EXECUTIVE SUMMARY

INTRODUCTION

Harper Creek Mining Corp. (HCMC; the proponent) is proposing to develop, construct, operate, close, decommission, and reclaim the proposed Harper Creek Project (the Project), located in British Columbia (BC). The Project has an estimated 28-year mine life based on a nominal ore throughput of 70,000 tonnes per day (tpd; 25 million tonnes per annum [tpa]).

The Project is located in the Thompson-Nicola area of BC, approximately 150 kilometres (km) northeast of Kamloops along the Southern Yellowhead Highway (Highway 5), and approximately 10 km southwest of the unincorporated municipality of Vavenby, BC (Figure 1 and 2). The Project is also located in the asserted traditional territory of the Shuswap Nation.

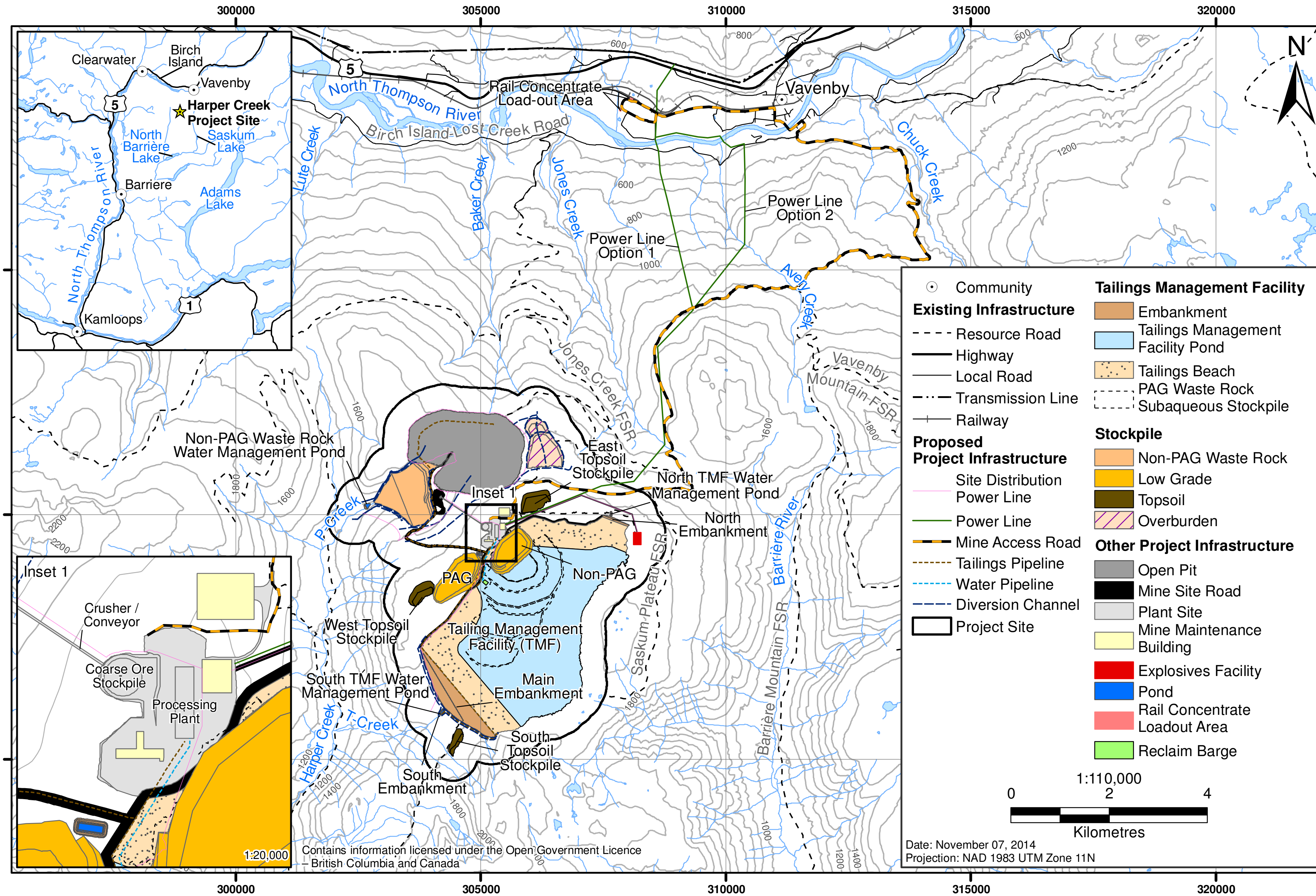
The Project Site has a footprint that covers an area of 1,939 ha at an elevation of approximately 1,800 meters above sea level (masl). The Project Site has been confirmed as non-fish bearing. The Project Site has been subject to many anthropogenic disturbances for decades, including fragmentation by Forest Service Roads (FSRs), extensive logging and active ranching.

The Project consists of an open pit mine, on-site ore processing facilities, a tailings management facility (for tailings solids storage, subaqueous storage of potentially acid-generating (PAG) waste rock, and recycling of water for processing), waste rock stockpiles, low-grade ore (LGO) and overburden stockpiles, a temporary construction camp, ancillary facilities, mine haul roads, sewage and waste management facilities, a 24-km access road between the Project Site and a rail load-out facility located on private land owned by HCMC in Vavenby, and a 14-km power line connecting the Project Site to the BC Hydro transmission line corridor in Vavenby. Ore will be processed on site through a conventional crushing, grinding, and flotation process to produce a copper concentrate, with gold and silver by-products. The concentrate will be transported via the existing Canadian National Railway network to the existing Vancouver Wharves storage, handling, and loading facilities located at Port Metro Vancouver for shipment to overseas smelters. The Project infrastructure is shown in Figure 2.

HCMC has used the environmental assessment (EA) process as a means to undertake a series of design changes to minimize the potential adverse effects of the Project and maximize the potential benefits. These design changes are more fully described below, and include optimization of the mine site footprint and general arrangement of the Project to reduce the spatial extent of the Project, re-design of the open pit to avoid wetland areas near the open pit, changing the water management strategy to achieve no discharge from the open pit to Baker Creek and to avoid the need for water treatment, relocation of waste rock and low grade stockpiles to reduce potential groundwater seepage, and relocation of PAG waste rock to the lower end of the tailings management facility to ensure it becomes subaqueous within one year, thereby reducing oxidation potential.

Figure 1
Harper Creek Project Location

Figure 2
Project Infrastructure (Year 23)



This Application for an Environmental Assessment Certificate / Environmental Impact Statement (Application/EIS) is intended to demonstrate that the Project will be undertaken in an environmentally acceptable manner that will provide social and economic benefits. The Project will promote economic prosperity throughout BC, particularly in the Thompson-Nicola area of BC. The Project will provide employment and commercial opportunities, while generating local, provincial, and federal tax revenues. The Project can be implemented without lasting adverse local or regional environmental or economic effects, and without undermining family or community well-being, public health or established and asserted Aboriginal rights and interests. Responsible mining practices, in compliance with the principles of sustainable development, will guide the implementation of the Project.

Purpose of Application / Environmental Impact Statement

This document constitutes an Application/EIS for the Project, to respectively meet provincial and federal EA requirements. As far as the provincial requirements are concerned, the Project triggers an EA under the BC *Environmental Assessment Act* (BC EAA; 2002a), since production capacity will exceed 75,000 tpa of mineral ore. As far as federal EA requirements are concerned, the Project was initiated in 2011 under the *Canadian Environmental Assessment Act* (CEAA; 1992) as a comprehensive study. On July 6, 2012, the CEAA 1992 was repealed and replaced by the *Canadian Environmental Assessment Act, 2012* (CEAA 2012; 2012). However, because the Project was subject to a comprehensive study under the former CEAA (1992; i.e., before the coming into force of CEAA 2012), it will continue to be assessed as if the former Act had not been repealed, in accordance with the Establishing Timelines for Comprehensive Studies Regulations (SOR/2011-139) of 2011 and the transitional provisions of CEAA 2012.

Organization of Application / Environmental Impact Statement

The Application/EIS is organized into parts and chapters in accordance with the Project Application Information Requirements (AIR; BC EAO 2011) for the Project as follows.

- **Front Matter:** This portion of the Application/EIS comprises the Preface, Acknowledgements, the Executive Summary, the Table of Contents, a list of Acronyms and Abbreviations, the Glossary, and the Table of Concordance.
- **Part A: Introduction and Background:** Chapters 1 through 8 provide an overview of the Project, the EA process, the nature and of scope of consultation activities, the description of the Project design and alternatives, characterization of geochemistry in the Project area, a description of closure and reclamation, and the effects assessment methodology.
- **Part B: Biophysical Environment Effects Assessments:** Chapters 9 through 16 provide effects assessments of the subject areas of air quality, noise, groundwater, hydrology, surface water quality, fish and aquatic resources, terrestrial ecosystems, and wildlife.
- **Part C: Human Environment Effects Assessment**: Chapters 17 through 22 provide assessments of human environment effects on the subject areas of socio-economics, commercial and non-commercial land use, visual quality, heritage, human health, and current use of lands and resources for traditional purposes.

- **Part D: Aboriginal Rights and Interests:** Chapter 23 assesses the effects of the Project on Aboriginal rights and related interests.
- **Part E: Environmental Management Plans and Reporting:** Chapter 24 outlines the proponent's initial Environmental Management System and Environmental Management Plans (EMPs) for 18 subject areas.
- **Part G: Federal Requirements:** Chapters 25 through 27 outline the federal requirements under CEAA 1992, including the potential effects of the Project on the capacity of renewable resources, potential environmental effects of accidents and malfunctions, and potential effects of the environment on the Project.
- **Part H: Summary and Conclusions:** Chapter 28 summarizes the residual Project-related and cumulative biophysical or human environmental effects, provides a Table of Conditions, and provides a conclusion.

Appendices are provided to support the main text of the Application/EIS, and referenced throughout the text as required.

PROJECT BACKGROUND AND OVERVIEW

The Proponent

HCMC is the proponent of the Project. HCMC is a wholly owned subsidiary of Yellowhead Mining Inc. (YMI). YMI was formed in 2005 as a private BC company specifically to acquire, explore, and, if feasible, develop the Harper Creek deposit. YMI is publicly traded on the Toronto Stock Exchange (TSX) in Canada. HCMC is planning to develop, manage, and operate the Project.

HCMC operates under the direction of Frank D. Wheatley, LL.B., B.Comm, as Chief Executive Officer. Communications regarding this Application/EIS should be directed to:

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Purpose of the Project

The purpose of the Project is to undertake sustainable mineral exploration and extraction activities in alignment with the objectives of responsible resource development, as outlined in the Government of Canada's *Economic Action Plan 2012* (Government of Canada 2012b), and to foster economic growth and prosperity in BC as outlined in *British Columbia's Mineral Exploration and Mining Strategy* (BC MEM 2012) and in the *BC Jobs Plan* (Government of British Columbia 2012a).

The "need for and purpose" of the project is defined by the Canadian Environmental Assessment Agency as the problem or opportunity that the proposed project is intending to solve or satisfy and what is to be achieved by carrying out the project. From the perspective of HCMC, the Project will meet a three-fold need, as follows:

- Help meet the current and forecasted demand for copper, gold, and silver
- Provide employment and business opportunities in an area of British Columbia that is adjusting from the collapse of the local forestry sector
- Provide important income to governments through taxes and royalties.

Copper is a primary metal used in many industrial and consumer applications worldwide and the demand for copper continues to grow. Global economic development from rapidly developing nations where economic growth is at a high level, such as China and India, is the primary factor that creates demand for copper. Between 2013 and 2016, global copper consumption has been forecasted to grow on average by 5% each year (US Global Investors 2012). The Project will help meet the current and forecasted demand for copper. Additionally, new gold and silver mine production in recent years has only replaced that of closed mines and future production is expected to be flat or declining. With the increasing difficulty in finding new deposits, increased costs of mine production, and the long lead times required to develop new mines, the gold and silver from the Project will help meet the current and forecasted demand.

In addition to meeting the current and forecasted demands for copper, gold, and silver, HCMC anticipates that the Project will bring training, employment opportunities, and increased investment in services to the local population and all of British Columbia. On a national level, the Project is timely given current copper, gold, and silver prices. Development of the Project will contribute to Canada's role as a producer of copper, gold and silver in the world economy. This purpose is consistent with the Government of Canada's overall strategy of encouraging private corporations to generate national export commodities and tax revenues from natural resource development.

Section 1.9 of the Application will discuss in greater detail the anticipated benefits of the Project including employment opportunities, government revenues, and contribution to community developments.

Project Benefits

In accordance with federal and provincial government priorities, developments such as the Project in question will support economic development opportunities while contributing to local, provincial, and national economies, as well as create long-term employment opportunities locally, regionally, and beyond. The construction of the Project is expected to directly and significantly impact BC, whereas regional impacts will be mostly felt in the North Thompson-Nicola region of BC.

To fully assess possible direct, indirect, and induced economic benefits of the Project, an economic impact model, the BC Input-Output Model, developed and maintained by BC Stats, was used. The estimated initial capital cost of this Project, including Provincial Sales Tax and bonding, is $1,025.8 million (Q1 2014, +15/-5%), including a contingency amount of $90.7 million. The total life of mine (LOM) operating cost for the Project is estimated at $8.18/t milled (+15/- 5%). The estimate includes mining, process, general and administrative costs, and site services. The unit costs are based on an annual ore production rate of 25,550,000 tpa (or 70,000 tpd), and operation of 365 d/a.

During Operations, the total Project spending is predicted at $5,829.7 million. Direct Project activities are expected to contribute $1,152.4 million to BC's GDP; an additional $2,465.2 million in BC's GDP and $1,269.9 million to GDP across Canada are expected to result from indirect and induced activities. Tax revenue derived from direct activities during the Operations phase is estimated at $435.4 million; Project-related indirect and induced activities are further expected to contribute $407.6 million.

The environmental assessment (EA) process for the Project involves a continuous exchange of information between HCMC, government agencies, Aboriginal groups and public stakeholders. This process contributes to improvements in the Project plan and design, including the selected mitigation measures to avoid, and/or minimize potential adverse effects of the Project. As a result of the EA process, the Project is not based solely on engineering or economic determinants, but rather on a balanced approach that includes environmental considerations and guides the sustainable development of the Project. A summary of the benefits of the EA process to Canadians is presented in Table 1.

Table 1. Summary of Benefits to Canadians from the EA Process

Category	Benefit
Prevention or Reduction of Environmental Effects	Project components locations and configurations are sited and designed to minimize overall potential effects on vegetation, wildlife, fish and fish habitat. For example, the TMF is located at the head of T-Creek and is not located in fish-bearing waterbodies, minimizing potential adverse effects on fish and fish habitat. Footprints of key Project components were consolidated and reduced to minimize effects, for example constructing a compacted overburden liner beneath the PAG LGO stockpile to reduce seepage and re-locating waste rock and low grade ore stockpiles to avoid discharge to Baker Creek. Additionally, the water management strategy for the Project was revised to avoid the need for water treatment.
	A Fish Habitat Offsetting Plan will be developed to create no net loss to fish habitat. As part of the offsetting plan, follow-up monitoring and reporting will be completed to assess and report on the predicted effectiveness of the habitat offsetting activities.
	The Project reuses previously disturbed areas to the extent possible and the infrastructure layout was planned in a manner that prevented or reduced impacts to the environment.
	The overall mine site layout for the Project was designed to be a compact mine site with the smallest footprint possible, to minimize overall environmental effects.

(continued)

Table 1. Summary of Benefits to Canadians from the EA Process (completed)

Category	Benefit
Maximized Environmental Benefits	The objectives of the Fish Habitat Offsetting Plan are to create an overall increase in the productive capacity of bull trout and coho salmon in the Harper Creek and Lion Creek watersheds.
	The objective of the closure and reclamation plan is to minimize any potential long-term environmental effects and to return all areas disturbed by the Project to a productive and acceptable land use. The detailed closure and reclamation plan (to be developed during *Mines Act* permitting) will include reclamation activities to create wetland areas near the reclaimed topsoil stockpiles, TMF and potentially other facility footprints.
Protection of Aboriginal Interests	HCMC engaged Simpcw Resources Limited to coordinate and lead the archaeological impact assessment of the Project site footprint to inform the Application/EIS. As well, HCMC provided the Simpcw First Nation with resources to conduct a traditional use study. Traditional knowledge (TK) from these activities was incorporated into the EA process to identify potential impacts on Aboriginal interests and to inform mitigation and accommodation measures.
Increases in Scientific Knowledge	Baseline field studies, monitoring and other scientific programs were carried out for the EA process related to fisheries, vegetation, wildlife, climate, water quality and other valued components (VCs). Aboriginal groups were involved in the collection of baseline information and field studies to support the incorporation of TK in the EA process. A traditional land use study for the Simpcw First Nation was also done to identify potential effects of the Project on Aboriginal interests.
Increase in Community and Social Benefits	The Project has provided employment opportunities for local residents and First Nation members for work relating to baseline studies and exploration of the Project site.
	A direct benefit of the Project to local communities is the projected employment that is generated by principal and ancillary activities. A total of up to 600 construction jobs and 450 permanent jobs will be created by the Project.
	The Project will increase federal, provincial and local governments' taxes and revenues through a combination of direct, indirect and induced effects. Approximately $116 million in taxes will be generated during construction and approximately $435 million in taxes during operations will be generated by the Project.
	HCMC's consultations with the Clearwater Sno-drifters Club and other recreational users in the area of the Project identified measures to address potential access management issues, including the potential development of two pullout or parking areas along the Vavenby Forest Service Road (FSR).

Project Location, Access, and History

The Project is located on provincial Crown land in the Regional District of Thompson-Nicola (Electoral Areas A, B, P, and O) of BC, approximately 150 km northeast of Kamloops along Highway 5, approximately 10 km southwest of the unincorporated municipality of Vavenby, BC (Figure 1). The Project is located within NTS map sheets 82M/5 and 82M/12, is geographically centred at 51°30′N latitude and 119°48′W longitude, and is situated at approximately 1,800 metres above sea level (masl).

Access to the Project Site from Highway 5 is via the Vavenby Bridge Road through Vavenby and across the North Thompson River to Birch Island Lost Creek Road (BILCR). From there, access to the site is along an existing 18.5-km network of existing FSRs.

The Harper Creek property area, and surrounding areas, has been the subject of exploration activities since 1966, when copper mineralization was discovered at the headwaters of Baker Creek and Harper Creek, after which claims were staked by two independent companies. These two companies formed a joint venture in 1970, and continued exploration work until 1974. The Property remained largely inactive of exploration activities until 2006, although the claims were the subject of a range of transactions in 1986, 1991, and 1996.

YMI obtained control of the claims in 2005 through a combination of claim staking, and purchase and option agreements, and began new exploration activities in 2006.

Regional Area

The surficial geology and landforms within the area affected by the proposed Project are predominantly the result of previous glaciations, namely the rounded nature of the mountain slopes and the presence of glacial till. Glacial lakes developed locally as the ice retreated, resulting in deposits of clay and fine sand accumulating in the lakes. Coarser beach deposits, comprising gravelly sands, accumulated along the shorelines. Glacial deposits have been eroded by the North Thompson River, resulting in the formation of glaciofluvial terraces, and colluvium has developed locally on the steeper side slopes of the valley as a result of soil creep and landslides.

