effects) –* **Note from Denison - Table 1-5.1 in Appendix 16-C identifies the relevant section of the EIS to which each proposed follow up activity refers. however, it is agreed that further clarity can be provided in this regard. <u>In the updated version of Table 1-5.1 a further, more specific reference to the section / subsection / statement (as appropriate) will be added to the "EIS Reference" column for greater traceability between the assessment section of the EIS for each of the technical disciplines and the proposed follow activities.</u>**
- o *the specific monitoring objective for that activity-* **Note from Denison - Table 1-5.1 in Appendix 16-C identifies the objectives of the proposed individual follow up programs.**
- o *planned schedule -* **Note from Denison -Table 1-5.1 in Appendix 16-C identifies the phases of the Project in which the proposed individual follow up programs will be executed. It is premature in Denison's view to develop specific "schedule" associated with all follow-up activities that are proposed. As noted in draft EIS Section 1.7.5, Licensing and Permitting, as well as in other responses to FIRT IRs, the Project is proceeding through sequential EA and licensing process. Given the sequential process to which Denison has committed it is planned that further detail will be developed to align with detailed engineering design through licensing and permitting and that this information will be available for review at that time. Denison understands that the Project cannot move forward until the appropriate Program / Plan / Procedure documentation is in place and has received approval through the regulatory process.**

· *roles and responsibilities to be played by the proponent, regulatory agencies, Indigenous people, local and regional organizations and others in the design, implementation and evaluation of the program results -* **Note from Denison – At this time and commensurate with the level of detail (i.e. concept) at which the follow up activities have been defined the proponent assumes responsibility for execution of all proposed activities. This may change as the program details are developed, and Denison presumes this is likely as it continues to work with the key Indigenous groups. It is noted however that provisions for follow up activities and monitoring are expected to be included in agreements developed between Denison and its key Indigenous partners and therefore it is inappropriate (and may remain so) that specific details regarding follow up activities be shared without the expressed consent of the agreement signatories. Regulatory agencies at the provincial and federal levels are expected to largely play a review/approval role consistent with their responsibilities under various laws/acts/licenses/permits under which the Project, and follow up activities, will be executed. At this time there are no specific plans with local and regional organizations as it pertains to the design, implementation and evaluation of the program results; but this may change in the future. <u>Per the above, Denison will add additional detail into Table 1-5.1 in Appendix 16-C with respect to roles and responsibilities consistent with the information provided in this IR response. As noted full disclosure of such information may not be possible as it would be</u>**

subject to non-disclosure covenants between Denison and its key Indigenous partners; nevertheless more specific information will be provided as is available.

- *possible involvement of independent researchers* – **Note from Denison – Involvement of independent researchers in follow up activities has not been identified at this time, nor has need for such been specifically flagged. This does not preclude possible involvement of independent researchers in the future; however, need for such has not been specifically flagged. As noted above, provisions for follow up activities and monitoring are expected to be included in agreements developed between Denison and its key Indigenous partners, and such follow up activities and monitoring could include independent research. The sharing of information related to this type of independent research can and would only be shared with the expressed consent of the agreement signatories. Per the above, Denison will add narrative to the text of Appendix 16-C clarifying the role of independent research that is consistent with the understanding of such at the time the final EIS is published.**
- *program funding sources* – **Note from Denison – As noted above, the proponent assumes responsibility for execution of all proposed follow up activities that have ben identified and therefore the funding of such. Also as noted above, provisions for follow up activities and monitoring that may be included in agreements developed between Denison and its key Indigenous partners will be subject to non-disclosure covenants in those agreements. This would include information concerning any funding that may be associated with these programs. It would inappropriate (and may remain so) that specific details regarding any funding that may be provided for follow up activities be shared without the expressed consent of the agreement signatories.**

- *information management and reporting (reporting frequency, methods and format)* – **Note from Denison – A framework for information management and reporting is provided in Section 1.2 of Appendix 16-C. As described in Section 1.2 of Appendix 16-C specific information management and reporting structures associated with follow up activities are proposed to be developed as part of the development of the Project Environmental Management System (EMS). The Project EMS will be developed during licensing and permitting and that this information, including more detailed information regarding information management and reporting (e.g., reporting frequency, methods and format) will be available for review at that time. Denison understands that the Project cannot move forward until the appropriate Program / Plan / Procedure documentation is in place and has received approval through the regulatory process.**

- *possible opportunities for the proponent to include the participation of the public and Indigenous groups, during the development and implementation of the program* – **Note from Denison – As noted above, Denison is committed to continuing the ongoing process of identifying opportunities the participation of the public and Indigenous groups as follow up activity programs evolve. There is nothing specific to share at this time but it is expected that further clarity in this respect with be provided in the near to medium terms. It is also understood that any information that can be shared only represents a snapshot in time. Since follow up activities will span the full lifecycle of the Project identification of potential opportunities for involvement is an ongoing process that will also span the full lifecycle of the Project.**

Denison anticipates that the lengthy and evolving EIS review process, and consideration of the public comments received by Denison on June 27th, 2023, will bring forward additional mitigation and follow up activities. Denison will update Section 16-C, Summary of Monitoring and Follow-up Programs, per the commentary provided in response to IR-237 and will also include changes resulting from the FIRT review process and the Saskatchewan Ministry of Environment review process. This section will align with the Project's Commitment Report which will be provided as part of the final EIS documentation.

Responses to Advice to Proponent

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent	Denison Response
AD-01	Canadian Nuclear Safety Commission (CNSC)	Glossary sections	There are terms used throughout the EIS that may either need defining, or inclusion in the glossary. · "Bounding", "bounding case" and "bound" are used frequently throughout the EIS to describe the scope of the assessment. For example, p. 2-6 the EIS States: "Denison has bound the environmental assessment above the deposit…" · "Laydown". P. 2-54 states: "During Construction, Denison plans to create a laydown area next to the future domestic landfill to temporarily store construction waste. Examples of materials include clean wood, plastics, metal, and concrete. The construction laydown area will not be lined, but it will have a berm surrounding the area to minimize run-on and runoff." · "Deflagration" (p. 2-22) · "Speed of sound" The EIS states: "Deflagration means the material burns slower than the speed of sound, thus no shock waves are generated. Propellant permeability enhancement methods reach injection pressures of up to 8,000 psi and are near instantaneous over periods of milli seconds…" (p. 2-22) - Explain briefly what is meant by "speed of sound" · "Dries" (p. 2-65): "the main dries will be located in the processing plant" · "Scarified" 2-84 Laydown areas will be scarified, covered with 0.5 to 1.0 m of stockpiled overburden, and vegetated with native, self-sustaining species. · "Furblock" (p. 4-29) · "Cutlines" (p. 4-101)	Add this terminology to either one of the early glossaries, or when describing the methodology, in order to help readers understand these terms (particularly non-technical readers, such as Indigenous peoples and members of the public).	Thank you for the advice comment. This will be addressed once the EIS is updated following the conclusion of the information requirement (IR) process.
AD-02	CNSC	General	Mining solution and lixiviant are used interchangeably throughout the EIS. When both are used periodically, may be difficult for a member of the public to recognize that these are one in the same (mining fluid seems more often used).	Be consistent in how this is referred to, in order to ensure it's clear to readers that these are one and the same.	Thank you for the advice comment. This will be addressed once the EIS is updated following the conclusion of the information requirement (IR) process.
AD-03	CNSC	Throughout the Executive Summary (ES) and draft EIS	Errors in formatting and grammar were identified throughout ES and EIS. Some examples are underlined below:	Please correct these and any other formatting, spelling or grammatical errors.	Thank you for the advice comment. This will be addressed once the EIS is updated following the conclusion of the information requirement (IR) process.
