JOINT APPLICATION INFORMATION REQUIREMENTS (JAIR)

Guidance Document

April 2024
Version 3.0

BRITISH COLUMBIA
Ministry of Energy, Mines and Low Carbon Innovation

BRITISH COLUMBIA
Ministry of Environment and Climate Change Strategy

PROVINCE OF BRITISH COLUMBIA
B.C. Ministry of Energy, Mines and Low Carbon Innovation
and
Ministry of Environment and Climate Change Strategy

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This document provides information regarding authorizations for major mines in British Columbia. Although references are made to legal requirements, the content of this document should not be interpreted as legal instructions or legal advice. Users of this document should refer directly to official copies of the legislation to determine legal requirements and seek their own legal counsel when case-specific interpretations are needed.

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Table of Contents

Purpose

This document presents the British Columbia (BC) Ministry of Energy, Mines and Low Carbon Innovation (EMLI)'s and the Ministry of Environment and Climate Change Strategy (ENV)'s expectations for major mine Proponents when preparing a Joint *Mines Act / Environmental Management Act* (MA/EMA) Application. This guidance document is expected to improve transparency in expectations as well as the consistency and quality of Applications submitted for review, by establishing minimum information requirements and a defined process for the pre-application phase for major mine projects. Additionally, this document provides minimum information requirements for Proponents when developing a Project Description (PD) and draft Information Requirements Table (IRT) and identifies minimum information requirements for each section of the IRT.

Introduction

Major mine applications vary greatly in nature, from minor revisions to approved mine plans, to major expansions, to greenfield mine developments. Although projects vary in scope, the general permitting process is consistent and includes initial discussions/meetings, a pre-application phase, a screening phase, a review phase, and a drafting/referral phase (Figure 1). Depending on project complexity, applications may range from a few pages to thousands of pages and may require review by both technical and non-technical audiences. The submission of consistent high-quality project descriptions and information requirements is expected to result in more efficient and effective pre-application conversations and processes to support the development of consistent high-quality applications.

Figure 1: General major mine permitting phases.

Pre-Application Phase

Before an Application is submitted, Proponents are expected to work with government agencies, Indigenous Nations, and stakeholders to introduce the proposed project using the standard PD template, IRT, and relevant presentations. The goal of the pre-application phase is to ensure Proponents clearly understand the information requirements necessary for their proposed project, enabling submission of a high-quality and complete Application. The pre-application process can be broken down into multiple stages, including: 1) Proponent development and submission of a PD and draft IRT, 2) EMLI, ENV, and Indigenous Nations review of the submitted PD, draft IRT, and accompanying documents, 3) pre-application IRT workshops and meetings, 4) finalization of the IRT and provision of an Application Instruction Document (AID) by ENV, and 5) Proponent finalization of the Application and submission of a full Application for screening.

Proponents should use the standard PD and IRT templates to ensure information is presented with a focus on identifying the proposed project components, impacts, residual risks, and proposed mitigations that have been determined by appropriate Qualified Professionals (QPs).

Project Description

The PD is a plain-language document that outlines the key components of a proposed project, including a schedule, description of proposed works and activities and why they are needed, anticipated permitting

requirements, and implications of the proposed project to the environment, worker health and safety, and Indigenous Nations, including socio-economic and cultural impacts. The purpose of the PD is to introduce proposed projects to the Provincial Government, Indigenous Nations, and potential Mine Review Committee (MRC) members. Additionally, the PD is intended to support Proponents in soliciting feedback from the Provincial Government and Indigenous Nations on information requirements, potential assessment methods, and permitting processes for the proposed project. The PD template has been structured to mirror the sections identified within the IRT, creating consistency in how information is organized between the two standard documents submitted during the pre-application phase. The PD supports EMLI and ENV staff and Indigenous Governments in the early identification of the project scope, Indigenous Nations consultation/engagement requirements, and potential risks to the environment, health, and safety associated with the project.

The template PD content may be modified as required to reflect the circumstances of the major mine project, such as:

- a new major mine proposal that has completed a provincial environmental assessment process under the British Columbia *Environmental Assessment Act* (*BCEAA*) that is moving to the statutory authorization stage (the PD should include a list of outstanding issues raised in the environmental assessment process that were determined to be best addressed during permitting, along with any Proponent commitments that could be included as conditions in statutory authorizations);
- an operating major mine requesting amendments to existing authorizations that do not exceed applicable modification thresholds under the *BCEAA* Reviewable Projects Regulation;
- a closed mine or mine in care and maintenance proposing to re-open and not subject to the provisions of the *BCEAA*; and
- a new major mine proposal with an annual production level below the applicable threshold in the *BCEAA* Reviewable Projects Regulation that is moving directly to the statutory authorization stage.

Information Requirements Table

The IRT is a high-level summary of the detailed information requirements outlined in this document and should be used in conjunction with this document. The purpose of the IRT is to provide a consistent and structured format for identifying information that needs to be included within an Application and sets out the information needed to support Indigenous Nations and provincial decision-makers in understanding the risks of a specific project. Additionally, the IRT is a tool used by EMLI, ENV, and Indigenous Nation reviewers to document site-specific information requirements or specific methods required to assess project impacts based on the details presented within the PD. The IRT is also used during the screening phase for reviewers to assess the presence/absence of information that must be included within the Application.

Not all information outlined in this document or the IRT is required for every Application. The PD and other project-specific factors, including engagement with EMLI, ENV, and Indigenous Nation reviewers, will guide the selection of what information is required for a specific project. Additionally, project specific issues may require the addition of information requirements not included in this guide.

Development and Submission of a PD and Draft IRT

Information and data provided by QPs and Indigenous Nations are integral to the successful development of a PD and a draft IRT. Proponents are encouraged to engage with Indigenous Nations as early as possible in project planning stages to build relationships and for information sharing purposes that may support the development of the PD, the draft IRT, and provincial consultation processes.

Proponents are also encouraged to access and use data from open sources provided by the province. The BC Government has several open-source data platforms (e.g., BC Data Catalogue) to assist Proponents in

assessing the potential for project components to overlap with surrounding land tenures (e.g., coal and mineral claims or leases).

Following recommendations from relevant QPs, the Proponent may adjust the information within each section and subsection of the PD and/or draft IRT, depending on the proposed project's specific circumstances or characteristics. If a Proponent identifies that a section and/or subsection does not apply to their project, a rationale for the omission of the standard information requirement should be provided within the PD and/or draft IRT.

Once Proponents have created a PD and draft IRT using the standard templates, they will submit the documents to EMLI and ENV. In addition to the PD and draft IRT, Proponents might be required to complete the ENV preliminary intake form, complete the discharge factors form, develop a location map, and pay the ENV application fee to Permit Administration: VictoriaEPD@gov.bc.ca. Proponents will also be required to submit the PD and draft IRT to EMLI through the Major Mine Office's (MMO) intake email: PermRecl@gov.bc.ca

Review of the PD and Draft IRT

EMLI, ENV, and Indigenous Nations will review and assess the information provided within the PD and draft IRT. Reviewers may ask clarifying questions and the Proponent and relevant QPs are expected to provide comprehensive responses. Additional requirements may be added to the draft IRT to meet project-specific requests made by Indigenous Nations.

Pre-Application Phase Meetings

Following the review of the PD and draft IRT, "pre-application" meetings with Proponents, Indigenous Nations, applicable provincial permitting agencies, and technical staff may be scheduled to discuss and confirm the scope of the project and proposed information requirements prior to finalization of the IRT. Proponents should discuss the need for, and purpose of, these meetings with the MMO Project Lead prior to scheduling. Not all projects will require pre-application meetings.

IRT Finalization

EMLI, ENV, and Indigenous Nations will review any additional information provided following pre-application meetings. When the review is complete, EMLI and ENV will sign off on the finalized IRT. Additionally, ENV will issue an AID with the finalized IRT to the Proponent.

The AID is a tool used by ENV to provide written confirmation of ENV's understanding of the proposed project and the information requirements set out in the final IRT; it also provides additional instructions regarding the *Environmental Management Act (EMA)* permitting process, Indigenous engagement requirements coordinated by EMLI, public notification requirements that may be coordinated with *Mines Act (MA)* requirements, and reporting requirements.

Pursuant to the Health, Safety, and Reclamation Code (HSRC), the Chief Permitting Officer (CPO) may require the Proponent to publish a notice in B.C.'s Gazette and in local newspapers regarding the *MA* Application. The Proponent should work with the MMO Project Lead to ensure public engagement requirements and efforts are well understood and coordinated where possible.

Preparing the Joint Application

The following sections of this document provide a template and identify the minimum information requirements associated with each header/section of the IRT for joint *MA/EMA* Applications. The Proponent and relevant QPs are responsible for reviewing and understanding all the required information for the Application, identified in the final IRT and AID and outlined in detail within each section of this

document. The Proponent and relevant QPs are also responsible for ensuring that all required information has been incorporated into the Application prior to submission.

While Proponents are encouraged to use the structure and order of information presented within the IRT and this document, this is not mandatory and, in some cases, there may be benefits to adopting a different table of contents to appropriately present project-specific information within the Application.

Upon Application development, if the Proponent identifies that certain information may no longer be required to support review by Indigenous Nations and provincial decision-makers, the rationale should be clearly documented in the Application. Proponents should discuss proposed deviations from the final IRT and Application template with EMLI and ENV before submitting an Application for screening.

Applications for *MA* permits must demonstrate compliance with the HSRC. Applications for variances to the HSRC must be made to the Office of the Chief Inspector of Mines and identified in the Application. Depending on project-specific considerations, information requirements in addition to those listed herein may be required.

Document Submission Requirements

All documents submitted to EMLI and/or ENV as part of the application process, including the PD/IRT, screening application, final Application, and review responses must adhere to the following naming convention:

- document naming convention: "*YYYY MM DD Short Descriptive Title (<50 characters)*";
- folder naming convention: "*App A – Short Section Title (<50 characters)*".

Please ensure that any PDF-formatted document includes bookmarks for at least each individual section/chapter and each individual appendix.

Proponents must submit all documents to EMLI and ENV as directed by the MMO.

Once an MRC is established, the MMO Project Lead may create a project-specific document-sharing portal for the Proponent, Indigenous Nations, and EMLI and ENV technical reviewers. The Proponent is also required to follow the document naming convention for all submissions through these portals.

Submitting documents that do not adhere to the document naming convention can lead to unnecessary delays in process timelines and may result in the submission being rejected and/or the Proponent being required to re-submit.

Submission of Confidential Information

For the purposes of this document, **Confidential Information** is defined as information that:

- is not publicly available;
- in respect of which the mining proponent or their consultant has taken measures that are reasonable in the circumstances to ensure that it remains not publicly available; and
- has actual or potential economic value to the mining proponent, their consultant, or their competitors because it is not publicly available, and its disclosure would result in a material financial loss to the mining proponent or their consultant or a material financial gain to their competitors.

Information will be received confidentially by the province if the Proponent adequately demonstrates that it meets the above definition of 'Confidential Information' as well as one or more of the acceptable harms outlined in Section 21 of the *Freedom of Information and Protection of Privacy Act* (FOIPPA). As outlined in Section 21 of the *FOIPPA*, acceptable harms to a proponent that would lead the province to refuse disclosure of information include, but are not limited to, the following:

- significant harm to the competitive position;
- significant interference with the negotiating position; or
- undue financial loss or gain to any person or organization.

Proponents are responsible for informing the MMO Project Lead in advance of the submission if they intend to submit information confidentially. When the information is submitted, Proponents must:

- demonstrate how the information in question meets the definition of 'Confidential Information';
- demonstrate how the information is covered by Section 21 of the *FOIPPA*;
- if the proposed confidential information is included in a larger, non-confidential document, ensure to:
    - provide the document with the proposed confidential information redacted and indicate where this has occurred in the document; and
    - provide the proposed confidential information in a separate document and clearly identify it as confidential; and
- if the proposed confidential information comprises the entire document, provide the document and clearly identify it as confidential.

The CPO and/or the ENV Section Head will determine if the information is consistent with the definition of 'Confidential Information'. If it is determined that the information does not meet the definition, the Proponent will be notified and required to submit the information unredacted.

1. Introduction and Project Overview

Provide contextual background information on the mining project, including Proponent identification, Application background, mine overview and development proposal, regulatory framework, and the mine design and assessment team.

1.1. Project Description

Provide a project description that outlines the proposed mine plan (if a new mine or mine expansion) or the key changes to an existing mine plan.

1.2. Proponent Information

Provide the following information for the operating company:

- overview, including the name, organization, and structure;
- registered legal name and registered address;
- name of the company representative managing the project;
- head office address and applicable contact names, phone and fax numbers, and email addresses; and
- contact information for key staff related to corporate health and safety, environmental management, community relations, etc.

1.3. Project Overview

1.3.1. Project History

Describe the project history leading up to the Application, including an overview of historic approvals and activities at the mine site and a list of previous reports, studies, designs, etc.

1.3.2. Overview of Products

Describe the product(s) that would be mined, production volume and rate, and projected mine life.

1.3.3. Location, Access, and Land Use

Provide an overview of current land uses, surrounding land uses, and downstream water use and users. Include figures/maps of the site showing all land use tenures, project location, and site access. List overlapping tenures including but not limited to:

- mineral, coal, and placer claims and leases;
- mineral, coal, and placer reserves;
- agricultural land reserves;
- surface ownership;
- crown tenures;
- land use planning polygons;
- old growth management areas;
- parks and protected areas;
- recreational sites and reserves;
- traplines;
- guide outfitter territories; and
- any other relevant land tenures.

Identify watersheds and Indigenous names of the geography in the area where applicable with phonetic spelling in parentheses. Reference latitude/longitude or UTM coordinates (noting coordinate reference system used and means of obtaining data).

1.3.4. Mine Components

Include introductory descriptions and associated detailed maps of the key mine components and on-site infrastructure. Ensure current conditions and any new project components are readily identifiable. Key components could include, but are not necessarily limited to, the following:

- open pits;
- underground workings;
- processing facilities, including crushing and conveying systems and concentrate handling;
- tailings storage facilities (TSFs);
- waste rock dumps;
- site water management facilities;
- water treatment facilities;
- ore stockpiles;
- overburden, soil, and construction stockpiles;
- borrow areas;
- haul roads;
- access and mine site roads;
- power supply and distribution;
- explosives facilities;
- ancillary buildings and other infrastructure (camps, loadout facilities, laydowns, offices, maintenance shops, etc.); and
- any other relevant facilities.

1.3.5. Mine Design and Assessment Team

Identify the consultants and individuals comprising the design and assessment team, along with their responsibilities and Application contributions. Ensure all technical assessments included in the Application are authenticated by a Qualified Professional (QP) registered in British Columbia.

1.3.6. Spatial Data

Spatial data requirements include the:

- physical disturbance proposed annually over the next 5 years and at the end of mine life;
- reclamation proposed annually over the next 5 years and at the end of mine life;
- proposed life of mine disturbance (Mine Plan) and reclamation program, which may be presented in regular interval segments (e.g., every five years) and/or as milestones;
- environmental sampling stations (on and off the mine site);
- existing and proposed site infrastructure (e.g., TSFs, waste rock dumps, ore stockpiles, soil stockpiles, water management structures, roads, borrow pits, building sites, landfills, exploration disturbances, etc.); and
- any other relevant project-specific attributes.

1.3.7. Concordance with Environmental Assessment Conditions

If an Environmental Assessment Certificate (EAC) exists for the project, include the following information:

- a summary table of permitting level issues raised, or commitments identified, during the Environmental Assessment (EA) process and where they are incorporated in the Application;
- a summary table of all applicable EAC conditions and where they are incorporated in the Application; and
- confirmation that the mine plan is consistent with the EAC project description.

1.4. Regulatory Framework

In this section, include:

- a description of current licenses/permits/authorizations associated with the mine; and
- a list of required licenses/permits/authorizations associated with the Application.

2. Indigenous Nation Engagement

This section contains general information to be included in an Application. Proponent engagement with individual Indigenous Nations may identify specific information requirements to consider. Note that the term Aboriginal Interests is defined as "*claimed or established treaty rights or Aboriginal rights (including title) that are recognized and affirmed under section 35 of the Constitution Act, 1982*."

2.1. Background

In this section:

- identify the Indigenous Nations potentially affected by the mine using the Public Consultative Areas Database[1]; and
- provide background information for each potentially affected Indigenous Nation including, but not limited to, ethnography, language, land use setting and planning, and governance including agreements pertaining to natural resource management, economy, and reserves.

2.2. Engagement Efforts and Information

In this section:

- summarize engagements undertaken with Indigenous Nations to date, including during the pre-application stage, and identify engagements planned during Application review;
- list any agreements reached between the Proponent and Indigenous Nations with respect to the preparation and review of the Application;
- list any additional information identified by Indigenous Nations as required for the Application;
- summarize methods and efforts to obtain information requested for inclusion by Indigenous Nations, such as Traditional Ecological Knowledge, Indigenous Law, processes and procedures (such as Indigenous Chance Find Procedures), or participation in field studies; and
- summarize in an issues-tracking table the key issues raised during engagement, such as cumulative effects or water quality (link to appropriate sections in this document), and the responses provided to Indigenous Nations.

2.3. Aboriginal Interests and Potential Project Impacts

In this section:

- summarize Aboriginal Interests that could potentially be adversely impacted by the project as learned by the Proponent from Indigenous Nations and other sources;
- identify potential adverse impacts of the project on Aboriginal Interests identified by First Nations and Indigenous Governing Bodies; and
- outline proposed mitigation measures designed to avoid, minimize, mitigate, or otherwise accommodate potential impacts to Aboriginal Interests including design considerations and other approaches (link to appropriate sections in this document).

2.4. Engagement and Participation Throughout Mine Life

In this section:

- outline strategies developed through engagement with Indigenous Nations that create opportunities for meaningful participation in post-mining land use planning, environmental monitoring programs, and reclamation activities; and

[1] https://www2.gov.bc.ca/gov/content/data/geographic-data-services/land-use/contacts-for-first-nation-consultation-areas

- outline opportunities for meaningful participation of Indigenous Nations in preliminary field reconnaissance and archaeology programs through all phases of mine life.

3. Baseline Information

Characterize and present baseline conditions, including pre-development (where available), and existing environmental conditions (before activities proposed in the Application affect the state of the environment) for the mine site and receiving environment.

For the baseline program, collect and assess sufficient information to:

- describe geology and topography;
- describe meteorological and climatic conditions;
- characterize surface water hydrology and groundwater hydrogeology;
- establish a water balance for the drainage area;
- document surface and groundwater use within and downstream of the project area;
- determine surface water, groundwater, and sediment quality prior to disturbance; and
- describe aquatic ecosystem attributes such as fish and fish habitat, tissue residues, and periphyton and benthic invertebrate communities.

Follow the detailed guidance provided in the Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators[2] and in the British Columbia Field Sampling Manual[3].

Please note that up to two years of recent baseline data may be required, depending on what is monitored (e.g., surface water quality vs. periphyton) and on the potential risk of the proposed activity to the environment. In addition to the required information as per the sections below, please provide, if applicable:

- a description of how baseline sampling locations have been coordinated among the various media types (e.g., air, water quality and quantity, benthic invertebrates, fish, etc.);
- an overview of the existing baseline data;
- a description of key physical, chemical, and biological characteristics of the receiving environment to which the baseline data relate; and
- the identity of sensitive receptors (including humans), valued components, and conditions relevant to potential impacts during the construction, operation, closure, and post-closure phases of the mine that determined the baseline data needs.

When not following the above referenced guidance documents, Proponents are encouraged to discuss with the Ministry of Environment and Climate Change Strategy (ENV), and potentially distribute a draft of the mine baseline monitoring program early in the development process to ensure the program will meet permitting requirements.

There may be some cases of amendments for which not all of the above information may be required. In this case, baseline and existing conditions information requirements need to be discussed with ENV before submission.

For all baseline information, please include data summary tables and tabulated raw data in appendices in electronic format with the Application, and, if applicable, upload data for storage in ENV's database.

[2] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf

[3] https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/laboratory-standards-quality-assurance/bc-field-sampling-manual

Please note that application requirements for air emission permits are not covered in this document. For these applications, please refer to the ENV Air Emissions Information Requirements Table[4] on the ENV website.

3.1. Meteorology and Climate

Describe how weather and climate will affect all aspects of the project. Summarize available and relevant meteorological and climate information and develop estimates of long-term baseline conditions at the mine property. Refer to detailed guidance provided in the Water and Air Baseline Monitoring Guidance Document[5].

Include the following information:

- a detailed map showing the location of site-specific and regional climate stations in relation to project facilities;
- a description of relevant local and regional meteorology and climate information sources;
- baseline data of normal and extreme ranges of the following climatic parameters at both monthly and annual intervals, including descriptions of the techniques used to determine them:
    - temperature;
    - precipitation (snowfall and rainfall);
    - snowpack;
    - evaporation;
    - solar radiation; and
    - wind speed and direction;
- recurrence interval analysis of extreme, short-duration events including rainfall, snowmelt, and wind speed;
- a minimum of two years of continuous site meteorological data, recorded at an appropriate sampling interval and directly incorporated into the above analyses;
- a quality control analysis of site-specific data to document and correct for erroneous measurements as well as detailed quality control and correction procedures;
- climate data, in an appendix, including site photos;
- an assessment of information gaps and a description of additional site-specific meteorological data collection proposed to augment existing data; and
- any other relevant information.

3.2. Geology

3.2.1. Deposit Geology

Summarize the mine site geology, including descriptions of major rock units, stratigraphy, structure, metamorphism, and geochemistry. Additionally, provide a detailed description of the ore deposit, including:

- ore deposit mineralogy (ore, gangue, waste, etc.), alteration type, deposit character, deposit classification, and age of mineralization;
- general ore controls; and
- average assay values and reserve information (proven, probable, and possible).

Include appropriate maps, figures, and cross-sections to illustrate the geologic setting and detailed mine site geology of the deposit at the appropriate scale(s).

[4] https://www2.gov.bc.ca/assets/gov/environment/waste-management/waste-discharge-authorization/guides/irt/irt-air-01_irt_for_air_emissions.pdf

[5] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf

3.2.2. Surficial Geology, Terrain, and Geohazard Mapping

Provide a summary of the surficial geology, terrain, and geohazard mapping for the mine site completed at a scale of 1:5,000 or as appropriate using the Terrain Classification System for British Columbia[6]. Show the resulting map polygons on appropriately scaled maps with the existing and proposed site infrastructure locations indicated. Encompass the footprints and upslope areas of all project infrastructure, including the mine site, access roads, Tailings Storage Facilities (TSFs), etc. Discuss the potential for the respective surficial deposits to act as groundwater pathways or barriers for contact water. Include any relevant hazards identified in Section 3.2.3 below on the maps.

The level of investigation and mapping associated with the surficial geology, terrain stability, and geohazards must be commensurate with the complexity of the geology and the site infrastructure.

3.2.3. Natural and Seismic Hazards Assessment

In this section:

- discuss natural hazards such as snow avalanches, landslides, geohazards, and earthquakes specific to the mine site, with reference to the mapping completed in Section 3.2.2 above;
- provide a seismic hazard assessment of the site; and
- discuss the potential impacts of natural hazards to proposed project infrastructure and refer to appropriate sections/documents containing a detailed assessment of risk and mitigation measures, where relevant.

3.2.4. Soil Survey and Soil Characterization for Reclamation

Provide a summary of the soil surveys for the mine footprint. Include supportive technical data such as soil classification and soil profile descriptions. Include the following soil survey information:

- identification and mapping of soil units;
- the location, depth, and volumes of soil types;
- potential soil and subsoil salvage locations;
- characterization of topsoil and subsoil for suitability as growth media for reclamation;
- characterization of soil hydraulic conductivity and potential for water infiltration;
- baseline soil metal concentrations;
- baseline soil nutrient information;
- a discussion of the potential for erosion; and
- any other relevant information.

3.3. Topography and Surface Drainage Features

Provide a description of the pre-mine topography and surface drainage features of the mine site and surrounding area. Supplement this description with maps, produced at a suitable scale, that demonstrate:

- drainage divides, areas of groundwater discharge, and locations of groundwater seeps, wetlands, and notable topographic features;
- the range of pre-mine slope configurations and typical slope cross-sections (including accompanying descriptions); and
- the entire drainage basin(s) in which the mine is located.

3.4. Water Quantity

3.4.1. Surface Water Quantity

Describe the existing hydrologic regime at the project location. Summarize available hydrological information relevant to the mine property and downstream receiving environment. A minimum of 24 consecutive months of site-specific monitoring data are required, and more are preferred, to assess trends

[6] https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/terclass_system_1997.pdf

and seasonal variation. Refer to detailed guidance provided in the Water and Air Baseline Monitoring Guidance Document[7].