A blanket of glacial till overlies much of the bedrock in the Project Site, while a surface veneer of colluvium is generally present in the areas of steeper terrain. Surficial soils locally comprise organic soils and silt-rich glacial lake deposits, which are particularly prone to erosion. Glaciofluvial outwash deposits and the fluvial terrace of the North Thompson River valley occur in the areas of the proposed power line and rail load-out facility respectively.

Geohazards mapped within the study area include debris slides, debris flows, debris slumps, rockfall, slumping in bedrock, and snow avalanche. A probabilistic seismicity assessment for the Project was carried out in 2012, as a required informant into the design parameters for the TMF and other Project geotechnical structures. The seismicity assessment points towards the Project being at low risk of a damaging seismic event.

Commercial land use in the region has largely focused on resource development, including forestry, agriculture, and mining. Other commercial land uses in the region include ranching and trapping. Public or non-commercial use includes hunting, hiking, snowmobiling, all-terrain vehicle riding, boating, and skiing.

Project Mineral Tenure

The mineral claims that comprise the Project consist of the 97 cell claims and 34 legacy claims which together cover a total area of 42,636.48 ha. HCMC owns 100% of all mineral claims and all claims are valid to November 3, 2024, at which time they will require renewal.

YMI obtained control of the mineral claims through a series of claim staking, purchase and option agreements in 2005. In the same year YMI located the historical core from earlier drilling campaigns from which selected holes were logged and sampled with the goal of verifying the historical analytical copper results. In 2006, YMI undertook the first phase of field exploration on the mineral claims, and in November 2010, all mineral claims were transferred to HCMC, a wholly owned subsidiary of YMI.

Project Schedule

The Project will have a 2-year Construction phase and a 28 year mine life. Below is a brief outline of each phase of the Project:

- Construction phase (2 years, including pre-construction and Construction activities up to commencement of operations);
- Operations 1 phase (23 years, including active mining in the open pit from Year 1 through to Year 23);
- Operations 2 phase (5 years of LGO processing will occur from the end of active mining through to the end of Year 28);
- Closure phase (7 years; active closure and reclamation activities while the open pit and TMF are filling); and
- Post-Closure phase (50 years; steady-state long-term closure conditions following active closure, with ongoing monitoring).

The proposed development schedule for the Construction phase of the Project is shown in Table 2 below.

Table 2. Harper Creek Project Development Schedule

Key Project Milestone	Milestone Date
Detailed Engineering Starts	Third Quarter 2015
Mines Act permit issued: Project released for construction	First Quarter 2016
Start construction	Second Quarter 2016
Mills delivered	Third Quarter 2017
BC Hydro provided power	Second Quarter 2018
Mechanical completion	Second Quarter 2018

ASSESSMENT PROCESS

Provincial and Federal Environmental Assessment Requirements

Proposed mine projects that meet a certain annual or daily throughput threshold must undergo an EA in accordance with provincial and federal legislation. Provincial assessments for metal mines are triggered at a throughput of 75,000 tpa of mineral ore; federal assessments for metal mines at a throughput of 3,000 tpd. The Project exceeds both thresholds.

The Project is subject to a coordinated provincial-federal EA process conducted under the principles of the now-expired Canada–British Columbia Agreement for Environmental Assessment Cooperation (the Agreement; CEA Agency 2014). The Agreement aligns key aspects of the assessment process to minimize duplication and improve efficiency (e.g., conducting joint public comment periods, coordinating Aboriginal consultation, using common documents that meet the requirements of both governments, and establishing common working groups to facilitate the review process).

Federal Environmental Assessment Process

The federal EA process for the Project was initiated in 2011, under the former *Canadian Environmental Assessment Act* (1992; amended in July 2010 by the *Jobs and Economic Growth Act* [2010]), as a comprehensive study. The federal EA process began in 2011 when HCMC submitted the revised Project Description to the Canadian Environmental Assessment Agency (CEA Agency). The CEA Agency determined that the Project, as described by the proponent, is subject to a comprehensive study pursuant to section 16(a) of the Comprehensive Study List Regulations (SOR/94-638) since the Project will involve the "[…] proposed construction, decommissioning, or abandonment of a metal mine, other than a gold mine, with an ore production capacity of 3,000 tpd or more." On April 14, 2011, the CEA Agency issued the Notice of Commencement (NoC), which stated that a federal EA is required. The NoC initiated the beginning of a 365-day government timeline limit for the EA.

Under the *Jobs and Economic Growth Act* (2010) amendments to CEAA (1992), two timelines were introduced for the federal EA process and prescribed in the Establishing Timelines for Comprehensive Studies Regulations (SOR/2011-139). This regulation requires the federal government to decide whether a comprehensive study is required within 90 calendar days of receiving a Project Description and legislates 365 calendar days for the government to complete the EA process, from the NoC to the posting of the Comprehensive Study Report (CSR) for public comment. For the proposed Harper Creek Project, the NoC for the Project was posted on April 27, 2011, and since then 51 days of government time have elapsed, with 314 days remaining.

A Background Information scoping document was posted to the Canadian Environmental Assessment Registry on April 28, 2011. The Background Information document identifies the scope of the assessment, factors to be considered, and information related to public participation and Aboriginal consultation to be included in the EIS. The Background Information document also provides the public with an opportunity to comment on the conduct of the comprehensive study. A federal public comment period on the Background Information was held between April 28 and May 30, 2011 to seek comments from the public on the Project and its potential environmental effects, to ensure that relevant issues were identified for consideration in the EIS.

Like the provincial process, the CEA Agency prepares a report (CSR), which summarizes the key findings, mitigation, and consultation issues related to the EA process for the Project. The CSR is subject to a third and final public comment period prior to being submitted to the federal Minister of the Environment for their review and decision.

After taking into consideration the EIS, public comments, and the adequacy of consultation activities conducted with Aboriginal groups by the CEA Agency, the Minister of the Environment is required to issue an EA Decision Statement under section 23(1) of CEAA (1992) for the Project. If the Project is approved, the Minister will issue an EA Decision Statement that describes the mitigation and follow-up conditions that the proponent must comply with. The Minister will then refer the project back to the responsible authorities to take their course of action decisions under section 37 of CEAA (1992).

Provincial Environmental Assessment Process

The provincial EA process, under the BC EAA, has two stages: the pre-Application and Application review stages. Although HCMC has been collecting environmental data and completing environmental studies since 2006, the pre-Application stage formally began in September 2008, with the submission of a Project Description by HCMC to the British Columbia Environmental Assessment Office (BC EAO), and the BC EAO issued an order under section 10 of the BC EAA on September 8, 2008. The Order confirmed that "the proposed Project constitutes a reviewable project pursuant to Part 3 of the Reviewable Projects Regulation (BC Reg 370/2002), since the proposed project is a new mine facility that, during operations, will have a production capacity greater than 75,000 tonnes per year of mineral ore". A section 11 Order was subsequently issued by the BC EAO on September 11, 2009, which established (per Schedule A of the Order) the scope, procedures and methods for the EA of the proposed Project. The BC EAO issued a section 13 Order on October 15, 2012, which amended the original section 11 Order.

HCMC prepared a draft AIR for the Project, which outlined the information that must be included in the Application, including the methods to be used to conduct the effects assessment. The BC EAO held a public comment period on the draft AIR between May 31 until June 30, 2011, and also sought comments from the technical working group established by the BC EAO to participate in the EA process. HCMC revised the AIR to incorporate the public and working group comments and the BC EAO issued the AIR on October 21, 2011.

The formal submission of the Application/EIS will trigger a 30-day screening period, during which the BC EAO (with feedback from the EA Working Group) will determine whether the submission meets the requirements outlined in the AIR. If the Application/EIS is determined to be sufficient, it will enter the Application review stage, comprising a 180-day review, which will involve the EA Working Group, Aboriginal groups, local government, and the public. These groups will have opportunities to provide comments on the Application/EIS; HCMC is required to track and respond to all of the comments.

During the Application review stage, the BC EAO will prepare an Assessment Report, which summarizes the results of the assessment. At the end of the Application review stage, the BC EAO will refer this report, and its recommendation and the draft EA certificate (which includes a Certified Project Description and conditions that must be met by HCMC if a certificate is issued), to the Minister of the Environment and the Minister of Energy and Mines. The Ministers' decision will be made within 45 days of a referral and is posted to the BC EAO's e-PIC website, along with the corresponding EA Certificate. If issued, the EA Certificate is a legally binding document granting conditional approval for the Project to proceed.

INFORMATION DISTRIBUTION AND CONSULTATION

Aboriginal Information Distribution and Consultation

The BC EAO established the Harper Creek Project Working Group (EA Working Group) in 2011 and invited representatives of First Nations listed in the section 11 Order, the Simpcw First Nation (SFN) and the Adams Lake Indian Band (ALIB) to be members. In October 2012, the BC EAO issued a section 13 Order inviting the Little Shuswap Lake Indian Band (LSLIB) and the Neskonlith Indian Band (NIB) to join the EA Working Group. In accordance with the BC EAO's section 11 and 13 Orders for the Project YMI is required to consult with the SFN, the ALIB, the NIB and the LSLIB. The section 13 Order specifies that the BC EAO will consult with Tk'emlups Indian Band with respect to potential effects on their Aboriginal interests arising from downstream effects. Guided by current federal policy under the CEA Agency, YMI has also informed Métis Nation BC (MNBC) about the Project and requested information about potential Project interactions with Métis rights and interests.

In October 2014, YMI provided copies of pre-Application consultation reports to SFN, ALIB, NIB, LSLIB and MNBC. Each report was tailored to YMI's consultation activities specific to that group. Each group had the opportunity to review and comment on their respective report.

HCMC has been tracking consultations with Aboriginal groups and the issues that have been raised during these consultations. Issues raised to date by Aboriginal groups include Aboriginal rights and title, air quality and noise, employment, training and economic opportunities, EMPs, land use, archaeology and heritage, consultation, cumulative effects, wildlife and wildlife habitat, traditional knowledge and use, and water quality and aquatic resources. These issues have been identified in Chapter 3 of the Application and in the Aboriginal Consultation Reports circulated to Aboriginal groups and MNBC for comment, prior to submission of the Application/EIS, where HCMC has identified how these issues have been considered and addressed in the Application/EIS.

HCMC will continue to consult with Aboriginal groups during the Application review stage, according to the Aboriginal Consultation Plan. HCMC will provide Aboriginal groups and MNBC with copies of the Application/EIS and written responses to their comments, and will attend the EA Working Group meetings to address questions and present Project information. HCMC will notify Aboriginal groups and MNBC about the public comment period on the Application/EIS. Comments from Aboriginal groups and MNBC, HCMC's responses to the comments, and consultations undertaken with Aboriginal groups and MNBC on the Application/EIS, will be summarized in a forthcoming Aboriginal Consultation Report.

Government Agency and Local Government Information Distribution

YMI's consultations with government agencies began in October 2007; it has consulted with government agencies primarily through the EA Working Group. However, HCMC has also met and corresponded regularly with provincial and federal regulatory agencies. Comments from agencies and HCMC's responses to the comments are summarized in the Application/EIS. Many provincial and federal agencies provided comments on the draft AIR, and the AIR was revised to address the comments.

Issues raised to date by government agencies include access and transportation, closure and reclamation, consultation, EA methodology, EMPs, fish and fish habitat, human health and country foods, hydrology, infrastructure and services, Project design, tailings management, terrestrial ecosystems and vegetation, traditional knowledge and use, water quality and aquatic resources, and wildlife and wildlife habitat. These issues have since been addressed.

HCMC will continue to consult with government agencies during the Application/EIS review stage, including providing the EA Working Group with copies of the Application/EIS, providing written responses to agency comments, and attending EA Working Group meetings to address questions and present Project information.

Public and Stakeholder Information Distribution and Consultation

HCMC has consulted with the public, including local governments, tenure holders, and stakeholders since September 2010, in accordance with its Public Consultation Plan. HCMC also notified local governments about the opportunities for public participation and provided posters to local government offices for posting in the communities where the open houses were being held. Communications with the public are documented and summarized in the Application/EIS, as are the issues raised by local governments, tenure holders, stakeholders, and the public, along with HCMC's responses to these issues. Comments received during the public comment period on the draft AIR, as well as issues and questions raised during the open houses, are also included in the Application/EIS.

The main issues raised by the public to date include access and transportation, closure and reclamation, employment, training, and economic opportunities, fish and fish habitat, hydrology, infrastructure and services, land use, Project design, socio-economic, terrestrial ecosystems and vegetation, visual quality, water quality and aquatic resources, and wildlife and wildlife habitat.

HCMC has provided two annual scholarships to Barriere and Clearwater High Schools since 2011; in 2014, it commenced two scholarships to Chase High School for post-secondary education in trades and environmental studies.

HCMC will continue to consult with the public during the Application/EIS review stage, as outlined in the Public Consultation Plan. The Application/EIS will be available on the BC EAO's website, and HCMC will advertise future open houses and the public comment period for the review of the Application/EIS.

PROJECT DESIGN AND ALTERNATIVES ASSESSMENT

Alternative Means of Undertaking the Project

Chapter 4 of the Application/EIS describes the processes and criteria that HCMC and its consultants have used to evaluate alternative means of developing the Project and to identify the preferred alternatives for the Project. It describes the main decisions that HCMC has made to construct and operate the Project in a manner that minimizes adverse environmental and socio-economic effects and maximizes beneficial effects.

Table 3 lists the major Project components and sub-components evaluated in the alternatives assessment based on the requirements outlined in the AIR. For each Project component, two or more options were identified. A screening assessment was completed to scope out unfeasible options based on technical and economic criteria. Where more than one feasible alternative was identified, further consideration was given to compare each alternative and evaluate how sensitive environmental and socio-economic receptors may be affected.

Table 3. Project Components Considered in the Alternative Means of Undertaking the Project

Project Component	Alternatives Considered	Selected Alternative	Rationale for Selection
Mining Method	Open pit Underground – block caving Combination of open pit and underground (block caving) mining	Open Pit	Only technically and economically feasible option
Tailings Management	Dry stack Paste tailing Conventional storage: TMF-1 Conventional storage: TMF-2 Conventional storage: TMF-3	Conventional storage: TMF-2	Dry stack and paste tailings are not technically feasible for the Project. Conventional sub-aqueous disposal of tailings in TMF-2 is the selected option because TMF-2 does not overprint fish habitat, and it has the smallest diverted catchment area.
Power Supply	Diesel generators LNG generator Power Line Option 1 – West Power Line Option 2 – East	Power Line Option 1 – West	Diesel and LNG generators are not economically feasible for the Project. The Power Line Option 1 is marginally preferred over Option 2 because of its marginally shorter and more direct routing.
Ore Processing – Ore Comminution	HPGR SAG	SAG	The SAG comminution method is the only technically feasible option due to Project ore properties.
Storage and Transportation of Copper Concentrate	Trucks Trucks and train	Trucks and Train	Trucks and train is the only economically feasible transportation method due to the cost of fuel.

(continued)

Table 3. Project Components Considered in the Alternative Means of Undertaking the Project (completed)

Project Component	Alternatives Considered	Selected Alternative	Rationale for Selection
Access Corridor	West then south. KP Road, Birch Island Bridge, BILCR, Jones Creek FSR East then south. McCorvie Road, Vavenby Bridge Road, Vavenby Bridge, BILCR, Vavenby Mountain FSR, Saskum Plateau FSR, Vavenby-Saskum FSR, and approximately 2.5 km of new road	East then south. McCorvie Road, Vavenby Bridge Road, Vavenby Bridge, BILCR, Vavenby Mountain FSR, Saskum Plateau FSR, Vavenby-Saskum FSR, and 2 km of new road	The east than south is the preferred option due to its significantly lower distance (approximately 50 km)
Employee Accommodations – Construction	Housed on site Housed off site	Housed on site	There is insufficient housing available in the Project area to house to Project Operations staff
Employee Accommodations – Operations	Housed on site Housed off site	Housed off site	Housing employees onsite during Project Operations is cost prohibitive
Waste Rock Management	Onland PAG and non-PAG waste rock stockpile Backfilling of waste rock in open pit Co-storage of PAG and non-PAG waste rock in TMF Co-storage of PAG waste rock in TMF, onland non-PAG waste rock stockpile	Co-storage of PAG waste rock in TMF, onland non-PAG waste rock stockpile	Co-storage of PAG WR in the TMF is the safest way to store PAG material; however the TMF does not have sufficient capacity to store non-PAG WR

Summary of Project Design Changes

Throughout the Project planning process, HCMC has made Project design decisions that, overall, minimize potential environmental and related social effects to Aboriginal people and the public. The design changes made to the Project during the EA process include:

- optimization of the mine site footprint and general arrangement of the Project to reduce spatial disturbance;
- re-designing the pit to avoid impacting wetland in an area northwest of the pit;
- making improvements and updating the Mine Waste and Water Management Design Report including:
  - change to the water management strategy to achieve no discharge from the open pit to Baker Creek, and
  - change to the water management strategy to avoid need for water treatment;

- relocating the waste rock and LGO stockpiles in consideration of potential groundwater seepage effects;
- adding a compacted overburden liner beneath the PAG LGO stockpile;
- relocating the PAG waste rock to the lower end of the TMF to ensure it is subaqueous within one year, reducing oxidization potential;
- pumping surplus water in the open pit to the TMF on a seasonal basis to minimize seepage during Operations;
- pumping open pit water to the TMF in perpetuity Post-Closure, rather than discharging to Baker Creek;
- designing a single discharge point from the TMF to spill to T Creek during Post-Closure; and
- designing water management ponds to collect seepage from the TMF and non-PAG waste rock stockpile, including embankments faced with High Density Polyethylene liners.

Summary of Project Description

Project Development History

Copper mineralization was discovered in 1966 in the headwaters of Harper and Baker creeks independently by two companies, Noranda and Quebec Cartier. After several commercial endeavours and changes in ownership, YMI obtained control of the Harper Creek mineral claims through a series of claim staking, purchase and option agreements, and in 2006 initiated field exploration on the claims.

In 2011, YMI published the results of a preliminary economic assessment (PEA 2011) of the Project, and in 2012 YMI completed a feasibility study that established the design criteria for a 70,000 tpd processing plant to produce a copper concentrate. An updated feasibility study was published in 2014 (Appendix 5-A, Technical Report and Feasibility Study), which incorporated a number of design changes related to the Project site and general arrangement referred to above, and provided updated mineral resource and reserve estimates, capital and operating cost estimates, and an updated economic analysis of the Project.

In April 2013, HCMC submitted an Application/EIS for the proposed Project. Screening comments were received from the BC EAO, the CEA Agency, and a range of other responsible agencies. The comments highlighted the need for additional information in the Application/EIS, as compared against the Project Application Information Requirements. This revised Application/EIS includes additional baseline data, alterations to the Project design and layout, updates to the modelling and effects assessments for valued components (VCs), and addresses all of the screening comments received from the BC EAO and the CEA Agency.

Project Geology

The Harper Creek property area is located within structurally complex, low-grade metamorphic rocks of the Eagle Bay Assemblage, part of the Kootenay Terrane on the western margin of the Omineca Belt in south-central BC. This assemblage is flanked by high-grade metamorphic rocks of the Shuswap Complex immediately to the east, also part of the Kootenay Terrane, and by rocks of the Fennell Assemblage immediately to the west. Factors contributing to the complexity of the area are its situation immediately east of the Quesnel Terrane representing a Late Triassic to Early Jurassic magmatic arc that formed along or near the western North American continental margin. The property area also lies within the Cretaceous Bayonne plutonic belt (Logan 2002) represented by two large batholiths, the Baldy batholith to the south and the Raft batholith to the north of the deposit.