AD-04	CNSC	Section 2.2.1 Mining (p. 2-4 to 2-5)	An arial view could be useful to help a reader understand the proposed freeze wall earlier in section 2 (e.g., The shape, whether it surrounds the deposit). This is unclear but there are good images further down in the EIS (i.e., Figure 2.3-1 on p. 2-78).	Consider adding image to Section 2.2.1, similar to or containing aspects of Figure 2.3-1.	Thank you for the advice comment. This will be addressed once the EIS is updated following the conclusion of the information requirement (IR) process.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent	Denison Response
AD-05	Transport Canada (TC)	Sections 2.2.3.2, 2.2.3.10, 2.2.5.1, 2.3.1.6, 8.3.4.2.2, 11.1.4.4.2,	The two water crossings over Kratchkowsky Creek and Hart Creek and the water intake and effluent discharge/intake pipeline and diffuser at Whitefish Lake may be subject to the *Canadian Navigable Waters Act* (CNWA). However, these works may be exempt from the CNWA, if they meet the requirements of the Minor Works Order.	*This advice pertains to the regulatory phase.* It is recommended that the Proponent self-assess each work using TC's Project Review Tool as follows: https://npp-submissions-demandes-ppn.tc.canada.ca/projectreview-outildexamenduprojet If the works do not fit the Minor Works Order, the Proponent has the option to either submit an application for approval to the NPP, or use the public resolution process, as these are all unscheduled waterways. The full text of the Minor Works Order is available here: https://laws-lois.justice.gc.ca/eng/regulations/SOR-2021-170/page-1.html. Background information on the NPP, the Minor Works Order, the application for approval process and the public resolution process are available here: https://tc.canada.ca/en/programs/navigation-protection-program/apply-npp	Acknowledged and Denison will address this in the regulatory phase as highlighted.
AD-06	Environment and Climate Change Canada (ECCC)	Section 2.2.3.8, Project Description	In this section it is stated that: "The third step of the Industrial Wastewater Treatment Plant (IWWTP) is anticipated to further neutralize and improve the remaining water quality proposed to be achieved with further pH adjustments through agitated tanks and a clarifier with negligible solids generation expected at this stage. Several additional technologies including ion exchange are being evaluated as part of an ongoing Best Available Technology Study to be complete as part of future permitting." ECCC would be interested in reviewing this study when it becomes available. Considering that the third step of the effluent treatment process in the IWWTP is still undergoing development, ECCC cannot make final conclusions regarding the efficacy of the treatment process. When final treatment technologies have been evaluated and selected, ECCC would like to review this information to allow for release to the environment.	ECCC requests the opportunity to review the Best Available Technology Study and selected treatment technologies for the IWWTP when the report becomes available.	The BATEA information for the IWWTP will be included in Denison's application to the CNSC for a license to operate. As such, ECCC can direct their review request for review to the CNSC.
AD-07	TC	Section 2.2.5.3	With respect to the proposed airstrip, under the *Aeronautics Act*, the proposed airstrip would be considered an "aerodrome", which is defined as: "aerodrome means any area of land, water (including the frozen surface thereof) or other supporting surface used, designed, prepared, equipped or set apart for use either in whole or in part for the arrival, departure, movement or servicing of aircraft and includes any buildings, installations and equipment situated thereon or associated therewith." Aerodromes, including the one proposed by Denison, are subject to the *Aeronautics Act* and the Canadian Aviation Regulations (CARs).	*This advice pertains to the regulatory phase.* The proponent must notify the Minister of Transport of the proposed airstrip (aerodrome). This notification, being a summary report to the Minister of Transport, is required by section 307 of the CARs (CARs 307). CARs 307 also requires Denison to undertake consultation in the prescribed manner before it constructs the proposed aerodrome at the mine site. Details of the consultation are to be included in the above-mentioned summary report to the Minister of Transport. CARs 307 identifies the requirement to consult to include anyone seeking to undertake a prescribed aerodrome work at a certified or non-certified aerodrome, whether it is the creation of a new aerodrome or, at an existing aerodrome, lengthening an existing runway or making a	Acknowledged and Denison will address this in the regulatory phase as highlighted.

Ref. #	**Department**	**Reference to EIS, appendices, or supporting documentation [1]**	**Context and Rationale**	**Advice to the Proponent**	**Denison Response**
				new one. The Regulation also provides minimum expectations for how the consultation should be conducted, including timelines, who to notify and under what circumstances. The intent of the Regulation is to compel consultation in advance of an aerodrome work that will result in sustained and regular impact on interested parties as identified in the Regulation. As the proposed aerodrome will not be within 4 kilometres of a city or built-up area, under CARs 307, the proponent is required to consult the following interested parties: (i) the Minister of Transport, (ii) the providers of air navigation services, (iii) the operator of a certified or registered aerodrome located within a radius of 30 nautical miles from the location of the proposed aerodrome work, (iv) the authority responsible for a protected area located within a radius of 4 000 m from the location of the proposed aerodrome work, (v) any local land use authority where the proposed aerodrome work is to be carried out, and (vi) the owner of any land bordering the land on which the proposed aerodrome work is to be carried out. Proponents are encouraged to share their plans with the local land use authority before the consultation period. The local land use authority may have information about other nearby projects or developments that could impact on the proponent's plans. In summary, regarding the airstrip (aerodrome), the proponent must complete the consultation and file the summary report with the Minister of Transport, prior to commencing construction of the aerodrome. Further details can be found at: https://laws-lois.justice.gc.ca/eng/regulations/SOR-96-433/FullText.html#s-307.01. TC recommends that the proponent contact TC's Aerodromes Group at CASPNR- SACRPN@tc.gc.ca before starting the consultation, to ensure it is completed in accordance with CARs 307.	
AD-08	CNSC	Figs. 3.4-1, 4.3. 1, and where applicable throughout the EIS	Some maps in the EIS do not contain highway numbers.	Please consider including the highway numbers on the maps early in the Draft EIS when laying out the project location so the reader can become familiar with road network within northern Saskatchewan when discussions take place.	Thank you for the advice comment. This will be addressed once the EIS is updated following the conclusion of the information requirement (IR) process.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent	Denison Response
AD-09	CNSC	Section 4, including Figures 4.3.1 and/or 4.3.2 and where applicable throughout the EIS.	The maps included in the EIS in sections do not have any Treaty boundaries. First Nation Treaties should be included on the map. Not all First Nations reserves, and boundaries are included on the map such as Cree Lake and Slush Lake, please include on map and consider adding others from the NAD.	It is recommended that Denison update the maps in these sections to include Treaty Boundaries and community locations are included on the Project location map in Figure 4.3.2 and other maps throughout the entire EIS where applicable.	Thank you for the advice comment. This will be addressed, as possible, once the EIS is updated following the conclusion of the information requirement (IR) process.
AD-10	CNSC	Section 4	Overall, CNSC believes that Denison is abiding by the communications strategies and products identified in their PIDP, but would be interested in additional information that is available.	While CNSC staff are satisfied that the proponent meets the requirements with this EIS, further clarity and detail on the strategic planning behind these communications activities would be beneficial and would further support the overall goals of the Project's engagement activities.	Acknowledged. Further details on the Public Information Program and Public Disclosure will form part of the documentation submitted in support of the CNSC licensing for the Project.
