Joint Application Information Requirements

for

Mines Act and *Environmental Management Act* Permits

Prepared by:

British Columbia Ministry of Energy, Mines and Petroleum Resources

&

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Abbreviations

AIA	Archaeological Impact Assessment
AID	Application Instruction Document
BACI	Before-After-Control-Impact
BAT	Best Achievable/Available Technology
CABIN	Canadian Aquatic Biomonitoring Network
CEMP	Construction Environmental Management Plan
CIH	Certified Industrial Hygienist
Code	Health, Safety and Reclamation Code for Mines in British Columbia
CSM	Conceptual Site Model
EA	Environmental Assessment
EAC	Environmental Assessment Certificate
EDF	Environmental Design Flood
EEM	Environmental Effects Monitoring
EGBC	Engineers and Geoscientists British Columbia
EIA	Environmental Impact Assessment
EMA	*Environmental Management Act*
EMS	Environmental Management System
EMPR	Ministry of Energy, Mines & Petroleum Resources
ENV	Ministry of Environment and Climate Change Strategy
EPD	Environmental Protection Division
FLNRD	Ministry of Forests, Lands, Natural Resource Operations, and Rural Development
GCMP	Ground Control Management Plan
HCA	*Heritage Conservation Act*
HVAC	Heating, Ventilation, and Air Conditioning
IDF	Inflow Design Flood
IDZ	Initial Dilution Zone
IFC	Issued for Construction
IPMP	Invasive Plant Management Plan
IRT	Information Requirements Table
MA	*Mines Act*
MSD	Musculoskeletal Disorder
MERP	Mine Emergency Response Plan
ML/ARD	Metal Leaching and Acid Rock Drainage
MRC	Mine Review Committee
NPV	Net Present Value
OHS	Occupational Health and Safety
OHSC	Occupational Health and Safety Committee
POC	Parameter of Concern
QA/QC	Quality Assurance/Quality Control

QPO	Quantitative Performance Objective
ROH	Registered Occupational Hygienist
SBEB	Science-Based Environmental Benchmark
SOP	Standard Operating Procedure
SPO	Site Performance Objective
TAR	Technical Assessment Report
TRP	Trigger Response Plan
TSF	Tailings Storage Facility
WHMIS	Workplace Hazardous Materials Information System
WOE	Weight of Evidence
WQG	Water Quality Guideline
WQO	Water Quality Objective

Preface

This Application Information Requirements document provides guidance on the technical information requirements expected to be submitted in support of a joint application for a *Mines Act* (*MA*) permit issued by the Ministry of Energy, Mines and Petroleum Resources (EMPR) and an effluent discharge permit issued under the *Environmental Management Act* (*EMA*) by the Ministry of Environment and Climate Change Strategy (ENV).

The information requirements presented in this document will be further developed through pre-application discussions with EMPR and ENV technical staff. This document is intended for both new and existing major mines, including proposed amendment applications or major expansions/extensions of mining projects. Combining the technical information requirements for the *MA* and *EMA* permit applications reduces the overlap of information required by EMPR and ENV and results in a single set of information requirements that supports both applications.

Mining project proponents will receive additional guidance from EMPR and ENV technical staff, EMPR's Major Mines Office, or Regional Operations with respect to more specific information requirements for their project as early as possible prior to submitting applications. ENV and EMPR require "pre-application" meetings with proponents, Indigenous Nations, applicable provincial permitting agencies, and technical staff to discuss and confirm the scope and detail of information requirements prior to application submission.

When developing the application that presents the information requirements outlined in this document, proponents are advised to present the information in the order listed in the table of contents. Additionally, proponents should reference the location of materials in the Information Requirements Table (IRT) in the right-hand column related to each line of the IRT.

Mines Act Permitting

Applications for *MA* permits must demonstrate compliance with the Health, Safety and Reclamation Code for Mines in British[1] (hereafter "the Code"). Depending on project-specific considerations, information requirements in addition to those listed herein may be required.

Applications must include detailed designs for all project components and phases of mine life. Proponents are expected to provide detailed engineering designs, management plans, and monitoring programs. Planning needs to be sufficiently detailed to ensure the health and safety of mine personnel and the public as well as the protection and reclamation of the land and watercourses affected by mining activities.

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

In addition to providing the technical information described in this document, proponents must ensure that *Mines Act* permit fees[2] are provided with the submission of an application, as applicable.

Environmental Management Act Permitting

This document includes the information requirements of a Technical Assessment Report (TAR) with particular emphasis on the Environmental Impact Assessment (EIA) normally required as part of the application (found in Technical Guidance 1 – *Environmental Management Act* Applications TERMS OF REFERENCE Environmental Impact and Technical Assessment Report[3]) and builds upon the generic guidance related to TAR preparation found in Guidance on Applications for Permits under the *Environmental Management Act* – Technical Assessment[4] (under the *Guidance for a Technical Assessment Report* pulldown menu).

In cases where construction significantly precedes operation, a proponent may submit an application for an *EMA* permit[5] (under the *New Permit, Approval or Operational Certificate: Forms, Templates, Fees & IRTs* pulldown menu) associated with construction effluent discharges prior to an application for operational effluent discharge permits. The application information requirements outlined in this document should be modified specifically for each project (single- or two-phase application) after discussion with and advice from the project-specific Mine Review Committee (MRC), specifically the ENV representatives.

In addition to providing the technical information described in this document, proponents must ensure that *EMA* permit fees[6] are provided with the submission of an initial application and all other relevant forms[7] to the Vic Admin mailbox: PermitAdministration.VictoriaEPD@gov.bc.ca. All permits, registrations, and authorizations under the *EMA* require the same initial application to Vic Admin and payment of fees to initiate the review process.

The Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators[8] must also be followed in the development of an application for an *EMA* permit. This document provides detailed direction regarding collecting and presenting baseline data as well as assessing and predicting the potential effects of a project on the aquatic environment. Prior

[2] https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/permitting/mines-act-permit-inspection-fees
[3] www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/eia__ta_tor.pdf
[4] https://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/guidance-forms-and-fees
[5] https://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/guidance-forms-and-fees
[6] https://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/guidance-forms-and-fees
[7] https://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/guidance-forms-and-fees
[8] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf

to intake of an application, proponents may contact ENV regarding advice on proposed baseline data collection programs.

Each qualified professional must provide signed Conflict of Interest Disclosure and Declaration of Competency forms, which will be provided by ENV with the Application Instruction Document (AID) at the end of the pre-application stage.

Prior to initiating the development of the Information Requirements Table (IRT), proponents must complete the intake step. This step involves submission of an initial project description, site map, draft application form, and payment of the application fees. Tracking of the application progress by ENV only occurs once intake is complete. Note that the proponent must also submit a final application form for authorization to discharge waste[9] under the *EMA*, in addition to providing the technical information described in this document when the final application is submitted.

These information requirements address effluent-related discharges only. For other waste discharges related to project activities, such as air emissions or solid waste or hazardous waste disposal, separate applications may be required. The Environmental Protection Division (EPD)'s fact sheet on waste authorizations and best practices for industrial camps[10] identifies the requirements for disposal of putrescible wastes (food wastes), solid waste, and hazardous waste for exploration, construction, and industrial camps.

Once an *EMA* authorization is issued, mine proponents are responsible for understanding and following the terms and conditions of their authorization. Ministry of Environment inspectors verify compliance with authorizations to ensure proponents are following requirements designed to protect the environment and human health. More information and guidance can be found on the Environmental Compliance in BC website[11].

Joint Information Requirements

The information requirements presented in this document are those relevant for a joint application for *MA* and *EMA* permits. The information requirements will be referenced and reviewed in the IRT discussions. Where an application refers to previously submitted information, a summary of that information should be provided under the appropriate section or subsection of the application, with hyperlinks to the corresponding sections of the previously submitted document(s) provided.

[9] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/mining_operations_fs.pdf
[10] www2.gov.bc.ca/assets/gov/environment/waste-management/sewage/mwr/workcampsfs.pdf
[11] https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/natural-resource-law-enforcement/environmental-compliance

From this point forward, the sections of this document provide a template for joint *MA*/*EMA* applications.

Executive Summary

Provide an executive summary that briefly describes the proposed project, identifies the authorizations being applied for, and identifies how the application information requirements developed with advice from the project-specific MRC and any additional input from technical agencies and First Nations is addressed in the application, and provide instruction for reviewers on where to find the specified information. If the application is for an expansion or amendment to an existing mine, clearly identify the new components (i.e., those not already permitted).

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 Application Background

Provide a general introduction to the application, including the purpose and scope. Provide an overview of the application structure.

1.2 Proponent Information

Include the following information for the operating company:

- overview, including the name, organization, and structure;
- the registered legal name and registered address;
- the name of the company representative managing the project;
- the 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 activities at the mine site and a list of previous related reports, studies, designs, etc.

1.3.2 Overview of Products, Markets, and Projected Project Benefits

Describe the product(s) that would be mined, market need, production volume and rate, projected mine life, number of new direct and indirect jobs created, and estimated capital investment.

1.3.3 Location, Access, and Land Use

Provide a description and figure of the site showing all mining tenures, project location, and site access. Reference latitude/longitude or UTM coordinates (noting coordinate reference system used and means of obtaining data). Provide an overview of current land uses, surrounding land uses, and downstream water use and users.

1.3.4 Mine Components and Off-Site Infrastructure

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 Development and Operations

Include a brief outline of the stages of mine development and operations, including proposed discharges and discharge locations, and stages of development.

1.3.6 Mine Design and Assessment Team

Identify the consultants and individuals comprising the design and assessment team, and their responsibilities and application contributions. Ensure all technical assessments included in the application are signed and stamped by a qualified licensed professional registered in British Columbia.

1.3.7 Spatial Data

Spatial data requirements include the:

- proposed permitted mine area, including a reasonable buffer around proposed disturbances;
- physical disturbance proposed annually over the next 5 years;

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

1.3.8 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 into 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 currently licenced/permitted/authorized works associated with the mine;
- an outline of required licences/permits/authorizations needed for development and/or operation, and any applicable regulations; and
- reference to a generic list of licences, permits, authorizations, and regulations that may be applicable to the mining project.

1.5 Indigenous Engagement

1.5.1 Background

In this section:

- identify the Aboriginal groups potentially affected by the mine;
- provide maps of established and/or asserted traditional territories of potentially affected Aboriginal groups; and
- provide background information for each potentially affected Aboriginal group including, but not limited to, ethnography, language, land use setting and planning, governance, economy, and reserves.

1.5.2 Asserted and Established Rights and Interests

In this section:

- make reference to the current use of lands and resources for traditional purposes assessment and identify uses of the project area by Indigenous Nations;
- identify any specific asserted Aboriginal rights about which the proponent has received information from Indigenous Nations or other sources;
- identify potential effects of the project on asserted or established Aboriginal rights;
- identify treaty rights that could be affected by the project;
- identify Aboriginal interests with respect to potential effects of the project; and
- describe mitigation measures, including design considerations, to avoid or accommodate for potential effects on asserted or established Aboriginal rights.

1.5.3 Engagement Efforts

In this section:

- summarize engagement undertaken with Indigenous Nations during the pre-application stage and identify engagement planned during application review;
- summarize key issues raised during engagement and the responses provided to Indigenous Nations (summarized in an issues tracking table); and
- identify potential adverse impacts of the project on potential or established Aboriginal and treaty rights as identified by affected Indigenous Nations.

2 Baseline Information

Characterization and presentation of baseline environmental conditions is a critical element in applying for permits under the *MA* and *EMA*.

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

- describe geology, geochemistry, 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.

For the proposed surface water and groundwater monitoring stations, identify those that will serve as reference or control sites throughout the mine life. For baseline monitoring data, a minimum of 24 consecutive months must be provided. If fewer than 24 consecutive months of data are proposed, it must be demonstrated, to the satisfaction of ENV technical staff, that sufficient data are available to adequately characterize the baseline conditions and support the development of predictive models and the effects assessment.

Comparison of sites that are impacted by the project with sites that are not impacted and to the baseline data will be required to determine if an unacceptable impact or change has occurred.

Follow the detailed guidance provided in the Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators[12] and in the British Columbia Field Sampling Manual[13].

In the sections below, describe in detail:

- sampling methods;
- sample preparation and hold times;
- analytical methods;
- analytical detection limits;
- quality assurance/quality control (QA/QC) procedures;
- data analysis methods; and
- any assumptions.

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

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

Distribute a draft of the mine baseline monitoring program to the relevant technical agencies early in the development process to ensure that the program will meet permitting requirements.

While the type and quantity of baseline data collected will vary by site, the application must include the information outlined below.

2.1 Summary

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

Include raw data, including field notes, in appendices, in electronic format (such as a USB memory stick) with the application, and, if applicable, upload for storage in ENV's Environmental Monitoring System database.

2.2 Meteorology and Climate

Describe how weather and climate will affect all aspects of the project. Summarize all 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[14].

Include the following information:

- a detailed map showing the location of all site-specific and regional climate stations in relation to project facilities;
- a description of all relevant local and regional meteorology and climate information sources;
- base line 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

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

    - 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 all site-specific data to document and correct for erroneous measurements as well as detail quality control and correction procedures;
- all 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

2.3 Geology

2.3.1 Regional Geology

In this section:

- describe the regional bedrock geological setting, with emphasis on the regional framework and including a description of the tectonic belt(s), terrain(s), physiography, and regional metamorphism and structure;
- describe the surficial geological setting, with emphasis on the nature and developmental history of surficial geological units;
- characterize the bedrock structures from the viewpoint of their potential to act as pathways or barriers for groundwater (both contact and non-contact);
- characterize the respective bedrock lithologies from the viewpoint of their relative capability to store and transmit groundwater;
- provide appropriate maps, figures, and cross-sections to illustrate the geologic setting at the appropriate scale, with legends, north arrow, and the project location clearly identified; and
- provide any other relevant information.

2.3.2 Deposit (Ore) Geology

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

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

2.3.3 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[15]. 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, 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 2.3.4 on the maps.

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

2.3.4 Natural and Seismic Hazards Assessments

In this section:

- discuss natural hazards such as snow avalanches, landslides, geohazards, and earthquakes specific to the mine, with reference to the mapping completed in Section 2.3.3;
- 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.

2.3.5 Soil Survey and Soil Characterization for Reclamation

Provide a summary of the soil survey 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;
- a discussion of the potential for erosion;
- baseline soil metal concentrations;
- baseline soil nutrient information; and
- any other relevant information.

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

2.4 Geochemical Characterization and Source Terms

Characterize the geochemistry of all geologic materials to be disturbed during each phase of the life of the mine (construction, operation, closure, and post-closure) and evaluate the metal leaching and acid rock drainage (ML/ARD) potential of each material.

Ensure the geochemical characterization program is sufficiently robust to support appropriate source term development, materials handling, mitigation, and contingency plans for the protection of land and watercourses. Develop the program in accordance with the following documents:

- Policy for Metal Leaching and Acid Rock Drainage at British Columbia Mine Sites[16] (July 1998);
- Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia[17] (August 1998); and
- Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials[18], MEND Report 1.20.1 (December 2009).

