July 7, 2023

VIA EMAIL

Major Mines Office
Mines Competitiveness and Authorizations Division
BC Ministry of Energy, Mines and Low Carbon Innovation
PO Box 9320 Stn Prov Govt, Victoria, BC V8W 9N3
permrecl@gov.bc.ca; Rosanna.Breiddal@gov.bc.ca

Attention: Rosanna Breiddal
Senior Project Lead

Dear Rosanna Breiddal;

Re: M-243 Amendment #9 – Request to Withdraw Surface Water and Area B

This letter is a request by Pretium Resources Inc. (Pretium), a member of the Newcrest Group of companies, to withdraw Area B and the surface water component from M-243 Amendment Application #9 (the Application), which was submitted in September 2022 and is currently under review.

Pretium submitted a separate amendment application to expand the Permitted Mine Area (PMA) for Area B (letter submitted July 4, 2023 via email). Since Area B is now being addressed via separate amendment application, its withdrawal from the Application is requested.

Pretium is no longer pursuing surface water as a potential new potable water source; therefore, withdrawal of this component (intake installation for surface water listed in Section 2.1.3 of the Application) is requested. Since Pretium is still pursuing groundwater as a potential new potable water source there is no change to the Water Supply Area described in the Application (Section 2.1.3).

Please contact me if you require any further information for this application.

Sincerely,

Sylvia VanZalingen

Sylvia Van Zalingen, M.S., P.Ag.
Director, Permitting
sylvia.vanzalingen@newcrest.com.au

cc:
T. Morris, S. Shaw, N. Dobsinsky, EMLI MMO
B. Wither, S. Masse, T. Murphy, L. Fredrickson, Newcrest Mining

NEWCREST

PRETIUM RESOURCES INC.

A member of the Newcrest Group of companies

Mines Act Permit M-243 Amendment Application #9

September 2022

EXECUTIVE SUMMARY

Overview of M-243 Amendment Application #9

This document is an application (the Application) by Pretium Resources Inc. (Pretium) to amend Brucejack Mine *Mines Act* Permit M-243 for the following purposes:

1. Permitted Mine Area (PMA) Expansion to the outer extents of the mining leases for the purposes of underground exploration and mining, minor associated surface infrastructure, and expansion of the km 72 Non-Potentially Acid Generating (NPAG) Quarry facility area, and to authorize additional PMA northwest of the mining leases for the purpose of potable water infrastructure. Potable water infrastructure would include water withdrawal infrastructure and connection of new potable water source(s) to the mine site potable water treatment facility, along with associated access and electrical supply. The proposed additional PMA totals 508 ha, including 277 ha within the mining leases and 231 ha contiguous with but outside of the mining leases. The proposed PMA outside of the mining leases is entirely within Newcrest's mineral tenures and excludes a 9 ha mining lease owned by others.

2. Expansion of the km 72 NPAG Quarry facility (allowable development) extents to enable quarrying of additional NPAG rock required for mine operations.

Pretium has also submitted an application to the BC Environmental Assessment Office (EAO) to amend its EA Certificate M15-01 Certified Project Description (CPD) boundary to expand it to the mining leases outer extents for the same purposes as the M-243 amendment application, and to authorize a CPD area equivalent to the requested PMA area northwest of the mining leases for the purpose of potable water withdrawal and related infrastructure. The M-243 PMA and EAC M15-01 CPD boundaries within the mining leases are similar but do not currently match. A key objective of the applications is to simplify and align the spatial extents of the two authorizations at the Brucejack Mine site.

Authorization of new infrastructure within the PMA extents is proposed to be addressed via BC Ministry of Energy, Mines and Low Carbon Innovation's (EMLI's) Notice of Departure (NOD) / NOD Self-Assessment (NODSA) process, which will define requirement for any additional permit amendment applications.

Effects assessments associated with this proposed expansion of the M-243 PMA are provided in EA Certificate M15-01 Amendment Application #9 (ERM 2022) (Appendix 1.1-1). As above, the proposed Water Supply Area of the two applications is identical. The proposed EAC CPD expansion within the mining leases (Peripheral Mining Area) is generally larger than or very similar to the proposed M-243 PMA expansion within this area.

Baseline Information and Environmental Setting

Extensive environmental baseline studies were conducted in support of the 2015 EAC/EIS and major permit applications. The baseline assessments are supported by ongoing environmental monitoring as reported annual *Mines Act/Environmental Management Act* (*MA/EMA*) Annual Reclamation Reports. The following environmental components are considered relevant to the scope of this Amendment Application:

- Geology and Mineralization;
- Geochemistry and Mine Water; and,
- Surface Drainage and Aquatic Resources.

Mine Plan

This is a boundaries amendment application requesting expansion of the M-243 PMA and the km 72 NPAG Quarry facility area. The application does not propose changes to the existing approved mine plan.

Mine Operations and Management

EMS Overview

Pretium implements its Brucejack Mine Environmental Management System (EMS) component management plans to achieve its regulatory requirements, including those contained within the management plans and requirements of the mine's authorizations. The latter include EAC M15-01, the CEAA 2012 Decision Statement, *Mines Act* Permit M-243, *EMA* permits PE-107835 (effluent discharge) and PA-107025 (air discharge), and the mine's *Water Sustainability Act (WSA)* water licenses.

The Brucejack Mine Environmental Management System (EMS) is comprised of 31 management plans, including 21 management plans required by EAC M15-01 Schedule B and 10 plans required by other authorizations. Pretium conducts reviews (internal and external) of the component management plans that comprise the Brucejack Mine EMS on an ongoing basis, and updates and distributes management plans and associated review results as required/appropriate

The following sections summarize how potential activities in the proposed PMA expansion areas will be managed in relation to key aspects of the EMS and the mine's other regulatory requirements. Additional authorizations will be sought as appropriate, as plans for infrastructure and activities within the proposed PMA expansion areas are advanced.

ML/ARD Management

The geochemistry and ML/ARD potential of Brucejack Mine rocks has been and continues to be assessed through comprehensive characterization studies and ongoing monitoring programs. Waste rock and exposure areas associated with future development within the proposed M-243 Amendment #9 PMA expansion areas will continue to be managed in accordance with the conditions of Permit M-243 and the mine's ML/ARD Management Plan. If geochemically distinct rocks are identified, additional studies will be carried out to characterize the materials and evaluate whether additional measures are appropriate. All mine waste rock, including any from within the proposed PMA expansion areas, will continue to be managed as PAG and either deposited subaqueously in the WRTSF or placed as backfill in the underground mine below the post-closure final water table elevation consistent with the approved ML/ARD Management Plan.

Water Management and Erosion Prevention and Sediment Control

Construction, use, and reclamation of infrastructure in the proposed PMA expansion area will be conducted with implementation of Environmental Management System (EMS) measures as appropriate, including water management planning at the design stage; implementation of erosion prevention and sediment control (EPSC) measures for surface infrastructure development; and expanded use of the underground mine water management system for underground mine and exploration development and associated surface openings (portals, ventilation raises, and air intakes).

Future mine openings will direct entrance drainage inward to the mine where water will be managed in the same manner as present with water ultimately included in the mine dewatering system and pumped to the mill process and mine water treatment plant. Treated effluent is either directed into the mill process stream or discharged to the contact water pond or the WRTSF. The mine water treatment plant effectively treats water from underground mining, along with surface water from the contact water collection area to meet the water quality conditions of *EMA* Effluent Permit PE-107835.

Groundwater

The Brucejack Mine groundwater system has been characterized through several hydrogeological field investigations which have established a broad monitoring well network within and proximal to the mine, as required by *EMA* Effluent Permit PE-107835. Continued dewatering of the VOK and West Zone workings has created and sustained a substantial cone of depression in the groundwater table in the footprint of the underground mine workings and farther afield. The Water Supply Area configuration allows for potential potable water sourcing distal from existing and future mine development (i.e., minimizing influence from the mine). Potable groundwater exploration in the Water Supply Area will include drilling of production/pumping and observation wells to facilitate an application under the *WSA* for a water license to withdraw groundwater.

Vegetation and Wildlife

Vegetation clearing and development within the Water Supply Area and Peripheral Mining Area may result in additional loss and/or alteration of alpine ecosystems. Several known rare plant and lichen observations are located within the proposed expansion areas. There are no anticipated interactions with parkland, riparian, or forested ecosystems, and there are no anticipated losses of rare ecosystems listed by the BC Conservation Data Centre associated with these proposed areas. Mitigation measures to avoid or minimize adverse effects on terrestrial ecology will be managed as specified in the mine's Vegetation Management Plan and Invasive Plants Management Plan.

Moose, mountain goat, grizzly bear, hoary marmot, raptors, migratory waterbirds, and migratory landbirds have high-quality habitat or suitable habitat that occurs within the Water Supply Area and Peripheral Mining Area. Mitigation measures to avoid or minimize adverse effects on wildlife and wildlife habitat are specified in the Wildlife Management Plan.

New mitigation and changes to the Wildlife Management Plan will be implemented as a result of activities within the Water Supply Area and Peripheral Mining Area that intrude into areas of known hoary marmot colonies. Avoidance of colonies, where feasible, is the primary mitigation to minimize effects of habitat loss and alteration and direct mortality due to burrow destruction. Where avoidance is not feasible, Pretium will contact BC Ministry of Forests (MoF) and Indigenous groups and seek to either harvest or move individuals to habitat outside the area of vegetation clearing.

Geotechnical and Geohazards

Geohazards mapping included within the Geohazards Management Plan will help inform facilities planning and design for the proposed PMA expansion areas. Geohazards and avalanche safety assessments will be completed for new surface infrastructure within the proposed PMA expansion areas during the planning and initial design stage, with geotechnical assessments also conducted and measures included in design as appropriate. Ground control will continue to be implemented in accordance with the Brucejack Mine Ground Control Management Plan (Pretium 2019a).

Reclamation and Closure Plan

The approved end land use for the Brucejack Mine site (M-243, Condition E.3) is wildlife habitat, particularly matrix habitat for mountain goat, grizzly bear and hoary marmot. The mine site provides matrix habitat for wildlife species resident in the general vicinity — i.e., hoary marmot, grizzly bear, and, to a more limited extent, mountain goat. Matrix habitat at the mine site is a rocky area with limited vegetation cover that does not provide life requisites for wildlife species (e.g., forage, cover, or other key habitat values), but which provides connectivity for animals to access adjacent habitat. It differs from a movement corridor in that it does not provide foraging value. As such, a central objective of reclamation planning for the mine site is to prevent the creation of obstructions or hazards to post-closure movement of wildlife.

The Brucejack mine site and vicinity have multiple unique or unusual characteristics that present substantial challenges for reclamation and are not typical of mines in BC (i.e. high elevation, harsh climatic conditions, ubiquity of geochemically reactive gossanous materials, and lack of pre-mine soil and ecosystem development). Because of these challenges, the general approach to reclamation planning for the mine has been to minimize surface disturbance through mine design and construction, and to create post-mine topography and conditions that will achieve the matrix habitat end land use and support passive natural revegetation to the extent feasible.

The approved end land use and the reclamation methods described in the Brucejack Reclamation and Closure Plan are proposed to also apply to new surface disturbances within the proposed PMA expansion areas. Similar to the mine site, the proposed PMA expansion areas are dominated by bedrock exposures at or near surface and significant portions of both the Peripheral Mining Area and the Water Supply Area have gossanous exposures.

Pre-development site-specific reclamation planning will be undertaken when there are specific facility plans and designs, however the overall approach to surficial materials handling will be similar to that of the existing PMA given the similarities between the two areas. In any areas where surficial materials suitable for use in reclamation are present, these will be salvaged and windrowed or stockpiled for use in final reclamation of these areas. Closure landforms, including for the proposed PMA expansion areas, will be designed to facilitate movement of wildlife through the post-mining landscape and to direct surface waters appropriately.

Opportunities for progressive reclamation within the mine site are currently limited to those that will support reclamation research. This will be revisited as reclamation research proceeds and additional information becomes available, and as surface development is planned for the proposed PMA expansion areas.

The km 72 NPAG quarry and the BJAR segment between Knipple Glacier and the mine site were constructed mostly or entirely in rock. No active revegetation is planned for these areas.

Modelling, Mitigation and Discharges

This application does not include any proposed changes that require updates to the Brucejack Mine water quality model, nor any that would require amendment of the mine's regulated discharges under Effluent Permit 107835. Waste rock and any ore from underground exploration development within the proposed Peripheral Mining Area will be included within the total waste quantities authorized under M-243 from the 2018 3800 tpd amendment, and total ore will remain within the 18.5 Mt LOM total authorized under EAC M15-01. Potential surface PAG rock excavation quantities from surface infrastructure within the PMA expansion areas will be included within (i.e. deducted from) the currently authorized waste rock deposition total for the WRTSF of 3.81 Mm^3. No changes to air discharges are proposed as part of this amendment application.

Environmental Monitoring

Environmental monitoring will be expanded as appropriate to include the proposed km 72 NPAG Quarry (e.g. additional materials characterization in accordance with the ML/ARD Management Plan, and additional geohazards monitoring and management as appropriate following the Geohazards Management Plan). Surface and underground rock excavation will continue to be characterized and monitored as per the ML/ARD Management Plan. Any new surface development within the proposed Peripheral Mining Area and Water Supply Area PMA expansions will be monitored as appropriate in accordance with new *WSA* authorizations that may be required and with applicable existing management plans such as the EPSC, Vegetation, and Wildlife Management Plans.

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ACRONYMS AND ABBREVIATIONS

ABA	Acid-base accounting
AEMP	Aquatics Effects Monitoring Program
ASX	Australian Securities Exchange
BC	British Columbia
BC EAO	British Columbia Environmental Assessment Office
BEC	Biogeoclimatic Ecosystem Classification
BJAR	Brucejack Access Road
CCME	Canadian Council of Ministers of the Environment
CEA Agency	Canadian Environmental Assessment Agency
CEAA	*Canadian Environmental Assessment Act*
CIS LRMP	Cassiar Iskut-Stikine Land and Resource Management Plan
CMAun	Coastal Mountain-heather Alpine
CPD	Certified Project Description
CWP	Contact Water Pond
EA	Environmental Assessment
EAC	Environmental Assessment Certificate
EAC Application	Environmental Assessment Certificate Application
EAO	Environmental Assessment Office
EMA	*BC Environmental Management Act*
EMLI	BC Ministry of Energy, Mines and Low Carbon Innovation
EIS	Environmental Impact Statement
EMS	Environmental Management System
EPSC	Erosion Prevention and Sediment Control
ERM	ERM Consultants Canada Ltd.
Granduc	Granduc Mines Limited
ha	hectare
km	kilometre

LHOS	Long-hole open stoping
LOM	Life of mine
LSA	Local Study Area
M-243	*Mines Act* Permit M-243
MA	*BC Mines Act*
masl	metres above sea level
m^3/d	cubic metres per day
MDMER	Metal and Diamond Mining Effluent Regulations
mine site	Core mine infrastructure area at the southwest end of Brucejack WRTSF
ML/ARD	metal leaching/acid rock drainage
Mt	Megatonne
Nass South SRMP	Nass South Sustainable Resource Management Plan
Newcana	Newhawk Gold Mines Ltd. and Lacana Mining Corp
Newcrest	Newcrest Mining Ltd.
Newhawk	Newhawk Gold Mines Ltd.
NLG	Nisg̲a'a Lisims Government
NOD	Notice of Departure
NODSA	Notice of Departure Self-Assessment
NPAG	Non-potentially acid generating
NPR	Neutralization potential ratio
PAG	Potentially acid generating
PMA	Permitted Mine Area
PNG	Papua New Guinea
PNGX	Papua New Guinea Market Exchange
Pretium	Pretium Resources Inc.
RSA	Regional Study Area
Silver Standard	Silver Standard Resources Inc.
STP	sewage treatment plant

SUP	Special Use Permit
t	tonnes
tpd	tonnes per day
TCG	Tahltan Central Government
TSS	Total Suspended Sediment
TSKLH	Tsetsaut Skii-km Lax Ha
TSX	Toronto Stock Exchange
VCs	Valued Components
VOK	Valley of the Kings
WRD	Waste Rock Dump
WRTSF	Waste Rock and Tailings Storage Facility
WSA	*Water Sustainability Act*
WTP	Water Treatment Plant
WZ	West Zone

1. INTRODUCTION AND PROJECT OVERVIEW

1.1 APPLICATION DESCRIPTION

This is an application (the Application) by Pretium Resources Inc. (Pretium) to amend Brucejack Mine *Mines Act* Permit M-243 for the following purposes:

1. Permitted Mine Area (PMA) Expansion to the outer extents of the mining leases for the purposes of underground exploration and mining, minor associated surface infrastructure, and expansion of the km 72 Non-Potentially Acid Generating (NPAG) Quarry facility area, and to authorize additional PMA northwest of the mining leases for the purpose of potable water infrastructure. Potable water infrastructure would include water withdrawal infrastructure and connection of new potable water source(s) to the mine site potable water treatment facility, along with associated access and electrical supply. The additional PMA includes four areas of expansion: in the northeast (66 ha), south (43 ha), west (168 ha) within the mining leases outer extents, and in the northwest (240 ha) contiguous with but outside of the mining leases (Figure 1.1-1).
2. Expansion of the km 72 NPAG Quarry facility (allowable development) extents to enable quarrying of additional NPAG rock required for mine operations.

Pretium has also submitted an application to BC Environmental Assessment Office (EAO) to amend its EA Certificate M15-01 Certified Project Description (CPD) boundary to expand it to the mining leases outer extents for the same purposes as the M-243 amendment application, and to authorize a CPD area equivalent to the requested PMA area northwest of the mining leases for the purpose of potable water withdrawal and related infrastructure. The M-243 PMA and EAC M15-01 CPD boundaries within the mining leases are similar but do not currently match (Figure 1.2-1). A key objective of the applications is to simplify and align the spatial extents of the two authorizations at the Brucejack Mine site.

This application does not propose to increase overall life-of-mine ore extraction beyond the EA Certificate's defined ore extraction limit. Planning for future infrastructure within the proposed PMA Peripheral Mining Area expansion area is not yet sufficiently advanced for specific locations, site layouts and engineering design information to be available; this will develop over time as underground exploration advances. Authorization of new infrastructure within the PMA extents is proposed to be addressed via BC Ministry of Energy, Mines and Low Carbon Innovation's (EMLI's) Notice of Departure (NOD) / NOD Self-Assessment (NODSA) process, which will define requirement for any additional permit amendment applications.

The proposed M-243 PMA boundary expansion will encompass an additional 508 ha (Figure 1.1-1). The Water Supply Area portion of the proposed M-243 PMA boundary expansion extends beyond the Brucejack mining leases, but is entirely within Newcrest's mineral tenures, within Pretium's MX-1-842 permit boundary. The proposed PMA expansion area excludes a 9 ha mining lease owned by others.

Effects assessments associated with this proposed expansion of the M-243 PMA are provided in M15-01 Amendment Application #9 (ERM 2022) (Appendix 1.1-1). As above, the proposed Water Supply Area of the two applications is identical (Figure 1.2-1). The proposed EAC CPD expansion within the mining leases (Peripheral Mining Area) is generally larger than or very similar to the proposed M-243 PMA expansion within in this area.

426000

429000

6260000

6257000

N

Emerald Lake

Ptarmigan Lake

Gold Pan Lake

Iceberg Lake

Catear/T2 Creek

231 ha

Brucejack Creek

Un-named Creek

WRTSF

C
(66 ha)

52 ha

VOK Creek

607 ha

A
(168 ha)

B
(43 ha)

Image Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

Current M-243 PMA Boundaries

M-243 Permitted Mine Area (2020)

Proposed Additions to M-243 PMA Boundary in Amendment #9

Peripheral Mining Area

Water Supply Area

Proposed Addition to M-243 Boundary in Amendment #8

Dec. 2021 PMA Application (Amendment #8 Application)

Mineral Tenures and Authorizations

Mining Lease

Newcrest Exploration Permit Boundary (MX-1-842)

Mineral Claims

Mining Lease - Owned by Others

Miscellaneous

WRTSF Waste Rock and Tailings Storage Facility

1:19,743

0 500 1,000

Metres

Coordinate System: NAD 1983 UTM Zone 9N

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PRETIUM RESOURCES INC.

A member of the Newcrest Group of companies

Map ID: BJAUTH20220908133

Imagery: 2019 ESRI Imagery | Date: September 13, 2022

Figure 1.1-1: M-243 Existing and Proposed Amendment #9 Permitted Mine Area Boundaries

1.2 PROPONENT INFORMATION

Pretium Resources Inc. is a member of the Newcrest Group of companies. Newcrest Mining Limited is a publicly traded company, with common shares trading on Australian Securities Exchange (ASX), Toronto Stock Exchange (TSX) and the Papua New Guinea (PNG) Exchange Markets (PNGX). Newcrest's head office is located in Melbourne, Australia. Following its acquisition of Pretium Resources Inc. in Q1 2022, Newcrest established a regional office in Vancouver BC. Newcrest also has a northwest BC office and warehouse located in Smithers BC. Newcrest owns operating mines in Australia, Canada and Papua New Guinea. Newcrest's Canadian mines are the Red Chris Mine and Brucejack Mine, both of which are located in northwest BC.

Pretium Resources Inc. is a corporation existing under the *Business Corporations Act* (British Columbia) and the permittee for Brucejack Mine authorizations.

Newcrest's regional office address and contact information is as follows:

Newcrest operations
2300 – 1055 Dunsmuir Street
Four Bentall Centre, PO Box 49334
Vancouver, BC, V7X 1L4
Phone: 604-558-1784
Toll Free: 1-877-558-1784
Website: www.newcrest.com

Communications regarding this application should be directed to:

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Smithers office
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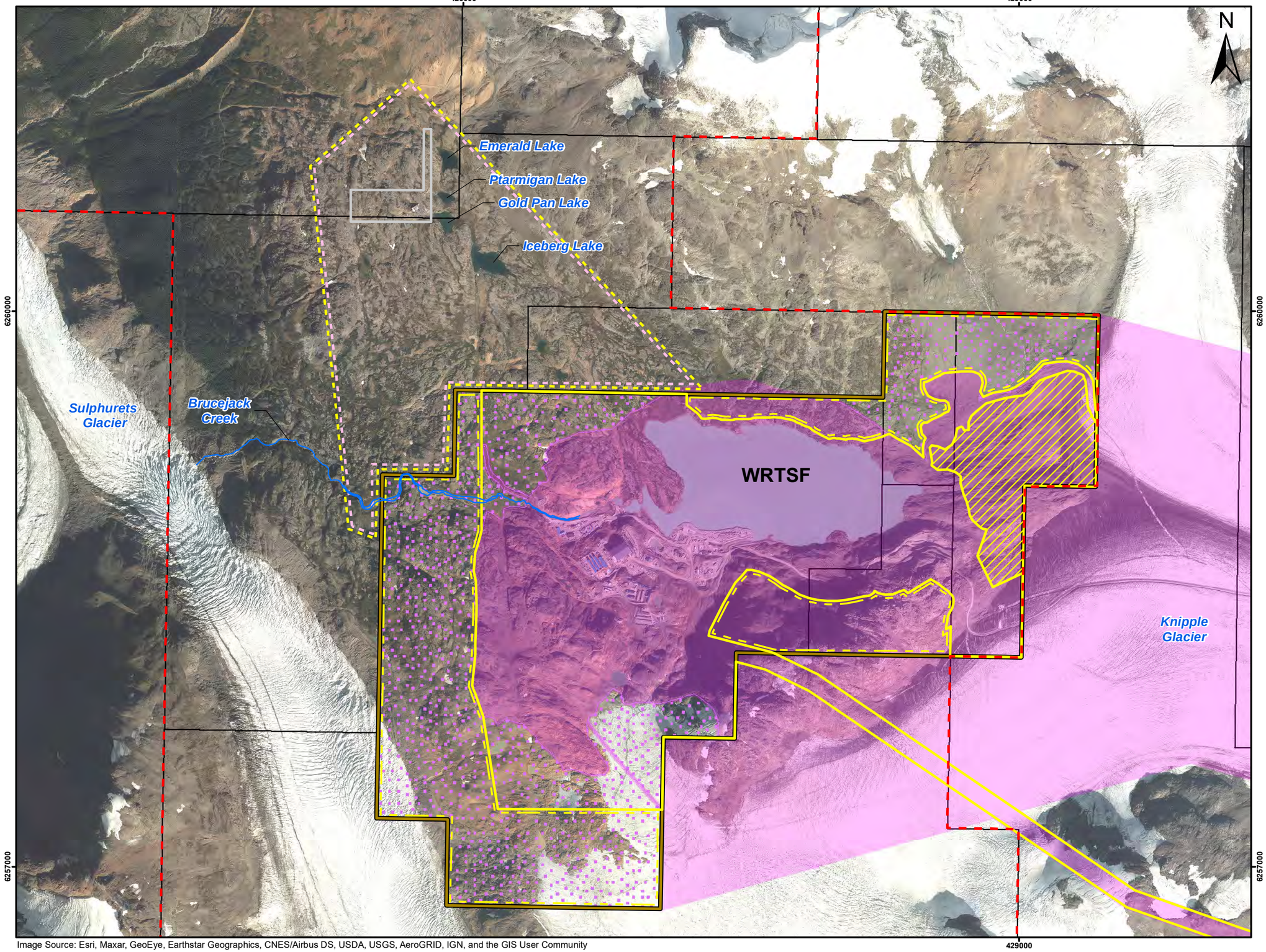
Smithers, BC V0J 2N5
Canada
Phone: 866-214-9772
Email: svanzalingen@pretivm.com



Legend

Current M-243 PMA Boundaries

- M-243 Permitted Mine Area (2020)

Proposed Additions to M-243 PMA Boundary in Amendment #9

- Peripheral Mining Area
- Water Supply Area

Proposed Addition to M-243 Boundary in Amendment #8

- M-243 Amendment #8 Application PMA

EAC #M15-01 CPD Boundaries

- Current EAC #15-01 CPD

Proposed Additions to EAC CPD Boundary in Amendment #9

- Peripheral Mining Area
- Water Supply Area

Mineral Tenures and Other Authorizations

- Mining Lease
- Mineral Claims
- Newcrest Exploration Permit Boundary (MX-1-842)
- Mining Lease - Owned by Others

Miscellaneous

- **WRTSF** Waste Rock and Tailings Storage Facility

1:20,000

0 500 1,000

Metres

Coordinate System: NAD 1983 UTM Zone 9N

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Map ID: BJAUTH20220912135

Imagery: 2019 ESRI Imagery | Date: September 13, 2022

Figure 1.2-1 Boundaries Comparison Between M-243 Amendment Application #9 PMA, Current M15-01 EAC CPD, and Proposed EAC CPD Amendment Application #9

1.3 MINE OVERVIEW

The Brucejack Mine is a gold-silver underground mine located in northwest BC approximately 950 km northwest of Vancouver and 60 km north-northwest of Stewart (Figure 1.3-1). Ground access to the mine is via the Brucejack Access Road (BJAR), an approximately 73 km all weather access road that extends west from km 215 of Highway 37 North, and that is authorized under Pretium's Special Use Permit (SUP) S25923. The BJAR provides year-round access to the mine and is primarily a gravel surface road except for a 12 km section that traverses the Knipple Glacier. Air access is via helicopter from Stewart or other local communities, or by charter fixed-wing aircraft to Pretium's Bowser Aerodrome located at km 50 of the BJAR.

The Brucejack Mine received provincial Environmental Assessment Certificate (EAC) M15-01 on March 26, 2015 and a federal *Canadian Environmental Assessment Act* (CEAA) 2012 Decision Statement on July 30, 2015. All the various provincial and federal authorizations required to construct, operate and decommission the mine were received in 2015. Surface construction activities began at the mine on September 5, 2015 and were completed mid-2017. Operations began in July 2017.

The mine's primary infrastructure (mine site) is located at the headwaters of Brucejack Creek at an elevation of approximately 1,365 masl. Mine site facilities are an underground mine and related surface facilities, including a mill with a mine Water Treatment Plant (WTP); WRTSF with a waste rock dump (WRD) for subaqueous waste rock deposition and into which tailings are also deposited; camp; fuel storage facilities; equipment laydown areas; mine site roads; surface water management system that includes a Contact Water Pond (CWP); sewage treatment facilities; waste handling facilities, including an incinerator; overburden stockpile; and an NPAG rock quarry at BJAR km 72 (Figure 1.3-2). The portion of the BJAR located within the mining leases is included in *MA* Permit M-243, as is the northernmost 19 km of the 56 km Brucejack transmission line. The Brucejack transmission line extends south from the mine to an intertie near the Long Lake Hydro facility and connects to the BC Hydro grid.

Portions of the Brucejack Mine, the BJAR and the Brucejack transmission line lie within the Nass Area of the Nisga'a Nation as defined in the Nisga'a Final Agreement, territory of the Tahltan Nation, and traditional territory of the Tsetsaut Skii km Lax Ha.

The WRTSF has an area of approximately 81 ha; its original maximum depth was approximately 85 m. The WRTSF has a short ice-free season, generally occurring from July through October. The receiving environment for discharge from the WRTSF is Brucejack Creek, which flows into Sulphurets Creek, which is in turn a tributary of the North Unuk River. The receiving environment is non-fish-bearing from the WRTSF outlet to a fish barrier located more than 20 km downstream along Sulphurets Creek and several hundred metres upstream of its confluence with the North Unuk River (Figure 1.3-3).

Ice, rock and recently deglaciated areas dominate the surficial materials at the mine site and surrounding areas, with the mine site surface rock and areas north and south of it being gossanous (mineralized, acidic rock on surface) (Figure 1.3-4). Given this, the mine site is either non-vegetated or only sparsely vegetated and, with respect to land use at capability, serves as matrix habitat for wildlife moving through the area (i.e., habitat through which wildlife will move, but which does not provide life requisites). Extensive information on the baseline environmental / ecological conditions of the Brucejack Mine area can be found in the mine's 2014 application for an Environmental Assessment Certificate / Environmental Impact Statement (Pretium 2014) and 2015 *Mines Act* (MA)/*Environmental Management Act* (*EMA*) Permits Application (Pretium 2015).

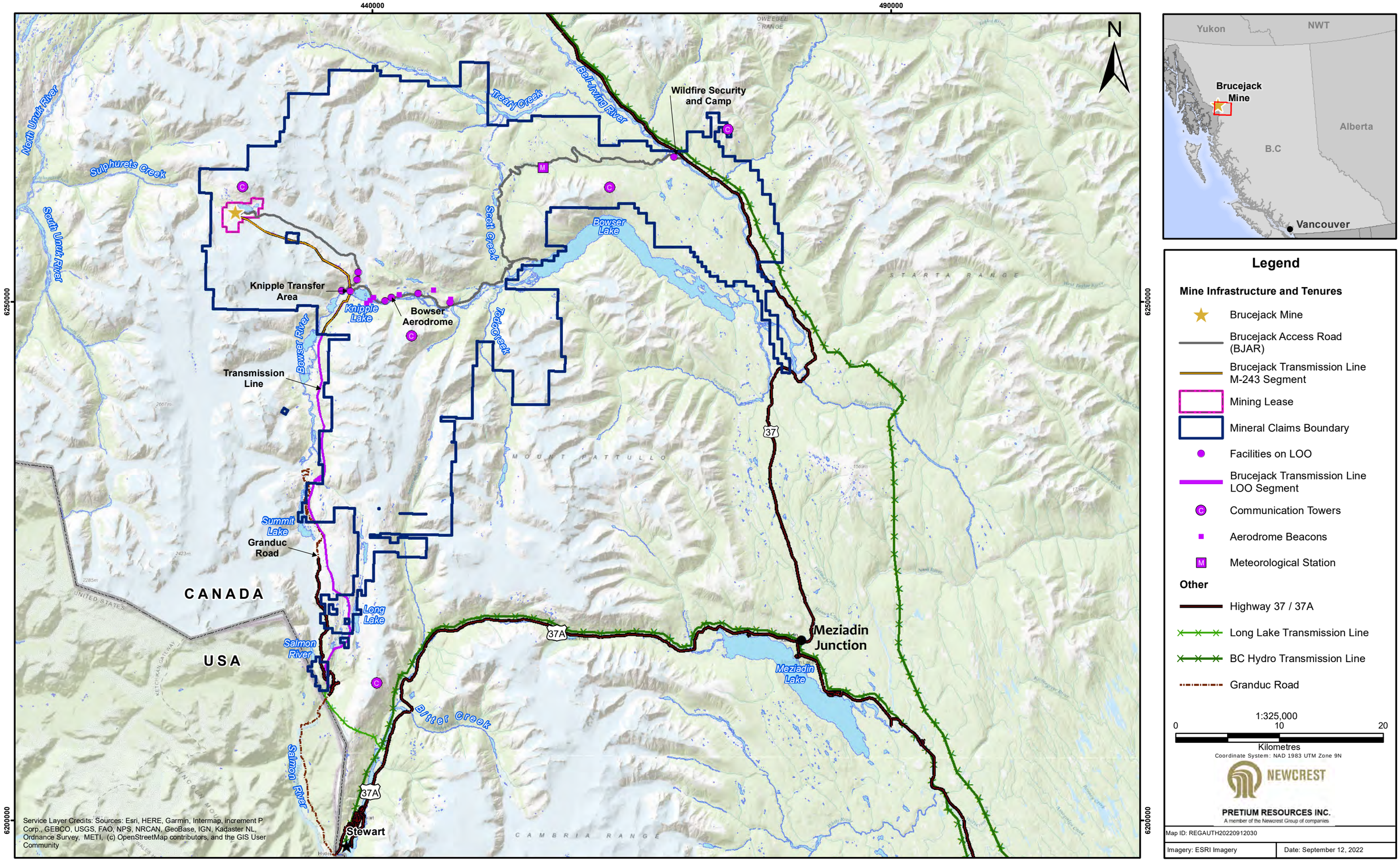
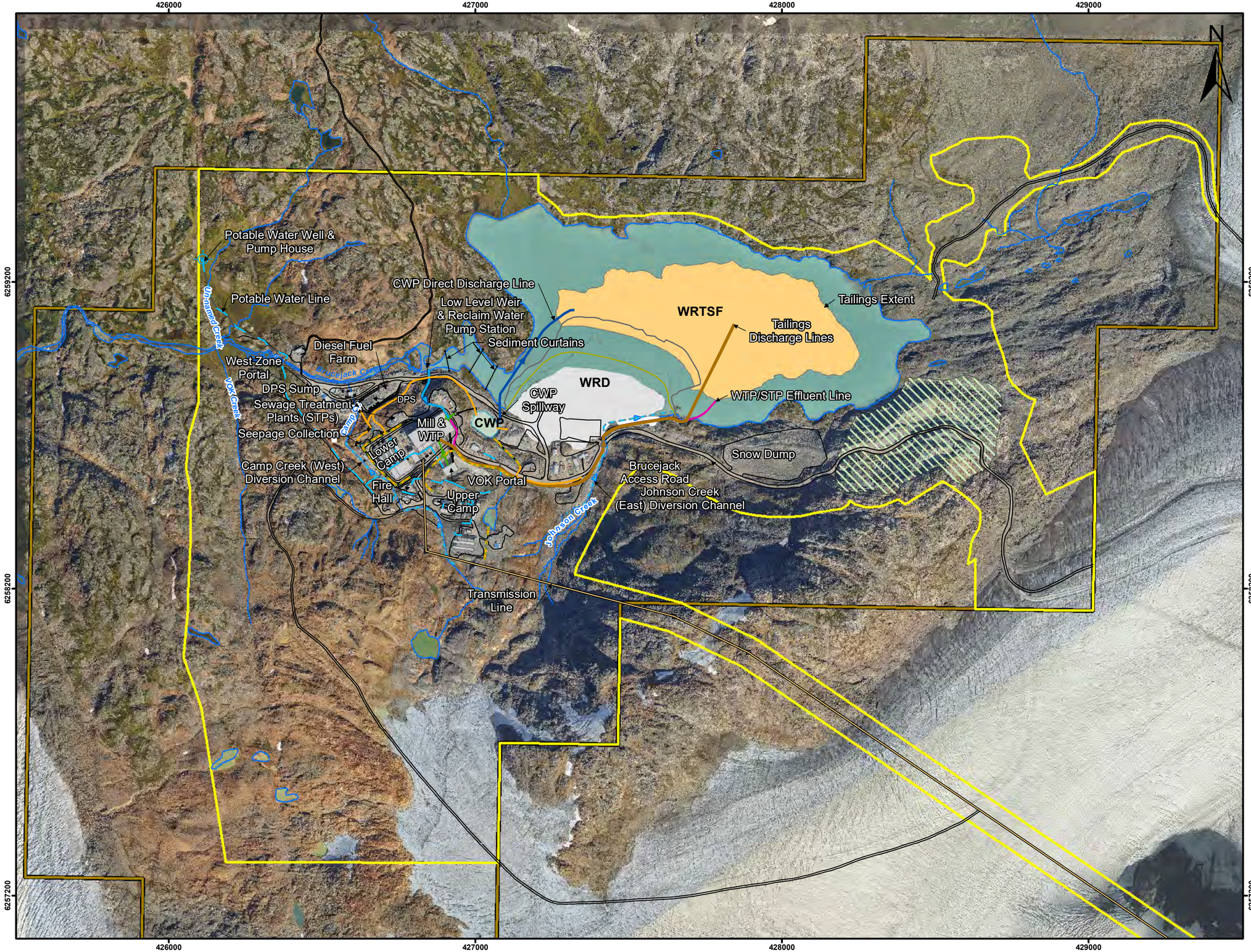


Figure 1.3-1. Brucejack Mine Regional Setting, Access and Tenures



Legend

Discharges & Water Management

- WTP/STP Effluent Line
- Tailings Discharge Lines
- CWP Direct Discharge Line
- Contact Water Ditch
- Contact Water Lines
- Non-Contact Surface Runoff
- Non-Contact Water Channel
- Reclaim Water Line
- Untreated or Off-Spec Water Line
- Potable Water Line
- **CWP** Contact Water Pond

Waste Rock and Tailings

- Tailings Deposition (Ultimate)
- Km 72 NPAQ Quarry
- Waste Rock Dump Ultimate Toe (3.81 M m3 Design)
- Waste Rock Dump Ultimate Crest (3.81 M m3 Design)
- **WRTSF** Waste Rock and Tailings Storage Facility
- **WRD** Waste Rock Dump

Mineral Tenure and Authorizatios

- Mining Lease
- M-243 Permitted Mine Boundary (2020)

Other

- Buildings
- Transmission Line
- Water Well & Pump
- **DPS** Diesel Power Station

1:12,000

0 250 500

Metres

Coordinate System: NAD 1983 UTM Zone 9N

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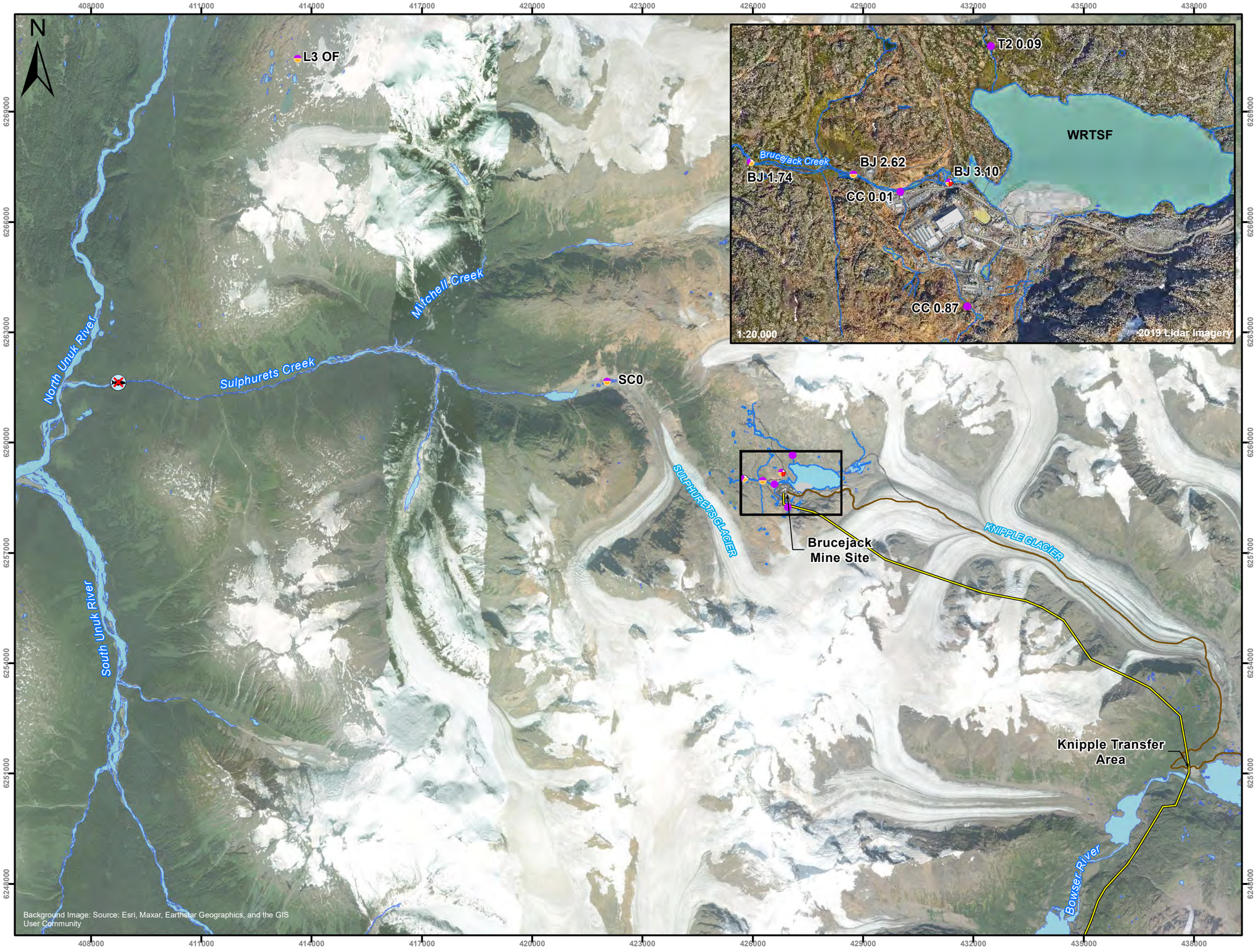
Map ID: BJAUTH20220912114

Imagery: 2019 Lidar | Date: September 12, 2022

Figure 1.3-2 Brucejack Mine: Mine Site Infrastructure and Approved *Mines Act* Permit M-243 PMA Boundary



Legend

Water Monitoring

- Flow
- WQ
- Sediment and Aquatic Biota
- Toxicity

Infrastructure

- Transmission Line
- Access Road
- Fish Barrier
- **WRTSF** Waste Rock and Tailings Storage Facility

1:20,000
0 2,000 4,000
Metres
Coordinate System: NAD 1983 UTM Zone 9N

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Map ID: BJSW20220912115b

Imagery: 2018 Satellite Imagery | Date: September 13, 2022

Figure 1.3-3. Brucejack Mine Aquatic Receiving Environment and Water Monitoring Sites

Figure 1.3-4. Mine Site Gossanous Terrain Setting as Viewed from Northeast to Southwest.

Potential environmental effects associated with the Brucejack Mine identified through the 2014 pre-development and subsequent environmental assessments have and continue to be mitigated and managed through implementation of the mine's design and associated planned mitigation measures, and implementation of requirements under the various authorizations. The latter requirements include the mine's Environmental Management Plans, including 21 plans required under EAC M15-01 Schedule B and additional plans required under other authorizations.

Brucejack Mine infrastructure is located within four mining leases: 1038597 (53.6 ha), 1038598 (553.6 ha), 1038599 (35.7 ha), and 1038600 (107.2 ha), the outer extents of which are shown on Figure 1.1-1.

1.4 MINE HISTORY

Exploration of the Brucejack Property and the surrounding region dates back to the 1880s, when placer gold was discovered in Sulphurets and Mitchell creeks. In 1935, prospectors Bruce and Jack Johnson discovered copper-molybdenum mineralization on the Sulphurets Property in the vicinity of the main copper zone located approximately 6 km northwest of Brucejack Lake.