AD-11	CNSC	Section 4 Indigenous Engagement Report (IER)	There is a summary of what engagement activities will occur moving forward. However, it is not clear which engagement activities/meetings will occur during the different stages of the EA/ project life cycle. Please provide additional details upon submission of the Final EIS.	Denison should consider clarifying in the updated IER which engagement activities will occur during each stage of the project moving forward as per Reg Doc 3.2.2 before submitting the Final EIS.	The engagement activities as outlined in the draft EIS are reflective of the iterative nature of engagement with respect to the Project. At the time of the filing of the final EIS, Denison will describe the status of engagement and future expected engagement activities to occur, which will continue to be aligned with the requirements of Reg Doc 3.2.2.
AD-12	CNSC	Section 4 IER	Information included in the EIS Section 4 and IER regarding engagement activities, communication and issues and concerns raised will need to be updated when the next version of the EIS is submitted. The EIS and IER will need to be updated to include information from Fall of 2022 until approximately two months prior to the submission date of the next EIS.	When re-submitting the EIS, ensure that the engagement log, issues and concerns tables and information about engagement activities done to date have been updated. No action needed only advice to update this section before submission with most up to date engagement activities including any that take place with other Indigenous Nations and communities not included in the Draft EIS.	Acknowledged.
AD-13	CNSC	Section 4 IER	Denison states that validation of VC selection was completed with ERFN, the Northern Village of Beauval, the Northern Village of Pinehouse Lake, and the Northern Hamlet of Patuanak (hereafter Beauval, Pinehouse, and Hamlet of Patuanak, respectively). The EIS states that this was completed through a shared online survey. The EIS also indicates that YNLR was also included in this process.	How has Denison validated VC selection with the other Indigenous Nations and communities that have showed interest and if so, by what methods (survey's, engagement, meetings, review of Draft sections etc.?) Did Indigenous Nations and communities select any VC's that were not included in the EIS and if so why not? Please elaborate and provide more details in the EIS on any other methods used including engagement sessions that were completed with Indigenous Nations and communities, through in-person community workshops, VC selection approval through early review of Draft EIS sections.	Section 4 of the draft EIS describes the approach taken related to the Indigenous and non-Indigenous Communities of Interest in relation to the Wheeler River Project. Denison has engaged with these entities regarding the validation of the VC selection. Denison has not undertaken VC validation activities with other Indigenous Nations or communities that have shown interest in the Project, owing to the systematic approach to engagement Denison has been following. This approach is consistent with the methodology presented to the CNSC by Denison in early 2020, for which confirmation was received in mid-2020 and reflected in the draft EIS. All activities undertaken in relation to engagement on VCs are currently described in the EIS; there are no additional details to add. Denison can confirm that it is unaware of additional or new VCs brought forward by other Indigenous Nations or communities that are not suitably captured within the current draft EA approach.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent	Denison Response
AD-14	CNSC	Section 4.3.1, Pg 246	On this page, Denison states that MN-S is "currently structured with a President, an Executive, a Provincial Metis Council, Regional Presidents, and Local Presidents. The wording of 'Regional President' is incorrect and should be changed to say, 'Regional Director'.	Please update all wording of "Regional President" to "Regional Director" when referring to MN-S.	Thank you for the advice comment. This will be corrected in the final EIS.
AD-15	ECCC	Sections 5.3.4 (Table 5.3-3); 8.1.3.3 Climate Change; 8.1.3.4 Climate Change Influenced Extreme Events; Table 15.4-1: Summary of Potential Effects of Short-term Extreme Weather Events on the Project and Associated Mitigation; Section 15.5 Climate Change.	The Proponent indicates that the Project's full lifetime is roughly 40 years (including the post- decommissioning phase) and that climate conditions are important design considerations for a number of sensitive aspects of the Project. Potential future climate changes and their potential effects on the Project and Valued Components (VCs) are described in various sections of the draft EIS. Notably, in Section 15.5.2, ensemble mean projections are provided for several climate variables for two future time periods and emissions scenarios (RCP 4.5 and 8.5). In Section 8.1.3.4, the Proponent describes possible future changes in short-duration precipitation extremes (based on Intensity Duration Frequency or IDF curves from the IDF_CC tool) and indicates that an increase in their frequency and magnitude may occur over the Project lifetime "… and may require consideration for greater storage and conveyance capacity for Project water management infrastructure" (p.8-41). The Proponent indicates that aspects of the Project are being designed to meet standards based on design values that appear to be derived from observed (i.e. historical) climate conditions (e.g. water management infrastructure; see Table 15.4-1). In Section 15.5.3, they indicate that an adaptive management approach will be used to address some aspects of future climate change as necessary. For example, page 15-19 of the draft EIS states that: "Denison will develop an Emergency Preparedness and Response Program for the Project to address forest fires and extreme weather that may occur. If unforeseen effects on the Project occur from longer and more severe forest fire seasons associated with climate change, or increased frequency or severity of extreme weather (e.g., ice storms, snowstorms, flooding), Denison will apply adaptive management that includes monitoring climate factors so that they can proactively mitigate or prevent adverse climate effects on the Project." (Emphasis added).	ECCC recommends that when considering potential future climate change and relevant effects on the Project, the Proponent consider the range of variability from the ensemble of models (not just the ensemble mean). ECCC also recommends that the Proponent consult the 2019 Canadian Standards Association Guidance on Intensity Duration Frequency for Canadian Water Resources practitioners , which provides examples of alternative methodologies to estimate future return values for design as needed. In terms of adaptive management, ECCC recommends that the Proponent clearly outline what climate factors will be monitored to mitigate or prevent adverse climate-related effects. This should include information on when and how the climate factors would be monitored and under what circumstances particular adaptive management approaches would be applied.	Please see response to IR-15, IR-103, IR-104, IR-235, and IR-236. The probable maximum precipitation (PMP) value of 493 mm selected for design of water management infrastructure, such as ponds, is similar to total annual precipitation (456 mm from Key Lake station, and 483 mm from 1981-2020 climate normals). The selected PMP is well above (>5 times higher): 1) current/measured 24-hour maximum precipitation, 2) modelled 1 in 100 year 24-hour return for current conditions, 3) modelled 1:100 year 24 hour return for a future (2020-2050) period, 4) the predicted maximum 1-day precipitation under different emissions scenarios for the future (including RCP8.5 in the 2021-2050 period). For comparison to the **design PMP of 493 mm**: - the measured maximum 24-hour precipitation from Key Lake station was **42.9 mm** and **72 mm** from 1981-2020 climate normals. - the modelled existing/current 1 in 100 year, 24 hour return using the IDF_CC Tool for the Wheeler River Project site was **79.9 mm** and at the Key Lake area was **56.4 mm**. - the modelled future (2020-2050) climate 1 in 100 year, 24 hour return using the IDF_CC Tool for the Wheeler River Project site was **88.6 mm** and at the Key Lake area was **62.0 mm**. - the predicted future climate (2021-2050) under the highest CO2e emissions scenario (RCP 8.5) shows maximum 1-day precipitation of **25.9 mm**. The PMP is much higher (> 5 times higher) than the observed and predicted 24-hour maximum precipitation and the 1:100 year 24 hour return. Completing the design using a large PMP provides confidence that the water management infrastructure will be sufficient and function under future climates as it relates to potential changes in precipitation.