The Harper Creek deposit is located within the Eagle Bay Assemblage which incorporates Lower Cambrian to Mississippian sedimentary and volcanic rocks deformed and metamorphosed during the Jurassic-Cretaceous orogeny (Schiarizza and Preto 1987). The Eagle Bay assemblage in south-central BC contains numerous although small polymetallic massive sulphide deposits, mainly within Devonian felsic volcanic rocks, formed in an arc volcanic environment in response to eastward subduction of a paleo-Pacific ocean (Hoy and Goutier 1986; Hoy 1996; Bailey, Paradis, and Johnston 2001). The Project is located in an extensive volcanogenic-hosted sulphide system within a mineralized envelope, and as defined by drilling to date, greater than 2.5 km along strike, over 2.0-m down-dip, and within a 1-km thickness of volcano-sedimentary stratigraphy.

Mineral Resources and Reserves

A mineral resource estimate was prepared for the Project, using a resource-grade model with a selected base cut-off grade for copper of 0.15%. The resource was reported within an optimal Lerchs-Grossman pit with an average copper recovery of 89% and a base metal price of US$3.50/lb copper. A total of 1,300,238 Mt of measured and indicated mineral resource was estimated.

The mineral reserve estimate prepared for the Project, using a copper price of US$2.25/lb and a 0.14% cut-off grade, indicated a proven and probable reserve for the Project of 716,175 Mt with an average grade for copper of 0.26%. Note that small amounts of gold and silver will also be processed, at average grades of 0.029 g/t and 1.2 g/t respectively.

Project Phases

The Project will be undertaken in phases, namely a Construction phase, two Operations phases (Operations 1 and Operations 2), a Closure phase, and a Post-Closure phase.

Construction Phase

The Construction phase is expected to last approximately 18 to 24 months. The following activities will be undertaken during the Construction phase:

- erection of temporary construction camp and ancillary facilities;
- main access road improvements;
- clearing, grubbing, and stockpiling of topsoil;
- bulk earthworks;

- pre-stripping of the open pit, stockpiling of topsoil, and generation of construction aggregate, mainly for tailings embankment construction;
- construction of the main substation at the plant site and a 14-km high-voltage power line (the "HCMC power line") connecting to the BC Hydro transmission line corridor;
- operation of a 150 m^3/hour to 200 m^3/hour concrete batch plant near the concentrator and primary crusher locations where the majority of concrete will be required;
- forming and placement of concrete foundations;
- supply and installation of pre-engineered buildings;
- supply and installation of primary crushing, grinding, flotation, regrind and concentrate dewatering circuits;
- fuel tank installation;
- earthworks for the cofferdam and Stage 1 main embankment for the TMF;
- installation of conveying and piping systems;
- construction of a concentrate load-out building and cold storage;
- repairs to the rail siding at the rail load-out facility in Vavenby; and
- removal of temporary construction camp and ancillary facilities.

Additional information specific to Construction is provided below in the section of this Executive Summary that deals with Project components and activities.

Operations Phases

The Operations phase will comprise a first stage of 23 years (Operations 1) and a second stage of five years (Operations 2). These stages are defined by the fact that the mining operations will cease in the open pit in the first half of Year 24 and the mine will begin processing LGO from the site stockpiles thereafter. The following activities will be undertaken during the Operations phases:

- development of the open pit and extraction of ore;
- operation of the non-PAG waste rock stockpile;
- operation of the non-PAG overburden stockpile;
- storage/stockpiling of ore;
- storage/stockpiling of LGO;
- crushing and processing of ore;
- transportation of concentrate to the rail load-out facility;
- construction and operation of the TMF, including PAG waste rock storage;
- transportation of workers and goods in and out of the Project Site; and
- fuel re-supply.

Additional information specific to Operations is provided below in the section of this Executive Summary that deals with Project components and activities.

Closure Phase

The Project design allows for substantial concurrent reclamation activities to occur from early in the life of the mine. The Closure activities are split into concurrent reclamation (Years 5 to 28) and final reclamation (Years 29 to 35).

The concurrent reclamation work will include activities such as applying soil covers, caps, and/or re-vegetation of Project stockpiles, the TMF and its embankments, and tailings beaches. The final reclamation work will include activities such as decommissioning, removal, or capping various stockpiles, ponds, pumps, roads, and water management ponds.

Additional information specific to the Closure phase is provided below in the section of this Executive Summary that deals with Project components and activities.

Post-Closure Phase

The final reclamation activities extend into the Post-closure phase of the Project and a nominal monitoring period of 50 years is envisaged. Additional information specific to the Post-Closure phase is provided below in the section of this Executive Summary that deals with Project components and activities.

Project Components and Activities

Project Site

The key mining components that will be located within the Project Site will be the open pit, haul roads, primary crusher, ore conveyor, processing plant and pipelines, the TMF, and the PAG, non-PAG, and LGO waste rock stockpiles, as well as overburden and topsoil stockpiles.

In support of the development of the Project, the following services will be provided:

- a mine access road about 24 km in total length resulting from improvements to existing FSR infrastructure, and which also includes construction of a new 2.5-km road section near the Project Site;
- a new 138-kV power line (the HCMC power line) approximately 14 km in length, connecting the plant site substation to the BC Hydro transmission line corridor;
- site distribution power lines (25 kV);
- permanent building structures;
- fresh water supply, fire/fresh water storage and distribution, and recycled water collection/storage/distribution;
- fuel storage and dispensing, sewage collection and treatment, drainage, and runoff settling ponds;

- temporary housing facilities for construction personnel;
- secondary roads, yard areas, and parking; and
- security, safety, and first aid facilities.

Tailings Management Facility

The TMF has been designed to provide for secure and permanent storage for 585 Mt of tailings and 237 Mt of PAG waste rock from the proposed mining operation. The TMF is located in a bowl-shaped basin in the upper reaches of an unnamed tributary to Harper Creek, which is classified as non-fish habitat and is isolated from migratory fish by a natural fish gradient barrier. The catchment is hydraulically contained by topography on three sides and will be confined by constructing an earthen dam on the fourth side to create the TMF.

The TMF for the Project has been designed in accordance with all Canadian Dam Association (CDA) standards. It has been assigned a classification of "very high" and has been designed using the highest possible flood and seismic criteria based on maximum probable events, including a maximum probable flood and a maximum credible earthquake. These maximum events represent 1 in 10,000-year events. In conjunction with the detailed design of the TMF for mine permitting, HCMC will prepare a Dam Breach Inundation Study by qualified design engineers.

The tailings dam will be constructed in several stages to provide the necessary storage capacity over the life of the Project. The dam will consist of a cofferdam and an initial starter embankment constructed during the Construction phase, an embankment raise during the first year of Operations, and annual staged embankment raises during the summer months thereafter over the life of the Project. The height of the annual raise will vary from 11 to 3 m depending on storage characteristics of the TMF and the volume of waste to be managed in the upcoming year. The total fill requirement for the main embankment is 58.4 Mm^3 of construction material, which will largely be provided by non-PAG waste rock from the open pit. The final stage of the main embankment is designed to reach an elevation of 1,836 m, which is approximately 185 m in height at the maximum dam section.

Two tailings streams will be generated in the process plant and transported to the TMF, these being rougher scavenger (bulk, ~ 93%) tails and cleaner scavenger (cleaner, ~ 7%) tails. The two tailings streams will be transported in separate pipelines to the TMF, following a pipeline road from the plant site. Bulk tailings will discharge from the embankment crest using spigots to build tailings beaches, while cleaner tailings will be deposited in an area that maintains the tailings solids in a subaqueous state perpetually. During the processing of the LGO stockpile, tailings will be directed to the open pit via two separate pipelines, in the same fashion as for deposition of tailings in the TMF.

Project Access Road and Power Line

The proposed operational access to site from Highway 5 is via the Vavenby Bridge Road through Vavenby and across the North Thompson River to the BILCR. From there, access is via an existing 18.5-km network of FSRs that climb up to the plant site from its junction at BILCR south of Vavenby. The FSRs that comprise the access road will be the Vavenby Mountain FSR, Saskum Plateau FSR, and Vavenby-Saskum FSR. A new section of road of about 2.5 km will need to be constructed from the Vavenby-Saskum FSR to the mine site. In order to improve access for both construction and mining, the FSRs will be upgraded by widening where necessary, improving alignments where practical, improving the BILCR/Vavenby Mountain FSR junction, and signage improvement.

During the Construction phase, oversized loads will require an alternative access across the North Thompson River as the Vavenby Bridge has not been designed to cater for such loads safely. The proposed temporary construction route access for oversize loads will be Highway 5, BILCR, Vavenby Mountain FSR, Saskum Plateau FSR, and Vavenby-Saskum FSR. This proposed route crosses the North Thompson River at the BILCR Bridge which has been design for heavier loads.

The road will be in frequent use during the Operations phase for the transport of concentrate from the Project Site to the rail load-out facility near Vavenby, amounting to approximately 20 truck-loads per day, each carrying approximately 40 tonnes of concentrate.

The average power demand of the Project is approximately 82 MW, which will be accessed from the BC Hydro grid. HCMC will construct a 14-km, 138-kV overhead power line from the BC Hydro transmission line, crossing the North Thompson River to the Project's main substation located adjacent to the processing plant, where it will be stepped down to 25 kV for distribution to Project infrastructure. The HCMC power line will be constructed using a combination of single wooden poles and H-frame structures as required.

Environmental Management System and Management Plans

An initial environmental management system (EMS) has been developed for the Project, as a set of procedures and processes that will allow HCMC to improve the company's environmental performance in a systematic way, and in accordance with regulatory requirements. It includes written plans describing how environmental management actions will be applied that are important to the Project meeting necessary environmental performance standards. A component of the EMS is an array of purpose-designed EMPs, which identify the environmental practices that will be applied during the Construction, Operations, and Closure phases of the proposed Project. The EMPs provide a baseline for the development of environmental management method statements and work instructions. The subject areas addressed in the EMPs include:

- Air Quality Management Plan;
- Archaeology and Heritage Management Plan;
- Emergency Response Plan;
- Explosives Handling Plan;
- Fish and Aquatic Effects Monitoring and Management Plan;
- Fuel and Hazardous Materials Management Plan;
- Groundwater Management Plan;
- Mine Waste and ML/ARD Management Plan;
- Noise Management Plan;

- Sediment and Erosion Control Plan;
- Selenium Management Plan;
- Site Water Management Plan;
- Soil Salvage and Storage Plan;
- Spill Prevention and Response Plan;
- Traffic and Access Management Plan;
- Vegetation Management Plan;
- Waste Management Plan; and
- Wildlife Management Plan.

The EMPs are underpinned by the principle of adaptive management. Continual monitoring of environmental conditions and review of performance against defined standards will allow HCMC to respond to the changing needs of environmental management throughout the course of the Project, as required.

Mining Method

The Project consists of a 70,000 tpd conventional copper concentrator and a combined electric and diesel-powered open pit mining operation. Mining will be by open pit methods in five phases of pit development and expansion over 28 years. The overall strip ratio is 0.76:1 and the total in-pit waste is 542 Mt. The ultimate pit will be 2,400 m long and 1,670 m wide with a depth of approximately 375 m. The dewatering system for the open pit will pump all seepage and precipitation inflows out of the pit from suitably located pit sumps and direct it to the TMF, thus keeping the pit bottom dry during normal operating conditions.

A qualified explosives contractor will be contracted to establish a facility to manufacture, store, and deliver bulk ammonium nitrate fuel oil (ANFO) during both the Construction and Operations phases, and a suitably removed location for the envisaged facility has been identified to the northeast of the TMF.

Mill feed and waste will be drilled by diesel and electric powered rotary drills and blasted using heavy ANFO. Mill feed and waste will be loaded into 227-t mine trucks by 42.0-m^3 electric hydraulic shovels and an 18.5-m^3 wheel loader. Run-of-mine ore will be hauled to the primary crusher located southwest of the pit. Crushed ore will be conveyed to the coarse ore stockpile located adjacent to the concentrator building and subsequently to the crushing, grinding, and flotation sections of the process plant. The concentrator design is conventional with primary crushing followed by semi-autogenous (SAG) mill and ball milling grinding and flotation producing a copper gold concentrate. Various standard chemical reagents will be added to the process slurry streams to facilitate the copper flotation process.

The concentrate will be dewatered and transported by truck approximately 25 km to an off-site rail load-out facility near Vavenby. The off-site facility will be capable of storing two days' worth of concentrate production. The copper concentrate will be then transported by train to Vancouver for shipment to overseas smelters.

The process plant will consist of:

- a primary crushing facility;
- overland conveying;
- crushed material stockpile and reclaim;
- primary grinding circuit, including a SAG mill, two ball mills, and hydrocyclones for classification;
- copper rougher and scavenger flotation;
- rougher and scavenger concentrate regrinding;
- copper cleaner flotation;
- copper concentrate thickening, filtration and stockpiling, including off site;
- concentrate handling; and
- tailings slurry disposal to the TMF and open pit for solids storage and recycling of process water.

Potential PAG waste rock will be placed in the TMF. Non-PAG waste rock will be placed in the valley to the west of the pit. Non-PAG and PAG LGO waste rock will be stockpiled separately to the southwest of the plant site adjacent to the TMF to allow runoff from the PAG LGO stockpile to be directed into the TMF. Ore will be mined from the open pit and hauled directly to the crusher for 24 years. The implementation of an elevated cut-off grade strategy requires the stockpiling of 116.9 Mt LGO. This material will be reclaimed and processed at the end of the open pit life for another four years.

The operational equipment fleet will incorporate large-scale units, which have been well proven in existing operations. In total, the mine will operate one diesel rotary drill, three electric rotary drills, three 42-m^3 electric hydraulic shovels, one 18-m^3 wheel loader, up to 28 mine haul trucks of 227-t capacity, and a fleet of support equipment.

Water Management

The Project Site is in an area of high annual precipitation with a mean annual precipitation of approximately 1,050 mm (at an elevation of 1,680 m). It is thus important to use water efficiently within the Project Site to support the milling of ore and to divert non-contact fresh water to the maximum extent practical.

The water management strategy involves collecting and managing site runoff from disturbed areas and maximizing the recycle of process water. Surplus water will be stored on site within the TMF and used as process water through the first 24 years of Operations. Process water for the final four years of Operations will primarily be derived from the open pit. The process water supply sources for the Project are from precipitation runoff from the Project Site facilities, water recycled from the TMF supernatant pond (Years 1 to 23) and the open pit (Years 24 to 28), and groundwater from open pit dewatering.

Sediment and erosion control strategies will include establishing diversion and runoff collection ditches, constructing sediment control ponds, and stabilizing disturbed land surfaces to minimize erosion. Sediment mobilization and erosion will be managed throughout the site by:

- installing sediment controls prior to construction activities;
- limiting the extent of disturbances as much as is practical;
- reducing water velocity across the exposed surfaces;
- progressively rehabilitating disturbed land and constructing drainage controls;
- protecting natural drainages and watercourses by constructing appropriate sediment control devices such as collection and diversion ditches, sediment traps and sediment ponds;
- restricting access to rehabilitated areas; and
- constructing surface drainage controls to intercept surface runoff.

Water management during the construction of the TMF, open pit, waste rock and overburden stockpiles, and associated facilities will consist of the following components:

- water management and sediment control structures, including temporary sediment ponds, cofferdams, diversion ditches and pumping systems;
- a southeast diversion channel constructed along the southern part of the TMF facility to divert clean water from the upslope catchment areas around the TMF;
- a series of temporary ponds and small pumping systems required during construction of the cofferdam to prevent sediment-laden water from entering the downstream receiving environment;
- following closure of the cofferdam and construction of the TMF seepage collection pond, temporary ponds can be released or pumped to the TMF;
- all runoff from the open pit will be collected in a sediment pond within the ultimate pit down-gradient of the pre-stripping area, the runoff from which will then be released to the receiving environment during the Construction phase; and
- water management ponds constructed below the LGO stockpiles and acting as sediment ponds during the Construction phase with sediment-free water being released to the receiving environment during this time.

The operational water management strategy for the TMF in particular, since it is anticipated to have a surplus of water over the life of the Project, will incorporate the following:

- full and secure storage of site contact water in the TMF following process start-up until the end of mining operations;
- process water to be discharged into the TMF with the tailings;

- tailings supernatant water to be reclaimed and pumped back to the mill for process water requirements;
- TMF embankment staging designed to contain four consecutive years of the 1 in 20-year high (wet) precipitation scenario, after which the embankment is designed to contain the median precipitation scenario for the remaining life of the mine;
- a tailings deposition strategy to be implemented to selectively develop tailings beaches along the embankments, thereby producing an extensive low permeability zone that facilitates seepage control and maintains the operational supernatant pond away from the crest of the embankment, also ensuring that the beaches are saturated and thus reducing the potential for dust generation;
- water management ponds downstream of the non-PAG LGO and the non-PAG waste rock stockpiles to collect sediment-laden runoff and infiltration from the waste stockpiles, the water from which will be pumped to the TMF for storage and recycling; and
- the TMF seepage collection pond to collect seepage and sediment-laden runoff, which will be pumped back to the TMF for storage and recycling.

Following completion of active mining operations in Year 24, reclaim water will continue to be sourced from the TMF through Year 24, although tailings deposition will commence within the open pit. The final four years of Operations will continue with tailings deposition in the open pit However, reclaim water will no longer come from the TMF, but instead be derived from the open pit. The TMF pond will receive natural runoff until such time as it reaches the invert of a spillway, which will be constructed during the Closure phase of the mine. The TMF will ultimately be able to accommodate a surplus water volume of 180 Mm^3.

Support and Ancillary Infrastructure

Fuel Supply, Storage, and Distribution

Diesel fuel for the mining, process, and ancillary facilities will be supplied from a diesel fuel storage facility, consisting of four above-ground 75,000-L capacity diesel fuel storage tanks suitable for four days of on-site usage, together with the necessary loading and dispensing equipment. The facility will be located near the truck shop and will include an appropriately sized gasoline storage tank that will accord with the regulations relevant to such storage, for the small number of gasoline-powered vehicles envisaged. A dedicated fuel truck (bowser) will transport diesel to the mining equipment operating in the pit and fuel replacement will be a daily occurrence from an off-site terminal. The transportation, storage, dispensing and use of fuels at the site will be conducted in compliance with all relevant government laws and regulations.

Potable Water

Potable water supply will be provided from groundwater wells drilled for this purpose, envisaged to be located in the undisturbed area north of the TMF. Abstraction volumes will be scaled to the demand dependent on personnel numbers; on average approximately 175 L per person per day is assumed. A storage capacity for fresh water of 2,600 m^3 is planned, together with 600 m^3 of fire water. Conventional water treatment including disinfection will be provided, consistent with public health requirements. The necessary regulatory authorization for such abstraction, treatment, and storage will be sought.

Domestic Waste Management

A Waste Management Plan has been compiled that is intended to minimize potentially adverse effects to the biophysical as well as human environment, in compliance with regulatory requirements. The focus of the plan will be on the reduction, reuse, recycling, and recovery of waste, all of which would be exhausted before disposing of waste materials.