Include a characterization program that considers all geologic materials, including:

- overburden;
- soils;
- construction materials;
- tailings;
- waste rock;
- ore and low-grade ore;
- coal and coal by-products (fine and coarse coal rejects, etc.);
- water treatment by-products; and
- any other relevant geologic materials.

At a minimum, assess the following mine components as part of the characterization program:

- open pit walls;
- underground workings (roof, floor, walls, gob, backfilled materials, etc.);
- TSFs
- waste rock dumps;
- water management structures;
- ore, overburden, soil, and construction stockpiles;
- coal and coal by-product stockpiles;
- borrow areas;
- haul roads;
- road cuts;

[16] www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/permitting/ml-ard_policy.pdf

[17] www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/permitting/ml-ard_guidelines.pdf

[18] mend-nedem.org/mend-report/prediction-manual-for-drainage-chemistry-from-sulphidic-geologic-materials

- plant/mill, ancillary buildings, and laydown areas; and
- any other relevant mine components.

2.4.1 Geochemical Characterization

Provide in this section:

- a description of the sample collection and analytical methods (static and kinetic) to demonstrate their appropriateness for the site-specific conditions and geologic materials, as well as relevance to the proposed storage environments;
- a description of the distribution of samples collected from the mine site for each geologic material and for each mine component, including maps, figures, plots, and tabulated data summaries, where appropriate, to demonstrate that geochemical and spatial variability are captured and spatial and/or temporal gaps in the datasets have been identified;
- results of static testing including, but not limited to, trace element content, acid base accounting, and mineralogical analyses;
- results of kinetic testing, 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;
- an assessment of the lag times to ARD onset for all potentially acid-generating materials and of metal-leaching potential/behaviour for all materials to be generated;
- an assessment of the loading contribution of blasting agents;
- development of site-specific geochemical criteria defining potentially acid-generating and/or metal-leaching materials, as required, to support waste management and handling;
- all raw datasets; and
- any other relevant information and analyses.

2.4.2 Geochemical Source Terms

In this section:

- provide a detailed materials balance for each mine component by geologic material type; and
- develop conservative geochemical source terms to reflect all geologic materials and secondary wastes. Specifically:
    - integrate source terms with the proposed mine plan for each phase of mine life (i.e., construction, operation, closure, and post-closure);
    - incorporate appropriate static and kinetic testing results;
    - provide a detailed description of all constraints, limitations, and assumptions (e.g., scaling factors, temperature corrections, flow rates, etc.);
    - provide a detailed description and summary of all calculations;
    - identify and discuss data gaps associated with the source terms;
    - provide all input data used in the development of source terms;

- provide all raw datasets; and
- include any other relevant information and analyses.

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

2.6 Water Quantity

For surface water, a minimum of 24 consecutive months of monitoring data is required, and more is preferred to assess trends and seasonal variation. For groundwater, collecting a minimum of quarterly water level measurements (i.e., within each of the four seasons) over 24 consecutive months (eight samples total) is required before submitting a permit application. More frequent monitoring (e.g., bi-monthly or monthly) is preferred in wells where groundwater level fluctuations are closely correlated with streamflow, which indicates high stream-aquifer hydraulic connection. Measurements are required for each water bearing strata intercepted by the monitoring wells. The linkages between surface water and groundwater quantity must be clearly identified.

2.6.1 Surface Water Quantity

Describe the existing hydrologic regime at the project location. Summarize all available hydrological information relevant to the mine property and downstream receiving environment. Refer to detailed guidance provided in the Water and Air Baseline Monitoring Guidance Document[19].

Include the following information:

- a description of pre-mine topography and surface drainage features;
- detailed maps showing all 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 all relevant site-specific and regional hydrology stations in relation to project facilities, and a summary of relevant station metadata

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

including period of record, drainage area, median 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, QA/QC procedures, and assignment of data grades as described in the Manual of British Columbia Hydrometric Standards[20];
- identification of spatial or temporal 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.

2.6.2 Groundwater Quantity

Describe the existing hydrogeological regime at the project location. Summarize all available hydrogeological information relevant to the mine property and the receiving environment. A minimum of two years of monthly groundwater level data is required in the baseline assessment. Refer to guidance on groundwater baseline monitoring provided in the Water and Air Baseline Monitoring Guidance Document[21].

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
    - tabulated monitoring well completion details including location, elevation, depth and well screen intervals, lithologic log, and hydraulic parameter estimates;

[20] https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/science-data/man_bc_hydrometric_stand_v10.pdf
[21] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf

- 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, storitivity, 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);
- a description of the water balance for the mine area that considers inputs and outputs of meteoric water, surface water, and groundwater;
- 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.

2.7 Water Quality

Include a detailed summary of the baseline water quality conditions present before project development. The linkages between surface water and groundwater quality must be clearly identified.

2.7.1 Surface Water Quality

Determine if water quality guidelines (WQGs) or water quality objectives (WQOs) have been attained by collecting five samples in 30 days during critical flows (high and low) and/or biologically relevant periods. Assess inter-annual variation or prepare science-based

environmental benchmarks (SBEBs) based on multiple years of water quality data. Refer to detailed guidance provided in the Water and Air Baseline Monitoring Guidance Document[22] and in Guidance for the Derivation and Application of Water Quality Objectives in British Columbia[23]. For SBEB development, contact ENV for further information and requirements on SBEBs and/or WQOs. Please review 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[24].

In this section:

- identify downstream surface water uses (e.g., aquatic life, drinking, irrigation, livestock watering, industrial, etc.) and water licenses;
- document and describe the rationale for baseline study design, including:
    - collection methods,
    - parameters analyzed (for a recommended list, refer to the Water and Air Baseline Monitoring Guidance Document[25]),
    - 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;
- identify sample locations and time windows or seasonality when baseline surface water quality may exceed provincial WQGs[26] for each Parameter of Concern (POC)[27];
- provide a summary of groundwater chemistry, including summary tables organized by POC, sample location, and date;
- provide a summary of the QA/QC results;
- indicate those samples with values that would classify them as POCs;
- clearly document the frequency and magnitude of exceedances;
- identify which data reflect un-impacted baseline versus conditions affected by previous development (e.g., exploration activities, historical mining activities);

[22] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf
[23] https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-objectives/wqo_proc_guidance.pdf
[24] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/tg8_framework_for_sbebs.pdf
[25] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf
[26] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines
[27] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/parameter_of_concern_fs.pdf

- use the principles of mass balance, as required, to establish the degree to which groundwater quality influences the 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;
- 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 gaps in the database; and
- provide any other relevant information.

2.7.2 Groundwater Quality

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 baseline study design, including:
    - parameters analyzed,
    - collection methods,
    - field instrumentation,
    - sampling frequency and period,
    - site locations,
    - depth of screen completions and associated hydrostratigraphic unit,
    - sample dates and size,
    - statistical considerations, and
    - QA/QC protocols;
- provide a detailed map of groundwater quality sampling locations, proposed 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 hydrstratigraphic unit;
- provide a summary of QA/QC results;
- indicate those samples with values that would classify them as POCs[28];
- indicate those samples with turbidity values greater than 200 NTU and discuss the influence of turbidity on concentrations of POCs in any interpretative discussions;

[28] 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 which data reflect un-impacted baseline 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.);
- identify sample locations and time windows or seasonality when baseline groundwater quality may exceed WQGs[29] 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.

2.8 Sediment Quality

Sediments must be sampled a minimum of once per year during summer low-flow periods. Refer to detailed guidance provided in the Water and Air Baseline Monitoring Guidance Document[30].

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[31] 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;

[29] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines

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

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

- identify those sample sites that appear to be influenced by groundwater discharge and/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 rationale/purpose of each site;
- identify which data reflect un-impacted baseline 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;
- compare, tabulate, and map existing sediment quality conditions relative to provincial WQGs[32] or the Canadian Council of Ministers of the Environment (CCME) Ministers Sediment Quality Guidelines for the Protection of Aquatic Life[33] (threshold or probable effect levels);
- identify spatial and/or temporal gaps in the database; and
- provide any other relevant information.

2.9 Fisheries and Aquatic Resources

Assess the potential impacts of discharges to the receiving environment during each phase of mine life using aquatic life baseline studies to determine ecosystem health and contribute to a weight of evidence (WOE) approach.

Ensure the study includes components 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 study.

Use appropriate biological monitoring tools to collect and present sufficient data to demonstrate that the program will be able to detect pre-determined changes considered to be biologically significant. A minimum of 24 consecutive months of data is required to determine the inter-annual variability and provide a suitable characterization of biological communities prior to development. If fewer than 24 consecutive months of data are 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[34].

[32] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines
[33] http://ceqg-rcqe.ccme.ca/en/index.html
[34] http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/water_air_baseline_monitoring.pdf

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 during the IRT discussions.

2.9.1 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[35]. 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 study design, including
    - collection methods,
    - organisms or communities analyzed,
    - sampling frequency and period,
    - 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 un-impacted baseline 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.

2.9.2 Fish and Fish Habitat

Resident fish populations and habitat are under the provincial jurisdiction of the Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (FLNR).

[35] http://publications.gc.ca/collections/collection_2012/ec/En84-87-2012-eng.pdf

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

- document and describe the rationale for 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[36] (red or blue listed), federally listed species (Committee on the Status of Endangered Wildlife in Canada[37], and Species at Risk Act[38]), and populations that are genetically distinct;
- describe the current and potential use of fish resources by Indigenous, sport, 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 un-impacted baseline 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.

2.9.3 Tissue Residues

Include a baseline study that develops a tissue residue database for fish and/or other organisms for metals and metalloids and, if appropriate, organic contaminants. 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. Analyze species and tissues humans consume if human health risk assessments are the focus.

Specifically:

- document and describe the rationale for the study design, including:

[36] https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre/explore-cdc-data/red-blue-yellow-lists
[37] https://www.canada.ca/en/environment-climate-change/services/committee-status-endangered-wildlife.html
[38] https://laws-lois.justice.gc.ca/eng/acts/s-15.3/

  - species and tissue types analyzed,
  - collection methods and frequency,
  - site locations,
  - statistical considerations, and
  - QA/AC protocols;
- identify which data reflect un-impacted baseline 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[39] or Canadian Tissue Residue Guidelines[40];
- 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.

2.10 Ecosystems and Wildlife

In this section, include:

- a summary of Terrestrial Ecosystem Mapping, Predictive Ecosystem Mapping, and the location of rare plants and ecosystems as well as invasive plants;
- 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 and vegetation metals analyses;
- a description of on-site and adjacent terrestrial and aquatic ecosystems;
- an inventory of potential biological receptors, including human populations;
- evidence of consultation with Indigenous Nations with regard to land use, wildlife, and vegetation; and
- other relevant information, as appropriate.

2.11 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),

[39] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines

[40] http://ceqg-rcqe.ccme.ca/download/en/290/

  - 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;
- an inventory of potential biological receptors, including human populations; and
- any other relevant information.

2.12 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[41].

Provide the site descriptions in table form, 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 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, who has the authority to stop excavation as deemed necessary, so that any archaeological resources can be handled under the terms of the permit.

2.13 Cultural Use

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

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

3 Mine Plan

3.1 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 Section 10.1.3.d.i of the Code); and
- any other relevant information.

3.2 Existing Development

Detail the present use and condition of the land and watercourses, including any previous or existing disturbance, developments, or infrastructure currently in place within the mine area.

3.3 Life of Mine Plan

Provide an overview of the life of mine plan, including (as applicable):

- the mine development sequence and schedule for all mine components for all phases of mine life (construction, operation, closure, and post-closure);
- an inventory of all mining waste materials (waste rock, tailings, overburden, rejects, etc.), including type, volume, and storage location;
- dimensions for each waste rock dump, TSF, stockpile, etc.;
- ongoing and completed reclamation areas;
- road and haul route construction and significant transportation or utilities infrastructure;
- water management and treatment infrastructure;
- planned investigation works;
- anticipated permit amendments/expansions;
- maps showing the location and extent of the above activities at a frequency no less than every 5 years; and
- any other relevant information.

3.4 Detailed Five Year Mine Plan

Provide a detailed, year-by-year, five year mine plan, including the following, as applicable:

- a development schedule for construction and mine sequencing for all mine components;
- an inventory of all mining waste materials (waste rock, tailings, overburden, rejects, etc.), including type, volume, storage locations, and scheduled sequencing;
- dimensions for each waste rock dump, TSF, stockpile, etc.;
- ongoing and completed reclamation areas;

- road and haul route construction and significant transportation or utilities infrastructure;
- water management and treatment infrastructure;
- planned investigation works;
- anticipated permit amendments/expansions;
- maps showing the location and extent of the above activities at no less than an annual frequency; and
- any other relevant information.

3.5 Mine Facility Designs and Development

Provide detailed designs for mine facilities, including, but not limited to:

- open pits;
- underground workings;
- processing plant (mill) and associated facilities (crushers, conveyors, etc.);
- TSFs and associated infrastructure;
- waste rock dumps;
- water management structures;
- ore, overburden, soil, and construction stockpiles;
- mine access and mine haulage roads;
- power supply and distribution infrastructure;
- explosives storage facilities;
- ancillary buildings and support infrastructure (camps, loadout facilities, laydowns, offices, maintenance shops, etc.); and
- any other relevant facilities.

Detailed design means that the submitted design is final and represents what will actually be constructed. It requires that the site has been adequately characterized, design criteria are clearly stated, analyses that support the design decisions are complete and all drawings and supporting reports are signed and stamped by a Professional Engineer as '*Detailed Design'*.

Show the locations and configurations of these facilities, describe proposed construction materials and methods, and provide the design basis and supporting analyses; this may require supplemental reporting from specialty consultants. Detailed design reports and supporting data should be provided in appendices. All buildings must meet BC Building Code requirements.

Provide the results and an assessment of condemnation drilling for permanent mine facilities (e.g., TSFs, waste rock dumps) to ensure that mineral resources will not be sterilized.