In 1960, Granduc Mines Limited (Granduc) and prospectors staked the main claim group covering the known copper and gold-silver occurrences, which collectively became known as the Sulphurets Property. The Sulphurets Property was a larger claim group that included what is now the Brucejack Property. Exploration was conducted by Granduc and Esso Minerals through 1984 evaluating high-grade prospects including the West Zone. In 1985 Newhawk Gold Mines Ltd. entered into a 60:40 joint venture with Granduc to explore and develop the Sulphurets Property.

Between 1986 and 1991, Granduc (40%) and the Newcana (Newhawk Gold Mines Ltd. and Lacana Mining Corp., 60%) Joint Venture spent approximately $21 million developing the West Zone (WZ) and other smaller precious metal veins on what would later become the Brucejack Property. The historic WZ portal, which provided access for development of several km of underground workings during the late 1980's, dates from this time. The Sulphurets Project was also proposed and approved during this period under the Regional Mine Development Review Process in existence at that time. Waste rock and ore from the historic advanced exploration activity was subsequently deposited into Brucejack Lake in 1999 under direction of BC Ministry of Energy and Mines.

Between 1999 and 2001, Silver Standard Resources (now SSR Mining Inc.) acquired interest and control of the Brucejack Gold Mine Project, including 100% interest in the Brucejack Property. Silver Standard Resources began initial exploration work on the Brucejack area in 2006 and began a large diamond drilling campaign on the Brucejack Valley of the Kings (VOK) Zone in 2009.

Pretium acquired the Brucejack Gold Mine Project, along with other associated assets, pursuant to an acquisition agreement dated October 28, 2010.

In 2012, Pretium commenced an underground exploration program designed to access the VOK deposit, excavate a 10,000t underground bulk sample and demonstrate continuity of the high-grade gold mineralization. In late December 2012, the widening of the historical WZ underground workings was completed and excavation commenced of the access ramp from the WZ workings to the VOK. The bulk sample was collected and processed to improve confidence in both the geological model and the ore grade estimate.

Following issuance of authorizations required for mine construction and operations during 2015, construction of the Brucejack Mine commenced in September 2015. Commercial production was declared on July 3, 2017. EA Certificate M15-01 authorizes production of up to 18.5 Mt of ore over the life-of-mine. *Mines Act* Permit M-243 authorizes a mining rate of 1,387,000 t on a calendar year basis (average 3,800 tpd). *Environmental Management Act* Permits PE-107835 and PA-107025 regulate mine effluent and air discharges respectively.

1.5 *MINES ACT* PERMIT AMENDMENT #9 APPLICATION TEAM

Pretium personnel and consultants who provided technical input or other major contributions to this application are listed in Table 1.5-1, along with their primary roles and professional designations.

Table 1.5-1. M-243 Amendment Application #9 Authors and Major Contributors

Personnel	Company	Title	Application Primary Role	Degree/ Professional Designation
Ben Wither	Pretium Resources Inc. (Pretium) / Newcrest Mining Limited	VP HSE and Permitting	Application senior review	B.Sc., M.B.A.
Sylvia Van Zalingen		Director, Permitting	Application management, senior review, preparation sections 1.1, 2.1, 2.2.1, 3.1, 4, 5.1, 6.1, 6.3.1, 6.4.3, 6.4.4, compilation section 6	M.S., P.Ag.
Brett DeHay-Turner		Hydrogeochemist	Application coordination, compilation and review, preparation sections 2.2.2, 3.2, 3.3, 5.2, 5.3, 7, 8	M.Sc., P.Geo.
Cam Mackay-Stotesbury		Site Project Engineer	Km 72 NPAG Quarry information and review for sections 2.2.3, 2.2.4; review section 5.6	B.A.Sc, E.I.T.
Alison Shaw	Lorax Environmental Services (Lorax)	Senior Geochemist	Senior technical review geochemistry and water quality, sections 2.2.2, 3.2, 3.3, 5.2, 5.3, 7	Ph.D., P.Geo.
Robert Goldblatt		Senior Biologist	Preparation sections 3.4, 5.3, application coordination support	B.Sc., R.P.Bio
Laura Findlater		Senior Hydrogeologist	Preparation section 5.4	B.Sc., P.Geo.,
Justin Straker	Integral Ecology Group (IEG)	Soil Scientist, Forest Ecologist	Appendix 6.1-1 sections 3.2 and 3.3, and associated excerpts contained in section 6	M.Sc., P.Ag.
Greg Sharam	ERM	Technical Director, Wildlife Biology, Terrestrial Ecology	Senior technical review, sections 5.5, 6.2 and 6.3.2 through 6.3.4	Ph.D., M.Sc.
Krystle Batiuk	ERM	Senior Consultant, Scientist	Preparation sections 5.5 and 6.3.2 through 6.3.4	M.N.R.M., P.Biol.

1.6 CONCORDANCE WITH EAC M15-01

Some of the proposed M-243 PMA expansion areas extend beyond the current EAC M15-01 CPD boundaries. An application to also expand the M15-01 CPD boundaries to the mining leases and to include an equivalent potable water supply area has been submitted to BC EAO and is included as Appendix 1.1-1.

1.7 PERMIT M-243 AMENDMENTS

Permit M-243 has been amended seven times since its initial issuance in 2015. These amendments are summarized below in Table 1.7-1. An eighth amendment, to expand the PMA to the eastern extent of the mining leases for the purpose of future realignment of the upper Brucejack Access Road ramp off/on the Knipple Glacier, was submitted in December 2021 and is under review.

Table 1.7-1. *Mines Act* Permit M-243 Amendment Summary

Amendment #	Amendment Date	Summary
1	August 26, 2015	Approving Groundwater Monitoring Plan.
2	September 9, 2015	Approving Updated ML/ARD Management Plan.
3	March 17, 2016	Approving Temporary PAG Waste Rock Stockpile and Non-PAG Quarry and Temporary PAG Waste Rock Stockpile.
4	August 4, 2016	Approving Changes for Disturbance Area and Construction Water Treatment Plant
5	April 3, 2017	Approving PAG Waste Rock Exposure Extension, Sludge Deposition with Tailings and Chromium Management Plan
6	December 14, 2018	Approving Mine Plan and Reclamation Program for Increased Production Rate and Waste Management
7	December 18, 2020	Approving West Zone Ramp, Additional Stope Development, and Underground Exploration

1.8 INDIGENOUS ENGAGEMENT

1.8.1 Overview

Pretium has engaged with the Tsetsaut Skii-km Lax Ha (TSKLH), Nisga'a Lisims Government (NLG), and Tahltan Central Government (TCG), as well as other Indigenous groups, since 2011. Pretium continues to implement its Aboriginal Consultation Plan, which is a component plan under EAC M15-01 Schedule B and part of the company's Environmental Management System.

In recent years, engagement has focused on permit amendment applications and related environmental matters as well as issues of interest to the Indigenous groups: specifically local employment, education, training, procurement, and most recently, COVID-19 status and measures.

All engagement activities are tracked and recorded using engagement tracking software and are regularly reviewed.

1.8.2 Engagement

Pretium's rationale and planning for expansion of the EAC M15-01 CPD and M-243 PMA to the mining leases extents (i.e., the Peripheral Mining Area component of this Amendment Application) were introduced to the Nisga'a Lisims Government (NLG) Lands and Resources Department and the Tahltan Central Government (TCG) Lands Department during meetings in March 2022. The Water Supply Area component of this Amendment Application was introduced to the NLG Lands and Resources Department and the TCG Lands Department during meetings in June and July 2022. This amendment application is being provided to NLG, TCG, and TSKLH at the same time it is submitted to BC EMLI.

2. M-243 AMENDMENT APPLICATION #9 AUTHORIZATION REQUESTS

2.1 PERMITTED MINE AREA CHANGES

2.1.1 Summary

The proposed M-243 PMA boundary expansion (Figure 1.1-1) is for two proposed categories of infrastructure inside and outside the mining leases, as follows:

1. **Peripheral Mining Area:** within the mining leases outer extents, with infrastructure in this area to include:
    - Underground Exploration and Mining. This is requested to allow for additional underground exploration and to increase Pretium's flexibility to re-configure the underground mine horizontal extents based on ore definition as underground mining and exploration proceed, within the M15-01 EA Certificate's defined life-of-mine (LOM) ore extraction limit (currently 18.5 Mt) and WRTSF waste rock placement limits under M-243 (current 3.81 Mm^3). This includes the ability to recover and process ore from exploration headings and related development.
    - Minor Surface Infrastructure. This is proposed to include access roads and trails; water and electrical lines; ventilation raises and air intakes for both underground mining and exploration; additional portals; power supply, including diesel generation and/or connection to existing hydro-electric power supply; storage or staging areas for mine supplies (including explosives magazines and fuel); communications facilities; meteorological stations; helipads; soil stockpiles; and temporary staging of waste rock.
    - Expansion of the km 72 NPAG Quarry facility area. This is requested to is requested to enable quarrying of additional NPAG rock required for mine operations.
2. **Water Supply Area**: This is an area beyond the mining leases for the purpose of potable water supply for the mine, along with associated access, electrical supply, and piping.

The proposed additional Peripheral Mining PMA includes three specific areas of expansion: in the west and southwest (Area A; 168 ha), in the south (Area B; 43 ha), and in the northeast (Area C; 66 ha) (Figure 1.1-1). The Water Supply Area located contiguous with but outside of the mining leases totals 231 ha excluding the 9 ha mining lease owned by Goldwedge Mines Inc.

This application does not propose to increase ore extraction beyond the EA Certificate's defined ore extraction limit. Authorization of specific new infrastructure within the PMA extents is proposed to be addressed via BC EMLI's Notice of Departure (NOD) / NOD Self-Assessment (NODSA) process, or future permit amendment applications, if required.

2.1.2 Peripheral Mining Area

The proposed additional PMA within the Brucejack mining leases (proposed Peripheral Mining Area) totals 277 ha, including 168 ha along the western and southwestern edge of the mining leases, 43 ha in the southeast, and 66 ha in the northeast (Areas A, B and C respectively) (refer to Figure 1.1-1). The proposed 43 ha PMA area in the southeastern part of the mining leases is already within the

M15-01 CPD extents, whereas the current PMA extends further than the M15-01 CPD in the west and southwest portions of the mining leases.

The existing PMA encompasses sufficient area for the current mine plan (i.e., planned extents of ore extraction). The current EAC CPD boundaries constrain Pretium's ability to mine part of the southern VOK deposit. The primary rationale to expand the PMA boundaries to the mining leases is to allow for:

1. Additional underground exploration in the western and southern extents of the mining leases (Peripheral Mining Area sub-areas A and B);
2. Expand the km 72 NPAG Quarry facility boundaries (sub-area B);
3. Boundaries simplification and alignment with the M15-01 EAC CPD (all three sub-areas); and
4. Future potential mine re-sequencing and reconfiguration into sub-areas A and B, subject to limits and requirements of applicable authorizations, including EAC M15-01, M-243, and the mine's *Environmental Management Act* permits (PE-107835 and PA-107025).

As noted previously, this application does not propose to increase LOM ore extraction beyond the limit under M15-01 (currently 18.5 Mt), or to increase waste rock deposition in the WRTSF beyond the limit under M-243 (currently 3.81 Mm^3). Exploration development waste rock and any intercepted ore, and any additional surface waste rock from inside or outside of the M-243 area, will be included within the regulated totals.

The proposed peripheral mining area changes will have ancillary facilities and activities that would generally result in a low level of surface development (i.e., no major structures beyond mine surface openings and associated access) relative to the existing primary mine facility area.

The following infrastructure or activities are possible within the proposed expansion of the Peripheral Mining Area, subject to applicable additional regulatory requirements (Notice of Departure from Approval or amendment to *Mines Act* Permit M-243, and/or amendment to other authorizations):

Underground exploration development, with this development connected to the existing underground mine workings;

- Underground mine ventilation raises (including for underground mine exploration);
- Underground mine portals (potentially including for underground mine exploration) with associated heating and ventilation;
- Underground mining using long-hole open stoping (LHOS) and longitudinal LHOS methods with a combination of rock and paste backfill;
- Explosives and detonator storage facilities;
- Fuel storage and fueling facilities;
- Power supply, including diesel generation and/or connection to existing mine hydro-electric power supply;
- Equipment and supply laydown areas, and waste staging;
- Access roads and trails;

- Potable and underground mining/exploration water supply source(s) and associated pipeline connections;
- Helipads;
- Meteorological stations (potentially additional remote avalanche control systems);
- Soil stockpiles from surface infrastructure development; and
- Communications facilities.

This *Mines Act* permit amendment application is does not seek authorization for specific surface infrastructure at this time beyond expansion of the km 72 NPAG Quarry facility area (also still subject to additional authorization when the updated design is complete).

2.1.3 Water Supply Area

Pretium currently utilizes a single groundwater well to provide potable water to the mine and has identified a need for supplemental sources both to increase supply capacity and for redundancy. Having stable water supply throughout the year is critical to business continuity and additional water sourced from the proposed area will provide insurance against disruption to supply.

Pretium plans to initiate investigations for potential surface and groundwater sources within the proposed Water Supply Area shown on Figure 1.1-1 in 2023. The proposed Water Supply Area is 231 ha in size excluding a 9 ha mining lease owned by others. It is outside of Pretium's mining leases but within its MX-1-842 mineral exploration permitted area and mineral claims extents.

Specific water supply infrastructure locations cannot be identified until groundwater drilling and other site investigations are complete, however for the purpose of effects assessment EAC Amendment Application #9 (Appendix 1.1-1, ERM 2022) allows for up to two groundwater wells and associated well-head infrastructure, one surface water intake and intake-associated infrastructure, three small pump houses (sea can-style), 15 m-wide access roads or trails to all three sources (i.e., all three routes), a 6-inch internal diameter pipeline (PVC or HDPE; heat traced or insulated), and power supply connection. Total surface disturbance required is estimated to require up to 14 ha (or 5.8 % of the total *Mines Act* permit boundary extension of 231 ha requested for the Water Supply Area).

Construction, operation, and decommissioning of the potable water infrastructure includes the following potential surface activities:

- Surveying and layout;
- Vegetation and surficial growth media removal / salvage (for reclamation when infrastructure is no longer required);
- Construction (including culverts) and operation of up to 15 m-wide access roads or trails;
- Removal of any excavated PAG rock to the WRTSF, although infrastructure will be planned to avoid or minimize need for PAG rock excavation;
- Placement of quarried NPAG rock is/as needed;
- Erosion prevention and sediment control;
- Well drilling and development (groundwater);
- Intake installation (surface water);

- Infrastructure assembly, testing, and commissioning;
- Water withdrawal operations; and
- Closure and reclamation (access trail, well abandonment/intake removal, pump house demolition).

Pretium is requesting a larger Water Supply Area PMA than will be required to construct and operate water supply sources. This approach accounts for hydrological and hydrogeological uncertainty that may pressure future mine site potable water availability, and the potential need to find other sources in future. The larger requested area will allow for operational flexibility to develop additional potable water sources in future should this be necessary.

New potable water source(s) will be subject to requirement for authorization under the *WSA* once the final source(s) is determined.

2.2 EXPANSION OF KM 72 NPAG QUARRY AREA

2.2.1 Overview

Expansion of the km 72 NPAG Quarry facility (allowable development) extents is requested to enable quarrying of additional NPAG rock required for mine operations. Proposed extents of the km 72 NPAG Quarry based on preliminary engineering assessment are shown on Figure 2.2-1. Figure 2.2-2 shows the km 72 NPAG Quarry as of August 2022.

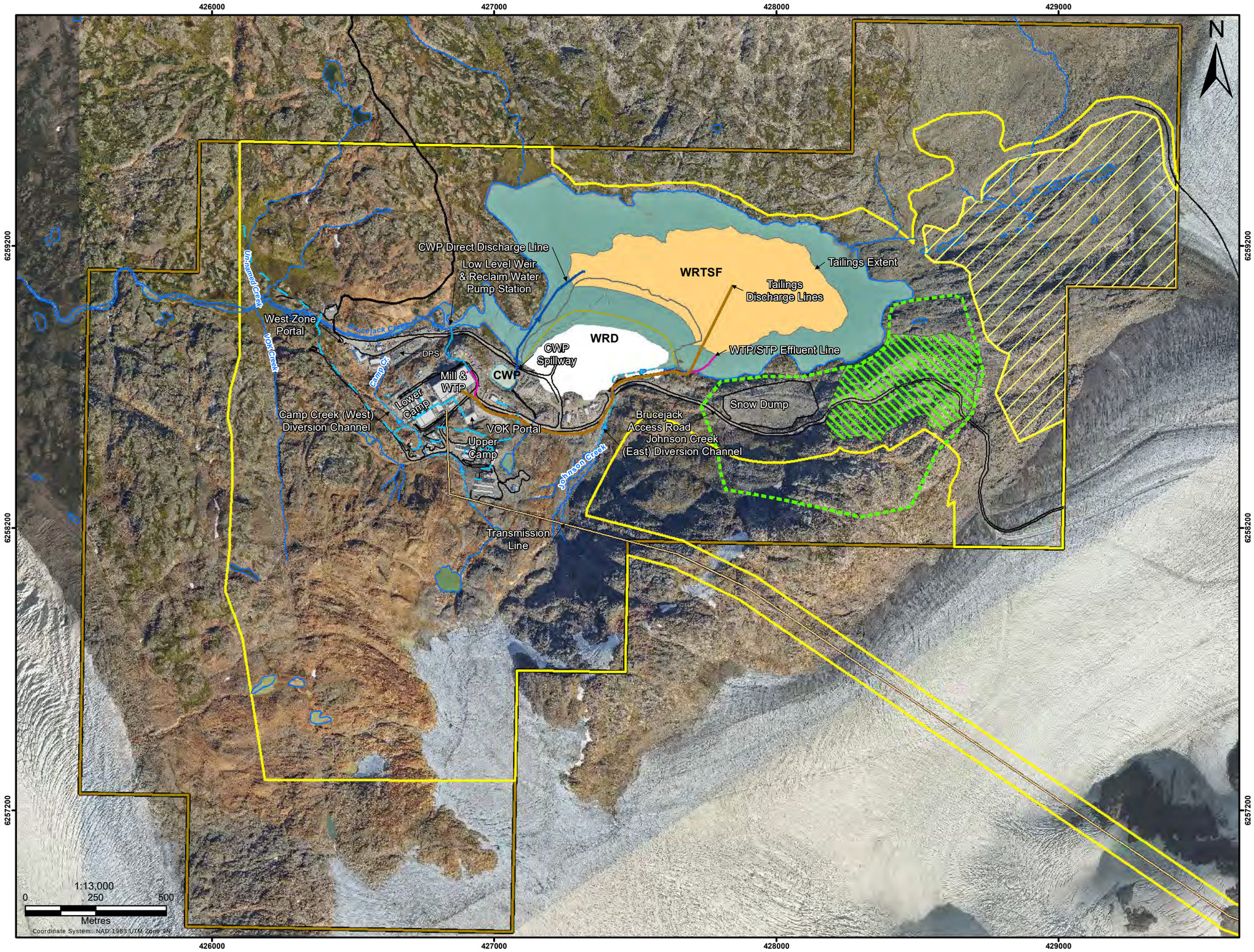
Pretium is requesting only the additional quarry facility areal extent as part of this M-243 amendment application and proposes that detailed design be addressed in 2023 via Notice of Departure (NOD) submission and process.

The km 72 NPAG Quarry re-design may allow for potential inclusion of northward access road development to reach the low-lying terrain east of the WRTSF and connection to the access road section approved and originally developed in 2015. This portion of the originally approved mine road access alignment remains a future option for realignment of the km 72 Brucejack Access Road ramp on/off the Knipple Glacier. Northward future access through the km 72 NPAG Quarry also provides potential access to the alternate East Waste Rock Dump, also part of the 2015 *MA/EMA* Permits application (Pretium 2015) and the Waste Rock and Tailings Management Plan from 2015 and 2016, should this be required in future. Figure 2.2-3 shows the access approved and constructed in 2015.

Any design for northward road access through the km 72 NPAG Quarry will be part of the separate NOD design and application submission when detailed design is complete.

2.2.2 ML/ARD

Pre-excavation ML/ARD characterization of materials will be conducted within the proposed km 72 NPAG Quarry expansion area and updated quarry design in accordance with existing procedures prescribed within the ML/ARD Management Plan (specifically, Section 6.1 NPAG Quarry and Section 6.2 Mine Site). Surface samples will be collected within the proposed km 72 NPAG Quarry expansion areas to help inform the updated quarry design, as appropriate. Additional confirmatory samples will be collected during drilling and prior to blasting, again according to existing NPAG Quarry procedures.



Legend

Proposed Infrastructure

- Proposed Km 72 Quarry Expansion

Existing Infrastructure

- Km 72 NPAQ Quarry

Waste Rock and Tailings

- Tailings Deposition (Ultimate)
- Waste Rock Dump Ultimate Toe (3.81 M m3 Design)
- Waste Rock Dump Ultimate Crest (3.81 M m3 Design)
- **WRD** Waste Rock Dump
- **WRTSF** Waste Rock and Tailings Storage Facility

Other Infrastructure

- **CWP** Contact Water Pond
- WTP/STP Effluent Line
- Tailings Discharge Lines
- CWP Direct Discharge Line
- Non-Contact Water Channel
- Reclaim Water Line
- Potable Water Line
- Buildings
- Transmission Line
- **DPS** Diesel Power Station

Mineral Tenures and Authorizations

- Mining Lease
- M-243 Permitted Mine Boundary (2020)
- Dec. 2021 PMA Application (Amendment #8 Application)

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Map ID: BJAUTH20220818125

Imagery: 2019 Lidar | Date: September 12, 2022

Figure 2.2-1 Brucejack Mine: Proposed km 72 NPAG Quarry Expansion Area

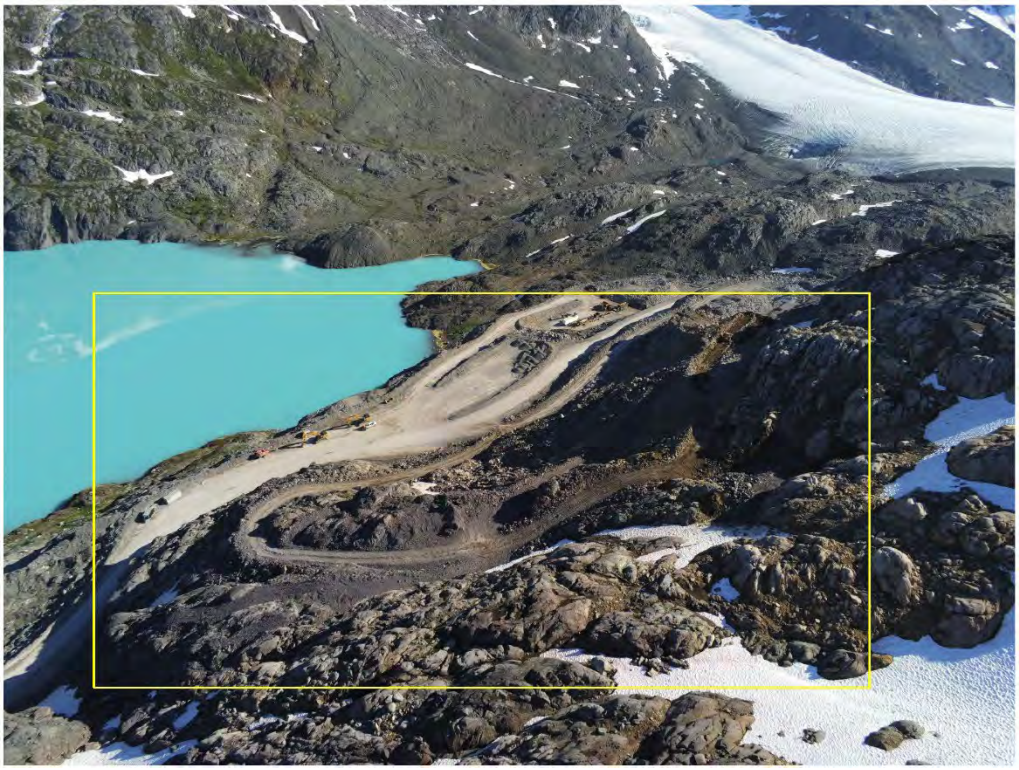

Figure 2.2-2. km 72 NPAG Quarry, August 2022.

Figure 2.2-3. Initial Mine Access Road Section North of km 72 NPAG Quarry Constructed in 2015

2.2.3 Preliminary Design Basis

Preliminary engineering assessment and design for expansion of the km 72 NPAG Quarry has been initiated, with final design completion targeted for early 2023. Geotechnical and geohazards assessments will be completed as part of the assessment and design process.

The preliminary design basis includes the following:

- Entire quarry to drain to the WRTSF, as it does with the current design;
- Haul ramp on the east side of the quarry;
- Ramp specifications of 12% gradient and 11 m total width, including running surface of 8 m and total berm width of 3 m;
- Overall pit slope angles maintained at maximum 41 to 43 degrees to mitigate avalanche risks;
- Minimum 2 phase approach;
- Bench heights from 6.5 m to 13.5 m dependent on location; and
- Minimum working bench width of 9 m.

The design package for the km 72 NPAG Quarry NOD submission will include a design report with relevant information from the site specific geotechnical and geohazards site investigations, development methodologies, quality control methods, and design specifications.

2.2.4 Km 72 NPAG Quarry Operating Procedures

The NOD submission will describe planned operating procedures for the km 72 NPAG Quarry, including any procedures required to address potential impacts related to geotechnical, geohazards, or avalanche hazards. With respect to avalanche hazards, Pretium plans to continue to operate the km 72 NPAG Quarry on a seasonal, mostly snow-free basis only.

2.2.5 Reclamation

The km 72 NPAG quarry is excavated in rock, and is benched into a steep, bedrock slope and designed such that the final quarry faces will be stable. The NPAG quarry will remain in place at closure, as no revegetation measures are feasible (Appendix 6.1-1).

3. BASELINE INFORMATION AND ENVIRONMENTAL SETTING

3.1 INTRODUCTION

Extensive environmental baseline information for the Brucejack Mine local and regional areas is available in the 2014 EAC/EIS Application (Pretium 2014), the 2015 *MA/EMA* Permits Application (Pretium 2015), the 2015 Annual report (Pretium 2016a), the ML/ARD baseline report (BGC 2014a), the surface water quality baseline report (ERM Rescan 2014a), the hydrogeology baseline report (BGC, 2014b), the hydrology baseline report (Rescan 2013a), wildlife characterization baseline report (Rescan 2013b), wildlife habitat suitability report (Rescan, 2013c), terrestrial ecology baseline report (Rescan 2014), aquatic ecology baseline report (ERM Rescan 2014b), land use (ERM Rescan, 2014c,d; Rescan, 2013d,e), and archeology report (Rescan 2013f). Additional monitoring information collected from 2015 onward is documented in the *MA/EMA* Permits Annual Reports (Pretium 2016a; 2017; 2018b; 2019b; 2020b; 2021; 2022). With respect to terrestrial resources, both the proposed Peripheral Mining Area and the Water Supply Area are entirely within the Local Study Area (LSA) and the Regional Study Area (RSA) for the terrestrial environmental Valued Components (VCs) used the for 2014 EAC/EIS Application and associated baseline reporting. All terrestrial environment VCs (terrain, soils, vegetation, wetlands and wildlife) had the same LSA.

The following subsections provide overviews of baseline and environmental setting information for the proposed PMA expansion areas for geology, geochemistry and mine water, and surface drainage and aquatic resources. Terrestrial ecosystems and the wildlife environmental setting are described in Section 6 and Appendix 6.1-1.

3.2 GEOLOGY AND MINERALIZATION

The Brucejack deposit is located on the western side of the Stikine Terrane in the Intermontane morphogeologic belt of the Canadian Cordillera and is currently defined as incorporating the VOK zone and West zone. The Brucejack deposit occurs in an exceptionally metals-rich tectonic assemblage hosted in volcanic island arc-related rocks of the Lower Jurassic Hazelton Group and is interpreted to be a deformed, porphyry-related transitional to intermediate sulphidation epithermal high-grade gold-silver deposit.

There is a distinct precious metal zonation between the VOK zone, which contains higher gold grades, and the West zone, which is significantly more silver rich. The VOK zone is currently defined over 1,200 m in east-west extent, 700 m in north-south extent, and 650 m in depth, and remains open to the east, west, and at depth. The West zone is currently defined over 590 m along its northwest strike, 560 m across strike, and down to 650 m in depth, and remains open to the northwest, southeast, and at depth to the northeast. The occurrence of structural corridors of higher-grade east-west mineralization within the broader stockwork zones represents an opportunity for longitudinal mining.

At the district level, the Brucejack deposit forms part of a well mineralized, north-south gossanous trend (the Sulphurets Mineral District) associated with a regional unconformity and proximal mineralized Early Jurassic porphyry intrusions on the eastern limb of the McTagg Anticlinorium. Rocks of the Sulphurets Mineral District record a long history of volcanism, telescoping magmatic-hydrothermal alteration, mineralization, and deformation.

Underground exploration proposed within the M-243 Amendment #9 PMA Peripheral Mining Area expansion area will initially target vein hosted gold mineralization in the VOK, West and Gossan Hill zones. Expansion drilling in the VOK area will target mineralization from various levels throughout the mine. Drilling in West zone will test the mineralization potential at depth

The proposed Water Supply Area PMA is underlain predominantly by volcanoclastic sandstones and conglomerates to the west and hornblende feldspar phyric latite fragmental and flows to the east.

3.3 GEOCHEMISTRY AND MINE WATER

The geochemistry of rock that has been or will be disturbed, excavated, or exposed at the Brucejack Mine has been characterized through static and kinetic test programs (BGC 2014a; Pretium 2016a, 2017, 2018b, 2019b, 2020b, 2021, 2022). The characterization programs have also evaluated the water quality impacts of explosives used for blasting and cement products used in shotcrete and paste backfill. Static tests include acid base accounting (ABA) analyses to evaluate whether material is PAG, elemental analyses to identify parameters that are elevated and of potential concern, and shake flask extraction tests to provide an indication of soluble loads and drainage chemistry. Kinetic tests including field bins, humidity cells and saturated columns have been carried out to assess the long-term behaviour of materials under site-specific conditions.

Summaries of the baseline study results and recent monitoring results related to geochemistry and mine impacted water are described below:

- Waste Rock: static and kinetic test results from six lithologic units indicate that rocks from all units are dominantly PAG (83%) with elevated concentrations of metals (e.g., silver, cadmium, zinc) and metalloids (arsenic, antimony) compared to continental crust. Many of the PAG samples contain significant amounts of carbonate minerals (mostly calcite) that will neutralize acidity generated and prolong the onset to acid generation (Pretium 2016a). Confirmatory sampling results through to the end of 2021 remain consistent with the baseline assessment (Pretium 2022).
- Ore, tailings, and paste backfill: The ore is characterized as PAG with elevated concentrations of silver, arsenic, cadmium, manganese, and selenium, compared to continental crust (BGC 2014a). Thickened tailings generated from the mill show the same metal enrichments, but samples are predominantly NPAG (Pretium 2018b, 2019b). Paste samples are similar in composition to thickened tailings, but with a slightly higher median NPR. Confirmatory sampling results through to the end of 2021 remain consistent with the baseline assessment (Pretium 2022).
- Quarry rock: The km 72 NPAG Quarry is comprised predominantly of volcanic (plagioclase-hornblende) porphyry, with lesser amounts of conglomerate, and has negligible sulfide mineralization. Characterization studies of the km 72 NPAG Quarry rock samples have confirmed that rock excavated from the km 72 NPAG Quarry is consistently NPAG, with low neutral metal leaching potential. Confirmatory sampling results through to the end of 2021 remain consistent with the baseline assessment (Pretium 2022).
- Underground mine water: Underground mine water at the Brucejack Mine is dominantly comprised of groundwater with added geochemical loads from blasted rock, wall rock, waste rock backfill, and paste backfill. Despite the prevalence of PAG waste rock, the neutralization afforded by carbonate minerals is expected to buffer any acid generated from sulphide oxidation reactions for several decades or more (Pretium 2015). Confirmatory sampling results

through to July 2022 suggest there are no sustained increases in dissolved metals associated with the onset of ML/ARD as predicted by kinetic tests (e.g., cadmium, cobalt, copper, iron, zinc) since gold production commenced in June 2017 (Pretium 2022).

- Water treatment plant effluent and associated treatment residues (i.e., sludge): The WTP effluent has consistently met design specifications. Sludge generated from the WTP is co-deposited with thickened tailings in the WRTSF. Static test results indicate that the sludge is NPAG with elevated concentrations (greater than 10x average continental crust concentrations) of several metals (e.g., silver, arsenic, cadmium, manganese, molybdenum, antimony, and selenium). The results show that the sludge is stable under a range of pH and redox conditions and low metal leaching rates are expected for the co-deposited tailings and sludge. Confirmatory sampling results through to the end of 2021 remain consistent with the baseline assessment (Pretium 2022).
- Excavated surface rock exposures and runoff: Non-contact surface runoff from areas immediately surrounding the mine site are directed to the WRTSF via the East (Johnson Creek) Diversion Channel, and to Camp Creek via the West (Camp Creek) Diversion Channel. Camp Creek runoff is naturally acidic, with elevated metal concentrations (e.g., silver, cadmium, copper, and zinc). The water quality of Mine Site contact water is assessed based on drainage into the CWP and shake flask experiments carried out on all surface exposed rock units.
- Explosives-related residues: Explosives-related residues contain water soluble nitrogen compounds that can affect water quality in the receiving environment. Site monitoring data have been used to derive and refine water quality predictions with respect to these compounds (Lorax 2020b).

The results of the baseline characterization studies have informed the development of the mine's ML/ARD Management, Nitrogen Management, Chromium Management and Closure Underground Water Quality Adaptive Management plans which are designed to prevent or minimize potential geochemistry and chemistry related adverse environmental effects associated with development, operation, and closure/reclamation of the Brucejack Mine. The monitoring programs described in the plans are also used to verify and update source terms for the mine's water quality model.

3.4 SURFACE DRAINAGE AND AQUATIC RESOURCES

The Brucejack mine site is situated within the Brucejack Creek watershed, which is a small headwater sub-basin within the Sulphurets Creek watershed (drainage area 299 km^2). Brucejack Creek drains into Sulphurets Creek before reaching the Unuk River (Figure 1.3-3), which flows southwest, eventually discharging to the Pacific Ocean northeast of Ketchikan, Alaska.

The WRTSF receives mine waste and treated effluents and is the headwaters to Brucejack Creek. Additional inputs to Brucejack Creek downstream of the mine's final compliance point (BJ 3.10) within Pilsner Valley (upper elevation section of Brucejack Creek) include natural seasonally acidic tributaries traversing the gossan to the south and east (Camp Creek and VOK Creek) and a small, circum-neutral pH tributary (Unnamed Creek) draining to Brucejack Creek from the north. Both Camp Creek and VOK Creek are seasonally dry, and Unnamed Creek is expected to be seasonally dry as well.

Within the proposed Water Supply Area, Catear/T2 Creek drains to the WRTSF (Figure 3.4-1). This is also a small, circum-neutral pH creek. The eastern portion of the proposed Water Supply Area drains to either the WRTSF or (primarily via Un-named Creek) to Brucejack Creek. The western part

of the proposed Water Supply Area and southern part of sub-area A of the proposed Peripheral Mining Area drain directly toward Sulphurets Creek. Most of Peripheral Mining Area sub-area B drains to the WRTSF, although a portion drains south toward a tributary of the Knipple Glacier. The western part of Peripheral Mining Area sub-area C drains to the WRTSF and the eastern part is within the Knipple Glacier (Bowser River) catchment.

Aquatic resources within and downstream of the mine site area are generally characterized by low density and richness of primary producers and aquatic invertebrates, which is typical for high elevation, alpine aquatic ecosystems (ERM Rescan 2014b). Extremely sparse productivity is observed in upper Sulphurets Creek and Sulphurets Lake due to heavy sediment loading from the Sulphurets glacier. Benthic invertebrates vary temporally and spatially in the lakes and stream surrounding the mine site area, with the density of aquatic invertebrates tending to increase at lower elevations in Sulphurets Creek and in the Unuk watershed. Baseline assessments in 2014 identified copepods as the dominant zooplankton taxa in Brucejack Lake (now the WRTSF), and there was substantial inter-annual variation in primary producers. No fish have been found for approximately 23 km downstream of the WRTSF outlet on account of a natural fish barrier in Sulphurets Creek, located approximately 300 m upstream of the confluence of Sulphurets Creek with the Unuk River.

4. MINE PLAN

As described in Sections 1.1 and 2.1, this application includes proposed expansion of the PMA boundaries to the mining leases outer extents (Peripheral Mining Area), with infrastructure in this area to include:

1. Underground Exploration and Mining. This is requested to allow for additional underground exploration and to increase Pretium's flexibility to re-configure the underground mine horizontal extents based on ore definition as underground mining and exploration proceed, within the M15-01 EA Certificate's defined LOM ore extraction limit (currently 18.5 Mt) and WRTSF waste rock placement limits under M-243 (current 3.81 Mm^3). This includes the ability to recover and process ore from exploration headings and related development.
2. Minor Surface Infrastructure. This is proposed to include access roads and trails; water and electrical lines; ventilation raises and air intakes for both underground mining and exploration; additional portals; power supply, including diesel generation and/or connection to existing hydro-electric power supply; storage or staging areas for mine supplies (including explosives magazines and fuel); communications facilities; meteorological stations; helipads; soil stockpiles; and temporary staging of waste rock.
3. Expansion of the km 72 NPAG Quarry facility area. This is requested to is requested to enable quarrying of additional NPAG rock required for mine operations.

An area beyond the mining leases (Water Supply Area) is also requested for the purpose of potable water supply for the mine, along with associated access, electrical supply, and piping.

This application is for proposed expansion of the M-243 PMA and km 72 NPAG Quarry facility area; it is not an application to update the approved mine plan. Planning for future infrastructure within the proposed PMA Peripheral Mining Area expansion area is not yet sufficiently advanced for specific locations, site layouts and engineering design information to be available; this will develop over time as underground exploration advances. Authorization of specific new infrastructure within the PMA extents is proposed to be addressed via BC EMLI's NOD /NODSA process.

Currently only underground exploration is planned to extend into Peripheral Mining Areas A and B. Based on the current limitations posed by EA Certificate M15-01, M-243 and PE-107835 in particular, it is expected that one or more of these authorizations will require additional amendment before mine operations can expand into those areas (i.e. aside from the km 72 NPAG Quarry facility expansion). There are no known mineable resources within Peripheral Mining Area C, nor any plans for surface infrastructure; this portion of the proposed PMA expansion is solely for boundary simplification at this time.

5. MINE OPERATIONS AND MANAGEMENT

5.1 INTRODUCTION

Pretium implements its Brucejack Mine Environmental Management System (EMS) component management plans to achieve its regulatory requirements, including those contained within the management plans and requirements of the mine's authorizations. The latter include EAC M15-01, the CEAA 2012 Decision Statement, *MA* Permit M-243, *EMA* permits PE-107835 (effluent discharge) and PA-107025 (air discharge), and the mine's *Water Sustainability Act* water licenses.

The Brucejack Mine Environmental Management System (EMS) is comprised of 31 management plans, including 21 management plans required by EAC M15-01 Schedule B and 10 plans required by other authorizations. Pretium conducts reviews (internal and external) of the component management plans that comprise the Brucejack Mine EMS on an ongoing basis, and updates and distributes management plans and associated review results as required/appropriate. Plan implementation inspections/audits and reviews of the plans themselves are scheduled specific to each management plan, with consideration of risk, as well as type, frequency and extent of monitoring (e.g., weekly water quality monitoring at the discharge location which verifies the effectiveness of all management plans that influence Brucejack Mine effluent quality).

The EAC M15-01 Component Management Plans are listed as follows:

- Aboriginal Consultation Plan
- Air Quality Management Plan
- Ancillary Infrastructure Decommissioning and Reclamation Plan (applies only at areas external to M-243)
- Aquatic Effects Monitoring Plan
- Avalanche Safety Plan
- Chemicals and Materials Storage and Handling Plan
- Economic and Social Effects Mitigation Plan
- Heritage Management Plan
- Health Services Monitoring Plan
- Invasive Plants Management Plan
- Metal Leaching and Acid Rock Drainage (ML/ARD) Management Plan
- Mine Emergency Response Plan
- Reclamation and Closure Plan
- Soils Management Plan
- Spill Response Plan
- Traffic and Access Management Plan
- Vegetation Management Plan

- Waste Management Plan
- Waste Rock and Tailings Storage Facility – OMS Manual
- Water Management Plan – OMS Manual
- Wildlife Management Plan

Management Plans required by other authorizations are as follows:

- Chromium Management Plan
- Closure Underground Water Quality Adaptive Management Plan
- Geohazards Management Plan
- Ground Control Management Plan
- Mountain Goat Management Plan
- Nitrogen Management Plan
- Refuse Incinerator Management Plan
- Subsidence Monitoring and Management Plan
- Surface Erosion Prevention and Sediment Control Plan
- Ventilation Plan

EMS component plan reviews are reported annually in each Annual Report for Permits M-243, PE-107835 and PA-107025. Updated Management Plans are also distributed annually via these annual reports and may additionally be distributed via applicable regulatory submissions.

The following sections summarize how potential activities in the proposed PMA expansion areas will be managed in relation to key aspects of the EMS and the mine's other regulatory requirements. Additional authorizations will be sought as appropriate, as plans for infrastructure and activities within the proposed PMA expansion areas are advanced.

5.2 ML/ARD MANAGEMENT

The geochemistry and ML/ARD potential of Brucejack Mine rocks has been and continues to be assessed through comprehensive characterization studies and ongoing monitoring programs. The geochemical data sets have been used to inform waste management plans and to predict associated water quality.

Most underground waste rock samples (83%) at the Brucejack Mine are PAG; however, most of the rocks have considerable neutralization potential, which is predicted to delay the onset of ARD for decades or more. Leachate results from humidity cell tests and field bin studies confirm this assertion. This is also supported by the observation of alkaline mine waters and no sustained increases in dissolved metals associated with the onset of ML/ARD (e.g., cadmium, cobalt, copper, iron, zinc, as predicted by kinetic tests) since gold production commenced in June 2017.

Waste rock and exposure areas associated with future development within the proposed M-243 Amendment #9 PMA expansion areas will continue to be managed in accordance with the conditions

of Permit M-243 and mine's ML/ARD Management Plan. If geochemically distinct rocks are identified, additional studies will be carried out to characterize the materials and evaluate whether additional measures are appropriate. All mine waste rock, including any from within the proposed PMA expansion areas, will continue to be managed as PAG and either deposited subaqueously in the WRTSF or placed as backfill in the underground mine below the post-closure final water table elevation consistent with the approved ML/ARD Management Plan (Pretium 2020c).

5.3 WATER MANAGEMENT AND EPSC

Construction, use, and reclamation of infrastructure in the proposed PMA expansion area will be conducted with implementation of EMS measures as appropriate, including water management planning at the design stage; implementation of erosion prevention and sediment control (EPSC) measures in Surface Erosion Prevention and Sediment Control Plan for surface infrastructure development; and expanded use of the underground mine water management system for underground mine and exploration development and associated surface openings.

Surface infrastructure measures will continue to include design and construction of water management structures and features such as ditches, swales, and culverts along and through new roads and trails.

Future mine openings (portals, ventilation raises, and air intakes) will be designed similar to existing openings, directing entrance drainage inward to the mine where water will be managed in the same manner as present with water ultimately included in the mine dewatering system and pumped to the mill process and mine water treatment plant. Underground mine water pumped to the mill first passes through a clarifier to remove most of the suspended sediment and then goes to the mine water treatment plant which further reduces total suspended sediment (TSS) before treated effluent is either directed into the mill process stream or discharged to the contact water pond or the WRTSF. The mine water treatment plant effectively treats water from underground mining, along with surface water from the contact water collection area, to have TSS levels below the 25 mg/L maximum specified by condition 1.2.3 of Brucejack Effluent Permit 107835.