Include the following information:

- a description of pre-mine topography and surface drainage features;
- detailed maps showing drainage basins (local and regional) that will be affected by the mine, areas of groundwater discharge, wetlands, licensed surface water extraction locations, and notable hydrologic features (e.g., glaciers, lakes, etc.);
- a detailed map showing the location of relevant site-specific and regional hydrology stations in relation to project facilities, and a summary of relevant station metadata including period of record, drainage area, basin elevation, and % area of notable hydrologic features (e.g., glaciers, lakes, etc.);
- evidence of continuous hydrometric data collection for drainages potentially affected by effluent discharge, water diversions, and seepages from waste rock and TSFs;
- a description and justification of baseline study design, methods of hydrometric station installation, sampling methods, Quality Assurance/Quality Control (QA/QC) procedures, and assignment of data grades as described in the Manual of British Columbia Hydrometric Standards[8];
- identification of spatial or temporal data gaps in the database and a description of additional site-specific data collection proposed to augment existing data;
- continuous site hydrology data directly incorporated into the following analyses:
    - a detailed hydrologic analysis of key surface drainages within and downstream of the project area to estimate long-term seasonal flow regimes;
    - a definition of monthly and annual streamflow normals and variability and critical low flow metrics; and
    - recurrence interval analyses of peak and low-flow events (instantaneous, annual, etc., as appropriate);
- demonstration of a reasonable balance between precipitation, snowpack, evapotranspiration, sublimation, and total runoff (surface and sub-surface flow) on an average annual basis;
- all hydrological datasets, including rating curves, manual measurements, plots of site-specific discharge, site photos, etc.;
- a summary of the predicted effects of climate change on the future climate and hydrology of the project area; and
- any other relevant information.

3.4.2. Groundwater Quantity

For groundwater, a minimum of one year of quarterly groundwater data (water levels) is required.

Describe the existing/baseline hydrogeological regime at the project location. Summarize available hydrogeological information relevant to the mine property and the receiving environment. Collection of continuous water level data is recommended to assess seasonal variations during the baseline evaluation of the project. Refer to guidance on groundwater baseline monitoring provided in the Water and Air Baseline Monitoring Guidance Document[9].

Include the following information:

- a description of the groundwater monitoring network, including the following:
    - plan-view map showing the groundwater monitoring well locations;
    - borehole and well logs; and

[7] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf
[8] https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/man_bc_hydrometric_stand_v2.pdf
[9] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf

    - tabulated monitoring well completion details including location, elevation, depth and well screen intervals, lithologic log, and hydraulic parameter estimates;
- a description of the groundwater monitoring program, including the following:
    - frequency of water level monitoring and groundwater sampling;
    - groundwater level monitoring methods (e.g., manual or automated);
    - sampling methods (including methods to achieve low sample turbidity);
    - analytical parameters being measured; and
    - QA/QC procedures;
- a description of the aquifers and aquitards surrounding the mine, including areas downstream of the mine property, with a description of the geometry (boundaries, lateral extent, and thickness) and hydraulic properties (hydraulic conductivity, transmissivity, anisotropy, specific yield, storativity, and effective porosity);
- a characterization of bedrock structures that could influence infiltration, flow directions, and seepage rates;
- a quantitative description of historical, existing, and planned groundwater extraction, including a reference to existing water licenses associated with the aquifers and surface watercourses that could be affected by mine water management activities (e.g., dewatering);
- an evaluation of horizontal and vertical hydraulic gradients for each hydrostratigraphic unit;
- a characterization of the baseline groundwater flow conditions that includes plan-view maps of interpreted groundwater level contours and flow directions and hydrogeological cross-sections showing aquifers and aquitards, areas of recharge and discharge, groundwater elevation measurements, time-series plots of measured groundwater elevations, and interpreted groundwater flow directions;
- an evaluation of groundwater and surface water interaction for important watercourses, including a plan map illustrating gaining and losing stream reaches;
- an evaluation of seasonal variability in groundwater levels between high and low water conditions, including groundwater hydrographs with precipitation to evaluate typical seasonal changes in groundwater levels for each hydrostratigraphic unit; and
- any other relevant information.

3.5. Water Quality

Describe the baseline water quality conditions present before project development. The linkages between surface water and groundwater quality must be clearly identified.

Provide raw data in a tabulated form, including applicable method detection limits and water quality guideline exceedances (in appendices and as Microsoft® Excel®-compatible electronic files).

3.5.1. Surface Water Quality

If pilot study data are not available for surface water to determine statistical power *a priori*, a minimum of monthly sampling for at least 24 months with additional weekly sampling (i.e., 5 samples in 30 days) during periods of maximum hydrograph fluctuation (e.g., freshet or fall rains and/or biologically relevant periods) at core baseline sampling locations is required. Determine if provincial Water Quality Guidelines (WQGs)[10] or Water Quality Objectives (WQOs)[11] have been attained. Where no provincial WQGs exist, attainment of Canadian Council of Ministers of the Environment (CCME) Guidelines[12] and Federal Environmental Quality Guidelines[13] is to be determined. This should be followed for all comparisons with a determination

[10] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines
[11] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-objectives
[12] https://ccme.ca/en/summary-table
[13] https://www.canada.ca/en/health-canada/services/chemical-substances/fact-sheets/federal-environmental-quality-guidelines.html

of exceedances of WQGs indicated in the text below. Assess seasonal and inter-annual variation. Refer to detailed guidance provided in the Water and Air Baseline Monitoring Guidance Document[14].

Where existing natural conditions exceed WQGs, natural toxicity modifying factors are identified in the baseline water quality dataset, and/or the most sensitive taxonomic groups used to develop the WQGs are absent, the Proponent may consider development of site-specific Science-based Environmental Benchmarks (SBEBs)[15]. Before embarking on SBEB development, contact ENV for further information and review (see Technical Guidance 8 Environmental Management Act Applications - A Framework for the Development and Use of Freshwater Science-Based Environmental Benchmarks for Aquatic Life in Environmental Management Act Permitting for Mines[16]).

In this section:

- identify downstream surface water uses (e.g., aquatic life, drinking, irrigation, livestock watering, and wildlife water use) and associated water licenses, where applicable;
- document and describe the rationale for the baseline study design, including:
    - collection methods;
    - parameters analyzed (for a recommended list, refer to the Water and Air Baseline Monitoring Guidance Document[17]);
    - field instrumentation;
    - sampling frequency and period, including high-, medium-, and low-flow periods;
    - site locations;
    - statistical considerations; and
    - QA/QC protocols;
- provide a detailed map showing water quality sampling locations, including proposed or existing discharge locations and areas of disturbance;
- name the certified laboratories used to analyze samples;
- provide a summary of surface water quality data, including summary tables organized by parameter, sample location, and date; and
- provide a summary of the QA/QC results.

For lakes, provide limnological characterizations at a representative deep station for each basin. Sampling design should be adequate to support determination of trophic status. In this section:

- identify sample locations and time windows or seasonality when existing surface water quality may exceed provincial WQGs[18], approved WQOs[19] or applicable CCME guidelines[20];
- clearly document the frequency and magnitude of exceedances;
- identify which data reflect unimpacted baseline conditions versus conditions affected by previous development (e.g., exploration activities, historical mining activities);
- use the principles of mass balance, as required, to establish the degree to which groundwater quality influences surface water quality throughout the range of flow rates, and the degree to which groundwater contributes to streamflow, as supported by the data, methods, analysis, and conclusions;

[14] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf
[15] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/tg8_framework_for_sbebs.pdf
[16] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/tg8_framework_for_sbebs.pdf
[17] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf
[18] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines
[19] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-objectives
[20] https://ccme.ca/en/summary-table

- illustrate spatial and temporal variation(s) in key parameters among sites using graphs that show variability in data (e.g., box plots);
- conduct surface water toxicity tests, if required (this may be needed if WQGs are exceeded due to historic mining or site disturbance and should be discussed with ENV staff);
- identify spatial and/or temporal data gaps in the database; and
- provide any other relevant information.

3.5.2. Groundwater Quality

The minimum period of record for the groundwater quality baseline study is one year of quarterly data, which allows for an assessment of seasonal variability.

Please review the Water and Air Baseline Monitoring Guidance Document[21] for details.

Describe the existing groundwater chemistry regime across the mine site and in the identified water-bearing strata. Include a description of well installation and development methods, and steps taken to ensure samples collected are representative and equilibrated with the surrounding groundwater system.

In this section:

- Summarize and describe the rationale for the baseline study design, including:
  - parameters analyzed;
  - collection methods;
  - field instrumentation;
  - sampling frequency and period;
  - site locations;
  - depth of screen completions and associated hydrostratigraphic units;
  - sample dates and size;
  - statistical considerations; and
  - QA/QC protocols;
- provide a detailed map of groundwater quality sampling locations, proposed and/or existing effluent discharge points to surface water, areas of contact water recharge to groundwater, and the arrangement of mine elements;
- name the certified laboratories used to analyze samples;
- provide a summary of groundwater chemistry, including summary tables organized by parameter, site, date, and hydrostratigraphic unit;
- provide a summary of QA/QC results;
- indicate those samples with values that would classify them as Parameters of Concern (POCs)[22];
- indicate those samples with turbidity values greater than 200 NTU and discuss the influence of turbidity on concentrations of POCs in any interpretative discussions;
- identify which data reflect unimpacted baseline conditions versus conditions affected by previous development (e.g., exploration activities, historical mining activities);
- illustrate spatial and temporal variation(s) in key parameters and among sites using maps, cross-sections, and graphs that illustrate data variability (e.g., box and whisker, time series, Piper plot, etc.);

[21] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf

[22] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/parameter_of_concern_fs.pdf

- identify sample locations and time windows or seasonality when baseline groundwater quality may exceed standards as per the BC Contaminated Sites Regulation[23] for each POC and/or WQGs[24] for each POC;
- assess the degree to which surface water quality is influenced by groundwater quality during periods of low flow, and the amount of flow that is contributed by groundwater discharge;
- prioritize the environmental receptors according to their potential sensitivity to groundwater discharge that could potentially include contact water;
- identify spatial and/or temporal gaps in the database; and
- provide any other relevant information.

3.6. Sediment Quality

Sediments must be sampled a minimum of once per year during summer low-flow periods before any mine construction or operation may influence sediment quality. Refer to detailed guidance provided in the Water and Air Baseline Monitoring Guidance Document[25].

For situations where baseline sediment conditions exceed guidelines, or when historic mining or other disturbances are potentially contributing to baseline sediment toxicity, discuss with ENV the need to simultaneously conduct extracted metals/acid volatile sulfides analyses and sediment toxicity testing.

In this section:

- document and describe the rationale for the baseline study design, including:
  - parameters analyzed (refer to the Water and Air Baseline Monitoring Guidance Document[26] for a recommended list);
  - field instrumentation;
  - sampling frequency and period;
  - site locations;
  - statistical considerations;
  - collection methods, including a rationale for the size fractions and the collection of samples from lotic and lentic environments; and
  - QA/QC protocols;
- identify those sample sites that appear to be influenced by groundwater discharge or could potentially receive contact water via groundwater discharge in the future;
- name the certified laboratories used to analyze samples;
- provide a summary table listing sample site locations, sample dates, sample size, and the rationale/purpose of each site;
- identify which data reflect unimpacted baseline conditions versus conditions affected by previous development (e.g., exploration activities, historical mining activities);
- include a detailed map of sampling locations as well as proposed or existing discharge locations and areas of disturbance;
- illustrate spatial and temporal variation in key parameters among sites using graphs or other appropriate tables or figures;

[23] https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/375_96_01

[24] BC WQGs: https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines; CCME WQGs: https://ccme.ca/en/summary-table; Federal Environmental Quality Guidelines: https://www.canada.ca/en/health-canada/services/chemical-substances/fact-sheets/federal-environmental-quality-guidelines.html

[25] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf

[26] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf

- compare, tabulate, and map existing sediment quality conditions relative to provincial WQGs[27] or (where provincial guidelines do not exist) the Canadian Council of Ministers of the Environment (CCME) Sediment Quality Guidelines for the Protection of Aquatic Life[28] (threshold or probable effect levels);
- identify spatial and/or temporal gaps in the database; and
- provide any other relevant information.

3.7. Fisheries and Aquatic Resources

Aquatic life baseline studies characterizing ecosystem health are important for new mining projects and amendments that could result in changes to aquatic conditions (e.g., water quality or habitat changes). Ensure the studies include components that may be affected by the mine, such as, but not necessarily limited to, plankton, periphyton, benthic invertebrates, shellfish, fish and fish habitat, macrophytes, and biological tissues. The complexity and types of aquatic and marine habitats potentially impacted, and the nature of the mine operation, will inform which aquatic organisms are identified for the baseline studies. It is recommended to discuss study designs with ENV Environmental Impact Assessment Biologists and Ministry of Forests (FOR) Fish Biologists.

Use appropriate biological monitoring tools to collect and present sufficient data to identify pre-project conditions to be used for comparison throughout the mine life. For most aquatic resources, sample collection should occur at minimum once per year during the summer/fall low flow period. A minimum of 1-2 years of annual data, depending on the specific target group, is required. A minimum of 2 years of annual data is required at sites where inter-annual variability can be expected. Provide a suitable characterization of biological communities prior to development. If fewer than 2 years of sampling/monitoring is proposed, it must be demonstrated, to the satisfaction of ENV technical staff, that sufficient data are available to adequately characterize the baseline conditions. Refer to detailed guidance provided in the Water and Air Baseline Monitoring Guidance Document[29].

For applications for discharges to streams, include the information outlined in the subsections below; lake and marine environments will require additional data collection. Discuss this further with ENV staff during the Information Requirements Table (IRT) development phase.

3.7.1. Periphyton and Benthic Invertebrate Community Measures

Use natural or artificial substrates for periphyton sampling; in either case, collect sufficient replicates to characterize variability of the site.

For benthic invertebrates, ENV recommends using the Reference Condition Approach sampling design using Canadian Aquatic Biomonitoring Network (CABIN) protocols, outlined in the CABIN field manual[30]. Most regions of the province have a predictive model within the CABIN database that can be used for data assessment. A Before After Control Impact (BACI) design using replicate samples (e.g., using a Hess sampler) is also a common approach.

In this section:

- document and describe the rationale for the study design, including:
    - collection methods (including number of replicates where the BACI approach is applicable);
    - organisms or communities analyzed;
    - sampling frequency and period;

[27] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines
[28] http://ceqg-rcqe.ccme.ca/en/index.html
[29] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf
[30] http://publications.gc.ca/collections/collection_2012/ec/En84-87-2012-eng.pdf

    - site locations;
    - statistical considerations; and
    - QA/QC protocols;
- name the certified laboratories used to analyze samples;
- provide maps of sampling sites relative to disturbance areas, seepage and discharge locations, and water quality and quantity sampling locations;
- summarize periphyton and benthic invertebrate community data;
- identify which data reflect unimpacted baseline conditions versus conditions affected by previous development (e.g., exploration activities, historical mining activities); and
- identify spatial and/or temporal gaps in the database.

For BACI designs, demonstrate that sufficient data have been collected to enable detection of biologically significant changes post-project development. Report the *a priori* statistical power of the sampling plan to provide an understanding of the program's strengths and weaknesses.

3.7.2. Fish and Fish Habitat

Resident fish populations and habitat are under the provincial jurisdiction of the Ministry of Water, Land, and Resource Stewardship (WLRS).

Contact regional WLRS fisheries staff for scientific collection permits and ensure study methods are consistent with regional and provincial protocols. In addition to information requested by WLRS:

- document and describe the rationale for the study design, including:
    - collection methods;
    - organisms or communities analyzed;
    - sampling frequency and period;
    - site locations;
    - statistical considerations; and
    - QA/QC protocols;
- provide maps of sampling and stream reach survey locations;
- identify the areas, if any, where groundwater discharge is higher than normal and whether this groundwater discharge is potentially influencing fish habitat;
- describe fish populations and determine the presence of provincially listed species and ecological communities[31] (red or blue listed), federally listed species (Committee on the Status of Endangered Wildlife in Canada[32] and Species at Risk Act[33]), and populations that are genetically distinct;
- describe the current and/or potential use of fish resources by Indigenous Nations or communities and/or sport and/or commercial fisheries;
- assess and describe fish habitat (spawning, over-wintering, rearing, etc.) relative to access roads and utility corridors, waste rock piles, and effluent discharge or seepage locations;
- identify which data reflect unimpacted baseline conditions versus conditions affected by previous development (e.g., exploration activities, historical mining activities);
- provide a brief description and rationale for a conceptual Fish Habitat Compensation Plan, if applicable;
- identify spatial and/or temporal gaps in the database; and
- provide any other relevant information.

3.7.3. Tissue Residues

A baseline study that develops a tissue residue database for fish and/or other organisms for metals, metalloids, and organic contaminants that have the potential to accumulate in tissue as well as tissue

[31] https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre/explore-cdc-data/red-blue-yellow-lists
[32] https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-list-species-assessed.html
[33] https://laws-lois.justice.gc.ca/eng/acts/s-15.3/

moisture content is required before any mine construction and operation that may affect tissue concentrations commences. Consider the animal's life history when selecting a fish species (or other organisms) for tissue residue analyses. Species with high site fidelity are preferred for environmental impact assessment. In addition, analyze species and tissues humans consume if human health risk assessments are the focus (including species used by Indigenous Nations).

Specifically:

- document and describe the rationale for the study design, including:
  - species and tissue types (e.g., full fish, gonads, liver, or muscle) analyzed;
  - size and life stage of specimen collected;
  - collection methods and frequency;
  - site locations;
  - statistical considerations; and
  - QA/QC protocols;
- identify which data reflect unimpacted baseline conditions versus conditions affected by previous development (e.g., exploration activities, historical mining activities);
- provide maps illustrating sampling sites relative to disturbance areas, seepage, and discharge locations;
- provide a summary table of the concentrations of contaminants in fish tissues, and compare baseline conditions relative to provincial WQGs[34] or Canadian Tissue Residue Guidelines[35];
- illustrate graphically the spatial and/or temporal variance(s) in key parameters among sites;
- identify spatial and/or temporal gaps in the database; and
- provide any other relevant information.

3.8. Ecosystems and Wildlife

In this section, include:

- a summary of Terrestrial Ecosystem Mapping, Predictive Ecosystem Mapping, and the location of rare plants and ecosystems[36] as well as invasive species;
- wildlife habitat suitability mapping, results of aerial wildlife surveys, and a description and location of any key wildlife features or habitats, including any species or ecological communities at risk;
- bio-terrain mapping;
- a description of on-site and adjacent terrestrial and aquatic ecosystems; and
- other relevant information, as appropriate.

In situations where existing or historic mining activities may have contributed to, or the proposed project is likely to lead to, increased metal concentrations in plants, vegetation metals analyses might be required. This is particularly important where Indigenous Nations use plants in areas potentially affected by the proposed mining project.

3.9. Potential Receptors of Mine-related Influences

Provide an inventory of potential biological receptors affected by the proposed project, including but not limited to species and ecological communities at risk. This information is to be included in the Conceptual Site Model as required under Section 6.3 of this document.

[34] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines
[35] https://ccme.ca/en/resources/tissue-residue
[36] https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre/explore-cdc-data/red-blue-yellow-lists

Water licences for domestic, irrigation, and livestock watering and existing recreational uses in receiving waters need to be tabulated and their locations identified on a map.

This section should also include evidence of consultation with Indigenous Nations regarding land use, wildlife, and vegetation and the results of such consultation regarding Indigenous use of water and potential receptors.

3.10. Land Status and Use

In this section, include:

- mapping and a summary of pre-mine land surface and mineral rights, and licensed or permitted users such as forestry, guides, outfitters, and trappers;
- descriptions of:
    - existing transportation routes (e.g., roads or waterways) within or adjacent to the mine site (also show these on maps/figures);
    - any known use or interest by Indigenous Nations;
    - any informal users who are not necessarily licensed (e.g., recreational users);
    - any known local land use and settlement patterns; and
    - on-site and adjacent terrestrial and aquatic ecosystems; and
- any other relevant information.

3.11. Archaeology

Provide maps and descriptions for all identified archaeological sites in the project impact zone. Maps based on those provided in the final Archaeological Impact Assessment (AIA) report may be adequate as overview maps. Provide detailed maps at a 1:500 scale for any sites that will be subject to additional systematic data collection under Heritage Conservation Act (HCA) Section 12 permits[37].

Provide the site descriptions in tabular format, including the Borden number, general location, previous work (whether an AIA was completed, site collected completely, or site avoided), and proposed mitigation (no further work, alteration under HCA Section 12, or mitigation under Section 14).

Provide a description of the required HCA permitting and concurrent archaeological activity, including (where applicable) the main terms and conditions of HCA Section 14 investigation permit(s) and the methodologies for HCA Section 14 inspection permit(s), the proposed HCA Section 12 alteration permit(s), and the Section 14 inspection permit for incidental finds during construction.

Provide a description of (and a commitment to) a chance-finds procedure and education of the construction crew. Terms of HCA Section 12 site alteration permits and Section 14 inspection permits, for incidental finds during construction, state that no land alteration may occur without an archaeologist on site to monitor and who has the authority to stop excavation as deemed necessary so that any archaeological resources can be handled under the terms of the permit.

3.12. Cultural Use

Provide a summary of the cultural use of the area as identified by Indigenous Nations. Provide maps and descriptions for all identified cultural sites (if known) in the project impact zone.

[37] http://www.bclaws.ca/civix/document/id/complete/statreg/96187_01

4. Mine Plan

4.1. Mine Plan Overview

Provide a brief overview of the mine plan including:

- mining methods;
- mining rates;
- projected mine life;
- processing methods;
- infrastructure requirements;
- supporting maps (as described in the Health, Safety, and Reclamation Code (HSRC)); and
- any other relevant information.

4.2. Existing and Permitted Mine Plan

Provide an overview of the existing disturbances and infrastructure on the mine site, as applicable:

- inventory of all mining waste materials (waste rock, tailings, overburden, rejects, etc.), including type, volume, and storage locations;
- description and configuration, including dimensions and storage capacity, of each waste rock dump, Tailings Storage Facility (TSF), stockpile, etc.;
- description and configuration of each open pit;
- description and configuration of underground workings including all openings to surface and surface crown pillars;
- description and configuration, including dimensions and capacity, of each sediment pond, dam, or other impoundment; and
- maps showing all mine infrastructure listed above.

Provide a summary of the currently permitted activities and infrastructure that are not yet developed, as applicable:

- inventory of all mining waste materials (waste rock, tailings, overburden, rejects, etc.), including type, volume, and storage locations;
- description and configuration, including dimensions and storage capacity, of each waste rock dump, TSF, stockpile, etc.;
- description and configuration of each open pit;
- description and configuration of underground workings including all openings to surface and surface crown pillars;
- description and configuration, including dimensions and capacity, of each sediment pond, dam, or other impoundment; and
- maps showing all mine infrastructure listed above.

4.3. Proposed Mine Plan

Provide an overview of the Life of Mine (LOM) plan, clearly indicating how the LOM plan has changed from the last *Mines Act (MA)* approval.

Provide a detailed, year-by-year, mine plan for the next five years (i.e., 5 Year Mine Plan; 5YMP), unless the Application will be for less than 5 years of mining, that clearly outlines the proposed mining activities and infrastructure. The 5YMP must demonstrate how the proposed mining activities and infrastructure align with, or differ from, previous *MA* approvals.

The LOM plan and 5YMP must include the following information, as applicable:

- mine development sequence and schedule for all mine components:

    - the LOM plan must include the mine development sequence for all phases of mine life at a frequency of at least every 5 years (construction, operation, closure, and post-closure); and
    - the 5YMP must include the mine development sequence for at least the next five years at no less than an annual frequency;
- inventory of all mining waste materials (waste rock, tailings, overburden, rejects, etc.), including type, volume, storage locations, and scheduled sequencing;
- description and configuration, including dimensions and storage capacity, of each waste rock dump, TSF, stockpile, etc.;
- ongoing and completed reclamation areas;
- mine road construction and significant transportation or utilities infrastructure;
- water management and treatment infrastructure;
- planned investigation works;
- maps showing all mine infrastructure and the above activities:
    - the LOM plan must include maps at a frequency no less than every 5 years; and
    - the 5YMP must include maps at no less than an annual frequency;
- a summary of the components of the proposed mine plan that require authorization under the *MA* and *Environmental Management Act (EMA)*;
- a summary of components of the proposed mine plan that may require review under the *Environmental Assessment Act* and regulations;
- a summary of the components of the proposed mine plan for which the Proponent is not seeking authorization at this time; and
- any other relevant information.

Mine plan maps must show the locations and footprints of mine infrastructure (existing, permitted, and proposed), including, but not limited to:

- open pits;
- underground workings;
- processing plant (mill) and associated facilities (crushers, conveyors, etc.);
- TSFs and water management facilities with dams and associated infrastructure;
- dumps and stockpiles;
- water management structures (including water treatment systems);
- mine roads;
- power supply and distribution infrastructure;
- explosives storage facilities;
- ancillary buildings and support infrastructure (camps, loadout facilities, laydowns, offices, maintenance shops, etc.);
- waste discharge locations; and
- any other relevant facilities.

4.4. Mine Facility Engineering Designs

Provide designs for the proposed mine facilities or proposed changes to existing or permitted facilities, including, but not limited to:

- open pits;
- underground workings;
- TSFs, dams, and associated infrastructure;
- dumps and stockpiles;
- water management structures;
- mine roads;
- processing plant (mill) and associated facilities (crushers, conveyors, etc.); and
- any other relevant facilities.

Information Requirements (IRs) for each mine facility are provided in Sections 4.4.1 through 4.4.8 of this document and are in addition to the Application requirements found in Part 10 of the HSRC. Additional supporting information to satisfy the IRs can be found in the Part 10 Guidance Document[38].

Engineering designs are required for each mine facility. The level of engineering design required depends on the facility, its risk profile, and the timing of implementation. The three design levels outlined in this section include:

- *Detailed Design Level*. This report precedes the issuance of Issued for Construction (IFC) design documents. Additional targeted site investigations or analyses prior to or during construction to fill in gaps identified during the *Detailed Design Level* stage are acceptable.