3.5.1 Open Pits

Provide an open pit detailed design report, signed and stamped by a Professional Engineer (or multiple professionals as required), that includes the following:

- site investigation information, including detailed geological and geotechnical information obtained from existing pit slopes, rock outcrops, drilling, and other investigations;
- details on pit limits, pit slope geometry, and pit slope design criteria (e.g., per Read & Stacey's *Guidelines for Open Pit Slope Design*[42]);
- pit slope designs based on stability analyses, including sensitivity analyses (overall slope, bench face angles, inter-ramp angles, bench heights, berm widths, etc.);
- a comprehensive analysis of relevant failure mechanisms (including kinematic and rock mass failure) for all critical slopes, including critical temporary slopes (slopes exposed for more than 12 months);
- designs for all phased open pit expansions based on:
    - a geological model,
    - a structural model,
    - a hydrogeological model,
    - a geotechnical (rock mechanics) model including structure and rock mass, and
    - historical experience;
- a description of pit water management, including surface water diversions and groundwater dewatering and slope depressurization methods, with the following information, as applicable:
    - surface water diversion design criteria,
    - the number, location, spacing, and design of dewatering wells,
    - the construction, operation, and closure of dewatering wells,
    - predicted drawdown zone,
    - slope depressurization requirements and recommendations,
    - estimated dewatering volumes from wells and in-pit sumps,
    - predicted lateral and vertical extents,
    - predicted quality of the pumped water,
    - discharge locations for water discharge location,
    - expected impacts on existing groundwater and surface water users, groundwater and surface water quantity and quality, and aquatic and terrestrial ecosystems, and
    - proposed mitigations for any impacts;
- a description of potential risks to the pit and mitigation measures posed by geohazards;
- a conceptual design for controlled blasting;
- a list and description of mobile equipment to be used;
- monitoring requirements for the pit walls, including instrumentation, movement thresholds, and response plan;
- drawings, plans, sections, and figures as required to illustrate the detailed pit design and the design basis; and
- any other relevant information.

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

3.5.2 Underground Workings

Provide an underground workings detailed design report, signed and stamped by a Professional Engineer (or multiple professionals as required), that includes the following:

- plans and sections showing all existing underground workings, including locations of all existing portals, shafts, stopes that break through to surface and areas of subsidence;
- details of the mine design and method of underground development;
- plans and sections showing proposed underground workings, including portals and shafts, crown pillars, stopes that break through to surface, extent of surface subsidence, areas of enhanced hydraulic connectivity between surface and underground, etc.;
- assessment of risk posed by geohazards and any planned mitigation;
- locations and designs for any bulkheads, tunnel plugs, dams storing water and saturated material, including those required for closure;
- locations and description of any ancillary infrastructure, including shops, lunchrooms, toilet facilities, fuel bays, etc.;
- a list and descriptions of mobile underground equipment;
- outline of the hazard associated with operating equipment in gassy environments (if required);
- ventilation requirements and plans for all underground workings;
- a Ground Control Management Plan (GCMP), consistent with industry standards, that includes the following components, as applicable:
    - design details specific to the method of underground development;
    - details of the ground control program including roles, responsibilities, accountabilities, implementation, records and communications, and a schedule for reviews and updates;
    - mining methods to be employed including dimensions of excavations and pillars as well as criteria used in their dimensioning;
    - predicted extent and magnitude of surface subsidence and hydraulic connectivity between the surface and underground;
    - design basis information and assumptions used to develop the mine design and the ground control program, including:
        - a geological model for the mine,
        - a structural model for the mine,
        - a hydrogeological model for the mine,
        - a geotechnical (rock mechanics) model for the mine including stress, structure, and rock mass, and
        - historical experience;
    - water control measures to be employed, including specific precautions to be taken where bodies of water, water bearing structures, overburden, tailings, etc., may inundate the mine workings;
    - ground support systems and materials to be employed, including criteria used in selection, dimensioning, spacing, and extent;

    - standards and procedures to ensure worker safety including:
        - minimum ground support standards to be employed at the mine,
        - blasting methods, and
        - employee procedures and training;
    - 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
    - risk management;
- a table of exploration boreholes and abandonment method (e.g., grouting, etc.) implemented for boreholes that intersect the underground mine workings and their anticipated influence on mine flooding and the post-closure water balance for the underground mine;
- predicted extent and magnitude of groundwater drawdown surrounding the mine workings; and
- any other relevant information.

3.5.3 Processing Plant (Mill) and Associated Facilities

Provide a geotechnical design report, signed and stamped by a Professional Engineer, that includes the following information:

- a 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;
- descriptions of hazardous products, with reference to relevant sections of the Construction Environmental Management Plan (Section 7.6) that address the safe handling and storage of these products;
- supporting information obtained from geotechnical site investigations;
- foundation design criteria and rationale;
- required parameters and designs for ventilation systems including heating, ventilation, and air conditioning (HVAC) systems and local exhaust ventilation;
- an assessment of bearing capacity, expected settlement, and a comparison with allowable settlements for the structure involved;
- a facility location drawing and description;
- a description of potential risks posed by geohazards and mitigation measures; and
- any other relevant information.

3.5.4 Tailings Storage Facility and Associated Infrastructure

Provide a TSF detailed design report, signed and stamped by a Professional Engineer (or multiple professionals as required), that includes the following information:

- an alternatives assessment for the TSF that assesses best available technology (BAT) (see Guidelines for the Assessment of Alternatives for Mine Waste Disposal)[43];
- foundation characterization, including data from geotechnical site investigations and laboratory testing, noting that foundation site investigations should be completed as per Engineers and Geoscientists British Columbia (EGBC) guidelines[44],
- an assessment of geohazards that could influence the TSF throughout its design lifetime and an explanation of how geohazards are managed in the design, including detailed designs for any geohazard mitigation structures;
- the consequence classification of the facility supported by a dam break and inundation study;
- a statement of the TSF design criteria, including, but not limited to:
    - the inflow design flood (IDF),
    - the environmental design flood (EDF) and justification for its selection,
    - seismic criteria (deterministic and probabilistic),
    - factors of safety, and
    - freeboard;
- foundation conditions, construction material, and tailings properties, including discussion of expected behavior under the range of stress conditions predicted for the TSF lifetime;
- an assessment of potential for static and seismic liquefaction for tailings, construction materials, and foundation materials;
- stability analyses, demonstrating compliance with the target factors of safety, that:
    - identify and justify all input parameters and phreatic conditions,
    - assess sensitivity to critical assumptions and provide results of sensitivity analyses, and
    - include figures showing the analysis model and critical slip surfaces;
- detailed designs for any water diversion structures and spillways associated with the TSF;
- a risk assessment as well as risk mitigation and management measures;
- predicted seepage rates and seepage management, addressing any potential for groundwater contamination and plans to monitor and mitigate;
- an assessment of potential effects and interactions with underground workings;
- plans and sections showing the TSF (heights, slopes, profiles, foundation, construction materials, tailings levels, contours, etc.) projected over the life of the mine;
- detailed closure plan and objectives for the facility; and
- any other relevant information.

Include the following TSF operational and water management information:

- a volume-elevation curve;

[43] https://www.canada.ca/en/environment-climate-change/services/managing-pollution/publications/guidelines-alternatives-mine-waste-disposal/chapter-1.html

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

- a filling curve;
- a raising schedule;
- a tailings deposition plan;
- a TSF-specific water balance and water management plan that is integrated into the Site-wide Water Balance Model (Section 5.3) and Mine Site Water Management Plan (Section 7.10);
- 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 response plans (TRPs); and
- any other relevant information.

3.5.5 Waste Rock Dumps

Provide a waste rock dump detailed design report, signed and stamped by a Professional Engineer (or multiple professionals as required), that includes the following:

- foundation characterization, including data from geotechnical site investigations and laboratory testing;
- an assessment of geohazards that could influence the waste rock dumps, and mitigation measures;
- a statement of the design criteria;
- foundation conditions as well as waste materials and properties;
- identification of the organics, soil, and overburden stripping requirements to enhance the stability of each facility and accommodate reclamation efforts;
    - for designs that do not require stripping, provide a rationale for the design decision and include representative foundation conditions in the stability analysis;
- an assessment of the potential for static and seismic liquefaction for foundation and waste materials;
- stability analyses, demonstrating compliance with the target factors of safety for both interim and final configurations:
    - identify and justify all input parameters and phreatic conditions,
    - assess sensitivity to critical assumptions and provide results of sensitivity analyses, and
    - provide figures showing the analysis model and critical slip surfaces;
- a water balance for waste piles that considers inputs and outputs of meteoric water, surface water, and groundwater;
- an assessment of the impact to surface water drainage, with detailed designs for water management structures associated with the waste rock dump (e.g., rock drains, diversion channels, sediment ponds);
- the configuration and design of each waste rock dump at closure;
- an assessment of potential run-out zones for all dumps;
- a risk assessment for all dumps and identification of all high-risk dumps;

- a description of how each facility will be constructed, including:
    - methods of disposal,
    - 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 each facility, including instrumentation, movement thresholds, and response;
- a description of operating practices, including any special handling related to ML/ARD management required as a result of characterization results outlined in Section 2.4, if applicable;
- appropriately scaled plans and sections of the facilities that are projected over the life of mine and include lift heights, maximum dump heights, storage capacity, slope angles, and foundation angles;
- an assessment of the potential for groundwater contamination and, if applicable, plans to monitor and mitigate groundwater contamination;
- a detailed closure plan and objectives for the facility; and
- any other relevant information.

3.5.6 Water Management Structures

For the purposes of the application, water management structures include dams, ponds, diversion structures/channels, etc.

Provide a water management structure detailed design report, signed and stamped by a Professional Engineer (or multiple professionals as required), that includes the following:

- the consequence classification of any dams;
- descriptions of the facilities, including embankment heights/excavation depths, slope angles, storage capacity, etc.;
- foundation characterization, including data from geotechnical site investigations and laboratory testing, noting that foundation site investigations must be completed as per EGBC guidelines[45];
- an assessment of geohazards that could influence the water management structures and an explanation of how geohazards are managed in the design;
- a statement of the design criteria, including, but not limited to:
    - the design flood,
    - seismic criteria (deterministic and probabilistic),
    - factors of safety, and
    - freeboard;

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

- foundation conditions as well as construction materials and properties;
- an assessment of the potential for static and seismic liquefaction for foundation and construction materials;
- stability analyses, demonstrating compliance with the target factors of safety, that:
    - identify and justify all input parameters and phreatic conditions,
    - assess sensitivity to critical assumptions and provide results of sensitivity analyses, and
    - include figures showing the analysis model and critical slip surfaces;
- designs for water diversion structures and spillways;
- an assessment of the hydraulic capacity of each ditch and channel and confirmation that they can safely convey the design flood without overtopping, side slope failure, or significant erosion;
- appropriately scaled plans and sections showing the facilities (e.g., heights, slopes, profiles, foundations, construction materials, contours, etc.) projected over the life of the mine;
- the detailed closure plan and objectives for the structures;
- any other relevant information.

Include the following operational water management information, as applicable:

- a water balance and water management plan that is integrated into the site-wide water balance;
- monitoring requirements, including the number, type, and location of instrumentation;
- a description of quantitative surface water flow monitoring locations;
- operational requirements, including threshold conditions or observations requiring actions, which should take the form of QPOs and associated TRPs; and
- any other relevant information.

Water management structures that convey contact water on the mine site should be designed to withstand a 1-in-200 year return period storm event. Sediment pond design should be consistent with the technical guidance on Assessing the Design, Size, and Operation of Sediment Ponds Used in Mining[46].

A memorandum of understanding[47] between EMPR and FLNRD exists regarding the regulation of impoundments and diversion structures at mine sites. This document provides clarification about which agency is responsible for the various types of impoundments, ponds, and diversion structures that may be required on a mine site and when a licence under the Water Act may be required.

[46] 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

[47] http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/developing-a-mine/mou_impoundments_diversions.pdf

3.5.7 Ore, Overburden, Soil, and Construction Stockpiles

Include the following information for any ore, overburden, soil, or construction stockpile:

- lift height, maximum stockpile height, storage capacity, slope angle, and foundation angle;
- expected volume and materials to be contained within the stockpile over time;
- geotechnical assessments and stability analyses by a Professional Engineer (for stockpiles over 6 m high);
- plans and sections showing the location and dimensions of the stockpile, projected over the life of mine; and
- any other relevant information.

Note that stockpiles meeting the definition of a major dump[48] must meet all of the requirements listed in Section 3.5.5 for waste rock dumps.

3.5.8 Mine Access and Mine Haulage Roads

Include:

- descriptions of mine access and haulage roads;
- drawings and sections showing road designs[49], including cut and fill slope angles, road widths, drainage measures, berm heights, and runaway lanes;
- construction methodology and specifications;
- anticipated foundation conditions;
- geotechnical assessments and stability analyses by a Professional Engineer (for cuts/fills over 6 m high);
- construction material selection criteria, referencing the appropriate ML/ARD characterization results used to develop selection criteria;
- a description of potential risks posed by geohazards and mitigation measures; and
- any other relevant information.

3.5.9 Power Supply and Distribution Infrastructure

Include the following information for power supply and distribution infrastructure:

- descriptions of any powerline(s) to the mine site;
- descriptions and mapping of utility corridors;
- descriptions and mapping of the on-site substation;
- descriptions of the on-site power distribution system;
- plans and drawings for each facility; and
- any other relevant information.

[48] As defined in the Code

[49] Roads should be designed, at a minimum, according to FLNRD's Engineering Manual (https://www2.gov.bc.ca/gov/content/industry/natural-resource-use/resource-roads/engineering-publications-permits/engineering-manual)

Accompany the electrical plans and drawings by a letter of assurance from a Professional Engineer indicating that they comply with the Canadian Electrical Code and M421-16 (Use of electricity in mines).

3.5.10 Explosives Storage Facilities

Include:

- a description of any on-site operational explosives storage and/or manufacturing facilities;
- a description of all plans to retain a licensed explosives contractor;
- a description of all plans for explosives use during mine construction;
- a description of all plans for explosive use during mine operation;
- an evaluation of explosives residuals in the discharge(s) from the site; and
- any other relevant information.

3.5.11 Ancillary Facilities and Support Infrastructure

This section includes all other ancillary facilities and support infrastructure such as shops, warehousing, laboratories, fueling stations, camps, offices, lunchrooms, sanitary conveniences, etc., not already listed in Sections 3.5.1 through 3.5.10. All buildings, as defined by the BC Building Code, shall meet BC Building Code requirements.

When designing fuel handling, transfer, and storage locations, pay attention to other relevant regulations and codes. For further guidance, also see A Field Guide to Fuel Handling, Transportation and Storage[50].

Include the following information for each ancillary facility and support infrastructure:

- a description of the location and a location map;
- appropriately scaled, detailed design drawings;
- a discussion of the foundation rationale and design;
- required parameters and design for ventilation systems, including HVAC systems and local exhaust ventilation;
- a description of the potential risks posed by geohazards and proposed mitigation measures;
- descriptions of items of particular relevance to the reclamation plan regarding locations, foundations, and nature of construction (e.g., movable modular units or “permanent” structures); and
- any other relevant information.

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

4 Reclamation and Closure Plan

4.1 End Land Use and Capability Objectives

Clearly identify and map end land use and land capability objectives for the mine disturbance. Ensure the map is overlain by the pit, tailings impoundment, waste rock dumps, and any other permanent facilities/disturbances that are to remain following closure. Provide a detailed description of how the proposed Reclamation and Closure Plan will achieve the end land use and land capability objectives. Clearly identify target eco-sites, biodiversity elements, and habitats for relevant wildlife species.

Develop reclamation objectives based on scientific understanding of the structural and functional characteristics and recovery trajectories of natural ecosystems (i.e., ecohydrological modelling). 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 restore what is disturbed. Present contingencies to address predicted challenges to achieving this objective.