5.4 GROUNDWATER

The Brucejack Mine groundwater system has been characterized through several hydrogeological field investigations which have established a broad monitoring well network within and proximal to the mine. The current monitoring network is comprised of 31 monitoring wells as prescribed by Appendix B of Effluent Permit PE-107835 (BJ-GW18-22A was destroyed in 2022, and replacement is under review). Four additional monitoring wells are monitored outside of permit requirements. All monitoring wells are located within the current M-243 PMA boundary, with the exception of BJ-GW14-14A/B which were drilled and installed during a 2014 potable water source investigation (BGC 2014c). All monitoring wells are equipped with dataloggers for continuous water level monitoring, while selected wells are sampled for groundwater quality on a quarterly or biannual basis. Inflows to the underground mine (and pumped to the water treatment plant) are also recorded daily per the Water Management Plan – OMS Manual (SRK 2020).

A stand-alone groundwater monitoring report has been included in every annual report submission since 2015, with the most recent report included as Appendix 6.1-1 in Pretium (2022). Existing conditions based on five years of monitoring data were summarized in the 2020 5 Year Mine Plan and Reclamation Update (Lorax 2020c in Pretium 2020f). The site-wide groundwater model was significantly updated for the 5 Year Mine Plan (Lorax 2020a) and has superseded the 2015 model

developed for permitting (BGC 2015). The 2020 groundwater model was calibrated to a near-continuous groundwater level and underground dewatering records collected prior to and during mine operations (2012 to 2018). The strong calibration to, and subsequent validation of, water level and underground flow data indicate that the groundwater model is conceptually sound and well-positioned as a tool for closure planning (Lorax 2020a) and informs the Closure Underground Water Quality Adaptive Management Plan (Pretium 2020g).

5.4.1 Monitoring and Management

Continued dewatering of the VOK and West Zone workings has created and sustained a substantial cone of depression in the groundwater table in the footprint of the underground mine workings and farther afield. Water levels collected at wells near the VOK Zone suggest that drawdown at historic wells exceeds 100 m and that a groundwater divide exists between the VOK and West Zone. The data record at higher elevation wells in near the VOK indicates that seasonal water level fluctuations are on the order of tens of meters and hydraulic gradients at well pairs are moderately to strongly downward, reflecting depressurization of the groundwater system from depth. Groundwater flowpaths are towards the mine except in the area immediately downgradient of the CWP. East of the West Zone, water levels at selected well pairs are lower than the elevation of the WRTSF (1,364.5 masl) which suggests that the WRTSF is recharging groundwater at its outlet.

Groundwater inflows to the mine show significant seasonal variation with minimum flows in winter months ranging from 500 m^3/d to 750 m^3/d over the last several years of operations. Peak monthly flows during the open water season have ranged from 2,500 m^3/d to 3,000 m^3/d over the last two years, with peak daily flows on the order of 4,000 m^3/d on a couple of occasions during the 2021 freshet. Underground flows have remained within the WTP treatment capacity of 10,000 m^3/d and simulated monthly average flows are expected to remain below this threshold through operations. Treatment rates will be maximized at 10,000 m^3/d over a 15-month period at closure as described in the Closure Underground Water Quality Adaptive Management Plan (Pretium 2020g). This 15-month period includes seven months of mine flooding which will be accelerated using reclaim from the WRTSF. The mine is predicted to flood to 1,400 masl.

All Brucejack monitoring wells screen groundwater that is neutral to slightly alkaline (pH 7 to 8.5). Brucejack groundwater quality appears largely unimpacted by mining operations except for subtle shifts in major ion chemistry in wells dewatered by VOK development and isolated influences of surface infrastructure on shallower wells (such as seepage from the CWP and salt application from the wash bay). This is expected since groundwater flowpaths are largely towards the mine. There are limited instances where dissolved trace metals are measured above their background levels. Selected dissolved metals, such as arsenic appear to be naturally elevated in the groundwater system and are spatially variable across the site.

5.4.2 Potable Groundwater Supply

The mine currently sources its potable water from a single dewatering well (D3) installed within the current M-243 boundary (Figure 1.3-2). Flow rates and water levels are continuously monitored and, as of August 2021, recorded on a one-minute frequency. Daily manual flow totalizer readings are also recorded and used to verify the datalogger measurements. Potable water is sampled and screened in accordance with the *Drinking Water Protection Act*.

Winter 2021/2022 withdrawal rates at the D3 well were on the order of 150 m^3/d and approached the sustainable yield of the well. This has prompted Pretium to improve efficiency of current potable water

usage and evaluate additional potable water sources including potential additional water supply wells in the proposed Water Supply Area (Figure 1.1-1). The Water Supply Area configuration allows for potential potable water sourcing distal from future mine development (i.e., minimizing influence from the mine) and includes areas that appear to occur in structurally disturbed areas as inferred from presence of lineaments on orthophotos. Potable groundwater exploration in the Water Supply Area will include drilling of a larger diameter well and, if initial drilling observations prove promising (i.e., high airlift yields produced), a second, smaller diameter observation well will be drilled and installed nearby. The purpose of the observation well is to facilitate interpretation of subsequent hydraulic testing of the pumping well that will inform an application for a groundwater use licence under the *Water Sustainability Act*.

5.5 VEGETATION AND WILDLIFE

Based on a review of terrestrial ecosystem mapping and the locations of rare plants and lichens identified through surveys completed as part of the 2012-13 Terrestrial Ecosystem Baseline Studies (Appendix 16-A of the EAC/EIS Application; Pretium 2014), vegetation clearing and development within the Water Supply Area and Peripheral Mining Area may result in additional loss and/or alteration of alpine ecosystems. Several known rare plant and lichen observations are located within the Water Supply Area and Peripheral Mining Area. There are no anticipated interactions with parkland, riparian, or forested ecosystems. There are no anticipated losses of rare ecosystems listed by the BC Conservation Data Centre associated with these proposed areas (BC CDC 2020). Moose, mountain goat, grizzly bear, hoary marmot, raptors, migratory waterbirds, and migratory landbirds have high-quality habitat or suitable habitat that occurs within the Water Supply Area and Peripheral Mining Area, based on the wildlife baseline reports from surveys completed between 2010 and 2013 (Rescan 2013b and Rescan 2013c) and terrestrial ecosystem mapping from surveys completed in 2012 and 2013 (Rescan, 2014).

Mitigation measures to avoid or minimize adverse effects on terrestrial ecology are specified in the mine's Vegetation Management Plan and Invasive Plants Management Plan. Mitigation measures outlined in the Vegetation Management Plan include best management practices for vegetation clearing to minimize fragmentation, edge effects, windthrow, and soil disturbance, including in sensitive areas like alpine ecosystems. Mitigation measures for rare plants and lichens include applying adaptive Project design changes to avoid harm to known rare plant and lichen populations, where feasible, and adhering to best management practices around known locations of rare plants and lichens. Best management practices include creating buffer zones around known rare plant and lichen habitats, wherever feasible, to avoid direct disturbance and to minimize potential effects related to fugitive dust transport, weed invasion, vehicular activities, and accidental spills. Where avoidance is not feasible and development is required within a buffer zone around plant populations, erect temporary fencing or other barriers around the nearby rare plant and lichen populations to avoid further disturbance to the site. Where avoidance is not feasible and removal of rare plants or lichens are necessary for development, the disturbed area will be recorded and reported in the annual report. Additional mitigation measures to minimize soil loss and degradation are specified in the Surface Erosion Prevention and Sediment Control Management Plan. The Invasive Plants Management Plan specifies measures to minimize the potential introduction and establishment of invasive plant species.

Mitigation measures to avoid or minimize adverse effects on wildlife and wildlife habitat are specified in the Wildlife Management Plan. The plan focuses on reducing the risk of direct and indirect wildlife mortality, mitigating the potential for human-wildlife conflicts, and minimizing the level of disturbance to wildlife and wildlife habitat as a result of mining activities or infrastructure. Measures to minimize

disturbance include avoiding sensitive timing windows whenever possible, conducting pre-clearing surveys, and/or reducing or limiting on-site activities to include only essential activities. In accordance with the Wildlife Management Plan, vegetation clearing activities that may disturb wildlife will be avoided during sensitive periods wherever feasible. For mountain goats, clearing activities during the kidding period (May 1 to July 15) will be avoided within 500 m of high-quality summer habitat. If activities are not avoidable, pre-clearing surveys will be conducted and work will be paused if goats with kids are observed within 500 m of activities. For grizzly bear, clearing activities between April 30 to October 31 will be avoided in high-quality habitat if bears are observed in the area and do not move away. If necessary, the mine's Environmental Manager may trigger a work pause to prevent disturbance to nearby bears. Management protocols for roads, including access roads at the mine site, are provided to minimize direct mortality as a result of wildlife-vehicle interactions, and disruption of movement or mortality as a result of attraction to the road or wildlife use of the road.

New mitigation and changes to the Wildlife Management Plan will be implemented as a result of activities within the Water Supply Area and Peripheral Mining Area that intrude into areas where known hoary marmot colonies were detected during the 2012 baseline surveys and 2022 aerial surveys. Pre-clearing surveys for hoary marmot colonies will be conducted in suitable habitat prior to construction activities, and mitigation will be implemented if marmot burrows are observed. If construction activities are scheduled during the winter when marmots are hibernating, pre-clearing surveys will be conducted during the previous fall. Avoidance of colonies, where feasible, is the primary mitigation to minimize effects of habitat loss and alteration and direct mortality due to burrow destruction. Where avoidance is not feasible, Pretium will work with Indigenous groups to either harvest or move individuals to habitat outside the area of vegetation clearing (e.g., newly created habitat, naturally occurring similar high-quality habitat). If hoary marmot removal is deemed necessary, the BC Ministry of Forests will be contacted, and the appropriate permits will be obtained.

5.6 GEOTECHNICAL AND GEOHAZARDS

Geohazards mapping of all Brucejack project infrastructure areas was completed pre-construction and is included in the Geohazards Management Plan. Annual reviews are conducted by a Professional Engineer or Geoscientist of mine site geohazard management practices, in accordance with M-243 Condition C.9, and reported in the Annual Report for *MA* Permit M-243 and *EMA* Permits PE-107835 and PA-107025.

Geohazards mapping included within the Geohazards Management Plan will help inform facilities planning and design for the proposed PMA expansion areas. Geohazards and avalanche safety assessments will be completed for new surface infrastructure within the proposed PMA expansion areas during the planning and initial design stage, with geotechnical assessments also conducted and measures included in design as appropriate. Facility-specific operating procedures for geohazards and geotechnical will also be developed and implemented as appropriate.

6. RECLAMATION AND CLOSURE PLAN

6.1 OVERVIEW

This chapter describes reclamation and closure planning concepts applicable to the proposed PMA expansion areas and proposed expansion of the km 72 NPAG Quarry. The most current Reclamation and Closure Plan for the Brucejack Mine was included as Chapter 3 of the Brucejack Gold Mine 2020 Mine Plan and Reclamation Program Update (2020 Update) (Pretium 2020f); this is provided as Appendix 6.1-1.

The approved end land use for the Brucejack Mine site (M-243, Condition E.3) is wildlife habitat, particularly matrix habitat for mountain goat, grizzly bear and hoary marmot. The mine site provides matrix habitat for wildlife species resident in the general vicinity — i.e., hoary marmot, grizzly bear, and, to a more limited extent, mountain goat. Matrix habitat at the mine site is a rocky area with limited vegetation cover that does not provide life requisites for wildlife species (e.g., forage, cover, or other key habitat values), but which provides connectivity for animals to access adjacent habitat. It differs from a movement corridor in that it does not provide foraging value. As such, a central objective of reclamation planning for the mine site is to prevent the creation of obstructions or hazards to post-closure movement of wildlife.

At closure, the existing mine site PMA area will be reclaimed to matrix habitat for mountain goat, grizzly bear and hoary marmot to facilitate movement by these target species and others, into better habitats. This will be achieved by reclamation measures that result in terrain that is free of mine related obstacles or hazards, thereby allowing free movement through the area by wildlife. The post-closure mine site will have low vegetation cover, consistent with its pre-mine condition and with surrounding areas, as most of the adjacent landscape is comprised of unvegetated bedrock exposures.

Terrestrial characteristics and wildlife habitat attributes values of the proposed PMA expansion areas are very similar to those of the mine site. As such, it is proposed that the same end land use be extended over these areas. Specific reclamation prescriptions will depend on what infrastructure is developed, but it is expected that the current suite of reclamation prescriptions will be applicable. All are subject to change dependent upon the outcomes of reclamation research currently in progress.

Brucejack Mine reclamation and closure planning has been integrated with mine planning and design since pre-construction environmental assessment and related pre-construction design work began in 2012 and 2013. The mine and its operations have been planned and designed to minimize the terrestrial development footprint and to prevent significant adverse effects on the downstream aquatic receiving environment, including both water quality and aquatic biota.

Based on the current mine plan, the remaining mine life is approximately 9 years, with operations ceasing at the end of 2032. This will be followed by a closure phase estimated at three years, including two years of closure and reclamation within the M-243 area and a third year of reclaiming off-site mine related infrastructure (i.e., the BJAR and adjacent infrastructure below Knipple Glacier, extending to the Highway 37N intersection, and the Licence of Occupation authorized portion of the transmission line). A monitoring period of five years is planned for the M-243 area at the beginning of the post-closure phase.

Brucejack Mine surface disturbance areas are limited in extent due primarily to it being an underground mine. The current M-243 total approved PMA, including a 100 m wide corridor along the northernmost 19.5 km of the transmission line, is 607 ha, of which 542 ha is within the mining leases. Actual disturbance within the mining leases at end of 2021 was calculated at 285.2 ha.

The following subsections provide reclamation and closure planning information pertinent to the proposed PMA expansion areas.

6.2 TERRESTRIAL ECOSYSTEM SETTING

6.2.1 Mine Site

The Brucejack mine site is situated in rugged mountainous terrain at approximately 1,400 masl. Surrounding peaks reach elevations exceeding 2,300 masl. Glaciers and ice fields surround the mine site area to the west, south and east (Figure 6.2-1). Recent and rapid deglaciation has resulted in over-steepened and unstable slopes in many locations. Recently deglaciated areas typically have limited, if any, soil development; where present, soils are derived from glacial till and colluvium.

The existing mine site infrastructure located along the southwest shore of the WRTSF, including the underground mine, mill and camp, is located primarily on bedrock outcropping with some slightly weathered parent materials occurring as pockets with alpine vegetation (Figure 6.2-2).

Prior to mine construction, the Brucejack mine site area was characterized as dominantly exposed bedrock, with approximately 80% of the mine site described as non-vegetated or sparsely vegetated (Figure 6.2-3) (Rescan 2014).

The existing mine site infrastructure area and most of the proposed PMA expansion area are located above the tree line in the Coastal Mountain-heather Alpine (undifferentiated; CMAun) Biogeoclimatic Ecosystem Classification (BEC) zone (Figure 6.2-4.). This zone has the harshest climate of any biogeoclimatic zone in BC. Temperatures are low for most of the year, with much wind and snow. Temperatures remain low even during the growing season, which has an exceptionally short frost-free period. Mean annual temperatures range from 0°C to 4°C. Patches of snow, névé, and firn persist late into the year.

Vegetation community development within the mine site and vicinity are limited by the poor quality and limited availability of growth media, high snow pack, high winds and low temperatures. Vegetation classes of the Alpine Group (MacKenzie 2012) were present pre-mine and remain in undeveloped areas as a mosaic across the landscape, with distribution determined by growth media depth, drainage and microclimate. The vegetation includes small shrubs, lichen and mosses. Most of the ecosystems within the mine site vicinity are early seral, disclimax, or edaphic climax ecosystems. Early seral ecosystems, such as the areas mapped as alder thicket, are those early in the successional status chrono-sequence. These include non- and sparsely vegetated, pioneer seral and young seral communities. Edaphic ecosystems include those maintained by local climatic and soil conditions that enable an ecosystem to perpetuate itself.

The small areas of vegetation that were present (and which remain in some locations) include small shrubs, lichens and mosses. Alpine Tundra Class vegetation communities are dominated by hardy ericaceous shrubs that can withstand the desiccating winds common in alpine environments. Alpine vegetation classes include Alpine Fellfield, Heath, and Meadow classes. Detailed vegetation and terrain mapping and descriptions of the mine site area are provided in Appendix 5 of the 2012-2013 Terrestrial Ecosystem Baseline Studies (Rescan 2014).

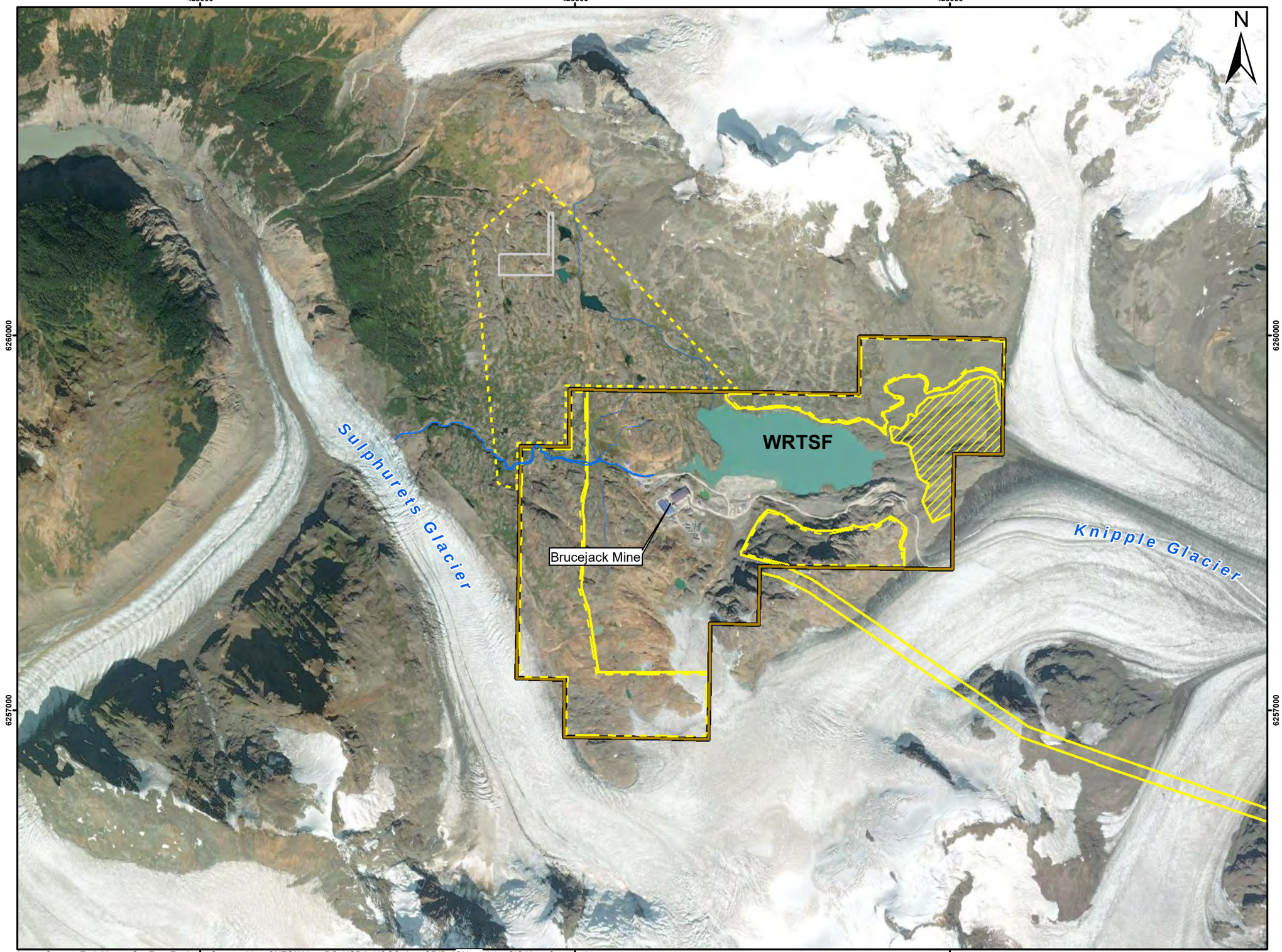

Image Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

Current M-243 PMA Boundaries

M-243 Permitted Mine Area (2020)

Proposed Additions to M-243 PMA Boundary in Amendment #9

Peripheral Mining Area

Water Supply Area

Proposed Addition to M-243 Boundary in Amendment #8

Dec. 2021 PMA Application Amendment #8 Application)

Mineral Leases

Mining Lease

Mining Lease - Owned by Others

Miscellaneous

WRTSF Waste Rock and Tailings Storage Facility

1:30,000

0 500 1,000

Metres

Coordinate System: NAD 1983 UTM Zone 9N

NEWCREST

PRETIUM RESOURCES INC.

A member of the Newcrest Group of companies

Map ID: BJAUTH20220918138

Imagery: 2019 ESRI Imagery | Date: September 19, 2022

Figure 6.2-1 Brucejack Gold Mine Glacial and Gossanous Terrain Setting

Figure 6.2-2. Brucejack Advanced Exploration 2013, Showing Mine Site Bedrock Outcrops and Pockets of Weathered Parent Materials.

Figure 6.2-3. Brucejack Mine Site During Exploration in 2012, Showing Bedrock Exposures and Limited Vegetation Extent.

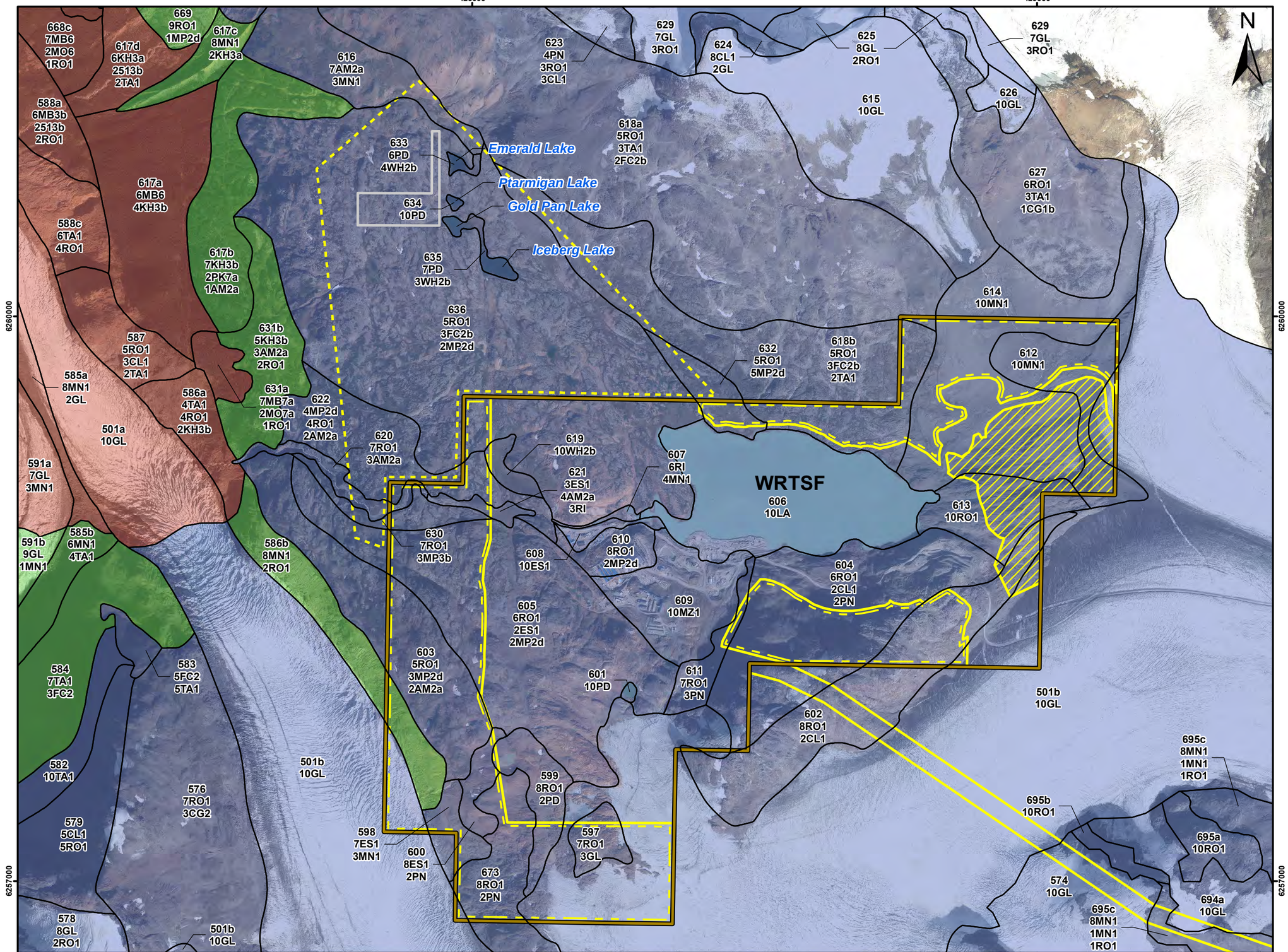

Image Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

Current M-243 PMA Boundaries

M-243 Permitted Mine Area (2020)

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Peripheral Mining Area

Water Supply Area

Proposed Addition to M-243 Boundary in Amendment #8

Dec. 2021 PMA Application (Amendment #8 Application)

Mineral Leases

Mining Lease

Mining Lease - Owned by Others

Miscellaneous

WRTSF Waste Rock and Tailings Storage Facility

BEC Zones

CMAun

MHmm2

MHmmp

Terrestrial Ecosystem Mapping

TEM Boundary

TEM Label

618b — TEM ID number
5RO1
3FC2b — Ecosystem Label for Deciles 1, 2 and 3
2TA1
Decile
Mapcode
Structural Stage
Structural Stage Modifier

1:20,000
0 500 1,000
Metres

Coordinate System: NAD 1983 UTM Zone 9N

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Imagery: 2019 ESRI Imagery | Date: September 13, 2022

Figure 6.2-4 M-243 Existing and Proposed Amendment #9 Permitted Mine Area Boundaries with TEM

6.2.2 PMA Expansion Areas

Appendix A of Environmental Assessment Certificate #M15-01 Amendment Application #9 (ERM 2022), included as Appendix 1.1-1 of this application, describes the Terrestrial Ecosystems mapped within the proposed PMA expansion areas based on August 2022 confirmatory field studies, and provides a description of the BEC units for the area as well as a summary of surficial terrain and ecosystems. Excerpts are provided as follows.

The CMAun BEC zone (Figure 6.2-5) occurs at high elevations throughout the coastal mountains of BC. This zone is a relatively moist environment, tends to have a deeper snowpack, and begins at lower elevations than other alpine zones (BC MOFR 2006). Much of the land area is dominated by glaciers, permanent snow/ice, or recently exposed rock (BC MOFR 2006). Non- and sparsely vegetated ecosystems include rock outcrops, talus, and moraine. Patches of snow, névé, and firn persist late into the year. Vegetation cover increases to the west towards the Sulphurets Valley. In this zone, vegetation classes of the Alpine Group (MacKenzie 2012) are present as a mosaic across the landscape, the distribution of which is determined by soil depth, drainage, and microclimate.

Figure 6.2-5. Example of the ecosystems and sparsely vegetated landscape within the CMAun Zone.

A small portion of the western edge of the Peripheral Mining Area, within the Sulphurets Creek direct catchment (Figure 6.2-4) contains Mountain Hemlock, Moist Maritime Parkland (MHmmp). The MHmmp zone (Figure 6.2-6) occurs at high elevations on the coastal mountains. This parkland region is the transitional zone in between forested subzones at lower elevations and the true alpine zone (CMAun) at higher elevations. This zone is one of Canada's wettest ecological zones, with a deep

snow cover and relatively short growing season (BC MOFR 1997). The MHmmp vegetation consists of mountain heathers (Cassiope spp.) and tree species such as mountain hemlock (Tsuga mertensiana), yellow-cedar (Chamaecyparis nootkatensis), and subalpine fir (Abies lasiocarpa), which are primarily in krummholz form and occur in irregular patches at the treeline (BC MOFR 1997).

Figure 6.2-6. Example of the ecosystems and krummholz growth at treeline within the MHmmp Zone.

Most of the ecosystems surrounding the mine site are early seral, edaphic climax, or disclimax ecosystems. Early seral ecosystems are those early in the successional status chrono-sequence and include non- and sparsely vegetated, pioneer seral, and young seral communities. Edaphic ecosystems include those maintained by local climatic and soil conditions that enable an ecosystem to perpetuate itself. For example, ecosystems affected by saturated soils will develop specific plant assemblages that will be maintained as long as the soil conditions remain. Such is the case with late snowbed ecosystems, which are maintained by the persistence of snowpack late into the growing season. Disclimax ecosystems include those maintained by repeated disturbance events, such as snow avalanches.

Vegetation community development in the area surrounding the mine site is influenced by the recent deposition of the soil parent material, excessive snow pack, wind, and cold temperatures. Vegetation classes mapped in the areas surrounding the mine site occur largely within the Alpine Group, including Alpine Tundra, Fellfield, Heath, and Meadow classes (MacKenzie 2012). Alpine Tundra vegetation communities are dominated by hardy ericaceous shrubs that can withstand the desiccating winds common in alpine environments. Alpine Fellfield are exposed ecosystems where the effects of frost and wind give rise to a characteristic low plant cover. Soils are either absent or exist as thin veneers, often derived from in-situ bedrock weathering, remnant glacial till, and colluvium. Thin annual

snowpack leads to active freeze–thaw cycles that push plants out of the soil. Since soils are typically very high in coarse fragments, vegetation cover is thin and growth is poor. Alpine Heath ecosystems are mountain-heather–dominated snowbeds that are widespread and common in snow-accumulating sites and upon stable substrates. Mountain-heather species are always prominent and site moisture is typically mesic and drier. Alpine Meadow ecosystems are forb-dominated (or large sedge–dominated) ecosystems. These ecosystems develop in areas of deeper continuous winter snowpack over deep or fine-textured and well-developed soils. Sites with seepage or unstable soils favour the Alpine Meadow Class over Alpine Heath ecosystems.

6.3 END LAND USE OBJECTIVE

6.3.1 Introduction

As described in Section 6.1, the approved end land use objective for the current Brucejack PMA is matrix habitat for wildlife species resident in the general vicinity, particularly hoary marmot, grizzly bear and mountain goat.

The proposed Water Supply Area and Peripheral Mining Area surrounding the Brucejack mine site and WRTSF occur in a landscape of rock outcrops and recently de-glaciated till (Figure 6.3-1) at elevations generally between approximately 1,400 m to 1,500 m. Within the Water Supply Area and Peripheral Mining Area, small pockets of vegetation occur a) at the wetland at the exit of the WRTSF that connects to Brucejack Creek, b) along Catear Creek, and c) on the west-facing slope above the Sulphurets Glacier.

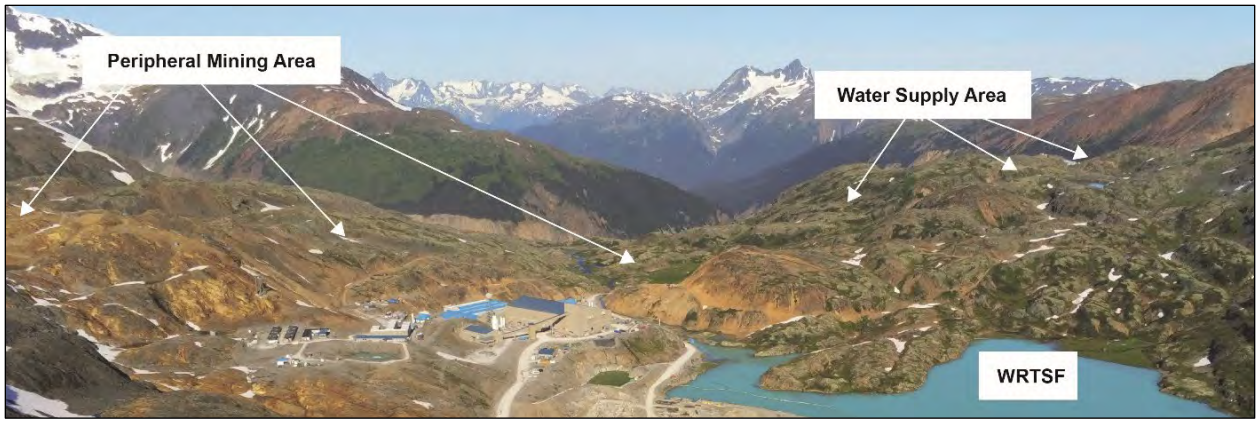


Figure 6.3-1. General Landscape of the Water Supply Area and Peripheral Mining Area, Facing West from the WRTSF

Baseline wildlife surveys conducted in 2010 to 2013, long term monitoring, updated baseline surveys in 2022, and habitat suitability mapping indicate that this area is used as a residence by a small number of hoary marmots and is likely used as matrix/movement habitat by mountain goats and grizzly bear. Therefore, the proposed end land use for the Peripheral Mining Area and the Water Supply Area proposed PMA expansion areas is matrix habitat for these species, which is reflective of current conditions and use as described in the following sections.

An additional consideration pertinent to end land use is that growth media (unconsolidated overburden and soils) at the mine site have naturally elevated metals concentrations, including arsenic, due to

being located on gossanous material. Additional details are provided below in Sections 6.4.1 and 6.4.2.

At closure, the existing mine site PMA area will be reclaimed to matrix habitat for mountain goat, grizzly bear and hoary marmot to facilitate movement by these target species and others, into better habitats. This will be achieved by reclamation measures that result in terrain that is free of mine related obstacles or hazards, thereby allowing free movement through the area by wildlife. The post-closure mine site will have low vegetation cover, consistent with its pre-mine condition and with surrounding areas, as most of the adjacent landscape is comprised of unvegetated bedrock exposures.

6.3.2 Hoary Marmot

Hoary marmots require soil or talus to dig their burrows, whereas the majority of the Water Supply Area and Peripheral Mining Area is exposed rock. Aerial and ground surveys in 2012 and 2022 indicate that hoary marmot colonies occur a) along Brucejack Creek and near the wetland at the exit of the WRTSF (Water Supply Area and Peripheral Mining Area A), b) where Catear Creek connects to the WRTSF (Water Supply Area), and c) on the east-facing lower slopes of the Mitchel Valley where it is generally too steep to conduct mining activities (Peripheral Mining Area A) (Figure 18.6-14a in Chapter 18 of the EAC/EIS Application; Pretium 2014). In Peripheral Mining Area C, high quality marmot habitat is modelled (Figure 18.6-14a in Chapter 18 of the EAC/EIS Application; Pretium 2014), based on the occurrence of low-lying vegetation; however, this area does not have the deep soils required for marmots to den. The current land use of the majority of the Water Supply Area and Peripheral Mining Area is as movement/matrix habitat for marmots, and it is proposed that the closure land use objectives remain as movement/matrix habitat.

6.3.3 Mountain Goat

Habitat suitability modelling indicate high quality summer and winter mountain goat habitat occurs discontinuously through the Water Supply Area and Peripheral Mining Area (Figures 18.6-4 and 18.6-6a in Chapter 18 of the EAC/EIS Application; Pretium 2014). Habitat suitability modelling for mountain goat focused on identifying areas within 400 m of exposed rock, at approximately a 30% slope and with south or south-west facing aspect (Appendix 18-A in the EAC/EIS Application; Pretium 2014) (Rescan 2013b). Subsequently, this modelling picks up areas of exposed rock and may provide a higher value for these areas than are observed in the field. In the field, mountain goats select for these variable, plus large contiguous areas of green vegetation, which is largely absent in the Water Supply Area and Peripheral Mining Area. Aerial survey results support this finding, with no observations of mountain goats on the exposed rock surrounding the Brucejack mine site and instead, identified mountain goats in large areas of contiguous vegetation (2010 and 2012 baseline surveys, Appendix 18-A in the EAC/EIS Application; Figure 18.6-6a in Chapter 18 of the EAC/EIS Application; Pretium 2014) (Rescan 2013b). Therefore, the Water Supply Area and Peripheral Mining Area is likely used by mountain goats as movement/matrix habitat, and it is proposed that movement/matrix is the end land use objective for the site.

The only proviso is that there is a contiguous block of vegetation downslope from the Brucejack mine site on the southwest-facing slope above the Mitchel Glacier within and immediately to the west of Peripheral Mining Area A (Figures 18.6-4 and 18.6-6a in Chapter 18 of the EAC/EIS Application; Pretium 2014). This area is >45% slope and in an area of high avalanche risk and so is unlikely to have any mining activity. If any ground disturbance occurs in this area, reclamation objectives should be to support re-growth of vegetation, by providing small-grained surface material where vegetation can establish.

6.3.4 Grizzly Bear

Habitat suitability modelling indicate high quality spring grizzly bear habitat occurs discontinuously through the Water Supply Area and northern portions of the Peripheral Mining Area (Figures 18.3-5 and 18.6-10 in Chapter 18 of the EAC/EIS Application; Pretium 2014). Habitat suitability modelling for grizzly bear focused on identifying large contiguous areas of vegetation where spring and summer herbs and rooted vegetation can grow, as a food supply. The closest large area of contiguous vegetation is the southwest-facing slope of the Mitchel Glacier Valley, located northwest of the Water Supply Area. Individual pixels of green vegetation were identified by the Predictive Ecosystem Model in the Water Supply Area and surrounding the Brucejack Creek wetland. However, in general these areas are made up of exposed rock, and do not support the contiguous large areas of vegetation preferred by grizzly bear. This is supported by long-term monitoring results, which have not recorded any grizzly bears feeding in the Brucejack mine site area. The Water Supply Area and Peripheral Mining Area are likely used by grizzly bear as movement/matrix habitat and that is the proposed end land use objective for the closure scenario.

6.4 RECLAMATION APPROACHES

6.4.1 Background

The Brucejack mine site and vicinity has multiple unique or unusual characteristics that present substantial challenges for reclamation and are not typical of mines in BC. As discussed above, these characteristics include the high elevation and harsh climatic conditions of the mine site area, the ubiquity of geochemically reactive gossanous materials throughout the mine site, and the pre-mine lack of soils and ecosystem development.

Because of these challenges, the general approach to reclamation planning for the mine has been to minimize surface disturbance through mine design and construction, and to then create post-mine topography and conditions that will achieve the matrix habitat end land use and support passive natural revegetation to the extent feasible. Key reclamation methods include recontouring to prevent barriers to movement of the target wildlife species and to create stable drainage features, and decompaction/scarification of potential growth media. Some limited additional measures are being investigated as a component of the reclamation research program, described in Appendix 6.1-1, Section 3.3.6.

The following sections describe pre-development conditions and the approach to surficial materials use for reclamation of the Brucejack mine site. A key issue informing this approach is that overburden available as growth media within the mine site is predominantly PAG, with elevated element concentrations, particularly arsenic (Lorax 2016). This overburden is not suitable for use in reclamation and is instead recommended for handling in ways that will minimize potential for incremental acid rock drainage and metal leaching. It is not presently known if there are any areas within the mine site in which surficial materials may be amenable to revegetation – this question is being investigated as part of the reclamation research program in progress.

6.4.2 Surficial Materials

6.4.2.1 Brucejack Mine Site Current PMA

The Brucejack mine site area is located in the high elevation, very cold CMAun BEC subzone. Prior to mine construction, vegetation was sparse, generally covering less than 20 percent of the mine site

and with little to no cover at the other facilities within the mine site area (Rescan 2014) (Figure 6.2-5 and Figure 6.4-1). This sparseness is due to the extensive occurrence of bedrock, and the limited amount and poor quality of unconsolidated surficial materials.

Baseline surveys of mine site surficial materials (Rescan 2014) determined that most of these materials are insufficiently weathered and developed to meet the definition of soils. Where soils are present, they are generally of poor quality for revegetation due to their high coarse fragment content, lack of development, and/or shallow depth to bedrock. Laboratory analyses indicate that most mine site surficial materials have metal exceedances based on Canadian Council of Ministers of the Environment (CCME) soil quality guidelines; these exceedances include arsenic (Rescan 2014).

A thorough assessment of mine site overburden geochemical characteristics and suitability for use in reclamation was conducted in 2015 (Appendix 3.3-1, Pretium 2020f). This assessment indicated that mine site overburden is predominantly potentially acid generating. All overburden samples exceeded the CCME Industrial Soil Quality Guidelines for arsenic. The surficial materials characterization is consistent with the mine site's location in/on a gossan (mineralized, oxidized rock extending to surface; Figure 6.4-2).

In synthesis, the survey data indicate that soils and other surficial materials at the Brucejack mine site are not suitable for use as reclamation growth media, and that overburden should not be spread as a reclamation cover but should be treated in a manner to minimize generation of acid rock drainage (Lorax 2016). Although approximately 30,000 m^3 of this material was salvaged and stockpiled as required by EMLI, there is no plan to use these materials as reclamation covers. Amendment of these materials, such as attempting to add neutralizing compounds, is not a feasible option. Vegetation cover pre-mine was limited and implementing measures such as enhancing soil size materials to promote plant growth is currently considered to pose a risk to local wildlife in that it may attract wildlife to consume vegetation with potential to contain elevated metals concentrations.

Shallow ripping will be conducted in areas of the mine site disturbance footprint as appropriate following decommissioning of structures to decompact surficial materials and facilitate any natural regeneration by native vegetation communities that may occur. These activities are consistent with the passive revegetation approach discussed in Appendix 6.1-1, Section 3.3.3.

Rock outcrops dominate the steep terrain at the km 72 NPAG quarry site and along the BJAR between the upper Knipple Glacier (km 71.6) and the mine site (km 73.3). This segment of the BJAR was pre-existing from prior exploration activities. It was widened as required during mine construction to meet EMLI/Code safety requirements; this was primarily accomplished through placement of quarried NPAG rock from the km 72 NPAG quarry. No surficial materials salvage was feasible at these locations during mine construction. Shallow ripping will be conducted on the BJAR surface as feasible at closure, provided that it does not compromise site stability and water management. The km 72 NPAG quarry will remain as exposed bedrock and boulders at closure.

Figure 6.4-1. Brucejack Mine Site 2008, Showing Sparse Vegetation Cover.

Figure 6.4-2. Brucejack Mine Site Located On/In a Gossan (Photo August 2013).

6.4.3 Proposed PMA Expansion Areas

As described in Section 6.2-2, the proposed PMA expansion areas are also dominated by bedrock exposures at or near surface. Significant portions of both the Peripheral Mining Area and the Water Supply Area also have gossanous exposures (Figure 6.4-3). Pre-development site-specific reclamation planning will be undertaken when there are specific facility plans and designs, however the overall approach to surficial materials handling will be similar to that of the existing PMA given the similarities between the two areas. In any areas where surficial materials suitable for use in reclamation are present, these will be salvaged and windrowed or stockpiled for use in final reclamation of these areas.

Like the mine site, the gossanous portions of the proposed PMA expansion areas have the same considerations with respect to PAG rock exposures. Measures in the ML/ARD Management Plan will be applicable to any bedrock excavation, including that bedrock excavation will be avoided or minimized as feasible, characterized pre-excavation, and any excavated bedrock and bedrock exposures will be managed in accordance with the plan and the applicable conditions of M-243.

As above, specific plans for management of surficial materials will be developed when there are surface development plans or designs.

6.4.4 Landform Design and Erosion Control

The mine site and vicinity, including the proposed PMA expansion areas, is located in a bedrock controlled, high elevation area. The bedrock surface is irregular with rounded surfaces broken by crevices and depressions where snow accumulates. Pre-mine, there were localized areas within the currently developed mine site with shallow slightly weathered overburden and limited areas with developed soil cover. The mine site is located adjacent to the WRTSF, and the bedrock and shallow overburden extends to the WRTSF shoreline, with few level areas.