During the Construction phase, sewage from the temporary camp will be gravity fed to holding tanks that will be periodically emptied by local community services. The putrescible waste from the offices and camp will be incinerated and the ash along with solid, non-flammable/non-hazardous materials will be disposed of in a site landfill. The site landfill will be located in an area of suitable substrate to accommodate such a facility and will be subjected to the required permit approvals.

For the Operations phase it is planned to install a portable sewage treatment plant (rotating biological contactors or other similar unit) to handle both black and grey water waste. The resultant wastewater, treated to an acceptable quality standard, will be released into the environment via a tile field. Sludge will be removed as required for efficient operation of the plant, and disposed of off-site. Domestic waste generated during the Operations phase will be a fraction of that generated during the Construction phase, due to the reduced number of staff on site and the fact that no accommodation and catering will be provided. The incinerator in use during the Construction phase will be decommissioned and removed. However, the landfill established during the Construction phase will be maintained during the Operations phase, at a reduced level of service.

Security and Emergency Preparedness

A gatehouse will be installed at the entrance to the Project Site to ensure the physical integrity of the facilities, and control and record the access of people to restricted areas. Additional gates may be installed on FSRs that enter the Project, after consultation with the BC Ministry of Forests, Lands and Natural Resource Operations (BC MFLNRO) and BC Ministry of Energy and Mines (BC MEM). The Project will not use KP Road to access the rail load-out facility, and it will remain gated, thus avoiding difficult traffic conditions at the intersection of KP Road and Highway 5.

A suitably equipped first-aid station will be located within the warehouse building at the plant site, where an ambulance will also be stationed. Personnel trained to the prescribed level of first-aid competency will be present at all the Project worksites and will staff the first-aid station as necessary. Two-way radios will be used for site communications and a radio control process will be implemented to manage traffic movement as required. A helipad will be located in proximity to the mill and truck shop and will be purpose-designed to meet security, safety, and aviation regulation requirements.

A preliminary Emergency Response Plan, which outlines measures to protect workers, the environment, and mine property, has been compiled. It is a proactive document that outlines avoidance and mitigation measures in the case of an emergency.

Workforce

It is estimated that 600 construction persons will be required at the peak of the Construction phase, which occurs in the second construction season when work is focused on the civil, mechanical, and electrical work. Construction personnel will be housed on site in a typical modular camp that will provide single occupancy rooms with shared common laundry, washroom, dining, and recreational facilities. The camp will be leased for the term of the Construction phase and removed once Construction is completed.

The Operations phase of the Project is expected to create a total of 11,248 person-years[1] of direct Project employment over the life of the mine (28 years). Of that, 6,936 person-years of employment will be in mining (up to 319 jobs), 2,856 person-years (approximately 102 jobs) in milling, and 1,036 person-years (approximately 37 jobs) in site services. An estimated 15 jobs will be created in administration. In the ninth year of the Operations phase, the employment will peak at 466 positions. HCMC predicts that approximately 12 to 15% of all direct jobs will be held by local workers. Operations personnel will reside off site in local communities such as Vavenby, Clearwater, and the surrounding area. The Closure and Post-Closure phases of the Project will provide limited employment opportunities.

GEOCHEMISTRY

The two objectives of metal leaching / acid rock drainage (ML/ARD) characterization are firstly to provide mine waste management criteria, and secondly to predict contact water chemistry (referred to as "source terms") for input into water quality assessments for the project.

ML/ARD potential of rock, tailings, overburden, and quarry materials for the Project was evaluated through conventional procedures including acid-base accounting, trace element analysis, mineralogy, shake flask extractions, humidity cells, subaerial and subaqueous columns, and on-site kinetic tests. Some test procedures were adapted to address site-specific questions. These tests indicated that some components of all materials except the quarry have ML/ARD potential. ML potential primarily exists for copper, selenium, and zinc.

For rock (waste rock and LGO), ARD potential is definable at the bench scale and can be segregated into non-PAG and PAG components for separate management during mining. PAG rock is not usefully correlated to rock type but segregation by ARD potential also results in segregation by sulphur content. Rougher tailings are non-PAG whereas cleaner tailings are PAG. Overburden from outside the pit limits is non-PAG due to low sulphur content. Within the pit footprint, near surface overburden is non-PAG but weathered bedrock may be PAG.

Geochemical data were used to develop source terms for 20 site features. The overall source term methodology considers rates of weathering under disposal conditions and solubility of weathering

[1] Person-years is used, rather than the number of potential positions, as there is a large number of various shifts, different job requirements, and different positions that would be difficult to categorize.

products. Weathering rates were derived from laboratory and field tests. Solubility limits were derived from thermodynamic calculations, Project-specific tests, and a database of drainage chemistry data from analogous mine sites.

CLOSURE AND RECLAMATION

A conceptual Closure and Reclamation plan for the proposed Project has been prepared, consistent with the Project's AIR and meeting the requirements under the BC *Mines Act* (1996c) and the Health, Safety and Reclamation Code for Mines in British Columbia (the Code; BC MEMPR 2008). Closure and reclamation planning for the Project will contribute to successful reclamation of the Project site at the end of mine life, and proactive considerations of closure needs will reduce changes in Project design, limit the amount of material re-handling, and minimize the environmental effects of the Project.

Closure and Reclamation Objectives

In meeting the requirements of the Code, the conceptual Closure and Reclamation plan developed for the Project will provide assurance to the provincial government that the site will be left in a condition that will limit any future liability to the people of BC. Specific objectives of the plan are:

- to return landform structure, heterogeneity, and stability in the Project Site to conditions similar to those existing without the Project;
- to ensure ground and surface water quality and soil conditions provide the necessary conditions for terrestrial and aquatic life, including fish; and
- to re-establish productive land use that allows for functional wildlife habitat.

Recognizing that stable landforms require stable foundations, the Project's permanent mine-related landforms, such as the open pit, the TMF, mine site roads, and waste rock and overburden stockpiles, have been designed to ensure long-term stability during mine Operations, after mine Closure, and after reclamation works are complete. With the end land use objective of providing functional wildlife habitat, the reclamation undertaken will over time result in the development of complex ecosystems and provide habitat for a variety of species of animals and plants currently occurring in the proposed Project Site. Functional wildlife habitat will also support the recreational uses occurring in the area.

Soil Management

The total area that will be disturbed by the end of the Operations phase of the Project will be approximately 1,900 ha. Following the 28 years of mine life, the majority of the Project Site will be closed, decommissioned, and/or reclaimed, although some facilities such as the pit will not be reclaimed but will only be decommissioned. Soil will only be required for those facilities that will be reclaimed and to this end, planning will include the conservation of soil materials suitable for reclamation purposes in areas disturbed by mining, where feasible. The objective is to salvage sufficient volumes of soil suitable for reclamation purposes in areas to be reclaimed.

Approximately 712 ha of land will be reclaimed for the Project and although the depth of soil required for reclamation will vary according to the site conditions of the areas to be reclaimed, the general plan is to apply a 30-cm thick soil cover where soils are required for reclamation. Approximately 1,891,750 m^3 of topsoil will thus be required. In areas potentially requiring a thicker cover, such as on the non-PAG waste rock stockpile, an initial thickness, where necessary, will be provided from stockpiled overburden, as a base for the topsoil and to ensure sufficient water holding capacity for plant growth. Approximately 1,216,000 m^3 of the stockpiled overburden will be required throughout the site for this purpose.

Progressive Reclamation

Progressive reclamation will be carried out where practical during the Construction and Operations phases of the Project, when a disturbed area is no longer required for operational purposes. The temporary construction camp, TMF, non-PAG LGO stockpile, and the overburden stockpile are cases in point.

The construction camp will be temporary since no accommodation will be required on site during Operations. As soon as construction of the mine is completed, and assuming the area has no further uses for mine associated operations, the camp will be dismantled and its reclamation may be an opportunity to replace some of the lost wetland and support western toad habitat. After cessation of mining operations in the open pit, a portion of the TMF can be reclaimed since the tailings from LGO processing will be redirected to the open pit. The upper beaches will be reclaimed to the extent safe and practical, and the dam faces will be planted with native grasses and shrubs suited to the site. The smaller of the two non-PAG LGO stockpiles will be processed and progressively reclaimed during Operations 1 (Years 1 to 5). Once overburden stripping is complete, the stockpile can be reclaimed.

Closure and Reclamation Planning

Open Pit

Closure of the pit includes backfilling with tailings and water to form a pit lake. Once the pit has reached an elevation between 1,530 and 1,545 m, excess water will be pumped to the TMF in perpetuity. The lowest elevation of the pit wall is expected to be an elevation of 1,555 m, which allows for 10 m of freeboard to manage storm inflows. An emergency spillway on the northern edge (lowest point of the pit rim) will be constructed to prepare for potential high precipitation events. At Closure, the pit will be bermed to stop inadvertent access to high walls. Pumping of water from the pit to the TMF will continue in the Post-Closure phase.

Non-PAG Waste Rock Stockpile and Low-grade Ore Stockpile Footprint

These stockpiles will respectively be shaped and have their surface loosened. They will then be covered with soil, seeded with a native seed mix, and planted with shrubs and tree seedlings suited to the area.

Topsoil Stockpiles

One of the three topsoil stockpiles, namely the eastern stockpile, will have partially occupied a wetland and its reclamation would present an opportunity to replace the lost wetland. Following recovery of the existing topsoil layer, the existing depressional area will be re-excavated to allow water to accumulate. With judicious planting and the accumulation of plant litter, a sustainable wetland can be created.

The other two stockpile areas will be re-vegetated with a native grass mix, some shrubs, and tree seedling suited to the Project Site, and with time result in a forested ecosystem.

Water Management and Process Plant Ponds

Water management ponds will generally have their linings compromised, be backfilled, and then reclaimed by vegetating with native seed mixes, shrubs, and tree seedlings. The timing of reclamation may, however, vary according to the period required for the quality of the water to improve to a level acceptable for release.

Crusher, Conveyor, and Coarse Ore Stockpile

Areas such as these where infrastructure was installed will generally have the equipment dismantled and removed for reuse or recycling, after draining fluids and making the equipment safe. Excavations will be backfilled and compacted surfaces ripped. A soil cover will be spread as appropriate and a native seed mix, shrubs, and tree seedlings planted.

Plant Site

The plant site will consist of several components, the important of which are the process plant, substation, warehouse and truck shop, fuel storage, explosives facility, process water pond, sewage treatment plant, and pipelines. Each of these will be closed and reclaimed as appropriate, generally through making the equipment safe, dismantling and removing the equipment, backfilling excavations or shaping surfaces, surface ripping, and re-vegetating with native plants.

The removal and disposal of chemicals (e.g. reagents) or potential contaminants (e.g. from the explosives facility) will receive particular attention.

Access Road and Power Line

The main access road to the Project Site will be required for dismantling, removal, and rehabilitation activities during the Closure phase. It will also need to be kept in use at a lower level of service during the Post-Closure phase, to transport materials and provide access to the Project Site for mine personnel undertaking maintenance and monitoring of the pumps and pipeline system for directing water from the open pit to the TMF. The power line will remain in operation throughout the Post-Closure phase until site power is no longer required.

Summary of Closure Activities

In summary of the Closure phase, all buildings and structures including the rail load-out facility will be removed and 868 ha (44%) of the Project Site will be reclaimed. This includes the footprints of the PAG LGO stockpile, the non-PAG waste rock stockpile, plant site, and overburden and topsoil stockpiles. The pit will be filled with water and excess water will be pumped to the TMF. The TMF dam faces and beaches will be reclaimed. The site roads and the power line will be required for ongoing monitoring of the TMF, the pit lake, and reclaimed areas of the Project Site.

Post-Closure Phase

The Post-Closure phase objective is to return the site to an open forested ecosystem for use as wildlife habitat. This will be brought about by re-vegetating areas with native grasses, shrubs, and trees to create an ecosystem that will support summer ungulate range for feeding, rearing, and shelter. This includes wetlands and the creation of western toad habitat in specific locations on the site. The complexity of the vegetation will increase with time and ultimately result in a sustainable ecosystem. The development of wildlife habitat will also provide the opportunity for hunting, trapping, and recreational activities, by Aboriginal groups and the public.

In total, approximately 868 ha of the Project Site will be reclaimed to forest, grasses and shrubs, and wetlands, representing about 44% of the land area disturbed for the Project. Of this, the reclaimed waste rock pile will result in approximately 107 ha and the TMF dam and beaches in approximately 452 ha of grass and shrub area. Monitoring and an adaptive management approach will be used to determine the success of habitat reclamation activities and what measures are required to meet the objectives for environmental management of the Project Site.

Closure and Reclamation Schedule

Progressive closure and reclamation activities will commence about five years into mining operations for the smaller non-PAG LGO stockpile and the temporary construction camp area if not needed for Operations. Substantial reclamation activities, including reclamation of tailings beaches, the tailings dam embankments, and topsoil stockpiles, will occur during the final five years of Operations. This will leave the PAG LGO stockpile footprint, non-PAG waste rock stockpile, and plant site infrastructure to be reclaimed during the Closure phase. Closure and reclamation activities will thus occur while concurrent reclamation is undertaken between Year 5 and Year 28, while final reclamation will be undertaken between Year 29 and Year 35.

Closure Costing

Preliminary closure and reclamation costs have been estimated for the Project at $16,377,490 (not including monitoring costs). Approximately $6,213,150 has been estimated to dismantle structures such as the mill, crusher, the water process pond, the conveyors, infrastructure related to the coarse ore stockpile, and various other buildings and structures, with no allowance for salvage value offsetting Closure costs.

The reclamation costs for other mine components and other minor costs have been estimated at $10,164,340. This includes costs for site preparation, soil spreading, and re-vegetation for areas such as the coarse ore and PAG LGO stockpile footprints, facility footprints, the TMF dam faces and beaches, as well as the waste rock and overburden stockpiles. More detailed closure and reclamation costing will be developed as required under the *Mines Act* (1996c) in conjunction with permitting.

Post-Closure Monitoring and Reporting

Monitoring is required under section 10.7.30 of the Code (BC MEMPR 2008), as well as the *Mines Act* (1996c) permit to be issued authorizing the construction, operation, and closure of the Project, and the *Environmental Management Act* (2003) permit to be issued authorizing the discharge of effluent from the TMF. Monitoring programs will be carried out during the Closure and Post-Closure phases and the results will be included in annual reports on reclamation and environmental monitoring per the Code (BC MEMPR 2008).

The monitoring will be carried out by suitably qualified environmental technicians and will encompass reclamation success, wetland re-establishment, surface water quality, groundwater quantity, geotechnical stability, and the management and stability of water impoundments, with particular attention to the TMF.

ASSESSMENT METHODOLOGY

The assessment methodology used to evaluate the effects of the Project on environmental, social, economic, health, and heritage components included: analysis of baseline studies, stakeholder feedback (including that of Aboriginal groups and the public), and the re-evaluation of Project designs (including evaluation of alternatives and improved mitigation measures). These iterations all contributed to the refinement of scope of the EA; it also led to the avoidance of certain effects, with mitigation measures designed to reduce the scale of unavoidable residual effects.

Issues scoping is fundamental to focusing the Application/EIS on those issues where there is the greatest potential to cause significant adverse effects, and to focus the assessment on those aspects of the environment that are of greatest importance to society. Each assessment chapter of the Application/EIS includes a description of the issues scoping process used to identify potential effects, as well as the process used to select assessment boundaries and to determine the potential interaction or cause-effect pathways between Project activities and the VCs selected for assessment. Components were scoped in consultation with key stakeholders, including Aboriginal communities and the EA Working Group, or they may also have been scoped as a legislated requirement.

Assessment boundaries define the maximum limit within which the EA is conducted. They encompass the areas within, and times during, which the Project is expected to interact with the identified VCs, as well as any administrative or technical boundaries that constrain the assessment of the identified VC.

The baseline against which the EA was carried out is described, according to criteria related to regional and historical overviews that deal respectively with current environmental conditions and historical and current projects. The findings of site-specific baseline studies are presented for each subject area, the details of which are provided in appendices to this Application/EIS.

Regarding the effects assessment and mitigation measures, each assessment chapter provides a detailed discussion of the key potential effects arising from the Project components and activities, as well as discussion and evaluation of mitigation measures that may be taken to reduce the potential for significant adverse effects. Formulating mitigation measures to avoid, minimize, restore or offset adverse effects to VCs allows for specified EMPs to be compiled. Where proposed mitigation measures are not sufficient to eliminate an effect, a residual effect is identified. Predicted residual effects are therefore the potential consequences of the Project on VCs; each assessment chapter of the Application/EIS describes direct, indirect, and induced residual effects of the Project as applicable.

To characterize the residual effects, and understand their likelihood, significance, and level of confidence in their assessment, a standard set of criteria (magnitude, geographic extent, duration, frequency, reversibility, and resiliency) are used to support a determination of significance. An assessment of likelihood of the residual effect occurring is also made but is not considered when evaluating the significance of an effect. Confidence and uncertainty in the outcomes or conclusions of the effects assessment is also evaluated. The assessment of residual effects and their significance are summarized for each subject area using a standard tabular format.

The potential for cumulative effects arises when the residual effects of a project overlap or interact with the same resource or receptor that is affected by the residual effects of other historical, existing, or reasonably foreseeable future projects or activities. The cumulative effects assessment (CEA) considers the potential environmental, economic, health, social, and heritage cumulative effects of the Project according to the requirements of the AIR, through well-understood cause-effect pathways. Past, present, and future projects and activities that may affect Project VCs are described in detail, and such scoping then allows for assessment, mitigation formulation, and characterization of residual cumulative effects to be undertaken.

Cumulative residual effects are those adverse effects remaining after the implementation of all mitigation measures, and are therefore the expected consequences of the Project on the selected VCs. Each assessment chapter of the Application/EIS describes direct, indirect, and induced cumulative residual effects of the Project as applicable.

Assessment of Potential Effects, Mitigation, and Significance of Residual Effects

Introduction

In accordance with the AIR, the EA evaluated the potential effects of the Project on environmental, social, economic, health, and heritage VCs. The assessment of each VC was undertaken in accordance with the methodology described in Chapter 8 of the Application/EIS; VCs are grouped under subject area headings described in the following sub-sections. The full assessment of effects, mitigation measures, residual effects, and cumulative effects are provided in Chapters 9 through 22.

Air Quality

Air quality is an important environmental factor in conserving the quality of local vegetation resources, wildlife, and human health. Activities associated with the Project have the potential to generate emissions of criteria air contaminant (CACs) and also lead to increased dust deposition. The main sources of emissions associated with the Project are fugitive dust sources such as vehicles travelling on unpaved roads and equipment activities such as bulldozing, while non-fugitive sources include stack emissions and vehicle exhaust emissions.

Baseline air quality at the Project Site is unaffected by anthropogenic sources, reflecting the Project's remoteness. Although there are a number of anthropogenic sources within the regional area, including within the town of Vavenby, overall air quality in the region is good due to the localized nature of emissions (i.e., hotspots).

The air quality assessment draws on local and regional baseline data, and results from detailed dispersion modelling, to predict the potential impact of emissions from the Project. The air quality modelling study was conducted to characterize the highest concentrations of each air quality indicator within the local study area (LSA). The results from the model were compared to relevant federal and provincial legislation.