Provide the following information, at a minimum:

- pre-disturbance ecosystems, habitats (terrestrial and aquatic), and other land uses for the mine disturbance footprint, classified in a manner that allows for the information to be presented in maps and tabulated inventories (e.g., biogeoclimatic site series, habitat mapping by wildlife species for the relevant life requisites);
- post-closure ecosystems, habitats, and other land uses for the post-mining landscape, presented in maps and tabulated inventories;
- a discussion of the changes to land capability that could result due to mining operations;
- a discussion of ecological succession for the site, identifying limiting factors that must be overcome to facilitate the desired recovery trajectory; and
- a discussion of challenges in terms of achieving the target of equivalent land capability that may be relevant depending on the nature of the proposed mining disturbance, providing substantial supporting rationale as well as research plans toward addressing the challenges if proposed post-mining land uses differ from pre-mining conditions.

The above information will inform the End Land Use Plan for the post-mining landscape. The End Land Use Plan will act as a blueprint to guide reclamation planning, research, and monitoring throughout the life of the mine. Clearly tie reclamation prescriptions to the targets identified in the End Land Use Plan, which is expected to inform all updates to the Reclamation and Closure Plan and may require adjustment throughout the life of the mine due to changes to the mine plan or adaptive management learnings.

Describe Valued Components that have been considered through the EA process, as described in Section 6, and in relevant provincial policies (e.g., Environmental Mitigation Policy[51]), for which activities related to reclamation have been proposed for mitigation. Clearly highlight these Valued Components in the End Land Use Plan, land capability mapping, and reclamation strategies and prescriptions.

4.2 Reclamation Approaches

Use general reclamation approaches that are well established in the early stages of mine design to proactively anticipate opportunities to incorporate reclamation requirements into mine planning. The approaches required will depend on the site-specific limiting factors to ecosystem recovery and re-establishment of natural successional processes and closure objectives of specific mine components. The challenges to reclamation could include (among many others) sensitive plant species, terrain stability, and/or growth medium quality and quantity. Identify challenges and address them with proposed approaches and prescriptions.

Describe how site preparation (i.e., decompaction, land-forming, surface preparation, etc.) is a critical component for reclamation success and is an overarching focus of the proposed reclamation prescriptions.

4.2.1 Soil Resources

Using natural soils for reclamation purposes is a well-established and key component of successful ecosystem restoration or revegetation in general. Ideally, all soil materials that exist in the pre-mining disturbance footprint are salvaged and stored for use in reclamation; however, it may not be feasible to safely and cost-effectively salvage all soils. Describe site-specific limitations related to soil salvage and provide a substantive supporting rationale if not all soils from the disturbance footprint will be salvaged. Generally, soil materials removed for mining purposes must not be buried or used as fill unless approval for such activities is granted.

Provide an inventory of estimated salvageable soils, classified by suitability if appropriate, keeping in mind that suitability of soil resources for reclamation may be relative to the intended use (i.e., suitability will depend on the physical and chemical characteristics of the mine components that require revegetation). Model the soil characteristics required to restore the target ecosystems to inform the soil replacement requirements. Compare salvage and replacement inventories to identify any potential shortfalls in volumes or soil characteristics that will need to be reconciled.

Identify alternative soil sources or plans to create a growth medium with similar physical characteristics (i.e., specific soil textures to achieve a target soil moisture regime) to natural soil that is known to support particular ecosystems. Ensure the overall basis of the soil replacement

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

plan is site specific and clearly tied to the end land use and land capability targets. Uniform soil depths projected over the mine disturbance footprint may not achieve this requirement.

Reconcile any projected shortfalls in soil quality. Address these by incorporating plans to apply soil amendments/fertilizers and selecting plant species for reclamation that enhance nutrient cycling processes in soil, all of which should be based on measured parameters in the site soil resources. Consider WQOs in regards to runoff depending on the soil chemistry and proposed amendments/fertilizers. Proposed use of biosolids or other organic matter residuals requires approval from both ENV and EMPR to import these materials to site. A separate biosolids management and monitoring plan may be required

If reclamation suitability of physical characteristics, such as high coarse fragment content, was used as a determinant of estimated volumes, it may be possible to review the suitability classifications to find further soil resources. For example, if a soil has a high coarse fragment content and is classified as poor or unsuitable for salvage, but is observed to support vegetation, it should be considered for salvage and use in reclamation.

Address the following in the proposed soil replacement strategy:

- timing, sequencing, and methods of soil replacement, including equipment to be used and materials and depths to be replaced on a facility-specific basis;
- requirements for amendments such as fertilizer and limestone;
- methods to monitor/alleviate compaction during and following re-application; and
- volumes of materials required based on end land use and land capability targets, estimated salvage volumes available for replacement, and methods to address any material shortfalls.

In addition to the soil replacement plan, provide a separate operational soil management plan that describes the operational controls and monitoring requirements that will be implemented to protect soil resources from loss, contamination, and degradation throughout mine life (Section 7.8).

4.2.2 Landform Design and Erosion Control

Develop plans for landform design (i.e., landforming) and watershed mapping (pre-mining and post-closure), including consideration of future erosion, creep, mass wasting, drainage control planning, and compatibility of final landforms with the surrounding landscape.

Explain how the post-closure landscape will be designed to meet the site-specific reclamation and closure objectives for long-term stability and erosion control, end land use and capability, and water quality/source control. Conduct run-off/infiltration modeling and use the results to describe how water will be directed over all of the post-closure landscapes to achieve the

reclamation objectives. Discuss the integration of mine planning, materials management, and reclamation landscape design (i.e., how is closure considered in operational mine planning).

4.2.3 Revegetation Strategy

Propose a revegetation strategy that clearly connects the target end land uses and land capability to the species selection process. Provide the specific species proposed and the rationale for selection. Describe the concepts of self-sustaining vegetation/ecosystems and basis for choosing appropriate species. Ultimate goals include self-sustaining revegetation, species appropriate for the local climate and site characteristics, and restoration of the structural and functional values in the landscape.

Develop re-vegetation strategies based on the following information sources:

- a baseline vegetation assessment, including Predictive Ecosystem Mapping and/or Terrestrial Ecosystem Mapping[52] for the mine footprint;
- site characteristics and plant succession patterns;
- species selection and densities tied to habitat/ecosystem targets; and
- end land use objectives.

Provide as much detail as possible in the revegetation plans based on the information known at the time. Present seeding rates and planting densities with the condition that they may be adjusted based on the findings of reclamation research and other assessments. Discuss how the plants will be sourced and any unknowns that need to be clarified.

4.2.4 Progressive Reclamation/Sequencing

Reclamation is an ongoing and progressive activity that occurs throughout all phases of the life of a mine. Progressive reclamation includes activities that are intended to result in incremental achievement of final reclamation and closure of the site. This differs from temporary revegetation or other activities that are intended to provide erosion control or visual aesthetics for an interim period.

Conducting progressive reclamation allows mine proponents to test the proposed reclamation approaches and prescriptions and fine tune them over time. The many other benefits to conducting progressive reclamation include incremental reduction of site liabilities, reduction in the post-closure period and related monitoring costs, and offsetting of closure costs through coordination of operational resources.

[52] https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre/explore-cdc-data/known-locations-of-species-and-ecosystems-at-risk/mapping-methods/ecosystems

Pro-actively seek opportunities to implement progressive reclamation in coordination with mine planning. Outline proposed sequencing and provide the key milestones that need to be considered.

4.2.5 Reclamation Research

The life of mine of any given project is based on several assumptions. In the early stages of mine planning, all necessary details are not always known. As the Reclamation and Closure Plan is intimately tied to the mine plan, some details may also be unknown, or prescriptions and approaches may be proposed based on other projects with different site conditions. It may also not be clear how gaps in knowledge and information can be resolved.

Given these uncertainties, develop a reclamation research program that is intended to a) test all approaches proposed in the Reclamation and Closure Plan based on the challenges and limitations identified and b) clarify all the gaps in information, identified to date, for the project.

Describe how the program is strategic and provide specific plans intended to answer the “what, where, how, when, and whys” related to the reclamation approach being tested and/or the gap in the Reclamation and Closure Plan being researched. Identify the methodology proposed for researching each topic and the study locations. Provide a tentative schedule for implementation of the research plans. For the implementation schedule, include key dates or milestones that are chosen to ensure that data are available in a timely manner to inform reclamation and closure plans when they are required. Propose contingencies if research findings do not conform to the assumptions and hypotheses.

Provide a plan for documenting research results and reporting annually, as well as how results will be used to inform updated reclamation and closure plans throughout life of mine.

Consider opportunities for collaboration with industry, government, and academia as they may create operational efficiencies and will enhance the knowledge base through information sharing and publication.

4.2.6 Reclamation Monitoring

Clearly establish goals, objectives, and measurable criteria to evaluate the Reclamation and Closure Plan with respect to appropriateness, implementation effectiveness, and success with respect to reclamation of mine disturbances. Include a detailed description of how environmental protection and quality control will be achieved during implementation of the reclamation and closure plan, particularly soils salvage, soil replacement, and any requirements pertaining to ML/ARD.

Clearly tie the performance objectives established to the long-term reclamation targets and mine component specific closure objectives. Provide defensible thresholds that will indicate when

targets have been achieved; this is best accomplished by establishing ecological/scientific benchmarks based on the characteristics of the target ecosystems and habitats. The process of establishing benchmarks will likely require data collection (e.g., plots) from reference or pre-mining ecosystems.

Test monitoring methodologies and calibrate with the performance objectives.

Include in the monitoring plan details of the authority and reporting sequence of any environmental staff and the procedure for providing reports and updates to government agency representatives, including those from EMPR's Health, Safety and Permitting Branch and ENV.

4.2.7 Habitat Compensation Works

Include a general description of all compensation works related to fish habitat, wetlands, caribou, or other compensation plans that may be required by provincial or federal agencies to address project impacts that have been identified or are projected to occur.

4.3 Trace Element Uptake in Soils and Vegetation

Outline in the reclamation plan the proposed program to assess trace element uptake in soils and vegetation that may be exposed to mining-related contaminants and the potential for food chain amplification, during both life of mine and closure/post-closure.

Include the following in the plan:

- relevant baseline and/or reference data collected in vegetation and soils;
- 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 POCs[53];
- a monitoring program that will be implemented throughout life of mine (sampling locations, approaches, etc.);
- a discussion of contingencies that may be implemented if the monitoring results indicate that metal uptake could compromise end land uses; and
- a description of how the metal uptake monitoring program may inform the reclamation research program.

4.4 Contaminated Sites and Human Health and Ecological Risk Assessment

Describe site investigations to be conducted according to the Contaminated Sites Regulation[54] (*EMA*) that will inform closure plans for particular mine components or areas where there are existing known or suspected areas of contamination.

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

[54] http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/375_96_00

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;
- provide water use determination as per Technical Guidance 6 on Contaminated Sites[55] and the Contaminated Sites Regulation[56] (*EMA*);
- 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[57].

Undertake a human health and ecological risk assessment to evaluate mitigation measures proposed as part of the reclamation and closure plan; this may be required to inform the reclamation and closure planning for the site to ensure that reclamation and closure objectives will be achieved.

Use the Conceptual Site Model (CSM; see Section 5.2 Conceptual Site Model) 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 plans proposed and will help identify data collection programs (such as metal uptake monitoring, materials characterization, groundwater/surface water monitoring) that are required to reduce uncertainties in the planning process.

4.5 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 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 EMPR.

4.6 Groundwater Well Decommissioning

Provide an inventory of geotechnical and 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

[55] https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/technical-guidance/tg06.pdf
[56] www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/375_96_00
[57] http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/375_96_00

requirements under the *Water Sustainability Act*[58] and minimum requirements in the Groundwater Protection Regulation (Parts 12, 12.1-12.2)[59].

4.7 Reclamation and Closure Prescriptions

Provide a life of mine reclamation plan for the closure or abandonment of the mining operation in reference to, and consistent with, Section 10 of the Code. Clearly demonstrate how all of the applicable reclamation standards outlined in the Code will be achieved for the mine disturbance footprint and proposed post-closure landscape.

Include the general reclamation approach and prescriptions (including landforming, soil placement, surface preparation and revegetation) for each site-specific component. For example, include comprehensive prescriptions for each individual dump as opposed to a general description of the treatment of all waste dumps on site.

Address the minimum requirements outlined in the following subsections.

4.7.1 Structures and Equipment

Provide a description of decommissioning activities for site infrastructure and utilities, including identification of structures and/or equipment to remain in place following mine decommissioning and proposed reclamation prescriptions for each area/feature. Include prescriptions for reclamation of building foundations and plans for decommissioning waste streams.

4.7.2 Waste Rock Dump Reclamation

In this section:

- describe in detail reclamation plans for each individual waste rock dump, including:
    - anticipated final configurations,
    - proposed re-sloping,
    - post-closure water management,
    - surface preparation to alleviate compaction and erosion control,
    - details of soil replacement, and
    - a description of proposed re-vegetation methods;
- provide contour/topographic maps/drawings of the final landform configuration;
- provide flow directions and post-closure watersheds; and
- provide post-mine cross-sections along with a map illustrating section locations.

Consider the following, at a minimum, for prescriptions:

[58] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/laws-rules/water-sustainability-act
[59] https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/laws-rules/groundwater-protection-regulation

- end land use and capability targets appropriate for the waste dump topography;
- snow/water retention (where appropriate), habitat diversity, and aesthetic consistency with the adjacent landscape;
- long-term water management features if required;
- waste rock characteristics and mitigation of ML/ARD if appropriate;
- trace element uptake in vegetation; and
- long-term stability of exposed slopes of all major dumps.

4.7.3 Tailings Storage Facility Reclamation

In this section:

- describe in detail reclamation plans proposed for each TSF, including
    - anticipated final TSF configuration,
    - any proposed re-sloping, and
    - post-closure water management requirements and criteria, including spillways, diversion channels, and collection structures;
- describe methods of soil replacement and proposed revegetation methods on tailings dam faces and beaches;
- address concerns related to trace element uptake in vegetation; and
- demonstrate the long-term stability of exposed slopes.

Consider the following, at a minimum, for prescriptions:

- end land use and capability targets appropriate for the tailings storage facility topography;
- snow/water retention (where appropriate), habitat diversity, and aesthetic consistency with the adjacent landscape;
- long-term water management features if required;
- tailings characteristics and mitigation of ML/ARD if appropriate;
- trace element uptake in vegetation; and
- long-term stability of exposed slopes of embankments and tailings beaches.

4.7.4 Open Pit Reclamation Prescriptions

Describe whether open pits will be flooded at closure and, if so, provide details of discharges, and the associated water quality, to the receiving environment. Include details of habitat creation to be undertaken within pit areas, including riparian and beaches, to meet productivity requirements. Finally, consider trace element uptake in vegetation.