The km 72 NPAG quarry east of the mine site is located in bedrock. The quarrying process results in excavated benches and walls in the sloping bedrock. The quarry is designed such that the final quarry faces will be stable.

Closure landforms, including for the proposed PMA expansion areas, will be designed to facilitate movement of wildlife through the post-mining landscape and to direct surface waters appropriately.

6.4.5 Revegetation Strategy

6.4.5.1 Mine Site Area

The overall revegetation strategy for the Brucejack mine site area is passive, consistent both with the end land use objective of matrix habitat and with the challenges associated with local surficial materials. It entails creating, to the extent feasible and consistent with the pre-mine and adjacent landscapes, post-mine site and substrate conditions conducive to natural revegetation. Site disturbances will generally be recontoured and decompacted through shallow ripping as feasible and be allowed to regenerate naturally to locally endemic vegetation communities.

Most of the high elevation plant species that would be appropriate for an active revegetation program of the mine site are not commercially available and would likely present substantial propagation difficulties. Potentially suitable species that may be commercially available are very unlikely to have

been sourced from northwest near coastal BC, and therefore, although the same species, may not necessarily be adapted to the site conditions at the Brucejack mine site. These difficulties are further exacerbated by limited soils extents, and - within the areas of gossanous exposures - by surficial materials characteristics assessed as being unsuitable for use in reclamation. Revegetation of gossanous materials has potential to result in plant tissues with elevated metals concentrations, which, if these tissues are consumed by wildlife, could detract from the objective of providing suitable matrix habitat. Because of these limitations and challenges, passive or “leave-for-natural" revegetation approaches are more likely to yield acceptable long-term results than revegetation with non-local plant species. Further discussion on revegetation research and metal uptake is presented in Appendix 6.1-1, on reclamation research. Nonetheless, current reclamation planning, and associated reclamation liability costing allows for seeding of areas with suitably textured material using the Brucejack high elevation seed mix (Table 6.4-1).

The km 72 NPAG quarry and the BJAR segment between Knipple Glacier and the mine site were constructed mostly or entirely in rock. No active revegetation is planned for these areas.

Table 6.4-1. Brucejack High Elevation Seed Mix.

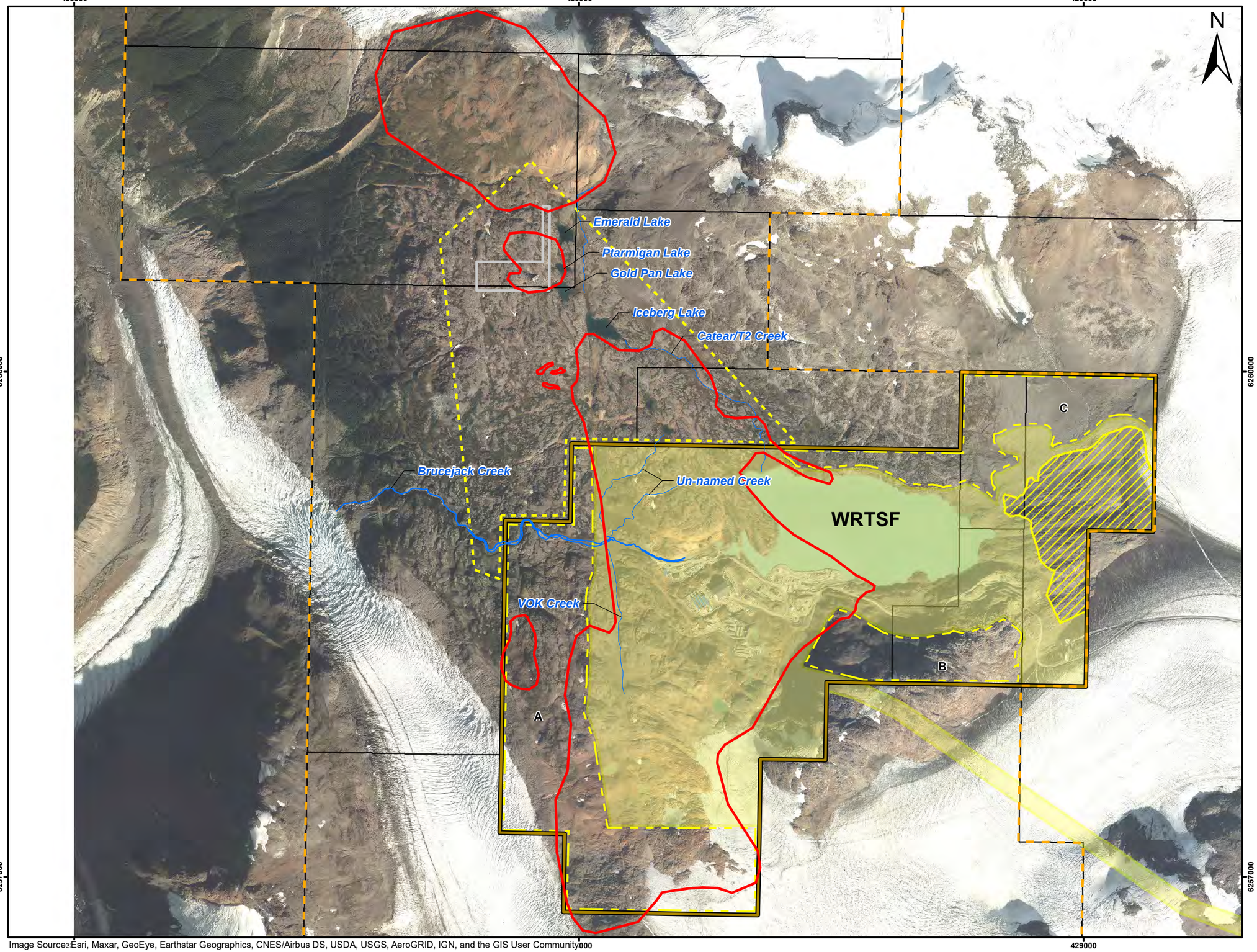
High Elevation Seed Mix (above 900 masl)	% by weight	Seeds/lb	% by Seed Count
Elymus trachycaulus, Slender Wheatgrass	60.00	145,000	20.58
Festuca saximontana, Rocky Mountain Fescue	20.00	679,000	32.12
Poa alpina, Alpine Bluegrass	10.00	1,000,000	23.65
Trisetum spicatum, Spike Trisetum	10.00	1,000,000	23.65
	100.00		100.00

6.4.6 Progressive Reclamation and Sequencing

Design of the Brucejack mine site has focused on efficient and essential use of surface disturbances. The mine site surface disturbance area is small (terrestrial infrastructure area of 60.79 ha), and the area is intensively used and needed for operations. Because Brucejack is an underground mine, incremental surface disturbances during mine life are very limited, and the site disturbance that is present is occupied by facilities and activities that will remain present throughout the mine life.

An additional consideration posed by revegetation efforts within the small and intensively used mine site is the risk this would pose to local wildlife. Establishing additional vegetation within the active mine site may attract hoary marmots and other small mammals, and possibly larger mammals such as bear. There is no feasible means to create barriers to prevent hoary marmot/small mammal ingress onto such areas, and this wildlife will be at increased risk of injury or mortality from traffic if present within the active mine site. Further, as described in Appendix 6.1-1, Section 3.3.7 additional research into metal uptake in vegetation is needed before there are efforts to establish vegetation within the gossanous area.

As a result of these factors, the opportunities for progressive reclamation within the mine site are currently limited to those that will support reclamation research (see Appendix 6.1-1, Section 3.3.7). This will be revisited as reclamation research proceeds and additional information becomes available, and as surface development is planned for the proposed PMA expansion areas. All other reclamation activities within the mine site will be completed during the closure phase.



Legend

Current M-243 PMA Boundaries

M-243 Permitted Mine Area (2020)

Proposed Additions to M-243 PMA Boundary in Amendment #9

Peripheral Mining Area

Water Supply Area

Proposed Addition to M-243 Boundary in Amendment #8

Dec. 2021 PMA Application (Amendment #8 Application)

Mineral Tenures and Authorizations

Mining Lease

Newcrest Exploration Permit Boundary (MX-1-842)

Mineral Claims

Mining Lease - Owned by Others

Miscellaneous

Approximate Gossan Extents

WRTSF — Waste Rock and Tailings Storage Facility

1:22,000

0 500 1,000

Metres

Coordinate System: NAD 1983 UTM Zone 9N

NEWCREST

PRETIUM RESOURCES INC.

A member of the Newcrest Group of companies

Map ID: BJAUTH20220909134

Imagery: 2019 ESRI Imagery | Date: September 13, 2022

Image Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 6.4-3 Brucejack Approximate Gossan Extents

6.5 RECLAMATION AND CLOSURE PRESCRIPTIONS

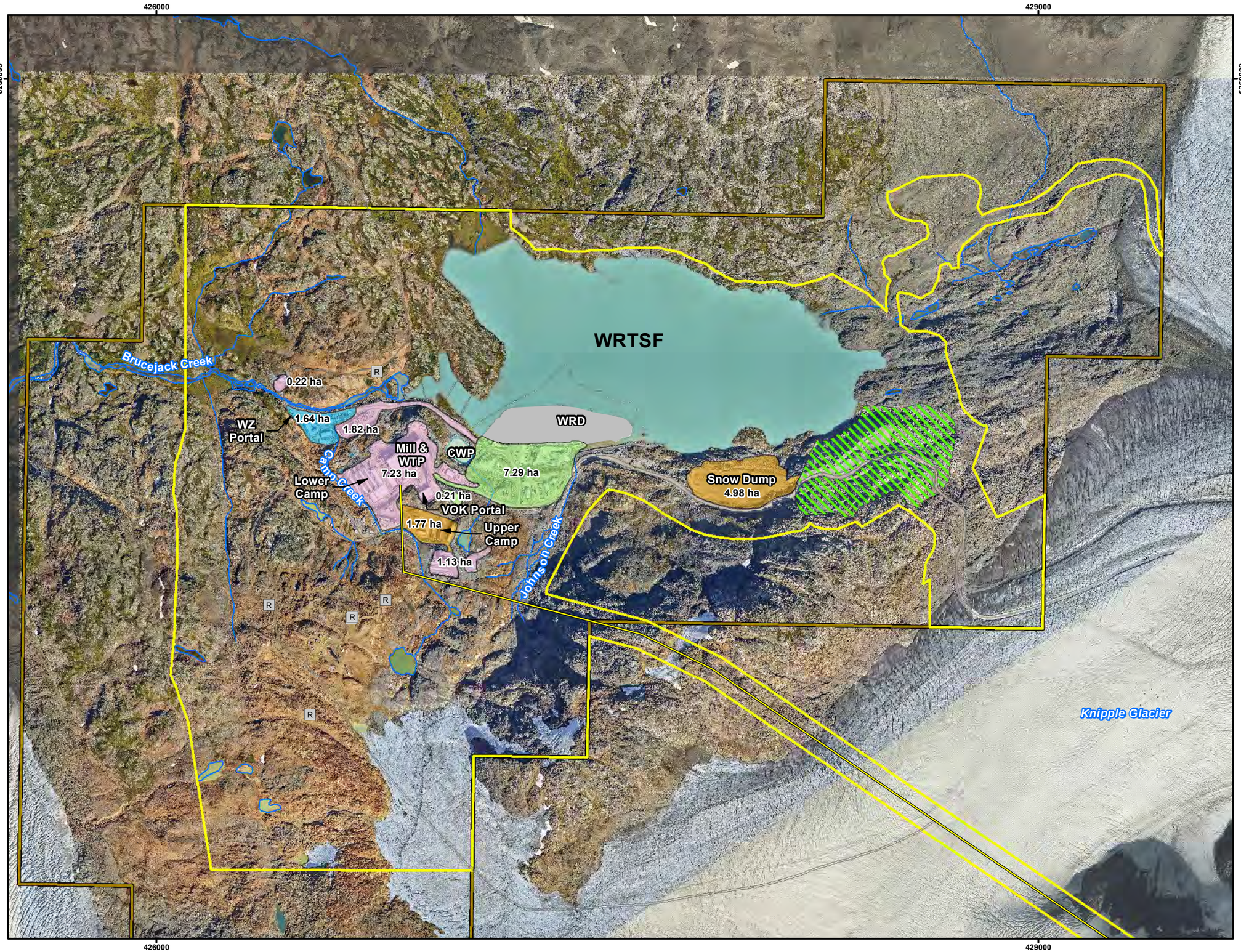
Reclamation and closure prescriptions for existing infrastructure at the Brucejack Mine, including the sequence and schedule, are presented in Appendix 6.1-1, Section 3.7.

Figure 6.5-1. summarizes mine site area surface reclamation treatments at closure. Recontouring and decompaction work during closure will be aimed primarily at preventing hazards or barriers to wildlife movement to achieve the end land use objective of wildlife matrix habitat (movement areas) particularly for mountain goat, grizzly bear, and hoary marmot (Permit M-243, Condition E.3). These animals will be able to move across the mine site post-closure to access foraging areas or other habitat that provides life requisites. Reclamation work during closure will be secondarily aimed, to the extent feasible and suitable, at creating conditions for passive revegetation via propagules from local endemic vegetation species in adjacent areas. The Brucejack reclamation liability costing includes seeding much of the mine site using Pretivm's high elevation native seed mixture, however a passive reclamation approach is preferred (refer to Appendix 6.1-1, Section 3.7).

Reclamation prescriptions are anticipated to be similar for new infrastructure in the proposed PMA expansion areas, however site and facility specific reclamation planning will be conducted at the planning and design stage with this information provided in NOD submissions as applicable and in updated reclamation plan submissions. It will also be reflected in updated reclamation liability costing submissions provided annually and as part of larger updates such as the five-year updates.

6.6 LONG-TERM STABILITY

The Brucejack Mine's surface development, including the km 72 NPAG quarry, has been designed and constructed following professional geotechnical and other engineering practices, and in accordance with M-243 and Code requirements. Mine facilities and post-closure surface landform sites are and will continue to be designed to remain stable throughout mine life and beyond through closure and post-closure.



Legend

Current M-243 PMA Boundaries

- M-243 Permitted Mine Area (2020)

Mineral Tenures

- Mining Lease

Reclamation Treatments

- Dozer (Excavator) recontouring, decompaction to 15cm as feasible.
- Shallow (5 to 10 cm max) decompaction as feasible, minor pad edge recontouring.
- Very minor recontouring (<10% of area), decompact as feasible 5 to 10 cm max.
- Very minor recontouring, decompact to 15cm.

Existing Infrastructure

- Km 72 NPAQ Quarry
- Buildings
- Transmission Line
- Reclamation Stockpile
- R — Air Raise
- **WRTSF** — Waste Rock and Tailings Storage Facility
- **CWP** — Contact Water Pond
- **WTP** — Water Treatment Plant
- **WZ** — West Zone

1:12,500

0 250 500

Metres

Coordinate System: NAD 1983 UTM Zone 9N

NEWCREST

PRETIUM RESOURCES INC.

A member of the Newcrest Group of companies

Map ID: BJAUTH20220914136

Imagery: 2019 Lidar | Date: September 14, 2022

Figure 6.5.1 Mine Site Reclamation Treatments at Closure

7. MODELLING, MITIGATION, AND DISCHARGES

The Brucejack Mine water quality model was updated with revised source terms for the 3800 tpd Amendment Application for Permits M-243 and PE-107835 in 2018 (Pretium 2018c) and again in July 2020 for the 2020 Mine Plan and Reclamation Program submission (2020 Update) (Lorax 2020b). The validity of source terms applied to the water quality model for the mine were assessed for those updates, along with a comprehensive evaluation of the water quality model as required by Condition D.4 (e) of *Mines Act* Permit M-243.

Water quality predictions are compared to concentrations of nutrients, major ions, and total and dissolved metals and reported annually in the Brucejack Mine *MA/EMA* Permits Annual Report in accordance with *Mines Act* Permit M-243 and effluent permit 107835 (Pretium 2016a, 2017, 2018b, 2019b, 2020b, 2021 and 2021). Geochemical source terms are also updated annually and included in the *MA/EMA* Permits Annual Report in accordance with M-243 Condition D.4(d)(v).

This application does not include any proposed changes that require updates to the Brucejack Mine water quality model, and nor any that would require amendment of the mine's regulated discharges under effluent permit 107835. Waste rock and any ore from underground exploration development within the proposed Peripheral Mining Area will be included within the total waste quantities authorized under M-243 from the 2018 3800 tpd amendment, and total ore will remain within the 18.5 Mt LOM total authorized under EAC M15-01. Potential surface PAG rock excavation quantities from surface infrastructure (including linear developments) within the PMA expansion area will also be included within (i.e., deducted from) the currently authorized waste rock deposition total for the WRTSF of 3.81 Mm^3.

No changes to air discharges are proposed as part of this amendment application. If new air discharges are required in future associated with underground exploration or mine development within the proposed PMA expansion area, amendment(s) to air permit 107025 will be applied for at that time.

8. ENVIRONMENTAL MONITORING

There is extensive environmental monitoring at the Brucejack Mine to meet the monitoring requirements of the mine's authorizations (e.g. EAC M15-01, CEAA 2012 Decision Statement, M-243, PE-107836, PA-107025, various *Water Sustainability Act* (*WSA*) and Northern Health authorizations) and component management plans of the EMS.

The scope of monitoring will be expanded as appropriate to include the proposed km 72 NPAG Quarry (e.g. additional materials characterization in accordance with the ML/ARD Management Plan, and additional geohazards monitoring and management as appropriate following the Geohazards Management Plan). Additional surface and underground rock excavation will be characterized and monitored as per the ML/ARD Management Plan. Any new surface development within the proposed Peripheral Mining Area and Water Supply Area PMA expansions will be monitored as appropriate in accordance with new *WSA* authorizations that may be required and with applicable existing management plans such as the EPSC, Vegetation, and Wildlife Management Plans. EAC Amendment #9 proposes specific monitoring measures for rare and endangered plants and certain wildlife species.

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APPENDIX 1.1.1 ENVIRONMENTAL ASSESSMENT CERTIFICATE #M15-01 AMENDMENT APPLICATION #9.

NEWCREST

PRETIUM RESOURCES INC.
A member of the Newcrest Group of companies

Brucejack Mine

Environmental Assessment Certificate #M15-01 Amendment Application #9

September 2022

Project No.: 0640316-02

The business of sustainability

ERM

September 2022

Brucejack Mine

Environmental Assessment Certificate #M15-01
Amendment Application #9

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ACRONYMS AND ABBREVIATIONS

ARD	Acid Rock Drainage
BC	British Columbia
CAC	Criteria Air Contaminant
CDC	Conservation Data Centre
Certificate	Environmental Assessment Certificate #M15-01
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPD	Certified Project Description
EAC Application	Application for an Environmental Assessment Certificate
EAO	British Columbia Environmental Assessment Office
EMA	*Environmental Management Act*
GHG	Greenhouse Gases
ha	hectares
HCA	*Heritage Conservation Act*
LHOS	Long-Hole Open Stoping
LSA	Local Study Area
NLG	Nisga'a Lisims Government
NPAG	Non-potentially Acid Generating
ML/ARD	Metal Leaching/Acid Rock Drainage
PAG	Potentially Acid Generating
Permit M-243	*Mines Act* Permit M-243
PMA	Permitted Mine Area
Pretium	Pretium Resources Inc.
Project	Brucejack Mine
RSA	Regional Study Area
SARA	*Species at Risk Act*
SRMP	Sustainable Resource Management Plan
TCG	Tahltan Central Government

VC	Valued Component
WRTSF	Waste Rock and Tailings Storage Facility
WSA	*Water Sustainability Act*

1. INTRODUCTION

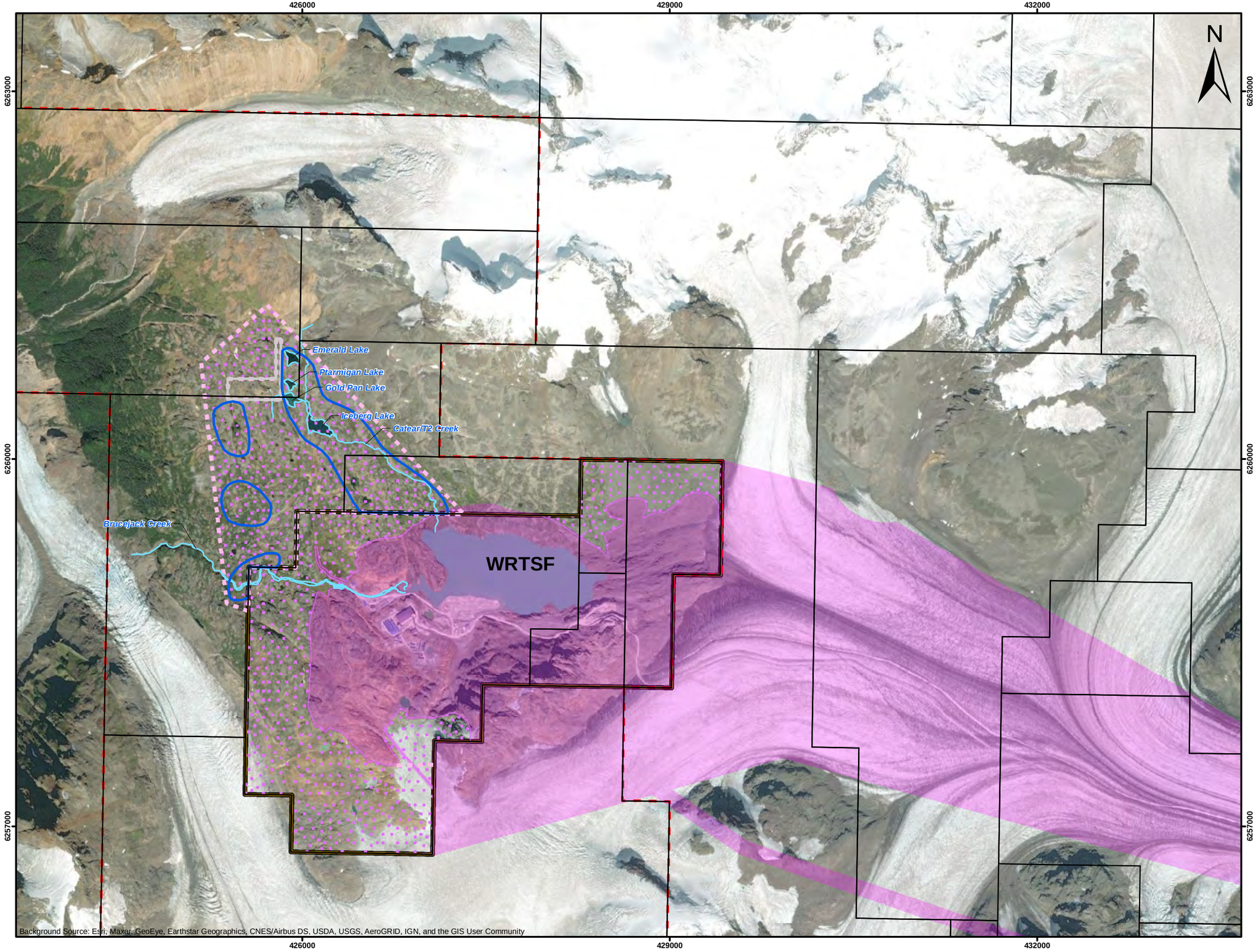
On March 26, 2015, Pretium Resources Inc. (Pretium) received Environmental Assessment Certificate #M15-01 (the Certificate) for the Brucejack Mine (the Project) pursuant to the British Columbia (BC) *Environmental Assessment Act* (SBC 2002, c. 43). Authorizations required to construct and operate the Project were received prior to the start of construction in September 2015, including Permit M-243 pursuant to the *Mines Act* (SBC 1996, c. 293), air permit 107025 and effluent permit 107835 pursuant to the *Environmental Management Act* (SBC 2003, c. 53), and the Decision Statement issued under Section 54 of the *Canadian Environmental Assessment Act, 2012* (SC 2012, c. 19, s. 52). On July 3, 2017, Pretium declared that commercial production had been achieved at the Brucejack Mine. The Environmental Assessment Office (EAO) determined on December 21, 2017, that the Project had substantially started, pursuant to Section 18 of the *Environmental Assessment Act*. The Certificate has been amended eight times, as approved by the EAO in March 2016, August 2016, November 2016, March 2017, November 2018, August 2019, April 2021, and June 2022.

Pursuant to section 32 of the BC *Environmental Assessment Act* (SBC 2018, c. 51), Pretium is seeking to amend the Certificate to extend the boundaries indicated in the Certified Project Description (CPD). The proposed changes in these boundaries are presented in Figure 1-1. The proposed CPD boundary expansion includes two categories (polygon types) of infrastructure inside and outside the mining leases, as follows:

1. **Water Supply Area**: An area beyond the mining leases for the purpose of potable water supply for the mine, along with associated access, electrical supply, and piping.
2. **Peripheral Mining Area:** An area within the mining leases outer extents, with infrastructure in this area to include:
    a. Underground Mining. This is requested to increase Pretium's flexibility to re-configure the underground mine horizontal extents based on ore definition as underground mining and exploration proceed, within the Certificate's defined ore extraction limit (currently 18.5 Mt). This includes the ability to recover and process ore from exploration headings and related development.
    b. Minor Surface Infrastructure. This is proposed to include access roads and trails; water and electrical lines; ventilation raises and air intakes for both underground mining and exploration; additional portals; power supply, including diesel generation and/or connection to existing hydro-electric power supply; storage or staging areas for mine supplies (including explosives magazines and fuel); communications facilities; meteorological stations; helipads; soil stockpiles; and temporary staging of waste rock.

This document (the Amendment Application) does not propose to increase ore extraction beyond the Certificate's defined ore extraction limit. Planning for future infrastructure within the proposed CPD Peripheral Mining Area expansion area is not yet sufficiently advanced for specific locations, site layouts and engineering design information to be available; this will develop over time as underground exploration advances.

This Amendment Application provides an assessment of the potential effects of the proposed Project changes on applicable valued components (VCs) described in the Application for an Environmental Assessment Certificate (the EAC Application; Pretium 2014), including any changes to the characterization of residual effects and determination of significance following the implementation of mitigation measures.



Legend

EAC #M15-01 CPD Boundaries

- Current EAC #15-01 CPD

Proposed Additions to EAC CPD Boundary in Amendment #9

- Peripheral Mining Area
- Water Supply Area

Mineral Tenures and Other Authorizations

- Newcrest Mining Leases
- Mineral Claims
- Newcrest Exploration Permit Boundary (MX-1-842)
- Mining Lease - Owned by Others

Miscellaneous

- Supplemental Water Source Investigation Areas
- **WRTSF** Waste Rock and Tailings Storage Facility

1:30,000

0 500 1,000

Metres

NEWCREST

PRETIUM RESOURCES INC.

A member of the Newcrest Group of companies

Map ID: BJAUTH20220804118

Imagery: ESRI Imagery | Date: August 17, 2022

Figure 1-1. EAC #M15-01 Existing and Proposed Amendment #9 CPD Boundaries

2. DESCRIPTION OF PROPOSED CHANGES AND ACTIVITIES

2.1 Water Supply Area

Pretium currently utilizes a single groundwater well to provide potable water to the mine and has identified a need for supplemental sources both to increase supply capacity and for redundancy. The existing well was unable to meet the mine site potable water requirements in May 2022, prior to the late onset of freshet. Pretium plans to initiate investigations for potential surface and groundwater sources within the Water Supply Area shown on Figure 1-1 during late summer 2022. The groundwater investigations will be conducted under Pretium's mineral exploration permit MX-1-842, as the drilling results will also be pertinent to site mineral exploration. The surface water source investigations do not entail mechanical disturbance. Pretium is targeting early October 2022 to have infrastructure associated with new water source(s) installed and operational, prior to freeze up.

Photos 2-1 and 2-2 show the general landscape and sparse vegetation coverage of the Water Supply Area (refer to Appendix A for a detailed description of the landscape and Terrestrial Ecosystem Mapping). The Water Supply Area is 231 ha in size and falls outside of Pretium's mining leases and current CPD boundary. Total surface disturbance required for the new infrastructure is estimated to require up to 14 hectares (ha) of disturbance (or 6% of the total CPD boundary extension requested for the Water Supply Area).

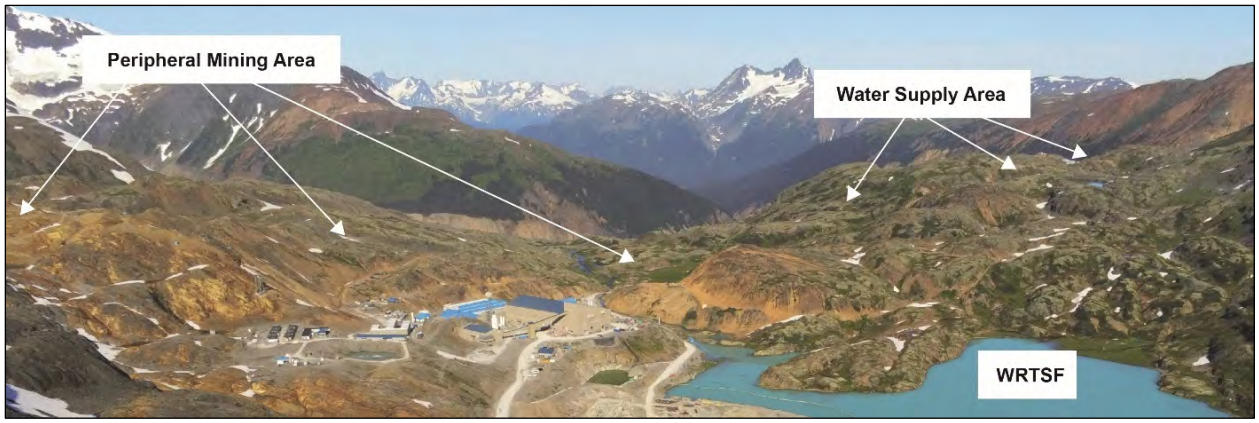


Photo 2-1: General landscape of the Water Supply Area and Peripheral Mining Area, facing west from the Waste Rock and Tailings Storage Facility.

Infrastructure required is anticipated to initially include up to two groundwater wells and one surface water intake, three small pump houses (sea can-style), maximum 15 m-wide access trails to all three sources (i.e., all three routes), up to 6-inch internal diameter pipeline (PVC or HDPE; heat traced and/or insulated), and power supply system connecting each potable water source to the mine site. The pipeline and power line systems will lay on the ground surface adjacent to the access trail or road surface and will not require excavation or overhead structures.

Construction, operation, and decommissioning of the potable water infrastructure will include the following surface activities:

- Construction (including culverts) and operation of maximum 15 m-wide access trails (actual width is likely to be less, however, a 15 m width has been conservatively assumed for the purpose of effects assessment);
- Sediment and erosion control;
- Well drilling and development (groundwater);

- Intake installation (surface water);
- Infrastructure assembly, testing, and commissioning;
- Water withdrawal operations;
- Equipment servicing; and
- Closure and reclamation (access trail, well abandonment/intake removal, pump house demolition).

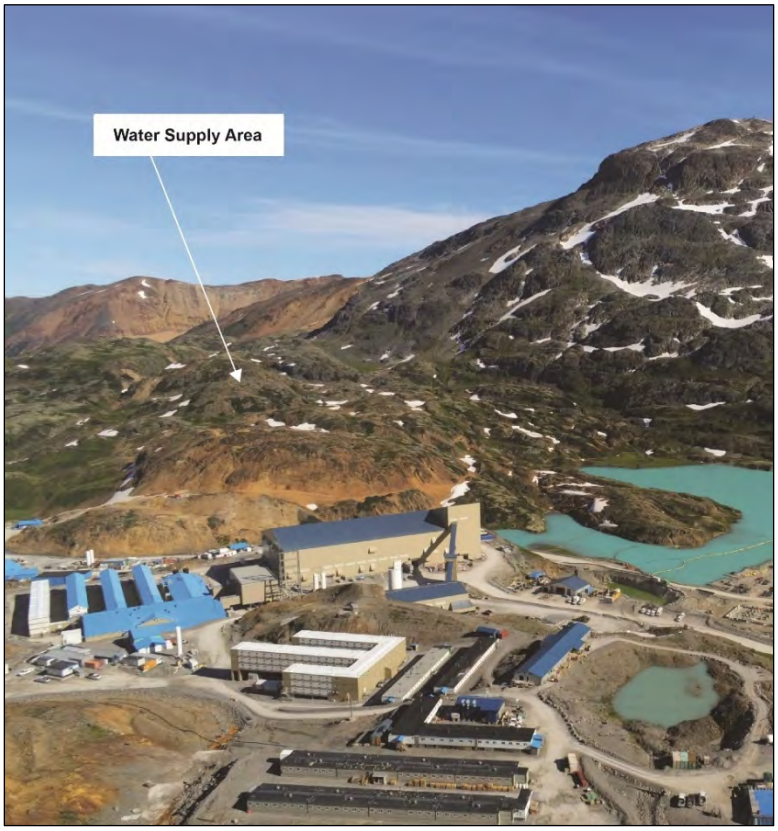


Photo 2-2: General landscape of the Water Supply Area, facing northwest from the Brucejack mine site.

Pretium has assessed a larger area in this Amendment Application than will be required to construct and operate the planned water supply sources (as shown of Figure 1-1). This approach accounts for annual variability in precipitation and groundwater levels, and climate change uncertainty. It also accounts for gradual expansion of the groundwater drawdown cone that results from underground mine and exploration development during mine life, which may impinge on future potable water availability in the Project area and result in the potential need to find other sources in the future. With this in mind, Pretium requests the EAC boundary be expanded as shown on Figure 1-1 authorizing potable water sourcing, use, and construction/operation of related infrastructure in this polygon. This would negate the need for future EAC amendment application(s) should a change in source be required.

The new potable water source(s) will be subject to water withdrawal authorization (Section 10 or Water License) under the *Water Sustainability Act* (WSA) that will be prepared once the final source(s) is determined. Development of mine related peripheral infrastructure within the Water Supply Area will also require amendment of the Brucejack *Mines Act* Permit M-243 Permitted Mine Area (PMA).

2.2 Peripheral Mining Area

Pretium is proposing to expand the Project's underground mine works (advanced exploration and ore extraction) and is seeking to extend its CPD boundary to align with the outer extents of its mining leases boundaries in order to undertake these works, as shown on Figure 1-1. As noted previously, no increase in ore extraction (up to a maximum of 18.5 Mt as set out in the Certificate) is currently being sought as part of these changes.

The proposed Project change would be considered a new peripheral mine area, with ancillary facilities and activities that would generally result in a low level of surface development (i.e., no major surface development or structures beyond mine surface openings and associated access), relative to the existing core mine area. All works will be reclaimed in accordance with the Project's Reclamation and Closure Plan.

Photos 2-1 and 2-3 show the bedrock outcrop dominated general landscape and sparse vegetation coverage of the Peripheral Mining Area (refer to Appendix A for a detailed description of the landscape and Terrestrial Ecosystem Mapping). The total new area associated with the alignment is 297.8 ha, split into 51.4 ha in an area northeast of the core mine area, and 246.4 ha in an area west of the core mine area (see Figure 1-1). For the purposes of the effects assessment, the total potential surface disturbance has been conservatively estimated to be up to 148.9 ha (or 50% of the total CPD boundary extension requested for the Peripheral Mining Area).

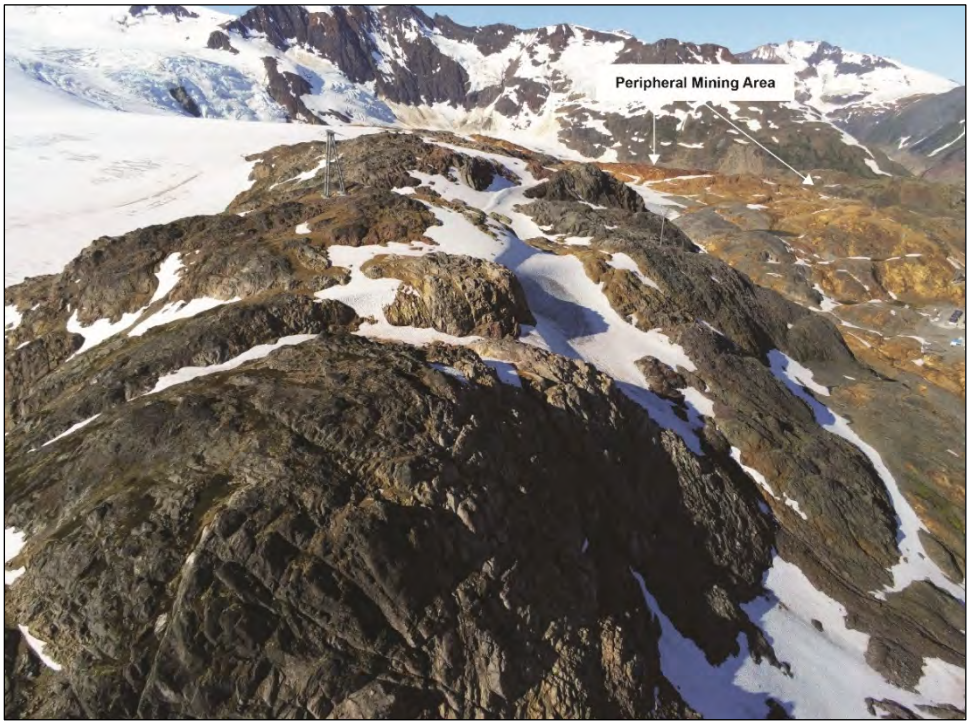


Photo 2-3: General landscape of the Peripheral Mining Area, facing southwest from the Waste Rock and Tailings Storage Facility.

The following infrastructure or activities are proposed within the Peripheral Mining Area:

- Underground mining using long-hole open stoping (LHOS) and longitudinal LHOS methods with a combination of rock and paste backfill. These methods are consistent with the confines of the EAC life of mine production limit, mine plan, and other restrictions of M-243, PE-107835, PA-107025 and other mine authorizations;

- Underground mine ventilation raises (including for underground mine exploration);
- Underground mine adits and portals (including for underground mine exploration) with associated heating and ventilation;
- Explosives and detonator storage facilities;
- Fuel storage and fueling facilities;
- Power supply, including diesel generation and/or connection to existing mine hydro-electric power supply;
- Equipment and supply laydown areas, and waste staging;
- Access roads and trails;
- Potable and underground mining/exploration water supply source(s) and associated pipeline connections;
- Helipads;
- Meteorological stations;
- Potential additional remote avalanche control systems;
- Soil stockpiles from surface infrastructure development; and
- Communications facilities.

The CPD boundary alignment for the Peripheral Mining Area will also be subject to a *Mines Act* Permit M-243 amendment, which is being submitted in parallel with this Amendment Application. The *Mines Act* permit amendment is primarily limited to administrative PMA boundary alignment and sub-surface works and will not seek authorization for specific surface infrastructure within the EAC Peripheral Mining Area at this time (this will be addressed though a departure from approval, or amendment).

3. ENGAGEMENT

3.1 Engagement with Indigenous Groups

Pretium's rationale and planning for the expansion to the mining leases (i.e., the Peripheral Mining Area component of this Amendment Application) were introduced to the Nisga'a Lisims Government (NLG) Lands and Resources Department and the Tahltan Central Government (TCG) Lands Department during meetings in March 2022. The Water Supply Area component of this Amendment Application was introduced to the NLG Lands and Resources Department and the TCG Lands Department during meetings in June and July 2022. This Amendment Application is being provided to NLG, TCG, and the Tsetsaut Skii km Lax Ha at the same time it is submitted to EAO.

3.2 Engagement with Government Agencies

Pretium held a pre-application conference call with EAO to discuss the content of this Amendment Application on May 17, 2022, provided an update on revised scope of the application on May 27, 2022, and provided a pre-application notice to EAO summarizing its request for this Amendment Application on July 14, 2022.

4. ASSESSMENT METHODOLOGY

This Amendment Application assesses the potential adverse effects of the proposed Project changes on applicable VCs considered in the EAC Application, as well as to any additional matters as set out in section 25 of the *Environmental Assessment Act* (SBC 2018, c. 51). The objective of this assessment is to determine whether consideration of the effects of proposed Project changes alters the conclusions of the EAC Application and whether new mitigation measures are required. The following chapter outlines the methodological approach taken to reach that determination in Chapters 5 and 6.

4.1 Identification of Potential Interactions with Proposed Project Changes

In Chapter 5, the potential for each of the proposed Project changes to interact with the VCs evaluated in the EAC Application as well as with the section 25 matters are considered, as described in this section.

4.1.1 Potential Interactions with Valued Components

In Chapter 5, the VCs are reviewed to identify potential interactions with the proposed Project changes. Interactions are rated in a matrix table according to the following criteria:

- ○ = an interaction is not expected; no further assessment is warranted.
- ◒ = an interaction is expected, but the potential for adverse effects resulting from the proposed project change is the same as (or less than) the effects assessed in the EAC Application, OR a previously unconsidered Project component or activity has the potential to result in negligible adverse effects; no further assessment is warranted.
- ● = an interaction is expected and has a greater or different potential for adverse effects in comparison with the EAC Application; further assessment is warranted.

Where interactions are expected and have a greater or different potential for adverse effects in comparison with the EAC Application, these VCs are carried forward for assessment in Chapter 6. Where interactions are not expected, or would result in the same, less, or negligible effects, these VCs are not carried forward in this assessment.

4.1.2 Potential Interactions with Section 25 Matters

Chapter 5 also considers additional matters consistent with section 25 of the *Environmental Assessment Act*. Under the previous *Environmental Assessment Act* (SBC 2002, c. 43), which was in force in the period when the EAC Application was submitted and Certificate #M15-01 was granted, these matters were not defined in legislation; instead, the required matters were determined by the Executive Director of the EAO or responsible minister on a project-by-project basis. In the case of the Project, many of the section 25 matters overlap, either wholly or partially, with the considerations that were required in the EAC Application.

A second matrix table is presented listing the matters for consideration under section 25 of the *Environmental Assessment Act*, including the relevant sections of the EAC Application where these matters were considered, where applicable. The potential for the proposed Project changes to interact with each of the section 25 matters are rated using similar criteria to those defined in the preceding section:

- ○ = an interaction is not expected; no further assessment is warranted.
- ◒ = an interaction is expected, but the potential for adverse effects resulting from the proposed project change is the same as (or less than) the effects assessed in the EAC Application, OR a previously unconsidered Project component or activity has the potential to result in negligible adverse effects; no further assessment is warranted.

- ● = an interaction is expected and has a greater or different potential for adverse effects in comparison with the EAC Application or was not considered in the EAC Application; further assessment is warranted.

4.2 Effects Assessment

If potential interactions with the proposed Project changes are classified as requiring further assessment in Chapter 5, those interactions are carried forward for assessment in Chapter 6, as described in this section.

4.2.1 Assessment of Potential Effects and Mitigation Measures

If potential effects related to either VCs or the section 25 matters resulting from proposed Project changes are identified, the mitigation measures identified in the Certificate (Schedule B), the commitments identified in management and monitoring plans, and the potential need for additional need for mitigation measures are considered, as appropriate.

4.2.2 Assessment of Predicted Changes and Residual and Cumulative Effects

The predicted changes to intermediate components resulting from proposed Project changes are evaluated and considered in the assessment of related receptor VCs. Use of the concept of intermediate and receptor components in assessment is aligned with the *Guideline for the Selection of Valued Components and Assessment of Potential Effects* (EAO 2013), which was in use at the time of preparation of the EAC Application. While current EAO policy (EAO 2020) has largely shifted away from use of these terms, the analysis in the following sections has continued to use this framing in order to maintain consistency with the EAC Application and previous amendment applications.

As noted in Section 6.4.1 of the EAC Application, intermediate components are specific attributes of the biophysical environment that, if affected (i.e., if there is a positive or negative change relative to the baseline condition), act as a pathway to pass on those changes to receptor components (thereby also having the potential to affect or change the baseline condition of a receptor component). Where a receptor component is perceived as important by the public, scientists, government agencies, Indigenous groups, or other stakeholders, these are referred to as receptor VCs.