AD-16	CNSC	Section 5.10 (p.70) and throughout the EIS	In section 5.10 of the ES, where the seven scenarios are listed, formatting is inconsistent. Likelihood is in quotes in some places, but not in all. **Not significant** is bolded inconsistently throughout the EIS. As well, in many cases noted as "not significant", where others note "are not expected to have a significant effect".	Suggest making formatting consistent if going to use quotes and bolding to highlight sections of the text. Also, validate that use of "not significant" and "are not expected to have a significant effect" are consistently used (where appropriate).	Thank you for the advice comment. This will be addressed, as possible, once the EIS is updated following the conclusion of the information requirement (IR) process.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent	Denison Response
AD-17	ECCC	Appendix 6-A Air Quality Technical Supporting Document A.10	Some of the off-road vehicles have an emission rating of Tier 2 but in Appendix 6-A Section A.10 the Proponent claims that "for non-road diesel combustion, Tier 4 emission factors were assumed". Choosing an engine with a lower Tier will increase emissions in NOx significantly and the Proponent should be using the best available technologies to minimize environmental impacts.	ECCC recommends that the Proponent choose engines that meet the most stringent emission standards to the extent possible, which are Tier 4 for the compression-ignition engines, during all phases of the Project.	Please see response to IR-139.
AD-18	ECCC	Appendix 6-C, Climate Baseline and GHG Emissions Report	Understanding Project emissions is important to inform analysis of a Project's potential impact on Canada's emissions targets and climate change commitments. ECCC notes that Section 4.0 and Appendix C: Greenhouse Gas Emissions Calculations of Appendix 6-C identifies the source of emissions and quantifies them in the construction, operation, and decommissioning phases of the Project, in accordance with the Draft Technical Guide Related to the SACC (Draft Technical Guide). While ECCC recognizes that the emissions will be relatively small in the post-decommissioning phase, the identification and quantification of the emissions in this phase is not found in the draft Environmental Impact Statement (EIS). The post- decommissioning phase is expected to last 15 years, likely going past 2050. The draft EIS does not discuss emission intensities of the Project, only the grid electricity. The draft EIS also does not discuss the Project's potential impacts on Canada's climate targets.	ECCC recommends that the identification of the sources of Greenhouse Gas (GHG) emissions and quantification of these emissions be described for the post-decommissioning phase, as done for the other phases. ECCC recommends the Proponent include discussion on the emission intensities of the mining of the product, following the guidance of the SACC and the Draft Technical Guide. ECCC recommends that the Proponent discuss the potential impacts that the Project may have on Canada's ability to meet its climate-related targets, following the guidance of the SACC and the Draft Technical Guide.	The Post-Decommissioning phase only includes monitoring (physical, chemical, and biological) and regulatory site inspections. These activities are not expected to generate any significant GHG releases. Notwithstanding, the calculated GHG emissions estimates for Construction, Operation and Decommissioning are expected to be sufficiently conservative to capture any incidental GHG releases during monitoring and inspection activities. The EIS anticipated an annual average production rate of approximately 4,082 metric tonnes of U_3O_8 and an annual net GHG releases of 30,702 metric tonnes CO2e over the operations phase of the project. The annualized GHG intensity during operations is estimated at 7.5 tonnes of CO2e / tonnes of U_3O_8. Section 2.5 of the EIS provides a summary of the anticipated GHG releases and a comparison to the nation- and province-wide GHG emissions. The project is expected to contribute less than 0.0043% to the nation-wide annual average. Given this very low contribution, the project is not expected to impact Canada's ability to meet its climate-related objectives and targets. Also see response for AD-19 (second paragraph).
AD-19	ECCC	Appendix 6-C, Climate Baseline and GHG Emissions Report	The draft EIS lacks information related to estimates of impact on carbon sinks and emissions from land-use changes. As land use shifts from a vegetated site prior to development, to an industrialized site, removal of vegetation and peat will have impacts on carbon sinks and construction emissions. Section 6, Appendix 6-C, 4.1.2 Land Use Change states that site-specific information of above- ground mass of vegetation was not available and default data from Table 20 of the Draft Technical Guide were applied. The default data is contained in this table is not applicable in this case, as they represent aboveground woody vegetation in cropland systems. ECCC recognizes that the usage of the median value of 0.51 for the carbon content is reasonable. From the information given in the draft EIS, it does not seem that the soil carbon was taken into account. In the absence of detailed information, the Proponent assumed that the area cleared would also be excavated (and drained in the case of wetland areas) which would create significant additional emissions from soil disturbances and drainage. Section 4.1.2 also states the Project involves clearing an area of	Land Use Change Regarding the lack of site-specific information of above-ground mass of vegetation, an initial site survey on-site using basic information such as site class and species would assist in determining the above-ground biomass. More specific data, such as regional data from provinces, forest companies, or literature may be available, and generic national data is available (e.g., Fo148-1-2E.pdf (publications.gc.ca), 4775.pdf (nrcan.gc.ca)). ECCC recommends that the Proponent also consider biomass that are not aboveground and confirm whether soil carbon is taken into account, as well as wetlands. Carbon Sinks ECCC recommends that the Proponent provide a quantitative and qualitative description of the Project's impact on carbon sinks, following the guidance of the SACC and the Draft Technical Guide.	Limited site-specific data were available to characterize land use change and impacts on carbon sinks. As such, the use of default values from the SACC/IPCC in conjunction with some limited habitat/vegetation data (extracted from Chapter 9.2 Terrestrial Environment – Vegetation and Ecosystems, Listed Plant Species and Wetlands) was employed and is considered reasonable at this stage of the assessment. Please note that additional information on the land use change GHG calculations can be found in Appendix 6-C Climate Baseline and Greenhouse Gas Emissions Report. In accordance with our discussions with the CNSC, Denison is committed to re-assessing the GHG and climate change components of the EIS and other elements of the SACC once more detailed, site-specific data becomes available (i.e., detailed feasibility and engineering studies). This is expected to include more detailed study around overall GHG emissions, carbon sinks

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent	Denison Response
			approximately 169.6 hectares. There are no estimates on the impact on carbon sinks related to the Project.		and mitigation options, best available technologies / best environmental practices, climate resiliency, net-zero carbon planning and offsetting.
AD-20	NRCan	Section 7.3.1, Physical Geography	Drumlins and eskers in the region trend Northeast to Southwest as opposed to northwest to southeast as written on page 7, line 18. Correct orientations are used on page 7, line 23.	NRCan recommends revising the text. Please refer to 250 000 scale Surficial Geology Lines from Quaternary mapping, CSRS NAD83 Zone 13, Saskatchewan Geological Survey 2017.	Acknowledged. The typo in the draft EIS, Section 7.3.1 will be corrected in the final EIS. In Section 7.3.1. the text will be updated to say the following: "The most important associated topographic features in the region are the northeast to southwest trending drumlins and eskers..." See also response to IR-54.
AD-21	NRCan	Section 7.3.2.3, Metacrystalline Basement Rock	Pegmatite missing from list of basement rock types.	NRCan suggests addition of pegmatite to the list of basement tock types as shown on Figure 7.3-6.	Denison will update the final EIS per NRCan's suggestion.
AD-22	NRCan	Section 7.3.3.1, Aquifer Properties, Section 7.3.2.3, Metacrystalline Basement Rock, Appendix 7A, 2.0, 2.3.1, 2.3.2	The terms "metacrystalline" and "metagranitic gneiss" are not frequently used terms in scientific literature. Gneiss is, by definition, a metamorphic rock.	NRCan suggests revision to "Crystalline Basement rocks" or "Basement metamorphic rocks", and "granitic gneiss" as used in Figure 7.3-6. Please refer to Oxford Dictionary of Earth Sciences.	Denison will update the final EIS per NRCan's suggestion.
AD-23	NRCan	Appendix 7A, 2.3.1, Metacrystalline basement rock	Orogeny is the process, orogen (or orogenic belt) is the feature produced by orogeny.	NRCan suggests replacing "Tran Hudson Orogeny" with Trans Hudson Orogen".	Denison will update the final EIS per NRCan's suggestion.