- *Feasibility Design Level.* This is an earlier stage of engineering effort and confidence in project execution than the *Detailed Design Level.*

- *Preliminary Designs.* This can be pre-feasibility or conceptual where the broad objectives and criteria of the facility are demonstrated. These may be provided in the form of a set of drawings with supporting documentation or as a report.

The types of data and analysis for each type of infrastructure will vary based on the design level. The definitions in the following accepted industry guidelines should be used to determine the *Detailed Design Level*, *Feasibility Design Level*, and *Preliminary Design Level*:

- For TSFs and dams:
  - *Site Characterization for Dam Foundations in BC. EGBC Professional Practice Guideline*. 2016. (Section 2.2.2)
- For open pits:
  - *Guidelines for Open Pit Slope Design*. Read, J. and Stacey, P. 2009. (Section 8.5)
- For waste dumps and stockpiles:
  - *Guidelines for Mine Waste Dump and Stockpile Design*. Hawley and Cunning. 2017. (Sections 2.5 to 2.10)
  - *Mined Rock and Overburden Piles – Investigation and Design Manual – Interim Guidelines*. British Columbia Mine Waste Rock Pile Research Committee, 1991. (Section 2.2)

All design reports must provide details of what will be constructed and be consistent with generally accepted industry guidance and the HSRC. Where generally accepted industry guidance is not followed, written justification from the design engineer must be provided in the design report. The studies and analyses to support the design must be advanced such that the design criteria can be demonstrated to be satisfied.

Within the design reports, the site must be adequately characterized, design criteria clearly stated, assumptions defended, suitable borrow and other material sources identified, stability analyses completed for critical stages, and the design reports indicated to be completed to a '*Detailed Design', 'Feasibility Design',* or *'Preliminary Design'* engineering stage. A reasonable level of conservatism must be built into the design such that a substantial change to the design is unlikely to be required.

All designs and design reports required in the sections below must be complete and final. Draft documents are not acceptable. **Additionally, all designs and design reports must be authenticated by a Professional Engineer (or other Qualified Professional (QP) as specified in the sections below) in accordance with Engineers and Geoscientists BC (EGBC) document authentication requirements.**

[38] https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/health-safety/health-safety-and-reclamation-code-for-mines-in-british-columbia/health-safety-reclamation-code-guidance

If an information requirement is not applicable to the Application, a rationale must be provided why it is not applicable.

4.4.1. Open Pits

At a minimum, provide a *Feasibility Design Level* open pit slope design report. All open pit design reports must include the following:

- drawings, plans, sections, and figures projected over the LOM, as required to illustrate the pit slope design and the design criteria;
- assessment of risks posed by geohazards and mitigation measures;
- site investigation information collected from the proposed open pit area, including geological and geotechnical information;
- pit slope design criteria, in accordance with accepted industry guidelines[39], based on the site characterization for all critical pit phases;
- pit slope designs including bench scale details, inter-ramp angles, and overall slope angles;
- stability assessments to support the pit slope design;
- risk assessments, including hazard identification, consequence, monitoring, and mitigation strategies;
- monitoring requirements for the pit walls;
- any recommendations to address design gaps, such as additional detailed investigations or analyses (if required); and
- any other relevant information.

Design reports for open pits that are more than 30 m deep, contain a multi-benched slope, or are otherwise reasonably considered high risk require the following additional information:

- site investigation information collected from the proposed open pit area, including geological and geotechnical information obtained from subsurface investigations, *in situ* testing, laboratory testing, and mapping;
- pit slope design criteria and design basis information and assumptions used to develop the pit design, including:
    - a geological model;
    - a structural model;
    - a hydrogeological model; and
    - a geotechnical model;
- relevant failure mechanisms (including kinematic and rock mass failure) for all critical/controlling design sections, including critical temporary slopes;
- stability analyses, demonstrating design criteria are met for critical interim and final configurations, including:
    - identification and justification for all input parameters and phreatic conditions;
    - a sensitivity assessment of critical assumptions; and
    - figures showing the analysis model and critical failure surfaces;
- a description of pit water management (surface water diversion, groundwater dewatering, and slope depressurization), including the following:
    - design criteria;
    - water management infrastructure design; and
    - a depressurization plan (i.e., number, location, spacing, depths of drains or wells); and
- any other relevant information.

4.4.2. Underground Workings

At a minimum, provide a *Feasibility Design Level* underground design report. All underground design reports must include the following:

[39]Example: Read, J. and Stacey, P. 2009. Guidelines for Open Pit Slope Design. CRC Press: Boca Raton, FL.

- plans and sections showing all existing and proposed underground workings, including locations of all existing portals, shafts, and stopes that break through to surface and areas of subsidence;
- assessment of risks posed by geohazards and mitigation measures;
- site investigation information collected from the proposed underground mine area, including geological and geotechnical information obtained from subsurface investigations, *in situ* testing, laboratory testing, and mapping;
- a Ground Control Management Plan (GCMP) that includes the following components:
    - designs of the method of underground development including dimensions of excavations, portals, shafts, pillars, crown pillars, planned breakthroughs to surface, extent of surface subsidence, areas of enhanced hydraulic connectivity between surface and underground, etc.;
    - design criteria and design basis information and assumptions used to develop the mine design and the ground control program, including:
        - a geological model;
        - a structural model;
        - a hydrogeological model;
        - a geotechnical model including stress; and
        - historical experience;
    - stability analyses, including relevant failure mechanisms;
    - predicted extent and magnitude of surface subsidence and hydraulic connectivity between the surface and underground;
    - ground support designs, including material selection, dimensioning, spacing, and extent;
    - details of the ground control program, including roles, responsibilities, accountabilities, implementation, records and communications, and a schedule for reviews and updates;
    - water control measures, including specific precautions to be taken where bodies of water, water-bearing structures, overburden, mud, tailings, etc., may inundate the mine workings;
    - locations and designs for any bulkheads, tunnel plugs, and dams storing water and/or saturated material, including those required for closure;
    - an instrumentation and monitoring program to verify acceptable performance, detect early signs of instability, and confirm design basis information and assumptions;
    - a QA/QC program; and
    - a communication program (i.e., Ground Control Logbook, hazard communication, and shift/crossover communication);
- relevant standards and procedures to ensure worker safety;
- contingency plans;
- consequences of failure;
- sensitivity analyses to provide the basis for design and critical assumptions;
- any recommendations to address design gaps, such as additional detailed investigations or analyses (if required); and
- any other relevant information.

4.4.3. Tailings Storage Facilities, Dams, and Associated Infrastructure

This section applies to TSFs, dams, and associated infrastructure that are required as part of the facility design, including spillways, seepage collection ponds, diversions, drainage channels, etc.

Information requirements for TSFs and dams are categorized by the type of facility in the following sections.

Information requirements for other surface water management structures not associated with dams, such as ponds/impoundments and other diversion channels, are included in later sections of this document, e.g., Section 4.4.5.

4.4.3.1. Small Dams

Revisions to Part 10 of the HSRC are anticipated in 2024. The anticipated revisions are for TSF and dam HSRC requirements, including exemptions for small dams meeting certain size, consequence, and design criteria. Definitions for Category 1 and Category 2 dams and potential exemptions to HSRC requirements will be specified in the revision to the HSRC.

Proposed Category 1 dams that are designed to settle suspended solids prior to discharging water to the environment, at a minimum, need to be clearly identified in a mine plan. Additional information noted in this section or Section 4.4.5.1 below may be required on a project-specific basis and should be discussed with the Ministry of Energy, Mines and Low Carbon Innovation (EMLI) and Ministry of Environment and Climate Change Strategy (ENV).

With the exception of Category 1 dams, *small dams* are defined as meeting all the following criteria (per Category 2 dams of the 2024 HSRC revision):

- is less than 2.5 m in height;
- has a maximum storage volume of 30,000 m^3;
- has a dam slope of 2H:1V or flatter;
- does not contain or impound tailings; and
- has a "Low" Consequence Classification.

At a minimum, provide *Preliminary Designs* for *small dams*. All designs must include the following:

- description of the facility, including purpose, location, storage capacity, dam configuration (height, slope angles, etc.), design life, etc.;
- statement of the design criteria and rationale for the selected design criteria, including, but not limited to:
    - environmental criteria, such as retention time to reduce Total Suspended Solids (TSS);
    - design flood;
    - seismic criteria;
    - factors of safety;
    - minimum freeboard; and
    - Consequence Classification; and
- Integration into the Site-wide Water Balance Model (Section 6.6 this document) and Mine Site Water Management Plan (Section 10.6 this document).

4.4.3.2. Low Consequence Classification Dams

At a minimum, provide a *Feasibility Design Level* design report for dams with a "Low" Consequence Classification that do not meet the definition of a *small dam*. All Low Consequence dam design reports must include the following:

- drawings, plans, sections, and figures projected over the life of mine, as required to illustrate the dam design and the design criteria;
- description of the facilities, including purpose, location, storage capacity, design life, etc.;
- assessment of risks posed by geohazards and mitigation measures;
- site characterization, including geotechnical site investigation information collected from the dam footprint obtained from subsurface investigations, *in situ* testing, laboratory testing, and mapping;
- foundation investigation, in accordance with EGBC guidelines[40], including a completed letter of assurance;
- risk assessment, and risk mitigation and management measures;
- Consequence Classification of the facility supported by a dam break and inundation study;
- a design basis document that includes the design criteria, including, but not limited to:
    - design flood and justification for its selection;

[40] https://www.egbc.ca/getmedia/13381165-a596-48c2-bc31-2c7f89966d0d/2016_Site-Characterization-for-Dam-Foundations_WEB_V1-2.aspx

    - seismic criteria;
    - factors of safety; and
    - minimum freeboard;
- foundation conditions, construction materials, and properties;
- assessment of potential for static and seismic liquefaction for foundation materials and construction materials;
- stability analyses, demonstrating design criteria are met, which:
    - identify and justify input parameters including phreatic conditions; and
    - include figures showing the analysis model and critical slip surfaces;
- assessment of the hydraulic capacity of each spillway and diversion and confirmation that they can safely convey the design flood without overtopping, side slope failure, or significant erosion;
- monitoring requirements, including the number, type, and location of instrumentation;
- operational requirements, including threshold conditions or observations requiring actions, in the form of Quantitative Performance Objectives (QPOs) and associated Trigger Action Response Plans (TARPs);
- integration with the Site-wide Water Balance Model (Section 6.6 this document) and Mine Site Water Management Plan (Section 10.6 this document);
- any recommendations to address design gaps, such as additional detailed investigations or analyses (if required); and
- any other relevant information.

4.4.3.3. Significant or Higher Consequence Classification Dams

At a minimum, provide a *Detailed Design Level* design report for dams with a "Significant", or higher, Consequence Classification, where construction is proposed within the next five years.

At a minimum, provide a *Feasibility Design Level* design report for dams with a "Significant", or higher, Consequence Classification, where construction is proposed after the next five years.

All Significant (or higher) Consequence dam design reports must include the following:

- all information requirements as noted in Section 4.4.3.2 of this document;
- assessment of risks posed by geohazards that could influence the dam throughout its lifetime, including closure and an explanation of how geohazards are managed in the design, including mitigation structures;
- sensitivity analysis of critical assumptions; and
- any other relevant information.

4.4.3.4. Tailings Storage Facilities

At a minimum, provide a *Detailed Design Level* design report for each TSF for stages of construction that are proposed within the next five years.

At a minimum, provide a *Feasibility Design Level* design report for each TSF where construction is proposed after the next five years.

All TSF design reports must include the following:

- all information requirements noted in Sections 4.4.3.2 and 4.4.3.3 of this document;
- Consequence Classification of the facility, supported by a dam breach and inundation study or a runout assessment for non-liquifiable tailings;
- foundation conditions, construction material, and tailings properties, including a discussion of expected behavior under the range of stress conditions predicted for the TSF lifetime;
- assessment of the potential for static and seismic liquefaction of tailings, construction materials, and foundation materials;
- water balance and water management plan integrated into the Site-wide Water Balance Model (Section 6.6 this document) and Mine Site Water Management Plan (Section 10.6 this document);

- operational and water management information:
    - volume-elevation curve;
    - filling curve;
    - raising schedule; and
    - tailings deposition plan;
- for new TSFs:
    - an alternative assessment for the TSF that assesses the best available technology in accordance with the Guidelines for the Assessment of Alternatives for Mine Waste Disposal[41]); and
    - for TSFs with a "Significant" Consequence Classification or higher, a third-party independent review report of the proposed TSF, and how the third-party independent review findings were addressed by the design engineer; and
- for modifications to existing TSFs:
    - updates to the best available technology assessment, site characterization, dam breach and inundation study, Consequence Classification, and closure designs are required, or it must be demonstrated that existing studies are still applicable.

4.4.4. Dumps and Stockpiles

For the purposes of this section, "dumps" refers to all waste rock dumps and ore, overburden, and soil stockpiles that will be constructed over the LOM on the mine site. Temporary stockpiles that are completely removed or replaced within 2 years are exempt from this section, such as stockpiles required for construction.

A waste rock dump that stores tailings (e.g., a comingled or co-disposal dump) is a TSF per the definition in the HSRC. This includes Mixed Coal Rejects (MCR). In case of any discrepancy between this document and the HSRC, the HSRC definition applies.

4.4.4.1. Dumps (Stability Class II or less)

At a minimum, provide a *Feasibility Design Level* design report for dumps that are classified as Dump Stability Class II or less. All dump design reports must include the following:

- an assessment of Dump Stability Class, prepared by a Professional Engineer, in accordance with accepted industry guidelines;
- drawings, plans, sections, and figures projected over the LOM, as required to illustrate the dump design and the design criteria (lift heights, maximum dump heights, slope angles, foundation angles, etc.);
- description of the facility, including purpose, location, footprint, storage capacity, design life, etc.;
- foundation conditions, dump materials, and properties;
- stability assessment;
- potential runout zone;
- any recommendations to address design gaps, such as additional detailed investigations or analyses (if required); and
- any other relevant information.

4.4.4.2. Dumps (Stability Class III or greater) and Major Dumps

At a minimum, provide a *Detailed Design Level* design report for dumps that are classified as Dump Stability Class III or greater and *major dumps* (as defined in the HSRC), where construction will be initiated within the next five years.

[41] https://www.canada.ca/en/environment-climate-change/services/managing-pollution/sources-industry/mining-effluent/metal-diamond-mining-effluent/tailings-impoundment-areas/guidelines-alternatives-mine-waste-disposal/chapter-2.html

At a minimum, provide a *Feasibility Design Level* design report for dumps that are classified as Dump Stability Class III or greater and *major dumps* (as defined in the HSRC), where construction will be initiated after the next five years.

All dump design reports must include the following:

- all information requirements under Section 4.4.4.1 of this document;
- site characterization including geotechnical site investigation information collected from the dump or stockpile footprint obtained from subsurface investigations, *in situ* testing, laboratory testing, and mapping;
- assessment of risks posed by geohazards and mitigation measures;
- risk assessment for all dumps and stockpiles and identification of all high-risk dumps;
- overburden stripping requirements to enhance the stability of each facility and accommodate reclamation efforts:
    - for facilities where stripping is not proposed, provide a rationale for the decision including assumptions made in the stability analysis;
- assessment of the potential for static and seismic liquefaction for foundation and waste materials;
- stability analyses, demonstrating design criteria are met for critical interim and final configurations:
    - identify and justify all input parameters and phreatic conditions;
    - assess sensitivity to critical assumptions; and
    - provide figures showing the analysis model and critical failure surfaces;
- designs for associated water management structures that affect stability, such as rock drains, diversion channels, etc.;
- assessment of potential run-out zones and designs of any catchment or run-out berms;
- description of how each facility will be constructed, including:
    - construction specifications;
    - cover system;
    - drainage collection system; and
    - discussion and reference to relevant sections of the Application that address these requirements in greater detail;
- monitoring requirements for the dump slopes, including TARPs; and
- any other relevant information.

4.4.5. Surface Water Management Structures

This section applies to all surface water management structures required as part of the mine plan to manage contact and non-contact water on the mine site. This includes ponds or impoundments (without dams) and water conveyance structures (i.e., ditches, diversion channels, catchment ditches, etc.).

Natural ground features (sometimes called *in situ* pillars) being used to retain water should be considered the same as a dam unless it can be demonstrated that there is no potential for the *in situ* pillar to fail due to overtopping, piping, slope failure, or other failure modes that result in an unexpected release of contents.

This section does not apply to roadside ditches or temporary water management structures such as those required to facilitate construction, provided they are within the catchment of the mine site contact water management system.

All contact water management facilities and any non-contact water management facilities associated with a TSF are authorized under the *MA*.

4.4.5.1. Ponds or Impoundments (without Dams)

At a minimum, provide a *Preliminary Design Level* design report for any pond or impoundment structure, authenticated by a QP, that includes the following:

- plans and sections showing the pond and spillway designs (excavation depths, slopes, profiles, foundation materials, construction material, etc.) and any liner details (if applicable);

- description of the facility, including purpose, location, storage capacity, design life, etc.;
- statement of the design criteria and rationale for the selected design criteria, including, but not limited to:
    - environmental criteria, such as retention time to reduce TSS, allowable seepage rate, etc.,
    - the design flood;
    - minimum freeboard; and
    - if conveying or storing contact water, designs to safely pass a minimum 1-in-200-year return-period storm event;
- sediment pond designs, consistent with the technical guidance on Assessing the Design, Size, and Operation of Sediment Ponds Used in Mining[42];
- integration into the Site-wide Water Balance Model (Section 6.6 this document) and Mine Site Water Management Plan (Section 10.6 this document);
- site characterization, including an assessment of geohazards;
- geotechnical assessments and designs, completed by a Professional Engineer for cut slopes over 6 m high or located on terrain that is classified as having a moderate or higher likelihood of initiating a landslide;
- any recommendations to address design gaps, such as additional detailed investigations or analyses (if required); and
- any other relevant information.

4.4.5.2. Water Conveyance Structures

At a minimum, provide a *Preliminary Design Level* design report for any water conveyance structure, authenticated by a QP, that includes the following:

- descriptions of the facilities, including plans and sections (plan view, profiles, cross sections, etc.), purpose, location, design life, etc.;
- assessment of geohazards and mitigation measures;
- statement of the design criteria, including, but not limited to:
    - seepage criteria;
    - the design event;
    - hydraulic capacity;
    - freeboard; and
    - if conveying or storing contact water, designs to safely pass a minimum 1-in-200-year return-period storm event;
- foundation conditions, and construction materials and properties;
- integration into the Site-wide Water Balance Model (Section 6.6 this document) and Mine Site Water Management Plan (Section 10.6 this document);
- monitoring and operational requirements;
- geotechnical assessments and designs completed by a Professional Engineer for cut/fill slopes over 6 m high or located on terrain that is classified as having a moderate or higher likelihood of initiating a landslide;
- any recommendations to address design gaps, such as additional detailed investigations or analyses (if required); and
- any other relevant information.

4.4.6. Mine Roads

This section includes all roads on the mine site, such as haul roads, mine access roads, and light duty roads. Roads within the Permitted Mine Area (PMA) that will be authorized by another agency (i.e., License of Occupation, etc.) must be identified in the Application and the responsible agency indicated.

[42] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/assessing_design_size_and_operation_of_sediment_ponds.pdf

At a minimum, provide a preliminary design for any road, authenticated by a QP, that includes the following:

- drawings and sections showing road designs in accordance with accepted industry guidelines[43], including cut and fill slope angles, road widths, drainage measures, runaway lanes, etc.;
- assessment of risks posed by geohazards (either natural or caused by mining activities) and mitigation measures in accordance with accepted industry guidelines[44];
- bridge design and criteria;
- construction methodology and specifications;
- culvert design criteria;
- geotechnical assessments and designs, completed by a Professional Engineer for cut/fill slopes over 6 m high or located on terrain that is classified as having a moderate or higher likelihood of initiating a landslide;
- any recommendations to address design gaps, such as additional detailed investigations or analyses (if required); and
- any other relevant information.

4.4.7. Processing Plant (Mill)

Provide a preliminary design for the processing plant, that includes the following:

- mill process description including inputs;
- products and non-product outputs for all stages of operations;
- process design criteria;
- flow sheets showing process streams, quantities, and significant equipment;
- description of all process reagents; and
- a facility location drawing and description.

4.4.8. Buildings, Ancillary Facilities, and Other Infrastructure

This section includes all buildings, ancillary facilities, and other infrastructure such as the mill, shops, crushers, conveyors, warehousing, laboratories, fueling stations, camps, offices, lunchrooms, sanitary conveniences, etc. All buildings, as defined by the BC Building Code, must meet BC Building Code and HSRC requirements.

A description of any electrical, mechanical, or other engineering design proposed in variance to existing HRSC requirements must be included in the application.

Electrical, Mechanical, and other engineering designs are not required to be submitted with the application. However, all HSRC required designs and reports must be provided post-permitting and pre-construction to the appropriate Inspector of Mines.

4.4.9. Closure Designs

This section applies to the closure design requirements for open pits, underground workings, dams, TSFs, dumps and stockpiles, and surface water management structures. Closure designs are ideally included in the design reports described above, and must demonstrate anticipated residual geotechnical risks at closure, and potential mitigations.

Closure designs are required to support the Application. The closure design IRs described below are intended for applications that include new facilities or existing facilities that are being modified.

The closure designs must demonstrate they are integrated with the Reclamation and Closure Plan in Section 5 of this document and the Reclamation Liability Cost Estimate (RLCE) in Section 11 of this document.

[43]Such as guidelines produced by EGBC or the Ministry of Forests for roads in other natural resource sectors.
[44]Such as EGBC Professional Practice Guidelines on Landslide Assessment in British Columbia V4.1 March 1, 2023.

All closure designs must be reviewed and updated, as necessary, at least every five years, as part of the Reclamation and Closure Plan update (required as per HRSC).

For mines that are applying to implement the closure design, *Detailed Design Level* closure design reports are required for open pits, underground workings, dams, TSFs, dumps, permanent stockpiles, and permanent surface water management structures.

4.4.9.1. Open Pits

At a minimum, provide *Preliminary Design Level* closure designs for each open pit. All closure designs must include the following:

- description of closure plans, including timelines for implementation;
- design criteria, including end land use and how the proposed closure design accommodates climate change;
- closure stability analysis, demonstrating closure design criteria are met;
- any recommendations to address design gaps, such as additional detailed investigations or analyses (if required); and
- long-term monitoring requirements.

4.4.9.2. Underground

At a minimum, provide *Preliminary Design Level* closure designs for each portal and other opening. All closure designs must include the following:

- any mitigation for long-term subsidence;
- any recommendations to address design gaps, such as additional detailed investigations or analyses (if required); and
- closure design criteria, including, but not limited to:
    - water management criteria;
    - seepage criteria (if applicable);
    - water chemistry;
    - design pressure/head (if applicable); and
    - design life of construction materials.

4.4.9.3. TSFs and Dams

At a minimum, provide *Feasibility Design Level* closure designs for each TSF and dam. All closure designs must include the following:

- description of closure plans for the facilities, including major modifications required for closure (including spillways) and timelines for implementation;
- alternatives assessment for TSF closure that assesses the best available technology (if not already completed above);
- closure design criteria including:
    - design flood;
    - seismic criteria;
    - factors of safety;
    - minimum freeboard;
    - Consequence Classification post-closure;
    - identification of closure 'Care Phases' as per the Canadian Dam Association (CDA) Mining Dam Bulletin[45], including estimated timelines for each 'Care Phase';
    - end land use; and
    - how the proposed closure design considers climate change;
- closure stability analysis, demonstrating closure design criteria are met and anticipated phreatic conditions;
- closure cover design and plans for design verification and implementation including field trials, etc.;

[45]Canadian Dam Association, 2014. Technical Bulletin – Application of Dam Safety Guidelines to Mining Dams.

- assessment of risks posed by geohazards post-closure and mitigation measures;
- long-term monitoring requirements;
- integration with the Site-wide Water Balance Model (Section 6.6 this document) and Mine Site Water Management Plan (Section 10.6 this document);
- identification of information gaps, assumptions, limitations, and uncertainties in the closure design, and recommendations how these will be addressed, including recommended timelines; and
- any other relevant information.

4.4.9.4. Dumps and Stockpiles

At a minimum, provide *Preliminary Design Level* closure designs for all dumps and stockpiles. All closure designs must include the following:

- description of closure plans, including timelines for implementation;
- design criteria, including end land use and how the proposed closure design accommodates climate change;
- closure cover design and plans for design verification and implementation;
- closure stability analysis, demonstrating closure design criteria are met;
- any recommendations to address design gaps, such as additional detailed investigations or analyses (if required); and
- long-term monitoring requirements.

4.4.9.5. Surface Water Management Structures

At a minimum, provide a *Preliminary Design Level* closure design report for all permanent surface water management structures that includes the following:

- closure criteria for each facility, including, but not limited to:
    - the design life of construction materials;
    - hydraulic and hydrologic design events; and
    - any recommendations to address design gaps, such as additional detailed investigations or analyses (if required).