For receptor VCs, residual effects resulting from proposed Project changes are evaluated for their potential to change the characterization of overall Project residual effects, as described in the EAC Application. Criteria used to characterize residual effects are consistent with the EAC Application and include: magnitude, duration, frequency, geographic extent, reversibility, resiliency, and ecological context. Criteria thresholds and ratings are considered when evaluating the significance of overall Project residual effects.

If the proposed Project changes are determined to result in changes to the conclusions of the EAC Application, the Project's potential contribution to cumulative effects are also re-evaluated.

5. IDENTIFICATION OF POTENTIAL INTERACTIONS WITH PROPOSED PROJECT CHANGES

5.1 Summary of Potential Interactions

Table 5.1-1 identifies potential interactions between the proposed Project changes and VCs assessed in the EAC Application, as described in Section 4.2.1. Sections 5.2 to 5.5 present the rationale for each interaction rating: either excluding (○ or ◒) the VC from further consideration, or including (●) the VC in the assessment presented in Chapter 6.

Table 5.1-1: Potential Interactions between Valued Components and Proposed Project Changes

Assessment Themes	Subject Area	Valued Component	Component Type	Water Supply Area	Peripheral Mining Area
Atmospheric Environment	Air	■ Air quality	Intermediate	◒	◒
	Climate	■ Climate	Receptor	◒	◒
	Noise	■ Noise	Intermediate	◒	◒
Freshwater Environment	Groundwater	■ Groundwater quantity ■ Groundwater quality	Intermediate	◒	◒
	Surface Water	■ Surface water quantity	Intermediate	◒	◒
		■ Surface water quality	Receptor	◒	◒
	Aquatic Resources	■ Primary and secondary producers	Receptor	◒	◒
	Fish and Fish Habitat	■ Fish habitat ■ Dolly Varden ■ Bull trout ■ Coho salmon ■ Sockeye salmon ■ Chinook salmon	Receptor	○	○
Terrestrial Environment	Terrain and soil	■ Soil quality ■ Soil quantity ■ Terrain stability	Intermediate	◒	◒
	Terrestrial ecology	■ Alpine ecosystems	Receptor	●	●
		■ Parkland ecosystems	Receptor	○	○
		■ Forested ecosystems	Receptor	○	○
		■ Floodplain ecosystems	Receptor	○	○
		■ Rare ecosystems	Receptor	○	○
		■ Culturally or economically important plants	Receptor	◒	◒
		■ Rare plant and lichens and their habitats	Receptor	●	●

Assessment Themes	Subject Area	Valued Component	Component Type	Water Supply Area	Peripheral Mining Area
Terrestrial Environment *(cont'd)*	Wetlands	■ Wetland extent	Receptor	○	◒
		■ Wetland function	Receptor	○	◒
	Wildlife and wildlife habitat	■ Moose	Receptor	◒	◒
		■ Mountain goat	Receptor	●	●
		■ Grizzly bear	Receptor	●	●
		■ American marten	Receptor	○	○
		■ Hoary marmot	Receptor	●	●
		■ Bats	Receptor	○	○
		■ Raptors (forest and ground-nesting)	Receptor	◒	◒
		■ Migratory waterbirds	Receptor	◒	◒
		■ Migratory landbirds	Receptor	◒	◒
		■ Western toad	Receptor	○	○
Human Environment	Economy	■ Income production and revenue ■ Labour market ■ Economic activity	Receptor	◒	◒
	Social	■ Education, skills, and training ■ Community infrastructure, services, and housing ■ Family and worker well-being	Receptor	◒	◒
	Heritage	■ Protected archaeological sites	Receptor	○	○
	Human health	■ Drinking water quality	Receptor	◒	◒
		■ Air quality	Receptor	○	○
		■ Noise	Receptor	○	○
		■ Country foods	Receptor	◒	◒
	Navigation	■ Navigation	Receptor	○	○
	Non-traditional land use	■ Commercial land use	Receptor	◒	◒
		■ Non-commercial land use	Receptor	◒	◒
	Current Aboriginal use	■ Fishing opportunities and practices	Receptor	○	○
		■ Hunting/trapping opportunities and practices	Receptor	◒	◒

Assessment Themes	Subject Area	Valued Component	Component Type	Water Supply Area	Peripheral Mining Area
Human Environment *(cont'd)*	Current Aboriginal use *(cont'd)*	▪ Plant gathering opportunities and practices	Receptor	○	○
		▪ Habitations, trails, burials, and other cultural landscapes	Receptor	◒	◒

Notes:

○ = *an interaction is not expected; no further assessment is warranted.*

◒ = *an interaction is expected, but the potential for adverse effects resulting from the proposed project change is the same as (or less than) the effects assessed in the EAC Application, OR a previously unconsidered Project component or activity has the potential to result in negligible adverse effects; no further assessment is warranted.*

● = *an interaction is expected, and has a greater or different potential for adverse effects in comparison with the EAC Application; further assessment is warranted.*

Similarly, Table 5.1-2 identifies potential interactions between the proposed Project changes and the section 25 matters, as described in Section 4.2.1. Section 5.6 then presents the rationale for each interaction rating: either excluding (○ or ◒) the section 25 matter from further consideration, or including (●) the section 25 matter in the assessment presented in Chapter 6.

Table 5.1-2: Potential Interactions between Section 25 Matters and Proposed Project Changes

Section 25 Matters*	EAC Application Chapter(s)	Proposed Project Changes
a. positive and negative direct and indirect effects of the reviewable project, including environmental, economic, social, cultural and health effects and adverse cumulative effects	7 to 25	Considered in Table 5.1-1 and Sections 5.2 to 5.5
b. risks and uncertainties associated with those effects, including the results of any interaction between effects	7 to 25	Considered in Table 5.1-1 and Sections 5.2 to 5.5
c. risks of malfunctions or accidents	31	◒
d. disproportionate effects on distinct human populations**,** including populations identified by gender	n/a	○
e. effects on biophysical factors that support ecosystem function	9 to 11 and 13 to 17	◒
f. effects on current and future generations	n/a	◒
g. consistency with any land-use plan of the government or an Indigenous nation if the plan is relevant to the assessment […]	24 and 29	◒
h. greenhouse gas emissions, including the potential effects on the province being able to meet its targets under the *Greenhouse Gas Reduction Targets Act*	12	◒
i. alternative means of carrying out the project that are technically and economically feasible, including through the use of the best available technologies, and the potential effects, risks and uncertainties of those alternatives	4	◒

Section 25 Matters*	EAC Application Chapter(s)	Proposed Project Changes
j. potential changes to the reviewable project that may be caused by the environment	32	○

Notes:

**Section 25(k) - "other prescribed matters" - is not included in this table because no other matters have been prescribed by the EAO.*

○ = *an interaction is not expected; no further assessment is warranted.*

◒ = *an interaction is expected, but the potential for adverse effects resulting from the proposed project change is the same as (or less than) the effects assessed in the EAC Application, OR a previously unconsidered Project component or activity has the potential to result in negligible adverse effects; no further assessment is warranted.*

● = *an interaction is expected, and has a greater or different potential for adverse effects in comparison with the EAC Application or was not considered in the EAC Application; further assessment is warranted.*

5.2 Atmospheric Environment

5.2.1 Air Quality

The EAC Application assessed the effects of emissions from stationary and mobile construction equipment and from emissions from ventilation raises and mine portals but did not consider the development of additional potable water sourcing or reconfiguration and lateral expansion of the Project's underground mine works with associated new surface infrastructure.

Construction and operation of additional potable groundwater or surface potable water source(s) is not anticipated to substantively increase criteria air contaminant (CAC) emissions for the Project. Air quality effects caused by tail pipe emissions from equipment used to develop new potable water source(s) and associated infrastructure are anticipated to be negligible to minor because the associated air emissions will be temporary and intermittent in nature, and the expected number of pieces of equipment operating in these areas are relatively small compared to other areas of operation at the Project. The negligible increases in CAC emissions will be addressed through the existing air quality and fugitive dust mitigation management plans.

Air quality effects will be caused by emissions due to the following components of the lateral expansion of the Project's underground mine works and associated new peripheral surface infrastructure:

- Underground mine ventilation raises;
- Underground mine portals;
- Temporary waste rock stockpiles associated with new mine openings (portals or ventilation raises);
- Diesel power generation;
- Access roads; and
- Soil stockpiles.

The air quality effects listed above include both gaseous tailpipe emissions from vehicles and stationary equipment as well as fugitive dust emissions from stockpiles and trails or roads. As there is no increase in the mine's ore processing rate there are expected to be only minor changes in overall emissions due to operations. The locations of some emissions will change due to the mine works listed above but the magnitude of emissions will stay roughly the same. Changes in emissions during the construction of the mine works and associated new surface infrastructure will be temporary and intermittent in nature and relatively minor in magnitude relative to overall Project emissions.

Overall, the air quality effects due to the lateral expansion of the mine's underground works and associated new surface infrastructure are expected to be minor. The results of the air dispersion modelling from the EAC Application indicate one predicted exceedance of 24-hour PM_{10} and the construction and operation of the underground works and associated new surface infrastructure is not expected to change this. In addition, no sensitive receptor sites are located near the proposed lateral expansion areas.

When considered in relation to the total Project effect on air quality, the incremental air emissions contributed by the proposed Project changes are not anticipated to result in new threshold exceedances. Potential air quality effects associated with the proposed Project changes will be managed in accordance with Pretium's Air Quality Management Plan (required under Conditions 1 and 2 of the Certificate), including equipment and vehicle maintenance.

Based on the foregoing, air quality is **excluded** from further assessment. The proposed Project changes are not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on air quality.

5.2.2 Climate

The EAC Application assessed greenhouse gas (GHG) emissions from vehicle and stationary equipment use at all areas of the Project but did not assess effects associated with additional potable water sourcing or lateral expansion of the Project's underground mine works and associated new surface infrastructure.

Construction, operation, and decommissioning of the proposed Project changes are anticipated to result in GHG emissions from vehicle and equipment fuel combustion. GHG emissions will be mitigated through management practices that promote fuel efficiency (Table 12.5-2 of the EAC Application). Additionally, Pretium is in the process of electrifying a portion of the underground mine fleet. Currently, three underground electric trucks are in operation, with a fourth truck on order.

Climate effects caused by tail pipe emissions from vehicles and equipment used in relation to the proposed Project changes are anticipated to be negligible to minor because the total emissions from activities at these locations will be very minor compared with both total Project emissions and provincial and federal totals. GHG emissions will continue to be estimated annually based on fuel usage and compared to federal and provincial reporting requirements, in accordance with Pretium's Air Quality Management Plan (required under Conditions 1 and 2 of the Certificate). When considered in relation to the total Project effect on climate, the incremental GHG emissions contributed are not anticipated to result in new threshold exceedances.

Based on the foregoing, climate is **excluded** from further assessment. The proposed Project changes are not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures with respect to the Project's effects on climate.

5.2.3 Noise

The EAC Application assessed noise from stationary and mobile construction equipment and from ventilation raises and mine portals but did not consider the construction of additional potable water sourcing or lateral expansion of the Project's underground mine works and development and use of associated new surface infrastructure. Overall, the Project was predicted to exceed noise criteria limits at the workers' accommodation, at one existing human receptor (Skii km Lax Ha Lodge), and for wildlife receptors with respect to functional habitat loss and disturbance (Table 8.8-1 in the EAC Application).

Noise generated by the construction of potable water sourcing, lateral expansion of the underground mine works, and associated new infrastructure is anticipated to be negligible to minor because the noise emissions associated with these activities will be temporary and intermittent in nature, and little to no

noise from underground mine construction activities can be heard on surface. There is anticipated to be no effect on noise levels at Skii km Lax Ha Lodge, which is located at the Bowser West Camp area near km 52 of the Brucejack Access Road, approximately 18 km away from the mine site, and more than 900 m lower in elevation.

Noise generated by the lateral expansion of the underground mine works would not increase overall noise levels but would create new noise sources related to surface vehicle traffic, deposition of excavated waste rock, and ventilation raises. The expected number of pieces of equipment operating in these areas will be relatively small compared to other areas of operation at the Project. Therefore, noise emissions due to activities in these areas are expected to be relatively small and the effects of the emissions limited in spatial extent. In addition, there are no sensitive receptor sites for noise located near the proposed lateral expansion area.

When considered in relation to the total Project effect on noise, the incremental noise contributed by the proposed Project changes is not anticipated to result in new threshold exceedances.

Based on the foregoing, noise is **excluded** from further assessment. The proposed Project changes are not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures with respect to the Project's effects on noise.

5.3 Freshwater Environment

5.3.1 Groundwater Quantity and Quality

5.3.1.1 Water Supply Area

The proposed Project changes will include the installation of new potable water sourcing, which may initially include up to two groundwater wells within the proposed Water Supply Area (Figure 1-1). Pretium currently utilizes a single groundwater well to provide potable water to the mine and has identified a need for supplemental sources both to increase supply capacity and for redundancy. The existing well was unable to meet the mine site potable water requirements in May 2022, prior to the late onset of freshet. Pretium plans to initiate investigations for potential potable water sources within the Water Supply Area during late summer 2022. Potable water from the existing groundwater well is piped to end users at the Brucejack camp and other facilities after being treated to meet drinking water requirements.

Any new groundwater potable water source within the proposed Water Supply Area will create localized groundwater drawdown when water is being withdrawn, which is expected to recover when the groundwater well is no longer required and groundwater withdrawal ceases. Groundwater drawdown is expected to follow fault systems, as the Brucejack mine site and vicinity, including the proposed Water Supply Area, is bedrock dominated with aquifers and mainly controlled by localized and regional fault systems. Shallow weathered bedrock, if sufficiently fractured, may also act locally as an aquifer. Groundwater recharge is from snowmelt and – depending on the location – from glacial melt. Creeks and ephemeral streams may also locally recharge the groundwater system. The extent of groundwater drawdown will vary seasonally, dependent on aquifer characteristics and any near surface water influence. Effects to groundwater from any new groundwater potable water source are considered minimal compared to the hydrogeological impacts assessed as part of the overall Project effects from dewatering the underground mine. Hydrogeological impacts of the mine may affect new groundwater potable water source(s) dependent on proximity to the mine and/or fault system connectivity.

Surface water drainage within the proposed Water Supply Area is dominantly diffuse overland flow draining either south toward Brucejack Creek and/or two small un-named tributaries located near the existing potable water source; southeast toward Catear Creek (also called Tributary 2 Creek or T2

Creek), which drains to the Waste Rock and Tailings Storage Facility (WRTSF); or north or westward directly toward Sulphurets Creek. There are no fish-bearing waterbodies within the proposed Water Supply Area; the nearest downstream fish-bearing waters are on lower Sulphurets Creek more than 20 km from the WRTSF discharge.

Benthic invertebrate taxa present within Brucejack Creek (predominantly the larval stages of insects such as chironomids and stoneflies, with oligochaete worms occasionally having a relatively high abundance at some of the Brucejack Creek monitoring sites) are known to be well adapted to variable flow conditions. Effects of groundwater drawdown from new groundwater potable water sources on flows in Brucejack Creek are anticipated to be minor, dependent on proximity and fault connectivity. Effects specific to each groundwater withdrawal source will be assessed further as part of the *Water Sustainability Act* (WSA) authorization required for each source. Ensuring that potential impacts to surface waterbody baseflow conditions are held to environmentally acceptable levels is expected to be a requirement of the WSA authorization(s).

Impacts to groundwater quality are unlikely with implementation of best practices and standard mitigation measures during exploration, installation, maintenance and decommissioning in accordance with WSA requirements and consistent with *Mines Act* Permit M-243.

Based on the foregoing, groundwater quantity and quality are **excluded** for further assessment with regards to the installation of groundwater wells for potable water. Groundwater wells are not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on groundwater quantity and quality.

5.3.1.2 Peripheral Mining Area

Groundwater dewatering required for operation of the Brucejack Mine results in a depression of groundwater levels (i.e., a drawdown cone). Additional groundwater drawdown will occur from vertical and lateral expansion of the underground mine extents and additional underground exploration within the proposed Peripheral Mining Area. Additional drawdown has the potential to further affect baseflow of Brucejack Creek and its tributaries and the WRTSF as discussed in the Hydrogeology Predictive Study (Chapter 9 of the EAC Application) and updated in the 2020 Update (Pretium, 2020).

Additional mine portals or other mine openings such as ventilation raises within the Peripheral Mining Area may result in additional surface water inflows into the underground mine unless designed – as is the case for existing mine openings – to prevent this from occurring. The associated development to these additional mine openings, and additional underground development for mining or exploration in general, will intercept groundwater.

The proposed above ground works related to the Peripheral Mining Area are unlikely to affect groundwater quantity.

The EAC Application acknowledges that the pumping and removal of water during the development of the underground mine development necessitates the underground water management system, and that this system has the potential for hydrogeological effects that are major in magnitude, but local in scale and reversible in the medium-term. Because the mine is located in the watershed headwaters, the proposed changes to the underground mine area are anticipated to have limited impact on aquatic values. The potential for impacts to surrounding waterbodies will continue to be evaluated through Condition D.4(b), (d), and (e) of *Mines Act* Permit M-243 and the requirements of effluent permit 107835, with a comprehensive evaluation of the water quality model completed every five years as part of the 5 Year Mine Plan and Reclamation Program Update (Pretium 2021).

Existing mitigation measures are anticipated to be sufficient to control groundwater quality prior to discharge and are outlined in the Metal Leaching and Acid Rock Drainage Management Plan and Water

Management Plan (required under Conditions 1 and 2 of the Certificate and consistent with *Mines Act* Permit M-243 and effluent permit 107835).

Based on the foregoing, groundwater quantity and quality are **excluded** for further assessment with regards to the Peripheral Mining Area. The Peripheral Mining Area is not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on groundwater quantity and quality.

5.3.2 Surface Water Quantity

5.3.2.1 Water Supply Area

A group of small lakes upstream and northwest of the WRTSF within the proposed Water Supply Area is being considered for potential potable water sourcing. These include two unnamed lakes, Iceberg Lake, Gold Pan Lake, Ptarmigan Lake, and Emerald Lake (Regional District of Kitimat-Stikine 2018). The lakes are ice covered except for two to three months of the year. All these lakes appear largely fed by snow melt, and flow into Catear Creek. Goldwedge Mine was developed in the 1980s as a small gold mine and is located on a single small mining lease adjacent to Gold Pan and Ptarmigan lakes, approximately 1,800 m northwest of the Brucejack mine site. Gold Pan Lake has been used for Goldwedge (formerly Catear) tailings deposition and mine dewatering. There are small local roads and trails at the Goldwedge/Catear site and exploration trails in the vicinity, including those used by Pretium. Goldwedge Mine was issued *Environmental Management Act* (EMA) effluent permit 109355 on December 2, 2019 authorizing discharge from underground dewatering to the northwest. During active dewatering, three water quality monitoring stations are sampled as per the effluent permit. The Goldwedge Mine also maintains monitoring programs on Iceberg Lake and the surrounding creeks (Regional District of Kitimat-Stikine 2018).

A water intake and associated infrastructure may be established at one of these lakes; however, pending confirmation of water quality, Emerald Lake will likely be prioritized to avoid any potential for impacts from Goldwedge Mine. Surface water withdrawal for potable water will result in periodic drawdown of the surface water source prior to re-filling by surface runoff from snow melt and/or rain. Catear Creek and its lakes have not had biological surveys, but it is expected that they are not fish-bearing, since no fish have been observed upstream of the fish barrier near the mouth of Sulphurets Creek. It is expected that Catear Creek has benthic invertebrate and periphyton communities that are similar to those recorded in annual biological surveys of Brucejack Creek and described in Section 5.3.1.1. Potential effects to aquatic life from water withdrawal from the Catear Creek watershed are expected to be similar to what was previously assessed for water withdrawal from the upper watershed of Brucejack Creek (ERM 2017). The same assessment concluded that reduced flows during winter low flow is conservatively predicted to be moderate, short- to medium-term, with local effects to aquatic organisms overwintering in the stream. The adaptations of aquatic organisms to overwintering conditions promote the resiliency and tolerance of the resident organisms to the potentially freezing conditions caused by reduced wetted width associated with water withdrawal during winter (ERM 2017). Ensuring that potential impacts to surface waterbody baseflow conditions are held to environmentally acceptable levels is expected to be a requirement of the WSA authorization(s).
Any additional effects to surface water quantity (flows) resulting from inadvertent overland flow redirection through the establishment of access trails and small roads and other above ground infrastructure will be mitigated through the implementation of erosion and sediment control measures and installation of culverts sized and orientated appropriately to allow for unimpeded flows during high flow conditions.

Based on the foregoing, surface water quantity is **excluded** for further assessment with regards to the siting of surface water intakes and the quantity of water withdrawn. Provided mitigation measures are applied, surface water intakes are not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on surface water quantity.

5.3.2.2 Peripheral Mining Area

Construction, operation, and decommissioning of the Peripheral Mining Area might require mitigation measures to intercept and control surface water inflow into the underground area. Standard mitigation measures are anticipated to be sufficient to control surface inflow into the mine and are outlined in the Water Management Plan (required under Conditions 1 and 2 of the Certificate and consistent with *Mines Act* Permit M-243). As a result of these measures, reduction in overland flow quantity is expected to be minimized.

Based on the foregoing, surface water quantity is **excluded** from further assessment with regards to the Peripheral Mining Area. The Peripheral Mining Area is not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on surface water quantity.

5.3.3 Surface Water Quality

5.3.3.1 Water Supply Area

Section 5.3.2 presents a discussion of waterbodies upstream and northwest of the WRTSF being considered as surface water sources for potable water.

In order to access, install, maintain, and decommission groundwater wells and surface water intakes, above ground infrastructure will be required with the potential to affect surface water quality. Additional surface access trails or small roads will be established to transport equipment and people to and from the proposed installation locations. These access trails and roads have the potential to cause sediment releases to down-gradient waterbodies during construction (with a focus on culvert installation), precipitation/snow melt events, and use (i.e., tracking). Existing best practices and mitigation measures outlined in the Surface Erosion Prevention and Sediment Control Plan (included as Appendix D to the Environmental Management Plan required under Conditions 1 and 2 of the Certificate), Water Management Plan (required under Conditions 1 and 2 of the Certificate) and M-243 and other authorizations will reduce the likelihood of sediment impacts to surface water quality, recognizing that the dynamic surface water flow regime in the region—which results in a large freshet flows—naturally deposits significant suspended material in the freshwater environment.

Hydrocarbon spills to water from drill rigs, off road vehicles, generators, and other equipment are a potential risk, but this risk will be mitigated through the application of mitigation measures and requirements as outlined in the Pretium's Spill Response Plan (required under Conditions 1 and 2 of the Certificate). Within the local study area (LSA), ML/ARD has the potential to occur as a result of surface disturbances and subsequent weathering of newly exposed rock.

Best management practices and mitigation measures outlined in the ML/ARD Management Plan and Water Management Plan (required under Conditions 1 and 2 of the Certificate) will be implemented to minimize land disturbance. Excavation of potentially acid generating (PAG) bedrock will be avoided for access routes, including through preferential use of non-potentially acid generating (NPAG) fill to avoid PAG rock excavation. If PAG rock excavation cannot be avoided, authorization will be sought via M-243 and work will be conducted in accordance with the ML/ARD Management Plan. Thus, the potential for ML/ARD effects along access trails or roads is considered negligible during all Project phases and potential effects are not considered further.

Other infrastructure to be installed with the potential to impact surface water quality includes the intake infrastructure. This infrastructure will be verified to be clean and care taken not to cause sediment releases during installation, following the ESC mitigation measures outlined in the Surface Erosion Prevention and Sediment Control Management Plan (included as Appendix D to the Environmental Management Plan required under Conditions 1 and 2 of the Certificate). All works will be subject to

decommissioning and reclamation requirements as outlined the Reclamation and Closure Plan (required under Conditions 1 and 2 of the Certificate).

Based on the foregoing, surface water quality is **excluded** from further assessment with regards to the construction, operation, and decommissioning of surface water intakes. Surface water intakes are not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on surface water quality.

5.3.3.2 Peripheral Mining Area

Construction, operation, and decommissioning of the Peripheral Mining Area will require mitigation measures to intercept and control surface water inflow into the underground area and thereby minimize generation of contact water (per discussion in Section 5.3.1). Standard mitigation measures are anticipated to be sufficient to control surface water quality prior to discharge for any surface water that does enter the mine area, as outlined in the Water Management Plan and Metal Leaching and Acid Rock Drainage Management Plan (required under Conditions 1 and 2 of the Certificate and consistent with *Mines Act* Permit M-243).

The life of mine ore extraction will remain within the 18.5 Mt limit of the EAC Application and no changes to waste deposition limits established under M-243 are being sought through the corresponding Amendment #9 Application for Permit M-243, therefore no significant effects to water quality are anticipated related to this Amendment Application and no amendment to effluent permit 107835 discharge limits is being sought.

Based on the foregoing, surface water quality is **excluded** from further assessment with regards to the Peripheral Mining Area. The Peripheral Mining Area is not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on surface water quantity.

5.3.4 Aquatic Resources

No changes to aquatic resources are anticipated because of the biological adaptations described above in Section 5.3.2.1, implementation of proposed mitigation measures to address potential changes to surface water quality and quantity, and implementation of WSA authorization required measures.

In the EAC Application, the residual effects to aquatic resources in the mine site area due to various Project activities, from erosion and sedimentation, and changes to surface water quality (ML/ARD and nutrient loading) was found to be not significant. For off-site Project infrastructure, these same effects were similarly determined to be not significant, as the predicted effects were anticipated to be indistinguishable from natural variation following application of best management practices and mitigation (Section 14.7 of the EAC Application). The potential for adverse effects to aquatic resources resulting from the proposed potable Water Supply Area and Peripheral Mining Area activities are anticipated to be in line with the effects assessed in the EAC Application.

Based on the foregoing, aquatic resources are **excluded** from further assessment with respect to the potable water supply and peripheral mining activities. The EAC Application's conclusions regarding the Project's negligible effects on aquatic resources remains unchanged.

5.3.5 Fish and Fish Habitat

The proposed Project changes are not expected to affect fish and fish habitat, since the nearest downstream fish habitat is located in lower Sulphurets Creek more than 20 km from the WRTSF discharge and the proposed Water Supply Area and Peripheral Mining Area.

Fish and fish habitat are **excluded** from further assessment. The proposed Project changes are not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on fish and fish habitat.

5.4 Terrestrial Environment

5.4.1 Terrain and Soil

Terrain and soil VCs include soil quantity, soil quality, and terrain stability.

The proposed Project changes have the potential to adversely affect terrain and soil due to soil removal, erosion, compaction, loss of soil fertility, petroleum product spills, and slope destabilization.

The EAC Application did not assess the effects of development within the Water Supply Area and Peripheral Mining Area on terrain and soil. Based on a review of soil mapping units (Appendix 7 of Appendix 16-A in the EAC Application), the majority of the Water Supply Area and Peripheral Mining Area have an in-situ ecologically functional soil rating of poor. There are two areas with an in-situ ecologically functional soil rating of good: one is just north of Sulphurets Creek on the western edge of the Water Supply Area, and the other is at a wetland within the Peripheral Mining Area. Based on review of terrain stability class (Appendix 5-F in the EAC Application), terrain stability in the Water Supply Area and Peripheral Mining Area ranges from low likelihood of landslides following disturbance (class II) to unstable (class V), with the majority having minor baseline stability issues (class IV).

The proposed Project changes are anticipated to pose a minor risk on terrain and soil. Any soils within proposed infrastructure development locations will be stripped and stockpiled for reclamation, and stabilization work will be completed, in accordance with the Soils Management Plan (required under Conditions 1 and 2 of the Certificate). Standard mitigation measures will effectively minimize compaction, loss of soil fertility and petroleum product spills. Geotechnical and geohazards assessment will be part of infrastructure planning and design to avoid adverse effects on terrain or adverse effects of terrain on infrastructure.

Based on the foregoing, terrain and soil are **excluded** from further assessment. The proposed Project changes are not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on terrain and soil.

5.4.2 Terrestrial Ecology

Terrestrial ecology VCs include rare plants and lichens, economic and culturally important plants, rare ecosystems, alpine ecosystems, parkland ecosystems, floodplain ecosystems, and forested ecosystems.

Vegetation clearing during construction, and to a lesser degree during closure and reclamation (e.g., slope stabilization and re-contouring activities) in the Water Supply Area and Peripheral Mining Area have the potential to adversely affect terrestrial ecology through loss of ecosystem function and extent. Construction, operation, and closure activities have the potential to adversely affect terrestrial ecology through alteration of ecosystem function due to soil compaction, loss of soil fertility, edge effects, wind throw, fragmentation, hydrological changes, dust, and invasive plants.

Potential effects on terrestrial ecology will be managed in accordance with Pretium's Vegetation Management Plan and Invasive Plants Management Plan (required under Conditions 1 and 2 of the Certificate).

The EAC Application did not assess the effects of development within the Water Supply Area and Peripheral Mining Area on the terrestrial ecology. Based on a review of terrestrial ecosystem mapping and the locations of rare plants and lichens identified through surveys completed as part of the 2012-13 Terrestrial Ecosystem Baseline Studies (Appendix 16-A of the EAC Application) the proposed

Project changes may have the potential to result in additional loss and/or alteration of the following terrestrial ecology VCs after the application of planned mitigation measures:

- **Alpine ecosystems:** Vegetation clearing and development within the Water Supply Area and Peripheral Mining Area may result in additional loss and/or alteration of alpine ecosystems.
- **Rare plants and lichens and their habitats:** Several known rare plant and lichen observations are located within the Water Supply Area and Peripheral Mining Area. Development within the Water Supply Area and Peripheral Mining Area may result in loss and/or alteration of rare plant and lichen habitat.

Potential habitat for soapberry, a culturally and economically important plant to the Tsetsaut / Skii km Lax Ha, might occur within the Water Supply Area and Peripheral Mining Area, mainly along the Brucejack Creek (Chapter 16 of the EAC Application). Although soapberry is considered the most important plant in terms of consumption, with its berries being consumed daily, interview and mapping data completed as part of the EAC Application (Appendix 25-B) indicate no evidence for the traditional use of the area near the Brucejack mine site, except as a travel route, and concluded that the value as a harvesting area is low (Rescan 2013). Soapberry habitat is typically located in low and mid-elevation semi-open forests and the primary characteristic defining soapberry habitat is dry to moderately dry well drained soils. The potential habitat occurrence in the Water Supply Area and Peripheral Mining Area (approximately 15 ha of low and medium potential habitat in both areas combined) is based on soil drainage characteristics defined as part of terrain mapping. Field surveys conducted around the mine site in August 2022 to verify Terrestrial Ecosystem Mapping included a reconnaissance survey of the Brucejack Creek for the presence of soapberry and none was identified. Although there is a potential for interaction with soapberry and the proposed Project changes, the potential for adverse effects is expected to be the same as or less than the effects assessed in the EAC Application, due to the low potential for harvesting and small area of potential interaction. Therefore, no further assessment is warranted as the EAC Application's conclusions regarding the Project's negligible effects on soapberry remains unchanged.

There are no anticipated interactions with parkland, riparian, or forested ecosystems. There are no anticipated losses of rare ecosystems listed by the BC Conservation Data Centre associated with these proposed areas (BC CDC 2020).

When considered in relation to the total Project effect on terrestrial ecology, the incremental effects contributed by the proposed Project changes may result in new threshold exceedances for the following VCs: alpine ecosystems and rare plants and lichens and their habitats.

Based on the foregoing, the above-listed terrestrial ecosystems VCs are **included** for further assessment. The proposed Project changes have the potential to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on terrestrial ecosystems.

5.4.3 Wetlands

Wetland VCs include wetland extent and wetland function.

Potential effects of the proposed Project changes on wetlands can follow one of two pathways: (1) Project component interaction with wetland extent and function resulting in a loss of extent and function; and (2) Project component interaction with one or more wetland functions resulting in an alteration of one or more wetland functions. Effects on wetland function could occur through hydrologic changes, fragmentation, edge effects, dust, sedimentation and waterborne pollutants, and invasive species.

Potential effects on wetlands associated with the proposed Project changes will be managed in accordance with Pretium's Vegetation Management Plan and Invasive Plants Management Plan (required under Conditions 1 and 2 of the Certificate).

The EAC Application did not assess the effects of development within the Water Supply Area and Peripheral Mining Area on wetlands. Overall, the EAC Application concluded that the Project will not result in loss of wetland extent because no wetland ecosystems were mapped within the Project footprint, but that the Project will alter approximately 518 ha of wetlands (Table 17.6-19 in the EAC Application). Based on review of wetland mapping in the 2012 Wetland Baseline Report (Appendix 17-A of the EAC Application), there is one mapped wetland within the Peripheral Mining Area, immediately west of the WRTSF and north of Brucejack Creek.

This wetland was considered in the Application to Amend Environmental Assessment Certificate #M15-01: Application No. 2 (ERM 2016), where a potable groundwater well and associated water pipeline was proposed, including the expansion of the boundaries indicated in the CPD at the time. Subsequent to the approval of Application No. 2, the water pipeline was installed along the surface of the mapped wetland along with a groundwater well terminating at the northwest boundary of this wetland. Application No. 2 anticipated that while the water well and pipeline would contribute to loss and alteration of extent and function of this 4.3 ha wetland, these additional effects would not change the findings of the EAC Application.

During the planning and design of the proposed Project changes, the remaining wetland will be considered and avoided to the extent feasible, to reduce further disturbance. If avoidance is not feasible (e.g., due to access requirements for new potable water sources), an assessment will be completed of the potential development effects on the wetland in order to advise on mitigation measures and minimize further disturbance. If loss of wetland extent or function is predicted, appropriate permitting and offsetting requirements will be followed. Mitigation monitoring will be considered as necessary to evaluate potential changes in extent or function.

Given this wetland was already assessed as part of Application No.2, and provided the wetland is avoided where feasible, it is **excluded** from further assessment.

5.4.4 Wildlife and Wildlife Habitat

Wildlife and wildlife habitat VCs include moose, mountain goat, grizzly bear, American marten, hoary marmot, bats, raptors, migratory waterbirds, migratory landbirds, and western toad.

Construction and operation activities have the potential to adversely affect wildlife and wildlife habitat through habitat loss and alteration, sensory disturbance, disruption of movement, direct mortality, indirect mortality, attractants, and chemical hazards. Closure and reclamation activities have the potential to adversely affect wildlife and wildlife habitat through indirect mortality and chemical hazards.

Potential effects on wildlife associated with the proposed Project changes will be managed in accordance with Pretium's Wildlife Management Plan (required under Conditions 1, 2, and 14 of the Certificate). Mitigation measures will include adherence to sensitive timing windows (e.g., breeding bird nesting window, grizzly bear denning period), buffers around sensitive wildlife features, and/or pre-clearing surveys.

The EAC Application did not assess the effects of development within the Water Supply Area and Peripheral Mining Area on wildlife and wildlife habitat. Based on the wildlife baseline reports from surveys completed between 2010 and 2013 (Appendices 18-A, 2013 Wildlife Characterization Baseline Report and 18-B, 2013 Wildlife Habitat Suitability Report, in the EAC Application) and terrestrial ecosystem mapping from surveys completed in 2012 and 2013 (Appendix 16-A, 2012-13 Terrestrial Ecosystem Baseline Studies, of the EAC Application), the proposed Project changes may have the potential to adversely affect the following wildlife and wildlife habitat VCs due to the occurrence of high-quality habitat or suitable habitat in the proposed areas: moose, mountain goat, grizzly bear, hoary marmot, raptors, migratory waterbirds, and migratory landbirds. The potential effects of the proposed Project changes on habitat loss and alteration, sensory disturbance, disruption of movement, and direct mortality are discussed for each of these VCs in the sections below.

The proposed Project changes are not anticipated to have additional risks of indirect mortality (i.e., increased hunting pressure from increased human access) compared to the assessment in the EAC Application. Indirect mortality risks on moose, mountain goat, and grizzly bear have been reduced or eliminated through access mitigation implemented as part of the Project. The Brucejack Access Road is gated, staffed, and controlled for traffic from Highway 37, eliminating (without access by force) the possibility of unauthorized vehicle access into the area. In addition, Project employees and contractors are prohibited from bringing personal firearms and weapons to work (per the Wildlife Management Plan required by Conditions 1, 2, and 14 of the Certificate). Indirect mortality is not considered a potential effect for hoary marmot because although marmots have cultural value and have been a food source for some Indigenous groups, they are not regularly hunted in the region (Appendix 18-A in the EAC Application); therefore, increased harvesting pressure in not anticipated as a result of the proposed Project changes.
Indirect mortality is not considered a potential effect for raptors, migratory waterbirds, or migratory landbirds as these species are not hunted or trapped to the extent that populations would be affected.

The proposed Project changes will not introduce new attractants or chemical hazards beyond what was assessed for the Project in the EAC Application; therefore, risks associated with attractants or chemical hazards are not anticipated to differ from the assessment in the EAC Application.

There are no anticipated interactions with the proposed Project changes and American marten, bats, and western toad because suitable habitats for these VCs do not occur within the Water Supply Area and Peripheral Mining Area.

Moose, mountain goat, grizzly bear, hoary marmot, raptors, migratory waterbirds, and migratory landbirds have high-quality habitat or suitable habitat that occurs within the Water Supply Area and Peripheral Mining Area. Given that the surface disturbance of the proposed areas is anticipated to be 6% of the Water Supply Area and 50% of the Peripheral Mining Area, a conservative estimate of habitat loss is calculated for each proposed area in Table 5.4-1, using these percentages. Although it is possible the amount of habitat loss might be more or less, depending on the placement of Project infrastructure, this estimate is considered conservative for the purposes of the effects assessment. The conservative estimate in Table 5.4-1 is then compared with the total amount of high-quality or suitable habitat for the VCs in the LSA and regional study area (RSA) in Table 5.4-2.

Table 5.4-1: Wildlife Habitat Loss due to Proposed Project Changes

Valued Component	Water Supply Area		Peripheral Mining Area		Combined Water Supply and Peripheral Mining Areas	
	Total Habitat (ha)	Conservative Estimate of 6% (ha)	Total Habitat (ha)	Conservative Estimate of 50% (ha)	Combined Total Habitat (ha)	Combined Conservative Estimate (ha)
Moose	27.19	1.63	10.18	5.09	37.37	6.72
Mountain Goat	64.05	3.84	63.98	31.99	128.03	35.83
Grizzly Bear	21.29	1.28	9.66	4.83	30.95	6.11
Hoary Marmot	2.57	0.15	31.07	15.54	33.64	15.69
Raptors – Ground-nesting	1.13	0.07	5.05	2.53	6.18	2.59
Migratory Waterbirds – Wetland	6.19	0.37	7.18	3.59	13.37	3.96
Migratory Waterbirds – Riverine[1]	0.09 km	0.01 km	0.29 km	0.15 km	0.38 km	0.16 km
Migratory Landbirds	231.00	14.00	297.80	148.90	537.80	162.90

[1] Suitable riparian habitat for riverine birds was mapped along rivers and streams and measured in terms of length (km) rather than area (ha).

Table 5.4-2: Wildlife Habitat Loss in Local and Regional Study Areas due to Proposed Project Changes

Valued Component	Habitat Loss in EAC Application (ha)	Conservative Estimate of Habitat Loss from Project Changes (ha)	Combined Habitat Loss from EAC Application and Project Changes (ha)	LSA				RSA			
				Total Habitat in LSA (ha)	Percentage of Habitat Loss in EAC Application (%)	Percentage of Habitat Loss from Project Changes (%)	Combined Percentage of Habitat Loss from EAC Application and Project Changes (%)	Total Habitat in RSA (ha)	Percentage of Habitat Loss in EAC Application (%)	Percentage of Habitat Loss from Project Changes (%)	Combined Percentage of Habitat Loss from EAC Application and Project Changes (%)
Moose	63.00	6.72	69.72	3,995	1.58	0.17	1.75	56,703	0.11	0.01	0.12
Mountain Goat	138.00	35.83	173.83	4,549	3.03	0.79	3.82	117,955	0.12	0.03	0.15
Grizzly Bear	143.13	6.11	149.24	100,010	0.14	0.01	0.15	134,876	0.11	<0.01	0.11
Hoary Marmot[1]	16.00	15.69	31.69	861	1.86	1.82	3.68	-	-	-	-
Raptors – Ground-nesting	3.30	2.59	5.89	4,134	0.08	0.06	0.14	48,089	0.01	0.01	0.01
Migratory Waterbirds – Wetland	2.30	3.96	6.26	831	0.28	0.48	0.75	9,048	0.03	0.04	0.07
Migratory Waterbirds – Riverine[2]	0.80 km	0.16 km	0.96 km	60 km	1.33	0.26	1.59	506 km	0.16	0.03	0.19
Migratory Landbirds	387.50	162.90	550.40	15,691	2.47	1.04	3.51	246,051	0.16	0.07	0.22

[1]Habitat for hoary marmot in the RSA was not calculated in the EAC Application due to the species' small home range.

[2]Suitable riparian habitat for riverine birds was mapped along rivers and streams and measured in terms of length (km) rather than area (ha).

5.4.4.1 Moose

There are small and scattered patches of high-quality early winter habitat for moose within the Water Supply Area and Peripheral Mining Area. Approximately 27.1 ha of high-quality habitat is in the Water Supply Area and 10.18 ha in the Peripheral Mining Area, which accounts for a conservative estimate of 1.63 ha of high-quality habitat lost in the Water Supply Area and 5.09 ha of high-quality habitat lost in the Peripheral Mining Area (6.72 ha combined; Table 5.4-1). This incremental loss of habitat represents a 0.17% of habitat in the LSA and 0.01% of habitat in the RSA (Table 5.4-2).

Despite there being potentially suitable habitat modelled in the area, it is unlikely that moose frequent this habitat due to the high elevation of these areas, and because of its fragmentation and isolation by the surrounding glacier. Moose are known to typically move along river drainages between seasonal ranges. As such, moose are more likely to use the river valleys located elsewhere in the LSA and RSA, including Treaty Creek, Scott Creek, Unuk River, Bell-Irving River, and the Bowser River drainage system (Chapter 18 of the EAC Application). This assumption is supported by observations made during 2011 baseline surveys and 2018 wildlife monitoring, where moose sightings were recorded in these river valleys, and none were observed near the mine site.

Due to the small percentage of incremental habitat loss predicted, the low likelihood of encountering moose in the proposed areas, and with the application of planned mitigation measures (e.g., avoidance of identified moose calving areas, avoidance of winter vegetation clearing in habitat rated as highly suitable), the potential effects of the proposed Project changes on moose will not change the conclusions reached in the EAC Application regarding habitat loss and alteration, sensory disturbance, disruption of movement, and direct mortality. Based on the foregoing, moose are **excluded** from further assessment.

5.4.4.2 Mountain Goat

There is approximately 64.05 ha of high-quality winter and summer habitat for mountain goat in the Water Supply Area and 63.99 ha in the Peripheral Mining Area, which accounts for a conservative estimate of 3.84 ha of high-quality habitat lost in the Water Supply Area and 31.99 ha of high-quality habitat lost in the Peripheral Mining Area (35.83 ha combined; Table 5.4-1). This estimated loss of habitat, combined with the assessed habitat lost in the EAC Application (138 ha, 3.03% of the LSA, 0.12% of the RSA), increases the amount of habitat lost by approximately 26% (173.83 ha combined, 3.82% of the LSA and 0.15% of the RSA; Table 5.4-2).

Habitat selection by mountain goats is largely driven by topographical features. Steep escape terrain (i.e., cliff or rocky topography) is a critical factor that drives selection of both summer and winter mountain goat habitats (Herbert and Turnbull 1977). High-quality habitats are areas close to escape terrain that support high-quality forage, such as shrubs, herbs, and krumholtz. Summer habitats tend to be vegetated areas near escape terrain above the treeline on south- and west-facing slopes. Winter habitats tend to be similar areas, but downslope, below the treeline.