4.7.5 Watercourse Reclamation Prescriptions

Provide details on mine site water management and the re-establishment of watercourses post-mining. Detail the water sources that will potentially be affected by ML/ARD and/or other mine effluents, and how contact water will be collected and treated to meet discharge water quality

criteria. Provide similar details for diversion systems of non-contact water that does not require collection and treatment. Include long-term operational and maintenance requirements.

Provide details of habitat creation and watercourse/riparian/wetland restoration and tie to the end land use and land capability requirements.

Provide the design basis for the prescriptions (e.g., flood return, flow rates, habitat elements, trace element uptake considerations, etc.).

4.7.6 Road Reclamation

Address road reclamation based on end land use and land capability targets as well as long-term stability. Provide detailed prescriptions for contouring, de-compaction, soil replacement, surface preparation, and revegetation. Identify (and map) roads required for implementation of post-closure monitoring and maintenance activities.

4.7.7 Schedule

Reclamation and closure plans are understood to be living documents that may undergo revisions as new data, methods, technologies, and information become available and therefore must be flexible. The Reclamation and Closure Plan is expected to be based on the best available information in place and implementable at any given time.

Include plans in timelines/schedules for action/follow up, specifically:

- mapping at key and/or regular intervals through life of mine; and
- a tabulated schedule by mine component and activity.

4.8 Detailed Five Year Mine Reclamation Plan

Provide a reclamation plan for the next five years of mine development, with a detailed schedule and specific milestones for implementing progressive reclamation plans and developing reclamation research programs. Content requirements of the reclamation plan may be determined on a project-specific basis between technical reviewers and project proponents.

Describe in the detailed five year reclamation and closure plan the activities needed to close the site at the end of the five years under an early closure scenario.

4.9 Temporary Shutdown

Describe potential temporary or short-term closure care and maintenance and monitoring 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. Outline in the care and maintenance plan any outstanding reclamation obligations at the time of shutdown and describe any circumstances that would trigger implementation of any part of the life of mine reclamation and closure plan.

Include a rationale for any changes to the regular monitoring program, including any ramp-down period following temporary closure and any ramp-up period prior to reopening.

Include a description of what actions would need to be taken if unplanned temporary shutdown were to occur at key times during life of mine based on an assessment of risk.

4.10 Post-Closure Monitoring and Maintenance

Describe potential long-term monitoring 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. Stipulate periodic reporting of inspections and environmental monitoring, including annual dam safety inspections, dam safety reviews, water quality monitoring, vegetation monitoring, etc. Include a thorough set of criteria and associated rationale for any changes relative to operational monitoring, as follows:

- inspection/monitoring locations;
- inspection/monitoring frequency;
- personnel required;
- sample processing and analytical specifications;
- access requirements; and
- reporting requirements.

Include in the post-closure monitoring program a reassessment of effects predictions in light of the data collected post-closure. Use the results of the reassessment to conclude whether or not the design of the post-closure monitoring program needs to be modified. Include in the reassessment the data, methods, and analysis used to support the conclusions.

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

- supplemental planting and fertilizing applications;
- soil/engineered cover maintenance;
- spillway maintenance;
- periodic road maintenance;
- diversion ditch maintenance;
- slope remediation on dams and waste dumps;
- geotechnical instrumentation repair or replacement; and
- well closures.

Include a brief summary of the monitoring and maintenance required for water treatment facilities proposed to mitigate water quality issues after operations end. A more detailed description must be included in Section 5.6.3.

4.11 Reclamation Cost Estimate

Describe methods to be used to determine the estimated cost to implement the reclamation and closure plans, addressing all liabilities resulting from mining operations. These cost estimates will form the basis of the timing and amounts of securities required as conditions of MA permits. When calculating costs:

- base all costs on third-party blue-book costs;
- apply contingencies to all costs and clearly indicate their use in the calculations;
- provide decommissioning and removal costs for all equipment, buildings, the mill, etc. (do not incorporate salvage value for offsetting costs);
- include present costing in an electronic spreadsheet, with annual costs incurred throughout the mine life;
- clearly lay out the detailed rationale and assumptions of analyses in the cost estimates;
- if the mine site will require long-term monitoring and maintenance, run a net-present-value (NPV) model for 100 years using discount rates provided by the Chief Inspector (note: short-term costs are not discounted, and long-term costs are discounted); and
- provide liability cost estimates signed by a qualified professional with expertise in liability costing estimation.

Costs may be submitted, with the approval of the Chief Inspector, in a separate confidential report as per Section 10.1.4.8 of the Code.

4.11.1 Conventional Reclamation and Closure

Provide cost estimates to address all of the conventional reclamation and closure prescriptions described in the plan. Typically, these costs are provided by type of mine component or disturbance; site-wide activities are required to achieve successful reclamation and closure of the site. Detailing costs for each individual mine component may provide greater clarity for reviewers compared to detailed prescriptions. Site-wide costs may include plans for contaminated sites investigations and remediation, maintenance costs to address revegetation application/ germination issues, dispersed infrastructure and monitoring wells, etc.

Provide a liability estimate to address the detailed five year reclamation and closure plan that would need to be implemented in the early closure scenario as well as the full life of mine build out as proposed. Provide the details as an annual build out to clarify the differences between these two versions.

4.11.2 Post-Closure Monitoring

Provide cost estimates for the long-term and post-closure monitoring programs. Including, but not limited to:

- reclamation monitoring;
- water quantity/quality sampling of groundwater and surface water;
- geotechnical monitoring (Dam Safety Investigation, Dam Safety Review, etc.);
- air quality;
- meteorology; and
- any additional requirements associated with the project.

4.11.3 Post-Closure Maintenance (excluding Water Treatment)

Provide cost estimates for the long-term and post-closure, capital and operating, maintenance requirements.

4.11.4 Life of Mine Water Treatment

Provide cost estimates for the capital and operating water treatment requirements for all phases of mine life. Refer to Section 5.6.3.12 for the required costing details.

5 Modelling, Mitigation, and Discharges

5.1 Summary

Provide an overview of each project component and the expected contaminant sources, as well as the planned water management and pollution control works or best management practices requirements for each. Include:

- open pits;
- underground workings;
- TSFs and associated infrastructure (including characterization of tailings quantity and quality);
- waste rock dumps;
- water management structures;
- ore, overburden, soil, and construction stockpiles;
- processing plant (mill) and associated facilities (crushers, conveyors, etc.);
- mine access and mine haulage roads; and
- any other relevant components.

Illustrate locations and zones of concern using tables and maps or other graphics. Include raw data in appendices, in electronic format (e.g. spreadsheet on a USB memory stick) with the application, and, if applicable, upload for storage in ENV's Environmental Monitoring System database.

5.2 Conceptual Site Model

To be most effective, a CSM should be developed in the beginning 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 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 POCs[60] from the mine site have been considered and evaluated;
- assess all major exposure routes or pathways via which POCs can reach the receiving environment and receptors, including consideration of surface water and groundwater transport mechanisms;
- identify all receptors that may be adversely affected by POCs released from the mine site;

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

- 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 (Section 1.3.4) and pathway(s) for each POC originating from the mine site and being transported to the receiving environment; and
- indicate how POC loadings will be contained, collected, stored, and/or mitigated.

Please refer to the guidance document regarding the Use of Conceptual Site Models to Support *EMA* Effluent Permit Applications[61].

5.3 Site-Wide Water Balance Model

Develop a quantitative site-wide water balance model to predict the impacts of mine site water management (e.g., withdrawals and inputs) on surface water and groundwater quantity, both on the mine site and in the receiving environment. The site-wide water balance model must consider drainage diversions, dewatering, erosion control, TSF, open pits, underground mine workings, waste rock seepage, groundwater interactions, effluent and contaminated seepage dilution ratios, etc. The TSF water balance (Section 3.5.4) is one component of the site-wide water balance model and must be appropriately integrated.

Include the following information in the site-wide water balance model:

- the mine plans for each phase of mine life, including baseline conditions (construction, operation, closure, and post-closure);
- baseline climate, hydrometric, and hydrogeological data collected under Sections 2.2, 2.6.1, and 2.6.2;
- estimates of recharge and discharge rates that are consistent with the precipitation records, topography, and surficial cover of the proposed project area, low-flow streamflow and spring flow records, inferred diffused seepage flows, and groundwater extraction;
- all drainage areas and runoff coefficients;
- estimated groundwater inflows and seepage rates (see Section 5.5);
- estimates of upper and lower bounds, and expected groundwater recharge;
- a summary of all components contributing to the model;
- a description of all prediction nodes and justification that they are suitably located to predict impacts on all water users and the aquatic environment;
- a summary of data sources utilized in developing the model;
- a justification of all water balance components that have been included and excluded, and the method used to estimate each of these components;
- a summary of all sources and uses for any water required in the mine site operation;
- a demonstration that the model is sufficiently calibrated to available measured and synthetic datasets;

[61] 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

- a base case for each phase of mine life (i.e., construction, operation, closure, and post-closure); and
- any other relevant information.

Use the site-wide water balance model to present the following information, for each phase of mine life (construction, operation, closure, and post-closure), and include a detailed summary of the results:

- a demonstration that the model is sufficiently calibrated to available measured and synthetic datasets;
- an assessment of how the mine operation will affect in-stream flow and any surface or groundwater licensees, during each phase of mine life, including throughout the range of in-stream flows because of withdrawals, diversions, induced losses to groundwater, and effluent discharge in consideration of climate, land use, and water allocation and withdrawal;
- an assessment of the impact of climate change;
- the uncertainties with the assessment, and how the uncertainties will be addressed;
- a summary of model results for the base case and sensitivity analysis scenarios, including but not limited to predicted stream flows, predicted changes in groundwater/surface water interaction, and predicted inflows/outflows for key mine site facilities;
- figures that illustrate the site-wide water balance model during each phase of mine life (construction, operation, closure, and post-closure); this should include schematics of all relevant processes and flow paths in the model;
- sensitivity analyses to evaluate conservative scenarios that may affect the base case for each phase of mine life, such as high-flow, low-flow, and operational uncertainties;
- a summary of how the results of sensitivity analysis scenarios have informed the water management plans for each phase of mine life; and
- any other relevant information.

5.4 Surface Water Quality Model

Develop a quantitative model for the study area that assesses the potential changes to water quality for key locations and receptors on the mine site in the receiving environment and provide a summary of the model and the assumptions used in a detailed report.

Develop a surface water quality model that is integrated with the site-wide water balance model (Section 5.3) and is representative of each phase of mine life (construction, operations, closure and post-closure). The model should include:

- the proposed mine plan;
- baseline water quality and water quantity conditions;
- a description of receptors within and downstream of the mine site;
- seasonal variability of baseline data and predicted changes with time;

- the baseline surface water and groundwater quality (Section 2.7);
- geochemical source terms stating assumed geochemical attenuation processes in the derivation of source terms or within the surface water quality model (Section 2.4.2);
- a comparison of source terms to measured conditions (observed water chemistry, loads or analogue sources);
- the mitigation methods proposed and evaluated in Section 5.6;
- the discharge of contact water to groundwater pathways, if applicable;
- contact water discharge to surface water pathways, if applicable;
- figures that illustrate the source terms, flow paths and active and passive discharge locations during each phase of mine life (construction, operation, closure and post-closure), this should include schematics of all relevant processes and flow paths in the model; and
- sensitivity scenarios to evaluate conservative scenarios that may affect the model for each phase of mine life.

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

- a description and rationale of all model sensitivity scenarios;
- a description of all model inputs, assumptions, and methods;
- a description of any model mechanisms that reduce loadings (e.g., attenuation, sorption, precipitation, loss to groundwater, etc.), including supporting observations and data;
- a description of all included and excluded parameters;
- a description of all prediction nodes and justification that they are suitably located to predict impacts on all water users and the aquatic environment;
- a description of data sources utilized in developing the model;
- a justification of all mine site components that have been included and excluded, and the method used to estimate each of these components;
- a description of the model inputs and assumptions regarding water treatment (if applicable); and
- any other relevant information.

In addition,

- demonstrate that the model is sufficiently calibrated to available measured datasets;
- evaluate the contribution of disturbances upstream of the mine site and resulting cumulative effects on surface water quality within the project area and further downstream during all stages of mine life;
- evaluate worst-case water quality scenarios, such as base flow and low dilution (7dQ10 flow) and high runoff conditions, that may lead to increased contaminant concentrations;
- consider the potential effects of contact water discharge via groundwater pathways, if any;
- summarize results for the model and sensitivity scenarios for predicted loadings at key mine site and receiving environment receptors;

- compare proposed discharge quality to known discharge criteria, guidelines, and/or industry practices;
- evaluate effluent characteristics relative to WQGs, WQOs, or SBEBs in the receiving environment throughout the year and determine the most sensitive times of the year;
- provide full characterization and predictions of all treated and untreated effluent sources (quality and quantity);
- describe the timing (e.g., seasonal, continuous, intermittent) of discharges to the environment;
- if an initial dilution zone (IDZ) is proposed, provide predicted water quality within and at the edge of the IDZ (see Section 5.9) and refer to Development and Use of Initial Dilution Zones in Effluent Discharge Authorizations[62];
- identify the times of year when effluent or seepage quality is expected to exceed water quality guidelines; and
- provide a gap analysis that identifies limitations and uncertainties in the model and provides recommendations for future assessment.

5.5 Groundwater Model

5.5.1 Conceptual Hydrogeologic Model

Develop a conceptual hydrogeologic model for the study area that integrates the baseline surface water and groundwater quantity and quality monitoring data and describes 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 model:

- the mine plans for each phase of mine life (i.e., construction, operation, closure, and post-closure);
- integration of the site-wide water balance model (Section 5.3);
- integration of the surface water quality model (Section 5.4);
- boundaries associated with observed and inferred groundwater divides, spatially distributed groundwater recharge and discharge areas, and areas where groundwater is interpreted to interact with surface water;
- geometry, lithology, hydraulic properties, and inferred confined/unconfined conditions of all hydrostratigraphic units (i.e., aquifers and aquitards);
- groundwater elevations, lateral and vertical hydraulic gradients, flow directions, and seasonality of the groundwater flow regime;

[62] 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

- groundwater flow velocities and travel times between sources of contact water (e.g., underground workings, open pit, tailings pond, waste rock piles, etc.) and downgradient surface watercourses;
- identification of main groundwater recharge and discharge zones;
- 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-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 relevant information.

Additionally, identify and justify all assumptions incorporated in the conceptual hydrogeological model and include figures that clearly summarize the geological and hydrostratigraphic data.