5. Reclamation and Closure Plan

5.1. End Land Use Objectives and Capability Metrics for Infrastructure / Disturbance Footprints

5.1.1. Pre-Mining End Land Use and Capability

Describe the baseline pre-mining end land use and capability metrics and how the information is being used to guide and inform reclamation plans and programs. If baseline or pre-mining end land use or capability data are not available for historically disturbed sites, Qualified Professionals (QPs) should consider using ecologically relevant reference sites to identify pre-mining end land use and capability characteristics. The intent of this section is to ensure that consideration is given to pre-mining ecosystem characteristics and that linkages between baseline pre-mining end land use and capability conditions or characteristics and the post-mining end land use and capability objectives are formed early within the mining cycle. Post-mining end land use and capability are described in Section 5.1.2 below.

Provide the following information, at a minimum:

- a description of existing land use statuses or designations, including but not limited to land tenures and licensed or permitted users such as forestry, cattle grazing, guides, outfitters, and trappers;
- descriptions of:
    - existing transportation routes (e.g., roads or waterways) within or adjacent to the mine site;
    - any known use or interest by Indigenous Nations;
    - any informal users who are not necessarily licensed (e.g., recreational users); and
    - any known local land use and settlement patterns, and on-site and adjacent terrestrial and aquatic ecosystems, and an inventory of potential biological receptors, including human populations;
- a description of meteorological and climatic conditions that influence the physical, chemical, and biological characteristics of the pre-mining ecosystems;
- a description of the topography of pre-mining landforms and how the topography of undisturbed landforms has been used to determine pre-mining capability;
- a description of the physical, chemical, and biological characteristics of pre-mining soils/overburden and how these characteristics have been used to quantify pre-mining capability metrics. Provide an inventory of estimated salvageable soils/overburden, classified by suitability;
- a description of the pre-mining or reference characteristics of surface water, sediment, and groundwater, and how these characteristics have been used to determine terrestrial and aquatic pre-mining capability metrics;
- a description of the pre-mining terrestrial conditions using terrestrial ecosystem mapping, predictive ecosystem mapping, and location of rare or endangered species and ecosystems, and how these characteristics have been used to quantify pre-mining capability and land use metrics. Pre-mining ecosystem information should be presented in digitized maps and tabulated inventories identifying the extent of pre-mining ecosystem types;
- a description of the pre-mining aquatic ecosystems including periphyton and benthic invertebrate community characteristics, fish and fish habitat, and aquatic species tissue residues. Pre-mining ecosystem information should be presented in digitized maps and tabulated inventories identifying the extent of pre-mining ecosystem types;
- a description of the pre-mining concentration of nutrients and metals within vegetation tissues and how these baseline characteristics have been used to quantify pre-mining capability metrics;
- a description of pre-mining wildlife features/habitats, including any species or ecological communities at risk, and how these characteristics have been used to quantify pre-mining capability and land use metrics;
- a summary of the Indigenous land use prior to mining (if Indigenous Nations provide and consent to including information related to Traditional Ecological Knowledge (TEK) or cultural land use)

and a description of how Indigenous usage has been incorporated to inform pre-mining capability and land use metrics. The Ministry of Energy, Mines and Low Carbon Innovation (EMLI) and Ministry of Environment and Climate Change Strategy (ENV) recognize that Indigenous knowledge and information is within the ownership of Indigenous Nations, and viewing or receiving associated information is a privilege that may require agreements with mining Proponents as well as government agencies for sharing;
- a summary of cultural heritage resources that have been impacted by operations or expected to be impacted over the next five years or life of mine; and
- other information as requested by the Chief Permitting Officer (CPO).

5.1.2. Post-Mining End Land Use and Capability Objectives/Metrics

Clearly identify post-mining end land use and capability objectives. In cases in which the proposed end land use is different from pre-mining use, provide detail regarding the future land use activities and rationale to support the change in end land use. Where the goal of the post-mining disturbance is to revert back to a natural pre-disturbance condition, provide end land use and capability objectives based on quantifiable characteristics and ecologically relevant metrics that link post-mining landscapes or ecosystems to the structure and function of the baseline, pre-mining, or reference ecosystems, as well as knowledge, research, and modelling used to determine the expected characteristics or conditions of reference ecosystems and landscapes, recovery trajectories of natural ecosystems (i.e., ecohydrological modelling), and TEK if provided by Indigenous Nations.

Note: While the term "end land use" may imply a terrestrial emphasis, EMLI takes a holistic interpretation that also includes aquatic ecosystems. EMLI has included the term "end land use" within this document to ensure consistency with the Health, Safety, and Reclamation Code. EMLI acknowledges that Indigenous Nations may have or propose other terms to describe ecosystem and landscape characteristics throughout the mining cycle.

Provide a detailed description of end land use and capability objectives for each project infrastructure and disturbance footprint type (e.g., linear/road disturbances, waste rock dumps, Tailings Storage Facilities (TSFs), open pits, etc.) and describe how the capability for individual ecosystems and cumulative systems at a landscape scale will not be less than the average that existed prior to mining. If the proposed land use is focused on wildlife habitat or ecosystems, clearly identify ecologically relevant metrics of success that define the target ecosystem conditions, biodiversity elements, and habitats for relevant wildlife species for each disturbance footprint or polygons identified within disturbance and reclamation tracking spatial files (e.g., ARR Shapefiles). Based on the overarching principle of equivalent capability, define predicted changes to land capability (e.g., ecosystems and habitats) resulting from mining operations and provide detailed plans to reclaim what has been disturbed to date and what will be disturbed over the next five years, as well as over the life of mine. Identify the time required for disturbed sites to meet end land use and capability objectives following the completion of reclamation activities. Present contingencies to address predicted challenges to achieving this objective.

Provide the following information, at a minimum:
- a description of projected post-closure landscapes, ecosystems, habitats, and other land uses for the post-mining landscape. Provide end land use designations and capabilities for each infrastructure/disturbance footprint. Display projected end land use and capabilities within digitized maps and tabulated inventories. Ensure post-mining/closure ecosystems and landscapes are linked to the site-specific disturbance area identifiers, such as polygon IDs within spatial data layers;
- a description of the modelling tools or methods used, as well as results identifying the soil and overburden characteristics required to establish post-mining target ecosystems or capabilities;
- a description of how modelling results were used to inform the soil replacement requirements for each disturbance footprint. Compare soil salvage and replacement inventories to identify any potential shortfalls in soil volumes or soil characteristics that will need to be reconciled through the reclamation program;

- a comparison of current site-specific ecosystem/climate conditions to those predicted at end of mining operations, 50 years post-closure, and climate scenarios up to the year 2100. If site-specific modelling or research is present beyond the year 2100, compare current site-specific ecosystems/climatic conditions to the predicted future conditions beyond 2100. Provide a description of how projected climate change scenarios or conditions were considered in end land use, capability objectives, and reclamation prescriptions. Describe how ecosystem resiliency and adaptation have been considered in reclamation planning and design;
- a description of the targeted ecosystems and potential targets throughout the predicted ecological succession trajectory for the sites based on identified end land use and capability objectives, identifying limiting factors that must be overcome to facilitate the ecological succession of target ecosystems;
- a tabulated inventory of pre-mining and post-mining ecosystems, identifying the total hectares of each ecosystem type, quantitative targets/ecological metrics-of-success, and expected percent change following reclamation activities;
- a capability loss mitigation plan (if residual impacts or ecosystem type capability (e.g., ecosystem function) losses remain following reclamation) that includes detailed mitigation measures or offsetting proposals and the implications for meeting land use and capability metrics;
- a description of challenges in terms of achieving the target equivalent land capability objectives that may be relevant depending on the nature of the proposed mining disturbance and providing substantial supporting rationale, as well as research plans toward addressing the challenges if proposed post-mining end land uses differ from pre-mining conditions; and
- other information as requested by the CPO.

5.2. Existing Mine Disturbance Footprints and Conditions

Provide the following information at a minimum:

- maps identifying the existing disturbance footprint, including the associated spatial data with application, and identifying mine infrastructure using a unique disturbance identifier and disturbance type. Refer to Section 1.3.6 of this document for spatial data requirements to identify each mine infrastructure type or disturbance; and
- a description of the existing disturbance footprint, including the identification of when the existing disturbances were approved and the specific approvals/permits associated with the mine infrastructure or disturbance.

5.3. Proposed 5-Year Mine Disturbance Footprint

Provide a description, maps, and associated spatial data identifying disturbance footprints within the next five years of mine development, with a detailed schedule and specific milestones for implementing progressive reclamation plans and developing reclamation research programs.

5.4. Life of Mine Disturbance Footprint

Provide a description, maps, and associated spatial data identifying disturbance footprints over the Life of Mine (LOM) development, with a detailed schedule and specific milestones for implementing progressive reclamation plans and developing reclamation research programs.

5.5. Reclamation and Closure Approaches and Prescriptions

Provide 5 Year Mine Plan and LOM Reclamation Plans for the closure of the mining operation in reference to, and consistent with, Section 10 of the Health, Safety, and Reclamation Code (HSRC). Clearly demonstrate how all applicable reclamation standards outlined in the HSRC will be achieved for the mine disturbance footprint and proposed post-closure landscape. Include the reclamation approach and prescriptions (including but not limited to landforming, soil/overburden placement, surface preparation, revegetation, and monitoring program) for each site-specific component. Include a detailed timeline for the

completion of reclamation for each disturbance polygon, site component, or area. For example, include comprehensive prescriptions for each individual waste rock dump as opposed to a general description of the treatment of all waste dumps on site. Content requirements of the reclamation plan may be determined on a project-specific basis by the company, Indigenous Nations, government technical reviewers, and QPs. Address the minimum requirements outlined in the following subsections for each project infrastructure and disturbance footprint type (e.g., linear/road disturbances, waste rock dumps, TSFs, open pits):

- **Design Basis:** Provide a description of the site-specific conditions (e.g., current and future climate conditions, pre-mining ecosystem conditions) as well as assumptions (e.g., Conceptual Site Model) and constraints associated with the design of mine infrastructure and facilities (Section 4 – Mine Plan (this document)) that influenced reclamation and closure designs (e.g., slope of landform, depth of cover systems, planting densities of vegetations species, etc.). The design basis should be specific for each individual mine infrastructure and facility type (e.g., administrative area/buildings, pits, water management structures, stockpiles, TSFs, waste dumps, and roads) and designs should integrate individual landforms/post-mining ecosystems into a landscape-level design for the entire mine site:
    - for example, describe whether open pits will be flooded at closure and, if so, how the pit will be integrated as part of a site-wide water treatment system. Include details of ecosystem creation within pit areas, including riparian areas, to meet end land use and capability objectives. If predicted water quality is not expected to be suitable for wildlife (e.g., aquatic and terrestrial), describe mitigation and management measures to limit exposure.
- **Closure Design:** Provide closure designs for each infrastructure or disturbance type identified in the Information Requirements Table. Identify the current gaps in closure design information, how those gaps will be addressed, and when. Explain how the closure design includes geochemical, geotechnical, ecological, end land use, and capability considerations. At a minimum, include landform designs, cover system designs, revegetation designs, and criteria for reclamation and closure success for each project infrastructure and disturbance footprint type (e.g., linear/road disturbances, waste rock dumps, TSFs, open pits)
    - **Landform Design**: Provide landform designs and explain how the sites will be designed to meet site-specific objectives for long-term stability and erosion control, end land use and capability, and water quality/source control. Conduct runoff/infiltration modelling and use the results to describe how water will be directed over all of the post-closure landforms as well as within the closure landscape. Identify locations for post-closure water management requirements and criteria, including diversion channels and collection structures.
    - **Cover System Design:** Provide cover system designs for proposed dry cover systems including information related to soil and overburden quality, geochemical characteristics of cover materials including Metal Leaching and Acid Rock Drainage (ML/ARD) potential, depth of cover materials, cover material volume requirements, compaction or decompaction requirements, site preparation methods, and any other relevant information. Where dry cover systems are intended to limit or prevent oxygen or water transfer to or from the underlying mine materials, describe the relevant physical and chemical characteristics of the cover materials and overall design (e.g., permeability, oxygen diffusion rate, layering within the cover system) (Section 6.4.1 this document). Model soil characteristics required to reclaim the target ecosystems to inform the soil replacement requirements. Compare salvage and replacement inventories and identify any potential shortfalls in volumes or soil characteristics that will need to be reconciled. Provide contour/topographic maps/drawings of the projected final landform configurations. Provide flow directions and post-closure watersheds. Provide post-mine cross-sections along with a map illustrating section locations.
    - **Revegetation Design**: Propose a revegetation strategy that clearly connects the proposed landform design, cover system design, and target end land uses and capability to the species selection process. Provide the site-specific targets and species proposed in the planting regime and the rationale for selection. Provide a breakdown of species selected and

densities tied to habitat/ecosystem and wildlife targets identified within end land use and capability objectives.

- **Criteria for Reclamation and Closure:** Provide the criteria and relevant quantitative metrics-of-success that will be used to demonstrate that reclamation activities have met or will assist in the recovery/support the ecological succession of degraded ecosystems to meet end land use and capability objectives. Criteria must consider geotechnical, geochemical, and ecological outcomes that would be used to define reclamation success that may be used in consideration of release of obligations of the *Mines Act (MA)* permit. Include anticipated timelines to achieve the criteria outlined. Timelines should be consistent with those identified in related monitoring programs.

5.6. Habitat Compensation

Include a general description of all compensation works, offsetting activities, or other compensation initiatives that may be required by provincial or federal agencies to address project impacts that have been identified or are projected to occur. As an example, compensation projects may be related to fish habitat, caribou habitat, or sensitive ecosystems such as wetlands.

5.7. Trace Elements in Soils and Vegetation

Provide a detailed description of the plan or program that is or will be implemented to assess trace element uptake in soils and vegetation that may be exposed to mining-related contaminants and the potential for food web amplification, during both life of mine and closure/post-closure. Include the following in the plan:

- relevant baseline pre-mining, pre-disturbance, and/or reference data collected for soils, vegetation, and wildlife;
- potential sources of metals and other contaminants that exist, or will exist, in the mine disturbance footprint;
- a description of data and research regarding bioaccumulation of the relevant Parameters of Potential Concern (PCOCs[46]);
- a monitoring program that will be implemented throughout the life of mine (schedule, sampling locations, approaches, etc.);
- a discussion of contingencies that may be implemented if the monitoring results indicate metal uptake could compromise end land uses; and
- a description of how the metal uptake monitoring program may inform the reclamation research program.

5.8. Contaminated Sites and Ecological Risk Assessment

Describe site investigations to be conducted according to the Contaminated Sites Regulation[47] *(Environmental Management Act (EMA))* that will inform closure plans for particular mine components or areas with existing known or suspected areas of contamination. For existing operations or sites with historical workings:

- provide an inventory of known or suspected site contamination and the potential for further soil or groundwater contamination on or near the site;
- identify remedial strategies to be used to mitigate and/or remediate contamination; and
- propose site decommissioning or planned site remedial activities, including information required for the completion of a site profile as described in the Contaminated Sites Regulation[48].

[46] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/parameter_of_concern_fs.pdf
[47] https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/375_96_01
[48] https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/375_96_01

Describe the results of human health and ecological risk assessments used to evaluate mitigation measures proposed as part of the Reclamation and Closure Plan; this may be required to inform reclamation and closure planning for the site to ensure reclamation and closure objectives will be achieved. Provide an overview of the Conceptual Site Model (CSM) to identify sources of contaminants and pathways to receptors, and to assist in mitigation planning. A CSM will assist in providing supporting rationale for the Reclamation and Closure Plan proposed and will help identify data collection programs (such as metal uptake monitoring, materials characterization, and groundwater/surface water monitoring) that are required to reduce uncertainties in the planning process.

5.9. Disposal of Chemicals, Reagents, Hazardous Materials, and Contaminated Materials

Provide a list of chemicals or reagents to be used on site and information on how these will be managed at closure. Provide a process for the identification of contaminated soil and plans for remediation. Removal, treatment, and/or disposal options should be evaluated and proposed. If treatment of contaminated soils is proposed on site, land treatment facility designs and management plans are required by both ENV and EMLI.

5.10. Groundwater Well Decommissioning

Provide an inventory of geotechnical, groundwater monitoring, and water supply wells and address how and when wells will be closed (e.g., water supply, monitoring, remediation, dewatering, geotechnical boreholes, test pits). Ensure closure is done in accordance with requirements under the *Water Sustainability Act*[49] and minimum requirements in the Groundwater Protection Regulation[50].

5.11. Reclamation and Closure Research

Reclamation research is required to test assumptions, identify and overcome site-specific limitations, test new approaches and hypotheses, and further refine reclamation prescriptions. Research may also be required for final closure design of structures, such as TSFs and waste rock covers.

Describe the reclamation research program that is intended to test assumptions and approaches proposed in the Reclamation and Closure Plan based on anticipated challenges, site-specific limitations, and knowledge gaps. Provide specific plans within the research program intended to address known uncertainties related to the reclamation approaches or assumptions. Identify the research hypotheses, methodology/study design (e.g., study area and experimental design, including sampling methodology), and analyses or monitoring to be conducted (e.g., laboratory and data analysis) for researching each topic and the study locations. Provide a schedule for implementation of the research initiatives that includes key dates or milestones chosen to ensure data or results are available to inform Reclamation and Closure Plan updates when required. For any closure cover system presented in Section 5.5 (this document), provide a research program for development of a detailed cover design, including research and trials for demonstration of cover system performance.

It is expected, at a minimum, that a reclamation research program will:

- determine the viability of revegetation with native plant species, including culturally important species, if available; and
- establish test plots to evaluate the reclamation approaches and prescriptions applied to confirm that ecological trajectories consistent with the land use and capability targets are being achieved.

Provide details for documenting research results and reporting annually, as well as how results will be used to inform updated Reclamation and Closure Plans throughout the life of mine.

[49] https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/14015
[50] https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/39_2016#section12

5.12. Reclamation Monitoring

To demonstrate reclamation success, monitoring should include goals, objectives, and measurable criteria to evaluate the Reclamation and Closure Plan with respect to end land use and capability objectives/targets, as well as benchmarks throughout the ecological succession process. Model requirements associated with site-specific predictions and assumptions (e.g., Conceptual Site Model, Section 6.3 this document) and monitoring requirements identified within Environmental Monitoring Programs (Section 9 this document) should be integrated within, and inform, the Reclamation Monitoring program and plans. Include a detailed description of how environmental protection and quality control will be achieved during implementation of the Reclamation and Closure Plan, including but not limited to soil and overburden salvage, soil replacement, wildlife, and revegetation.

Clearly identify ecologically relevant and quantitative metrics-of-success, targets, and specific closure objectives of each mine component. Provide defensible thresholds that will indicate when targets have been achieved; this is best accomplished by establishing benchmarks based on the characteristics of the pre-mining conditions or target reference ecosystems and habitats. Details of timing, extent, duration, and individual actions required to implement all aspects of ecosystem and wildlife monitoring programs must be provided to develop security estimates for the post-closure period. Provide the following information, at a minimum:

- inspection/monitoring locations associated with ecosystem and wildlife end land use and capability objectives;
- inspection/monitoring frequency associated with ecosystem and wildlife end land use and capability objectives;
- personnel required;
- monitoring methodology
- sample processing and analytical specifications;
- site access requirements;
- statistical analyses to be completed;
- reporting requirements; and
- other relevant information or as requested by the CPO.

5.13. Post-closure Reclamation Maintenance

Describe potential long-term maintenance that may be required to achieve the projected ecological trajectories of ecosystems as well as final end land use and capability objectives/targets.

Provide a description of the requirements for post-closure maintenance, including but not necessarily limited to:

- soil/cover system maintenance;
- supplemental planting, seeding, and fertilizing applications; and
- slope remediation on dams and waste dumps.

5.14. Care and Maintenance

Describe what would occur in the event of a temporary shutdown or care and maintenance scenario by proposing a Care and Maintenance Plan. Provide information on potential additions to established/permitted monitoring programs that may be required for surface water quality and quantity, groundwater quality and quantity, geotechnical, ML/ARD, reclamation, erosion and sediment control, site security, or other requirements, depending on the site and closure scenario. Include a process for development of a Care and Maintenance Plan that will be implemented during this time. It is expected that the Care and Maintenance Plan will:

- include digitized map(s) showing the location and extent of all site activities at the time of mine shutdown;

- demonstrate consideration, evaluation, and a summary of the potential health, safety, and environmental risks to the mine site and receiving environment due to changes to site facilities and/or site management activities;
- provide site-wide water balance and water quality modelling for the proposed Care and Maintenance scenario. The water balance must demonstrate volumes of water stored on site in each location and possible ranges of rates and timing of any discharges (treated or otherwise) based on an appropriate range of climatic conditions, as determined by a QP;
- geotechnical changes:
    - a summary of monitoring and maintenance actions required, including the timing of initial completion and frequency of recurrence, for the TSFs, dams, major dumps, and pit slopes during Care and Maintenance; and
    - identification of changes, if any are required during Care and Maintenance, to quantifiable performance objectives or Trigger Action Response Plans (TARPs) planned for the operations provided by the design engineer for each;
- reclamation and closure changes:
    - identification of any changes that would result to the Reclamation and Closure Plan as a result of a Care and Maintenance period. This should include potential triggers and timelines for initiating implementation of any part of the Reclamation and Closure Plan and/or any short-term or progressive reclamation to be carried out during Care and Maintenance;
- Care and Maintenance Reclamation Liability Cost Estimate:
    - identification of any aspects of the 5 Year Care and Maintenance Plan that, if implemented within the first 5 years of mine life, would result in a substantial increase to the estimated liability costs included in the detailed Reclamation Liability Cost Estimate (Section 11 this document) submitted with the Application;
- monitoring changes:
    - additions to environmental monitoring programs that may be required during the Care and Maintenance phase, including compliance/monitoring requirements;
- mitigation changes:
    - updates or changes to mitigation methods including, but not limited to, water treatment that may be required during temporary closure. This must include the identification and evaluation of any new mitigation methods that may be implemented;
- management plan changes:
    - updates or changes to management plans that may be required during the Care and Maintenance phase for surface water quality and quantity, groundwater quality and quantity, geotechnical aspects, ML/ARD, reclamation, erosion and sediment control, site security, materials management (particularly hazardous materials), or other requirements; and
- additional considerations:
    - any contingency plans to maintain compliance in consideration of relevant uncertainties and the risks posed by Care and Maintenance, and details of planned adaptive management processes; and
    - other information as requested by the CPO.

6. Water Quality Mitigation and Water Modelling

6.1. Metal Leaching and Acid Rock Drainage Characterization

Provide a detailed geochemical characterization of Metal Leaching and Acid Rock Drainage (ML/ARD) potential for each geologic and mining-related material to be disturbed, produced, excavated, imported, and stored during each phase of the life of the mine, including construction and post-closure. This information must be provided by a Qualified Professional (QP) in a standalone document.

Ensure the ML/ARD characterization program supports appropriate materials handling, source term[51] development, and mitigation and contingency plans for the protection of land and watercourses. Demonstrate how the program was developed in accordance with the Health, Safety, and Reclamation Code (HSRC) and with current best practices and guidance for ML/ARD prediction and prevention, including the following documents:

- Policy for Metal Leaching and Acid Rock Drainage at British Columbia Mine Sites[52] (July 1998);
- Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia[53] (August 1998); and
- Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials[54], MEND Report 1.20.1 (December 2009).

Ensure the characterization program considers materials that will be excavated, exposed, or produced by mining activities, including material that is imported to the mine site. This includes consideration of mine components including:

- open pit walls and benches;
- underground workings (roof, floor, walls, gob, backfilled materials, etc.);
- tailings (including tailings amendments) and Tailings Storage Facilities (TSFs);
- waste rock and waste rock dumps/spoils;
- overburden/alluvium/colluvium and other material stockpiles, including contaminated soils;
- ore, including low-grade ore stockpiles;
- coal and coal by-product stockpiles (i.e., fine and coarse coal rejects);
- water treatment waste by-products (i.e., residual solids, sludge, brine, etc.);
- borrow areas, quarries, and construction materials;
- water management structures;
- road cut and fill;
- cut and fill to facilitate construction of plant/mill, ancillary buildings, and laydown areas; and
- any other relevant materials or mine components.

Provide a description of geochemical characterization in this section that includes:

- a geochemical conceptual model that outlines the materials that will be excavated, exposed, or produced, and the storage conditions for these materials, for each phase of the life of mine;
- a description of the material sample collection and analytical methods, including details of certified laboratories used to process and analyze samples, for each analysis (static and kinetic);

[51] Geochemical source terms refer to representative chemical mass release rates for specific geologic materials, used to calibrate and predict drainage chemistry in water quality models.
[52] www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/permitting/ml-ard_policy.pdf
[53] www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/permitting/ml-ard_guidelines.pdf
[54] mend-nedem.org/mend-report/prediction-manual-for-drainage-chemistry-from-sulphidic-geologic-materials

- sampling and analytical Quality Assurance/Quality Control (QA/QC) procedures and results, including analysis and interpretation of results;
- rationale for selecting the analytical methods, including designs relevant to the storage environment that conservatively simulate the expected field conditions and can be utilized to predict reaction rates and drainage chemistry (e.g., humidity cell tests, subaqueous column tests, field barrel leach tests, site drainage monitoring, etc.);
- demonstration that geochemical and spatial variability are captured and spatial and/or temporal gaps in the datasets are identified, which should include a description of the distribution of geochemical samples collected from (or intended to represent) each mine component;
- characterization of the sources of acid potential (AP), neutralization potential (NP), and metal leaching, which should include the following:
    - static testing including, but not limited to, trace element content and acid base accounting; and
    - results of mineralogical analyses (e.g., X-ray Diffraction (XRD), QEMSCAN);
- characterization of the rates of release of chemical constituents to inform source term development, which should include the results of kinetic testing (e.g., humidity cell tests, subaqueous column tests, field leach barrel tests);
- recommendations for further sampling and analyses to address and resolve limitations and uncertainties that create potential environmental impacts;
- maps, figures, plots, and tabulated data summaries, with appropriate comparisons to relevant standards and guidelines as applicable; and
- any other relevant information and analyses.