High-quality habitat was mapped based on terrain characteristics, including escape terrain. Escape terrain was identified using a topographic model to isolate areas of steep slopes (40° to 70°; BC MOE 2010) and mountainous topography devoid of vegetation. Habitats in very close proximity to escape terrain had the highest habitat values, which steadily decreased with increasing distance from escape terrain, based on results from previous studies (Fox, Smith, and Schoen 1989; RTEC 2006; BC MOE 2010).

Due to the abundance of suitable, rocky escape terrain throughout the RSA, high-rated mountain goat habitat for both winter and summer was widely distributed across the RSA. During baseline surveys (Appendix 18-A in the EAC Application), suitable terrain west of the Brucejack mine site and on either side of Sulphurets Creek supported a substantial proportion of the mountain goat population during the winter and summer, although none were observed within the Water Supply Area and Peripheral Mining Area.

Given the amount of high-quality habitat within the Water Supply Area and Peripheral Mining Area, there is the potential for interaction with the proposed Project changes and mountain goats. Therefore, the proposed Project changes have the potential to result in additional adverse effects of habitat loss and alteration compared to the assessment in the EAC Application.

Due to the increased potential for interaction in the Water Supply Area and Peripheral Mining Area, the proposed Project changes might result in potential effects of sensory disturbance due to construction and operation noise levels, disruption of movement due to development of infrastructure at high elevation, and direct mortality due to vehicle collisions along access roads located at high elevations.

When considered in relation to the total Project effect on wildlife and wildlife habitat, the incremental effects contributed by the proposed Project changes may result in new threshold exceedances for mountain goats as a result of potential habitat loss and alteration, sensory disturbance, disruption of movement, and direct mortality.

Based on the foregoing, mountain goat are **included** for further assessment with respect to the Water Supply Area and Peripheral Mining Area. The proposed Project changes have the potential to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on mountain goat.

5.4.4.3 Grizzly Bear

There is approximately 21.29 ha of high-quality spring habitat for grizzly bear in the Water Supply Area and 9.66 ha in the Peripheral Mining Area, which accounts for a conservative estimate of 1.28 ha of high-quality habitat lost in the Water Supply Area and 4.83 ha of high-quality habitat lost in the Peripheral Mining Area (6.11 ha combined; Table 5.4-1). This estimated loss of habitat, combined with the assessed habitat lost in the EAC Application (143 ha, 0.14% of the LSA, 0.11% of the RSA), increases the amount of habitat lost by approximately 4% (149.24 ha combined, 0.15% of the LSA and 0.11% of the RSA; Table 5.4-2).

Spring grizzly bear habitat is typically limited to lower elevations due to the deeper snowpacks at higher elevations, however, spring habitat may occur in open avalanche chutes at mid to high elevations where preferred forage exists. In the EAC Application, high-quality spring habitat was modelled based on preferred forage, including grasses and herbs, vegetation on nutrient rich and moist sites (e.g., wetlands, avalanche chutes), open canopied mature forest capable of early berry production, and open habitats capable of sustaining a berry crop over winter. The ecosystems surrounding the mine site are consistent with this description; open avalanche chutes, wetland habitat, and open habitats that support berries. In addition, high-quality protein habitat occurs in the Water Supply Area and Peripheral Mining Area due to the presence of hoary marmots, which are a reliable protein source for grizzly bears. There is also high-quality summer habitat, and high value grizzly bear habitat mapped by the Cassiar Iskut-Stikine Land and Resource Management Plan, just outside the Water Supply Area along Sulphurets creek.

Given the amount of high-quality habitat within the Water Supply Area and Peripheral Mining Area, there is the potential for interaction with the proposed Project changes and grizzly bear. Therefore, the proposed Project changes have the potential to result in additional adverse effects of habitat loss and alteration compared to the assessment in the EAC Application.

Due to the increased potential for interaction in the Water Supply Area and Peripheral Mining Area, the proposed Project changes might result in potential effects of sensory disturbance due to construction and operation noise levels, disruption of movement between low to high elevation or between alpine areas, and direct mortality due to vehicle collisions along access roads.

When considered in relation to the total Project effect on wildlife and wildlife habitat, the incremental effects contributed by the proposed Project changes may result in new threshold exceedances for grizzly

bear as a result of potential habitat loss and alteration, sensory disturbance, disruption of movement, and direct mortality.

Based on the foregoing, grizzly bear are **included** for further assessment with respect to the Water Supply Area and Peripheral Mining Area. The proposed Project changes have the potential to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on grizzly bear.

5.4.4.4 Hoary Marmot

There is approximately 2.57 ha of high-quality habitat for hoary marmot in the Water Supply Area and 31.07 ha in the Peripheral Mining Area, which accounts for a conservative estimate of 0.15 ha of high-quality habitat lost in the Water Supply Area and 15.54 ha of high-quality habitat lost in the Peripheral Mining Area (15.69 ha combined; Table 5.4-1). This estimated loss of habitat, combined with the assessed habitat lost in the EAC Application (16 ha, 1.86% of the LSA), increases the amount of habitat lost by approximately 98% (31.69 ha combined, 3.68% of LSA; Table 5.4-2).

Hoary marmots generally live in family colonies that occupy several burrows in mountainous alpine and subalpine habitats along rocky slopes, hillsides, and alpine meadows (Nagorsen 2005). The Water Supply Area and Peripheral Mining Area contain suitable alpine habitat, specifically non-vegetated and sparsely vegetated areas with rocky outcrops. In addition to high-quality habitat, there are three known colonies in the Water Supply Area and 15 known colonies in the Peripheral Mining Area, which were identified during 2012 baseline surveys (Appendix 18-A in the EAC Application) and additional aerial surveys conducted in August 2022. Given the amount of high-quality habitat and the number of known colonies within the Water Supply Area and Peripheral Mining Area, there is the potential for interaction with the proposed Project changes and hoary marmot.

When considered in relation to the total Project effect on wildlife and wildlife habitat, the incremental effects contributed by the proposed Project changes may result in new threshold exceedances for hoary marmot as a result of habitat loss and alteration, sensory disturbance, disruption of movement, and direct mortality due to burrow destruction or vehicle collisions.

Based on the foregoing, hoary marmot is **included** for further assessment with respect to the Water Supply Area and Peripheral Mining Area. The proposed Project changes have the potential to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on hoary marmot.

5.4.4.5 Raptors

There is no suitable forest-nesting raptor habitat in the Water Supply Area and Peripheral Mining Area, but there are small patches of suitable ground-nesting raptor habitat. Approximately 1.13 ha of suitable ground-nesting habitat is in the Water Supply Area and 5.05 ha in the Peripheral Mining Area, which accounts for a conservative estimate of 0.07 ha of suitable habitat lost in the Water Supply Area and 2.53 ha of suitable habitat lost in the Peripheral Mining Area (2.59 ha combined; Table 5.4-1). This incremental loss of habitat represents a small percentage of habitat in the LSA (0.06%) and RSA (0.01%; Table 5.4-2).

Ground-nesting raptor habitat was represented in the EAC Application by suitable short-eared owl habitat, which was mapped based on low elevation forests, with open habitat modifiers, and wetland habitats. Ground-nesting raptors frequently choose a nesting site adjacent to wetlands where they forage for small mammals (Wiggins, Holt, and Leasure 2006; COSEWIC 2008). Breeding habitat consists of open country with short vegetation, including rangelands, grasslands, near dry marshes, bushy fields, and forest clearings (Campbell et al. 1997). Although wetland habitats were identified in the Water Supply Area and

Peripheral Mining Area, it is very unlikely that short-eared owl nest in this high elevation habitat and there have been no observations of owls around the mine site.

Due to the small percentage of incremental habitat loss predicted, the low likelihood of encountering ground-nesting raptors in the proposed areas, and with application of planned mitigation measures (e.g., pre-clearing surveys, avoidance of breeding season, buffers around identified active nests) as described in the Wildlife Management Plan (required by Conditions 1, 2 and 14 of the Certificate), the potential effects of the proposed Project changes on raptors will not change the conclusions reached in the EAC Application regarding habitat loss and alteration, sensory disturbance, disruption of movement, and direct mortality. Based on the foregoing, raptors are **excluded** from further assessment.

5.4.4.6 Migratory Waterbirds

There is no suitable cavity-nesting bird habitat in the Water Supply Area and Peripheral Mining Area, but there are small patches of suitable wetland and riverine bird habitat. Approximately 6.19 ha of suitable wetland bird habitat is in the Water Supply Area and 7.18 ha in the Peripheral Mining Area, which accounts for a conservative estimate of 0.36 ha of suitable habitat lost in the Water Supply Area and 3.59 ha of suitable habitat lost in the Peripheral Mining Area (3.96 ha combined; Table 5.4-1). This incremental loss of habitat represents a small percentage of habitat in the LSA (0.48%) and RSA (0.04%; Table 5.4-2). Approximately 0.09 km of suitable riverine bird habitat is in the Water Supply Area and 0.29 km in the Peripheral Mining Area, which accounts for a conservative estimate of 0.01 km of suitable habitat lost in the Water Supply Area and 0.15 km of suitable habitat lost in the Peripheral Mining Area (0.16 km combined; Table 5.4-1). This incremental loss of habitat represents a small percentage of habitat in the LSA (0.26%) and RSA (0.03%; Table 5.4-2).

Wetland birds typically breed in nests constructed along the edges of waterbodies such as wetlands, marshes, or lakes. Nests are commonly concealed in grasses, clumps of emergent vegetation such as cattails and bulrush, or under riparian vegetation (Campbell et al. 1990). Suitable habitat for riverine birds was identified as rivers and streams of order two and larger. Harlequin ducks, a riverine bird, were observed in pairs along upper sections of Sulphurets Creek, outside of the Water Supply Area (Appendix 18-A of the EAC Application). They generally build their nests on the ground in riparian areas on mid-stream islands (Robertson and Goudie 1999).

The majority of suitable wetland bird habitat within the LSA was modelled along Bowser River and Knipple Lake. The majority of suitable riverine bird habitat within the LSA was modelled along the Bowser River. During spring and fall migrations, the highest concentrations of waterbirds were observed in calm, low-flowing waterbodies within the RSA along the Bell-Irving River, Treaty Creek, Bowser River, and the lower Unuk River. No waterbirds were observed near the mine site.

Due to the small percentage of incremental habitat loss predicted, and with application of planned mitigation measures (e.g., pre-clearing surveys, avoidance of breeding season, buffers around identified active nests) as described in the Wildlife Management Plan (required by Conditions 1, 2 and 14 of the Certificate), the potential effects of the proposed Project changes on migratory waterbirds will not change the conclusions reached in the EAC Application regarding habitat loss and alteration, sensory disturbance, disruption of movement, and direct mortality. Based on the foregoing, migratory waterbirds are **excluded** from further assessment.

5.4.4.7 Migratory Landbirds

Habitat for migratory landbirds is ubiquitous throughout the LSA and RSA. The entire area of the Water Supply Area (231 ha) and Peripheral Mining Area (298 ha) is suitable habitat for migratory birds. The conservative estimates of habitat loss are 14 ha in the Water Supply Area and 149 ha in the

Peripheral Mining Area (162.90 ha combined; Table 5.4-1). This incremental loss of habitat represents a small percentage of habitat in the LSA (1.04%) and RSA (0.07%; Table 5.4-2).

During baseline surveys (Appendix 18-A in the EAC Application), there were a greater number of breeding pairs and species of landbirds in the low to mid-elevation ecosystems elsewhere in the LSA and RSA, compared to the numbers detected in the high elevation alpine ecosystems surrounding the mine site. These alpine areas have persistent snow cover limiting available nesting habitat for breeding birds. The pattern of low bird abundance in alpine areas parallels findings of low abundance and species richness of alpine bird communities in general (Martin 2001). The alpine bird community does, however, support characteristic species that were only detected in the higher elevations. During 2010 and 2012 baseline surveys, Say's phoebe (*Sayornis saya*), barn swallow (*Hirundo rustica*), and sooty grouse (*Dendragapus fuliginosus*) were observed in and around the Water Supply Area and Peripheral Mining Area. Barn swallow and sooty grouse are provincially listed as Special Concern due to population decline. Barn swallow is also listed as Threatened on Schedule 1 of the *Species at Risk Act* (SARA) and is currently under consideration for status change to Special Concern based on recent assessment in 2021 by the Committee on the status of Endangered Wildlife in Canada (COSEWIC).

During construction and operation activities in the Water Supply Area and Peripheral Mining Area, it is expected that birds (including SARA-listed species and provincial species of conservation concern) will establish other territories and the disruption from the proposed Project changes will be temporary. Because the majority of available habitat within the RSA will remain, and with application of planned mitigation measures (e.g., pre-clearing surveys, avoidance of breeding season, 50 m buffers around identified active nests) as described in the Wildlife Management Plan (required by Conditions 1, 2 and 14 of the Certificate), the potential effects of the proposed Project changes on migratory landbirds will not change the conclusions reached in the EAC Application regarding habitat loss and alteration, sensory disturbance, disruption of movement, and direct mortality. Based on the foregoing, migratory landbirds are **excluded** from further assessment.

5.5 Human Environment

5.5.1 Economy

Economic VCs include income production and revenue, labour market, and economic activity.

The proposed Project changes will result in negligible adjustments to employment and procurement and will not change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding economic effects. Therefore, economic effects are **excluded** from further assessment.

5.5.2 Social

Social VCs include education, skills, and training; community infrastructure, services, and housing; and family and worker well-being.

The proposed Project changes are anticipated to result in negligible changes in employment and procurement associated with the Project and will not result in demographic change in local communities. Consequently, no changes are anticipated for educational profile and attainment levels, demand on infrastructure and services, or change in worker and family well-being.

Based on the foregoing, social effects are **excluded** from further assessment. The proposed Project changes are not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's social effects.

5.5.3 Heritage

Heritage VCs include protected archaeological sites, protected historical resources, and protected palaeontological resources.

Protected historical resources and palaeontological resources have not been identified within proximity to the proposed Project changes. One protected archaeological site has been identified in proximity to the Project changes. Archaeological site HcTn-1, consisting of a single obsidian flake, was located on a decaying bedrock outcrop within the proposed amendment area. The site has been assigned Legacy Status by the Archaeology Branch and is no longer protected by the *Heritage Conservation Act* (HCA). No further work is required at the site.

All areas within the Water Supply Area and Peripheral Mining Area have been subject to archaeological assessment and no sites protected under HCA were identified. If protected sites are identified through the Chance Find Procedure, appropriate mitigation measures will be applied up to and including re-design of planned works and establishment of appropriate buffers, consistent with established measures described in the Heritage Management Plan (required under Condition 2 of the Certificate).

Based on the foregoing, heritage effects are **excluded** from further assessment. The proposed Project changes are not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's social effects.

5.5.4 Human Health

The human health VCs are drinking water quality, air quality, noise, and country foods.

Potable water ingestion by workers (including off-duty workers) from the domestic water supply was considered in Section 21 of the EAC Application. Water quality at the mine site area was scoped out of the drinking water assessment since there is no operable pathway in that area for human exposure to drinking water from surface sources. Since the proposed mitigation for protection of human health was to ensure that drinking water quality guidelines were met for the potable water supply, no effects to human health due to drinking water were anticipated. The water from the new potable water source will be connected to the existing potable water treatment facility and treated as required to meet BC and Canadian drinking water requirements before use. Therefore, the findings of the EAC Application are unchanged by the new location for the potable water supply source.

No human receptors are within sufficient proximity to the proposed Project changes to experience health effects from noise or air quality (Figure 21.4-1 in the EAC Application). The proposed Project changes will not adversely affect water quality (see Section 5.3.3) and will therefore not interact with drinking water quality for other water users or with country foods.

Based on the foregoing, human health is **excluded** from further assessment. The proposed Project changes are not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on human health.

5.5.5 Navigable Waters

The proposed Project changes will not interact with navigable waters.

Based on the foregoing, navigable waters are **excluded** from further assessment. The proposed Project changes are not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on navigable waters.

5.5.6 Non-traditional Land Use

The non-traditional land use VCs are commercial land use and non-commercial land use.

The EAC Application assessed effects on Guide Outfitter Licence 601036, Commercial Recreation Licence 6406136 (heli-skiing) and Commercial Recreation Licence 6406985 (guided backcountry expeditions). Non-commercial land use was excluded from the effects assessment.

Since the EAC Application, Guide Outfitter Licence 601036 has been updated to Licences 601113 and 601084. The proposed Project changes represent an insignificant increase in total tenure overlap (existing CPD and proposed CPD are 0.66% and 0.015%, respectively) and will not adversely affect the ability of commercial land users to access their tenures or the abundance and distribution of wildlife (see Section 5.4.4). No effects on quality of experience are anticipated for Commercial Recreation Licence 6406136, due to the distance of heli-skiing activities relative to the proposed Project changes. Incremental effects on the quality of experience of Commercial Recreation Licence 6406985 are anticipated to be negligible relative to other Project components.

Based on the foregoing, non-traditional land use effects are **excluded** from further assessment. The proposed Project changes are not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on non-traditional land use.

5.5.7 Current Aboriginal Use

The current Aboriginal use VCs are fishing, hunting/trapping and plant gathering opportunities and practices; and habitations, trails, burials, and other cultural landscapes.

The proposed Project changes will not adversely affect the ability of Indigenous peoples to access land use sites, the abundance and distribution of wildlife (see Section 5.4.4), or the quality of country foods (see Section 5.5.4). Incremental effects on the quality of experience of Indigenous land users are anticipated to be negligible relative to other Project components.

Based on the foregoing, current Aboriginal use is **excluded** from further assessment. The proposed Project changes are not anticipated to change the EAC Application's characterization of residual effects and/or management and mitigation measures regarding the Project's effects on current Aboriginal use.

5.6 Consideration of Section 25 Matters

5.6.1 Accidents and Malfunctions

Section 25(c) requires consideration of the "risks of malfunctions or accidents." Chapter 31 of the EAC Application assessed the risks of malfunctions and accidents with regards to the Project, including the potential for accidents during the same activities involved in the proposed Project changes (e.g., construction of off-site infrastructure including use of heavy equipment, erosion, and dust control measures, and water management).

Construction, operation, and decommissioning of the proposed Project changes will be managed in accordance with Pretium's Mine Emergency Response Plan, Air Quality Management Plan, Chemicals and Materials Storage and Handling Plan, Spill Response Plan, and Vegetation Management Plan (required under Conditions 1 and 2 of the Certificate), Surface Erosion Prevention and Sediment Control Management Plan (included as Appendix D to the Environmental Management Plan required under Conditions 1 and 2 of the Certificate and consistent with *Mines Act* Permit M-243), and Reclamation and Closure Plan.

Based on the foregoing, Section 25(c) is **excluded** from further assessment with respect to the proposed Project changes.

5.6.2 Distinct Populations

Section 25(d) requires consideration of "disproportionate effects on distinct human populations, including populations identified by gender." As noted in Section 5.5, potential interactions between the proposed Project changes and the human environment (including economic and social effects as well as heritage, human health, navigable waters, non-traditional land use, and current Aboriginal use) are anticipated to be negligible.

Based on the foregoing, Section 25(d) is **excluded** from further assessment with respect to the proposed Project changes.

5.6.3 Effects on Biophysical Factors Supporting Ecosystem Function

Section 25(e) requires consideration of the "effects on biophysical factors that support ecosystem function." Ecosystem function depends on the long-term integrity of the physical, chemical, and biological components of ecosystems (e.g., vegetation, water, soil) and how they interact with each other.

The potential interactions of the proposed Project changes with many of these ecosystem components are considered at the individual VC level in Sections 5.2 through 5.4 of this document. In terms of the overall impact to ecosystem function at a broader level (i.e., watershed or landscape), the proposed Project changes will represent a small incremental change to biophysical factors within the RSA relative to the Project and will not change the conclusions reached in the EAC Application.

Based on the foregoing, Section 25(e) is **excluded** from further assessment with respect to the proposed Project changes.

5.6.4 Current and Future Generations

Section 25(f) requires consideration of "effects on current and future generations." This matter, linked to the concept of sustainability, looks at the Project's effects in terms of equity across a generational timescale, and was not explicitly considered in the EAC Application.

Table 5.6-1 examines the potential for the proposed Project changes to produce effects at this timescale and magnitude relative to the Project design articulated in the CPD.

Table 5.6-1: Potential for Proposed Project Changes to Change the Project's Effects on Current and Future Generations

Potential for Change To…	Description of Change
Development options: Are development options for future generations being increased, maintained, or reduced by the proposed Project changes?	**Maintained:** The proposed Project changes represent incremental increases to the Project design, and development options for future generations remain largely unchanged.
Access to resources: Will future generations have more, the same, or less access to environmental, cultural, economic, and social resources because of the proposed Project changes?	**The same:** The proposed Project changes are not anticipated to reduce or increase access to resources for future generations.
Distribution of impacts and benefits: Will the distribution of impacts and benefits of the Project across generations be distributed less equally, as equally, or more equally because of the proposed Project changes?	**As equally:** The proposed Project changes will not result in a greater differentiation between impacts or benefits across generations.

Based on the foregoing, Section 25(f) is **excluded** from further assessment with respect to the proposed Project changes.

5.6.5 Consistency with Land Use Plans

Section 25(g) requires consideration of "consistency with any land-use plan of the government or an Indigenous nation if the plan is relevant to the assessment." The Project's consistency with such plans is discussed in Chapter 24 of the EAC Application.

The proposed Project changes are located within the Nass South Sustainable Resource Management Plan (SRMP) Area (BC MFLNRORD 2012), developed with input from Nisga'a Lisims Government and Gitanyow First Nation to address sustainable management of land, water, and resources (BC MFLNRORD 2016). The Nass South SRMP provides management direction for seven resources: water, biodiversity, timber, botanical forest products, fisheries, cultural heritage resources, and wildlife. The SRMP identifies two zones for area-specific management (the Hanna-Tintina Area and specific water management units), neither of which overlap with the proposed Project changes or the land use study areas defined in the EAC Application. Mineral exploration and road-related resource development are permitted in all zones, subject to legislative requirements.

Based on the foregoing, Section 25(g) is **excluded** from further assessment with respect to the proposed Project changes.

5.6.6 Greenhouse Gas Emissions and Provincial Targets

Section 25(h) requires consideration of "greenhouse gas emissions, including the potential effects on the province being able to meet its targets under the *Greenhouse Gas Reduction Targets Act*."

As outlined in Section 5.2.2 of this Amendment Application, the proposed Project changes are likely to result in a small increase in GHG emissions relative to overall Project emissions. Annual direct facility-level GHG emissions for the Project were estimated to be 33,943 tonnes carbon dioxide equivalent (t CO_{2e}) in the EAC Application. This annual total represents 0.05% of annual emissions in BC (68,600,000 t CO_{2e}) in 2019. Estimated GHG production in 2021 by the Project was 29,743 t CO_{2e}; the small increase in GHG emissions from proposed changes to the Project represent a fraction of the current facility-level GHG emissions and will have negligible impacts on the province's ability to meet its targets under the *Greenhouse Gas Reduction Targets Act*.

Based on the foregoing, Section 25(h) is **excluded** from further assessment with respect to the proposed Project changes.

5.6.7 Alternative Means of Carrying Out the Project

Section 25(i) requires consideration of "alternative means of carrying out the project that are technically and economically feasible, including through the use of the best available technologies, and the potential effects, risks and uncertainties of those alternatives." Chapter 4 of the EAC Application presented an assessment of the alternatives considered as part of the original Project design, including ore production technologies, mine waste disposal, treatment of contaminated water, and transportation route and mode.

The proposed Project changes do not comprise a change in terms of mining methods or other technologies and alternatives contemplated in the EAC Application. Based on the foregoing, Section 25(i) is **excluded** from further assessment with respect to the proposed Project changes.

5.6.8 Effects of the Environment on the Project

Section 25(j) requires consideration of "potential changes to the project that may be caused by the environment." Chapter 32 of the EAC Application considered the effects of the environment on the Project, including a range of climate conditions, geophysical effects, wildfire, and climate change; this chapter also identifies measures to mitigate these effects, as well as contingency plans and response options.

The proposed Project changes are not expected to require additional mitigation measures, contingency plans, or response options beyond what was presented in the EAC Application. Based on the foregoing, Section 25(j) is **excluded** from further assessment with respect to the proposed Project changes.

5.7 Summary

As described in the preceding sections, three terrestrial ecology VCs (alpine ecosystems, culturally or economically important plants, and rare plants and lichens and their habitats) and three wildlife and wildlife habitat VCs (mountain goat, grizzly bear, and hoary marmot) are carried forward for further assessment in Chapter 6.

6. EFFECTS ASSESSMENT

Where potential interactions with the proposed Project changes were identified as requiring further assessment in Chapter 5, those interactions are carried forward for assessment in the sections below.

6.1 Terrestrial Ecology

6.1.1 Introduction

The Project's potential effects on terrestrial ecology VCs are assessed in Section 16 of the EAC Application. The EAC Application assessed the potential of the Project to affect terrestrial ecology as a result of loss of ecosystem extent and/or function and alteration of ecosystem function. Overall, the EAC Application determined that the Project will result in the following residual effects:

- Loss and/or alteration of ecosystem function and/or extent on alpine ecosystems, rated not significant;
- Alteration of ecosystem function and/or extent on parkland ecosystems, rated not significant;
- Alteration of ecosystem function and/or extent on forested ecosystems, rated not significant;
- Alteration of ecosystem function and/or extent on floodplain ecosystems, rated not significant;
- Loss of culturally or economically important plant habitat (specifically devil's club and pine mushroom), rated not significant; and
- Alteration of rare plant and lichen habitat, rated not significant.

No detectable residual effects were anticipated for rare ecosystems.

The proposed Project changes in the Water Supply Area and Peripheral Mining Area have the potential to result in the following effects on terrestrial ecology due to vegetation clearing, soil compaction, loss of soil fertility, edge effects, wind throw, fragmentation, hydrological changes, dust, and the introduction and spread of invasive plants:

- Loss and/or alteration of ecosystem function and/or extent on alpine ecosystems; and
- Loss and/or alteration of rare plants and lichen and/or rare plant and lichen habitat.

The following sections assess the potential effects of the proposed Project changes on terrestrial ecology.

6.1.2 Assessment Scope

The regulatory and policy framework, baseline characterization, VCs, and assessment boundaries for this assessment are as described in Sections 16.2, 16.3, and 16.4 of the EAC Application. Cumulative baseline study reports for terrestrial ecology are located in Appendix 16-A of the EAC Application.

The potential loss or alteration of alpine ecosystem extent and function was assessed using a conservative estimate of the surface disturbance anticipated, assuming that approximately 6% of the Water Supply Area and 50% of the Peripheral Mining Area is required for the development of the proposed Project changes. These percentages were used to derive conservative estimates of ecosystem loss within each proposed area. Although it is possible the amount of ecosystem loss might be more or less, depending on the placement of Project infrastructure, this estimate is considered conservative for the purposes of the effects assessment.

The potential loss or alteration of rare plants and lichens was assessed using the full extent of the Water Supply Area and Peripheral Mining Area, as the precise location of potential vegetation clearing and ground disturbance in relation to known observations within the proposed areas is unknown.

6.1.3 Assessment of Potential Effects

6.1.3.1 Potential Effects on Alpine Ecosystems

The EAC Application assessed the potential effects (loss or alteration of ecosystem function and extent) of the Project on alpine, parkland, forested, and floodplain ecosystems using a spatial risk model. The risk model included seven potential effects on ecosystem function and extent: surface disturbance, dust effects, edge effects, introduction and/or spread of invasive plant species, windthrow, fragmentation, and alteration of hydrological connectivity. The effects were characterized in the model based on the probability of an interaction (i.e., the likelihood that a Project effect will interact with a terrestrial ecology VC) and the consequence of the interaction (i.e., the relative importance of the ecosystem function). The details of the risk model are described in Sections 16.5.1 to 16.5.4 of the EAC Application.

For the assessment of the proposed Project changes, the risk model could not be updated due to the complexity of the inputs required. Without a project design and proposed footprint, it is not possible to accurately use the model to calculate the effects from dust, edges, spread of invasive species, windthrow, fragmentation, and hydrological connectivity changes. Instead, the amount of ecosystem loss within the proposed areas was conservatively estimated (using 6% of the Water Supply Area and 50% of the Peripheral Mining Area) and rated as moderate to high risk to alpine ecosystems (Table 6.1-1).

Table 6.1-1: Alpine Ecosystem Loss in the Local Study Area due to Proposed Project Changes

Project Area		Area of Alpine Ecosystems (ha)	Area Rated Moderate and High Risk to Alpine Ecosystems (ha)[1]	Percentage of the LSA (%)[2]
EAC Application	LSA	3,645.00	31.00	0.85
Proposed Project Changes	Water Supply Area	226.07	13.56	0.37
	Peripheral Mining Area	149.03	74.52	2.04
	Total	**375.10**	**88.08**	**2.42**
Grand Total		**-**	**119.08**	**3.27**

[1] For the Water Supply Area and Peripheral Mining Area, the area rated as moderate and high risk to alpine ecosystems is based on the conservative estimates of surface disturbance in these areas (i.e., 6% of the Water Supply Area and 50% of the Peripheral Mining Area).

[2] Percentage of area rated moderate and high risk to alpine ecosystems compared with the total area of alpine ecosystems in the LSA.

This conservative rating was based on the probability and consequence criteria defined for each attribute input used for the risk model (summarized in Tables 16.5-2a and 16.5-2b in the EAC Application). The following attributes of the risk model are characteristic of the alpine ecosystems in the Water Supply Area and Peripheral Mining Area:

- Infrastructure footprint or clearing; rated high (10/10 rating weight);
- Regosolic soils; rated low (3/10 rating weight);
- Low biogeoclimatic ecosystem productivity; rated low (3/10 rating weight);
- Mountain goat high-quality winter habitat; rated high (10/10 rating weight); and
- Known rare plant and lichen observations; rated high (10/10 rating weight).

As per the rating weights assigned to the above attributes, the area of ecosystem loss in the Water Supply Area and Peripheral Mining Area is conservatively rated moderate to high risk to alpine ecosystems due to the clearing required for development, the wildlife habitat suitability mapping (specifically for mountain goat high-quality winter habitat), and the rare plant habitat located immediately northwest of the WRTSF.

Although alpine ecosystems have overall low to moderate importance of ecosystem function, they also have low resiliency to disturbance. The majority of the ecosystems in the Water Supply Area and Peripheral Mining Area have shallow, poorly developed soils (i.e., regosolic soils), and as a result are relatively unproductive (from a biomass accumulation perspective). However, alpine ecosystems are also easily degraded by disturbance (McPhee et al. 2000), such as the use of access roads and compaction due to vehicle and foot traffic. Once degraded, these ecosystems may not recover to pre-disturbance levels even in the long term (Frank and del Moral 1986; Forbes, Ebersole, and Strandberg 2001; Mingyu et al. 2009).

There is approximately 226.07 ha of alpine ecosystem in the Water Supply Area and 149.03 ha in the Peripheral Mining Area, which accounts for a conservative estimate of 13.56 ha in the Water Supply Area and 74.52 ha in the Peripheral Mining Area of ecosystem lost rated as moderate to high risk to alpine ecosystems (88.08 ha combined; Table 6.1-1). This estimated loss of alpine ecosystem, combined with the assessed loss of moderate and high risk to alpine ecosystems in the EAC Application (31.11 ha, 0.85% of the LSA), almost triples the amount of ecosystem lost rated as moderate and high risk to alpine ecosystems in the LSA (119.08 ha combined, 3.27% of the LSA).

6.1.3.2 Potential Effects on Rare Plants and Lichens and Associated Habitat

There were no known locations of rare plants and lichens within the Project footprint assessed in the EAC Application; as such, no loss of rare plants and lichens was anticipated. However, there were a number of rare plants and lichens in close proximity to the Project development, which could be altered by dust deposition, fragmentation, changes in hydrological connectivity or impacts from vehicular or foot traffic during any phase of the Project. There were 25 lichens (including red and blue listed species with NatureServe ranks ranging from a SARA list candidate to apparently secure), 2 mosses (including a red listed species with a NatureServe rank of critically imperiled to imperiled) and 7 vascular plants (including blue listed species with NatureServe ranks ranging from imperiled to vulnerable) identified as potentially impacted by Project activities.

Several of the rare plant and lichen species found during the 2012-13 baseline surveys (Appendix 16-A of the EAC Application) and presented in the EAC Application have since been re-assessed by the Conservation Data Centre (CDC) and the ranks have been updated. Within the Water Supply Area and Peripheral Mining Area specifically, all previously blue and red-listed lichen species found have been re-classified to yellow-listed, with the exception of *Collema ceraniscum*, found in the Peripheral Mining Area, which was re-classified from red-listed to blue-listed. All previously identified rare moss and vascular plant species remain ranked as presented in the EAC Application, with the exception of *Epilobium hornemannii ssp behringianum* and *Woodsia alpina*, found in the Water Supply Area, which were re-classified from blue-listed to unknown.

Within the Water Supply Area and Peripheral Mining Area, there are 12 known rare plant and lichen observations, previously identified during 2012-13 baseline surveys (Appendix 16-A of the EAC Application). Specifically in the Water Supply Area, there are 3 rare lichen, 4 rare moss, and 4 rare vascular plant species (Table 6.1-2). In the Peripheral Mining Area, there are 2 rare lichen species, one of which also occurs in the Water Supply Area (Table 6.1-2). Given these occurrences, the proposed Project changes may result in loss and alteration of rare plant and lichen habitat.

Table 6.1-2: Rare Plants and Lichens Observed in Proposed Areas

Species and Lifeform	BC CDC Rank	NatureServe S Rank	Individual Count
Water Supply Area			
Lichens			
Bryocaulon hyperboreum[1]	New for BC	Not ranked	1
Phaeophyscia cf. nigricans	Rare new species	Not ranked	2
Umbilicaria sp. nov.	Rare new species	Not ranked	1
Mosses			
Bryum calobryoides	Red	S1S3	1
Plagiobryum demissum	Red	S1S3	1
Psilopilum cavifolium	Red	S1S2	2
Sarmentypnum pseudosarmentosum	New for BC	Not ranked	2
Vascular Plants			
Carex sp. nov.	Rare new species	Not ranked	1
Draba sp. nov.	Rare new species	Not ranked	2
Epilobium hornemannii ssp. behringianum	Unknown	SU	1
Woodsia alpina	Unknown	SU	1
Peripheral Mining Area			
Lichens			
Bryocaulon hyperboreum[1]	New for BC	Not ranked	2
Collema ceraniscum	Blue	S3	1

[1]Species observed in Water Supply Area and Peripheral Mining Area.

6.1.4 Mitigation Measures

Mitigation measures to avoid or minimize Project effects on terrestrial ecology are specified in the Vegetation Management Plan and Invasive Plants Management Plan (required by Conditions 1 and 2 of the Certificate). Mitigation measures outlined in the Vegetation Management Plan include best management practices for vegetation clearing to minimize fragmentation, edge effects, windthrow, and soil disturbance, including in sensitive areas like alpine ecosystems.

Mitigation measures for rare plants and lichens include applying adaptive Project design changes to avoid harm to known rare plant and lichen populations, where feasible, and adhering to best management practices around known locations of rare plants and lichens. Best management practices include creating buffer zones around known rare plant and lichen habitats, wherever feasible, to avoid direct disturbance and to minimize potential effects related to fugitive dust transport, weed invasion, vehicular activities, and accidental spills. Where avoidance is not feasible and development is required within a buffer zone around plant populations, erect temporary fencing or other barriers around the nearby rare plant and lichen populations to avoid further disturbance to the site. Where avoidance is not feasible and removal of rare plants or lichens are necessary for development, the disturbed area will be recorded and reported in the annual report.

Additional mitigation measures to minimize soil loss and degradation are specified in the Surface Erosion Prevention and Sediment Control Management Plan (included as Appendix D to the Environmental Management Plan required under Conditions 1 and 2 of the Certificate). The Invasive Plants

Management Plan (required under Conditions 1 and 2 of the Certificate) specifies measures to minimize the potential introduction and establishment of invasive plant species.

No further mitigation measures are proposed and no changes to any management plans are required.

6.1.5 Assessment of Residual Effects

The following sections re-characterize the Project's residual effects on terrestrial ecology based on the proposed Project changes, and reconsider the significance, likelihood, and confidence for the residual effects.

6.1.5.1 Re-characterization of Residual Effects on Terrestrial Ecology

Section 16.7 of the EAC Application characterizes residual effects of the Project on terrestrial ecology, which are summarized in Table 16.8-1 of the EAC Application.

Following the application of management and mitigation measures, the proposed Project changes are not anticipated to change the characterization of the Project's residual effects on alpine ecosystems as described in the EAC Application.

In the EAC Application, no rare plants or lichens were expected to be removed as a result of the Project since none were present within the Project footprint. However, a number of rare plants and lichens in close proximity to the Project footprint could be altered by dust deposition, fragmentation, changes in hydrological connectivity, or impacts from vehicular or foot traffic. For the proposed Project changes, there is potential for vegetation clearing and development in the Water Supply Area and Peripheral Mining Area to overlap with known rare plant and lichen observations and habitat. Following the application of mitigation measures, specifically best management practices such as avoidance of known rare plant and lichen locations wherever feasible, as described in the Vegetation Management Plan (required under Conditions 1 and 2 of the Certificate), the characterization of the Project's residual effects on rare plant and lichen habitat remains as described in the EAC Application.

6.1.5.2 Significance, Likelihood, and Confidence for Residual Effects on Terrestrial Ecology

Section 16.8 of the EAC Application determined that the Project's residual effects on terrestrial ecology are not significant. This conclusion remains valid for the Project when considering the proposed Project changes, as there are no resulting changes to the characterization of the residual effects of the Project on any of the terrestrial ecology VCs.

The assessment of the likelihood and confidence for these residual effects remains unchanged from the EAC Application (summarized in Table 16.8-1 of the EAC Application).

6.1.6 Assessment of Cumulative Effects

Cumulative effects on terrestrial ecology are assessed in Section 16.10 of the EAC Application. These conclusions remain valid for the Project when considering the proposed Project changes.

6.1.7 Conclusion

The Project's residual and cumulative effects on terrestrial ecology were determined to be not significant in the EAC Application. Consideration of the proposed Project changes does not change this conclusion. Additional mitigation measures are not proposed and changes to management plans are not required.

6.2 Wildlife and Wildlife Habitat

6.2.1 Introduction

The Project's potential effects on wildlife and wildlife habitat VCs are assessed in Section 18 of the EAC Application. The EAC Application assessed the potential of the Project to affect wildlife and wildlife habitat as a result of habitat loss and alteration, sensory disturbance, disruption of movement, direct mortality, indirect mortality, attractants, and chemical hazards. Overall, the EAC Application determined that the Project will result in the following residual effects to the following VCs:

- Moose: disruption of movement, direct mortality and injury, and indirect mortality;
- Mountain goat: sensory disturbance and indirect mortality;
- Grizzly bear: disruption of movement, direction mortality and injury, indirect mortality, and attractants;
- American marten: attractants; and
- Western toad: direct mortality and injury.

No detectable residual effects were anticipated for hoary marmot, bats, raptors, migratory waterbirds, migratory landbirds, and western toad.

The proposed Project changes in the Water Supply Area and Peripheral Mining Area have the potential to result in the following effects on wildlife and wildlife habitat:

- Mountain goat: habitat loss and alteration, sensory disturbance, disruption of movement, and direct mortality;
- Grizzly bear: habitat loss and alteration, sensory disturbance, disruption of movement, and direct mortality; and
- Hoary marmot: habitat loss and alteration, sensory disturbance, disruption of movement, and direct mortality.

The following sections assess the potential effects of the proposed Project changes on wildlife and wildlife habitat.

6.2.2 Assessment Scope

The regulatory and policy framework, baseline characterization, VCs, and assessment boundaries for this assessment are as described in Sections 18.2, 18.3, and 18.4 of the EAC Application. Cumulative baseline study reports for terrestrial ecology are located in Appendix 18-A of the EAC Application.

The potential loss or alteration of wildlife habitat was assessed using a conservative estimate of the surface disturbance anticipated for the Water Supply Area and Peripheral Mining Area. Approximately 6% of the Water Supply Area and 50% of the Peripheral Mining Area is conservatively assumed for the development of the proposed Project changes in these areas. As such, these percentages were used to determine conservative estimates of habitat loss within each proposed area. Although it is possible the amount of ecosystem loss might be more or less, depending on the placement of Project infrastructure, this estimate is considered conservative for the purposes of the effects assessment.

The potential loss or alteration of hoary marmot colonies was assessed using the full extent of the Water Supply Area and Peripheral Mining Area, as the precise location of potential vegetation clearing and ground disturbance in relation to known colony locations within the proposed areas is unknown.

6.2.3 Assessment of Potential Effects

6.2.3.1 Potential Effects on Mountain Goat

In the EAC Application, the loss and alteration of high-quality summer and winter habitat associated with the Project was estimated at 138 ha. During the winter, mean mountain goat home range size is approximately 140 ha for females and 271 ha for males (Taylor, Wall, and Kulis 2006), but can be as small as 20 ha (Fox, Smith, and Schoen 1989). Therefore, the loss of habitat from the Project (138 ha) could be equivalent to a maximum of 6.9 home ranges, or as little as half of a home range (average 3.7 home ranges). For summer habitat specifically, the loss and alteration associated with the Project was estimated at 113 ha. Based on summer baseline surveys in 2010 and 2012 (Appendix 18-A in the EAC Application), the average mountain goat density was 0.26 goats per km^2 (0.0026 goats per ha). Therefore, the loss of 113 ha of summer habitat would affect 0.3 of a home range.

With the proposed Project changes, the loss and alteration of high-quality summer and winter habitat increases by approximately 36 ha (conservative estimate of habitat loss in the Water Supply Area and Peripheral Mining Area combined), making the total estimated habitat loss 174 ha. Based on the aforementioned home range sizes, this combined estimated habitat loss could be equivalent to a maximum of 8.7 home ranges, or as little as 0.6 home ranges. For summer habitat specifically, approximately 30 ha was conservatively estimated in the Water Supply Area and Peripheral Mining Area, making the total estimated habitat loss 143 ha. Based on the average mountain goat density in the RSA, this equates to 0.4 of a home range affected by habitat loss due to the combined loss from the Project and proposed Project changes.

6.2.3.2 Potential Effects on Grizzly Bear

In the EAC Application, the loss and alteration of high-quality habitat (across all four seasons) associated with the Project was estimated at 143 ha. This loss is equivalent to approximately 11% of the mean estimated home range for a single female grizzly bear and 2% of the mean estimated home range for a single male grizzly bear based on conservative movement detections estimated during the 2011 and 2012 baseline studies (Appendix 18-A in the EAC Application). In a regional comparison, the loss of 143 ha is equivalent to 3% of a female coastal grizzly bear home range and 1% of a female interior grizzly bear home range, 1% of a male coastal grizzly bear home range, and less than 1% of a male interior grizzly bear home range (MacHutchon, Himmer, and Bryden 1993; Ciarniello 2006). Based on the grizzly bear individuals identified in the RSA (37 bears), an average of 3.9 ha of high-quality habitat per bear may be altered.

With the proposed Project changes, the loss and alteration of high-quality habitat increases by 6 ha (conservative estimate of spring habitat loss in the Water Supply Area and Peripheral Mining Area combined), making the total estimated habitat loss 149 ha. This incremental loss of habitat represents a small percentage of habitat in the LSA (0.15%) and RSA (0.11%; Table 5.4-2). Based on the grizzly bear individuals identified in the RSA (37 bears), this equates to habitat loss of an average of 4 ha of high-quality habitat per bear due to the combined loss from the Project and proposed Project changes.

6.2.3.3 Potential Effects on Hoary Marmot

In the EAC Application, minimal high-quality habitat intersected with the Project assessment footprint (16 ha, 2% of the LSA) and one colony, north of the mine site and within the mine site assessment area, was identified as potentially lost or altered. However, since the colony and associated habitat was not within the infrastructure footprint and not expected to be cleared due to development of Project infrastructure, no colony loss or alteration, or direct mortality due to burrow destruction, was expected to occur.