5.5.2 Numerical Hydrogeologic Model

Develop a numerical groundwater model capable of representing the current hydrogeological understanding for the study area by following the Guidelines for Groundwater Modelling to Assess Impacts of Proposed Natural Resource Development Activities[63]. Apply the numerical model to predict changes in groundwater flows and levels and estimate the groundwater input rates at key surface water receptors that will potentially occur within the study area because of the project. Include in the numerical groundwater model:

- a summary of the model objectives;
- the mine plans, including all underground workings, for each phase of mine life (construction, operation, closure, and post-closure);
- integration of the conceptual hydrogeological model (Section 5.5.1);
- integration of the regional and local climate data (Section 2.2);
- boundaries of the study area and receiving environment assessment points (e.g., surface and groundwater users, drinking water aquifers, fish-bearing streams, etc.);

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

- the modelling framework, including the software, spatial and temporal discretization of the study area, the required input and the output generated by the model, and all supporting input/output processing tools (e.g., spreadsheets, GIS files, etc.);
- 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);
- 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;
- a 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;
- 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;
- 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.

5.6 Mitigation Methods

Describe proposed effluent mitigation methods including source control, management, containment, or treatment methods. These can include, but are not limited to:

- source control methods to mitigate the production of POCs[64] (explosives best management, water covers, waste rock blending, etc.)
- management control methods to reduce the volume of contaminated water (non-contact water diversion, seepage collection, waste rock segregation, cover systems, etc.);
- incorporation of assumed geochemical attenuation processes in the derivation of source terms or within the surface water quality model;
- retention of contaminated water in surface ponds, TSF, open pits, etc.;
- passive effluent treatment technologies (wetlands, bioreactors, saturated backfills, etc.);
- active effluent treatment technologies;

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

- recycling, re-use and reduction strategies; and
- adaptive management strategies and how they will be implemented to ensure human health and the environment are protected.

In addition,

- discuss options for contaminant source control, containment, or mitigation methods and describe how best management practices and ENV's Best Achievable Technology (BAT)[65] (Section 5.6.1) have been applied;
- describe the design and use of proposed source control methods and management practices, and include detailed designs of all proposed discharge works (e.g., outfalls, spillways, channels, etc.);
- propose effluent discharge limits for POCs[66] that can be shown to be protective of the receiving environment and its receptors; and
- describe the timing (e.g., seasonal, continuous, intermittent) of discharges to the environment.

5.6.1 Best Achievable Technology Evaluation

Undertake and submit an ENV BAT[67] review if untreated effluent concentrations at the source are predicted to exceed acute WQGs.

The BAT provides ENV staff with the information to support the consideration of SBEB's, IDZ's and waste discharge standards. The outcome of the BAT is one of the many aspects considered when developing waste discharge standards and permit conditions.

5.6.2 Volume and Quantity Control Methods

Clearly describe and summarize the incorporation of management and quality control methods to reduce the amount and volume of contaminants being generated by the project.

5.6.3 Geochemical Attenuation Processes

Clearly describe and summarize the geochemical and physical processes incorporated into the Surface Water Quality Model (Section 5.4) or Numerical Groundwater Model (Section 5.5.2), including, but not limited to, mechanisms such as sorption, precipitation, or other attenuating mechanisms. Provide supporting documentation demonstrating the feasibility and viability of these mechanisms under the expected site conditions, including but not limited to direct field observations, laboratory experiment results, analogue site results, or scientific literature reviews.

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

5.6.4 Water Treatment

Water treatment should only be proposed when best management practices 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, over all phases of mine life, that it will be employed. Methods for water treatment include both active and semi-passive water treatment processes.

5.6.4.1 Description

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

- proposed treatment method(s);
- process flow sheets;
- treatment capacity;
- retention times;
- materials and reagents used;
- reagent sourcing and transport;
- power requirements;
- pumping requirements;
- personnel requirements; and
- any other relevant information.

5.6.4.2 Location

Provide a location map and relevant diagrams that indicate the location of the water treatment facility being proposed.

5.6.4.3 Detailed Design

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

- effective drainage collection, conveyance, and storage systems that can handle peak climatic and hydrological events;
- support for designs by site hydrology and geotechnical information (see Section 3.5.3 Processing Plant and Associated Facilities);
- engineering of the facility and supporting infrastructure, including geotechnical, electrical and mechanical information;
- information on treatment methods, process flow sheets treatment capacity, retention times, materials and reagents used, reagent sourcing and transport, etc.;
- assessment of potential health and safety risks and management plans/safe work procedures; and
- any other relevant information.

5.6.4.4 Treatment Effectiveness

Assess the effectiveness of the proposed water treatment facility in mitigating POCs[68] under a range of conditions reasonably expected for the mine site. This includes, but is not limited to, performance of the collection and treatment systems under the expected variable influent chemistry, flow rates, operating temperatures, and hydraulic retention times.

The proposed water treatment method(s) effectiveness must be demonstrated through site-specific piloting. Detailed analogue site or treatment method data may be acceptable if it can be demonstrated that they provide a reasonable comparison to the conditions expected for the proposed project. Consult with EMPR and ENV on the specific requirements for the project well in advance of application submission.

5.6.4.5 Performance Risks

Assess performance risks collection and treatment (i.e., extreme weather [icing, snow loading, flows, etc.], power outage, wearing of parts, scaling, reagent supply interruption, plugging, by-passing/short circuiting, etc.) and provide appropriate contingency plans.

5.6.4.6 Influent and Effluent Water Quality

Provide an estimate of influent and effluent water quality and flow rates from all 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 water quality to known discharge criteria, guidelines, and/or industry practices;
- an evaluation of end-of-pipe effluent POC[69] concentrations, based on meeting or exceeding WQGs in the receiving environment during the most sensitive times of the year; and
- propose effluent discharge limits and demonstrate how they are protective of the receiving environment and its receptors.

5.6.4.7 Waste and By-Products

Handling and disposal practices for water treatment wastes and by-products are an important consideration for understanding the potential long-term effects of on-site disposal methods.

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

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

Provide the following detailed information for all waste and by-products anticipated to be produced from the proposed water treatment facility:

- production rate and total volumes to be generated on a year-by-year basis for each phase of mine life; and
- detailed geochemical and physical characterization results.

If disposal of any of the water treatment waste and by-products are proposed to be managed on the mine site, provide the following detailed information:

- detailed geochemical and physical testing to assess the long-term geochemical stability of the proposed disposal method;
- long-term disposal plans that address long-term geochemical and physical stability, as well as reclamation and closure;
- development of conservative source terms;
- incorporation of the disposal scenario into the site-wide water balance model, surface water quality model, and numerical hydrogeological model, 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.

5.6.4.8 Maintenance

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

5.6.4.9 Emergency Response Plans

Include in this section emergency procedures and contingencies for malfunctions and upsets to the water collection infrastructure and water treatment facilities.

5.6.4.10 Monitoring Plans

Include in this section:

- proposed monitoring programs for water collection and water treatment (water quality, flow, other aspects of system performance, etc.); and
- reporting plans.

5.6.4.11 Schedule

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

5.6.4.12 Cost Estimate

Include a detailed summary of the capital and operating costs associated with the proposed water treatment facilities, for all phases of mine life in the Reclamation Cost Estimate (Section 4.11). Clearly outline and describe all assumptions and calculations employed to determine individual parameters. Include appropriate contingency factors for all calculated costs.

Capital costs include, but are not limited to:

- design and construction of the water treatment facilities and associated infrastructure; and
- required infrastructure maintenance and upgrades.

Operating costs include, but are not limited to:

- reagent usage rates and amounts (delivered cost);
- power requirements (including plant operation, pumping of seepage, heating of buildings, etc.);
- personnel requirements (include information on how many people are needed to operate water treatment plants and conduct monitoring programs);
- water quantity and quality monitoring, sampling, and analyses; and
- handling and disposal of wastes and by-products.

If the mine site will require long-term water treatment, include an NPV model run for 100 years using discount rates provided by the Chief Inspector (note: short-term costs are not discounted, and long-term costs are discounted). Provide a water treatment cost estimate signed by a qualified professional with expertise in costing estimation.

5.7 Domestic Water/Sewage Treatment

Although these application requirements primarily address the main effluent discharge, sewage and solid waste disposal also require authorizations under the 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)[70] 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 ENV website[71]. Additional direction on how best to include sewage disposal information in the application package should be sought from ENV EPD staff.

[70] https://www2.gov.bc.ca/gov/content/environment/waste-management/sewage/municipal-wastewater-regulation
[71] https://www2.gov.bc.ca/gov/content/environment/waste-management/sewage/municipal-wastewater-regulation

5.8 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; and
- discuss options for contaminant source control, containment, or mitigation methods and describe how best management practices and ENV's BAT[72] have been applied.

5.9 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[73].

Provide all information necessary to support the proposed IDZ based on best professional judgement. Include the following at a minimum:

- a description of why an IDZ is necessary and how best management practices and the BAT[74] (Section 5.6.1) are applied prior to consideration of an IDZ;
- proposed dimensions of the IDZ;
- a CSM;
- 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.

Review the checklist with ENV prior to beginning the application process. Please refer to the ENV Guidance on IDZ[75].

[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/tg11_development_and_use_of_idz.pdf
[74] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/pulp-paper-wood/best_achievable_control_tech.pdf
[75] 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

6 Environmental Assessment Predictions

Assess potential residual environmental effects and evaluate the risks of the mine project in the context of human health, water users, and aquatic and terrestrial resources. In this predictive work, consider the mine plan and proposed mitigation techniques, and build on available baseline environmental data and waste discharge characteristics anticipated over the life of the mine. In the environmental effects assessment, also consider cumulative effects within the watershed. Note the following definitions:

- **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 effect threaten the existence of a rare species or an isolated population of a particularly 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 water quality guidelines or existing water quality objectives and SBEBs are initial tools to help determine magnitude. Risk increases with the number of parameters that are predicted to approach or exceed guidelines and 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 a lower 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.
- **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).

Ensure that environmental effects predictions:

- identify spatial and temporal boundaries for effects prediction (note these could vary depending on the environmental value being considered);
- identify POCs[76];
- identify risk and endangered/rare ecosystems and associated components and indicators (measurable metrics) as outlined in Procedures for Mitigating Impacts on Environmental Values[77];

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

[77] https://www2.gov.bc.ca/assets/gov/environment/natural-resource-policy-legislation/environmental-mitigation-policy/em_procedures_may27_2014.pdf

- describe the current condition of environmental components and indicators for each value identified and predicted changes from current (baseline) condition;
- identify risk(s) to environmental values compared to baseline and assess mitigation options to avoid, minimize, and restore on site;
- develop or refine the CSM, conceptual ecological models, or frameworks to define and illustrate all exposure pathways or mechanisms linking contaminants or conditions of potential concern to the assessment endpoints (receptors). The models aid in the design of monitoring programs and facilitate the establishment and testing of hypotheses regarding the predicted relationships between stressors and assessment endpoints;
- propose site-specific assessment endpoints (e.g., drinking water quality, fish health/survival, etc.). Assessment endpoints are similar to Valued Components as described in the Guideline for the Selection of Valued Components and Assessment of Potential Effects[78] and in the Environmental Mitigation Policy[79];
- propose measurement endpoints for each assessment endpoint (chemical, toxicological, or biological), for example:
    - for fish survival, this might be toxicity as measured in lab toxicity tests or based on existing WQGs,
    - for water quality, this might be chemical concentrations of particular contaminants, and
    - for benthic invertebrates, this might be community metrics or indices, etc.;
- predict the incremental changes in parameters or measurement endpoints over existing receiving environment conditions using mass balance modelling or other techniques;
- compare predicted quality of ambient water and sediment, tailings water, effluent, and seepage concentrations to provincial WQGs[80] or existing WQOs to estimate the potential severity of impact(s). In some cases, it may be necessary to develop SBEBs (for specific sites associated with a permit decision) to complete an effects assessment;
- consider the potential for synergistic effects of mine disturbance and cumulative effects of other environmental stressors external to the mine or from previous exploration and/or mining activities;
- identify risk(s) to aquatic and terrestrial resources compared to baseline and evaluate risk reduction options;
- use scientifically defensible monitoring and impact assessment tools in a weight of evidence (WOE) approach, where the range of tools is commensurate with the level of risk;
- acknowledge uncertainties in the assessment due to data gaps or model assumptions; and
- develop a discharge plan.

[78] https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/environmental-assessments/guidance-documents/eao-guidance-selection-of-valued-components.pdf

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

[80] www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines

Describe the predicted residual effects on aquatic and terrestrial resources in the receiving environment. Residual effects are those effects remaining after implementation of all mitigation techniques evaluated and proposed in a joint MA/EMA application. Describe the predicted effects that would occur if the mitigation measures proved to be ineffective. Summarize potential impacts by environmental value and location using tables and graphically illustrate the pathways from contaminant sources to receptors (CSM). Summarize risks to environmental values, including surface and groundwater and aquatic and terrestrial resources.

Include raw data in appendices, in electronic format (such as a USB memory stick) with the application, and, if applicable, upload data for storage in ENV's Environmental Monitoring System database.

6.1 Aquatic Resources

In this section:

- describe study boundaries and assessment endpoints (e.g., loss of habitat, fish or invertebrate tissue concentrations, abnormalities, benthic invertebrate, periphyton, or fish community metrics, etc.);
- use the CSM (Section 5.2) to describe the contaminant transport or mine disturbance factors linking sources to receptors, and establish a risk assessment process;
- describe and discuss the potential for bio-accumulation or bio-concentration of contaminants, and the associated risk to assessment endpoints (e.g., fish health, consumers of fish flesh, etc.);
- predict changes in aquatic resources and other receptors at species, community, and/or ecosystem levels as appropriate;
- propose measurement endpoints and discuss the relevance of these measures in a WOE approach to increase confidence in impact prediction for the site;
- consider the contribution of cumulative effects on the aquatic resources and other receptors (where appropriate) from disturbances outside the project area and further downstream during mine operation and following mine closure;
- identify data gaps and uncertainties in models, and describe how they would be addressed in adaptive management and environmental monitoring plans; and
- assess potential human health risks.

6.2 Terrestrial Resources

In this section:

- describe study boundaries and assessment endpoints (e.g., loss of habitat, vegetation tissue concentrations, vegetation community metrics, exposure limits for relevant wildlife species);

- utilize the process detailed in Procedures for Mitigating Impacts on Environmental Values[81] to evaluate the potential effects on terrestrial values for the appropriate area of influence;
- use the CSM (Section 5.2) to describe the contaminant transport or mine disturbance factors linking sources to receptors, and establish a risk-assessment process;
- describe and discuss the potential for bio-accumulation or bio-concentration of contaminants, and the associated risk to assessment endpoints (e.g., ecosystem and habitat function, wildlife health);
- consider the potential effects of relevant exposure pathways, if any;
- consider the contribution of cumulative effects on the terrestrial resources (where appropriate) from disturbances outside the project area and further downstream during mine operation and following mine closure;
- identify data gaps and uncertainties in models, and describe how they would be addressed in adaptive management and environmental monitoring plans and reclamation research programs (in Section 4.2.5); and
- assess potential human health risks.