Project residual effects on air quality are discussed in Chapter 9, and include the potential for increased CAC emissions and dust deposition. Dispersion modelling was used to determine the magnitude of the effect of Project operations. The results were then compared to relevant standards and objectives. The effect of increases in CAC concentrations and dust deposition levels on air quality, after implementation of mitigation measures including the Air Quality Management Plan, is assessed as **not significant (moderate).**

A cumulative assessment was carried out in order to assess the combined impacts of the Project with other projects in the area. Three projects and activities are identified as potentially having a cumulative effect: Vavenby Sawmill, the Foghorn Polymetallic Project, and transportation activities related to forestry and mineral exploration; however, they are all considered low risk. The cumulative effect of increases in CACs and dust deposition on air quality is assessed as **not significant (moderate).**

Noise

Noise is defined as any undesirable sound that may irritate people, disturb rest or sleep, cause loss of hearing, or otherwise affect the quality of life of affected individuals (Health Insider 2002). Noise can result in psychological and physiological effects (e.g., stress), mental health effects, effects on residential behaviour (WHO 1999), as well as avoidance behaviour wildlife populations that cause them to not access important habitats.

Potential noise sources in the surrounding area include the unincorporated municipality of Vavenby, approximately 10 km northwest of the Project Site. There is also a lumber mill in Vavenby, and active logging in the area surrounding the Project Site, along with a network of FSRs. Highway

5 runs along the North Thompson River and at its closest point is approximately 7 km to the north of the Project Site and is a significant source of noise in the area.

Noise is a valued component that is used to inform the effects assessment for other VCs (i.e., wildlife, human health, and current use of lands and resources for traditional purposes). Sources of emission were identified and included in the noise model. Noise modelling was used to predict noise levels from continuous noise sources during the Construction and Operations phases, and to predict peak sound levels from blasting events. The main sources of continuous noise are the operating equipment, which increased noise from baseline levels for a distance of approximately a few kilometres from the Project Site, and within 50 m from the roads. Blasting noise led to greater increases, but these noise levels were not continuous.

Project residual effects on noise are discussed in Chapter 10, and include increased noise levels associated with Construction and Operations activities, such as blasting, operating machinery, and traffic. Noise modelling was conducted to predict noise levels within the regional study area (RSA) and the residual effects of noise on sensitive receptors, and the results compared to appropriate guidelines, such as World Health Organization (WHO) recommendations and guidance from Health Canada. The effect of noise level increases due to Project activities is assessed as **not significant (minor).**

The cumulative effect of Project noise combined with noise associated with the Vavenby Sawmill and the Foghorn Pollymetallic Project, as well as with hunting, harvesting, fishing, transportation, and forestry were also assessed. There has been a no registration reserve under the *Mineral Tenure Act* (1996b) Chapter 292 for uranium and thorium since 2008. As a result, there is a high level of uncertainty as to the timing for the development of the Foghorn project and whether the project would be constructed during the life of the Project. Therefore, the potential for it to interact with the Project is unlikely. The noise effects of the rest of the above activities, including the Vavenby Sawmill, are captured in baseline noise monitoring; therefore, the cumulative effect of the Project on noise levels is assessed as **not significant (minor).**

Groundwater

Groundwater is a key component of the ecosystem. To assess the potential effects of the Project on groundwater quantity and quality, hydrogeology baseline studies were carried out in 2011 to 2014 within the footprints of the key mine components (e.g., open pit, non-PAG waste rock stockpile, PAG-LGO stockpile, and TMF) and immediate downstream areas within the LSA. The objectives of the baseline studies were to characterize the groundwater flow regime and quality at the pre-mining conditions and to collect the data for the development of a conceptual and numerical hydrogeological model as part of the groundwater effects assessment. The methodologies utilized in the baseline studies included borehole drilling, monitoring well installation and development, hydraulic testing, geophysical survey, and groundwater quality sampling. The data collected included groundwater level elevations, hydraulic gradients, permeability of overburden and bedrock, and groundwater chemistry (see details in Appendix 11-A).

Using the hydrogeological baseline data as of April 2014, together with the available meteorological, hydrological, geological and geotechnical information, a conceptual hydrogeological model was developed to represent the groundwater system at the Project Site, and a three-dimensional numerical groundwater flow model was built within the LSA (see details in Appendix 11-B). The model was developed and run in steady-state, using the industry standard software MODFLOW-SURFACT and the approach of representing the discrete fractured bedrock formations with the equivalent porous media. The objectives of the modelling were to support the characterization of the baseline pre-mining conditions and to evaluate potential effects of the Project on groundwater. The baseline model was calibrated to measure groundwater elevations from 21 on-site monitoring wells and to synthetic baseflow estimates for five hydrometric stations within the LSA. The predictive modelling was implemented using the calibrated baseline model to simulate the potential effects of the Project during the Operations and Post-Closure phases.

The groundwater flow modelling results demonstrated that the proposed Project will affect groundwater quantity and quality significantly within the local mine site and immediate downstream catchments of the P Creek, T Creek, Harper Creek, Baker Creek, and Jones Creek. With the implementation of the mitigation measures, the overall residual effects of the Project for both groundwater quantity and quality are assessed to be **not significant (moderate)** beyond the LSA (see Chapter 11). No cumulative effects are anticipated from the past, present, and future projects and activities located in the hydrogeology study area. The existing supply wells for groundwater use in the downstream of the open pit are predicted not to be affected by the mining.

A follow-up long-term groundwater monitoring plan has been developed as part of the Groundwater Management Plan (Section 24.8) to monitor the potential effects on groundwater in the catchments in the downstream of the major mine components. An adaptive management plan can be initiated if the monitoring results show that the effect in the receiving groundwater environment is significant enough to warrant further attention.

Hydrology

Hydrology is a key component of the aquatic environment, linked to other ecosystem components, including surface water quality, fish and fish habitat, and aquatic resources. The Project could affect hydrology by altering streamflows. Surface water quantity was selected as the hydrology VC based on issues raised during consultation and the potential for Project-related effects.

The 2011 to 2014 hydrology baseline monitoring program collected hydrometric data and characterized the spatial and temporal variation in flows in the LSA. Hydrometric stations were established at multiple creeks that could potentially be affected by the proposed Project. These include the Baker Creek, Jones Creek, T Creek, P Creek, and Harper Creek. These on-site data were augmented by long-term hydrometric data from Water Survey of Canada stations within the LSA and RSA.

The Project has been designed to reduce adverse effects by optimizing alternatives, incorporating specific design changes, following best management practices, and enhancing Project benefits. Mitigation by design includes a variety of diversion, collection, and storage/settlement structures to manage water for the Project. These mitigation measures reduce the potential effects of the Project on hydrology; however, they are not expected to fully eliminate such effects. The mitigation measures are thought to be moderately effective, and residual changes to streamflows are expected within the Baker Creek, Jones Creek, T Creek, P Creek, and Harper Creek.

Chapter 12 provides a detailed discussion of the quantitative information, including baseline studies and watershed modelling that was used to assess the potential for Project-related effects to surface water quantity. After considering mitigation measures, residual effects, i.e., altered streamflows, were identified for surface water quantity. Medium and high streamflow changes are anticipated to be confined within the LSA. Predicted effects on the RSA streamflows (i.e., Barrière and North Thompson rivers) are negligible (less than 5% flow reduction). The residual effects on surface water quantity as a result of Project activities are assessed as **not significant (moderate).**

As noted previously, Project-related residual effects on surface water quantity beyond the LSA boundaries are not predicted. Further, no past, present, or reasonably foreseeable future project is expected to affect streamflows within the Project LSA. Thus, no interactions between the Project and other projects are expected with regards to streamflow changes, and therefore no cumulative effects assessment regarding streamflows has been undertaken.

Surface Water Quality

Surface water quality is a vital component of the biophysical and human environment and is protected under provincial and federal legislation. The physical and chemical constituents of water are important in determining aquatic ecosystem productivity, fish and aquatic life habitat quality, and toxicity. Surface water is highly valued by First Nations, local residents, and the provincial and federal governments. Surface water quality was selected as a VC based on issues raised during consultation and the potential for Project-related effects.

The 2007 to 2014 surface water quality baseline studies program was carried out to characterize the spatial and temporal variation in the baseline study area. Water quality was closely tied to the seasonal fluctuations of water flow. Temporally, pH, alkalinity, and concentrations of anions were generally lowest during freshet high flows (May to June) and greatest during low-flow periods, which likely reflected increased discharge of tributaries during the freshet period, as well as snow melt and heavy rainfall events that diluted concentrations of major ions. Conversely turbidity was highest during the freshet period (May to June) due to the greater volumes of discharge within streams. Concentrations of total and dissolved aluminum and iron, and total cadmium, chromium, cobalt, copper, lead, manganese, nickel, and thallium exhibited quite distinct seasonality, with the highest concentrations per site generally occurring during high-flow freshet periods.

A water quality model was developed to estimate Project-related changes to water quality. The predictive water quality model was developed using the life-of-mine watershed model and geochemical source terms and incorporated Project design mitigations.

Potential Project-related effects on surface water quality are assessed by qualitative and quantitative studies (e.g., predictive modelling). After considering mitigation measures, predicted adverse effects on water quality due to a change in chemical concentrations (primarily increased concentrations of cadmium, copper, and selenium above guidelines and beyond the range of natural variability) were determined in P Creek, T Creek, and Harper Creek, and in the outlet of North Barrière Lake and Barrière River.

The residual effect on water quality in T Creek, during Closure and Post-Closure, is assessed as **significant (major).** T Creek receives chemical loading from unrecovered seepage from the TMF during Operations and discharge of excess water from the TMF during Closure and Post-Closure. Additional water management options to reduce concentrations of water quality parameters and mitigate water quality effects in T Creek continue to be investigated by HCMC through iterative technical and predictive studies. The results of these studies and details of additional mitigation measures will be made available to the EA Working Group as feasible options are identified.

Residual effects on P Creek and Harper Creek, the outlet of North Barrière Lake and Barrière River are assessed as **not significant (moderate)**. Residual effects are partially reversible and affect waterbodies with low resiliency due to the presence of Bull Trout.

Potential water quality effects in the outlet of North Barrière Lake and Barrière River were qualitatively assessed based on the predications in lower Harper Creek. There is some limited potential for a change in water quality in the outlet of North Barrière Lake and potentially the upper portion of Barrière River, until dilution is sufficient to reduce concentrations below BC water quality guidelines or background conditions.

No potential spatial interactions with other human actions are identified for Project-related residual effects due to change in water quality in P Creek, T Creek, or Harper Creek, the outlet of North Barrière Lake; therefore, no potential cumulative effects are identified.

Fish and Aquatic Resources

Fish and aquatic resources represent the ecological components of the aquatic environment that may be affected by the Project. Baseline studies of fish, fish habitat, and aquatic resources were conducted between 2008 and 2014 to characterize existing conditions in the waterways surrounding the Project Site. The fish community was composed of Bull Trout (*Salvelinus confluentus*), Coho Salmon (*Oncorhynchus kisutch*), Rainbow Trout (*O. mykiss)*, Mountain Whitefish (*Prosopium williamsoni*), Torrent Sculpin (*Cottus rhotheus*), and Longnose Dace (*Rhinichthys cataractae*). The distribution of fish is affected by the presence of natural barriers preventing many species from occupying the upstream reaches of creeks, including those within the Project Site.

In the Harper Creek watershed, Bull Trout are the most widely distributed, and were the only species found upstream of the 2-m waterfall at km 18.5 of upper Harper Creek, as well as in the lower fish-bearing reaches of T Creek and P Creek. All other fish species were observed only in the lower reaches of lower Harper Creek. Aquatic resources, which were defined as sediment quality and the communities of aquatic primary and secondary producers, in the area around the Project Site, consisted of low productivity communities of primary and secondary producers typical in headwater, high-relief streams. Sediments were composed mainly of sand with some gravel, and some metal concentrations in sediment were greater than sediment quality guidelines for the protection of aquatic life.

The Project Site has been confirmed as fishless; therefore, the assessment for potential residual effects on fish, fish habitat, and aquatic resources has focused on the environment downstream from the Project Site. The assessment of aquatic resources also included fishless streams within the Project Site.

Potential residual effects on fish, fish habitat, and aquatic resources from changes in water quantity and water quality were assessed using a combination of quantitative modelling for hydrology and water quality and qualitative analysis to predict the magnitude and extent of residual effects, and are discussed in Chapter 14. None of the three fish VC species, Bull Trout, Rainbow Trout, or Coho Salmon are listed on Schedule 1 of the federal *Species At Risk Act* (2002c). The predicted changes in water quantity in upper Harper Creek between P Creek and T Creek may have adverse effects on fish, fish habitat, and aquatic resources, as these sections of stream are likely to experience prolonged periods of decreased water quantity (through Post-Closure) below established threshold and pre-mine levels. After considering mitigation measures, including the Fish Habitat Offsetting Plan, this residual effect is assessed as **not significant (moderate)** in T Creek, P Creek, and upper Harper Creek, and **not significant (minor)** further downstream from the Project Site.

Residual effects to fish or aquatic resources associated with predicted changes in water quality in P Creek, T Creek, upper Harper Creek, and lower Harper Creek were identified, since predicted concentrations for a number of metals (e.g., cadmium, copper, selenium, and zinc) or ions (e.g., sulphate) are greater than BC water quality guidelines. The change in water quality could potentially affect fish or aquatic resources by affecting health, abundance, or community structure. This residual effect is assessed as **not significant (moderate)** in waterways downstream closest to the TMF (i.e., T Creek and upper Harper Creek), and **not significant (minor)** in waterways that are further away from the TMF (i.e., P Creek and lower Harper Creek). Additional water management options to reduce concentrations of water quality parameters and mitigate water quality effects in T Creek continue to be investigated by HCMC through iterative technical and predictive studies. The results of these studies and details of additional mitigation measures will be made available to the EA Working Group as feasible options are identified.

Predicted changes in water quality from nutrient loading are also predicted to cause observable changes in the primary and secondary producer communities in T Creek and upper Harper Creek. However, all of these predicted effects are restricted to the LSA. Therefore, because of the limited geographic extent and the expected recovery of aquatic resources in the long-term, the residual effects are assessed as **not significant (moderate)**.

No cumulative effects are predicted because no spatial overlap between Project residual effects and other projects, activities, or human actions are expected within the cumulative effects assessment boundaries.

Vegetation

Terrestrial ecosystems are biotic expressions of the interaction between soils and regional climate. They provide functions and ecological services including hydrology, wildlife, productivity, carbon cycling and human well-being. Project activities have the potential to affect terrestrial ecosystems and their components and VCs were selected to assess potential Project effects. VCs included rare plants, rock outcrops, and traditional use plants, ecological communities at risk (ECAR), wetlands, and old-growth forests.

Baseline vegetation studies were conducted to establish the presence and distribution of the potential VCs. A LSA of 11,084.5 ha was chosen that encompassed all Project facilities and included a 1-km buffer to capture potential Project effects. Terrestrial Ecosystem Mapping (TEM) and field surveys including rare plants were conducted in the LSA in 2011 and 2012. Based on these studies rare plants, ECAR, wetlands, and old-growth forests were selected as VCs. Rock outcrops and traditional plants were scoped out of the assessment.

Baseline studies identified 564 vascular plant species, 146 mosses, and 331 lichens in the LSA. Two Red- and five Blue-listed vascular plant species, three Red- and two Blue-listed mosses, and 21 listed lichen species occur in the LSA. Of the 12 ECAR identified as potentially occurring within the LSA, three were mapped by the TEM. Two of these are associated with forested ecosystems and the third is associated with fens. All three are Blue-listed by the BC Conservation Data Centre (BC CDC). Eight wetlands (208.7 ha) were identified by the TEM within the LSA. Vegetation resource inventory was used to identify 3093.6 ha of old-growth in the LSA.

To categorize effects on terrestrial ecology VCs, potential effects of the Project were divided into two categories: loss and alteration. Loss of VCs will occur in the Project Site due to clearing of vegetation and grubbing and will occur primarily during the Construction and Operations phases. Alteration to terrestrial ecology VC plants and ecosystems will potentially occur as a result of fugitive dust, contaminants, invasive species, and edge effects. Mitigation measures will be applied to reduce or offset Project effects by impact avoidance through Project design, by impact reduction and technical mitigation through modifications of Construction and Operations methods, and by reclamation.

Chapter 15 discusses the Project's potential effects on terrestrial ecology (vegetation) that were identified through best management practices, scientific literature, and technical expertise/professional judgment. Despite application of mitigation measures, residual effects of the Project on vegetation are expected. These effects include loss of habitat for rare plants, ECAR, wetlands, and old-growth forests, as well as habitat alteration for wetlands.

The Project will result in the loss of 10 rare plant occurrences, which is considered high magnitude and of regional extent, specifically for Howell's quillwort, where five occurrences will be lost and only a few other occurrences have been recorded in the province. Approximately 11% (13.9 ha) of all ECAR mapped in the LSA will be lost/removed as a result of Construction and Operations, including all 3.4 ha of the tufted clubrush /golden star moss and 9.3 ha or 46% of the Lodgepole pine / dwarf blueberry / peat-mosses ECAR. Loss of ECAR as a result of the Project will be high magnitude. The Project is expected to result in the loss of 140 ha of wetland-meadow areas within the LSA. Reclamation will provide 17.6 ha of wetlands which will mitigate this effect. Effects of habitat loss for rare plants, ECAR, and wetlands were assessed as **significant (major).** Alteration of wetlands and loss of old-growth forests were assessed as being **not significant (minor)** and **not significant (moderate)**, respectively**.**

The cumulative effects of the Project, when considering several sawmills and the Trans Mountain Pipeline were also assessed. Cumulative effects for all four VCs (rare plants, ECAR, wetlands, and old-growth forests) are assessed as being **not significant (minor)** or unknown. A follow-up program including additional field surveys in the ESSFwc2 within the RSA for rare plants specifically for Howell's quillwort are discussed in the Vegetation Management Plan (Section 24.17). Results from follow-up monitoring program may reduce these impacts, and successful high-elevation wetland reclamation could result in a change in the significance rating. A follow-up program to re-map the wetlands in and directly adjacent to the TMF will be conducted to more accurately characterize wetland extent and type, the details of which are discussed in the Vegetation Management Plan (Section 24.17). This information will refine the total loss of wetland extent caused by the project and inform reclamation planning activities.

Wildlife and Wildlife Habitat

Wildlife represents a highly valued component of the biophysical landscape and is protected under numerous land tenure agreements, and provincial and federal legislations. Multiple wildlife VCs were chosen to focus on the issues of highest concern based on potential spatial and temporal overlap between the Project and proposed VC, on governmental, First Nations, or stakeholder interests, and on availability of data and analytical tools to measure Project effects. The wildlife VCs include moose, mountain caribou, mule deer, grizzly bear, wolverine, fisher, bat species at risk, barn swallows, common nighthawk, harlequin duck, olive-side flycatcher, bald eagle, northern goshawk, and western toad.

Wildlife baseline studies were conducted primarily for the LSA and for some species for the RSA, using existing literature, field data, and habitat suitability mapping based on the TEM. Field surveys were conducted in 2008 and 2011 to determine presence and distribution of amphibians, migratory birds, raptors, bats, furbearers, bears, and ungulates. Habitat suitability models were developed for the LSA to provide a means of identifying the spatial extent and distribution of habitats and were used to assess the potential effects of the proposed Project. Habitat suitability models were developed for western toad, barn swallow, olive-sided flycatcher, bald eagle, northern goshawk, grizzly bear, moose, and caribou within the LSA, in conjunction with ecosystem mapping studies.