Use the geochemical characterization data in conjunction with the proposed mine plan to provide an assessment of the following:

- appropriate methods and criteria for determining the ARD potential of characterized materials, including:
    - site-specific and material-specific methods for determining NP, including relevant correction or adjustment factors if applicable (e.g., for siderite);
    - site-specific and material-specific methods for determining AP, including relevant correction or adjustment factors if applicable (e.g., for sulphate species); and
    - proposed operational NP Ratios (NPRs) for each material.
- ARD onset lag times for materials characterized as Potentially Acid Generating (PAG) under the proposed storage conditions;
- metal leaching potential for materials, including identification of specific constituents of concern over a range of pH values, under the proposed storage conditions;
- nitrogen species loading contribution from blasting agents;
- chemical loadings from process reagents; and
- data limitations and uncertainties, including any materials that have not been fully characterized, identification of the environmental risks associated with the limitations and uncertainties, and a description of how these limitations and uncertainties have been addressed in the assessment.

6.2. Geochemical Source Terms

Develop geochemical source terms to represent conservative chemical mass release rates for materials characterized in Section 6.1 above. In this section:

- provide a detailed materials balance for each mine component, material type, and geologic unit;
- integrate source terms with the proposed mine plan for each phase of mine life (i.e., construction, operation, closure, and post-closure);
- incorporate up-to-date static and kinetic testing results;
- provide a detailed description of constraints, limitations, and assumptions (e.g., scaling factors, temperature corrections, solid to liquid ratios, etc.);

- provide a detailed description and rationale of any applied or assumed geochemical or physical mechanisms such as sorption, precipitation, or other attenuating mechanisms incorporated into source terms;
- provide a detailed description and rationale of any applied laboratory to field scaling factors;
- provide a detailed description and rationale of assumptions regarding the nitrogen species loading contribution from blasting agents;
- provide a detailed description and summary of calculations;
- identify and discuss data gaps associated with the source terms; and
- include any other relevant information and analyses.

6.3. Conceptual Site Model

To be most effective, a Conceptual Site Model (CSM) should be developed in the early stages of an assessment or design of a project and be updated regularly as additional data are gathered. A CSM should be a stand-alone document, ideally in a format accessible to a general audience and submitted or included with the Technical Assessment Report (TAR) for an Application, ensuring that regulators and stakeholders all have a similar context for communicating concerns and approvals.

The CSM is used in the Application to:

- determine how significant sources of Parameters of Concern (POCs)[55] from the mine site have been considered and evaluated;
- assess major pathways for POCs to reach the receiving environment and receptors, including consideration of surface water and groundwater transport mechanisms from point source[56] and Non-Point Source (NPS)[57] discharges;
- identify receptors that may be adversely affected by POCs released from the mine site;
- determine the data collection requirements to validate and refine the CSM in relation to the 'completion' of pathways from sources to receptors;
- provide an overview of the potential source and pathway(s) for each POC originating from the mine site and being transported to the receiving environment;
- indicate how POC loadings will be contained, collected, stored, and/or mitigated; and
- aid in the design of monitoring programs and facilitate the establishment and testing of hypotheses regarding the predicted relationships between stressors and assessment endpoints.

Please refer to the guidance document regarding the Use of Conceptual Site Models to Support *Environmental Management Act (EMA)* Effluent Permit Applications[58].

6.4. Water Quality Mitigation Measures

Describe proposed water and effluent quality mitigation measures for each project component and each stage of the mine life. In addition to the information requirements outlined by mitigation category in the following sub-sections, for each proposed mitigation method:

[55] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/parameter_of_concern_fs.pdf

[56] Discernible, confined, and/or discrete conveyance of effluent through a final discharge point, often referred to as "end-of-pipe".

[57] Discharge of effluent that does not meet the definition for point source discharge. In other words, NPS discharge is effluent that is not collected and discharged through a single discharge point. Rather, the effluent infiltrates to ground at unknown volumes, locations, and/or times.

[58] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/csm_to_support_ema_permit_app.pdf

- demonstrate how the selection of the method has considered the guiding principles and hierarchy for ML/ARD mitigation, as described in the Policy[59] and Guidelines[60] for ML/ARD at mine sites in BC;
- evaluate the individual mitigation in terms of its contribution to the cumulative risk, liability, and land use impact of the mine;
- demonstrate the compatibility of the mitigation with the mine plan and the current and future biogeoclimatic conditions at the site;
- indicate the specific objective of the mitigation, and how the effectiveness of the mitigation will be evaluated; and
- if management of mining-related materials is involved, ensure the mitigation considers the suitability of the specific material type(s) for the selected storage environment or handling procedure, with reference to the ML/ARD characterization for that material detailed in Section 6.1 above.

6.4.1. Source Control

Source control is an approach or measure that is intended to prevent or reduce the production and/or release of Parameters of Potential Concern (POPCs)[61] from a mined material or disturbed area into the receiving environment. Provide details on source control practices incorporated into the mine plan, including management measures and engineered controls.

6.4.1.1. Management Practices

Provide details of materials management practices incorporated into the mine design, operating procedures, materials handling procedures, and closure planning to minimize the excavation of PAG and/or ML materials and to prevent or reduce the production and/or release of POPCs. Management practices could include, but are not limited to:

- best management procedures for explosives;
- waste handling procedures to minimize exposure, rehandling, and storage of PAG waste; and
- avoidance of PAG waste as a component of mine design.

6.4.1.2. Engineered Controls

Provide details of engineered source control mitigation methods. Engineered controls include mitigations such as:

- underwater storage of PAG or potentially ML waste materials, including storage in constructed surface impoundments or backfilling into pits and/or underground workings;
- designing waste rock stockpiles to prevent generation and/or release of ML/ARD, such as through layering or blending of waste materials; and
- engineered cover or liner systems.

Include the following information for engineered source control methods:

- detailed designs for engineered systems and structures. If detailed designs are not available and the mitigation is not required until the end of mine life (e.g., engineered cover systems), provide designs that will support the calculation of accurate Reclamation Liability Cost Estimates, and a detailed implementation plan for developing the detailed design, with clearly identified gaps and timelines for addressing the gaps;

[59] www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/permitting/ml-ard_policy.pdf
[60] www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/permitting/ml-ard_guidelines.pdf
[61] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/parameter_of_concern_fs.pdf

- an assessment of the technology readiness level of any proposed technologies, with reference to the Technology Readiness Level (TRL) Interim Technical Guidance[62];
- supporting documentation demonstrating the feasibility and viability of the proposed source control(s) under the range of expected site conditions;
- where underwater storage (e.g., in a TSF, pit lake, or flooded underground workings) is proposed as a mitigation at any stage of the mine life, provide:
    - volumes of water required to maintain underwater storage;
    - water management details identifying how flooding will be achieved and maintained;
    - an assessment of the impacts of delayed and/or incomplete flooding on the relevant waste materials, with reference to the geochemical characterization in Section 6.1 of this document; and
    - contingencies for maintaining flooded conditions under a range of climate scenarios;
- where blending or layering of Non-Potentially Acid Generating (NPAG) and PAG wastes is proposed as a mitigation, provide the following:
    - detailed materials handling and placement plans, including processes for blending or layering wastes, design criteria, plans for rehandling or redepositing materials, and measures to minimize rehandling;
    - detailed designs and deposition plans for temporary storage of PAG wastes, if required by the timing of materials excavation, including conservative estimates of maximum temporary storage time frames for PAG materials prior to blending;
    - detailed designs of contact water management associated with temporary stockpiles, if applicable;
    - material balances over the life of mine, demonstrating that neutralizing materials are available in sufficient proportions and with acceptable timing of excavation for blending to be feasible and compatible with the mine plan; and
    - comprehensive geochemical characterization of blended materials to demonstrate that effective neutralization of PAG materials can be achieved at the proposed blending ratio(s). Geochemical test work to support blending mitigations must consider site-specific factors (e.g., climate, grain size distribution) in addition to geochemical and physical heterogeneity in blended materials;
- where engineered cover or liner systems are proposed as a reclamation and closure mitigation, reference the information requirements provided in Section 5.5 of this document in addition to the requirements in this section;
- detailed contingency plans for controls; and
- any other relevant information.

6.4.2. Water Management Measures

Most *Mines Act (MA)* permittees are required to maintain a system of drainage diversion and collection ditches to minimize contaminant loadings from areas of disturbance or waste disposal. Describe and summarize the water management methods included in the mine plan to minimize the volume of contact water and release of contaminant loadings to the environment. Water management methods include, but are not limited to:

- non-contact water diversion;
- seepage collection and pump-back;
- contact water storage, including lined facilities; and
- reuse/recycling of water to meet processing requirements (e.g., mill reclaim).

[62] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/min-21_interim_guidance_on_technology_readiness_assessment.pdf

6.4.3. Technology Selection

If a technology is proposed as a primary mitigation method for water quality, a Best Achievable Technology (BAT) Assessment[63] and Technology Readiness Assessment (TRA)[64] may be required.

6.4.3.1. Best Achievable Technology Evaluation

Undertake and submit a Ministry of Environment and Climate Change Strategy (ENV) BAT Assessment[65] if untreated effluent concentrations at the source are predicted to exceed applicable water quality thresholds. Applicable water quality thresholds are primarily used as a screening tool at this stage to identify chemical constituents that may pose potential risk to the environment (refer to the Parameters of Concern Fact Sheet[66]). In most cases, applicable thresholds will be BC WQGs[67] for the most sensitive user. Where BC WQGs do not exist, Canadian Council of Ministers of the Environment (CCME) Guidelines[68] and/or Federal Environmental Quality Guidelines[69] may apply. Where approved Water Quality Objectives (WQOs)[70] exist, those should also be considered. In some cases, accepted Science Based Environmental Benchmarks (SBEBs) may be used; refer to ENV Technical Guidance 8 A Framework for the Development and Use of Freshwater Science-Based Environmental Benchmarks for Aquatic Life in Environmental Management Act Permitting for Mines[71].

The BAT Assessment provides ENV staff with the information to support the consideration of SBEBs, Initial Dilution Zones (IDZs), and waste discharge standards. The outcome of the BAT Assessment is one of the many aspects considered when developing waste discharge standards and permit conditions.

Note that the Proponent must follow ENV prescribed mining industry-specific methodology for the preparation of a BAT Assessment, in addition to following the BAT general approach described in the BAT Fact Sheet[72].

6.4.3.2. Technology Readiness Assessment

Undertake and submit a determination of the TRL for technologies proposed as primary mitigation for project impacts. The TRL scale has nine levels and refers to the readiness of an emerging technology. Guidance on TRL determination is provided in the Technology Readiness Assessment Interim Technical Guidance document[73].

Technologies assessed at TRL-8 or TRL-9 are considered proven technologies and are generally deemed acceptable to meet initial information requirements for *MA/EMA* Applications. Technologies assessed at TRL-7 or below are considered research and development technologies, and Proponents are expected to

[63] https://www2.gov.bc.ca/assets/gov/environment/waste-management/waste-discharge-authorization/guides/bat_assessment_steps.pdf
[64] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/min-21_interim_guidance_on_technology_readiness_assessment.pdf
[65] https://www2.gov.bc.ca/assets/gov/environment/waste-management/waste-discharge-authorization/guides/bat_assessment_steps.pdf
[66] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/parameter_of_concern_fs.pdf
[67] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines
[68] https://ccme.ca/en/summary-table
[69] https://www.canada.ca/en/health-canada/services/chemical-substances/fact-sheets/federal-environmental-quality-guidelines.html
[70] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-objectives
[71] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/tg8_framework_for_sbebs.pdf
[72] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/pulp-paper-wood/best_achievable_control_tech.pdf
[73] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/min-21_interim_guidance_on_technology_readiness_assessment.pdf

conduct considerable work to collect site-specific data to support the planning process for an *MA/EMA* Application.

6.4.4. Water and Effluent Treatment

Water treatment should only be proposed when source control and water management measures are demonstrated to be insufficient to fully mitigate water quality concerns. When water treatment is proposed as a mitigation method for water quality, the Application must provide sufficient information demonstrating the ability of the proposed technology to perform under the range of predicted site-specific conditions, and over each phase of mine life, that it will be employed. Methods for water treatment include both active and semi-passive water treatment processes. The information requirements in this section must be provided for proposed water treatment systems on the mine site, including systems that are not proposed to discharge effluent directly to the receiving environment.

6.4.4.1. Description

Provide a description of each water treatment facility that includes detailed information on:

- proposed treatment method(s);
- process flow sheets;
- hydraulic capacity (m^3/day);
- retention times;
- media and reagents used;
- media and reagent sourcing and transport;
- temperature control systems;
- power requirements;
- pumping requirements;
- system redundancies;
- personnel requirements;
- generation of by-products and/or treatment waste; and
- any other relevant information.

6.4.4.2. Location

Provide a location map and relevant diagrams that indicate the location of the water treatment facility being proposed. Include associated pipelines and conveyance structures for influent and effluent.

6.4.4.3. Detailed Design

Provide detailed design aspects of the proposed water treatment facility, including:

- effective influent collection, conveyance, and storage systems that can handle peak climatic and hydrological events;
- support for designs by site hydrology and geotechnical information;
- engineering of the facility and supporting infrastructure, including geotechnical, electrical, and mechanical information;
- information on treatment methods, process flow sheets, hydraulic capacity, retention times, media and reagents used, media and reagent sourcing and transport, generation of by-products and treatment waste, etc.;
- assessment of potential health and safety risks and management plans/safe work procedures; and
- any other relevant information.

6.4.4.4. Site-specific Treatment Effectiveness

Assess the effectiveness of the proposed water treatment facility in mitigating POCs[74] under variable water quality and hydrological conditions reasonably expected for the mine site. This includes, but is not limited

[74] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/parameter_of_concern_fs.pdf

to, performance of the collection and treatment systems under the expected range of influent chemistry and element speciation, flow rates, operating temperatures, and hydraulic retention times.

Site-specific treatment effectiveness may be demonstrated through various methods, including site-specific piloting and detailed analogue site or treatment method data. Consult with ENV and the Ministry of Energy, Mines and Low Carbon Innovation (EMLI) on the specific requirements for the project well in advance of Application submission.

6.4.4.5. Performance Risks

Assess performance risks related to collection and treatment, and indicate how those risks will be mitigated and managed by design and/or operation of the treatment facility. Examples of performance risks include, but are not limited to:

- extreme weather (e.g., icing, snow loading, flows, etc.);
- power outages;
- wearing of parts;
- scaling;
- reagent supply interruption;
- plugging;
- biofouling; and
- hydraulic by-passing/short circuiting.

For *in situ* biological treatment systems, provide a quantitative assessment of the longevity of the treatment facility, potential for reversibility of sequestered contaminants, maximum capacity of sequestered contaminants, and expected life span. If the expected life span is not sufficient to meet the required treatment duration, indicate what subsequent treatment facility or contingency measure(s) will be implemented once the *in situ* biological treatment system reaches capacity.

6.4.4.6. Influent and Effluent Water Quality

Provide an estimate of influent and treated effluent water quality and flow rates from sources reporting to the water treatment facility, including but not limited to:

- estimates and trends for each phase of mine life;
- statistical evaluation of the results;
- a comparison of proposed treated effluent water quality to known discharge criteria, guidelines, and/or industry practices; and
- an evaluation of end-of-pipe effluent POC[75] concentrations, based on meeting or exceeding applicable water quality thresholds (BC WQGs[76] (where BC WQGs do not exist, Canadian Council of Ministers of the Environment (CCME) Guidelines[77] and/or Federal Environmental Quality Guidelines[78] may apply), approved WQOs[79], or accepted SBEBs[80]) in the receiving environment during the most sensitive times of the year.

Propose effluent discharge limits (volumes and concentrations) and demonstrate how they are protective of the receiving environment and its receptors. Ensure proposed limits result in no acute toxicity to aquatic organisms at the point of discharge and no exceedances of the Metal and Diamond Mining Effluent Regulation (MDMER), if applicable. If an IDZ is proposed, ensure no chronic toxicity results beyond the

[75] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/parameter_of_concern_fs.pdf
[76] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines
[77] https://ccme.ca/en/summary-table
[78] https://www.canada.ca/en/health-canada/services/chemical-substances/fact-sheets/federal-environmental-quality-guidelines.html
[79] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-objectives
[80] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/tg8_framework_for_sbebs.pdf

edge of the IDZ (achieve this by back-calculating discharge concentration and volume limits using contaminant-specific WQGs, Water Quality Objective (WQOs), or SBEBs (as accepted by ENV) as values in the mass balance model).

6.4.4.7. Waste By-products

Characterization of water treatment waste by-products is an important component for understanding the potential long-term effects of on-site handling and disposal methods. Waste by-products include solid (e.g., sludge) and liquid (e.g., membrane brine) wastes.

Provide the following detailed information for waste by-products from the proposed water treatment facility:

- production rate and total volumes generated on an annual basis for each phase of mine life;
- detailed descriptions of the mechanism(s) for by-product generation; and
- detailed geochemical and physical characterization results (see Section 6.1 this document).

If water treatment by-product disposal and storage is proposed on the mine site, provide the following information:

- a long-term disposal and storage plan that demonstrates management strategies for maintaining long-term (>50 years) geochemical and physical stability and addresses end land use and capability objectives;
- location, layout, and design of the water treatment waste by-product storage facility, as required;
- storage facility liner material, thickness, and expected lifespan, as required;
- groundwater and surface water monitoring programs for the storage facility;
- development of a conservative water treatment waste source term;
- incorporation of the disposal scenario into the Site-wide Water Balance Model (Section 6.6 this document), Surface Water Quality Model (Section 6.7 this document), and Numerical Hydrogeologic Model (Section 6.5.2 this document), as required;
- assessment of environmental effects and risks and mitigation/management plans;
- assessment of potential health and safety risks and management plans/safe work procedures; and
- any other relevant information.

If storage for a treatment by-product as a solid waste (e.g., sludge) is proposed on the mine site, provide the following additional information:

- detailed geochemical and physical testing to assess the long-term (>50 years) geochemical stability of the proposed disposal method, including mineralogical testing;
- management strategies for maintaining storage conditions that promote long-term physical and geochemical stability; and
- assessment of the conditions that would cause treatment by-products to become physically or geochemically unstable.

If long-term water treatment is proposed, include an assessment of contingency waste management for a scenario where the volume of treatment by-products generated exceeds the capacity of the proposed storage facility.

6.4.4.8. Maintenance

Describe maintenance and replacement plans for water collection infrastructure and water treatment facilities over the period the water treatment facility is required.

6.4.4.9. Emergency Response Procedures

Include in this section emergency procedures for low- and high-risk malfunctions and upsets to the water collection infrastructure and water treatment facilities, including during commissioning and operations phases. Provide the likelihood of these risks occurring (low, moderate, high) during infrastructure and facility operations. Include contingency plans (e.g., contingency storage for water requiring treatment) for chemical and fuel storage areas.

6.4.4.10. Contingency Plans

Include in this section contingency measures for partial or complete failure of the water treatment system(s) over the period the water treatment facility is required, including during commissioning. At a minimum, include contingency plans for the following:

- unintended production of water that does not meet treatment specifications (off-spec), including measures for retreatment, removal, and/or storage; and
- managing influent water volumes in excess of the water treatment capacity.

If on-site storage of water that cannot be discharged is proposed as a contingency, water balance and quality modelling should incorporate a scenario demonstrating implementation of the contingency. Relevant hydrologic and geochemical conditions should be included (i.e., if water volumes are in excess of the water treatment capacity, is there sufficient storage in the intended contingency storage facility?).

6.4.4.11. Monitoring Plans

Include in this section the following details for water treatment monitoring plans:

- influent collection volumes and flow rates;
- influent and treated effluent water quality, chemical speciation, by-products, and physical parameters in comparison to discharge criteria and/or objectives, as required;
- operational performance of the treatment facility, including but not limited to, treatment throughput, facility availability, and load removal rates for POCs[81] requiring treatment;
- a Trigger Action Response Plan (TARP) during potential periods of reduced treatment performance;
- water treatment waste volumes and characterization results; and
- reporting plans.

6.4.4.12. Schedule

Provide time schedules for construction, commissioning, operation, and closure of water collection and water treatment facilities to be employed during each phase of mine life (construction, operation, closure, and post-closure).

6.4.5. Water Treatment Research and Development Program

Water treatment research and development programs (i.e., treatment trials) may require authorization under the *MA* and/or *EMA* if determined to have reached a TRL of 5 or higher. For any planned or proposed treatment trials, reference Table 1 in Appendix B of the Technology Readiness Assessment Interim Technical Guidance document[82] to identify if authorization may be required.

For water treatment research and development programs requiring authorization, develop a Water Treatment Trial Implementation Plan, including research objectives, studies to be performed, and how success of the trial will be determined. This plan should demonstrate how the water treatment trial will facilitate collection of information required in Section 6.4.4 above for authorization of an operational water treatment facility.

Additionally, provide the following information regarding the proposed trial(s):

- a description of the trial water treatment facility including:
    - location map;
    - details of integration with any other site infrastructure or facilities, including other water treatment facilities, as applicable;
    - proposed treatment methods;
    - types, quantities, and storage details for any materials and reagents used;

[81] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/parameter_of_concern_fs.pdf

[82] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/min-21_interim_guidance_on_technology_readiness_assessment.pdf

    - power requirements; and
    - pumping requirements.
- an assessment of the effect of the trial water treatment facility on the operability and effluent discharge quality of any other water treatment facility, if applicable;
- a detailed design of the trial water treatment facility, including information on treatment methods and assessment of potential health and safety risks and management plan/safe work procedures;
- a water management plan for the trial water treatment facility, including influent source(s), treatment volumes, effluent discharge location(s), and any other information relevant to water management;
- a description of performance risks;
- contingencies for unintended production of water that does not meet treatment specifications (off-spec), including measures for retreatment, removal, and/or storage;
- detailed information on waste and by-products, including storage and/or disposal;
- a monitoring and reporting plan; and
- a schedule, including trial end date.

6.5. Hydrogeologic Modelling

Conceptual and numerical hydrogeologic models must be developed by a QP. The QP's authenticated document(s) must be accompanied by signed Declaration of Competency and Conflict of Interest forms[83].

6.5.1. Conceptual Hydrogeologic Model

Develop a Conceptual Hydrogeologic Model for the study area that integrates source-pathway-receptor linkages following the Guidelines for Groundwater Modelling to Assess Impacts of Proposed Natural Resource Development Activities[84]. The linkages should be developed from baseline surface water and groundwater quantity and quality monitoring data. The conceptual model should describe the controls on groundwater recharge, levels, flow directions, and discharges within the study area. Include in the model domain the project location and areas both upgradient and downgradient of the mine where the mine may impact groundwater quantity or quality.

Include in the Conceptual Hydrogeologic Model:

- the mine plans for each phase of mine life (i.e., construction, operation, closure, and post-closure) and how they are expected to affect the groundwater system;
- hydrostratigraphy, recharge/discharge boundaries, groundwater divides, and impermeable boundaries;
- extent of unconfined and confined unconsolidated aquifers and permeable bedrock formations;
- characterization of the hydraulic conductivities of both the unconsolidated and bedrock formations, especially in locations where groundwater and surface water are likely to interact;
- geo-referenced locations and elevations of wells (including monitoring wells and geologic borings) and natural discharges;
- groundwater elevations, lateral and vertical hydraulic gradients, flow directions, and seasonality of the groundwater flow regime;
- potentiometric water level contours and inferred groundwater flow paths in permeable formations (aquifers) and across low permeability formations (aquitards);
- groundwater flow velocities and travel times between sources of contact water (e.g., underground workings, open pit(s), tailings pond(s), waste rock pile(s), etc.) and downgradient surface watercourses;
- identification of main groundwater recharge and discharge zones;

[83] https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/environmental-guidance-and-policy/professional-accountability

[84] http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/groundwater_modelling_guidelines_final-2012.pdf

- identification of areas of groundwater that are under the direct influence of surface water (e.g., zones of precipitation recharge and losing stream reaches), and the surface water features that depend on groundwater discharge (e.g., stream base flow, springs, wetlands);
- the degree to which surface water quality is influenced by groundwater quality during periods of low flow (e.g., by comparing surface water and groundwater chemistry), and a description of the contribution of groundwater base flow to total streamflow throughout the year;
- hydrogeochemical signature(s) of groundwater in the project area and correlation with other aspects of the hydrogeologic model (e.g., lithology, surface water/groundwater interaction);
- spatial and temporal variation(s) in key chemical parameters and among sampling sites;
- potential groundwater flow pathways for contact water from contaminant sources to groundwater discharge areas, with consideration of groundwater/surface water interactions; and
- any other information relevant to groundwater characterization.

Additionally, identify and justify assumptions incorporated in the Conceptual Hydrogeological Model and include figures that summarize the geological and hydrostratigraphic data.