AD-24	NRCan	Appendix 7A, 2.3.1, Metacrystalline basement rock	Quartzite is by definition a metamorphic rock, and the term is used later without the meta- prefix.	NRCan suggests replacement of the term "meta-quartzite" with "quartzite".	Denison will update the final EIS per NRCan's suggestion.
AD-25	NRCan	Appendix 7A, 2.3.4, Athabasca Group Sandstones and Conglomerates	Sands are unlithified, whereas you are referring to grain sizes in this case.	In Table 2-1, NRCan suggests replacing the term "sands" with "grain sizes" under MFc and MFb descriptions.	Denison will update the final EIS per NRCan's suggestion.
AD-26	NRCan	Appendix 7A, 2.3.5, Overburden	Typo on page 2, line 7: "A grain size sample was collected in GWR-033 from approximately 9 m below ground surface, and the same consisted of 8.8% clay (less than 4 µm).	NRCan suggests revision of "same" to "sample" and clay to "clay-sized" grains.	Denison will update the final EIS per NRCan's suggestion.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent	Denison Response
AD-27	CNSC	Section 8.2.1.3 – Spatial and Temporal Boundaries	It is noted that McGowan Lake is an identified reference lake for the Key Lake Mill site. With the establishment of the Wheeler River mine, effluent would be flowing into McGowan Lake, which could potentially interfere with Key Lake's environmental monitoring program by compromising McGowan Lake's baseline conditions. Depending on the loading of COPC's into McGowan Lake and resultant water concentrations, it may no longer be accepted as an acceptable reference lake for use by Key Lake. This would require Cameco to modify their monitoring program at the Key Lake Mill.	The CNSC advises Denison to communicate with Cameco to ensure they are aware of this situation. Coordination between the two companies may be necessary to ensure Key Lakes environmental monitoring program is not compromised. It is recommended to discuss this potential issue with Cameco ahead of time to determine the best path forward.	Denison will communicate with Cameco through the Saskatchewan Mining Association to highlight the timing of the start of the Project as it may relate to Cameco's use of regional lakes for reference lake purposes. McGowan Lake will no longer be suitable as a reference lake for Cameco once the Wheeler River Project starts operating, since it will be downstream of treated effluent release. Alpha Lake (LA-9 in Denison's aquatic baseline studies) will likely be outside of any influence from Denison's activities. Please note that Denison has previously been in communication with the Saskatchewan Ministry of Environment, Environmental Protection Branch regarding the baseline study work Denison completed as part of the Environmental Assessment process and the potential changes to McGowan lake (a Cameco's reference lake) from the proposed Wheeler Project. Reference: Email from Janna Switzer (Denison) to George Bihun (MOE) on May 12, 2020.
AD-28	ECCC	Section 8.2.4.2.3 Appendix 10-A, Section 3.1.1.2	Tables 8.2-9 and 8.2-10 in Section 8.2.4.2.3 Part II_S8 Aquatic Environment and Table 3-1 in Appendix 10-A Section 3.1.1.2 demonstrate predicted maximum effluent concentrations of Constituents of Potential Concern (COPCs) and maximum predicted receiving environment concentrations. The final effluent quality discharge target for uranium is 0.057 mg/L. However, the Canadian Council of Ministers of the Environment (CCME) water short-term (acute) water quality guidelines for the protection of aquatic life is 0.033 mg/L. The proposed effluent discharge target for uranium exceeds the acute water quality guideline, indicating effluent may pose the risk of being acutely lethal to aquatic biota at end-of-pipe. While uranium is not a Schedule 4 substance with prescribed concentration limits under the Metal and Diamond Mining Effluent Regulations (MDMER), the MDMER requires the characterization of uranium concentrations in effluent under Schedule 5, and requires that all mine effluent released from final discharge points be non-acutely lethal. Under Schedule 5 Section 9(d) of the MDMER, the Proponent will likely be required to conduct selenium fish tissue sampling if average annual concentrations of selenium in effluent equals or exceeds 5 ug/L.	Discharges from the proposed Project will alter water quality in the immediate receiving area, and this may include some sublethal effects on aquatic biota, which must be minimized. It remains the Proponent's responsibility to adhere to the MDMER to ensure that effluent at the end-of-pipe from all final discharge points be non-acutely lethal and meet requirements for prescribed deleterious substances under Schedule 4 of the regulations.	Denison fully understands its obligations with respect to the MDMER and will comply with the MDMER end of pipe effluent discharge criteria.
AD-29	CNSC	Section 8.3.3 Figures 8.3.5 etc. 8.5-4	It does not appear that aquatic baseline sampling maps for Russell Lake have LAB 1 and 2 locations showing the baseline sampling locations within Russell Lake. (Figures 8.3.5). Please update the Figures throughout aquatic environment section to include of the baseline sampling studies/ locations within Russell Lake.	Please update maps and sections in EIS to reflect aquatic baseline studies that were completed.	Thank you for the advice comment. This will be addressed, as possible, once the EIS is updated following the conclusion of the information requirement (IR) process.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent	Denison Response
AD-30	CNSC	EIS sections 8.4.3.2.4 Benthic Invertebrate Community and 8.4.7.6 Climate Change Considerations	ECCC EEM guidance recommends the use of multiple reference areas as it offers the greatest statistical power to detect a meaningful difference between a reference area and an exposure area and can also give an indication of variability among reference areas. It is also important to incorporate multiple reference locations into the study design to aid in designing against spatial confounding factors. Section 3 of the Aquatic Environment Baseline Study Report details the similarities between benthic invertebrate communities by using the mean Bray-Curtis index between sampling locations and the median reference condition for the lake group size. It's not clear in the EIS if there are any issues expected to be able to use this data to compare project effect locations to references sites into the future, as some sampling locations are currently not very similar to the reference sites. In addition, climate change could affect the sediment and benthic communities in the future. The EIS states "the frequency and magnitude of extreme precipitation events have the potential to change water levels and flows in the RSA, which may affect sediment transport, deposition, and therefore benthic invertebrate habitat. Changes to average and upper and lower bounds of ambient temperatures may also affect aquatic habitat, which in turn may affect benthic invertebrate communities. Climate change over the life of the Project (i.e., 35 to 40 years) will be monitored as part of the Project's environmental monitoring programs, and influences on water quality, sediment quality, and benthic invertebrates will require adaptive management to mitigate any potential effects of the Project that may be exacerbated by climate-related changes on the aquatic environment". It is recommended to ensure that appropriate number/location of reference sites are sampled to enable any changes to sediment or benthic invertebrate communities that may be due to climate changes, and not project effects, are able to be assessed.	Considering climate change may change the lake conditions from baseline conditions, and that there is already natural variability between lakes that will be used as reference lakes and exposure lakes, it could become difficult to show changes to sediment/benthic invertebrates are not due to project activities, therefore there is a recommendation to ensure the current baseline data is adequate, and to consider if additional data, and addition of additional reference stations, will be needed moving forward.	Changes in landscape influence and lake conditions are not limited to those brought about by climate change. The preparation of a study design under the MDMER EEM program strives to ensure that a single reference area or multiple reference areas are as representative of a control condition as possible. Best practice is to undertake an analysis of candidate reference areas using the existing baseline information and investigate their utility as controls prior to project development. A preliminary EEM study can be completed that will allow for a Before-After-Control-Impact study design, that will provide the ability to monitor change not only in the exposure areas, but in the reference areas, thereby allowing for a reasonable assessment of potential mine related impacts.