Potential effects on wildlife and wildlife habitat as a result of the Project were identified through best management practices, scientific literature, and technical expertise/professional judgment, as set out in Chapter 16. Application of proposed mitigation programs is anticipated to prevent residual effects to all but five of the fourteen wildlife VCs identified: western toad, Harlequin Ducks, Olive-sided Flycatcher, grizzly bear, and moose. Individual Harlequin Ducks (and their eggs and active nests) are protected under the *Migratory Birds Convention Act* (1994). Olive-sided Flycatchers and western toads are provincially Blue-listed and are listed on Schedule 1 of SARA; flycatchers are also designated as Threatened by COSEWIC (BC CDC 2014). Grizzly bear are provincially Blue-listed, federally listed as a species of Special Concern, and are an identified wildlife species under the *Forest and Range Protection Act* (2002b). The residual effects predicted are habitat alteration (for western toad, Harlequin Ducks, grizzly bear, and moose); habitat disturbance and displacement (for Olive-sided Flycatcher); and mortality (for western toad). These residual effects are all assessed as **not significant (moderate for western toad habitat loss, and minor for the rest).**

An assessment of cumulative effects was also conducted that evaluated the effects of the Project in addition to other mining projects, forestry, and other land use activities in the area. Four VCs were identified as potentially having residual cumulative effects: (western toad, Olive-sided Flycatcher, grizzly bear, and moose). While all four VCs with residual effects have the potential to be affected by cumulative interactions with other projects and activities in the RSA, cumulative effects are all considered to be **not significant (minor).**

Socio-economics

Potential socio-economic effects of the Project were assessed for four selected valued components: community growth (economic); housing; community infrastructure and services; and community health and well-being (social). The socio-economic regional study area included the following areas:

- Incorporated communities: Sun Peaks, Chase, Blue River, Avola, and Kamloops.
- Electoral Areas: Thompson Headwaters Electoral Area B, Rivers and the Peaks Electoral Area P, Wells Gray Country Electoral Area A, and Lower North Thompson Electoral Area O.
- Indian Reserves: Sahhaltkum IR#4 [Adams Lake Indian Band (ALIB)], Quaaout IR#1 [Little Shuswap Lake Indian Band (LSLIB)], and Neskonlith IRs#1 and 2 [Neskonlith Indian Band (NIB)].

Detailed information was collected to describe the existing conditions of community population and demographics; community infrastructure, services, and housing; education, skills development, and training; and community well-being. Detailed information is provided in Appendix 17-A, Socio-economic Baseline Data.

The assessment focussed on the following effects: increased competition for skilled labour; loss of a local employer; increase in housing demand; increased pressure on community infrastructure and services; increased pressure on public safety and protection services; change in family life; increased public health and safety risks on Highway 5 and local roads; and increased risks to worker health and safety resulting from unsafe conditions. The assessment concludes that one residual and one cumulative effect are anticipated. The assessment of increased competition for skilled workers within the RSA resulted in a **not significant (moderate)** finding for both a project and a cumulative effect. Mitigation measures include no-solicitation at local millworks, collaborating with employment service agencies, and establishing local employment and supply policies.

Commercial and Non-Commercial Land Use

Project-related effects on commercial and non-commercial land uses are assessed in Chapter 18. Commercial interests include forestry, agriculture and trapping, and non-commercial interests include public recreation, hunting and fishing. Effects were also assessed on navigable waters (portions of lower Harper Creek and the North Thompson River) as well as private land.

The two proposed power line route options cross private land, with ALR zoning, and a woodlot with a private land component. During Operations, Closure, and Post-Closure, entry on to private land may be required to monitor the power line. This access is expected to be infrequent. HCMC has initiated discussions with private landowners with respect to the route and construction of a power line, and potential mitigation options. HCMC will work with private landowners on the power line route to identify potential mitigation measures to enable power line construction; and secure necessary approval from the Agricultural Land Commission for the power line right of way (if it crosses ALR-zoned land).

The Project has the potential to affect access to navigable waters during the construction of the power line across the North Thompson River. Flows of navigable waterbodies may be impacted by the Operations, Closure, and Post-Closure phases. Based on the effects assessment, lower Harper Creek and North Thompson River are considered navigable as there is documented public and Aboriginal use of these waterbodies. No residual effects are anticipated on navigable waters as the power line will not substantially interfere with navigation, and HCMC has committed to meet Transport Canada standards and regulations for aerial cables (power and communication) (Transport Canada 2009a).

No impacts are expected on trapline holder as HCMC has mitigation agreements in place with trapline holders TR0337T001 and TR0341T003.

Mine construction will impact one range tenure, RAN077435, in the Harper Mountain Range Unit, which overlaps the Project Site (Figure 3). No impacts on RAN077435 are anticipated during any phase of the Project because the range tenure holder moved to a vacant grazing tenure outside of the LSA in 2014. Construction of the power line has the potential to temporarily disrupt the use of RAN077140, which overlaps the two proposed power line route options.

Local land owners use the FSRs to move sheep to alternative grazing areas outside the Project Site. HCMC will communicate and work with the private landowners regarding movement of sheep to grazing areas. This disruption will be temporary and short-term given the length of the Construction phase. HCMC has an agreement with BC FRNRO for potential impacts of the Project on use of this tenure (RAN077435); HCMC has agreed to the installation of a cattle guard to control livestock drift if needed; in consultation with BC MFLNRO along the mine access road, and installation of wing fencing, at appropriate locations along the mine access road to prevent cattle drift, if required; upgrading the FSRs to improve overall road condition and safety for users; monitoring of livestock movement along mine access road; and implementation of the Site Water Management Plan (Section 24.13) and Sediment and Erosion Control Plan (Section 24.11).

A short section of the proposed power line route enters RAN077141 to connect to the existing BC Hydro 138-kV transmission line near Vavenby. No impacts on RAN077141 are anticipated during any phase of the Project due to the limited interaction with the power line.

With the implementation of the identified mitigation measured (see Table 18.5-2), the Project is not expected to affect forest licensees' access and use of their tenures. No further consideration of effects is warranted.

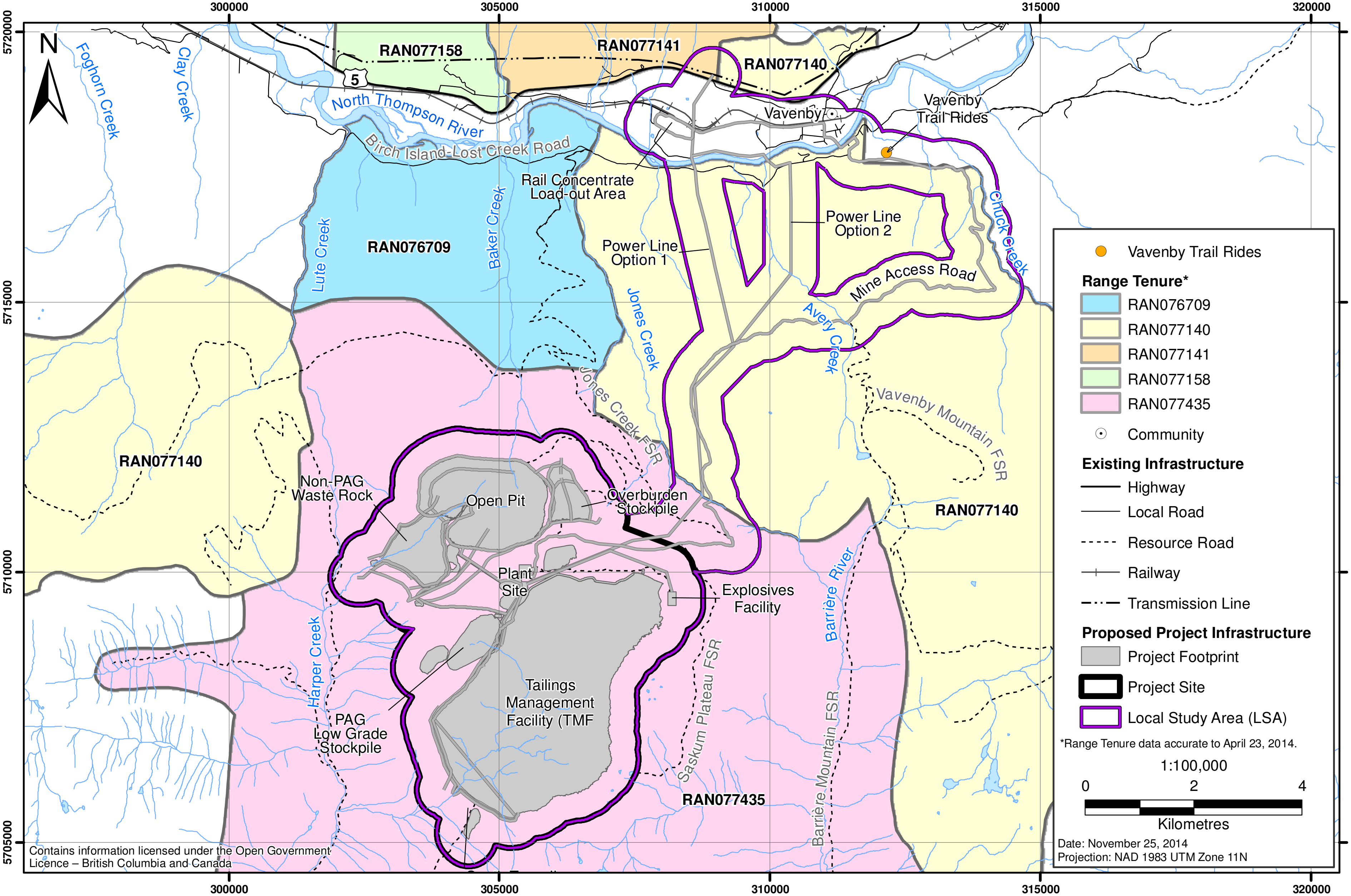
The commercial and non-commercial land use assessment identified only one residual effect as a result of the Project, a possible change in the quality and experience of the natural environment for public land users which resulted in a finding of **not significant (minor)** and no cumulative effects.

Visual Quality

Provincial or federal legislation do not directly regulate visual and aesthetic resource studies. The requirements of the *Forest and Range Practices Act* (2002b) apply to the forestry industry; however, proponents of developments other than those related to the forestry industry are, encouraged to apply the same design principles to limit the effect of their activities on visual quality. More particularly, the Kamloops LRMP (BC ILMB 1995) has identified visually sensitive areas with specific visual quality objectives, which indicate the desired visual condition of the area within their jurisdiction.

Figure 3

Range Tenures in the Local Study Area



Based on the knowledge that objects that occupy an arc of smaller than 0.5 degrees in size become invisible for the viewer (WMO 2008), an initial baseline study area was established of 56 km around the project components. Within this radius a viewshed analysis identified which areas have an unobstructed view on the Project based on the morphology of the landscape. The locations of land users, whether commercial, non-commercial or traditional, were superimposed over the outcome of the analysis, to identify the land users potentially affected by the Project. Figures are presented that illustrate the outcome of this analysis in relation to commercial and non-commercial recreation activities. From this analysis, 17 important viewpoints were selected for specific assessment.

The assessment indicated that five viewpoints are related to a visually sensitive area with a visual quality objective as described in the Kamloops LRMP. These viewpoints were assessed using the BC MFLNRO's Visual Impact Assessment Procedure (BC MOF 2008). The potential visual effect on the remaining 12 viewpoints were rated using the HASSEL Matrix (HASSELL 2005). This matrix uses five visual effect aspects, namely: the existing landscape visual character; the degree of modification; the horizontal effect; the vertical effect; and distance. The application of the matrix resulted in a final effect rating.

Spatial information, including baseline studies, geographic information systems (GIS), enhanced photographic imagery, and recognized tabular assessment methods, as detailed in Chapter 19, were used to assess the potential for the visual quality of the greater area to be affected by the visibility of infrastructure that would comprise the Project. The residual effect of alteration of the landscape associated with construction and operation activities is assessed as **not significant (moderate).**

Of the three active projects (the Vavenby and Barriere sawmills and the Trans Mountain Pipeline) and the four foreseeable future projects (the Shannon Creek Hydroelectric Project, North Thompson Transmission Project, Trans Mountain Pipeline Extension Project, and Foghorn Polymetallic Project), only the cumulative effects of the Vavenby Sawmill, North Thompson Transmission Project, and Foghorn Polymetallic Project warrant consideration, since the other four projects would fall outside the areas of potential visibility. Given the changed landscape at the Vavenby Sawmill's location and the disparate nature of the vistas from the sawmill, it was excluded from the cumulative effects assessment. Both the North Thompson Transmission Project and the Foghorn Polymetallic Project are greater than 8 km away from the Project, and were also excluded from the cumulative effects assessment. Thus, no cumulative effects on visual quality are anticipated.

Archaeology and Heritage

There are 32 known archaeological sites within the RSA, 25 of which are located in the North Thompson River Valley. Twenty-eight of the sites are prehistoric and four are historic. The 28 prehistoric sites include: six sites with only lithic material; two sites identified as petroforms; two sites with cultural depressions identified as cache pits; 18 sites that have at least one cultural depression identified as a house pit (two of which have an associated burial site). The four historic sites contain habitation features, including two potential homesteads, a log cabin, and a railway construction camp. Of the 32 sites in the RSA, only the two petroform sites (Eiqw-2 and EjQw-2) are located within the LSA. Five areas of archaeological potential were located in previously undisturbed areas that extend from the Vavenby-Saskum FSRs and along the two power line route options (Anderson 2014; Appendix 20-C).

The effects assessment for archaeology and heritage in Chapter 22 concludes there will be a residual effect related to the disturbance of known protected archaeological resources EiQw-2 and EjQw-2 (rock cairns), which was assessed as **not-significant (moderate**), and disturbance of unknown archaeological sites, which was assessed as **not-significant (minor).** No cumulative effects are expected as the two rock cairns identified at the Project Site can only interact with the Project (since it is within the Project Site). The function of the rock cairns is currently unknown. YMI will consult with the BC Archaeology Branch and potentially affected First Nations on mitigation measures.

Human Health

The human health effects assessment includes the regulatory and policy framework (Section 21.2), scoping the effects assessment (Section 21.3), and the baseline conditions of the Project area (Section 21.4). Section 21.5 describes the potential Project-related human health effects due to changes in noise level or air, drinking water, and country foods quality, along with mitigation measures. The significance of residual effects (Section 21.5.4) and the confidence and uncertainty in the determination of significance (Section 21.5.5) are provided based on the methodology outlined in Chapter 8. An assessment of cumulative effects to human health is also included (Section 21.6).

Residual effects on human health due to the Project may occur due to changes in:

- Air Quality
  - predicted 24-hour PM_{10} concentrations during the Construction phase were above the BC ambient air quality objective at the temporary construction camp for workers located on site and during the Operations phase at the upper pullout area for snowmobiles;
- Country Foods
  - emissions from the Project have the potential to affect the quality of country foods;
- Drinking Water Quality
  - predicted selenium concentrations in T Creek were above Health Canada and BC drinking water quality guidelines; and
- Noise Levels
  - predicted daytime noise levels were above the guideline for speech interference during the Construction phase at the upper pullout area for snowmobiles and during the Operations phase at the upper and lower pullout areas for snowmobiles; and
  - predicted nighttime noise levels at location T02 (a surface water licence location, C124889) were above the guideline for sleep disturbance.

Mitigation measures for the residual effects include:

- an Air Quality Management Plan;
- no hunting, fishing, or berry collecting at the Project Site; various management plans to minimize risk to environmental quality (e.g., air, water, soil, and vegetation quality) or VCs that are used as country foods (e.g., fish or wildlife);

- various management plans to minimize the changes in water quality; and
- a Noise Management Plan.

All of the residual effects to the human health VC listed above were rated as **not significant (minor)**.

No potential cumulative effects to human health due to changes in air quality, country foods, drinking water quality, and noise levels were identified due to a lack of spatial or temporal linkages with the Project residual effects. Therefore, no additional mitigation measures were identified and no characterization of cumulative residual effects is required.

Current Use of Lands and Resources for Traditional Purposes

"Current Use of Lands and Resources for Traditional Purposes" is defined as "any practice or activity that is part of the Aboriginal group's distinctive culture and has been routinely practiced by the Aboriginal group within a timeframe extending from the recent past to the present" (CEA Agency May 2014). Environmental effects caused by the Project that indirectly affect the current use of lands and resources for traditional purposes by Aboriginal peoples is a requirement to be assessed under CEAA (1992).

The proposed Project is located within the traditional territory of the Secwepemc (Shuswap) Nation which includes SFN, ALIB, NIB and LSLIB. The Secwepemc Nation asserts interests to Secwepemcul'ecw territory, an area that encompasses approximately 145,000 km^2 of the central interior region of the province. The Project Site is located within the asserted and historic territory of the North Thompson (Simpcwl'ecw) Division (Teit 1909), which today is recognized as SFN territory (SFN 2010). Less than 0.1% of SFN traditional territory is overlapped by the Project. ALIB, NIB, and LSLIB are members of the historical Shuswap Lakes Division. The Project Site is outside of the historical Lakes Division boundary. The Lakes Division members also assert interests in the Neskonlith Douglas Claim Reserve area, a few kilometers south of the Project Site. The northwest corner of the reserve claim area overlaps with the downstream receiving environment of the Project Site (i.e., Harper Creek and North Barrière Lake watershed). Historically, Métis have lived in the regional area of the Project, and may exercise their Aboriginal right to harvest within the Project site.

Hunting, trapping, fishing, gathering sustenance and medicinal plant foods, and pursuing other traditional activities are central to the economies of Aboriginal groups inhabiting the North Thompson River. Salmon is an important country food to the SFN and Lakes Division, procured by various fishing methods. Species hunted included moose, mule and white-tailed deer, and to a lesser extent mountain goat. Plant-derived sustenance foods and medicines are used extensively by these Aboriginal groups, with a reliance on a variety of plants including berries, edible tubers and bulbs, and medicinal plants.

During baseline studies for the Project the Simpcw have indicated they currently fish for Bull Trout in upper Harper Creek, and Rainbow Trout in the LSA; Sockeye, Coho, Chinook, Bull Trout and Rainbow Trout from the North Thompson River; and Sockeye, Coho and Chinook salmon from the Barrière River. Specific fishing sites or areas in upper Harper Creek have not been identified. The Project Site itself is non fish-bearing. Simpcw historically shared caribou hunting territories from north of Adams Lake, throughout the TumTum, Oliver, Finn, and Avola Creek Areas with members of the historical Shuswap Lakes Division (Appendix 22-A). Documented hunting sites are outside of the Current Aboriginal Use LSA but within the RSA. Simpcw have also identified traditional food gathering sites in the LSA and RSA. Sites in the LSA include areas near Vavenby, Harp and Vavenby Mountains, Harper Creek, along the North Thompson River from Vavenby to Messiter, north and south shores of the North Thompson River between Vavenby and Clearwater, and the south side of the North Thompson River, and both sides of Chuck Creek.

Based on the review of publically available secondary source materials and YMI's consultations with the ALIB, NIB, and LSLIB, fishing sites, hunting and trapping areas, plant gathering sites, habitations, trails, cultural or spiritual sites used by the Shuswap Lakes Division have not been identified within the Current Aboriginal Use LSA, including near the Project Site. The ALIB did provide a list (Appendix 23-C) of culturally important fish, wildlife and plant species which were considered in the terrestrial ecology (Chapter 15), wildlife (Chapter 16), human health (Chapter 21), and current use of lands and resources (Chapter 22) assessments.