6.5.2. Numerical Hydrogeologic Model

Develop a Numerical Hydrogeologic Model capable of representing the existing/baseline hydrogeological understanding of the study area by following the Guidelines for Groundwater Modelling to Assess Impacts of Proposed Natural Resource Development Activities[85]. Apply the numerical model to predict changes in groundwater flows and levels and estimate the groundwater input rates at key surface water receptors that may occur within the study area due to the project.

Include in the Numerical Hydrogeologic Model:

- a summary of the model objectives;
- model conceptualization, including the mine plans, such as underground workings or pit developments, for each phase of mine life (construction, operation, closure, and post-closure) and how they are expected to affect the groundwater system;
- selection and construction of the numerical model;
- integration of the Conceptual Hydrogeologic Model (Section 6.5.1 this document);
- integration of regional and local climate data (Section 3.1 this document);
- boundaries of the study area and receiving environment assessment points (e.g., surface and groundwater users, drinking water aquifers, fish-bearing streams, etc.);
- the modelling framework, including the software, spatial and temporal discretization of the study area, required input for and output generated by the model, and supporting input/output processing tools (e.g., spreadsheets, GIS files, etc.);
- model calibration, including calibration statistics (e.g., mean, maximum, and minimum groundwater head residual, and normalized root mean square error) and supporting calibration plots (e.g., observed versus modelled groundwater levels, time plots of observed and modelled groundwater hydrographs);
- uncertainty analysis, including identification of key elements of uncertainty in the assumptions, boundary conditions, and parameters used in the model as well as approaches to reduce the model uncertainty;
- sensitivity analysis, where the effects of changes in the main elements of model uncertainty (e.g., precipitation recharge, groundwater inflows and outflows along the boundaries of the study area, hydraulic conductivity) are assessed to quantify the accuracy of model predictions;
- model predictions, including a description of the predicted changes in groundwater flow (recharge/discharge) and key contaminant concentrations and loads in near- and far-field locations from the groundwater contamination sources and in groundwater discharge areas, in high- and low-flow conditions, and for each phase of the mine;

[85] http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/groundwater_modelling_guidelines_final-2012.pdf

- an evaluation of potential cumulative effects resulting from the mining operations and other anthropogenic activities;
- an uncertainty analysis for each aspect of the estimated effects, including identification of data gaps, sources of uncertainty in data and models, range of uncertainty, and sensitivity of the effects on the groundwater system to uncertain variables and parameters as well as a description of how data gaps and uncertainties would be addressed; and
- any other relevant information.

6.6. Site-wide Water Balance Model

Develop a quantitative Site-wide Water Balance Model for the study area to project the impacts of mine site water management (e.g., withdrawals and inputs) on water quantity for key locations on the mine site and in the receiving environment. Modelling methods, inputs, assumptions, and results must be provided in a detailed report. The spatial and temporal scale of the model should be defined based on the purpose of the modelling exercise, with a monthly timestep being the minimum acceptable frequency for the receiving environment water quantity modelling. Larger timesteps than monthly (lower frequencies) are usually not acceptable.

The Site-Wide Water Balance Model must be developed by a QP. The QP's authenticated document(s) must be accompanied by signed Declaration of Competency and Conflict of Interest forms[86].

The Site-wide Water Balance Model must be representative of each phase of mine life (construction, operations, closure, and post-closure). The model should include:

- mine inputs and assumptions consistent with the proposed mine plan (e.g., mine production rates, dewatering estimates, mill water use, diversion and collection ditch efficiency, waste rock seepage estimates and flow paths, design capacity of water management and treatment infrastructure, etc.). The TSF water balance (Section 4.4.3.4 this document) must be appropriately integrated into the site-wide model;
- physical inputs (e.g., drainage areas, topography, and land use by mine phases);
- climate inputs and assumptions (e.g., temperature, precipitation, snowpack and snowmelt volumes, and evaporation);
- hydrologic inputs and assumptions (e.g., hydrologic model for mine facilities and receiving environment, estimates of groundwater recharge and discharge, etc.);
- model prediction nodes at locations of interest within the mine site and downstream in the receiving environment (i.e., sites of potentially affected receptors);
- the mitigation methods proposed and evaluated in accordance with the information requirements in Section 6.4 above;
- contact water discharged to surface water and groundwater pathways, if applicable; and
- sensitivity scenarios to evaluate the uncertainty of model assumptions that may affect the model results for each phase of mine life, including but not limited to:
    - climate and/or streamflow variability;
    - hydrogeologic assumptions; and
    - climate change.

Include the following information about the Site-wide Water Balance Model in a comprehensive report:

- a description of the mine water management plan for each phase of mine life, including baseline/current conditions (construction, operation, closure, and post-closure);
- figures illustrating how surface and groundwater flow paths are conceptualized in the model for the mine site and receiving environment for each phase of mine life, including schematics of relevant processes and flow paths in the model;

[86] https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/environmental-guidance-and-policy/professional-accountability

- figures illustrating model prediction nodes, existing and proposed mine components, and relevant existing and proposed monitoring locations;
- a description and rationale for the selection of:
    - input and prediction node locations, including an evaluation of suitability for prediction of impacts on key mine facilities, water users, and the aquatic environment;
    - model inputs, assumptions, and methods;
    - mine site components that have been included and excluded, and the methods used to estimate each of these components; and
    - model base case and sensitivity scenarios;
- model inputs and assumptions regarding mitigation measures, including the effectiveness of mitigation or management measures (e.g., water interception/diversion/pump-back systems, liners and covers, etc.);
- demonstration that the model is sufficiently calibrated to available measured and synthetic datasets for both the mine site and receiving environment (e.g., water levels in the TSF, effluent discharge rates, flow data from the mine infrastructure and receiving environment, etc.);
- summarized model results for model prediction nodes and scenarios in tabular and graphical format, including:
    - projected inflows and outflows for key mine site facilities;
    - projected quantity and timing (e.g., seasonal, continuous, intermittent) of discharges to the environment;
    - projected changes to receiving environment streamflow; and
    - projected changes in groundwater/surface water interactions;
- an assessment of how the mine operation will affect instream flow and any surface or groundwater licensees, during each phase of mine life, including throughout the range of instream flows due to withdrawals, diversions, induced losses to groundwater, and effluent discharge in consideration of climate, land use, and water allocation and withdrawal;
- a summary of how the results of sensitivity analysis scenarios have informed the water management plans for each phase of mine life;
- a gap analysis that identifies limitations and uncertainties in the model and provides recommendations for future assessment; and
- any other relevant information.

6.7. Surface Water Quality Model

Develop a quantitative model for the study area that identifies the potential changes to water quality for key locations on the mine site and in the receiving environment related to potentially affected receptors. Modelling methods, inputs, assumptions, and results must be provided in a detailed report. The spatial and temporal scale of the model should be defined based on the purpose of the modelling exercise, with a monthly timestep being the minimum acceptable frequency for the receiving environment surface water quality modelling. Larger timesteps than monthly (lower frequencies) are usually not acceptable.

The water quality model must be developed by a QP. The QP's authenticated document(s) must be accompanied by signed Declaration of Competency and Conflict of Interest forms[87].

The surface water quality model must be integrated with the Site-wide Water Balance Model (Section 6.6 above) and be representative of each phase of mine life (construction, operations, closure, and post-closure). The model should include:

- the proposed mine plan;
- baseline or existing surface water and groundwater quality conditions (Section 3.5 this document);
- mass loading sources within the mine site, with assigned geochemical source terms (Section 6.2 this document);

[87] https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/environmental-guidance-and-policy/professional-accountability

- model nodes at locations of interest within the mine site and downstream in the receiving environment (i.e., sites of potentially affected receptors);
- seasonal variability of baseline data and predicted changes with time;
- the mitigation methods proposed and evaluated in Section 6.4 above;
- contact water discharge to groundwater pathways, if applicable;
- contact water discharge to surface water pathways, if applicable; and
- sensitivity scenarios to evaluate the uncertainty in model assumptions that may affect the model for each phase of mine life, including but not limited to the following:
    - climate and/or streamflow variability;
    - conservative geochemistry and water quality source term assumptions; and
    - climate change.

Include the following information about the surface water quality model in the report:

- a description and rationale for the selection of:
    - input and prediction node locations, including an evaluation of suitability for assessment of effects on water users and aquatic environments;
    - model sensitivity scenarios;
    - model inputs, assumptions, and methods;
    - model mechanisms that reduce loadings (e.g., attenuation, sorption, precipitation, loss to groundwater, etc.), including supporting observations and data;
    - any geochemical equilibrium or solubility modelling conducted (e.g., PHREEQC), including details of assumptions regarding specific elements or minerals, with supporting data and model input/output files;
    - included and excluded parameters;
    - assumed scaling factors for source terms;
    - data sources utilized in developing the model; and
    - mine site components that have been included and excluded, and the method used to estimate each of these components;
- model inputs and assumptions regarding water treatment, if applicable (e.g., influent rates, parameter removal rates, waste by-product quantity and quality);
- model inputs and assumptions regarding the effectiveness of water management and mitigation measures;
- demonstration that the model is sufficiently calibrated to representative measured datasets;
- comparison of source terms to representative measured conditions (observed water chemistry, loads, or analogue sources); and
- figures that illustrate the source terms, flow paths, model nodes, and active and passive discharge locations during each phase of mine life (construction, operation, closure, and post-closure); this should include schematics of relevant processes and flow paths in the model.

The report must include summarized model results for model predictions and scenarios, including:

- a comparison of results to existing conditions and applicable water quality thresholds[88] and/or known discharge criteria, in both tabular and graphical format;
- full characterization and predictions of treated and untreated effluent discharge sources (quality and quantity) to the receiving environment;
- the timing (e.g., seasonal, continuous, intermittent) of discharges to the environment;
- if an IDZ is proposed (see Section 7.3.1 this document), predicted water quality within and at the edge of the IDZ;

[88]BC WQGs: https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines; CCME WQGs: https://ccme.ca/en/summary-table; Federal Environmental Quality Guidelines: https://www.canada.ca/en/health-canada/services/chemical-substances/fact-sheets/federal-environmental-quality-guidelines.html; and Accepted SBEBs: https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/tg8_framework_for_sbebs.pdf

- a gap analysis that identifies limitations and uncertainties in the model and provides recommendations for future assessment; and
- any other relevant information.

7. Effluent Discharges to the Environment

7.1. Domestic Water/Sewage Treatment

Although these Application requirements primarily address the main effluent discharge, sewage and solid waste disposal also require authorizations under the *Environmental Management Act (EMA)* and may require separate Applications.

For sewage discharges greater than 100 persons, or where discharge is to surface waters, registration under the Municipal Wastewater Regulation (MWR)[89] is desirable. Alternatively, the sewage discharges may be included with the overall effluent permit for the site.

For more information on registering under the MWR, see the Ministry of Environment and Climate Change Strategy (ENV) website[90]. Additional direction on how best to include sewage disposal information in the Application package should be sought from ENV Environmental Protection Division (EPD) staff.

7.2. Effluent Discharge

In this section:

- provide detailed designs of all proposed discharge works (e.g., outfalls, spillways, channels, diffusers);
- describe the timing (e.g., seasonal, continuous, intermittent) of discharges to the environment;
- discuss options for contaminant source control, containment, or mitigation methods and describe how best management practices and ENV's Best Achievable Technology (BAT) Assessment[91] have been applied;
- provide full characterization and predictions of all treated and untreated effluent sources (quality and quantity);
- compare proposed discharge quality to known discharge criteria, guidelines, and/or industry practices;
- describe the timing (e.g., seasonal, continuous, intermittent) of discharges to the environment;
- evaluate effluent characteristics relative to applicable water quality thresholds (in most cases, applicable thresholds will be BC Water Quality Guidelines (WQGs)[92] (where BC WQGs do not exist, Canadian Council of Ministers of the Environment (CCME) Guidelines[93] and/or Federal Environmental Quality Guidelines[94] may apply), approved Water Quality Objectives (WQOs)[95], or in some cases accepted Science Based Environmental Benchmarks (SBEBs))[96] to determine

[89] https://www2.gov.bc.ca/gov/content/environment/waste-management/sewage/municipal-wastewater-regulation
[90] https://www2.gov.bc.ca/gov/content/environment/waste-management/sewage/municipal-wastewater-regulation
[91] https://www2.gov.bc.ca/assets/gov/environment/waste-management/waste-discharge-authorization/guides/bat_assessment_steps.pdf
[92] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines
[93] https://ccme.ca/en/summary-table
[94] https://www.canada.ca/en/health-canada/services/chemical-substances/fact-sheets/federal-environmental-quality-guidelines.html
[95] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-objectives
[96] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/tg8_framework_for_sbebs.pdf

parameters of potential concern as per the BC ENV Parameters of Concern Factsheet[97] and identify the times of year when effluent or seepage quality is expected to exceed these applicable thresholds;

- if an Initial Dilution Zone (IDZ) is proposed, provide predicted water quality within and at the edge of the IDZ (see Section 7.3.1 below) and refer to Development and Use of Initial Dilution Zones in Effluent Discharge Authorizations[98];
- ensure surface and groundwater use downstream is not compromised and no chronic toxicity occurs in surface waters (including as surface water recharge occurs). Note that this information may form the basis for terms or conditions incorporated into the *EMA* effluent discharge permit;
- incorporate the Conceptual Site Model (CSM) (Section 6.3 this document); and
- propose effluent quality limits (or other appropriate limits) and trigger levels/conditions (as per the Trigger Response Plan (TRP)[99]) that will trigger an action in response to observed or measured changes in conditions that are approaching management objectives. This TRP should be in place to proactively ensure permit limits are being met and discharges are not negatively impacting the receiving environment.

7.2.1. Non-point Source Discharges

A Non-Point Source (NPS)[100] discharge describes effluent that is not collected and discharged through a final discharge point, but rather infiltrates to ground at unknown volumes, locations, and times (e.g., seepage from a waste pile).

Authorization of a NPS discharge is typically focused on groundwater monitoring and development of trigger-level groundwater quality limits that are linked to a TRP. The plan describes the trigger limits and escalating management measures if the trigger limits are exceeded, as well as reporting requirements.

The Conceptual and Numerical Hydrogeologic Models (Section 6.5 this document) and Site-wide Water Balance Model (Section 6.6 this document) will inform the regulation of NPS discharges and development of the TRP.

7.3. Receiving Environment Modelling

For receiving water quantity and quality modelling, please refer to Sections 6.5, 6.6, and 6.7 of this document that describe predictive modelling for the mine site and receiving environments.

7.3.1. Initial Dilution Zone

The IDZ is a three-dimensional zone around a point of discharge where mixing of the effluent and receiving waters occurs. Detailed guidance on where and when IDZs are appropriate and how they should be developed in the environment for authorized effluent discharges under the *EMA* is provided in the Development and Use of Initial Dilution Zones in Effluent Discharge Authorizations[101].

Provide all information listed in Appendix A of that guidance as necessary to support the proposed IDZ, based on best professional judgement. Include, at a minimum, the following:

[97] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/parameter_of_concern_fs.pdf
[98] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/tg11_development_and_use_of_idz.pdf
[99] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/tg12_trigger_response_plans.pdf
[100] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/7276_env_rob_dtg_factsheet.pdf
[101] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/tg11_development_and_use_of_idz.pdf

- a description of why an IDZ is necessary and how best management practices and the BAT Assessment[102] (Section 6.4.3.1 this document) are applied prior to consideration of an IDZ;
- proposed dimensions of the IDZ;
- a CSM for the effluent discharge and IDZ;
- receiving water characteristics;
- effluent discharge characteristics;
- physical and aquatic life receptors of effluent discharge to receiving waters;
- an environmental impact assessment of effluent discharge to the receiving environment;
- methods for physical mixing analyses;
- results of physical mixing analyses; and
- a proposed monitoring program.

Please review the checklist with ENV prior to beginning the application process.

[102] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/pulp-paper-wood/best_achievable_control_tech.pdf

8. Environmental Effects Assessment

Assess potential residual environmental effects and evaluate the risks of the project in the context of human health, water users, aquatic and terrestrial receptors, and habitat.

Please note that Application requirements for air emission permits are not covered in this document. For these applications, please refer to the Ministry of Environment and Climate Change Strategy (ENV) Air Emissions Information Requirements Table (IRT)[103] on the ENV website.

Use the results of the predictive hydrogeologic models (Section 6.5 this document), Site-wide Water Balance Model (Section 6.6 this document), and Surface Water Quality Model (Section 6.7 this document) and compare those to appropriate thresholds (e.g., Water Quality Guidelines (WQGs)[104], Water Quality Objectives (WQOs)[105], Science-Based Environmental Benchmarks (SBEBs)[106], Site Performance Objectives (SPOs), baseline) to determine potential effects on receptors. In this predictive work, consider the mine plan and proposed mitigation techniques, and build on baseline environmental data and waste discharge characteristics anticipated over the life of the mine. Cumulative effects within the watershed must also be considered.

When assessing project effects, the following factors must be considered:

- **Context:** the ability of the environment to accept change. The effects of a project may have a greater impact if they occur in areas that are ecologically sensitive or significant and/or have little resilience to imposed stresses. Will the effects threaten the existence of a rare species or an isolated population of a valued species? Do environmental factors increase the potential for bioaccumulation of any contaminants?
- **Magnitude**: the expected size or severity of the effect. A comparison to WQGs[107] or existing WQOs[108] and SBEBs[109] (as accepted by ENV) are initial tools to help determine magnitude. Risk increases with the number of parameters that are predicted to approach or exceed guidelines, as well as the frequency and the size of the exceedances.
- **Extent**: the spatial scale over which the effect is expected. Impacts could extend beyond the direct disturbance footprint.
- **Duration**: the length of time the effect is expected to persist. This could be related to the length of time organisms are exposed to a toxicant or stressor combined with reversibility or the length of time habitat conditions will be altered until habitat functions are restored.
- **Frequency**: how often the residual effect occurs. Episodic or infrequent effects or exposure may have less impact than continuous long-term and/or frequent effects. Seasonality/time of year and time of day may also be factors depending on the receptor.

[103] https://www2.gov.bc.ca/assets/gov/environment/waste-management/waste-discharge-authorization/guides/irt/irt-air-01_irt_for_air_emissions.pdf

[104] BC WQGs: https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines; CCME WQGs: https://ccme.ca/en/summary-table; Federal Environmental Quality Guidelines: https://www.canada.ca/en/health-canada/services/chemical-substances/fact-sheets/federal-environmental-quality-guidelines.html

[105] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-objectives

[106] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/tg8_framework_for_sbebs.pdf

[107] BC WQGs: https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines; CCME WQGs: https://ccme.ca/en/summary-table; Federal Environmental Quality Guidelines: https://www.canada.ca/en/health-canada/services/chemical-substances/fact-sheets/federal-environmental-quality-guidelines.html

[108] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-objectives

[109] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/tg8_framework_for_sbebs.pdf

- **Reversibility**: whether an effect can be reversed once the physical work or activity causing the disturbance ceases. The definition of reversibility may need to be constrained to timeframes (e.g., habitat alterations may not be reversible for decades or even centuries).

In the following sections:

- identify environmental values and potential receptors;
- describe and provide a rationale for spatial and temporal assessment boundaries as well as assessment endpoints (e.g., loss of habitat, fish or invertebrate tissue concentrations, abnormalities, toxicity, benthic invertebrate, periphyton, or fish community metrics, etc.);
- use the Conceptual Site Model (CSM) (Section 6.3 this document) to describe the contaminant transport or mine disturbance factors linking sources to receptors, and establish a risk assessment process;
- describe the predicted residual effects throughout the year and over time for each mine phase on aquatic life, wildlife, livestock, agriculture, and human health as well as endangered/rare species and ecosystems within the proposed permitted mine area and in the receiving environment (residual effects are those effects remaining after implementation of all mitigation techniques evaluated and proposed in a joint *Mines Act/Environmental Management Act (MA/EMA)* Application);
- consider the potential for synergistic effects due to the mine and cumulative effects in conjunction with other environmental stressors external to the mine or from previous exploration;
- describe the predicted effects that would occur if the mitigation measures prove to be ineffective;
- acknowledge uncertainties in the assessment due to data gaps or model assumptions and identify how these will be addressed in adaptive management and environmental monitoring plans; and
- summarize potential impacts by environmental value and location using tables.

8.1. Aquatic Environment

Comparisons of hydrogeological, water balance, and water quality modelling predictions (identified in Sections 6.5, 6.6, and 6.7 this document) to baseline conditions and protective thresholds (such as WQGs or instream flow needs) form the basis for the aquatic effects assessment. A range of potential predicted conditions (various climate scenarios) need to be considered to identify seasonal averages versus effects from more extreme climates.

In this assessment:

- describe how surface water and groundwater quantity and environmental quality are predicted to change from background and whether, how frequently, and by how much a WQG[110] for the protection of potential receptors in the area (or, if applicable, a WQO, SBEB, SPO, or other agreed upon threshold) is predicted to be exceeded. Groundwater should be compared to contaminated sites standards (source drinking WQGs[111] apply to groundwater where wells for domestic or municipal purposes exist);
- where sediment and tissue concentrations are of interest and can be predicted, similar information regarding changes from background and exceedance of thresholds or standards should be included;
- identify how these predicted conditions translate into effects on aquatic or terrestrial receptors and habitats (provide supporting information for this assessment);
- describe and discuss the potential for bio-accumulation or bio-concentration of contaminants, and the associated risk to assessment endpoints (e.g., fish health, fish consumer health, etc.); and

[110]WQGs in the receiving water should be calculated based on background concentrations of toxicity modifying factors versus the use of mine-induced concentrations of these factors. BC WQGs: https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines; CCME WQGs: https://ccme.ca/en/summary-table; Federal Environmental Quality Guidelines: https://www.canada.ca/en/health-canada/services/chemical-substances/fact-sheets/federal-environmental-quality-guidelines.html

[111]https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/drinking-water-and-recreation/source_drinking_water_quality_guidelines_bcenv.pdf

- discuss the relevance of measurement endpoints in a Weight of Evidence (WOE) approach to increase confidence in impact assessment.

8.2. Terrestrial Environment

For assessment of terrestrial effects, please use the process detailed in Procedures for Mitigating Impacts on Environmental Values[112].

Effects on terrestrial ecosystems or receptors may result from habitat loss or alteration or a change in environmental quality.

In both cases, it is important the changes from background are described and the effects on ecosystems and receptors assessed using appropriate thresholds (e.g., instream flow needs, WQGs for the protection of wildlife or livestock). For this purpose, the following factors need to be considered:

- potential for bio-accumulation or bio-concentration of contaminants, and the associated risk to assessment endpoints (e.g., ecosystem and habitat function, wildlife health); and
- contribution of cumulative effects on the terrestrial resources (where appropriate) from the proposed mine activities in conjunction with disturbances outside the project area and further downstream during mine operation and following mine closure.

Please also identify data gaps and uncertainties and describe how they would be addressed in adaptive management and environmental monitoring plans (Sections 9 and 10 this document) as well as reclamation research programs (Section 5 this document).

8.3. Human Health

Effects on human health may be caused by changes in environmental quality (e.g., groundwater quality, surface water quality, contaminant concentrations in tissue) and related to ingestion or other forms of exposure (e.g., inhalation, skin contact, etc.).

Locations of water licences and domestic water intakes as well as recreational areas where exposure to project-related contaminants may occur must be identified. Indirect exposure (e.g., through ingestion of plants or biota) as per the CSM (see Section 6.3 this document) must also be considered in the assessment.

Comparison to appropriate thresholds (e.g., source drinking WQGs[113], tissue guidelines, recreational WQGs) should be provided, identifying locations, seasonality, frequency, and magnitude of predicted exceedances.

In some cases, a Human Health Risk Assessment (HHRA) may be required. If so, the British Columbia Guidance for Prospective Human Health Risk Assessment[114] must be followed.

Existing consumption rates by local residents and Indigenous Nations must be confirmed and considered when evaluating the risk of the project to human health.

[112] https://www2.gov.bc.ca/assets/gov/environment/natural-resource-policy-legislation/environmental-mitigation-policy/em_procedures_may27_2014.pdf
[113] https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/drinking-water-and-recreation/source_drinking_water_quality_guidelines_bcenv.pdf
[114] https://www2.gov.bc.ca/assets/gov/health/keeping-bc-healthy-safe/healthy-communities/bc-hhra-guidance.pdf

9. Environmental Monitoring

Include proposed monitoring and reporting programs that enable ongoing evaluation of waste management performance and receiving environment conditions. The monitoring programs should also be used to verify predictions proposed in the Application. Increased sampling frequency and a Weight of Evidence (WOE) approach to the monitoring program are necessary early in mine life to support adaptive management. Over the different phases of mine life (construction, operation, closure, post-closure), monitoring requirements may be adjusted to reflect the results of ongoing assessment work and the needs at each phase. The Ministry of Environment and Climate Change Strategy (ENV) Water and Air Baseline Monitoring Guidance Document[115] should be consulted for mine-related monitoring requirements.

Where applicable, integrate the requirements of the federal Environmental Effects Monitoring (EEM) program under the Metal and Diamond Mining Effluent Regulations[116] into the monitoring program design. However, be aware that the federal EEM program is generic and not normally sufficient to address provincial regulatory requirements.