AD-31	CNSC	Section 8.4.6.1, Residual Effects Characterization	The EIS states "Local Indigenous communities have expressed direct concern with respect to mercury. Mercury has not been identified as a COPC for the Project as it is currently not present in the receiving environment (i.e., background condition) at detectable concentrations and will not be produced as part of the mine process; therefore, it will not be discharged to the aquatic environment. However, it is understood that potential nutrient enrichment-related effects are possible and can be linked to increases in mercury in the environment." Based off concerns from Indigenous communities, and the fact that phosphate is a COPC in the effluent, and elevated concentrations of mercury were measured near the	Please consider adding methylmercury to the environment sampling plans (such as fish dorsal muscle) in order to confirm there are no unexpected effects of the project on levels, and to satisfy stakeholder concerns.	Refer to response to IR-100.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent	Denison Response
			Kratchkowsky Lake bottom, adding methylmercury to the environment sampling plans may be beneficial.		
AD-32	CNSC	Section 9.1.8.3, Appendix 10-A (ERA) section 3.2.1.5	It appears there is no consistency between the assessment of soil quality in the ERA and the baseline soil sampling program presented in the EIS. The baseline program includes 10 soil permanent sampling locations (Appendix 9-B, section 2.5). Sampling at these locations is proposed to be continued during the Operation Phase, and monitoring data will be compiled and reported annually/periodically (EIS section 9.1.8.3). Conversely, the ERA estimates and predicts concentrations of COPC in soil based on atmospheric deposition. Furthermore, the location of ecological receptors in the ERA (Figure 5-2) is different from the permanent soil sampling plot locations (Appendix 9-B, Figure 2.5-1). It is unclear why measured baseline soil quality data were not discussed in the ERA and whether future monitoring data will be considered in the ERA to verify accuracy of predicted COPC concentrations	Please clarify how baseline measured data on COPC concentrations in soil is considered in the current and future iterations of the ERA.	Baseline measured soil data were used in the ERA to characterize the existing environment. The IMPACT model was used to predict the Project contributions for the Project phases above baseline. The baseline soil concentrations used in the model are provided in Section 3.5.1 and Table 3-8 of Appendix A in Appendix 10-A (ERA). The ERA will be revised according to the periodic review requirements in CSA N288.6-22 which will reflect ongoing data collected from monitoring programs.
AD-33	CNSC	Section 9.3.3.1.2	Indigenous knowledge is summarized with regard to moose, including: · Calving sites close to the Wheeler River, with lots of muskeg in the area. A moose calving area is located in the Terrestrial RSA, southwest of the Project Area. · A wildlife corridor is used by moose, running between Cree Lake (outside and to the west of the Terrestrial RSA) and Russel Lake (in the southern portion of the Terrestrial RSA). It is unclear how this information is incorporated into the residual effects assessment.	Please clarify how Indigenous knowledge on moose calving sites and corridors in the RSA is incorporated into the residual effects assessment for the key indicator "moose".	The sites identified by IK were explicitly considered in the impact assessment as indicated by their identification as overlapping with the Terrestrial RSA as noted in the question. However, the areas were not expressly discussed in the residual effects assessment because there is no anticipated spatial overlap of those areas with direct or indirect Project effects. The Indigenous Knowledge provided by ERFN and SVS (2022) identifies a moose calving site (Feature 1001-08) ~ 2 km southwest, and a wildlife corridor ~6 km south of the Project Area (as depicted in Figure 4. Map B, page 16 of ERFN and SVS 2022). Both areas are within the Terrestrial RSA but outside the Wildlife LSA. The reference to "Calving sites close to the Wheeler River…" refers to a broad area that is 45 km east of the Project Area, well beyond interactions with the Project Area. The presence of the areas identified through IK was acknowledged in Section 9.3.3.1.2 (Information from Indigenous Knowledge, Local Knowledge, and Engagement) in Part II, Sec. 9 of the Draft EIS. The assessment (Sec. 9.3.4.2) considered alteration and/or habitat loss at the LSA and RSA scale. Section 9.3.4.2.1 (pg. 9-210) summarizes the effects on moose habitat as follows: "Habitat alteration through sensory disturbance effects (such as noise, dust deposition, and artificial light) is expected to result in reduced habitat quality and effectiveness near Project components and infrastructure reaching beyond the Project Area into the Wildlife LSA…." Further, Sec. 9.3.6.2.1 (Alteration and/or Loss of Habitat, pg. 9-230) identifies that an area within a 500 m radius of the Project Area will be influenced by the Project and likely make the habitat within that area less suitable for use by moose. Therefore, the effects of the Project on moose calving have been appropriately assessed and are expected to be contained within the Wildlife

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent	Denison Response
					LSA. That affected area does not overlap with the moose calving site or the wildlife corridor identified by IK.
AD-34	CNSC	Appendix 9-B	Baseline studies for birds are restricted to short time frames in one year only, for example: · Breeding Songbird Point Count Call Survey (June 7 and 17, 2017) · Aerial Waterfowl and Raptor Stick Nest Survey (June 15 and 16, 2017) The Canadian Wildlife Service (2022) recommends: · Consider the potential effects of projects on birds throughout the year and document the distribution and abundance of birds in all seasons. Some species may be under-represented in existing data bases due to temporally restricted periods of detectability. · Explicitly target species at risk and other focal species. · Conduct at least two years of field surveys as a national standard for major projects, so that temporal variability can be considered in future comparisons to baseline data. **Reference:** Canadian Wildlife Service. 2022. Guidance Regarding Data Needed to Support Assessment of Project Effects on Birds. Environment and Climate Change Canada, Gatineau, Quebec. 80 p.	Please consider conducting surveys following CWS's recommendations or provide an explanation as to how current baseline data for birds is sufficient to characterize the existing environment.	The data collected as part of the baseline studies for birds was focused on the habitat types and areas most likely to be disturbed as a result of the Project. Conducting additional baseline surveys for waterfowl, raptors, and breeding birds is not anticipated to result in changes to the assessment outcomes and predictions made as part of the effects assessment, which was habitat-based, for avian species. The assessment methods used a conservative approach with the assumption that following the implementation of site-specific mitigation measures, the proposed Project activities would have a residual effect on these species guilds regardless of species presence on site. However, to supplement the species data that were collected as part of the baseline field program, Denison is willing to acquire additional information on species presence in the RSA from existing sources, specifically from the Saskatchewan Breeding Bird Atlas (Birds Canada). However, collection and consideration of this information is not expected to affect the findings and/or conclusions stated in the draft EIS as the assessment was habitat-based to address all species.
AD-35	CNSC	Section 10, IMPACT MODEL	Denison discusses details of the IMPACT model but has not provided scenario(s) used to facilitate review.	Please consider providing CNSC with the IMPACT model scenario file(s) in the spirit of regulatory cooperation.	The intent of Appendix A to Appendix 10-A is to provide the inputs used for the IMPACT model as well as all of the characteristics for human and ecological receptors. Where site-specific data were not used in the model it can be assumed that default values from CSA N288.1-20 were used in the IMPACT model. As such, Denison does not intend to provide the scenario files.