Within the Thompson-Okanagan region, MNBC have identified historic and traditional pursuits that include subsistence harvesting and trapping (Letter from MNBC to HCMC, December 22, 2011; Appendix 23-D). HCMC has reviewed information on the MNBC website and asked MNBC for specific information on how the Project may impact their Aboriginal interests. At the time of submission of the Application/EIS no information has been received. Review of available secondary source materials did not identify any current fishing, hunting, trapping, or gathering sites or areas, or current use of habitations, trails, cultural or spiritual sites used by MNBC within the Current Aboriginal Use LSA or RSA.

The effects assessment for Current Aboriginal Use in Chapter 22 concludes that four residual and two cumulative residual effects are anticipated. The assessment of a possible change in the ability to access or use cultural sites (rock cairns) resulted in a **not-significant (moderate)** finding and no cumulative effects. The assessment of possible changes in the quality and experience of the natural environment resulted in a **not-significant (moderate)** finding for both project and cumulative effects, while the possible change in abundance and distribution of fish resources resulted in a **not-significant (minor)** finding and no cumulative effects. The assessment of possible changes in the abundance and distribution of hunting and trapping resources resulted in a **not-significant (minor)** finding for both project and cumulative effects.

The Project is considered unlikely to result in significant adverse effects on current Aboriginal use.

Assessment of Aboriginal Rights and Interests

YMI initiated consultations with Aboriginal groups in 2006 and 2007[2], prior to formally entering the EA process in September 2008[3]. YMI engagement activities with Aboriginal groups during the

[2] The exception is consultation with the Métis Nation BC (MNBC), whom YMI first engaged in early 2012.

pre-Application stage have included meetings, site visits, correspondence, information distribution, and First Nations' participation in environmental baseline studies. The purpose of YMI's engagement activities was to provide Aboriginal groups with the information they require to determine if and how the Project may affect their Aboriginal rights and related interests, and to provide Aboriginal groups with the opportunity to share information about their Aboriginal rights and related interests as they relate to the Project. Engagement activities were also intended to provide First Nations with the opportunity to identify issues and concerns about the Project, and discuss potential mitigation and accommodation measures. Since the beginning of the EA process, YMI has adapted its consultation efforts in accordance with provincial section 11 and 13 Orders, the strength of claim assessments completed by the provincial and federal governments, and the stated preferences of the First Nations involved. Consultation is an on-going process and will continue throughout the life of the Project.

Consultation with the MNBC by YMI has focused on opportunities to provide information on traditional knowledge and traditional use in relation to the Project, and providing Project updates and information. YMI will continue to communicate and provide opportunities for the MNBC to provide information regarding concerns or potential impacts on their interests during the Application/EIS review stage.

Issues raised by Aboriginal groups around effects on a number of VCs included the following issues summarized as:

- **Surface water quantity**: changes to water quantity on fish and aquatic habitat, due to a reduction in flows on Harper, Baker, and Jones creeks;
- **Fish and fish habitat**: effects of construction of the TMF on downstream fish and aquatic habitat resulting in a loss of fish habitat and reduced Bull Trout productivity;
- **Air quality**: effects of fugitive dust deposition on aquatic and plant habitat, and possible contamination of country foods;
- **Wildlife**: habitat alteration and potential displacement of wildlife (moose and grizzly bear) due to sensory disturbance (noise; traffic);
- **Cultural heritage**: potential for impacts on access to, and practices within, culturally important areas impacted by mining operations; and
- **Current use of lands and resources for traditional purposes**: potential impacts on fishing, hunting and trapping, gathering and other culturally important sites located within the Project Site.

There is a lack of detailed, site-specific information related to where First Nations' currently use lands and resources within the Project Site and local area. For this reason, a conservative approach was taken on the assessment of the impacts on Aboriginal rights. It was assumed that rights can be

[3] Consultation was suspended between early 2009 until late 2010 when the Project was put on hold. Consultation activities resumed in early 2011 when the BC Environmental Assessment Office (BC EAO) and Canadian Environmental Assessment Agency (CEA Agency) accepted the updated Project Description.

exercised anywhere in a First Nations asserted traditional territory regardless of whether ethno-historical data supports site-specific use or not. The assessment on current use of lands and resources for traditional purposes and impacts on Aboriginal rights resulted in the following conclusions (Table 28.6-2):

- Change in the ability to access or use cultural sites due to the loss of the rock cairns currently situated in the area of the proposed TMF; this was determined to be a **not significant (moderate)** impact on cultural use rights for the SFN, and a **not significant (negligible)** impact on cultural use rights for the historical Lakes Division members and MNBC;
- Changes in the quality and experience of the natural environment in the Harp Mountain area due to changes in visual quality; assessed as having a **not significant** (**moderate)** impact on cultural use rights (for the SFN), and a **not significant** (**negligible)** impact on cultural use rights for the historical Shuswap Lakes Division members and MNBC;
- Change in the abundance and distribution of fish (Bull Trout) resources due to changes in surface water quantity in P and T creeks and upper Harper Creek (between P and T creeks) and country foods quality in the lower Harper Creek and North Barièrre River watershed; this effect was assessed as **not significant** (**minor)** for impacts on SFN and historical Lakes Division fishing rights, and a **not significant** (**negligible)** impact on MNBC fishing rights;
- Change in the abundance and distribution of wildlife resources (moose) as a result of habitat alteration; assessed as having a **not significant** (**negligible)** impact on hunting rights for all Aboriginal groups; and
- Change in access to gathering resources as a result of habitat loss across the Project Site; this effect was considered to be **not significant (minor)** on SFN gathering rights, and a **not significant (negligible)** impact on the historical Shuswap Lakes Division member bands and MNBC gathering rights.

Impacts on other Aboriginal interests, issues and concerns that do not have a rights based component were also assessed. Based on the issues identified in Appendix 3-F, key concerns and their association with Aboriginal peoples included:

- Employment and training opportunities, and barriers to such (e.g., community capacities and skills levels) (assessed in Chapter 17);
- Impacts to community socio-economic development (assessed in Chapter 17);
- Concern regarding impacts of the mine operation on culture, health and social well-being (assessed in Chapter 17);
- Socio-economic and cultural effects (Assessed in Chapters 17, 22, and 23); and
- Job and income stability for community members employed with the Project (assessed in Chapter 17).

Potential effects to human health and socio-economic and cultural impacts on First Nations communities were also assessed, and took into consideration air quality, drinking water quality, country foods quality, and noise. Residual effects to human health had a negligible magnitude and were **not significant (minor).** This means that human health would not be expected to change noticeably from baseline conditions.

Potential effects on socio-economic and cultural impacts took into consideration economic, social, and cultural well-being. Generally, positive effects would be expected due to increased opportunity for First Nations employment and income, and business capacity and investment throughout the Project until the Closure or Post-Closure phases. The potential for some effects on economic well-being may occur during Project Closure (i.e., ending of employment or business opportunities), or due to competition for skilled workers during Project Operations. The potential for some effects were noted for social well-being such as an increased demand for housing, increased pressure on community infrastructure or social services, and social risks due to increased income levels and stress on families. The potential for effects on cultural well-being may include cultural effects related to shift work, increased income, or changes in the frequency of traditional land use. However, with mitigation, residual effects to economic, social, or cultural well-being are not expected.

FEDERAL REQUIREMENTS

Accidents and Malfunctions

The Application/EIS assess the environmental effects of the following potential accidents and malfunctions, in accordance with the requirements under CEAA (1992):

- Spills and leaks, including fuel, concentrate, or other hazardous material spills:
  - fuel spill on land;
  - fuel spill on water;
  - spill of hazardous substance on land;
  - spill of hazardous substance on water
- Fires or explosions:
  - fire or explosion on site;
  - fire or explosion causing a wildfire
- Failure of sediment and erosion control measures; and
- Failure of the TMF containment dam:
  - overtopping of dam;
  - catastrophic failure of TMF dam

A fuel spill into the terrestrial or aquatic environments could occur as a result of an accident that releases some or all of a load of fuel along the main access road during transportation. The evaluated scenarios assume the entire load of a standard tri-drive fuel truck (48,000 L) to be deposited into the terrestrial environment along the transport route. A fuel spill into the terrestrial environment is expected to have a moderate to high risk of interaction with air quality, groundwater, rare plants, vegetation, and wildlife. A fuel spill in water is expected to have a moderate to high risk of interaction with surface water quality, fish and fish habitat, aquatic resources, ecological communities at risk, rare plants, wetlands, and wildlife. Both scenarios have a **Low** probability of occurring during the Construction and Operations phases. For a spill to the terrestrial environment, a consequence rating of **Low** was allocated, with an associated **Low** overall risk assessment. For a spill into the aquatic environment, a consequence rating of **High** was allocated, with an associated **Moderate** overall risk assessment.

With respect to a hazardous spill, the spill of copper concentrate was considered. A hazardous substances spill on land would have a moderate to high risk of interaction with air quality, groundwater, vegetation and wildlife. A hazardous substances spill on water would have a high to moderate risk of interaction with surface water quality, fish and fish habitat, aquatic resources, vegetation, and wildlife. Both scenarios have a **Low** probability of occurring during the Construction and Operations phases, a consequence rating of **Moderate** was allocated, with associated **Moderately-low** overall risk assessments.

A fire or explosion could be caused by a number of failure modes, including equipment or machinery malfunction, improper use or storage of explosives, combustion of inflammable materials, or careless human activity. Environmental factors such as dry summer weather, high winds, and lightening can increase the risk of fires. A fire or explosion on-site would have a moderate to high risk of interaction with air quality, noise, and groundwater. This scenario has a **Moderate** probability of during Construction and Operations, a consequence rating of **Low** was allocated, with associated **Moderately-low** overall risk assessments.

A forest fire caused by a fire or explosion on the Project Site could expand outside the boundaries of the Project and therefore cause a wildfire. A wildfire could also arise from an off-site vehicle accident. A fire or explosion causing a wildfire would have a high to moderate risk of interaction with all biophysical VCs. This scenario has a **Low** probability of occurring during Construction and Operations; however, a consequence rating of **High** was allocated due to the potentially large temporal and geographical of extent of effects to several VCs. As a result, an overall risk assessment of **Moderate** was assigned**.**

With respect to a failure of the sediment and erosion control measures, the resultant effects will lead to increased surface erosion from disturbed areas, increased sediment load to downstream receiving environments, and siltation or erosion of downstream watercourses or waterbodies. The failure of sediment and erosion control measures would have a moderate risk of interaction with surface water, fish and fish habitat, aquatic resources, and vegetation. This scenario has a **Low** probability of occurring during Construction and Operations with a corresponding consequence rating of **Low**. As a result, an overall risk assessment of **Low** was assigned**.**

The dam overtopping scenario assumes that an unknown volume of water overtops the larger, south embankment. Dam overtopping could conceivably be caused by an extreme hydrologic event, such as an unprecedented rain storm during the spring melt (i.e., a rain-on-snow event). The overtopping of the TMF dam would have a moderate to high risk of interaction with surface water, fish and fish habitat, aquatic resources, vegetation, amphibians, and land use. This scenario has a **Negligible** probability of occurring during Construction and Operations, with a corresponding consequence rating of **High**. As a result, an overall risk assessment of **Moderately-low** was assigned**.**

Although catastrophic dam failures are extremely rare and the majority are caused by issues surrounding water, failure can also be caused by operational error or an unexpected seismic event. A catastrophic TMF dam failure would have a high risk of interaction with surface water, fish and fish habitat, aquatic resources, vegetation, and wildlife. This scenario has a **Negligible** probability of occurring all Project phases, with a corresponding consequence rating of **Severe**. As a result, an overall risk assessment of **Moderate** was assigned**.**

Table 4 summarizes the environmental risk predicted for each accidents and malfunction scenario.

Table 4. Summary of Risk for the Potential Accidents and Malfunctions

Probability	Consequence				
	Negligible	Low	Moderate	High	Severe
Negligible			TMF embankment overtopping.		Catastrophic TMF dam failure.
Low		Fuel spill on land. Failure of sediment/erosion control measures.	Spill of hazardous substances on land. Spill of hazardous substances in water.	Fire or explosion causing a wildfire. Fuel spill in water.	
Moderate		Fire or explosion on site.			
High					
Severe					

Capacity of Renewable Resources

The Application/EIA considered potential Project-related effects to renewable resources, in accordance with the requirements under CEAA (1992), which state the environmental assessments must address the capacity of renewable resources that are likely to be significantly affected by the Project to meet the needs of the present and the future.

The assessment was carried out through the evaluation of the effects on VCs considered to act as renewable resources. Project-related effects to renewable resources were characterized, and the capacity of resources that may be affected by the Project to provide for current and future uses was evaluated. Resources that may be "significantly affected" by the Project were defined as those that had residual effects from the Project following mitigation, and where residual effects were of moderate to major scale.

Several VCs were considered to be renewable resources and were evaluated for Project-related effects, including air quality, fish and fish habitat, moose, mule deer, mountain caribou, commercial interest – forestry, commercial interest – agriculture, and commercial interest – trapping. Of these, only air quality and fish and fish habitat were expected to have moderate scale residual effects, while the remainder had no residual effects or residual effects of minor scale.

The capacity of renewable resources to continue to meet the needs of the present and those of the future is not anticipated to be significantly affected by the Project for air quality and fish and fish habitat. There will be increases in CAC emissions and fugitive dust deposition over the life of the Project, which will affect air quality, but these effects will be localized to the Project and baseline air quality will be restored following closure. Therefore, the capacity of the atmospheric environment to continue providing clean air for current and future resource users will not be affected.

EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Potential effects of the environment on the Project were assessed in accordance with section 2(1) of CEAA (1992). The potential environmental effects that were assessed include:

- climatic conditions, typically as a result of extreme weather events, including:
  - typical, wet and dry periods of precipitation;
  - extreme temperatures and freeze-thaw cycles;
- surface water flows;
- wildfires;
- geophysical events, including:
  - natural seismic events and associated effects such as liquefaction;
  - slope stability and mass wasting events; and
- climate change.

The elevation at the proposed Project Site is about 1,800 metres above sea level (masl). Mean annual air temperature in the Project area is approximately 1.2ºC, with short warm summers and long cold winters. The mean annual precipitation for the Project Site between 2007 and 2011 was 420 millimetres (mm; ERM Rescan 2014). Near the Project Site, the highest average measured monthly snowpack was 48.0 cm, measured in December 2012. The Project is located in area of low seismic risk, but a relatively high risk of wildfires.

The assessment found that the Project facilities and infrastructure have been designed to handle extreme weather events and other potential effects of the environment. To address seismic events and potential effects, the Project has been designed to meet anticipated seismic requirements. Return periods of 5,000 and 10,000 years for earthquakes of 7.0 and 7.3 magnitude respectively were selected as conservative design parameters for the Project. The potential effects to the Project from climate change impacts will be taken into account in the design of the Project facilities. However, even with design and further mitigation measures, the Project may be affected by forest fires which could result in some temporary disruptions until mine operations can be fully restored. An Emergency Response Plan including procedures in response to forest fires will be developed and implemented as part of the Environmental Management System described in Chapter 24.

FOLLOW-UP PROGRAMS

In accordance with the *Operational Policy Statement for Follow-Up Programs under the Canadian Environmental Assessment Act* (CEA Agency 2011), follow-up programs (the purpose of which are to verify the accuracy of the conclusions reached in the Application/EIS and/or to determine the effectiveness of any measures taken to mitigate the adverse effects of the Project) have been proposed for groundwater quality, fish and aquatic resources, rare plants, ecosystems at risk, and wetlands.

Groundwater Quality Follow-up Program

Groundwater Management Plan. A follow-up long-term groundwater monitoring plan has been developed as part of the Groundwater Management Plan (Section 24.8) to monitor the potential effects on groundwater in the catchments downstream of the major mine components. An adaptive management plan can be initiated if the monitoring results show that the effect in the receiving groundwater environment is significant enough to warrant further attention.

Fish and Aquatic Resources Follow-up Programs

Selenium Management Plan. The Selenium Management Plan is proposed as a follow-up program to proactively mitigate risks due to selenium in the aquatic environment. The framework of the Selenium Management Plan is designed to meet best practices for environmental and technical performance objectives for the Project, in addition to ensuring statutory requirements are considered and addressed. The framework of the Selenium Management Plan is supported by four aspects: prediction, prevention, mitigation, and monitoring, that together form an effective strategy to achieve environmental protection. Monitoring of water quality, sediment quality, and tissue residues in biota is included as part of the Selenium Management Plan. Potential risks due to selenium will be adaptively managed based on the results of the proposed monitoring plan to ensure that risks are mitigated before adverse effects occur in the receiving environment.

Fish Habitat Offsetting Plan. The development of the TMF and waste rock storage infrastructure will take place in non-fish bearing portions of T Creek and P Creek. However, due to flow reductions causing a loss of fish habitat in upper Harper Creek (between P Creek and T Creek), P Creek, and T Creek, a *Fisheries Act* authorization will be required, supported by a fish habitat offsetting plan. A Fish Habitat Offsetting Plan (FHOP; Appendix 14-E) was developed for the Project in accordance with *Fisheries Act* requirements and the Fisheries Protection Policy Statement (DFO 2013). The FOP is concerned exclusively with the design of two offsetting options in Lion Creek and lower Harper Creek. The FHOP was developed with input from the Department of Fisheries and Oceans (DFO) and the British Columbia Ministry of Environment (MOE).

Terrestrial Ecology Follow-up Programs

Rare Plants and Ecosystems at Risk Surveys. The confidence in the characterization of the residual Project effects to rare plants was considered to be low. Based on the current information, rare plants will experience significant adverse cumulative effects. However, this is an artefact of a lack of regional knowledge. Although general conclusions of the Projects effects on rare plants are sound, the distribution of rare plants outside of the survey areas is unknown. As such, it is difficult to determine the scale of the effect of the Project on rare plant abundance and distribution. Establishing the distribution and extent of additional rare plant occurrences within the ESSFwc2 will help to better characterise the regional impacts of the project. Additional field surveys in the ESSFwc2 within the RSA for rare plants, specifically for Howell's quillwort, should be conducted as part of a Follow-up Program, the details of which are discussed in the Vegetation Management Plan (Section 24.17).

Similarly, knowledge of the presence and distribution of ECAR in the RSA is limited. Establishing the distribution and extent of additional ECAR occurrences within the ESSFwc2 would help better characterize the effects of the Project and enable a determination of significance.

Wetland Mapping. Due to the complex mosaic of wetlands and upland terrestrial ecosystems located in the proposed TMF area, accurate mapping of these areas on hardcopy photos is challenging and potential overestimates of wetland extent can occur. Use of new technologies such as new high resolution imagery and light detection and ranging (LIDAR) information provide much greater resolution and allow for more accurate delineation and interpretation of ecosystem boundaries and types. During final Project design, new imagery, LIDAR, or other high resolution remote sensing data may be required. A Follow-up Program to re-map the wetlands in and directly adjacent to the TMF will be conducted to more accurately characterize wetland extent and type, the details of which are discussed in the Vegetation Management Plan (Section 24.17). This information will refine the total loss of wetland extent caused by the project and inform reclamation planning activities.

Summary And Conclusions

The Application/EIA represents the Proponent's proposal for the Harper Creek Project. The purpose of this Application/EIS is to demonstrate that the Project will be environmentally, socially and economically beneficial, and will meet objectives of various government and regulatory bodies for responsible resource development. The Project will promote economic activity in BC, particularly in the North Thompson – Nicola region of BC. It will provide jobs, generate business opportunities, and produce local, provincial and federal tax revenues.