At a minimum, the proposed project will require comprehensive monitoring programs for the mine site, proposed discharges, immediate receiving environments, receptor exposure sites (e.g., edge of Initial Dilution Zones (IDZs) and far-field locations) and a broader Aquatic Effects Monitoring Program. In each case, monitoring programs must include the following:

- monitoring objectives;
- proposed study design, including rationale and program details for each media and location, including:
    - monitoring methods;
    - monitoring locations (including depths, where relevant), with coordinates, and depicted on detailed maps showing each location in relation to mine infrastructure, model nodes, effluent discharge, and seepage sources;
    - rationale for the distribution of monitoring locations (including depths, where relevant);
    - sampling frequencies and periods, including high-, medium-, and low-flow periods;
    - parameters, including Parameters of Potential Concern (POPCs) or Parameters of Concern (POCs)[117], to be measured at each location and their known effects to local biota or related species;
    - analytical lab procedures to be used;
    - Quality Assurance/Quality Control (QA/QC) and data management protocols;
    - name(s) of the certified laboratories used to analyze samples;
    - methods for data analysis and assessment techniques, including comparisons to relevant guidelines and objectives; and
    - any other relevant information;
- how a Conceptual Site Model (CSM) (Section 6.3 this document) was considered in each plan;
- evaluation of the suitability of the program for detecting effects from the project;
- how the program will be used to verify, calibrate, and update hydrogeologic models (Section 6.5 this document), the Site-wide Water Balance Model (Section 6.6 this document), and the Surface Water Quality Model (Section 6.7 this document);
- reporting requirements and review schedules for each monitoring plan;
- roles and responsibilities associated with the plan, including persons accountable and connections to other departments;
- a change management procedure for updates to the monitoring program; and

[115] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf
[116] http://laws-lois.justice.gc.ca/eng/regulations/SOR-2002-222/index.html
[117] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/parameter_of_concern_fs.pdf

- any other relevant information.

The monitoring programs must:

- be based on guidance provided in the Water and Air Baseline Monitoring Guidance Document[118];
- conform to methods and QA/QC procedures specified in the British Columbia Field Sampling Manual[119] and the Environmental Data Quality Assurance Regulation *(Environmental Management Act (EMA))*[120]; and
- use analyses that follow standard analytical methods as specified in the most recent edition of the British Columbia Environmental Laboratory Manual[121] and associated supplements.

Note: Aquatic Effects Monitoring Programs should be linked closely to baseline monitoring programs, particularly if a Before After Control Impact (BACI) study design is proposed.

Describe QA/QC protocols in monitoring programs, including but not limited to the following:

- equipment checks and calibration;
- field procedures to minimize data-collection errors;
- sampling equipment de-contamination;
- blank sampling;
- replicate sampling;
- data quality objectives and related assessment of replicate and blank samples;
- assessment of ion balance (where applicable);
- assessment of the influence of suspended solids on dissolved concentrations in groundwater samples;
- comparison of aggregate parameters with analytical parameters (e.g., conductivity with total dissolved solids, total dissolved solids with the sum of analyzed concentrations); and
- flagging of outlier data points that do not represent actual conditions, with rationale.

Consult Part A of the British Columbia Field Sampling Manual[122] for detailed guidance on QA/QC protocols.

9.1. Mine Site Water Monitoring Program

Develop and describe a monitoring program for surface water, groundwater, and seepage water quantity and quality within the proposed permitted mine area (i.e., Tailings Storage Facilities (TSFs), waste rock storage areas, stockpiles, water management structures, etc.) that includes each phase of the mine life. The monitoring program should be designed to provide early warning of the onset of Acid Rock Drainage (ARD) and/or an increase in contaminant loading as well as to support the ongoing evaluation, reconciliation, and refinement of hydrogeologic, water balance, and surface water quality modelling.

The Mine Site Water Monitoring Program must be in a standalone document authenticated by a Qualified Professional (QP).

[118] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf
[119] https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/laboratory-standards-quality-assurance/bc-field-sampling-manual
[120] http://www.bclaws.ca/Recon/document/ID/freeside/22_301_90
[121] https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/laboratory-standards-quality-assurance/bc-environmental-laboratory-manual
[122] https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/laboratory-standards-quality-assurance/bc-field-sampling-manual

9.2. Discharge Monitoring Program

Describe monitoring programs specific to mine discharge effluent, seepage, and solid waste. In these monitoring programs, use appropriate physical (e.g., volume), chemical (e.g., concentrations), or short- and long-term toxicological measures, as these limits will form the basis for terms and conditions incorporated into the *EMA* effluent discharge permit. Compare data to permitted effluent discharge limits. Where possible (point sources), effluent quality and flow must be frequently and continuously determined, respectively. Seepage and groundwater monitoring will be essential where leaching is expected.

9.3. Environmental Monitoring Program

Develop an Environmental Monitoring Program that includes physical, chemical, and biological measurements to evaluate the efficacy of the permit for protecting the near-field (proximate to the discharge points and IDZ, if proposed) and far-field receiving environments. *EMA* permits with air emissions may require additional monitoring of the ambient air conditions and associated terrestrial receptors (e.g., plant tissue chemistry).

Samples for the Environmental Monitoring Program often include surface water, groundwater, sediment, air, tissue, and other media that may be influenced by the mine and may result in potential impacts to receptors (e.g., aquatic or terrestrial plants, fish, benthic invertebrates, periphyton, zooplankton, amphibians, mollusks, or bird eggs). Biotic components may be monitored in a separate, or associated, Aquatic Effects Monitoring Program (Section 9.4 below). Environmental monitoring is recommended at representative reference sites, in addition to exposure sites, to control for changes that are not related to permitted activities.

The Environmental Monitoring Program must:

- maintain consistent, long-term monitoring stations that will be active over the life of the project to facilitate long-term trend analysis;
- make a commitment to add monitoring stations, if needed, during the life of the project as the understanding of site conditions evolves;
- ensure sampling is concurrent with effluent discharge monitoring to understand the relationship between effluent quality and receiving environment water quality;
- estimate flows in the receiving environment to understand seasonal variability in water quality and calculate receiving environment loading and effluent dilution;
- include groundwater testing to determine potential impacts from discharges to ground and complement surface water monitoring efforts, if groundwater–surface water interactions are important;
- include comparisons to the relevant Water Quality Guidelines (WQGs)[123] and, where applicable, Water Quality Objectives (WQOs)[124], Science-Based Environmental Benchmarks (SBEBs)[125], contaminated site standards, Site Performance Objectives (SPOs), and permit limits, as well as background and predicted receiving water quality;
- summarize the assessment of the potential environmental effects, risks, and mitigation/management plans to be followed during emergencies and unexpected shutdown events for the pollution control systems; and

[123]WQGs in the receiving water should be calculated based on background concentrations of toxicity modifying factors versus the use of mine-induced concentrations of these factors. BC WQGs: https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines; CCME WQGs: https://ccme.ca/en/summary-table; Federal Environmental Quality Guidelines: https://www.canada.ca/en/health-canada/services/chemical-substances/fact-sheets/federal-environmental-quality-guidelines.html

[124]https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-objectives

[125]https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/tg8_framework_for_sbebs.pdf

- clearly link predicted effects to the associated components of the environmental monitoring program and show linkages in a table.

The program proposed in the Application will be reviewed and considered for permit conditions related to receiving environment monitoring. For groundwater monitoring, information must be provided on the range of monitoring depths that will be included for each individual monitoring location.

An important component of groundwater monitoring for projects with discharge to ground is the establishment of water quality trigger-level concentrations to allow early warning signs that can be used to prevent impacts to the environment and/or exceedances of specified limits at compliance points in the environment (for example, monitoring wells at the property boundary could be used to set compliance points). The monitoring sites and their trigger-level concentrations should be described in a Trigger Response Plan (TRP), which should outline escalating management measures, such as supplemental monitoring, investigations, and mitigations, if the water quality triggers are exceeded.

9.4. Aquatic Effects Monitoring Program

An Aquatic Effects Monitoring Program evaluates the effectiveness of the permit in protecting receiving environment biota. Where identified in the Information Requirements Table (IRT) and when required by the permit, permittees must design and implement an Aquatic Effects Monitoring Program that is capable of detecting the effects of receiving water quality changes due to effluent discharges, seepage, and other mining-related activities on biota (individually and cumulatively). The size and scope of the Aquatic Effects Monitoring Program is commensurate with the risk posed by the project and the potential sensitivity of the receptors. Owing to the inherent variability of biological systems, results from Aquatic Effects Monitoring Programs may be incorporated into a WOE matrix that combines a set of chemical parameters, toxicity results, tissue concentrations, and/or community composition data. A WOE matrix is one tool for evaluating if observed changes in receiving environment biota are linked to contaminant concentrations in effluent. Such a matrix can support other tools, such as Toxicity Identification Evaluation (TIE), in identifying toxicants that cause observed effects.

Prepare the Aquatic Effects Monitoring Program study design in consultation with ENV staff; approval from the Director may be required. The Aquatic Effects Monitoring Program will likely include measurements related to water, sediment, benthic invertebrates, and/or fish. Other valued ecosystem components or assessment endpoints (e.g., periphyton, fish tissue, etc.) may also be appropriate as identified in the baseline or impact assessment studies. Planning, implementation of, and reporting on Aquatic Effects Monitoring Program studies may cycle on an annual or multi-year basis. The Water and Air Baseline Monitoring Guidance Document[126] provides methods for aquatic life monitoring.

[126] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf

10. Management Plans

Describe the key mine management plans required to address environmental, operational, and health and safety issues noted throughout the Application. Present these plans in a manner that reflects site-specific operational management and monitoring requirements. Note that additional plans may be required to reflect site-specific management objectives.

Mine management plans are considered living documents and are expected to be kept up to date, reviewed routinely, and made available at the mine site at all times. These plans shall reference relevant policies and establish proactive procedures and Standard Operating Procedures (SOPs) to provide direction for management, mine site employees, and contractors. These plans shall also include provisions for training requirements to ensure all personnel involved in implementing the respective management plans are competent to fulfill their roles.

Ultimately, the management plans developed should reflect what will occur operationally on the mine site and be as detailed as possible, including maps, drawings, and sampling methodologies with details such as sampling location coordinates. The expectation is that these will be the plans implemented by site personnel and possibly contractors. With that objective in mind, the versions provided in the Application should not represent high-level framework documents; rather they should be executable by those responsible to do so. The plans will be subject to technical review during the permitting process. They will be required to be reviewed and revised regularly throughout the life of mine (or other periods of time in which they are to be implemented).

The environmental aspects of all mining projects include considerable uncertainty. Incorporate, as necessary, an adaptive management approach into the development of key Management Plans and Adaptive Management Plans. In doing this, demonstrate how the environmental uncertainties will be dealt with and how predictions will be tracked. Additionally, Trigger Action Response Plans (TARPs) ensure the implementation of planned contingency measures if identified environmental conditions (triggers) occur. They are not considered adaptive management. Descriptions of Adaptive Management Plans and TARPs are provided in Technical Guidance 20: Development and Use of Adaptive Management Plans[127] and Technical Guidance 12: Trigger Response Plans[128], respectively.

Consider the following guiding principles for adaptive management and incorporate them into plans as appropriate:

- measurable objectives for each of the potential environmental effects;
- management alternatives (i.e., specific actions that could be taken, if necessary);
- predictive models that will be used to inform the decision-making process; and
- monitoring protocols for collecting the data required to determine whether the objectives are being met.

Describe the implementation of the iterative phase of adaptive management, including the following components:

- the decision-making process;
- follow-up monitoring after any adaptive management decision, particularly the rationale for whether to implement new monitoring and/or to discontinue existing monitoring;
- provision for any additional site characterization that might be required;

[127] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/tg20_guide_to_preparing_adaptive_management_plans.pdf
[128] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/tg12_trigger_response_plans.pdf

- the nature and timing of the assessment and analysis (e.g., water quality model, site-wide water balance, groundwater model, etc.) that will be conducted after follow-up monitoring and/or site characterization has been completed; and
- how the assessment will be used to inform the understanding of present and future environmental effects, and the implementation of pragmatic management strategies.

10.1. Environmental Management System

Provide a summary of an overall Environmental Management System (EMS) that will be applicable during all phases of mine life (construction, operation, closure, and post-closure). The detailed environmental management plans that comprise the EMS are living documents and should be updated as appropriate during mine life.

In this section, provide:

- an environmental policy statement;
- context on environmental management roles and responsibilities;
- information on statutory requirements, including applicable local, provincial, or federal environmental standards and guidelines, permit requirements, regulations, and orders;
- information on environmental standards and procedures, including all applicable sector-specific standards, guidelines, best management practices, and codes of practice (e.g., Responsible Care, CSA, ASTM, RISC, GWPR);
- a description of the mine's organizational structure; and
- a description of proposed training programs.

10.2. Erosion and Sediment Control Plan

Provide an Erosion and Sediment Control Plan (ESCP) that identifies procedures to be followed during construction, operation, closure, and post-closure. The purpose of the ESCP is to identify controls and activities that will be implemented if disturbance of vegetation is planned and may result in exposed topsoil and/or mineral soil, create compacted areas, concentrate water on slopes, or change site conditions in a manner that could result in surficial erosion and/or sediment-laden runoff that could potentially enter surface water systems or ecosystems. The plan must be authenticated by a Qualified Professional (QP) with relevant expertise.

Provide details on proposed activities, including but not limited to:

- roles, responsibilities, and training requirements;
- an assessment of erosion potential (e.g., risk) and consequence in the proposed mine footprint;
- a description of how erosion and sediment control will be managed during construction and throughout the mine life;
- descriptions of methods to be used;
- drawings and/or maps of where erosion or sediment control prescriptions will be applied;
- a detailed event-based effectiveness monitoring program including monitoring locations and frequencies;
- a response plan including specific triggers, actions to be taken, and contingency plans;
- record keeping and reporting protocols; and
- adaptive management processes.

For additional details, refer to the Ministry of Energy, Mines and Low Carbon Innovation (EMLI)'s guidance document for developing an Erosion and Sediment Control Plan for Mines in British Columbia[129].

[129] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/erosion_sediment_control_plan_guide.pdf

10.3. Soil Management Plan

Provide a Soil Management Plan (SMP) that identifies procedures to be followed during construction, operation, closure, and post-closure. The purpose of the SMP is to identify controls and activities associated with a project having the potential to disturb soil resources and where soil replacement is required to reclaim and revegetate lands disturbed through mining-related activities. The plan must be authenticated by a QP with relevant expertise.

Provide details on proposed activities, including but not limited to:

- an assessment of soil characteristics (i.e., physical, chemical, and biological soil quality) and quantities in the proposed mine footprint;
- a description of how soil resources will be managed during construction and throughout life of mine;
- methods for salvaging soil and managing erosion and soil degradation/contamination risks;
- total depth to be salvaged and anticipated volumes of each soil type;
- equipment to be used and constraints (e.g., slopes, etc.) on stripping;
- drawings and/or maps of where soil resources will be salvaged and stockpiled;
- erosion control and sediment retention measures required for exposed surfaces;
- description of soil stockpile locations (and maps), volumes, dimensions, and anticipated storage durations;
- identification of layers or materials to be stored separately, and justification for doing so;
- storage requirements, including erosion and sediment control, and marking/identification of stockpiles according to the soil handling plan;
- descriptions of stockpile protection activities that will be implemented during the storage period;
- proposed training or supervision of operators by QPs;
- monitoring programs, including monitoring locations and frequencies;
- roles, responsibilities, and training requirements;
- record keeping and reporting protocols; and
- adaptive management processes.

For additional details, refer to EMLI's guidance document for developing a Soil Management Plan for Mines in British Columbia.

10.4. Construction Environmental Management Plan

Provide a Construction Environmental Management Plan (CEMP) that identifies procedures to be followed during construction, operation, closure, and post-closure. The purpose of the CEMP is to identify controls to avoid, minimize, and mitigate impacts as a result of mining construction activities. The plan is to include results from pre-disturbance field surveys to inform site-specific mitigation measures in the CEMP. The plan must be authenticated by a QP with relevant expertise.

Provide details on proposed activities, including but not limited to:

- an assessment of environmental values and conditions in the proposed mine footprint;
- a description of how environmental values will be managed during construction and throughout life of mine, including:
    - dust management;
    - erosion and sediment control;
    - vegetation management;
    - wildlife management;
    - invasive species management;
    - rare/endangered flora, fauna, and ecosystems;
    - bird nesting;
    - fish, amphibian, and wildlife salvage;
    - aquatic and terrestrial habitat protection;

    - soil salvage;
    - archaeological or cultural heritage resources;
    - surface water and groundwater protection; and
    - spill response;
- detailed construction plans;
- monitoring programs, including monitoring locations and frequencies;
- roles, responsibilities, and training requirements;
- record keeping and reporting protocols; and
- adaptive management processes.

For additional details, refer to EMLI's guidance document for developing a Construction Environmental Management Plan for Mines in British Columbia.

10.5. Metal Leaching and Acid Rock Drainage Management Plan

Provide day-to-day operational management, handling, monitoring, and storage procedures for acid-generating, Potentially Acid Generating (PAG), or potentially metal leaching (ML) materials. The plan must demonstrate that materials handling plans have been developed to prevent or minimize the production and release of acidic drainage and metals or Parameters of Potential Concern (POPCs)[130], to levels that assure protection of environmental quality. The plan must be authenticated by a QP with relevant expertise.

10.5.1. Definition of PAG and Metal Leaching Materials

Use the results of the Metal Leaching and Acid Rock Drainage (ML/ARD) Characterization Program (Section 6.1 this document) to propose site-specific operational geochemical criteria defining PAG, Non-Potentially Acid Generating (NPAG), and potentially ML materials. In the absence of site-specific criteria, EMLI applies the following standard definitions:

- materials are defined as PAG if they have a Neutralization Potential Ratio (NPR) (Neutralization Potential (NP)/Acid Potential (AP)) <2, where AP is determined using total sulphur and NP is determined using the modified Sobek method; and
- materials are defined as potentially ML if they contain soluble metal levels (as determined by the shake flask test) higher than the receiving water objectives.

A detailed rationale must be provided to support any deviation from these standard definitions and standard tests when developing operational geochemical criteria. Criteria may be specific to individual geologic materials and/or storage environments.

10.5.2. ML/ARD Management

Describe specific aspects of ML/ARD management, including but not limited to, the following:

- management purposes and objectives for each material to be managed, with reference to relevant regulatory requirements (e.g., requirements for segregation of PAG materials, limitations on use of ML materials for construction, etc.);
- a site map clearly indicating storage facilities and stockpiles for materials;
- a flow chart or conceptual diagram that illustrates the material processing and/or movement (e.g., hauling) of materials on site;
- procedures for tracking material movement and placement/disposal;
- a summary table of capacities for each storage facility and/or stockpile, dates active, and timeline for reclamation;
- a summary of key ML/ARD mitigation measures, including operational constraints for use, storage, and capacity limits of potentially ML and PAG materials;

[130] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/parameter_of_concern_fs.pdf

- a clear presentation of contingency plans for management, handling, and storage of potentially ML and PAG materials, including operational triggers for implementation of contingencies;
- SOPs and Quality Assurance/Quality Control (QA/QC) procedures;
- a process for change management; and
- any other relevant information.

10.5.3. ML/ARD Monitoring

Develop and describe an operational characterization and monitoring program for ML/ARD, with reference to materials and mine components characterized in Section 6.1 of this document. The monitoring program should include the following information for each material type and sampling location:

- objectives;
- sampling frequencies and locations, with a rationale for the distribution of monitoring locations and the selection of materials to be monitored;
- details of geochemical characterization tests, both on-site and off-site, to address data gaps and support validation of source terms, as identified in Section 6.2 of this document;
- detailed sampling and analytical testing procedures, including SOPs;
- diagnostic features significant to ML/ARD that will be recorded during sampling (e.g., carbonate and sulphide mineralogy and abundance, alteration, significant structural features, texture, etc.);
- name of the certified laboratories used to analyze samples, including details of on-site and off-site laboratories;
- QA/QC protocols;
- a change management procedure for updates to the monitoring program; and
- any other relevant information.

The ML/ARD Monitoring Program must be in a standalone document authenticated by a QP.

10.5.4. ML/ARD Reporting

The ML/ARD Management Plan must also include the following details:

- data management protocols, including procedures for developing and maintaining a materials inventory of mined materials;
- review schedules;
- roles and responsibility associated with the plan, including persons accountable and connections to other departments; and
- reporting requirements and schedules.

10.6. Mine Site Water Management Plan

Provide operational management procedures for the effective interception, conveyance, diversion, and storage of contact and non-contact water on the mine site. The purpose of the plan is to demonstrate how water will be managed at the mine site through each phase of mine life to maintain regulatory compliance, including implementation of water quality mitigation measures listed in Section 6.4 of this document and associated contingency measures. The plan must be authenticated by a QP with relevant expertise.

For each phase of mine life, include details on the following:

- the management plan purpose and objectives, with reference to relevant regulatory requirements and water quality mitigation measures;
- detailed descriptions, including site map(s), diagrams, and schematics, of overall site water management processes and infrastructure;
- details on use(s) of existing drainages;
- proposed water usage and water sources for the mine, detailing the watershed or source area boundary for the water supply;
- a description of sources, flow paths, storage facilities, and discharges for surface water and groundwater;

- integration of water quality or quantity mitigation measures required during the mine life (e.g., water treatment, groundwater interception, flow augmentation, etc.);
- assessment of upset conditions (e.g., extreme flow conditions, icing, etc.) and impacts on the performance of relevant infrastructure;
- contingency plans for mitigating potential impacts related to failure of any component(s) of the plan;
- roles and responsibilities associated with the plan, including persons accountable, connections to other departments, and process for change management; and
- any other relevant information.

The following information should be used to inform the development of the plan, but does not need to be included in the submitted plan if it is included elsewhere in the Application:

- site-wide water balance, including water balance for each relevant structure;
- tailings management and supernatant recovery systems (if required);
- geotechnical, hydrologic, hydrogeologic, and hydraulic stability assessments and designs for all water storage structures, water diversions, interceptors, and sediment retention structures, including key mine elements (e.g., open pits, underground workings, waste rock storage, stockpile areas);
- proposed water sources for the mine, including hydrogeological information (location, capture zone, yield, water quality, groundwater source in relation to geological units, well construction details, etc.) for groundwater sources to be utilized (including seepage);
- design of water treatment system(s);
- design of groundwater seepage mitigation or interception structures (dewatering wells, underground drains, etc.); and
- description of flow augmentation measures that might be required during low-flow periods to compensate for any induced streamflow losses to groundwater.

10.7. Vegetation Management Plan

Provide a Vegetation Management Plan (VMP) that identifies procedures to be followed during construction, operation, closure, and post-closure. The purpose of the VMP is to ensure that disturbance is limited to approved areas within the Permitted Mine Area (PMA) and that effects of approved disturbances are effectively mitigated. The plan must be authenticated by a QP with relevant expertise.

Provide details on proposed activities for achieving the objectives within the VMP and maintaining compliance with associated permits, acts, or legislation, including:

- best management practices during construction and operation;
- training requirements;
- detailed monitoring and reporting plans;
- provisions for adaptive mitigation;
- ongoing consultation with stakeholders; and
- considerations for reclamation planning.

Include SOPs for addressing, if applicable, riparian areas, old growth and mature forests, rare and at-risk species and ecosystems, metal uptake, large/coarse woody debris, and invasive plant species.

10.8. Invasive Plant Management Plan

Provide an Invasive Plant Management Plan (IPMP) that identifies procedures to be followed during construction, operation, closure, and post-closure. The purpose of the IPMP is to clearly outline activities to manage the ingress, establishment, and spread of invasive plants on areas disturbed by mine activities and manage vectors that transport invasive plant seed and materials to site from other areas. The plan must be authenticated by a QP with relevant expertise.

Provide details on proposed activities for achieving the objectives, including:

- best management practices throughout life of mine;
- training requirements;
- site inventory/potential invasive plants;
- treatment options for different species;
- detailed monitoring and reporting plans;
- provisions for adaptive management; and
- ongoing consultation with stakeholders.

Include SOPs for addressing invasive plant species. When appropriate, cross-reference the IPMP to other management plans, such as the Soil Management Plan and Erosion and Sediment Control Plan. For additional details, refer to EMLI's guidance document for developing an Invasive Plant Management Plan for Mines in British Columbia.

10.9. Wildlife Management Plan

Provide a Wildlife Management Plan (WMP) that identifies procedures to be followed during construction, operation, closure, and post-closure. The purpose of the WMP is to identify site/project-specific procedures and activities that will be implemented throughout all phases of the mine life to limit and mitigate impacts to wildlife within the PMA. The plan must be authenticated by a QP with relevant expertise.

Provide details on proposed activities for achieving the objectives, including:

- best management practices throughout life of mine;
- employee education requirements and programs as related to those practices;
- detailed monitoring and reporting plans;
- provision for adaptive mitigation;
- ongoing consultation with stakeholders; and
- preliminary recommendations for consideration during reclamation planning.

Specific plans to address individual wildlife species, in particular species at risk, may be required (e.g., bats and caribou). Ensure that wildlife monitoring programs address requirements outlined and regulated by other agencies (e.g., Ministry of Water, Land, and Resource Stewardship). For additional details, refer to EMLI's guidance document for developing a Wildlife Management Plan for Mines in British Columbia.