[81] https://www2.gov.bc.ca/assets/gov/environment/natural-resource-policy-legislation/environmental-mitigation-policy/em_procedures_may27_2014.pdf

7 Environmental Monitoring

Include proposed monitoring and reporting programs that enable ongoing evaluation of waste management performance and receiving environment condition, as well as evaluation of predictions proposed in the application. Ensure monitoring programs are initially spatially comprehensive, including monitoring sites at reference or control locations, end-of-pipe locations, and exposure sites, such as edges of IDZs and far-field locations. Increased sampling frequency and a 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.

Where applicable, integrate the requirements of the federal Environmental Effects Monitoring (EEM) program under the Metal and Diamond Mining Effluent Regulations[82] into the monitoring program design. However, be aware that the federal EEM program is generic and not normally sufficient to address provincial regulatory requirements.

7.1 Environmental Monitoring Program Design

Discuss monitoring program requirements with EMPR and ENV technical staff early in the mine planning stage. At a minimum, the proposed project will require comprehensive monitoring programs for the mine site, proposed discharges, immediate receiving environments, and a broader Aquatic Effects Monitoring Program. In each case, the following must be included in the monitoring programs:

- proposed study design;
- objectives;
- incorporation of the CSM;
- a description of POCs[83] and their known effects to local biota or related species;
- established methods for detecting changes in sensitive receptors (may include a combination of toxicity testing, tissue sampling, and community/abundance data);
- site locations (should be mapped, with coordinates provided);
- sampling frequency;
- parameters for assessment;
- sampling and analytical lab methodology;
- rationale for proposed sampling program;
- proposed assessment techniques;
- comparisons to relevant guidelines and objectives;
- proposed QA/QC programs;
- reporting schedule; and

[82] http://laws-lois.justice.gc.ca/eng/regulations/SOR-2002-222/index.html

[83] 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[84];
- conform to methods and QA/QC procedures specified in the British Columbia Field Sampling Manual[85] and the Environmental Data Quality Assurance Regulation (*EMA*)[86];
- use analyses that follow standard analytical methods as specified in the most recent edition of the British Columbia Environmental Laboratory Manual[87] and associated supplements; and
- other information, as required by EMPR and ENV technical staff.

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

Describe quality assurance 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;
- assessment of replicate 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);
- flagging of outlier data points that do not represent actual conditions; and
- identification of the laboratories used to complete analytical tests.

Consult Part A of the British Columbia Field Sampling Manual[88] for detailed guidance on QA/QC.

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

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

[86] http://www.bclaws.ca/Recon/document/ID/freeside/22_301_90

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

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

7.2 Mine Site Water Monitoring Program

Develop a comprehensive monitoring program for surface water, groundwater and seepage water quantity and quality within the proposed permitted mine area (e.g. tailings storage facilities, waste rock dumps, stockpiles, water management structures, etc.) that includes each phase of mine life (construction, operation, closure, post-closure). The monitoring program should be designed to support the on-going evaluation and refinement of predictions proposed in Section 5. The monitoring program should include the following information:

- objectives;
- monitoring methods;
- monitoring locations, including a detailed map showing each location;
- rationale for the distribution of monitoring locations (including depths, where relevant), and how they relate to the maintenance and improvement of the site-wide water balance model (Section 5.3), surface water quality model (Section 5.4), and groundwater model (Section 5.5);
- for groundwater, information must be provided on the range of monitoring depths that will be included for each individual monitoring location; and
- POCs[89] to be measured at each location;
- sampling frequency and period, including high-, medium-, and low-flow periods;
- analytical testing procedures to be used;
- QA/QC protocols;
- name of the certified laboratories used to analyze samples;
- comparisons to relevant guidelines and objectives;
- methods for data analyses;
- reporting schedule; and
- any other relevant information.

The Mine Site Water Monitoring Program should be combined with the Environmental Monitoring Program (Section 7.4) and Post-Closure Environmental Monitoring Program (Section 7.5) and incorporated into the Mine Site Water Management Plan (Section 9.6)

7.3 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.

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

7.4 Environment 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 IDZ, if proposed) and far-field receiving environment. 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, 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 Program (Section 7.6). 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;
- use groundwater testing to complement surface water monitoring efforts, if groundwater–surface water interactions are important;
- include comparisons to the relevant WQG, WQO, SBEB, or Site Performance Objective (SPO) thresholds;
- 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
- clearly link predicted effects to the associated components of the environmental monitoring program and show linkages in a table.

The proposed monitoring of surface water and groundwater quantity and quality in the receiving environment should be combined with the Mine Site Water Monitoring Program (Section 7.2 and included in the Mine Site Water Management Plan (Section 9.6).

7.5 Post-Closure Environmental Monitoring Program

Post-closure monitoring may be less intensive then operational environmental monitoring if closure activities have effectively mitigated or removed environmental liabilities; however,

permitted waste discharges frequently remain in the post-closure phase, and environmental monitoring over the long term may be required.

Provide a thorough rationale for changes to the following components of the operational Environmental Monitoring Program (Section 7.4) when transitioning to the post-closure phase:

- monitoring locations;
- monitoring frequency; and
- measurement parameters.

Ensure the Post-closure Monitoring Program has the same fundamental components as the operational Environment Monitoring Program (i.e., clearly stated objectives, methods, etc.).

Include a comparison of predicted contaminant concentrations and environmental effects from the most recent and relevant *EMA* Permit or Permit Amendment Application or Closure Plan to the results from Post-closure Monitoring. Provide explanations if monitoring results meaningfully differ from impact assessment predictions. Use the results of the comparison to inform the design of the Post-closure Monitoring Program and, where applicable, update the predictive models (Section 5).

The proposed monitoring of surface water and groundwater quantity and quality in the receiving environment should be combined with the Mine Site Water Monitoring Program (Section 7.2) and included in the Mine Site Water Management Plan (Section 9.6).

7.6 Aquatic Effects Monitoring Program

An Aquatic Effects Monitoring Program evaluates the effectiveness of the permit for protecting receiving environment biota. When required by the permit, permittees must design and implement an Aquatic Effects Monitoring Program that is capable of detecting the potential effects of receiving water quality changes due to effluent discharges, seepages, and mining-related activities, on biota, separately and cumulatively. The size and scope of the Aquatic Effects Monitoring Program is commensurate with the risk posed by the project. 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 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, and reporting of Aquatic Effects Monitoring Program studies may cycle on an annual or multi-year basis.

8 Health and Safety

Health and safety programs and plans submitted in the permit application are considered living documents and are expected to be kept up to date, reviewed routinely, and be made available at the mine site at all times. The expectation is that these programs and plans will be implemented by site personnel and possibly contractors. With that objective in mind, the information provided in this section should be of a level of detail that is executable by those responsible to do so. The information provided will be subject to technical review during the permitting process and revised program and plan components are to be developed based on feedback provided by technical reviewers.

8.1 Occupational Health and Safety Program

Describe the Occupational Health and Safety (OHS) Program for the project. Identify how the program will work to protect employees and all other persons from undue risks to their health and safety arising out of or in connection with activities of the project. Address all phases of the project, including exploration, development, construction, operation, reclamation, and closure. Ensure the OHS Program is developed by persons qualified to do so based on their knowledge, training, and experience. Please see Section 1.6.9 of the Code when developing this portion of the application and refer to the OHS page of EMPR's website[90] for further information.

Provide the components of the OHS Program, including but not limited to:

- management of and responsibilities for health and safety;
- promotion of a positive health and safety culture;
- prevention of injury and disease;
- Occupational Health and Safety Committee (OHSC) requirements;
- provisions for regular health and safety meetings;
- workplace inspections, investigations, and dangerous occurrence reporting;
- general safety rules;
- identification and control of hazards;
- safe work procedures;
- tracking and trending of OHS records and stats;
- if applicable, health and safety management of contractors; and
- relevant health and safety sub-programs (see section below for more detail).

Depending on the project, it may not be possible to develop all elements of the OHS Program in detail during the permitting phase.

[90] https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/health-safety/occupational-health

8.1.1 Occupational Health Risk Assessment

Include an initial occupational health risk assessment, developed by a qualified person in the field of occupational hygiene (e.g., Certified Industrial Hygienist (CIH), Registered Occupational Hygienist (ROH), or person with equivalent experience acceptable to the Chief Inspector). Provide the components of the assessment, including but not limited to:

- all anticipated physical, chemical, biological, and ergonomic hazards;
- strategies to minimize and control those hazards in the design of project components;
- drawings and detailed plans for HVAC and local exhaust ventilation; and
- exposure control plans and safe work procedures.

Identify information sources used to inform this assessment. Outline in greater detail the exposure control plans and/or safe work procedures for occupational health hazards that will require consideration during permitting due to a project-specific hazard or require immediate implementation after permit issuance to begin activity under the permit.

The information provided in this section is expected to inform the Workplace Monitoring Program required by Section 2.1.3 of the Code. Additional guidance is available on the Occupational Health website[91] and in the Workplace Monitoring Procedures Manual.

8.1.2 Ergonomics

Assess the potential for musculoskeletal disorders (MSDs). As per Section 3.3.5 of the Code, when a material's handling task endangers the safety of the persons doing the work, the mine shall either redesign the work area, provide mechanical lifting aids, and/or redesign the physical parameters of the task. Further, as per Section 2.9.1 of the Code, where the equipment, work procedure, or working condition in a work area causes an MSD to the upper limbs of a worker due to repetition or force, preventative measures must be implemented. These include modification of equipment, work procedures, or the rescheduling of work to reduce physical demands.

Consider ergonomics throughout the mine design planning process where workers are performing tasks to meet or exceed Code requirements. Many materials handling tasks, work procedures, working conditions, and/or equipment that contribute to MSDs can be eliminated or reduced through workplace system design that considers the physical and cognitive needs and capabilities of the worker population. Proactively applying ergonomic principles can optimize system functioning to prevent occupational injury or reduce the severity of harm as well as improve work efficiency, productivity, and product quality.

Include ergonomic considerations for:

- work environment;

[91] https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/health-safety/occupational-health

- workstations and machinery;
- work equipment and tools;
- manual materials handling; and
- work processes and procedures.

Where applicable, end-user (e.g., workers, supervisors) and OHSC stakeholder participation is an essential part of a design process that considers ergonomics to gain detailed knowledge of operations, performance of tasks, and identification of training and orientation requirements.

8.1.3 Emergency Wash Facilities

List the planned or existing emergency wash facilities that will be available to meet the requirements of Section 2.4.1 of the Code. Provide details that clearly identify how the facilities will meet the Code requirements, including information on the potable water source.

Identify facilities in detailed facility drawings (as required in Section 3.5). Clearly reference information regarding facility locations that are included elsewhere in the application. Utilize best practice standards when determining emergency wash facility type and location. Reference the standard(s) utilized to inform this section.

8.1.4 Hazardous Dust

Assess the potential for fugitive dusts or other materials to be released and accumulate in a building or enclosed space where they could cause a fire or explosion or be potentially hazardous if inhaled or ingested. Develop a contingency plan for cleanup of these dusts or materials early in the design phase of a project to ensure cleanup can be facilitated in a manner that is timely and does not introduce a secondary hazard to health and safety (see Section 2.3.5 of the Code). Describe contingency measures, which may include, but not be limited to, establishment of wash down capabilities and sump collection or engineered vacuum system with connection to a dust collector. Ensure that locations considered for this assessment include, but are not limited to, surface and underground crushing, grinding and conveying facilities, operator control rooms, laboratories, and QA/QC facilities.

The information provided in this section must be incorporated into the Combustible Dust Management Plan (Section 9.15), if required for the proposed project.

8.1.5 Lunchrooms, Mine Dry, and Sanitary Conveniences

List the planned or existing facilities that will be utilized to meet the relevant requirements of Sections 2.4.2 and 2.11.1 through 2.11.15 of the Code during all project phases, for both surface and underground operations. Include the facilities on a general site layout and detailed facility drawings (as required in Section 3.5). Clearly reference in this section information regarding facility locations that are included elsewhere in the application. Include a contingency

plan for facilities to accommodate potential increases in the number of workers on site, including contractors, during the life of the mine to ensure the permitted mine plan is capable of accommodating such increases.

8.2 Post-Permitting Requirements

During the permitting phase of a project, not all information may be available at the level of detail that will be required for construction or operation phases. This information is typically identified during the permit review process and captured in *MA* permit conditions. Information identified for review and submission to the Chief Inspector of Mines is required to be submitted 60 days prior to commencement of the initial construction phase. The following outlines information that is commonly required in the post-permitting, pre-construction phase of the project.

8.2.1 Issued for Construction Plans

Ensure that Issued for Construction (IFC) plans are prepared by qualified professionals or persons who, in the opinion of the Chief Inspector of Mines, are qualified to perform the work. At a minimum, include the following information:

- designs and details for processing facilities, mine buildings and other infrastructure, water treatment facilities, and significant utilities infrastructure, including:
    - general HVAC systems and local exhaust ventilation (in particular for locations such as reagent storage and handling, crushing, screening and conveying circuits, laboratories, weld bays, and shops). Information provided must indicate what contaminants the system was designed to capture, hoods, fans, duct sizes/lengths, air flows, and discharge,
    - plumbing,
    - emergency wash station type and locations,
    - mechanical, and
    - locations of emergency exits, signage, and lighting;
- process flow sheets;
- designs and details for hazardous material storage and handling areas including information on storage containers, secondary containment, flammability/explosive risk, incompatibilities, and individual chemical requirements such as temperature and moisture;
- designs and details that address areas where combustible dust management will be required (if applicable); and
- electrical drawings, including power generation, power transmission lines, and location of substations. Electrical equipment must be approved for use in Canada as defined by CSA Standard M421.

8.2.2 Letters of Assurance

Prior to building occupancy, submit to the Chief Inspector of Mines schedules as per the "Letters of Assurance" section of the B.C. Building Code[92] that are prepared, sealed, and signed by qualified professionals. In addition, provide the following:

- confirmation of compliance with the B.C Building Code and BC Fire Code[93] for non-permanent infrastructure; and
- buried services drawings.

Prior to the introduction of electricity at the mine site and use of the electrical distribution system, submit to the Chief Inspector of Mines a letter of assurance from a Professional Engineer ensuring that as-built installations comply with the Canadian Electrical Code and CSA Standard M421-16, as described by Sections 5.1 and 5.2 of the Code.

Ensure that the permit application considers these compliance requirements accordingly in the designs of project infrastructure at the permit application phase.

8.2.3 Occupational Health Programs

Provide programs, plans, and procedures related to occupational health prior to the start of activities occurring under the permit. These include, but are not limited to: Workplace Monitoring Program, Medical Surveillance Program, Hearing Conservation Program, Respiratory Protection Program, and Musculoskeletal Disorder Prevention Training Program. Information provided in other sections of the application will be used to inform the development of these programs.

Ensure these programs are prepared by a qualified professional in occupational hygiene (e.g., CIH, ROH, or person with equivalent experience acceptable to the Chief Inspector).

8.2.4 Workplace Hazardous Materials Information System (WHMIS)

Submit documentation demonstrating how WHMIS requirements in the Code will be met prior to activities involving the use, storage, and handling of hazardous products conducted under the permit. Include procedures for the safe use, storage, handling, and disposal of a hazardous product, prepared by persons qualified to do so based on the person's knowledge, training, and experience.