HCMC believes that the Project can also be implemented without lasting adverse local or regional environmental or economic effects, and without undermining family or community wellbeing, public health or the rights and interests of potentially affected Aboriginal groups. The Project will be developed in accordance with applicable regulations, industry standards, and responsible mining practices that comply with sustainable development standards.

The Harper Creek Project also poses a relatively low risk of adverse environmental, social, economic, health, are heritage effects. While some effects are unavoidable, HCMC is committed to working with local communities, Aboriginal peoples, and regulatory agencies to ensure that such effects are minimized.

The conclusions of the proponent's assessments of the Project-specific and cumulative residual effects of the Harper Creek Project are summarized in Table 5.

Table 5. Summary of Residual Effects, Mitigation Measures, and Significance

Key Residual Effects	Project Phase	Mitigation Measures	Significance of Residual Effects	
			Project	Cumulative
Air Quality (Chapter 9)				
Increase in TSP, PM_{10};, $PM_{2.5}$, and dust deposition	Construction, Operations 1, Operations 2	Emission reduction measures, e.g., baghouses. Fugitive dust reduction measures, e.g., road watering. Implementation of: • Air Quality Management Plan	Not significant (moderate)	Not significant (moderate)
Noise (Chapter 10)				
Increase in noise level	Construction	Consider noise in equipment selection, adequate maintenance, reduce vehicle speed, avoid idling, and optimize construction design and site layout. Implementation of: • Noise Management Plan	Not significant (minor)	Not significant (minor)
Increase in noise level	Operations	Consider noise in equipment selection, adequate maintenance, reduce vehicle speed, avoid idling, and optimize construction design and site layout. Implementation of: • Noise Management Plan	Not significant (minor)	Not significant (minor)

(continued)

Table 5. Summary of Residual Effects, Mitigation Measures, and Significance (continued)

Key Residual Effects	Project Phase	Mitigation Measures	Significance of Residual Effects	
			Project	Cumulative
Groundwater (Chapter 11)				
Alteration of groundwater levels and flow patterns (flow directions, hydraulic gradients and flow rates) arising from mine activities, waste rock and water management	Construction, Operations, Closure, Post-Closure	Decommission and removal of open pit water management system during Operations 2, pit refilled with water but elevation controlled, and excess water pumped to tailings management facility. Partial reclamation of non-PAG waste rock stockpile during Operations 2 and final reclamation during Closure; decommission and removal of the Water Management Pond during the final reclamation at Closure. Low-grade ore stockpiles stored in the TMF catchment during Operations 1, processed and removed in Operations 2. For PAG waste rock stockpile, sub-aqueous disposal and management inside the TMF during Operations. For low-grade ore stockpile, ores processed and removed in Operations 2. Progressive reclamation of overburden stockpile during Operations 2. Partial reclamation of topsoil stockpiles during Construction and Operations, and removal during Closure. Partial reclamation of TMF tailings beaches and embankments during Operations 2, and final reclamation of TMF embankments and beaches during Closure; decommission and reclamation of the Water Management Pond during final reclamation at Closure. Implementation of: • Groundwater Management Plan • Mine Waste and ML/ARD Management Plan • Site Water Management Plan	Not significant (moderate)	n/a

(continued)

Table 5. Summary of Residual Effects, Mitigation Measures, and Significance (continued)

Key Residual Effects	Project Phase	Mitigation Measures	Significance of Residual Effects: Project	Significance of Residual Effects: Cumulative
Groundwater (Chapter 11; cont'd)				
Degradation of groundwater quality due to seepage of contact water	Construction, Operations, Closure, Post-Closure	Open pit refilled with water but elevation controlled and excess water pumped to TMF. At the non-PAG waste rock stockpile, runoff diversion and collection ditches; seepage collection and storage in TMF during Operations; partial reclamation during Operations 2 and final reclamation during Closure; decommission and removal of Water Management Pond during final reclamation at Closure. Low-grade ore stockpiles stored in TMF catchment during Operations 1, processed and removed in Operations 2. At the PAG waste rock stockpile, sub-aqueous disposal and managed inside TMF during Operations, reclaimed with TMF at Closure. For the low-grade ore stockpile, ores processed and removed in Operations 2. Progressive reclamation of the overburden stockpile during Operations 2. Partial reclamation of the topsoil stockpiles during Construction and Operations, and used for reclamation and removal during Closure. Partial reclamation of TMF tailings beaches and embankments during Operations 2, and final reclamation of TMF embankments and beaches during Closure; decommission and reclamation of the Water Management Pond during final reclamation at Closure. Low-permeability embankment materials, seepage collection drains and recovery pond, pumping back. Implementation of: • Groundwater Management Plan • Mine Waste and ML/ARD Management Plan	Not significant (moderate)	n/a

(continued)

Table 5. Summary of Residual Effects, Mitigation Measures, and Significance (continued)

Key Residual Effects	Project Phase	Mitigation Measures	Significance of Residual Effects: Project	Significance of Residual Effects: Cumulative
Hydrology (Chapter 12)				
Altered streamflow	Construction, Operations, Closure, Post-Closure	Separating non-contact and contact water, and reusing contact water to minimize the use of freshwater, and therefore to minimize streamflow changes. Implementation of: • Sediment and Erosion Control Plan (to avoid morphologic changes) • Site Water Management Plan	Not significant (moderate)	n/a
Surface Water Quality (Chapter 13)				
Change in surface water quality in P Creek	Operations	Implementation of: • Air Quality Management Plan • Fish and Aquatic Effects Monitoring and Management Plan • Groundwater Management Plan • Mine Waste and ML/ARD Management Plan • Sediment and Erosion Control Plan • Selenium Management Plan • Site Water Management Plan • Soil Salvage and Storage Plan	Not significant (moderate)	n/a
Change in surface water quality in T Creek	Closure and Post-Closure	Implementation of: • Air Quality Management Pla; • Fish and Aquatic Effects Monitoring and Management Plan • Groundwater Management Plan • Mine Waste and ML/ARD Management Plan • Sediment and Erosion Control Plan • Selenium Management Plan • Site Water Management Plan • Soil Salvage and Storage Plan	Significant (major)	n/a

(continued)

Table 5. Summary of Residual Effects, Mitigation Measures, and Significance (continued)

Key Residual Effects	Project Phase	Mitigation Measures	Significance of Residual Effects	
			Project	Cumulative
Surface Water Quality (Chapter 13; cont'd)				
Change in surface water quality in upper Harper Creek	Construction, Operations, Closure, and Post-Closure	Implementation of: • Air Quality Management Plan • Fish and Aquatic Effects Monitoring and Management Plan • Groundwater Management Plan • Mine Waste and ML/ARD Management Plan • Sediment and Erosion Control Plan • Selenium Management Plan • Site Water Management Plan • Soil Salvage and Storage Plan	Not significant (moderate)	n/a
Change in surface water quality in lower Harper Creek	Closure and Post-Closure	Implementation of: • Air Quality Management Plan • Fish and Aquatic Effects Monitoring and Management Plan • Groundwater Management Plan • Mine Waste and ML/ARD Management Plan • Sediment and Erosion Control Plan • Selenium Management Plan • Site Water Management Plan • Soil Salvage and Storage Plan	Not significant (moderate)	n/a

(continued)

Table 5. Summary of Residual Effects, Mitigation Measures, and Significance (continued)

Key Residual Effects	Project Phase	Mitigation Measures	Significance of Residual Effects: Project	Significance of Residual Effects: Cumulative
Surface Water Quality (Chapter 13; cont'd)				
Change in surface water quality at the outlet of North Barrière Lake and Barrière River[4]	Closure, and Post-Closure	Implementation of: • Air Quality Management Plan • Fish and Aquatic Effects Monitoring and Management Plan • Groundwater Management Plan • Mine Waste and ML/ARD Management Plan • Sediment and Erosion Control Plan • Selenium Management Plan • Site Water Management Plan • Soil Salvage and Storage Plan	Not significant (moderate)	n/a
Fish and Fish Habitat (Chapter 14)				
Changes in surface water quantity	Construction, Operations, Closure, Post-Closure	Diverting non-contact and contact water; maintaining natural networks; reusing contact water to minimize the use of freshwater. Implementation of: • Sediment and Erosion Control Plan (to avoid morphologic changes) • Fish and Aquatic Effects Monitoring and Management Plan • Site Water Management Plan • Fish Habitat Offsetting Plan	Not significant (moderate)	n/a[a]

(continued)

[4] Potential water quality effects in the outlet of North Barrière Lake and Barrière River were qualitatively assessed based on the predications in lower Harper Creek. There is some limited potential for a change in water quality in the outlet of North Barrière Lake and potentially the upper portion of Barrière River, until dilution is sufficient to reduce concentrations below BC Water Quality Guidelines or background conditions.

Table 5. Summary of Residual Effects, Mitigation Measures, and Significance (continued)

Key Residual Effects	Project Phase	Mitigation Measures	Significance of Residual Effects	
			Project	Cumulative
Fish and Fish Habitat (Chapter 14; cont'd)				
Potential for toxicity due to changes in water quality in P Creek and Lower Harper Creek	Construction, Operations, Closure, Post-Closure	Implementation of: • Mine Waste and ML/ARD Management Plan • Fish and Aquatic Effects Monitoring and Management Plan • Selenium Management Plan • Soil Salvage and Storage Plan • Site Water Management Plan • Sediment and Erosion Control Plan • Explosives Handling Plan	Not significant (minor)	n/a[a]
Potential for toxicity due to changes in water quality in T Creek and Upper Harper Creek	Construction, Operations, Closure, Post-Closure	Implementation of: • Mine Waste and ML/ARD Management Plan • Fish and Aquatic Effects Monitoring and Management Plan • Selenium Management Plan • Soil Salvage and Storage Plan • Site Water Management Plan • Sediment and Erosion Control Plan • Explosives Handling Plan	Not significant (moderate)	n/a[a]
Aquatic Resources				
Changes in water quantity	Construction, Operations, Closure, Post-Closure	Diverting non-contact and contact water; maintaining natural networks; reusing contact water to minimize the use of freshwater. Implementation of: • Sediment and Erosion Control Plan (to avoid morphologic changes) • Fish and Aquatic Effects Monitoring and Management Plan • Site Water Management Plan • Sediment and Erosion Control Plan • Fish Habitat Offsetting Plan	Not significant (moderate)	n/a[a]

(continued)

Table 5. Summary of Residual Effects, Mitigation Measures, and Significance (continued)

Key Residual Effects	Project Phase	Mitigation Measures	Significance of Residual Effects	
			Project	Cumulative
Potential for toxicity due to changes in water quality in P Creek and Lower Harper Creek	Construction, Operations, Closure, Post-Closure	Implementation of: • Mine Waste and ML/ARD Management Plan • Fish and Aquatic Effects Monitoring and Management Plan • Selenium Management Plan • Soil Salvage and Storage Plan • Site Water Management Plan • Sediment and Erosion Control Plan • Explosives Handling Plan	Not significant (minor)	n/a[a]
Potential for toxicity due to changes in water quality in T Creek and Upper Harper Creek	Construction, Operations, Closure, Post-Closure	Implementation of: • Mine Waste and ML/ARD Management Plan • Fish and Aquatic Effects Monitoring and Management Plan • Selenium Management Plan • Soil Salvage and Storage Plan • Site Water Management Plan • Sediment and Erosion Control Plan • Explosives Handling Plan	Not significant (moderate)	n/a[a]
Effects due to nutrient loading	Construction, Operations, Closure, Post-Closure	Diverting contact and mine water to TMF; Implementation of: • Explosives Handling Plan	Not significant (moderate)	n/a[a]
Terrestrial Ecology (Chapter 15)				
Vegetation				
Loss of rare plants	Construction, Operations	Avoidance where possible, protect (dust control), flagged buffers, reclamation of wetlands, regional Howell's quillwort surveys in the ESSFwc2. Implementation of: • Air Quality Management Plan • Vegetation Management Plan	Significant (major)	Unknown

(continued)

Table 5. Summary of Residual Effects, Mitigation Measures, and Significance (continued)

Key Residual Effects	Project Phase	Mitigation Measures	Significance of Residual Effects	
			Project	Cumulative
Vegetation (cont'd)				
Loss of ecological communities at risk	Construction	Avoidance, flagged buffers, reclamation of ECAR, regional surveys within the ESSFwc2. Implementation of: • Air Quality Management Plan • Vegetation Management Plan	Significant (major)	Not significant (moderate)
Loss of wetlands	Construction, Operations, Closure, Post-Closure	Avoidance where possible. Reclamation during Closure. Implementation of: • Air Quality Management Plan • Vegetation Management Plan	Significant (major)	Not significant (moderate)
Alteration of wetlands	Construction, Operations, Closure, Post-Closure	Appropriate culverts, manage edge effects, dust management, contaminants control measures, invasive plant species control, reclamation Implementation of: • Air Quality Management Plan • Vegetation Management Plan	Not significant (minor)	n/a
Loss of old-growth forests	Construction	Avoidance, reclamation of disturbed areas, windthrow management, marking of vegetation clearance boundaries, reclamation	Not significant (moderate)	Not significant (minor)
Wildlife (Chapter 16)				
Western toad: habitat alteration	Construction, Operations	Wetland reclamation and pocket wetland creation. Implementation of: • Wildlife Management Plan	Not significant (moderate)	Not significant (minor)
Western toad: mortality	Construction, Operations	Speed limits, adaptive management along roads, avoid breeding sites during clearing activities.	Not significant (minor)	n/a
Harlequin Duck: habitat alteration	Operations, Closure and Post-Closure	Implementation of: • Selenium Management Plan	Not significant (minor)	n/a

(continued)

Table 5. Summary of Residual Effects, Mitigation Measures, and Significance (continued)

Key Residual Effects	Project Phase	Mitigation Measures	Significance of Residual Effects	
			Project	Cumulative
Wildlife (Chapter 16; cont'd)				
Olive-sided Flycatcher: disturbance and displacement	Construction, Operations	Implementation of: • Wildlife Management Plan • Noise Management Plan	Not significant (minor)	Not significant (minor)
Grizzly bear: habitat alteration	Construction, Operations	Re-vegetation, reclamation.	Not significant (minor)	Not significant (moderate)
Moose: habitat alteration	Construction, Operations	Re-vegetation, reclamation.	Not significant (minor)	Not significant (minor)
Socio-economics (Chapter 17)				
Increased competition for skilled workers	Construction, Operations	Practice of no-solicitation at local millworks; participate in regional discussions on labour supply/ demand issues; local employment and supply policies.	Not Significant (moderate)	Not-Significant (moderate)
Commercial and Non-commercial Land Use (Chapter 18)				
Change in quality and experience of natural environment for public users	Construction, Operations	Follow visual design principles (e.g., utilizing vegetation screens and feathering forest edges along cleared areas and rights of ways) Implementation of: • Noise Management Plan	Not significant (minor)	n/a
Visual Quality Assessment (Chapter 19)				
Alteration to the landscape associated with the Project components and infrastructure	Construction, Operations	Re-vegetate disturbed areas	Not significant (moderate)	n/a

(continued)

Table 5. Summary of Residual Effects, Mitigation Measures, and Significance (continued)

Key Residual Effects	Project Phase	Mitigation Measures	Significance of Residual Effects: Project	Significance of Residual Effects: Cumulative
Archaeology and Heritage (Chapter 20)				
Disturbance of Known Archaeological Sites	Construction, Operations	Data recovery under BC *Heritage Conservation Act* Section 14 Site Investigation Permit and, if necessary, undertake measures in accordance with the cultural practices of the affected community. Implementation of: • Archaeology and Heritage Management Plan • Chance Find Procedure	Not significant (moderate)	n/a
Disturbance of Unknown Archaeological Sites	Construction, Operations	Data recovery under BC *Heritage Conservation Act* Section 14 Site Investigation Permit and, if necessary, undertake measures in accordance with the cultural practices of the affected community. Implementation of: • Archaeology and Heritage Management Plan • Chance Find Procedure	Not significant (minor)	n/a
Human Health (Chapter 21)				
Decrease in air quality that could affect human health	Construction, Operations	Project design,Implementation of: • Air Quality Management Plan	Not significant (minor)	Not significant (minor)
Decrease in country foods quality that could affect human health in consumers of country foods	Construction, Operations, Closure, Post-Closure	No hunting or berry collecting at the Project Site Implementation of: • Selenium Management Plan • Vegetation Management Plan • Site Water Management Plan • Air Quality Management Plan • Sediment and Erosion Control Management Plan • Fish and Aquatic Effects Monitoring and Management Plan • Mine Waste and ML/ARD Management Plan	Not significant (minor)	Not significant (minor)

(continued)

Table 5. Summary of Residual Effects, Mitigation Measures, and Significance (continued)

Key Residual Effects	Project Phase	Mitigation Measures	Significance of Residual Effects	
			Project	Cumulative
Human Health (Chapter 21; cont'd)				
Decrease in drinking water quality that could affect human health through consumption of water	Closure, Post-Closure	Project design to minimize the changes in water quality. Implementation of: • Fish and Aquatic Effects Monitoring and Management Plan • Groundwater Management Plan • Mine Waste and ML/ARD Management Plan • Sediment and Erosion Control Plan • Selenium Management Plan	Not significant (minor)	Not significant (minor)
Increase in noise levels that could affect human health	Construction, Operations	Consider noise in equipment selection, adequate equipment maintenance, reducing vehicle speed, avoid idling, and optimize construction design and site layout. Implementation of: • Noise Management Plan	Not significant (minor)	Not significant (minor)
Current Use of Land and Resources for Traditional Purposes (Chapter 22)				
Change in access to traditional sites – rock cairns	Construction, Operations, Closure, Post-Closure	Mitigation measures will be developed in consultation with local First Nations, and the BC Archaeology Branch.	Not significant (moderate)	n/a
Change in Quality and Experience of Natural Environment – visual quality	Construction, Operations, Closure, Post-Closure	Follow visual design principles (e.g., utilizing vegetation screens and feathering forest edges along cleared areas and rights of ways; Re-vegetate disturbed areas not directly affected by the Project during construction and operations; Re-vegetate directly disturbed areas following decommissioning and closure.	Not significant (moderate)	n/a

(continued)

Table 5. Summary of Residual Effects, Mitigation Measures, and Significance (completed)

Key Residual Effects	Project Phase	Mitigation Measures	Significance of Residual Effects	
			Project	Cumulative
Current Use of Land and Resources for Traditional Purposes (Chapter 22; cont'd)				
Change in abundance and distribution of resources- fishing	Construction, Operations, Closure	Implementation of: • Mine Waste and ML/ARD Management Plan • Fish and Aquatic Effects Monitoring and Management Plan • Selenium Management Plan • Soil Salvage and Storage Plan • Site Water Management Plan • Sediment and Erosion Control Plan • Explosives Handling Plan • Fish Habitat Offsetting Plan f.	Not significant (minor)	n/a
Change in abundance and distribution of resources- hunting and trapping	Construction, Operations, Closure	Implementation of: • Wildlife Management Plan • Noise Management Plan), • Selenium Management Plan • Spill Prevention and Response Plan; • Air Quality Management Plan • Vegetation Management Plan • Prohibition of hunting by staff.	Not significant (minor)	Not significant (minor)

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