AD-36	English River First Nation (ERFN)	Section 10.1.3.2, Traditional Foods Diet (p. 10-15)	The EIS States: "The ERFN is comprised of seven reserve lands across Saskatchewan" (p. 10-15). While this is accurately reflecting a source document, the source document is incorrect.	Please update to "The ERFN is comprised of seven historical settlements that have now grown into 19 different reserves across Saskatchewan"	Thank you for the advice comment. This will be addressed, as possible, once the EIS is updated following the conclusion of the information requirement (IR) process.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent	Denison Response
AD-37	CNSC	Section 10.1.9, Human Health Summary and Appendix 10-A – 4.4.1 Risk Estimation	The Human Health section of the EIS, as well as the ERA, indicates that there is an exceedance for selenium for the fisher/trapper receptor, with the Project estimated to contribute to the majority of this exceedance (0.93 of the HQ). While the assessment is conservative by assuming an increase intake rate of fish solely sourced from Russel Lake, the precautionary principle should be considered to ensure in reality the HQ for selenium remains below 1, even under conservative assumptions.	Please conduct of effluent, water, and aquatic organism monitoring (as already suggested in EIS) to confirm HQ's are highly conservative in the EIS modelling and receptors remain protected. Should it be determined Se concentrations are increasing in the environment at such a rate as there may be in impact to the environment or human health, installation of a selenium removal circuit into the effluent treatment process should be considered. The proponent should ensure that the proposed wastewater treatment system design incorporates the capability for expansion or upgrades in alignment with the precautionary approach, pollution prevention, and continuous improvement.	Denison acknowledges that a robust effluent and environmental monitoring program will be developed to confirm all EIS modelling predictions. The ERA will be revised according to the periodic review requirements in CSA N288.6-22 which will reflect ongoing data collected from monitoring programs.
AD-38	CNSC	Appendix 10-A (ERA)	It is unclear if measured or modelled COPC concentrations in blueberry were used in the calculations of human receptor dose. Similarly, it is unclear if measured or modelled COPC concentrations in lichen and blueberry were used in the calculations of ecological receptor dose. CSA N288.6-22, Clause 7.3.6 states that "Measured concentrations of COPCs should be used, where possible, in the exposure assessment." Please see the Clause for further information.	Please clarify if measured or modelled COPC concentrations in blueberry / lichen were used in the calculations of human and ecological receptor dose.	Measured baseline lichen data were used in the ERA to characterize the existing environment. The IMPACT model was used to predict the Project contributions for the Project phases above baseline. Measured baseline blueberry data were used for model calibration to determine if there was good agreement between measured data and modelled data. The IMPACT model was used to predict both baseline and Project contributions for blueberries. The ERA will be revised according to the periodic review requirements in CSA N288.6-22 which will reflect ongoing data collected from monitoring programs.
AD-39	CNSC	Appendix 10-A (ERA), Table 2-2	Table 2-2: Estimated Home Ranges of Selected Terrestrial Ecological Receptors Based on the reference McLoughlin et al. (2016), the Home Range for Woodland Caribou is indicated as "Expected = 80 km2" which represents the mean range sizes pooled over the two study years for calving/post-calving. The indicated Minimum (67 km2) and Maximum (267 km2), however, do not relate to the calving/post-calving stage, which is not clearly stated in Table 2-2. In contrast, these values are actually mean range size values for autumn/rut and early winter, respectively, as described in the source document on Page 83 (McLoughlin et al., 2016). It should be noted that in terms of true minimum and maximum, the source document states that individual home ranges, based on up to two years of GPS locations, varied in size from 16.2 km2 to 1363.9 km2 (Page 82 of McLoughlin et al., 2016). Reference: McLoughlin et al. 2016. Population dynamics and critical habitat of woodland caribou in the Saskatchewan Boreal Shield. Interim Project Report, 2013–2016. Department of Biology, University of Saskatchewan, Saskatoon. 162 pp. Available online at http://mcloughlinlab.ca/lab/wp-content/uploads/2019/06/2013-2016-SK-Boreal-Shield-Caribou- Project-Interim-Report-Nov-18-2016.pdf	Please provide clear details on the source of the home range values listed in Table 2-2.	Denison acknowledges the comment and will add clarification in Table 2-2 of Appendix A in Appendix 10-A that the minimum represents the autumn/rut and the maximum represents the early winter.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent	Denison Response
AD-40	CNSC	Appendix 10-A (ERA) section 3.2.1.5	Although the soil type selected in the ERA for modeling of atmospheric deposition to soil is sandy soil, organic soils have been delineated and characterized (section 9.1.3.3 of the EIS) as valued component (i.e., "Organic Matter/Peat"). It is unclear if the soil quality modeling performed in the ERA is protective for soil types other than sandy soil.	Please clarify if COPC modeling based on sandy soil is protective of organic/peaty soil and provide justification.	The majority of the soil in the Project Area and LSA is considered sandy soil. Section 9.1.3.2 of the EIS states "Mineral soils are associated with upland sites and (in all likelihood) anthropogenically disturbed land that, together, correspond with >99% of the Project Area and 91.5% of the LSA (Figure 9.1-8). The predominate mineral soils within the RSA have been classified as Sandy Dystric Brunisols (Smith et al. 2011)." Organic matter/peat was included as a VC in the EIS because of the concern regarding drying and losing biological function through groundwater interactions, and not in terms of assessment of soil quality. Additionally, Section 9.1.3.3 of the EIS acknowledges that organic soils is limited in the Project Area. As such, this comment is considered not applicable.
AD-41	CNSC	Appendix 10-A (ERA), Table 5-5	Table 5-5: Complete Exposure Pathways for All Selected Ecological Receptors to be Assessed using the IMPACT Model The exposure pathway for phytoplankton is stated as "direct contact in sediment", however, phytoplankton live suspended in the water column. It is acknowledged that in the IMPACT modelling report, phytoplankton is described with an occupancy factor of 1 in water (Table 2-5).	Please add the pathway "direct contact in water" to Table 5-5 and revise all calculations accordingly.	Table 5-5 will be revised to state "direct contact in water" for phytoplankton. No calculation changes are needed.
AD-42	CNSC	Appendix 10-A (ERA), Table B.12	Table B.12: Sample Calculation – Adult Recreational Fisher/Hunter (McGowan Lake) Dose and Risk Calculations for Selenium The source for the Terrestrial Plant Ingestion Dose for Labrador tea and blueberry is stated as "Table C.5", however, this table could not be located.	Please provide the referred-to Table C.5 or an alternate source of information for the Terrestrial Plant Ingestion Dose for Labrador tea and blueberry.	Thank you for the advice comment. This will be addressed, as possible, once the EIS is updated following the conclusion of the information requirement (IR) process.
AD-43	CNSC	Appendix 10-A (ERA), Environmental Risk Assessment for Wheeler River Technical Support Document	The ERA is prepared by Ecometrix and submitted to Denison Mines. It is unclear if the ERA submitted has been reviewed and accepted by the proponent (Denison Mines). CSA N286-12 clause 9.5.5 specifies that "the selected supplier's technical documents that are required to be submitted shall be reviewed and accepted". Meeting these CSA N286-12 requirements will ensure that the proponent has control of the purchased services as a future licensee applicant.	Provide clarifications if ERA documents have been reviewed and accepted by the proponent.	See response to IR-202 which indicates that Denison reviewed and accepted the ERA. This text will be added to Appendix 10-A.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent	Denison Response
AD-44	CNSC	Section 11	It is not clear whether all of the interested Indigenous Nations and communities were engaged on the results and findings of the Heritage Resources Impact Assessments (HHRIA) or just ERFN?	CNSC staff would appreciate an update on any engagement activities that have taken place with regards to any of the HHRIAs for the Project, or any site or thing that is of historical, archaeological, paleontological or architectural significance as requested by other Indigenous Nations and communities to date.	Denison confirms that the results of the Project-related HRIAs were discussed with ERFN, as they expressed interest in further understanding the nature of the work undertaken. The Saskatchewan Ministry of Parks, Culture and Sport, Heritage Conservation Branch (HCB) administers The Heritage Property Act. Regulatory approval as per section 63 of The Heritage Property Act (GS 80) was granted for the Project for the two separate HRIAs (HCB File No. 16-2102, December 14, 2017 and HCB File No. 19-933 February 12th, 2020). The results of the HRIAs were included and formed part of the draft EIS. Comments made by Indigenous communities on this section of the EIS will therefore be responded to accordingly by Denison, where appropriate. Additionally, as noted in Section 11.3.2, “The Heritage Resource Management Plan (HRMP) was informed by engagement with ERFN, who recommended that the HRMP should include a mechanism to involve Indigenous communities where appropriate (21-EN-ERFN-591.1; 21-EN-ERFN-591.2) (see Appendix 11-B).” The mechanism to involve Indigenous communities has been included in the HRMP and allows for general notification to Indigenous communities should an artefact be found, which provides flexibility to engage all appropriate Indigenous nations accordingly.