10.10. Fugitive Dust Management Plan

Provide a Fugitive Dust Management Plan (FDMP) that identifies procedures to be followed during construction, operation, closure, and post-closure. The purpose of the FDMP is to is to clearly identify how dust will be controlled from all non-point sources and to identify what site-specific mitigation measures will be implemented to limit or mitigate the potential for dust to impact various receptors, including communities and the environment. The plan must be authenticated by a QP with relevant expertise.

Provide details on the proposed activities for achieving relevant objectives, including but not limited to:

- identification and detailed descriptions of project fugitive dust-emitting sources;
- tracking and monitoring of sources, including methods and approaches;
- identification of sensitive receptors and potential effects;
- methods and approaches for controlling/minimizing the production of fugitive dust;
- fugitive dust triggers, response and contingency plans;
- drawings and/or maps of where sources are located;
- monitoring programs, including monitoring locations and frequencies;
- roles, responsibilities, and training requirements;
- record keeping and reporting protocols; and
- adaptive management processes.

For additional details, refer to EMLI's guidance document for developing a Fugitive Dust Management Plan for Mines in British Columbia[131].

10.11. Archaeological Management and Impact Mitigation Plan

Provide an Archaeological Management and Impact Mitigation Plan that identifies procedures to be followed during construction, operation, closure, and post-closure. Address the following:

- archaeological and cultural heritage resources awareness training;
- training for archaeological monitoring;
- detailed chance-find procedures, including obtaining required permits;
- applicable legislation, regulations, and guidelines;
- Heritage Inspection and Alteration Permits; and
- procedures and protocols for the protection of existing sites.

10.12. Fuel Management and Spill Control Plan

Provide a Fuel Management and Spill Control Plan that identifies procedures to be followed during construction, operation, closure, and post-closure. Outline the following:

- fuel handling and transportation;
- dispensing and storage facilities and related equipment;
- an assessment of risk for human health and environment related to potential spills of substances found on the mine site;
- hazardous waste management and transport procedures;
- environmental protection measures including Best Management Practices (BMPs);
- monitoring programs;
- roles, responsibilities, and training requirements;
- record keeping and reporting protocols; and
- adaptive management processes.

Use the following regulations and codes when developing the Fuel Management and Spill Control Plan:

- B.C. Building and Fire Codes;
- *Environmental Management Act (EMA)*;
- Petroleum Storage Facilities; and
- Storm Water Regulation.

For further guidance, refer to A Field Guide to Fuel Handling, Transportation, and Storage[132]. Include an Emergency Response Plan in accordance with regulatory requirements, including a Spill Response Plan for the prevention and management of spills and fugitive emissions on site and on product transportation routes. Develop a contingency plan for preventing, minimizing, and containing spills. Include plans for process upsets and non-compliant discharges (e.g., collection ponds with pump-back systems, back-up treatment systems).

10.13. Combustible Dust Management Plan

Where combustible dust may be a hazard, a Combustible Dust Management Plan must be provided. The plan must be prepared by professionals or persons who, in the opinion of the Chief Inspector, are qualified to perform the work. The plan must include the following:

- both surface and underground operations;
- the mining and processing methods being proposed;

[131] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/dust_management_plan_guidance.pdf

[132] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/oilandgas/fuel_handle_guide.pdf

- building designs required for dust management; and
- reference to the best practices used to develop the plan.

10.14. Chemicals and Materials Storage, Transfer, and Handling Plan

List and provide descriptions of potential chemicals and substances classified as or deemed to be potentially hazardous that will be used and produced during any mine/project phase (e.g., construction, development, operation). Describe storage, transfer, and handling plans and procedures for the identified chemicals and substances. Clearly indicate how compliance with Sections 2.3.3, 2.3.4, 2.3.6, 2.3.8, and 2.13.1 through 2.13.19 of the Health, Safety, and Reclamation Code (HSRC) will be achieved.

Given that the hazardous products utilized during construction and operation are likely to be adjusted over the life of the project, outline a policy or procedure for product procurement that identifies and assigns responsibility and a process for assessing storage, emergency/spill response, potential worker exposure, and general health and safety considerations prior to bringing a new product on site.

Refer to the Hazardous Waste Regulation[133] of the *EMA* for further information on hazardous materials.

10.15. Waste (Refuse and Emissions) Management Plan

Describe waste management strategies to be followed during construction, operation, closure, and post-closure. Clearly outline all discharges through the various construction and operation phases of the project, including the following:

- air contaminants:
    - list potential sources, including open burning, incineration, spills, dust, fugitive emissions from all processes (including cooling), emissions from ponds and yards, and emissions from electrical generation (depending on the mining process, an air discharge permit may be required);
- effluents:
    - list sources, including spills, exfiltration, spray irrigation, other losses from processes (including cooling), and sewage and stormwater discharges;
- refuse:
    - list sources, including spills and other losses of materials such as leachate, materials from landfilling or land-farming, or recyclable materials; and
- contaminated soil management:
    - provide plans to remediate or manage soils impacted by spills on the site;
    - provide detailed descriptions of any proposed pollution control and/or water management necessary during construction and operations to manage existing contamination;
    - identify remedial strategies to be used to mitigate and/or remediate contamination;
    - identify a monitoring proposal to aid in characterizing potential groundwater contamination; and
    - provide information on proposed site decommissioning or planned site remedial activities, including information required for the completion of a site profile as described in the *EMA*.

[133] http://www.bclaws.ca/Recon/document/ID/freeside/63_88_01

11. Reclamation Liability Cost Estimate

The Major Mines Reclamation Security Policy (Interim)[134] describes the regulatory context of a Reclamation Liability Cost Estimate (RLCE), strategies for reducing site liabilities, the main criteria for an RLCE, and the eligibility criteria and calculation methods for the Exploration Incentive Security amount. The policy also describes administration of RLCEs and financial instruments that are accepted by the Ministry of Energy, Mines and Low Carbon Innovation (EMLI) as financial assurance.

The RLCE must describe the methods used to determine the estimated cost to implement the Reclamation and Closure Plan, as outlined in Section 5 of this document, addressing all liabilities resulting from mining operations, including any required source controls or mitigation measures. These estimated costs are then used by the Chief Permitting Officer (CPO) to determine the amount and timing of reclamation security for the mine.

The following sections provide detailed guidance to Proponents on the format and detailed information required in an RLCE accompanying a *Mines Act* or a joint *Mines Act/Environmental Management Act (MA/EMA)* permit application or a Five-Year Reclamation Program Update for Major Mines in BC, required as per Sections 10.1.3(i) and 10.4.1(2) of the Health, Safety, and Reclamation Code (HSRC).

The RLCE must be prepared by a qualified person(s).

11.1. RLCE Parameters

The RLCE must be developed to be consistent with the parameters outlined below.

11.1.1. Time Period

The RLCE must include all costs required to implement the Reclamation and Closure Plan and maintain compliance with provincial and federal regulatory requirements over a 100-year period.

Year 1 of the 100-year period must be set to the year the RLCE is submitted, regardless of whether the site is in construction, operation, care and maintenance, or closure.

11.1.2. Costing Scenarios

The RLCE must include the following two scenarios for the 100-year period:

- the calculated liability and reclamation and closure costs associated with the existing site disturbance and implementation of the next five years of the mine plan; and
- the calculated liability and reclamation and closure costs associated with the life of mine, where the permitted mine plan is fully implemented.

For both scenarios, the RLCE must show the following total cost estimates:

- total RLCE without any discounts or credits applied to any cost category;
- total RLCE with applicable discounts applied to the eligible cost categories; and
- total RLCE with applicable discounts and any eligible Exploration Incentive Security credits applied.

11.1.3. Progressive Reclamation

The planned implementation of the Reclamation and Closure Plan during the operations phase (i.e., progressive reclamation) cannot be discounted from the RLCE until the work has been completed and

[134] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/reclamation-and-closure/major_mines_reclamation_security_policy_interim_v1_05apr2022.pdf

demonstrated to the Chief Inspector that the implemented progressive reclamation supports the achievement of land use and capability objectives.

11.1.4. Third-party Costs

All costs associated with implementing the Reclamation and Closure Plan, required mitigations, and maintaining compliance with all regulatory requirements must be based on recent third-party information sources, which can include quotes, estimates, or invoices received from suppliers, contractors, and/or consultants. Costs associated with conventional reclamation activities, labour and equipment rates, engineering, project management, mobilization/demobilization, equipment and structure removal/disposal, site monitoring, capital and operating costs for source controls and mitigation measures, and site maintenance must be based on recent third-party information sources, which can include quotes, estimates, or invoices received from suppliers, contractors, and/or consultants:

- Equipment rates can also be informed by the BC Road Builders and Heavy Construction Association Equipment Rental Rate Guide – The Blue Book; and
- Equipment productivity rates can also be determined from manufacturer sources, such as the Caterpillar Performance Handbook or similar published reference information.

11.1.5. Revenue Streams

All revenue sources related to implementation of the Reclamation and Closure Plan and operation of the site must be excluded from the RLCE.

This includes any revenue that may be generated from non-mining activities on the mine site (e.g., landfilling, power generation, etc.) as well as any revenue that could potentially be generated from salvage of equipment or materials.

11.1.6. Mobilization/Demobilization

The mobilization/demobilization of equipment and staff from the mine site may be estimated as 5% of the value of the costs associated with the physical work to be conducted (equipment, labour, and materials/supplies) or based on recent prior work of a similar nature.

11.1.7. Project Management

The project management costs associated with implementation of the Reclamation and Closure Plan may be estimated as 10% of the value of the physical work to be conducted or estimates based on recent prior work of a similar nature.

11.1.8. Engineering/Consulting Costs

These are costs required to complete future design and/or construction and/or reporting work outlined in the Reclamation and Closure Plan.

Engineering/consulting costs must be based on a cost estimate provided by an engineering/consulting firm or a conservative estimate based on recent prior work of a similar nature.

11.1.9. Contingency Fees

A minimum 15% contingency must be applied to the final, undiscounted, RLCE.

Higher contingencies may be applied at the discretion of the CPO based on the level of uncertainty.

If lower contingencies are being proposed, justification must be included in the RLCE and be acceptable to the CPO.

Applied contingencies from vendor quotes/specific estimates do not need to have the 15% contingency re-applied, provided the minimum 15% contingency is included in the quote.

11.1.10. Discount Rates

Discount rates must not be applied to short-term site activities (i.e., Cost Categories 1 to 3)

Discount rates must only be applied to long-term mine site activities (e.g., Cost Categories 4 to 7)

The following discount rates must be applied to mine sites with an undiscounted RLCE <$50M:

- Years 1 to 5: 1.5%; Years 6 to 30: 2.0%; Years 31 to 100: 3.0%.

The following discount rate must be applied to mine sites with an undiscounted RLCE >$50M:

- Years 1 to 100: 4.0%.

The 4.0% discount rate cannot be applied to reduce the RLCE below $50M after the inclusion of contingencies.

11.2. Required Components

The RLCE accompanying an Application must be comprised of two main components:

1. RLCE Summary Report; and
2. RLCE Spreadsheets.

11.2.1. RLCE Summary Report

The RLCE Summary Report, also referred to as a Basis of Estimate, links the Reclamation and Closure Plan to the RLCE Spreadsheets and must include the following information:

- all relevant cost requirements (i.e., information requirements) outlined in this document;
- the assumptions, supporting information, and calculation methods for each included cost requirement;
- The Cost Estimate Classification System and Cost Estimate Class(es), and expected accuracy range(s); and
- the total undiscounted costs and discounted costs.

11.2.2. RLCE Spreadsheets

The RLCE Spreadsheets must:

- be provided in, or compatible with, Microsoft® Excel®;
- be unlocked and editable, with all inputs and calculations made visible;
- report undiscounted costs for all cost requirements, in all Cost Categories, before and after any applied contingencies; and
- report costs for all cost requirements, in all Cost Categories, on an annual basis, and be consistent with the Reclamation and Closure Plan and the RLCE Summary Report.

The RLCE Spreadsheets must include:

- a separate section/tab for each Cost Category outlined in Section 11.3 below:
    - the relevant cost requirements for each Cost Category must be individually listed;
    - any values and/or assumptions used in calculations of cost requirements must be included; and
    - all cost requirements must be shown over a 100-year period; and
- A summary section/tab that includes the annual totals for each Cost Category over a 100-year period.

The costs presented in the post-closure phase would include line items from all Cost Categories.

It is recommended that, for a tabular presentation of all post-closure costs over the entire RLCE term, line items and Cost Categories be grouped together based on their eligibility for discounting for ease of review.

11.3. Cost Categories

This section presents each of the Cost Categories that comprise the RLCE and the specific cost requirements (i.e., information requirements) for each. The Cost Categories include:

- Cost Category 1 – Infrastructural Removal;
- Cost Category 2 – Site Remediation;
- Cost Category 3 – Conventional Reclamation;
- Cost Category 4 – Water Quality Mitigations;
- Cost Category 5 – Site Staffing;
- Cost Category 6 – Site Maintenance; and
- Cost Category 7 – Site Monitoring and Reporting.

11.3.1. Cost Category 1 – Infrastructure Removal

Infrastructure removal includes the costs associated with the removal of all infrastructure from within the Permitted Mine Area (PMA).

11.3.1.1. General Requirements

The RLCE Spreadsheet must include the total cost and the removal year for each separate piece of infrastructure that will be removed within the 100-year period.

The RLCE Summary Report must include:

- a breakdown of the labour, equipment, and disposal cost for each separate piece of infrastructure; and
- a summary of infrastructure that is required for site operations beyond the 100-year period and will not be removed.

11.3.1.2. Infrastructure Types

Infrastructure types include, but are not limited to:

- buildings and foundations;
- machinery and mechanical equipment (e.g., haul trucks, mobile crushers, drills, pumps, etc.);
- water management structures (e.g., ponds, sumps, ditches, diversion channels, embankments, berms, etc.);
- roads;
- groundwater wells;
- other structures not housed within a building (e.g., conveyors, storage tanks, fuel stations, pipelines, etc.);
- utilities (e.g., powerlines, substations, booster stations, etc.); and
- chemicals/reagents (collection, containment, and removal from site).

11.3.2. Cost Category 2 – Site Remediation

Site remediation includes all activities associated with the investigation, characterization, and on-site treatment of contaminated sites within the PMA to ensure the mine site remains in compliance with the HSRC, the *MA* permit, the *EMA* permit, and other relevant authorizations over the 100-year period.

11.3.2.1. Contaminated Sites Investigations

The RLCE Spreadsheet must include the cost for each individual site requiring investigation within the PMA.

The RLCE Summary Report must include:

- a summary of each site area requiring investigation;
- a summary of the required investigation for each site area; and
- a summary of the assessment, remediation, monitoring, and reporting requirements and costs.

11.3.2.2. Soil Treatment

The RLCE Spreadsheet must include the cost for each soil treatment site within the PMA.

The RLCE Summary Report must include:

- a summary of each site area requiring investigation;
- a summary of the required investigation for each site area; and
- a summary of the assessment, remediation, monitoring, and reporting requirements and costs.

11.3.3. Cost Category 3 – Conventional Reclamation

Conventional reclamation includes all activities associated with the physical implementation of the Reclamation and Closure Plan to achieve site-specific end land uses and must include the physical reclamation of all disturbances associated with the *MA* permit, unless otherwise exempted by the Chief Inspector. This must include all decommissioning, earthworks, and revegetation, as well as the design and construction of closure infrastructure.

11.3.3.1. General Requirements

When there is more than one occurrence of a mine component on a site (such as two separate waste rock dumps), the conventional reclamation cost must be provided separately for each.

The RLCE must include the cost to conduct studies, complete detailed closure designs, and implement all work required for the closure of individual facilities, if not already conducted. These costs must be based on cost estimates provided by an engineering/consulting firm with applicable Qualified Professionals (QPs) or a conservative estimate based on recent prior work of a similar nature.

The RLCE Spreadsheet must include each reclamation activity and the associated cost, including the assumed unit costs, for each mine component, including any calculations.

The RLCE Summary Report must provide:

- a detailed summary of each mine component, including surface area, prescribed reclamation activities, and assumed costs of each activity (i.e., equipment, labour, material costs, etc.); and
- a summary of the individual cost for each reclamation activity of each mine component, including any assumptions, calculations, and equations applied.

11.3.3.2. Mine Components

Conventional reclamation costs must be provided for the following mine components, if present, within the PMA:

- open pits;
- underground workings (including adits, portals, shafts, etc.);
- Tailings Storage Facilities (TSFs);
- sediment ponds and other dams;
- waste rock dumps;
- ore stockpiles;
- coarse coal rejects stockpiles;
- soil/overburden stockpiles;
- quarries;
- borrows;
- linear features (e.g., roads, powerline, pipeline, and conveyor coordinators);
- plant site (e.g., mill, shops, administration buildings, etc.);
- laydown areas;
- other disturbed areas; and
- any other site-specific components.

11.3.3.3. Reclamation Activities

For each mine component, the following reclamation activities, if applicable, must be included:

- recontouring;
- growth media placement (e.g., overburden, soil, amendments);
- site preparation (e.g., ripping/scarifying, mounding, etc.);
- seeding, planting, and specialized revegetation work;
- specific habitat restoration elements (e.g., stream channel reconstruction);
- design and construction of closure features (e.g., spillways, portal plugs, etc.); and
- erosion protection.

11.3.3.4. Costs

The following costs must be included for each conventional reclamation activity:

- engineering studies, designs, and implementation costs, if applicable;
- surface area;
- material volume;
- labour cost;
- equipment cost (e.g., hourly, daily);
- fuel cost; and
- procurement and delivery of materials (e.g., rock, riprap, soil, overburden, amendments, seed, planting species, etc.).

11.3.4. Cost Category 4 – Water Quality Mitigations

Water quality mitigations (mitigations) includes all capital costs and operating costs associated with the source control and/or water and effluent treatment processes or systems (mitigations) included in Section 6 of this document, as follows:

- capital costs:
  - must be provided for any proposed mitigation. Capital costs are not required for already constructed and/or operating mitigations;
  - must be based on costs provided by a third-party supplier or the actual cost of a similar system used elsewhere; and
  - may be excluded if the mitigation will be constructed when > 10 years remain in the mine's operating life, at the discretion of the CPO; and
- operating costs:
  - must be based on costs provided by a third-party supplier or on a conservative estimate based on costs to operate a similar mitigation elsewhere; and
  - for existing mitigations, current operating costs may be used to determine future operating costs. However, it must be demonstrated that the actual operating costs incurred during previous years are representative of future costs.

11.3.4.1. General Requirements

The RLCE Spreadsheet must include the following:

- construction and decommissioning capital costs for each mitigation;
- operational costs of each mitigation, with the delivered cost for each operational component shown separately for each year of operation over the 100-year period; and
- capital and operating costs at the point during the 100-year period when the mitigation would be required.

The RLCE Summary Report must include:

- a timeline of the assumed constructed, commissioning, maintenance, and, if applicable, replacement or decommissioning;
- the maintenance requirements, including parts and labour;
- the assumed lifespan and replacement frequency;
- the assumed consumption rate for all required reagents; and
- the assumed production rates of any treatment by-products requiring handling and disposal.

11.3.4.2. Capital Costs

Capital costs are one-time cost requirements associated with the initial construction and/or replacement of each mitigation and associated infrastructure, as well as the final decommissioning of the infrastructure, if planned during the 100-year period.

The capital costs must include the following:

- design/engineering costs required to provide Issued for Construction (IFC) design details;
- materials procurement (delivered costs for imported material; excavation and transport costs for site-sourced material);
- construction:
    - equipment (operation and mobilization/demobilization);
    - personnel; and
    - monitoring and reporting;
- commissioning;
- decommissioning;
- project management; and
- other site-specific costs.

11.3.4.3. Operating Costs

Operating costs include the cost requirements associated with the operation, maintenance, monitoring, and reporting of each mitigation. For proposed mitigations that will be operated over multiple years, the operating costs must be included for each year of operation.

The operating costs must include the following:

- site personnel requirements (for operation, maintenance, and monitoring programs);
- materials, instrumentation, and/or reagents;
- power requirements;
- maintenance and, if applicable, replacement costs;
- handling and disposal of wastes and by-products;
- monitoring, including water quality and quantity, sampling, and analyses;
- reporting requirements (if separate from site personnel); and
- other site-specific costs.

11.3.5. Cost Category 5 – Site Staffing

Site staffing includes all staff and/or contractor positions required to carry out reclamation and closure activities and to ensure the mine site remains in compliance with the HSRC, the *MA* permit, the *EMA* permit, and other relevant authorizations over the 100-year period.

11.3.5.1. General Requirements

The RLCE Spreadsheet must include the total cost for all staff positions required for each year of the 100-year period.

The RLCE Summary Report must include:

- a breakdown of the number of site staff positions, a summary of each position's responsibilities, and a rationale for each position if it is not required to be in place full-time over the 100-year period; these staff positions must not include those staff positions required for the operation, monitoring, and maintenance in Cost Category 3; and
- the assumed weekly hours worked and the annual average salary for each staff position based on third-party contractor rates, which must be commensurate with the skill requirements and reflective of current market rates.

11.3.6. Cost Category 6 – Site Maintenance

Site maintenance includes all costs required to ensure the remaining site infrastructure is monitored, maintained, and reported on as required to ensure the mine site remains in compliance with the HSRC, the *MA* permit, the *EMA* permit, and other relevant authorizations over the 100-year period.

11.3.6.1. General Requirements

The RLCE Spreadsheet must include the total cost for each site maintenance requirement for each year of the 100-year period.

The RLCE Summary Report must include:

- a summary of each piece of site infrastructure that is required over the full 100-year period, not including those included in Cost Category 4; and
- a summary of the operating and maintenance requirements and estimated costs for each piece of site infrastructure based on third-party rates.

11.3.6.2. Site Maintenance Items

Site maintenance items include:

- site access infrastructure;
- invasive species management;
- vegetation management (e.g., maintenance required for dam or cover integrity);
- utilities and powerlines;
- roadways;
- buildings;
- site water management systems:
    - including all collection ditches, diversion ditches, collection ponds, sediment ponds (including dredging), spillways, culverts, piping, pumps, etc.; and
    - excluding the water management items included in Cost Category 4;
- vehicles and site equipment;
- storage and disposal of fuels and oils; and
- adaptive reclamation activities (e.g., fill planting, reseeding, additional fertilizer applications, etc.).

11.3.7. Cost Category 7 – Site Monitoring and Reporting

Site Monitoring and Reporting includes all monitoring programs and reporting required to maintain regulatory compliance with the HSRC, the *MA* permit, the *EMA* permit, and federal regulations, including the Metal and Diamond Effluent Regulations[135], over the 100-year period.

11.3.7.1. General Requirements

The RLCE Spreadsheet must include the total cost for each required monitoring program and report for each year of the 100-year period.

The RLCE Summary Report must include:

- a summary of the required monitoring programs, including the number of monitoring locations, number of samples per event, and event frequency per year and over the 100-year period;
- a summary of the costs associated with each monitoring program;
- a summary of each required report, including provincial and federal requirements, including the name of each required report and the submission frequency over the 100-year period; and
- a summary of the costs associated with each required report, including the number of personnel, data interpretation and report generation time required, and required personnel and hourly rates.

11.3.7.2. Monitoring Programs

The required monitoring programs include the following:

- reclamation monitoring program as outlined in Section 5 of this document;

[135] https://laws-lois.justice.gc.ca/eng/regulations/SOR-2002-222/FullText.html

- surface water and groundwater quantity/quality monitoring programs:
    - must include all monitoring locations, sampling frequencies, and sampling for parameters identified in the current *MA* and *EMA* permits and currently required under federal regulations;
    - must be assumed to occur over the full 100-year period;
    - may not assume any reductions in frequencies, monitoring sites, or parameters during the different stages of mine life, unless already included in the *MA* and *EMA* permits or federal regulations; and
    - do not include the monitoring requirements included in Cost Category 4;
- geotechnical monitoring programs, including:
    - all HSRC and permit required activities and reports (e.g., Dam Safety Investigations (DSI), Dam Safety Reviews (DSRs), Independent Tailings Review Board (ITRB), etc.);
    - TSF and dam monitoring;
    - subsidence monitoring;
    - open pit slope monitoring;
    - waste rock dump monitoring;
    - instrumentation maintenance and replacement; and
    - Operation, Maintenance, and Surveillance (OMS) manual updates and revisions; and
- site-specific monitoring programs required by the *MA* and *EMA* permits:
    - Metal Leaching and Acid Rock Drainage (ML/ARD) monitoring, air quality, meteorology, aquatic effects, etc.

11.3.7.3. Monitoring Costs

The following cost items must be included in the total monitoring program cost:

- number of monitoring locations;
- monitoring frequency per year;
- monitoring frequency over the 100-year period;
- analytical parameters being monitored;
- personnel:
    - time required;
    - hourly rate;
    - overhead (travel, accommodation, meals; transportation); and
    - site staff may be utilized and the component of their salary associated with monitoring programs must be summarized in Cost Category 5; and
- laboratory analysis (including shipping).

11.3.7.4. Reporting Costs

The required reports include all the reports currently included in the HSRC, the *MA* and *EMA* permits, and federal regulations. The following cost items must be included in the total cost for each required report:

- report frequency;
- total number of reports over the 100-year period;
- data interpretation and report writing time; and
- personnel:
    - hourly rate; and
    - site staff may be utilized, and the component of their salary associated with monitoring programs must be summarized in Cost Category 5.

Joint Application Information Requirements (JAIR) Guidance Document