8.2.5 Additional Information and Certifications

Provide the following additional information and/or certifications post-permitting and prior to use, commissioning, or commencement of the following as applicable:

[92] http://www.bccodes.ca/building-code.html
[93] http://www.bccodes.ca/fire-code.html

- documentation of commissioning and load testing of any cranes to be installed for the project prior to these devices being put into service;
- approval for boilers and elevators from the Chief Inspector of Mines prior to installation and commissioning of these devices;
- certification of pressure vessels[94] as per the Boiler and Pressure Vessels Act and CSA B-51;
- details of any underground mine air heaters and details of the required safety devices that will be installed with these heaters; and
- details of carbon monoxide monitoring, shutdown, and alarm devices that will be installed on any compressors delivering compressed air to the underground workings

[94] https://pveng.com/home/canadian-registration-number-crn/

9 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 be 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 that 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 and drawings. 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 and revised plans are to be developed based on feedback provided. They will be required to be reviewed and revised regularly throughout life of mine (or other period 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-Response Plans (TRP) ensure the implementation of planned contingency measures in the event that identified environmental conditions (triggers) occur. They are not considered adaptive management. A description of Adaptive Management Plans and TRPs are provided in the IDZ Guidance[95].

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.

[95] 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

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;
- the nature and timing of the assessment and analysis (e.g., water quality model, site-wide water balance, groundwater model, etc.) that will be done 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.

9.1 Environmental Management System

Provide a brief 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.

9.2 Surface Erosion Prevention and Sediment Control Plan

Provide conceptual methods for prevention of erosion and sediment discharge during all phases of mine life (construction, operation, closure, and post-closure). A more detailed, site-specific, stand-alone plan will need to be submitted to the Chief Inspector prior to the commencement of construction activities.

Include the following specific areas:

- the mine site (plant sites, pits, waste dumps, TSFs, etc.);
- all access roads; and
- any utility corridors.

Provide:

- information on roles, responsibilities, and training requirements;
- an assessment of erosion potential (i.e., risk) and consequence;
- 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 prescriptions will be applied;
- erosion control/sediment control plans for disturbed surfaces and soil stockpiles;
- a detailed event-based effectiveness monitoring program including locations and frequencies; and
- a response plan including specific triggers, actions to be taken, and reporting protocols.

Address the potential for sediment release from internal sloped structures such as waste rock dumps and any segments of pit walls through the Water Management Plan.

For further guidance on developing sediment and erosion control plans, consult Technical Guidance 3 – *Environmental Management Act*: Developing a Mining Erosion and Sediment Control Plan[96].

9.3 Soil Management Plan

The Soil Management Plan will direct implementation of best management practices during soil salvage, stockpiling, and application operations, and guide salvage monitoring and stockpile maintenance provisions, training, supervision, and QA/QC.

Include the soil salvage and stockpiling approaches that will be utilized on a site-specific basis. Describe in detail the soil handling practices for all activities related to salvage, stockpiling, and application in reclamation, based on information collected in accordance with baseline data. Provide a map showing soil ratings and proposed salvage depths.

Include the following information related to soil salvage:

- descriptions, including relative physical and chemical suitability, of soils (or suitable overburden) to be salvaged;
- identification of materials or layers to be stripped separately and how to operationally distinguish them;
- total depth to be salvaged and anticipated volumes of each soil type;
- equipment to be used and constraints (e.g., slopes, etc.) on stripping;
- erosion control and sediment retention measures required for exposed surfaces; and
- proposed training or supervision of operators by a qualified professional.

Include the following information related to soil storage/stockpiling:

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

- 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; and
- descriptions of stockpile protection activities that will be implemented during the storage period.

For further guidance on developing sediment and erosion control plans, consult Technical Guidance 3 – *Environmental Management Act*: Developing a Mining Erosion and Sediment Control Plan[97].

9.4 Construction Environmental Management Plan

It is understood that construction may not be a discrete activity that happens once throughout mine life. Over the life of mine, a separate Construction Environmental Management Plan (CEMP) may need to be developed for each independent construction project on the mine footprint to ensure the plans are site specific and executable on the ground.

The CEMP should describe:

- the project schedule;
- a plan for the co-ordination and management of the construction workforce; and
- proposed phases of the project, including site preparation and construction.

At a minimum, address the following, tailored to the construction activities/locations proposed:

- vegetation management, including buffer setbacks, rare and sensitive plant protection, seed/plant material collection, and invasive plant prevention;
- drainage control and water management;
- soil management, including salvage and stockpiling procedures for soil and large woody debris;
- site-specific erosion and sediment control;
- wildlife protection, such as timing windows, wildlife-human interaction management, and pre-construction surveys;
- a fuel management and spill response strategy;
- event-based effectiveness monitoring for all of the above; and
- reporting.

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

9.5 ML/ARD Management Plan

Provide day-to-day operational management and handling procedures for materials based on the integration of the ML/ARD geochemistry (Section 2.4) and water quality baseline studies (Section 2.7) with the scheduling and sequencing defined in the Mine Plan (Section 3).

Describe the material characteristics and operational characterization methods with reference to the relevant regulatory requirements, proposed handling and storage plan, proposed monitoring plan, and contingency plans for all materials produced or exposed during mining activities, which may include, but is not limited to, the following:

- waste rock;
- tailings;
- ore;
- coal and coal waste;
- pit walls;
- underground workings;
- quarry and borrow material;
- construction material;
- overburden and soil;
- water treatment plant secondary wastes and spent substrates; and
- any other relevant materials.

Describe aspects of the plan, including but not limited to, the following:

- the management purpose and objectives;
- a site setting section that includes the location, climate, and geology of the project and provides references to documents where additional detail can be found;
- definitions and classification criteria for potentially metal-leaching and acid-generating materials;
- a site map clearly indicating storage facilities and stockpiles for all materials;
- a summary table of capacities for each storage facility and/or stockpile, dates active, and timeline for reclamation;
- a flow chart or conceptual diagram that illustrates the material processing and/or movement (e.g., hauling) of materials on site;
- a detailed monitoring program that includes sampling frequencies, precise sampling locations, and analysis for each material type;
- detail sampling and analysis procedures or SOPs, including QA/QC programs;
- data management protocols and reporting requirements;
- roles and responsibilities associated with the plan, including persons accountable, connections to other departments, and process for change management;
- relationship to other management plans and documents;
- a clear presentation of contingency plans and relevant TRPs; and
- any other relevant information.

9.6 Mine Site Water Management Plan

Provide the operational management and monitoring procedures for each phase of mine life, as well as contingency measures, for the effective interception, conveyance, diversion, storage, and discharge of water (contact and non-contact) on the mine site.

Develop the plan based on the integration of meteorology and climate studies (Section 2.2), water quantity (Section 2.6) and quality (Section 2.7) baseline studies, the site-wide water balance model (Section 5.3), surface water quality model (Section 5.4), numerical groundwater model (Section 5.5), treatment requirements (Section 5.6), discharge requirements (Section 5.8), and the mine plan (Section 3).

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

- objectives of the plan, and relationship to other management plans;
- mine site staff roles and responsibilities;
- regulatory requirements and relevant authorizations;
- site overview including environmental and climatic conditions;
- 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;
- the layout of all water management infrastructure;
- a description of sources, flow paths, storage facilities, and discharges for all surface water;
- figures that illustrate the site-wide water balance, including flow rates;
- risks and potential impacts of mining and waste discharges to water quality and quantity;
- monitoring locations for surface water and groundwater quality and quantity;
- monitoring program details including the rationale for each monitoring location, coordinates, frequencies, analyzed and/or measured parameters, SOPs, QA/QC program, and reporting details;
- integration of any 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;
- TRPs for upset conditions, and contingency plans for mitigating potential impacts related to failure of any component(s) of the plan;
- analysis of potential impacts if contingencies fail; and
- any other relevant information.

The plan should be developed based on the following detailed information:

- water balance for each relevant structure;
- site-wide water balance;
- tailings management and supernatant recovery systems (if required);

- geotechnical, hydrologic, hydrogeologic, and hydraulic stability assessments 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);
- preliminary designs of water and sediment control ponds as well as water diversion, interception, and conveyance structures (consistent with the geotechnical, hydrologic, hydrogeological, and hydraulic stability assessments, and based on relevant water balance information) in accordance with the technical guidance on Assessing the Design, Size, and Operation of Sediment Ponds Used in Mining[98];
- proposed water sources for the mine, detailing the watershed or source area boundary for the water intake (if surface water, include any springs and hydrologic assessments) and providing hydrogeologic information (location, capture zone, yield, water quality, groundwater source in relation to geological units, well construction details, etc.) for all groundwater sources to be utilized (including seepage);
- any relevant conditions in the permits from the regional health authority for the construction of wells and operation of the water system;
- design of the conveyance system for the water treatment plant;
- design of any groundwater seepage mitigation or interception structures (dewatering wells, underground drains, etc.); and,
- description of any flow augmentation measures that might be required during low-flow periods to compensate for any induced streamflow losses to groundwater.

The plan should also include a detailed summary of all surface water and groundwater monitoring that will occur within the mine site boundary and in the receiving environment for each phase of mine life. The plan should include the following information for both surface water and groundwater monitoring:

- objectives;
- monitoring methods;
- monitoring locations, including a detailed map showing each location;
- rationale for the distribution of monitoring locations (including depths, where relevant), and how they relate to the maintenance and improvement of the site-wide water balance model (Section 5.3), surface water quality model (Section 5.4), and groundwater model (Section 5.5);
- for groundwater, information must be provided on the range of monitoring depths that will be included for each individual monitoring location; and
- POCs[99] to be measured at each location;
- sampling frequency and period, including high-, medium-, and low-flow periods;
- analytical testing procedures to be used;

[98] 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

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

- QA/QC protocols;
- name of the certified laboratories used to analyze samples;
- comparisons to relevant guidelines and objectives;
- methods for data analyses;
- reporting schedule; and
- any other relevant information.

9.7 Discharge Management Plan

Provide operational plans for all discharges to surface water or groundwater. Include the following information:

- discharge limits (volumes and concentrations) that ensure no acute toxicity to aquatic organisms at the point of discharge and no chronic toxicity beyond the edge of the IDZ. Achieve this by back-calculating discharge concentration and volume limits using contaminant-specific WQGs, WQOs, or SBEBs as values in the mass balance model;
- ensure groundwater use downstream is not compromised and no chronic toxicity occurs in surface waters as surface water recharge occurs. Note: This information may form the basis for terms or conditions incorporated into the EMA effluent discharge permit;
- incorporation of the CSM (Section 5.2);
- describe emergency procedures for pollution control system malfunctions/upsets, and include contingency plans (e.g., contingency storage for water requiring treatment) for chemical and fuel storage areas; and
- propose effluent quality limits (or other appropriate limits) and trigger levels/conditions (as per the TRP[100]) that will trigger an action to address and mitigate unexpected or deteriorating effluent quality. This TRP should be in place to proactively ensure permit limits are being met and discharges are not negatively impacting the receiving environment.

9.8 Vegetation Management Plan

The objectives of the Vegetation Management Plan are to ensure that disturbance is limited to permitted boundaries and that effects of disturbance are mitigated in a timely manner.

Provide details on proposed activities for achieving the objectives, 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.

[100] 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

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. If prudent, develop a separate invasive plant management plan to highlight the key considerations for early identification and effective management of invasive plants to facilitate successful site reclamation.

9.9 Invasive Plant Management Plan

The objectives of the Invasive Plant Management Plan (IPMP) are to ensure that measures are implemented to prevent ingress of invasive plants to mine sites and that early detection systems are in place to ensure required management activities are conducted as soon as possible. Effective management of invasive plants is key for successful reclamation of mine disturbances.

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, erosion and sediment control plans, etc.

9.10 Wildlife Management Plan

The objective of the Wildlife Management Plan is to minimize impacts on wildlife in the project area, with particular reference to focal species of interest and species at risk.

Provide details on proposed activities for achieving the objective, 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 FLNR.

9.11 Archaeological Management and Impact Mitigation Plan

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
- protection of existing sites.

9.12 Mine Emergency Response Plan

The Code requires all mines in British Columbia to have a Mine Emergency Response Plan (MERP). Consider all phases of the mine's activity in the preparation of the MERP, including exploration, development, construction, operation, and reclamation. Adapt and update the MERP as required as it progresses through each phase. The Province has developed a MERP Guidelines document that suggests approaches for preparing, training, and organizing personnel for managing a mine emergency. In accordance with Section 10.4.2.1.e of the Code, integrate the TSF emergency preparedness and response plan into the MERP.

9.13 Mine Site Traffic Control Plan

Provide a general description of the Mine Site Traffic Control Plan, which should include information on the following:

- radio frequencies;
- maximum allowable speeds for the vehicles in use;
- rules for passing;
- "stop" and "yield" locations;
- priority rules for various vehicles;
- rules for night operation;
- maximum operating grades;
- emergency run-off protection;
- shoulder barriers;
- access roads to the mine site, including:
    - access restrictions,
    - load restrictions (if any),
    - radio frequencies to be used by local traffic, and
    - route maps showing key locations or turns for access roads to the mine site; and
- other relevant information, as required.

9.14 Fuel Management and Spill Control Plan

Outline the following:

- fuel handling and transportation;
- dispensing and storage facilities and related equipment; and
- procedures regarding fuel management and spill control to be followed at the mine site during construction and operation.

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

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

This is not intended to be an exhaustive list. For further guidance, refer to A Field Guide to Fuel Handling, Transportation and Storage[101].

Include an Emergency Response Plan in accordance with regulatory requirements, including a Spill Response Plan for 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). A number of guidance documents[102] [103] [104] [105] can be used to inform contingency plans.

9.15 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:

- include both surface and underground operations;
- the mining and processing methods being proposed;
- building designs required for dust management; and
- reference the best practises used to develop the plan.

[101] https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/oilandgas/fuel_handle_guide.pdf
[102] www2.gov.bc.ca/gov/content/environment/air-land-water/spills-environmental-emergencies/planning-prevention-response/industry-emergency-response-plans
[103] http://www.scc.ca/en/standardsdb/standards/18899
[104] http://www.bclaws.ca/civix/document/id/complete/statreg/263_90
[105] http://www.ec.gc.ca/lcpe-cepa/D6ADAD2D-2E02-4885-81AE-788168284720/guide-eng.pdf

9.16 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 (including toxic chemicals/substances) and 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 2.13.20 of the Code 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*[106] of the *EMA* for further information on hazardous materials.

9.17 Waste (Refuse and Emissions) Management Plan

Briefly 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;
- contaminated soil management:
  - provide plans to remediate or manage soils impacted by spills on the site[107];
  - provide detailed descriptions of any proposed pollution control and/or water management necessary during construction and operations to manage existing contamination;

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

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

- 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*[108].

[108] http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/375_96_00