In the Water Supply Area and Peripheral Mining Area, additional high-quality habitat is expected to be lost or altered. Furthermore, there are three known colonies in the Water Supply Area and 15 known colonies in the Peripheral Mining Area, which were identified during 2012 baseline surveys (Appendix 18-A in the EAC Application) and additional aerial surveys conducted in August 2022. With the proposed Project changes, the loss and alteration of high-quality habitat increases by approximately 16 ha (conservative estimate of habitat loss in the Water Supply Area and Peripheral Mining Area combined), for a total estimated habitat loss of 32 ha.

The potential effects of sensory disturbance, disruption of movement, and direct mortality due to vehicle collisions were not previously assessed for hoary marmot in the EAC Application. Sensory disturbance was not anticipated due to the tendency of hoary marmot to habituate to human presence, with little or no effect on their reproductive and survival rates (Griffin 2007). In addition, potential effects due to sensory disturbance to marmots appears to lessen with repeated exposure, suggesting that marmots habituate to human disturbances (Li et al. 2011). Disruption of movement and direct mortality due to vehicle collisions were not anticipated because hoary marmot have small home ranges (approximately 13.5 ha; Holmes 1984) and forage within a few hundred metres of a burrow entrance (Banfield 1981), making it unlikely for the Project infrastructure and activities assessed in the EAC Application to disrupt movement or contribute to direct mortality due to vehicle collisions.

Due to the increased potential for interaction in the Water Supply Area and Peripheral Mining Area, the proposed Project changes might result in potential effects of direct mortality due to vehicle collisions. However, potential effects of sensory disturbance and disruption of movement are not anticipated as a result of the proposed Project changes due to the habitual tendency and small home ranges of hoary marmot.

6.2.4 Mitigation Measures

Mitigation measures to avoid or minimize Project effects on wildlife and wildlife habitat are specified in the Wildlife Management Plan. The plan focuses on reducing the risk of direct and indirect wildlife mortality, mitigating the potential for human-wildlife conflicts, and minimizing the level of disturbance to wildlife and wildlife habitat as a result of Project activities or infrastructure. Measures to minimize disturbance include avoiding sensitive timing windows whenever possible, conducting pre-clearing surveys, and/or reducing or limiting on-site activities to include only essential activities.

In accordance with the Wildlife Management Plan, Project vegetation clearing activities that may disturb wildlife will be avoided during sensitive periods wherever feasible. For mountain goats, clearing activities during the kidding period (May 1 to July 15) will be avoided within 500 m of high-quality summer habitat. If activities are not avoidable, pre-clearing surveys will be conducted and work will be paused if goats with kids are observed within 500 m of activities. For grizzly bear, clearing activities between April 30 to October 31 will be avoided in high-quality habitat if bears are observed in the area and do not move away. If necessary, the Project's Environmental Manager may trigger a work pause to prevent disturbance to nearby bears. Management protocols for Project roads, including access roads at the mine site, are provided to minimize direct mortality as a result of wildlife-vehicle interactions, and disruption of movement or mortality as a result of attraction to the road or wildlife use of the road.

Additional mitigation measures to minimize loss of high-quality habitat as a result of soil and vegetation loss or degradation are specified in the Surface Erosion Prevention and Sediment Control Management Plan and Vegetation Management Plan (included as Appendix D to the Environmental Management Plan required under Conditions 1 and 2 of the Certificate).

New mitigation and changes to the Wildlife Management Plan (required by Conditions 1, 2 and 14 of the Certificate) will be implemented as a result of proposed Project changes intruding into areas where known hoary marmot colonies were detected during the 2012 baseline surveys (Appendix 18-A in the EAC

Application) and 2022 aerial surveys. Pre-clearing surveys for hoary marmot colonies will be conducted in suitable habitat prior to construction activities, and mitigation will be implemented if marmot burrows are observed. If construction activities are scheduled during the winter when marmots are hibernating, pre-clearing surveys will be conducted during the previous fall. Avoidance of colonies, where feasible, is the primary mitigation to minimize effects of habitat loss and alteration and direct mortality due to burrow destruction. Where avoidance is not feasible, Pretium will work with Indigenous groups to either harvest or move individuals to habitat outside the area of vegetation clearing (e.g., newly created habitat, naturally occurring similar high-quality habitat). If hoary marmot removal is deemed necessary, the BC Ministry of Forests (or the appropriate governing agency) will be contacted and the appropriate permits will be obtained.

6.2.5 Assessment of Residual Effects

The following sections re-characterize the Project's residual effects on wildlife and wildlife habitat based on the proposed Project changes, and reconsider the significance, likelihood, and confidence for the residual effects.

6.2.5.1 Re-characterization of Residual Effects on Wildlife and Wildlife Habitat

Section 18.7 of the EAC Application characterizes residual effects of the Project on wildlife and wildlife habitat, which are summarized in Table 18.8-1 of the EAC Application.

Following the application of management and mitigation measures, the proposed Project changes are not anticipated to change the characterization of the Project's residual effects on mountain goat and grizzly bear as described in the EAC Application.

As per the EAC Application, no residual effects of habitat loss or alteration were expected for mountain goat and grizzly bear. Given the small percentage of incremental habitat loss predicted for these VCs, residual effects of habitat loss for mountain goat and grizzly bear are not expected as a result of the proposed Project changes either. Given the minimal additional encroachment into high-quality habitat, the proposed Project changes are also not anticipated to change the characterization of the Project's residual effects on sensory disturbance for mountain goat, and disruption of movement and direct mortality for grizzly bear, as described in the EAC Application. Project residual effects were not anticipated for disruption of movement and direct mortality for mountain goat, and sensory disturbance for grizzly bear.

In the EAC Application, no residual effects on hoary marmot were expected as a result of the Project since minimal high-quality habitat and no known colonies intersected with the infrastructure footprint expected to be cleared. Due to the proposed Project changes intruding into areas where known hoary marmot colonies are located, residual effects are expected with respect to loss and alteration of habitat and direct mortality due to vehicle collisions and burrow destruction.

The residual effects of habitat loss and alteration and direct mortality are predicted to be **low** in magnitude and **local** in geographic extent, as the effects are restricted to the proposed area of development and not predicted to affect the viability of the local hoary marmot population. For habitat loss and alteration, frequency of the effect will occur **once**, and for direct mortality, the frequency will be **sporadic** as direct mortality due to vehicle collisions could occur occasionally during any phase of the Project. Duration of the effects is expected to be **long-term** (lasting for the life of the Project, or between 26 and 50 years), but is reversible in the **long-term** once burrow habitat can be reclaimed during closure of the mine. Resiliency is **high** due to the habitual tendency of marmots to human disturbances (Li et al. 2011), and accordingly, ecological context is **low** as hoary marmot can respond and adapt to nearby Project activities. These characterizations are summarized in Table 6.2-1 in the following section.

6.2.5.2 Significance, Likelihood, and Confidence for Residual Effects on Wildlife and Wildlife Habitat

Section 18.8 of the EAC Application determined that the Project's residual effects on wildlife and wildlife habitat are not significant. This conclusion remains valid for the Project when considering the proposed Project changes and characterizations of residual effects for the wildlife and wildlife habitat VCs. The assessment of the likelihood and confidence for these residual effects remains unchanged from the EAC Application for mountain goat and grizzly bear (summarized in Table 18.8-1 of the EAC Application).

For hoary marmot, the residual effects on habitat loss and alteration and direct mortality are predicted to be **not significant** (Table 6.2-1). The likelihood of residual effects is estimated to be **medium** because although effects are likely, they may not occur given the uncertainty of the footprint location.
The confidence in the overall residual effects is **medium**. While there is a high level of confidence in the location of high-quality habitat and colonies, there is uncertainty with respect to where and to what degree loss or alteration may occur given the lack of information on Project design and footprint extent.

Table 6.2-1: Characterization of Residual Effects on Hoary Marmot

	Evaluation Criteria									
Residual Effect	Magnitude	Duration	Frequency	Geographic Extent	Reversibility	Resiliency	Ecological Context	Likelihood	Significance	Confidence
Habitat loss and alteration	L	LT	O	L	RL	H	L	M	NS	M
Direct mortality	L	LT	S	L	RL	H	L	M	NS	M

Notes:
Magnitude: L=low; M=moderate; H=high
Duration: ST=short-term; MT=medium-term; LT=long-term; FF=far future
Frequency: O=once; S=sporadic; R=regular; C=continuous
Geographic extent: L=local; La=landscape; R=regional; BR=beyond regional
Reversibility: RS=reversible short-term; RM=reversible medium-term; RL=reversible long-term; IR=irreversible
Resiliency: L=low; N=neutral; H=high
Ecological context: L=low; N=neutral; H=high
Likelihood: L=low; M=medium; H=high
Significance: S=significant; NS=not significant
Confidence: L=low; M=medium; H=high

6.2.6 Assessment of Cumulative Effects

Cumulative effects on wildlife and wildlife habitat are assessed in Section 18.10 of the EAC Application. These conclusions remain valid for the Project when considering the proposed Project changes.

6.2.7 Conclusion

The Project's residual and cumulative effects on wildlife and wildlife habitat were determined to be not significant in the EAC Application. Consideration of the proposed Project changes does not change this conclusion. Additional mitigation measures are proposed for hoary marmot and changes to the Wildlife Management Plan are recommended.

7. INDIGENOUS INTERESTS

The Tsetsaut/Skii km Lax Ha asserted traditional territory extends from the north side of Cranberry River in the south, to Ningunsaw Pass in the north. To the west, it is bounded by the Unuk River, while the Groundhog Range lies on its eastern boundary. The proposed Project changes are within the traditional territory of the Tsetsaut/Skii km Lax Ha.

The Nass Area, as defined in the Nisga'a Final Agreement, follows the Bowser River drainage. The Nass Area does not overlap with the proposed Project changes.

The Tahltan Nation traditional territory covers an area of approximately 93,500 km^2 that stretches from the BC-Alaska border in the west to the Stikine Plateau in the east, and from the BC-Yukon border in the north to the Unuk River and Treaty Creek areas in the south. A portion of the Tahltan Nation traditional territory south of Treaty Creek along the Bell-Irving River overlaps a portion of the Brucejack Access Road near the Bell-Irving River. The Tahltan Nation traditional territory does not overlap the proposed Project changes.

Potential effects of the Project on Indigenous peoples' current use of lands and resources for traditional purposes is assessed in Section 25 of the EAC Application. As described in Section 25.4.3.1 of the EAC Application, key effects of the Project on Indigenous peoples' current use include change in access to lands and resources, change in experience of the natural environment, change in the abundance and distribution of resources, and change in the quality of resources.

The proposed Project changes will not interact with Indigenous peoples' access to lands and resources. Changes in noise are anticipated to be negligible and no changes to visual quality are expected; consequently, the proposed Project changes are not anticipated to alter the Project's potential effects on Indigenous peoples' quality of experience of the natural environment. The proposed Project changes are not expected to modify the Project's anticipated effects on wildlife, vegetation, and fish or fish habitat.

Consequently, the proposed Project changes are not anticipated to alter the Project's potential effects on abundance and distribution of resources. The proposed Project changes are not anticipated to alter the Project's effects on the quality of resources, as no changes to effects on country foods are anticipated.

Potential effects of the Project on Indigenous rights and interests are assessed in Section 26 of the EAC Application. The proposed Project changes are not anticipated to modify the Project's anticipated effects on Indigenous peoples' rights to fish, hunt, trap, or gather. The proposed Project changes are not anticipated to alter the Project's interaction with Indigenous peoples' employment and economic opportunities, education, skills, and training, or concern over economic losses from a change in use of lands and resources.

8. SUMMARY

Potential interactions between the proposed Project changes and the VCs with potential for adverse effects beyond what was considered in the EAC Application were identified for the terrestrial environment, specifically for the following receptor VCs:

- **Terrestrial ecology:** alpine ecosystems and rare plants and lichens and their habitats; and
- **Wildlife and wildlife habitat:** mountain goat, grizzly bear, and hoary marmot.

No potential interactions were identified between the proposed Project changes and the remaining intermediate component or receptor VCs.

The matters listed in section 25 of the *Environmental Assessment Act* were also considered in light of the proposed Project changes; no potential interactions beyond what was assessed in the EAC Application were identified.

The potential effects of the proposed Project changes on the identified VCs were assessed following the same methodology used in the EAC Application. New residual effects were identified relating to the proposed Project changes for hoary marmot. The assessment did not result in a change to the characterization of residual effects for any other VCs compared to the EAC Application. The proposed Project changes are not expected to change the significance of the Project's residual or cumulative effects on any VC as evaluated in the EAC Application.

New mitigation measures have been identified to address the potential effects on hoary marmot and changes to the Wildlife Management Plan (as required by Conditions 1 and 2 of the Certificate) will be implemented. The remaining mitigation measures identified in this Amendment Application (i.e., implementation of a specific management plan) are consistent with those in the EAC Application, the conditions of the Certificate (Schedule B), and the mitigation measures described in the Brucejack Access Road Impact Assessment Report (Pretium 2015).

Based on the above, Pretium proposes the following amendment to the Certificate:

- Changes to Figures 1-1, 1-2a and 1-2b in Schedule A of the CPD to accommodate the EAC Boundary extension (as shown on Figure 1-1 and as described in Section 2).

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APPENDIX A TERRESTRIAL ECOSYSTEM MAPPING

Appendix A: Terrestrial Ecosystem Mapping

Terrestrial Ecosystem Mapping (TEM) was prepared for the Project as part of the EAC Application. Methods, including field work, are provided in Appendix 16-A of the EAC Application (2012-13 Terrestrial Ecosystem Baseline Studies). Field surveys to verify the TEM for the Project were completed in August 2022. One polygon around the Brucejack Creek area was updated due to transition in the vegetation since it was last classified in 2012. There were no changes to the ecosystem types in the polygon, but the deciles (percentage of each ecosystem type) were adjusted.

The following provides a detailed description of the Biogeoclimatic Ecosystem Classification (BEC) units within the Water Supply Area and Peripheral Mining Area as well as a summary of surficial terrain and ecosystems within the area surrounding the mine site. Figure A-1 displays the BEC and TEM for the Water Supply Area and Peripheral Mining Area, as well as the surrounding landscape. Tables A-1 and A-2 define the TEM map codes and structural stages used in Figure A-1.

Table A-1: Terrestrial Ecosystems Mapped within the Water Supply Area and Peripheral Mining Area

BEC Unit	Ecosystem Name	Map Code	General Ecosystem Type
CMAun	Glacier	GL	Non-vegetated
CMAun	Rock Outcrop	RO	Sparsely Vegetated
CMAun	Talus	TA	Sparsely Vegetated
CMAun	Fescue Lichen	FC	Drier Herb
CMAun	Mountain-heather – Partridgefoot	MP	Mesic Shrub/Herb
CMAun	Moraine	MN	Sparsely Vegetated
CMAun	Herb Meadow	AM	Mesic Herb
CMAun	Cliff	CL	Sparsely Vegetated
CMAun	Lake	LA	Non-vegetated
CMAun	Cryptogam – Altai Fescue	CG	Drier Herb
CMAun	Permanent Snow/Ice	PN	Non-vegetated
CMAun	Exposed Soil	ES	Sparsely Vegetated
CMAun	N/A (mine infrastructure)	MZ	N/A (mine infrastructure)
CMAun	Pond	PD	Non-vegetated
CMAun	Herb Wetland (undescribed)	WH	Wetland Shrub/Herb
CMAun	River	RI	Non-vegetated
MHmm2	Moraine	MN	Sparsely Vegetated
MHmm2	HmBa – Blueberry	MB	Mesic Forest
MHmm2	Glacier	GL	Non-vegetated
MHmm2	Krummholz	KH	Parkland Forest/Krummholz
MHmm2	Talus	TA	Sparsely Vegetated

BEC Unit	Ecosystem Name	Map Code	General Ecosystem Type
MHmm2	Rock Outcrop	RO	Sparsely Vegetated
MHmm2	Deciduous Shrub	51	Wetter Shrub/Herb
MHmm2	BaHm – Oak Fern	MO	Mesic Forest
MHmm2	Cliff	CL	Sparsely Vegetated
MHmm2	Parkland Forest	PK	Parkland Forest/Krummholz
MHmm2	BaHm – Twistedstalk	MT	Moist Forest
MHmm2	Herb Meadow	AM	Mesic Herb
MHmmp	Krummholz	KH	Parkland Forest/Krummholz
MHmmp	Moraine	MN	Sparsely Vegetated
MHmmp	Talus	TA	Sparsely Vegetated
MHmmp	Glacier	GL	Non-vegetated
MHmmp	Rock Outcrop	RO	Sparsely Vegetated
MHmmp	Herb Meadow	AM	Mesic Herb
MHmmp	Fescue Lichen	FC	Drier Herb
MHmmp	Mountain-heather - Partridgefoot	MP	Mesic Shrub/Herb
MHmmp	Parkland Forest	PK	Parkland Forest/Krummholz
MHmmp	Deciduous Shrub	51	Wetter Shrub/Herb

Table A-2: Vegetation Structural Stages for Terrestrial Ecosystems Mapping

Structural Stage Code	Structural Stage
1	Sparse/Bryoid
2	Herb/Dwarf shrub
3	Shrub (Herb)
4	Pole/Sapling
5	Young Forest
6	Mature Forest
7	Old Forest
N/A	Non-vegetated (water/snow/anthropogenic)

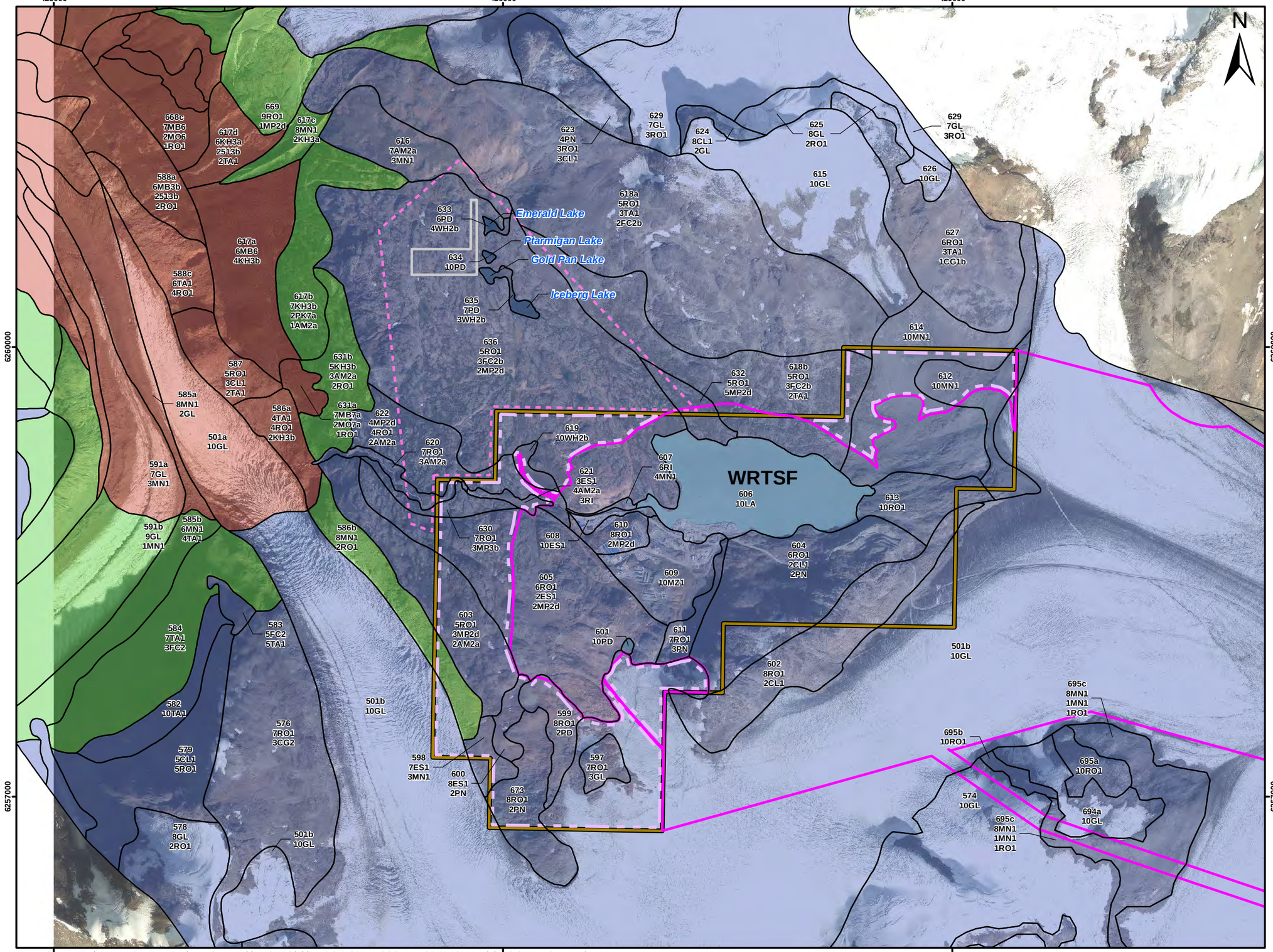

Image Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

Proposed Additions to EAC CPD Boundary in Amendment #9

- Peripheral Mining Area
- Water Supply Area
- Current EAC #15-01 CPD

Mining Leases

- Mining Lease
- Mining Lease - Owned by Others

Miscellaneous

- **WRTSF** Waste Rock and Tailings Storage Facility

BEC Zones

- CMAun
- MHmm2
- MHmmp

Terrestrial Ecosystem Mapping

- TEM Boundary

TEM Label

618b — TEM ID number
5RO1
3FC2b — Ecosystem Label for Deciles 1, 2 and 3
2TA1
Decile
Mapcode
Structural Stage
Structural Stage Modifier

1:25,000
0 500 1,000
Metres
Coordinate System: NAD 1983 UTM Zone 9N

NEWCREST
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Map ID: BJVEG20220826130
Imagery: 2019 ESRI Imagery
Date: August 31, 2022

Figure A-1. EAC #M15-01 Existing and Proposed Amendment #9 CPD Boundaries with TEM

Description of BEC in the Water Supply Area and Peripheral Mining Area

The majority of the Water Supply Area and Peripheral Mining Area consists of one BEC unit; Coastal Mountain-heather Alpine - Undifferentiated (CMAun). The CMAun zone (Photo A-1) occurs at high elevations throughout the coastal mountains of BC. This zone is a relatively moist environment, tends to have a deeper snowpack, and begins at lower elevations than other alpine zones (BC MOFR 2006). Much of the land area is dominated by glaciers, permanent snow/ice, or recently exposed rock (BC MOFR 2006). Non- and sparsely vegetated ecosystems include rock outcrops, talus, and moraine. Patches of snow, névé, and firn persist late into the year. Vegetation cover increases to the west towards the Sulphurets Valley. In this zone, vegetation classes of the Alpine Group (MacKenzie 2012) are present as a mosaic across the landscape, the distribution of which is determined by soil depth, drainage, and microclimate.

Photo A-1: Example of the ecosystems and sparsely vegetated landscape within the CMAun Zone.

A small portion of the western edge of the Peripheral Mining Area contains Mountain Hemlock, Moist Maritime Parkland (MHmmp). The MHmmp zone (Photo A-2) occurs at high elevations on the coastal mountains. This parkland region is the transitional zone in between forested subzones at lower elevations and the true alpine zone (CMAun) at higher elevations. This zone is one of Canada's wettest ecological zones, with a deep snow cover and relatively short growing season (BC MOFR 1997). The MHmmp vegetation consists of mountain heathers (Cassiope spp.) and tree species such as mountain hemlock (*Tsuga mertensiana*), yellow-cedar (*Chamaecyparis nootkatensis*), and subalpine fir (*Abies lasiocarpa*), which are primarily in krummholz form and occur in irregular patches at the treeline (BC MOFR 1997).

Photo A-2. Example of the ecosystems and krummholz growth at treeline within the MHmmp Zone.

Description of Ecosystems in the Water Supply Area and Peripheral Mining Area

Most of the ecosystems surrounding the mine site are early seral, edaphic climax, or disclimax ecosystems. Early seral ecosystems are those early in the successional status chrono-sequence and include non- and sparsely vegetated, pioneer seral, and young seral communities. Edaphic ecosystems include those maintained by local climatic and soil conditions that enable an ecosystem to perpetuate itself. For example, ecosystems affected by saturated soils will develop specific plant assemblages that will be maintained as long as the soil conditions remain. Such is the case with late snowbed ecosystems, which are maintained by the persistence of snowpack late into the growing season. Disclimax ecosystems include those maintained by repeated disturbance events, such as snow avalanches.

Vegetation community development in the surrounding mine site area is influenced by the recent deposition of the soil parent material, excessive snow pack, wind, and cold temperatures. Vegetation classes mapped in the areas surrounding the mine site occur largely within the Alpine Group, including Alpine Tundra, Fellfield, Heath, and Meadow classes (MacKenzie 2012). Alpine Tundra vegetation communities are dominated by hardy ericaceous shrubs that can withstand the desiccating winds common in alpine environments. Alpine Fellfield are exposed ecosystems where the effects of frost and wind give rise to a characteristic low plant cover. Soils are either absent or exist as thin veneers, often derived from in-situ bedrock weathering, remnant glacial till, and colluvium. Thin annual snowpack leads to active freeze–thaw cycles that push plants out of the soil. Since soils are typically very high in coarse fragments, vegetation cover is thin and growth is poor. Alpine Heath ecosystems are mountain-heather–dominated snowbeds that are widespread and common in snow-accumulating sites and upon stable substrates. Mountain-heather species are always prominent and site moisture is typically mesic and drier. Alpine Meadow ecosystems are forb-dominated (or large sedge–dominated) ecosystems. These ecosystems develop in areas of deeper continuous winter snowpack over deep or fine-textured and well-developed soils. Sites with seepage or unstable soils favour the Alpine Meadow Class over Alpine Heath ecosystems.

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APPENDIX 6.1-1. RECLAMATION PROGRAM UPDATE

3 RECLAMATION PROGRAM UPDATE

3.1 INTRODUCTION

This chapter is the updated Reclamation Program for the Brucejack Gold Mine, originally presented as the Brucejack Reclamation and Closure Plan in the 2015 Brucejack Gold Mine Project Application for *Mines Act* and *Environmental Management Act* Permits (*MA & EMA* Permits) (Pretivm 2015). It incorporates reclamation program information included in Annual Reports for *Mines Act* Permit M-243 and *Environmental Management Act* Effluent Permit 107835 (PE-107835) and Air Permit 107025 (PA-107025) (Pretivm 2016, 2017, 2018a, 2019, and 2020a). Chapter content includes end land use and capability objectives; reclamation approaches, prescriptions and research; a five-year reclamation plan; and the conceptual final reclamation plan.

Brucejack Mine reclamation and closure planning has been integrated with mine planning and design since pre-construction environmental assessment and related pre-construction design work began in 2012 and 2013. The mine and its operations have been planned and designed to minimize the terrestrial development footprint and to prevent significant adverse effects on the downstream aquatic receiving environment, including both water quality and aquatic biota.

Based on the current mine plan (refer to Chapter 2), the remaining mine life is approximately 12 years, with operations ceasing at the end of 2032. This will be followed by a closure phase estimated at three years, that includes two years of closure and reclamation within the M-243 area and a third year of reclaiming off-site mine related infrastructure (i.e. the BJAR and adjacent infrastructure below Knipple Glacier, extending to the Highway 37 intersection, and the Licence of Occupation (LOO) authorized portion of the transmission line. A monitoring period of five years is planned for the M-243 area at the beginning of the post-closure phase.

This updated Reclamation Program addresses mine infrastructure components and site disturbance authorized under Permit M-243, including mine development within the mining leases (i.e. mine site area) (Figure 3.1-1) and the portion of the mine's transmission line extending south from the mining leases to Pretivm's Mineral Claim #1026976 (Figure 3.1-2). Permit M-243 authorizes the northernmost 19.5 km of the transmission line, whereas the 37.5 km segment south of that is authorized under *Land Act* LOO #6408729.

Brucejack Mine surface disturbance areas are limited in extent due primarily to it being an underground mine. The M-243 approved surface disturbance area is 465.1 ha (Figure 3.1-1 and Figure 3.1-2), including the waste rock and tailings storage facility (WRTSF) (76.59 ha), the km 72 non-potentially acid generating (NPAG) quarry (14.35 ha) and a 100 m wide corridor along the northernmost 19.5 km of the transmission line. Actual disturbance at end of 2019 was calculated at 150.94 ha within the mining leases (Figure 3.1-3), with an additional 65.77 ha along the transmission line. The terrestrial disturbance area total for the mine site is 60.79 ha, which includes mine site infrastructure and related disturbance areas. The transmission line calculated surface disturbance is primarily within the 6.7 km southernmost segment that is below treeline. Most of the northernmost 12.8 km of the transmission line is comprised of clear spans over bedrock and ice; towers in this section are anchored in bedrock.

Figure 3.1-1 ***Mines Act*** **Permit M-243 Disturbance Boundary within Mining Leases**

PRETIVM

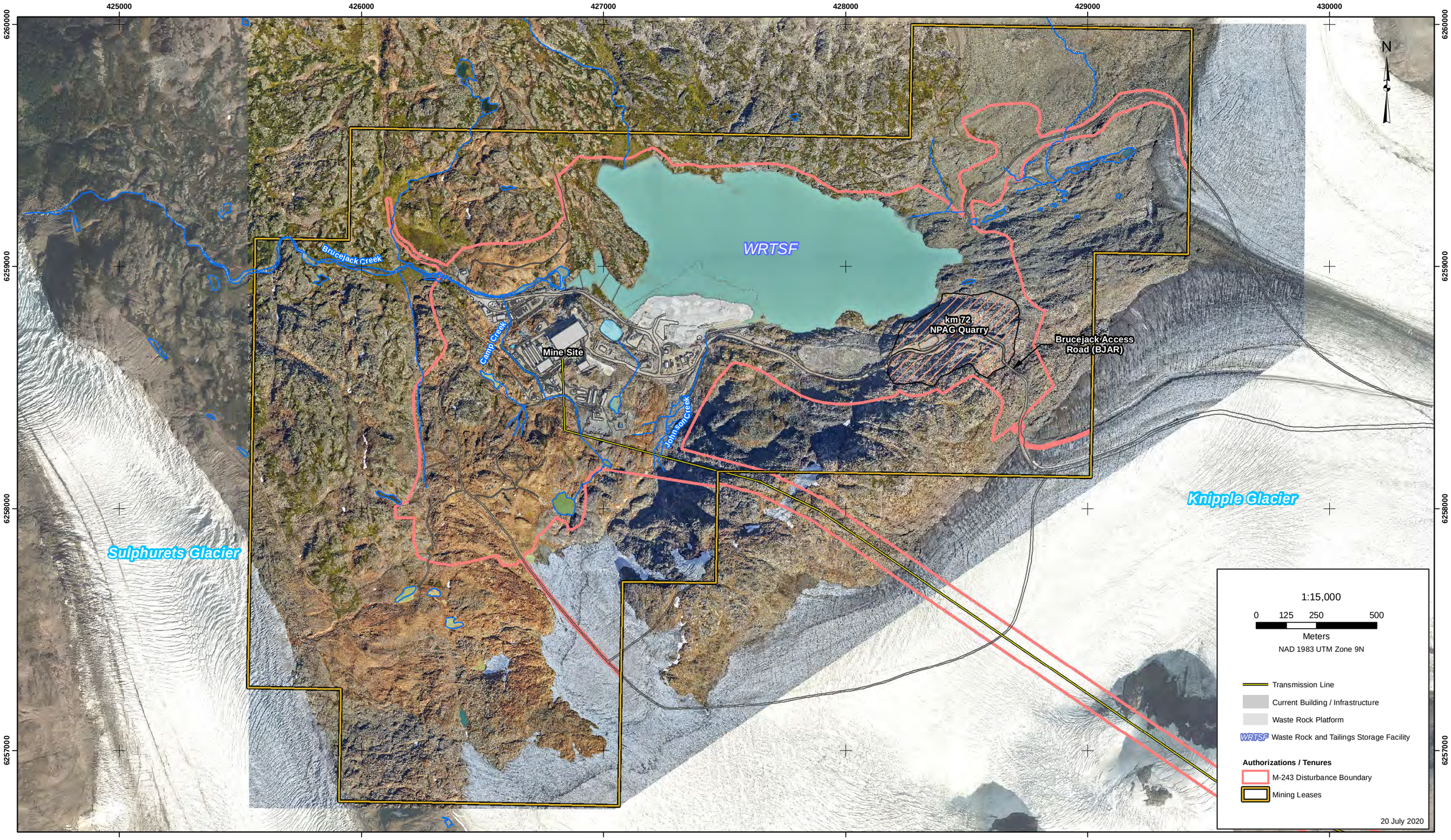

Figure 3.1-2 ***Mines Act*** **Permit M-243 Disturbance Boundary**

PRETIVM

Figure 3.1-3. Mine Site Area Surface Plan End of 2020

PRETIVM

426000 427000 428000 429000

6259000

6258000

N

Brucejack Creek

Weir and Water Reclaim

WZ Portal

Camp Creek

Mill & WTP

CWP

Tailings

WRTSF

WRD

Brucejack Access Road (BJAR)

Phase 2 Camp

VOK Portal

Phase 1 Camp

Johnson Creek

R

Authorizations / Tenures

- M-243 Disturbance Boundary
- Mining Lease

2020 Extents

- Transmission Line
- R Air Raise
- Current Building / Infrastructure

- Contact Water Collection Ditch
- Contact Water Collection Pipeline
- Fresh Water Intake to Mill
- Intermittent Contact Water Pipeline
- Non-Contact Water Diversion
- Spillway

- CWP Direct Discharge Line
- WTP/STP Effluent Line
- Tailings Discharge Lines
- Tailings Support Cables
- NPAG Quarry
- Snow Dump
- Tailings (2020)
- Waste Rock Dump (WRD) (2020)

- WRTSF Waste Rock and Tailings Storage Facility
- CWP Contact Water Pond
- WTP Water Treatment Plant
- WZ West Zone

NAD 1983 UTM Zone 9N

1:10,000

0 50 100 200 300 400 500

Meters

Background Image: Lidar 2019

426000 427000 428000 429000

20 July 2020

Tree and shrub clearing of the transmission line right-of-way during construction was necessary over only the southernmost 6.7 km tree and shrub covered portion, and occurred to an average width of approximately 60 m. Access was almost entirely by helicopter, and trees were hand-felled and left in place with no disturbance of surficial soils and limited disturbance of existing vegetation over most of the cleared area. The tree felling approach was planned and approved, in part as an environmental protection/mitigation measure to limit ground-based access along the cleared right-of-way (ROW). Disturbance of surficial materials was limited, being primarily confined to tower bases. The tower sites were seeded with Pretivm's high elevation native species seed mix following completion of construction at each site. Post-construction, vegetation along the transmission line has continued to grow, undisturbed. Some mechanical vegetation control will be necessary in future if/when woody vegetation cover reaches heights that pose a safety and operational risk for the line.

3.2 END LAND USE AND CAPABILITY OBJECTIVES

3.2.1 Background

End land use and capability objectives for Brucejack Mine components have been integrated with mine planning and design to promote successful reclamation and closure. Pre-development land use and conditions generally form the basis for identifying the end land use and capability objectives. The requirement to consider end land use for the mine site area is stated in Section 10.7.4 (Land Use) of the Health, Safety and Reclamation Code for Mines in British Columbia (Code) (MEMPR 2017): "The land surface shall be reclaimed to an end land use approved by the chief inspector that considers previous and potential uses." The requirement to achieve an appropriate post-mine land capability is stated in Code Section 10.7.5 (Capability): "Excluding lands that are not to be reclaimed, the average land capability to be achieved on the remaining lands shall not be less than the average that existed prior to mining, unless the land capability is not consistent with the approved end land use or compromises long-term physical and/or geochemical stability."

These Code requirements are reflected in *Mines Act* Permit M-243. Condition E.3 requires Pretivm to "reclaim the land with the intention of re-establishing average pre-mining capability to the following end land use objective: wildlife habitat, particularly matrix habitat for mountain goat, grizzly bear and hoary marmot on the mine site and high elevation sections of the transmission line, and moose and grizzly bear habitat at lower elevations of the transmission line. Achieving land capability objectives and habitat enhancement shall guide the reclamation program." Part E of Permit M-243 contains additional reclamation related requirements.

This updated Reclamation Program provides the plan of how end land use and land capability objectives will be achieved to the extent feasible, or site conditions created that will allow these to be achieved, by the end of the Brucejack Mine's closure period.

3.2.2 Mine Site Area

The Brucejack mine site area encompasses all existing and proposed infrastructure west of the upper Knipple Glacier, including the mine site, WRTSF, Brucejack access road (BJAR) km 71.6 (ice interface

location) to km 73.3, and the km 72 NPAG quarry (Figure 3.1-3). The mine site area is situated in rugged mountainous terrain at approximately 1,400 masl. Surrounding peaks reach elevations exceeding 2,300 masl. Glaciers and ice fields surround the mine site area to the west, south and east. Recent and rapid deglaciation has resulted in over-steepened and unstable slopes in many locations. Recently deglaciated areas typically have limited, if any, soil development; where present, soils are derived from glacial till and colluvium.

The mine site (core mine infrastructure located along the southwest shore of the WRTSF, including the underground mine, mill and camp) is located primarily on bedrock outcropping with some slightly weathered parent materials occurring as pockets with alpine vegetation (Figure 3.2-1).

Prior to mine construction, the Brucejack mine site area was characterized as dominantly exposed bedrock, with approximately 80% of the mine site described as non-vegetated or sparsely vegetated (Figure 3.2-2) (ERM Rescan 2014a). The mine site area is located above the tree line in the Coastal Mountain-heather Alpine (undifferentiated; CMAun) Biogeoclimatic Ecosystem Classification (BEC) zone. This zone has the harshest climate of any biogeoclimatic zone in BC. Temperatures are low for most of the year, with much wind and snow. Temperatures remain low even during the growing season, which has an exceptionally short frost-free period. Mean annual temperatures range from 0°C to 4°C. Patches of snow, névé, and firn persist late into the year.

Figure 3.2-1. Brucejack Advanced Exploration 2013, Showing Mine Site Bedrock Outcrops and Pockets of Weathered Parent Materials.

Figure 3.2-2. Brucejack Mine Site 2012, Showing Bedrock Exposures and Limited Vegetation Extent.

Vegetation community development within the mine site area was limited by the poor quality and limited availability of growth media, high snow pack, high winds and low temperatures. Vegetation classes of the Alpine Group (MacKenzie 2012) were present as a mosaic across the landscape, the distribution of which was determined by growth media depth, drainage and microclimate. The vegetation includes small shrubs, lichen and mosses. Most of the ecosystems within the mine site area are early seral, disclimax, or edaphic climax ecosystems. Early seral ecosystems, such as the areas mapped as alder thicket, are those early in the successional status chrono-sequence. These include non- and sparsely vegetated, pioneer seral and young seral communities. Edaphic ecosystems include those maintained by local climatic and soil conditions that enable an ecosystem to perpetuate itself.

The small areas of vegetation that were present (and which remain in some locations) include small shrubs, lichens and mosses. Alpine Tundra Class vegetation communities are dominated by hardy ericaceous shrubs that can withstand the desiccating winds common in alpine environments. Alpine vegetation classes include Alpine Fellfield, Heath, and Meadow classes. Detailed vegetation and terrain mapping and descriptions of the mine site area are provided in Appendix 5 of the 2012-2013 Terrestrial Ecosystem Baseline Studies (ERM Rescan 2014a).

As described in Section 3.2.1, pre-mine habitat assessments of the mine site classified the habitat as matrix habitat for wildlife species resident in the general vicinity: hoary marmot, grizzly bear, and, to

a more limited extent, mountain goat (ERM Rescan 2013b). One hoary marmot colony is known to be present north of the mine site, across Brucejack Creek. Hoary marmots have also been observed on the slopes north and northwest of the mill. Beginning during Pretivm's advanced exploration activities in 2011, grizzly and/or black bears have been occasionally observed passing through the area north of Brucejack Creek and the (now) WRTSF, or south and high above the mine site along the winter access that traverses the upper VOK area.

An additional consideration pertinent to end land use is that growth media (unconsolidated overburden and soils) at the mine site have naturally elevated metals concentrations, including arsenic, due to being located on gossanous material. Additional details are provided below in Section 3.3.2.

At closure, the mine site will be reclaimed to matrix habitat for mountain goat, grizzly bear and hoary marmot to facilitate movement by these target species and others, into better habitats. This will be achieved by reclamation measures that result in terrain that is free of mine related obstacles or hazards, thereby allowing free movement through the area by wildlife. The post-closure mine site will have low vegetation cover, consistent with its pre-mine condition and with surrounding areas, as most of the adjacent landscape is comprised of unvegetated bedrock exposures.

3.2.3 Brucejack Transmission Line

Brucejack transmission line infrastructure will be removed during final reclamation. Due to the transmission line surface disturbance being primarily limited tower base sites and effects to vegetation cover consequently being very limited, vegetation cover will have essentially the same extent at closure as it did pre-construction.

The M-243 portion of the Brucejack transmission line grades from old forest in the south to early seral ecosystems and non-vegetated areas in the north. Within the 6.7 km forested segment, mountain hemlock (*Tsuga mertensiana*) is a dominant species, with lesser presence of mountain hemlock (*Tsuga heterophylla*). Other tree species include subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*) and black cottonwood (*Populus trichocarpa*). Colluvium, moraine, rock and ice are the dominant surficial materials mapped in the northernmost 12.8 km of the transmission line (ERM Rescan 2014a).

As above, most of the M-243 portion of the transmission line route is located either above treeline or in high subalpine areas. Transmission line construction was helicopter supported, with road based support within the M-243 section limited to a few towers near the BJAR. Transmission line tower base sizes vary with the tower type, with most being approximately 3 m in diameter. Towers were sited on bedrock as much as possible (Figure 3.2-3). Due to all these factors, surface disturbance and effects on vegetation as a result of the transmission line are very limited.

At closure, the transmission line will be reclaimed to wildlife habitat, particularly matrix habitat for mountain goat, grizzly bear and hoary marmot in the high elevation sections, and moose and grizzly bear habitat at lower elevations of the transmission line. Transmission line development has not altered terrain except to a very limited extent (approximately 200 m length) at Knipple transfer area.

Removal of the towers, conductors and Knipple substation will remove whatever limited obstacles to wildlife movement are posed by the transmission line. Due to the lack of soil disturbance between tower sites in the southern vegetated portion of the M-243 transmission line extent, the limited extent of tower sites on materials other than bedrock, and the fact that disturbed soils around tower bases have already been seeded, the end land use objectives for the transmission line are expected to be achieved.

Figure 3.2-3. Transmission Tower on Bedrock in M-243 Vegetated Section (Photo August 2019).

3.3 RECLAMATION APPROACHES

3.3.1 Background

The Brucejack mine site area has multiple unique or unusual characteristics that present substantial challenges for reclamation and are not typical of mines in BC. As discussed above, these characteristics include the high elevation and harsh climatic conditions of the mine site area, the ubiquity of geochemically reactive gossanous materials throughout the mine site, and the pre-mine lack of soils and ecosystem development.

Because of these challenges, the general approach to reclamation planning for the mine has been to minimize surface disturbance through mine design and construction, and to then create post-mine

topography and conditions that will achieve the matrix habitat end land use and support passive natural revegetation to the extent feasible. Key reclamation methods include recontouring to prevent barriers to movement of the target wildlife species and to create stable drainage features, and decompaction/scarification of potential growth media. Some limited additional measures will be investigated as a component of the reclamation research program, discussed below.

The following sections describe pre-development conditions and the approach to surficial materials use for reclamation within the Brucejack mine site area and the M-243 portion of the transmission line. A key issue informing this approach is that overburden available as growth media within the mine site is predominantly PAG, with elevated element concentrations, particularly arsenic (Shaw and Simpson 2016) (Appendix 3.3-1). This overburden is not suitable for use in reclamation and is instead recommended for handling in ways that will minimize potential for incremental acid rock drainage and metal leaching. It is not presently known if there are any areas within the mine site in which surficial materials may be amenable to revegetation – this question will be investigated as part of the reclamation research program during mine operations.