AD-45	CNSC	Section 11.1.4.5.2. Perceived Suitability/Safe Use of Resources (p. 11-59)	The EIS States: “Section 2.6.1 in Section 2 describes the extensive review of mining methods that led to the decision to adopt the ISR mining method.” (p. 11-59). This reference is not correct, as this section does not contain a review of the mining methods.	Please update this to reflect the appropriate section.	Thank you for the advice comment. This will be addressed, as possible, once the EIS is updated following the conclusion of the information requirement (IR) process.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent	Denison Response
AD-46	TC	Section 14.6.7.2	Transport Canada would like to clarify that although the proponent may use a third party to assist in developing emergency response assistance plans (ERAPs), it is the proponent's responsibility to submit the ERAP application(s) to Transport Canada, per Section 7(1) of the *Transportation of Dangerous Goods Act, 1992* as follows: Emergency response assistance plan 7 (1) No person shall import, offer for transport, handle or transport dangerous goods in a quantity or concentration that is specified by regulation — or that is within a range of quantities or concentrations that is specified by regulation — unless the person has an emergency response assistance plan that is approved under this section before (a) importing the dangerous goods; (b) offering the dangerous goods for transport; or (c) handling or transporting the dangerous goods, in the case where no other person is required to have an emergency response assistance plan under paragraph (a) or (b) in respect of that handling or transporting.	*This advice pertains to the regulatory phase.* Transport Canada notes that the sentence highlighted in yellow below is incorrect and should be revised or removed. While a contractor could assist the proponent to develop the ERAP(s), it is the responsibility of the proponent to apply to Transport Canada for approval of the plan(s). 14.6.7.2 Design and Mitigation Considerations Principal traffic risk mitigation measures include: • traffic control measures such as speed limits; • travel management plans; • spill and emergency response planning; and • driver training. Additionally, Denison considered several provisions to make sure that the effects of a terrestrial release of hazardous materials are as low as practicable. In addition to transportation mitigations listed for Scenarios 1 and 2, the following provisions were considered. • The Transportation of Dangerous Goods Act, 1992 (Government of Canada 2019) outlines the requirements for entities that transport dangerous goods to establish emergency response assistance plans. These plans list specialized personnel and equipment that are required for responding to an incident. ***It is expected that a contractor responsible for the transportation of uranium concentrate, fuel, and hazardous chemicals would develop these plans.***	Acknowledged. Section 14 will be updated in the final EIS to clearly state that while a contractor could assist Denison to develop the ERAP(s), it is Denison's responsibility to apply to Transport Canada for approval of the plan(s).
AD-47	Health Canada (HC)	Appendix 14-A (p. 8-9)	**Context:** No emergency response plan has been provided within the draft EIS, which states that emergency response plans will be developed in the future (Section 14 Appendix 14-A, p.8-9). **Rationale:** For any emergency event, Health Canada considers the protection of human health as a primary consideration in the development of emergency preparedness and response plans. This includes monitoring for human health impacts and the provision of health-related guidance. Further, this will be a requirement of the licensing process. The proponent should ensure that the emergency response plans consider the protection of all relevant potential human receptors that could be impacted by an onsite or project-related off- site accident involving the release of chemical and/or radiological substances.	It is recommended that Denison develop an emergency response plan in consultation with potentially affected communities and stakeholders that includes, but is not limited to, the following: 1. All relevant contact information of the communities, especially related to km 160 of Hwy 914, which is the location of a cultural camp that has been established by the English River First Nation and km 67 of Hwy 914 that is a gathering location for the Kineepik Metis Local associated with the Northern Village of Pinehouse. 2. Description of the mechanisms for communication with communities in case of an emergency. 3. Description of the partnership with and the training of local communities and local responders (see Section 14 Appendix 14-B, p.1). 4. Description of mutual aid agreements with neighboring industries/municipalities, where appropriate.	Denison acknowledges the comment and thanks Health Canada for the recommendations as to the development of its Emergency Response Plan. As noted in the draft EIS, Denison has committed to the development of an Emergency Preparedness and Response Program as a component of its Environmental Management System (EMS). The objectives of the program are generically consistent with the recommendations that have been provided and Denison, as it has demonstrated to date, is committed to meaningful engagement with communities of interest and will solicit input and advice during all aspects of program development. For reference it is noted that as it concerns its EMS framework documentation hierarchy it is expected that three levels of documentation will be developed – Programs, Plans and Procedures. The emergency preparedness and response documentation will follow this hierarchy and input from interested parties will be solicited during all phase of program/plan/procedure development. Denison intends to develop this documentation as it advances through the licensing phase of Project realization.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent	Denison Response
AD-48	ECCC	Appendix 16-C, Summary of Monitoring and Follow-up Programs	Appendix 16-C does not include consideration of any monitoring and follow-up programs regarding GHGs.	ECCC recommends that the Proponent consider developing a GHG follow-up program to measure and compare actual GHG emissions against the draft EIS estimates, including reporting the Project's actual emissions and updating the emissions estimates as needed.	Denison anticipates being subject to ECCC's reporting requirements for emitters over 10,000 tonnes CO2e and the information is collected under section 26 of the Canadian Environmental Protection Act. This was noted in the draft EIS, Section 2.5 Greenhouse Gas Emissions.
AD-49	ECCC	Appendix 16-A Summary of Residual Effects Appendix 16-B Summary of Cumulative Effects	ECCC notes that GHG mitigation measures have not been considered for the Project. Furthermore, the Project's lifetime is expected to extend into 2050 and beyond. Consistent with the information requirements of the SACC, and aligning with Canada's commitment to achieve net-zero GHG emissions by 2050, the Proponent should provide a credible plan that describes how the Project will achieve net-zero emissions by 2050.	ECCC recommends that the draft EIS include an assessment of potential GHG mitigation measures throughout all phases of the Project. This could include a Best Available Technologies / Best Environmental Practices (BAT/BEP) Determination, as described in Section 3.2 of the Draft Technical Guide. ECCC also recommends that the Proponent provide a credible Net-Zero Plan on how to achieve the target of 0 kt CO2 eq/year, for the year 2050 and beyond, following the guidance of the SACC and the Draft Technical Guide.	GHGs were not included as a VC or KI in the draft EIS and as such, there are no specific GHG-related mitigation measures in Appendix 16. However, many of the mitigation measures for the VC Air Quality related to combustion products would also be associated with a reduction in the Project's Scope 1 emissions. As noted in the draft EIS, Section 2.5, at this stage in the Project Denison will look for opportunities to optimize energy management and improve the energy intensity of the Project where practical. Also see response for AD-19 (second paragraph). Denison will consider the option of preparing a climate resiliency assessment with consideration to best available technologies / environmental practices (BAT/BEP) as well as a net-zero plan as the Project advances. Section 2.5 of the EIS provides a summary of the anticipated GHG releases and a comparison to the nation- and province-wide GHG emissions. The project is expected to contribute less than 0.0043% to the nation-wide annual average. Given this very low contribution, the project is not expected to impact Canada's ability to meet its climate-related objectives and targets.