3.3.2 Surficial Materials

3.3.2.1 Brucejack Mine Site Area

The Brucejack mine site area is located in the high elevation, very cold CMAun BEC subzone. Prior to mine construction, vegetation was sparse, generally covering less than 20 percent of the mine site and with little to no cover at the other facilities within the mine site area (ERM Rescan 2014a) (Figure 3.2-2 and Figure 3.3-1). This sparseness is due to the extensive occurrence of bedrock, and the limited amount and poor quality of unconsolidated surficial materials.

Baseline surveys of mine site surficial materials (ERM Rescan 2014a) determined that most of these materials are insufficiently weathered and developed to meet the definition of soils. Where soils are present, they are generally of poor quality for revegetation due to their high coarse fragment content, lack of development, and/or shallow depth to bedrock. Laboratory analyses indicate that most mine site surficial materials have metal exceedances based on Canadian Council of Ministers of the Environment (CCME) soil quality guidelines; these exceedances include arsenic (ERM Rescan 2014a).

A thorough assessment of mine site overburden geochemical characteristics and suitability for use in reclamation was conducted in 2015 (Appendix 3.3-1). This assessment indicated that mine site overburden is predominantly potentially acid generating. All overburden samples exceeded the CCME Industrial Soil Quality Guidelines for arsenic. The surficial materials characterization is consistent with the mine site's location in/on a gossan (mineralized, oxidized rock extending to surface; Figure 3.3-2).

In synthesis, the survey data indicate that soils and other surficial materials at the Brucejack mine site are not suitable for use as reclamation growth media, and that overburden should not be spread as a reclamation cover but should be treated in a manner to minimize generation of acid rock drainage (Shaw and Simpson 2016). Although approximately 30,000 m^3 of this material was salvaged and stockpiled as required by the Ministry of Energy, Mines and Petroleum Resources (MEMPR), there is

no plan to use these materials as reclamation covers. Amendment of these materials, such as attempting to add neutralizing compounds, is not a feasible option. Vegetation cover pre-mine was limited and implementing measures such as enhancing soil size materials to promote plant growth is currently considered to pose a risk to local wildlife in that it may attract wildlife to consume vegetation with potential to contain elevated metals concentrations.

Figure 3.3-1. Brucejack Mine Site 2008, Showing Sparse Vegetation Cover.

Shallow ripping will be conducted in areas of the mine site disturbance footprint as appropriate following decommissioning of structures to decompact surficial materials and facilitate any natural regeneration by native vegetation communities that may occur. These activities are consistent with the passive revegetation approach discussed below in Section 3.3.3.

Rock outcrops dominate the steep terrain at the km 72 NPAG quarry site and along the BJAR between the upper Knipple Glacier (km 71.6) and the mine site (km 73.3). This section of the BJAR was pre-existing from prior exploration activities. It was widened as required during mine construction to meet MEMPR/Code safety requirements; this was primarily accomplished through placement of quarried NPAG rock from the km 72 NPAG quarry. No surficial materials salvage was feasible at these locations during mine construction. Shallow ripping will be conducted on the BJAR surface as feasible at closure, provided that it does not compromise site stability and water management. The km 72 NPAG quarry will remain as exposed bedrock and boulders at closure.

Figure 3.3-2. Brucejack Mine Site Located On/In a Gossan (Photo August 2013).

3.3.2.2 Transmission Line

As described in Section 3.2.3, the northernmost 12.8 km of the Brucejack transmission line is comprised of clear spans over bedrock and ice dominated alpine terrain (Figure 3.3-3). Towers and lines were installed by helicopter. Towers are anchored in bedrock (Figure 3.3-3 and Figure 3.3-4). Reclamation of this section of the transmission line at closure will entail removal of towers and conductor line.

The southern 6.7 km of the M-243 transmission line section was mostly vegetated pre-construction, however even here there are extensive areas of bedrock exposure or shallow growth media over bedrock, and most towers in this section are also anchored in bedrock (Figure 3.2-3). Trees were hand felled, and soils and surficial materials were not disturbed except at the tower sites due to tower construction using helicopter support. The small disturbed areas around tower sites with potential to support plant growth were seeded following transmission line construction. During mine closure, the towers and line along this portion of the transmission line will also be removed. No reclamation specific to surficial materials is planned at these tower sites at closure beyond minor recontouring by hand and additional seeding as appropriate.

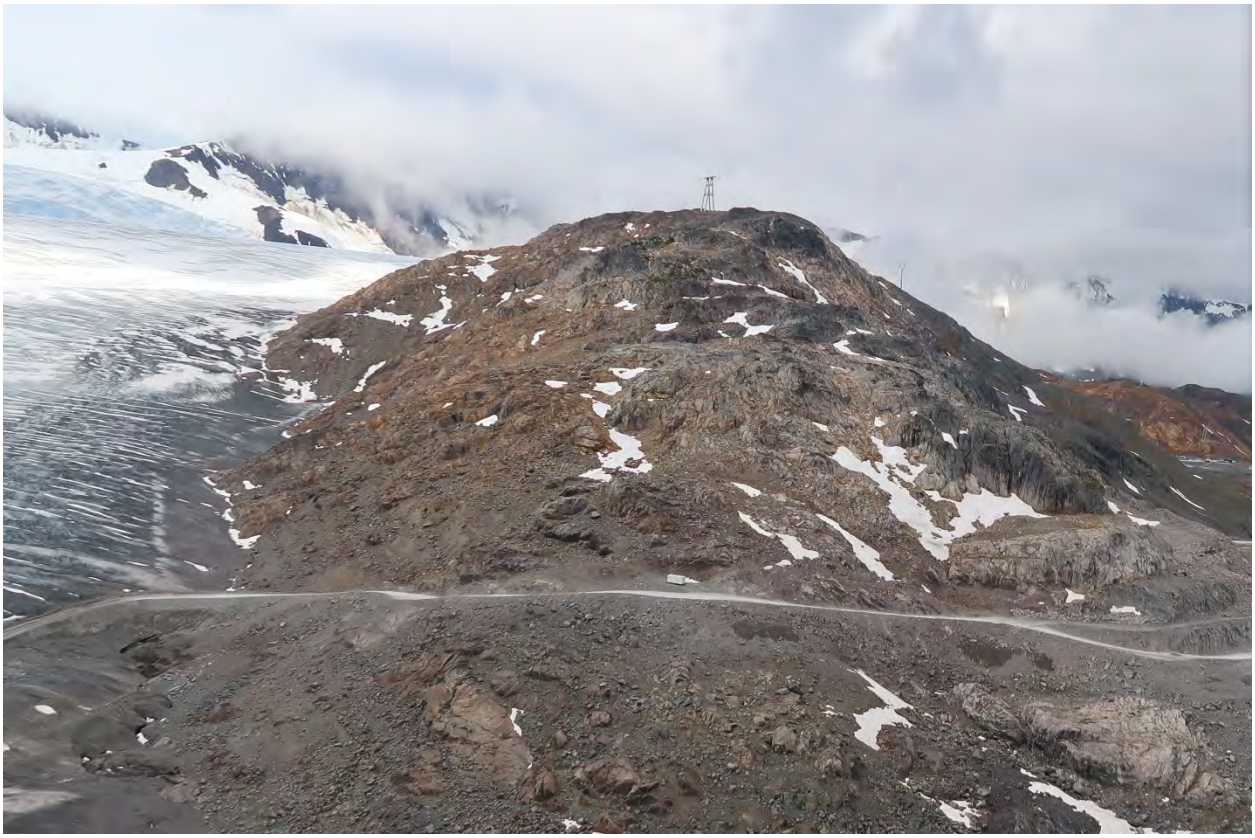

Figure 3.3-3. Transmission Line Towers in Northernmost Bedrock and Ice Section (Photo July 2018).

3.3.3 Landform Design and Erosion Control

3.3.3.1 Mine Site Area

The mine site is located in a bedrock controlled, high elevation area (Figure 3.3-5). The bedrock surface is irregular with rounded surfaces broken by crevices and depressions where snow accumulates. Pre-mine, there were localized areas with shallow slightly weathered overburden and limited areas with developed soil cover. The mine site is located adjacent to the WRTSF, and the bedrock and shallow overburden extends to the WRTSF shoreline, with few level areas.

Mine construction required development of level pads (Figure 3.3-6 and Figure 3.7-1) for surface infrastructure such as the mill and camp buildings. Parts of the pads were created by bedrock excavation; the remainder of the leveling was achieved by filling and compaction using excavated crushed rock sourced from the km 72 NPAG quarry. The pads are designed to be stable, and resulted in approximately 15 ha of level area being created on the site (see also Figure 3.7-2, pads only).

Figure 3.3-4. Transmission Line Tower, Northernmost Transmission Line Section (Photo July 2020).

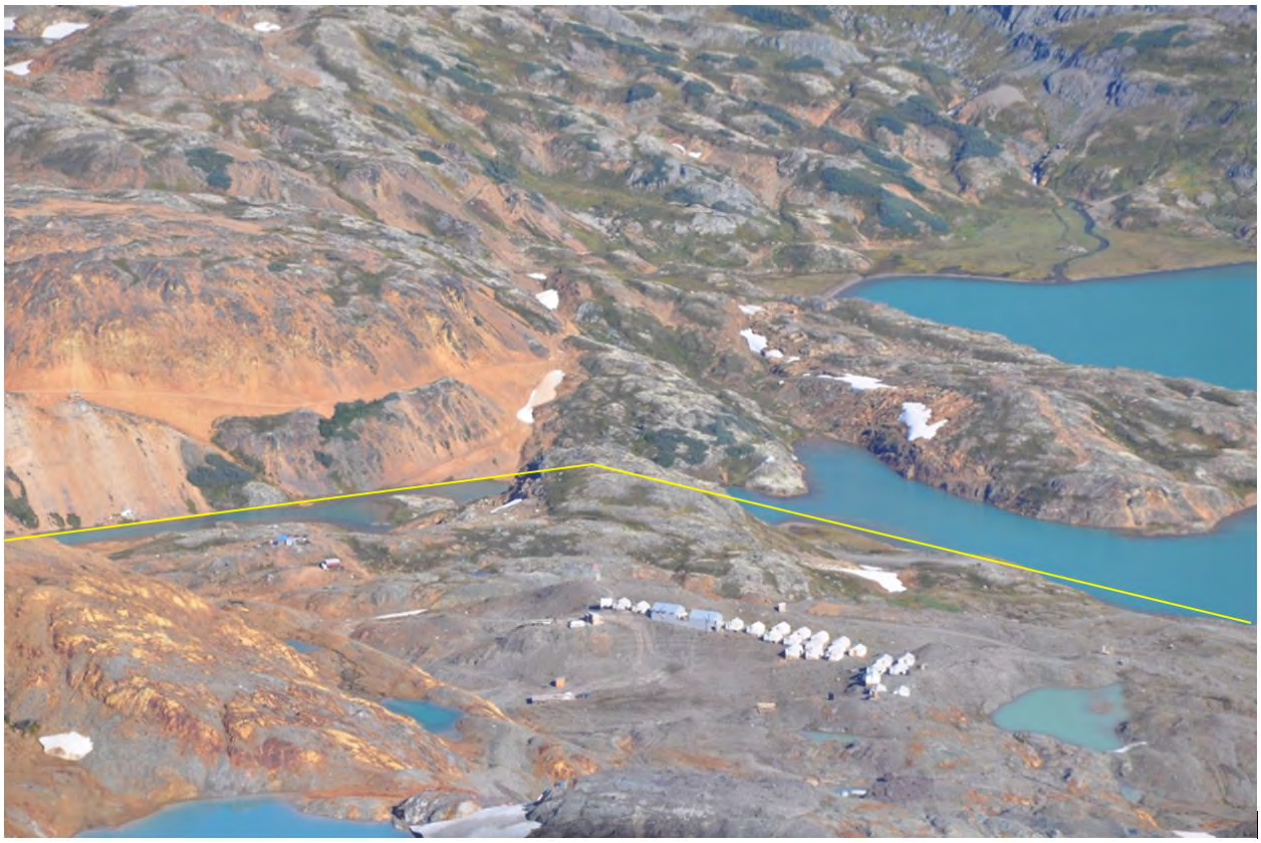

Figure 3.3-5. Mine Site 2008 During Exploration, Showing Bedrock Control.

The km 72 NPAG quarry east of the mine site is located in bedrock. The quarrying process results in excavated benches and walls in the sloping bedrock (Figure 3.3-7). The quarry is designed such that the final quarry faces will be stable.

Closure landforms will be designed to facilitate movement of wildlife through the post-mining landscape (discussed below), and to direct surface waters appropriately. This updated Reclamation Program describes current concepts for post-closure surface drainage configuration and control. This is based on the post-closure water quality predictions and stability requirements for remaining water management structures. Erosion prevention and sediment control will continue to be accomplished through designed surface water management features. Post-closure, much of the mine site will continue to drain to the WRTSF, which will continue to passively collect and settle sediment.

Figure 3.3-6. Development of Mine Site Level Pads During Construction with PAG Bedrock Excavation and Quarried NPAG Rock Fill, October 2015.

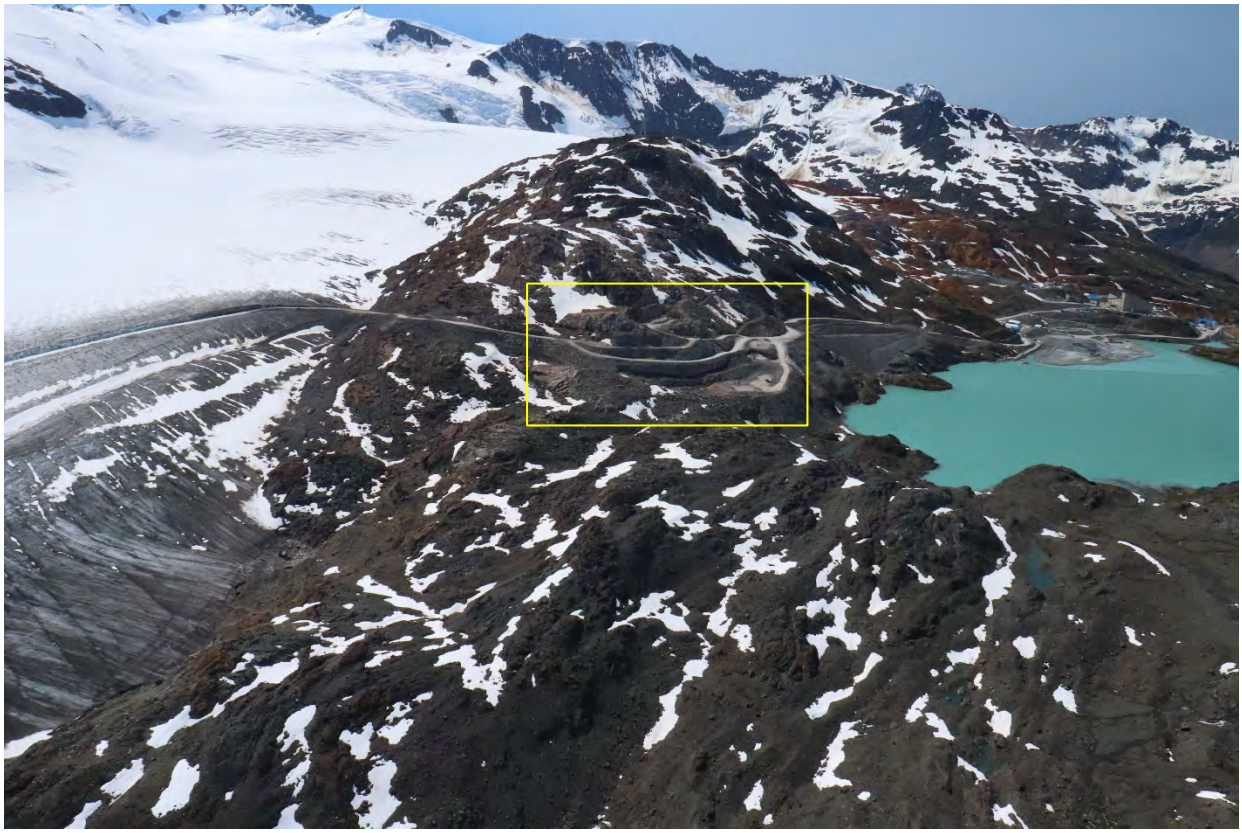

Figure 3.3-7. Km 72 NPAG Quarry (Photo July 2020)

3.3.3.2 Transmission Line

Transmission line construction entailed very minimal surface disturbance and no significant effects on landforms. The Knipple substation was constructed on the pad (in gravel substrate) developed for Knipple transfer area and camp infrastructure (Figure 3.3-8). Much of this area had been previously leveled for the Granduc-Newcana joint venture use of this site for staging during the 1980s. The substation site is level, well drained (gravel and coarse textured materials substrate), stable and not subject to erosion.

Removal of the transmission line infrastructure at closure (towers, conductor and Knipple substation) will result in the post- transmission line landforms being almost identical to the pre-mining landscape. There will be very minor and localized terrain changes compared to pre-development at some tower sites, but these are mainly limited to the vegetated southern portion of the line and are expected to become obscured by vegetation over time. The Knipple substation pad will be left level, in approximately the same topographical condition as existed prior to Pretivm's use of this site. Erosion is not expected to be a significant consideration at any of the tower sites or at the substation.

Figure 3.3-8. Knipple Substation, July 2020.

3.3.4 Revegetation Strategy

3.3.4.1 Mine Site Area

The overall revegetation strategy for the Brucejack mine site area is passive, and consistent both with the end land use objective of matrix habitat, and with the challenges associated with local surficial materials. It entails creating, to the extent feasible and consistent with the pre-mine and adjacent landscapes, post-mine site and substrate conditions conducive to natural revegetation. Site disturbances will generally be recontoured and decompacted through shallow ripping as feasible and be allowed to regenerate naturally to locally endemic vegetation communities.

Most of the high elevation plant species that would be appropriate for an active revegetation program of the mine site are not commercially available, and would likely present substantial propagation difficulties. Potentially suitable species that may be commercially available are very unlikely to have been sourced from northwest near coastal BC, and therefore, although the same species, may not necessarily be adapted to the site conditions at the Brucejack mine site. These difficulties are further exacerbated by the mine site surficial materials, which are acid generating or PAG, have elevated metals concentrations, and have been assessed as being unsuitable for use in reclamation. Revegetation of these materials has potential to result in plant tissues with elevated metals concentrations, which, if these tissues are consumed by wildlife, could detract from the objective of

providing suitable matrix habitat. Because of these limitations and challenges, passive or "leave-for-natural" revegetation approaches are more likely to yield acceptable long-term results than revegetation with non-local plant species. Further discussion on revegetation research and metal uptake is presented in Section 3.3.7.2 below on reclamation research.

The km 72 NPAG quarry and the BJAR segment between Knipple Glacier and the mine site were constructed mostly or entirely in rock. No active revegetation is planned for these areas.

3.3.4.2 Transmission Line

As described in Section 3.3.2.2, transmission line towers within the northernmost 12.8 km of the transmission line are anchored into exposed bedrock. No revegetation is feasible or planned for these locations. Most transmission line towers in the southern 6.7 km of the transmission line are also anchored in bedrock, however wherever there are growth media available following removal of towers and lines at closure, this will be seeded with Pretivm's high elevation or low elevation seed mix (Table 3.3-1 and Table 3.3-2) as appropriate to the elevation (see Figure 3.3-9 as an example). Because vegetation in the areas surrounding the towers has not been disturbed beyond felling trees (Figure 3.3-10), it is expected that any tower sites with materials suitable for plant growth will revegetate naturally within a few years of transmission line removal, irrespective of any reclamation measures. The total area of tower bases and adjacent disturbed areas within the vegetated portion of the transmission line has been calculated at a total of 0.303 ha from analysis of site orthophotography. There are 13 towers in this section averaging 233 m^2 of surface disturbance per site (approximately 15 m by 15 m).

Table 3.3-1. Brucejack Low Elevation Seed Mix.

Low Elevation (sub 900 masl)	% by weight	Seeds/lb	% by Seed Count
Agrosis scabra, **Ticklegrass**	1.00	4,000,000	18.36
Bromus sitchensis, **Alaska (Sitka) Brome**[1]	33.00	100,000	15.14
Elymus glaucus, **Blue Wildrye**	30.00	131,000	18.04
Elymus trachycaulus, **Slender Wheatgrass**	26.00	145,000	17.30
Festuca saximontana, **Rocky Mountain Fescue**	10.00	679,000	31.16
	100.00		100.00

[1]Alaska brome may be substituted for Mountain Brome

Table 3.3-2. Brucejack High Elevation Seed Mix.

High Elevation Seed Mix (above 900 masl)	% by weight	Seeds/lb	% by Seed Count
Elymus trachycaulus, **Slender Wheatgrass**	60.00	145,000	20.58
Festuca saximontana, **Rocky Mountain Fescue**	20.00	679,000	32.12
Poa alpina, **Alpine Bluegrass**	10.00	1,000,000	23.65
Trisetum spicatum, **Spike Trisetum**	10.00	1,000,000	23.65
	100.00		100.00

Figure 3.3-9. Seeded Transmission Line Tower Site (Photo July 2020).

Figure 3.3-10. Transmission Line Natural Vegetation Cover Following Clearing (Photo July 2020).

3.3.5 Progressive Reclamation and Sequencing

3.3.5.1 Mine Site

Design of the Brucejack mine site has focussed on efficient and essential use of surface disturbances. The mine site surface disturbance area is small (terrestrial infrastructure area of 60.79 ha), and the area is intensively used and needed for operations. Because Brucejack is an underground mine, incremental surface disturbances during mine life are very limited, and the site disturbance that is present is occupied by facilities and activities that will remain present throughout mine life.

An additional consideration posed by revegetation efforts within the small and intensively used mine site is the risk this would pose to local wildlife. Establishing additional vegetation within the active mine site may attract hoary marmots and other small mammals, and possibly larger mammals such as bear. There is no feasible means to create barriers to prevent hoary marmot/small mammal ingress

onto such areas, and this wildlife will be at increased risk of injury or mortality from traffic if present within the active mine site. Further, as described in Section 3.3.7, additional research into metal uptake in vegetation is needed before there are efforts to establish vegetation within the gossanous area.

As a result of these factors, the opportunities for progressive reclamation within the mine site are currently limited to those that will support reclamation research (see Section 3.3.7). This will be revisited as reclamation research proceeds and additional information becomes available. All other reclamation activities within the mine site will be completed during the closure phase.

3.3.5.2 Transmission Line

Tower sites within the 6.7 km vegetated portion of the M-243 authorized portion of the transmission line were seeded at the time each tower was completed. Vegetation disturbance between tower sites was limited to hand felling of trees due to use of helicopter support for line construction and absence of road access for all but a few tower sites within and near Knipple transfer area. Vegetation within the transmission line cleared width has been allowed to grow without further disturbance since the transmission line was completed (Figure 3.3-10).

Although vegetation regrowth at many tower sites has been excellent (Figure 3.3-9), there are small areas of limited growth at some tower sites. This appears in many cases to be related to bedrock presence at or near surface, or placement of compacted fill for certain tower sites (micro-piles) where tower anchoring to bedrock was not feasible. M-243 tower sites outside of the gossanous area will be assessed and catalogued for revegetation success by the end of 2021 and efforts to establish additional vegetation cover (e.g. alder plantings) will be initiated no later than 2022.

The Knipple substation is located within the constructed gravel surface of the Knipple transfer area. The substation extent must remain vegetation free for as long as the substation remains active. M-243 portions of the Knipple pad outside of the substation will be active for LOM as part of Knipple transfer area activities; this pad area is also tenured under LOO #6408836.

3.3.6 Reclamation Research

3.3.6.1 Purpose and Objectives

The purpose of the Brucejack Mine reclamation research program is two-fold:

1. To address and reduce any identified uncertainties in the ability to achieve the objectives of the reclamation program, and
2. To test any key assumptions upon which successful reclamation is based.

Three primary and related uncertainties have been identified; these are the focus of the Brucejack reclamation research program over the next five years:

1. What is the potential for metal uptake in any vegetation that establishes on mine site surficial materials;

2. Does any metal uptake that occurs pose or have the potential to pose concerns for any wildlife consuming this vegetation; and
3. Given the acid generating or PAG, and metalliferous characteristics of mine site surficial materials and its unsuitability on that basis as reclamation material, should there be active revegetation of the mine site as part of the mine-reclamation program (i.e. revegetation that would result in vegetation cover beyond what occurs naturally; potentially increasing the risk beyond what would occur naturally).

These uncertainties are inter-related in that findings from further research into metal uptake by plants could have implications for vegetation establishment on metalliferous mine site surficial materials. Reclamation research programs to address these uncertainties are discussed in more detail in the subsections below.

3.3.6.2 Trace Elements in Soils and Vegetation and Metal Uptake

Due to the mine site location on a gossan with mineralization to surface, trace elements in soils and growth media are elevated. Depending on the vegetation species and the trace elements that are present, metal uptake may occur. For example, soil size surficial materials (weathered parent material) and soils within the mine site are known to have elevated concentrations of arsenic. It is not expected that mine activities will significantly increase or change this. Surface stockpiling of excavated rock from the underground mine has been temporary and limited.

Waste rock is hauled directly to the shore of the WRTSF for subaqueous disposal, with stockpiling duration limited to a short period (two years maximum). Snow cover and frozen conditions through most of the year and wet conditions through much of the remainder limits fugitive dust production and dispersal, as does the crushed NPAG rock surfacing of most site roads. Road watering is used as needed during the short summer season to limit road dust. Similar measures (road surfacing and watering) are used in the underground mine. There are pollution control works in the mill to manage dust sources there, in accordance with PA-107025 and the Air Quality Management Plan (Appendix 4-1).

As noted above, surficial materials available as growth media within the mine site are PAG or acid generating, metalliferous, and have been found to be unsuitable for use in reclamation. Additional research is needed to provide more information on pre-mine conditions with respect to metals concentrations in vegetation, and to evaluate the implications and risks of revegetating site surficial materials.

As part of the terrestrial baseline program to support applications for mine authorizations, soils and vegetation were sampled at 11 sites in 2012 in the vicinity of the mine site area, and at six reference locations of similar elevation (ERM Rescan 2014a) (Figure 3.3-11). Soil samples were collected at all sites, along with samples of the terrestrial lichen *Cladina stygia*. Samples of the blueberry *Vaccinium uliginosum* were also collected at one of the mine site sampling locations and at one reference site. Assessment of results from this sampling program indicate that all mine site soil samples had arsenic concentrations exceeding CCME industrial soil quality guidelines, as well as four of six of the reference sites. There was some evidence of elevated arsenic concentrations in the lichen samples,

although the occurrence of elevated levels was not as ubiquitous as in soil samples. Arsenic concentrations were below detection limits in blueberry samples.

To advance understanding of the relationship between soil and vegetation element concentrations and the ability of vegetation to establish in metalliferous materials, a research program with five components will be conducted:

4. Sampling of surficial materials and vegetation once at the locations that were sampled in 2012, or where these sites no longer exist, at analogous locations (Figure 3.3-12).
5. Single-time sampling of surficial materials and vegetation co-located with the two historic dustfall canisters (Figure 3.3-12).
6. Opportunistic single-time sampling of surficial materials and vegetation at additional sites both within the gossanous surficial materials within/adjacent to the mine site area, and in adjacent non-gossanous areas for contrast.
7. Opportunistic single-time sampling vegetation, and co-located sampling of surficial materials, that has established on disturbed materials within the mine site area [both gossanous and (thought to be) non-gossanous].
8. Collection and removal of surficial materials for a greenhouse study using grasses to examine uptake in candidate species with potential for use in reclamation seeding within the mine site area.

Sampling programs 1 through 4 above will be conducted during 2021. The greenhouse study will be initiated no later than 2022.

All surficial materials will be analyzed for physical and chemical properties as described in Section 3.3.6.3 below. Vegetation sampling will include re-sampling of *C. stygia* and *V. uliginosum* at sites previously sampled in 2012, and will also include sampling of additional vascular species that could be consumed by hoary marmot. Selection of plant species for sampling will occur during a reconnaissance survey in support of this sampling program. Lichen samples will be cleaned of non-lichen tissue and mineral materials prior to processing. All vegetation samples will be analyzed for total element concentrations on a dry-weight basis by inductively coupled mass spectrometry (ICP-MS). This program is designed to be developed iteratively, so that results from initial sampling can be used to inform development of subsequent program phases as necessary.

Figure 3.3-11. Baseline 2012 Soils and Vegetation Sampling Locations and Approximate Outline of Gossanous Surficial Materials

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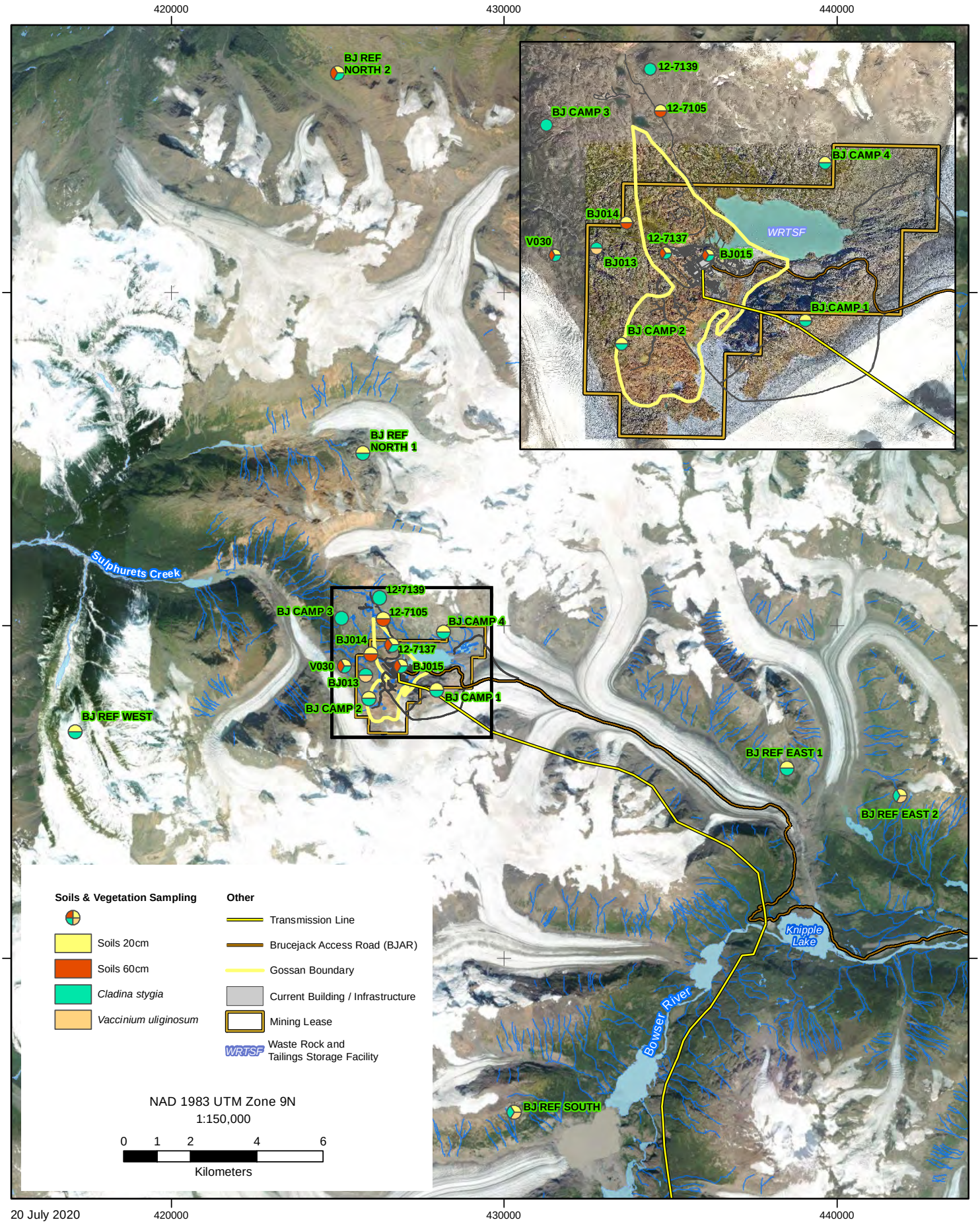
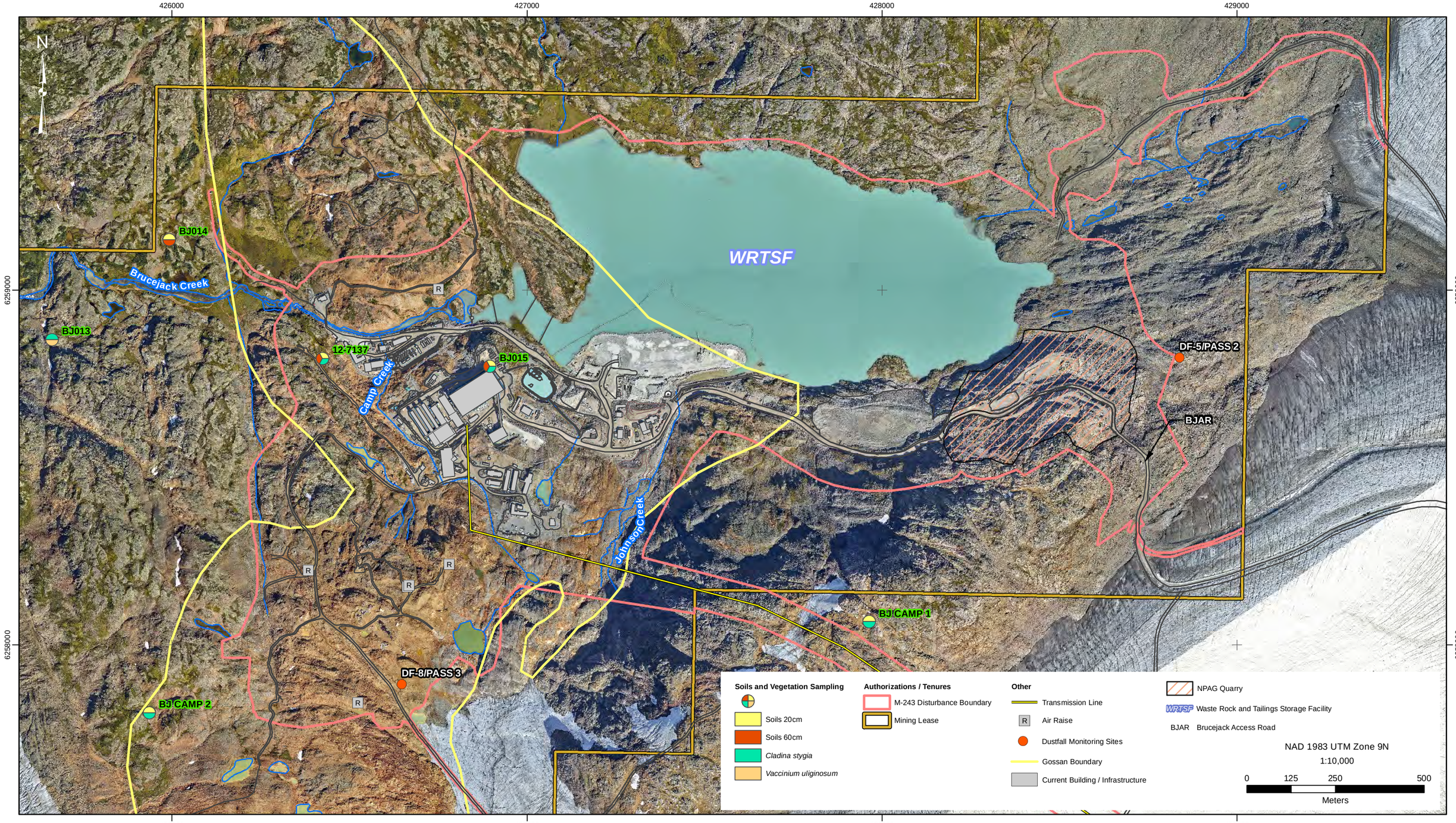


Figure 3.3-12. Planned Soils and Vegetation Sampling Locations and Approximate Outline of Gossanous Surficial Materials in the Mine Site Area



3.3.6.3 Vegetation Establishment

Research will be conducted to identify opportunities to establish limited native vegetation cover on unamended local materials, such that any risks to wildlife due to metal uptake in vegetation are unlikely to exceed those present before mine development. As above, additional sampling of vegetation present within the gossan will be conducted to improve the overall understanding of extent of risk. It is expected that as weathering and related acid production from surficial materials increases, the ability of the materials to support plant growth will decline until the acid has been depleted.

The research program will consist of a survey and enumeration of candidate materials and sites for revegetation, and application of a native seed mix to these areas to test establishment techniques, success, and resultant metal uptake. Initial potential candidate sites within the mine site are identified in Figure 3.3-13. Potential sites north of Brucejack Creek will also be investigated, as well as other sites within the gossanous area.

In identified candidate areas, any compacted materials will be ripped or otherwise decompacted as appropriate before seeding. Surficial materials will be described and tested for a range of physical and chemical parameters. Physical parameters will primarily consist of particle-size distribution. Chemical parameters will include pH, electrical conductivity, organic-matter content, total nitrogen, and a standard suite of analytes used for geochemical evaluation, including:

- total inorganic carbon,
- total carbon,
- sulphide sulphur,
- sulphate sulphur,
- total sulphur,
- insoluble sulphur (calculation),
- paste pH,
- modified neutralization potential (NP),
- acid production potential, carbonate acid NP and NP ratio (calculated),
- solid phase element by ICP-MS, and
- shake flask extraction (SFE).

The purpose of these analyses will be to aid in interpretation of revegetation results, and to allow comparison to other materials that have been tested on site, including previously tested overburden and materials included in the metals uptake reclamation research program discussed in Section 3.3.6.2.

Prepared sites will be seeded with Pretivm's high elevation native seed mix (Table 3.3-2), adjusted as necessary dependent on commercial availability of species at the time of seeding.

Figure 3.3-13 Candidate Reclamation Research Field Sites

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426500 427000 427500 428000

6259000

6258500

N

WRTSF

Brucejack Creek

WZ Portal

WRD

CWP

Mill & WTP

Camp Creek

Seepage Collection

Phase 2 Camp

VOK Portal

Camp Creek (West) Diversion Channel

Overburden Stockpiles

Johnson Creek (East) Diversion Channel

Phase 1 Camp

Johnson Creek

1:5,000

NAD 1983 UTM Zone 9N

0 50 100 200

Meters

Candidate Reclamation Research Area

Building Infrastructure

Waste Rock Platform

Culvert

Transmission Line

WRTSF Waste Rock and Tailings Storage Facility

CWP Contact Water Pond

WRD Waste Rock Dump

WTP Water Treatment Plant

WZ West Zone

*Background Image: Lidar 2019

426500 427000 427500 428000

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The seed will be certified weed free and will be applied at 60 kg/ha. As the disturbed soil has a low organic matter content and low fertility, fertilizer [16-16-16 nitrogen, phosphorus and potassium (NPK)] will be applied at 40 kg/ha or more to promote plant establishment.

Survey and identification of candidate areas will be completed by the end of the summer of 2021, with establishment of plots initiated during 2022. Results will be monitored on an annual basis and reported in annual reclamation reports beginning with the 2023 annual report. Research trial approaches may be adjusted based on initial findings.

3.3.7 Reclamation Monitoring

3.3.7.1 Reclamation Success

Mines Act Permit M-243 directs that a reclamation success monitoring program be designed to evaluate the success of revegetation, landscape design, and erosion control, and that the program must specify sampling parameters and performance criteria. As noted, unlike most other mines in BC, the Brucejack Mine is an underground mine with small surface footprint that will remain active throughout the mine life. Also atypical compared to other mines in the province, reclamation planning for the mine does not incorporate extensive ecological reclamation actions due to the harsh climate, lack of soils, and unsuitable nature of local surficial materials for supporting revegetation.

Thus, the reclamation monitoring program for Brucejack is focused on site specific reclamation objectives. The applicability of a revegetation monitoring program will be evaluated based on results from the metal uptake and revegetation research programs.

Sediment from most of the mine site is well managed through mine design and implementation of the Water Management Plan – OMS Manual (Appendix 4-1). Most of the mine site drains passively either directly to the WRTSF or to the WRTSF via the CWP, and will continue to do so post-closure. A portion of the mine site is contained within the contact water management system, which captures runoff and ultimately directs it to treatment by the WTP prior to discharge to the WRTSF. Post-closure, some of the mine site drainage area will continue to report directly to the CWP, which will then discharge to the WRTSF. The remainder – primarily the mill and phase 2 camp pads – will drain passively to Camp Creek. These areas are dominantly bedrock or capped with NPAG crushed rock; erosion from these areas post-closure is not considered to be a significant consideration. Effectiveness of erosion control measures over the entire mine site is intensively monitored through the PE-107835 water quality monitoring program requirements, which include a stringent discharge limit for TSS at the WRTSF outlet and additional monitoring for TSS and other parameters in the downstream aquatic receiving environment. This monitoring provides rapid early warning of any significant erosion from locations not draining passively to the WRTSF or contained within the contact water management system. This monitoring program will continue through the closure period, thereby continuing to provide early warning of any significant site erosion during the active reclamation period.

Post-mine, pads, decommissioned roads (including drainage crossings), the km 72 NPAG quarry, the WRD pad, and other post-mine landscape features will be inspected for stability and performance. Repairs will be carried out if and as needed. This and other post-mine monitoring programs related to reclamation success are described in Section 3.11.

3.3.7.2 Metal Uptake

The metal uptake monitoring program will be developed based on results from the planned metal uptake research program, as additional information is required to understand what monitoring will be required, if any. These results will be provided in annual reclamation reports, and a metal uptake monitoring program will be presented as appropriate once an informed and robust approach can be developed from research program findings.

3.4 CONTAMINATED SITE REQUIREMENTS

Contaminated site requirements for a BC mine are focused on the non-core areas (Part 5 - Remediation of Mineral Exploration Sites and Mines, Chapter 53, *Environmental Management Act* [2003]). At the Brucejack Mine, this focus is primarily on the plant site area where fuel, process chemicals, lubricants and other related substances, are stored, dispensed, and handled. Contaminated sites requirements also apply at the Knipple substation.

Hydrocarbon and chemical spill prevention at the Brucejack Mine and at the Knipple substation is addressed through the design and use of lined storage/dispensing facilities, secondary tank containment, routine inspection and maintenance and other mitigation measures, as required and appropriate. Detailed storage and handling requirements and procedures for relevant substances at the mine and its associated infrastructure, including the Knipple substation, are provided in Pretivm's Chemicals and Materials Storage and Handling Plan (Appendix 4-1).

In addition to the robust infrastructure spill prevention measures, Pretivm implements its Spill Response Plan (Appendix 4-1) through a rigorous site-wide spill response program. This program includes orientation in spill mitigation and response for all Pretivm employees and contractors, distribution of spill response standard operating procedures (SOPs), augmented spill response training for select site personnel, equipping all vehicles and equipment with spill response kits and staging larger spill response equipment caches around the mine site area. Personnel are required and trained to clean up all spills that occur, and to report all spills internally, regardless of size. Dedicated collection and containment bins for hydrocarbon contaminated materials are sited at multiple locations within the mine site area, and are processed and disposed of at an off site licensed facility. Spills exceeding prescribed quantities, or spills that enter, or are likely to enter a body of water are reported externally in accordance with the *EMA* Spill Reporting Regulation (BC Reg. 221/2017). With these measures in place, it is expected that the potential for significant residual spill-contaminated material present at the mine during closure is low.

At closure, fuel, chemicals and other related substances no longer required will be prepared for transport according to relevant regulations and in congruence with Pretivm's Chemicals and Materials Storage and Handling Plan. During final reclamation work at mine closure, a risk-based assessment program will be developed and implemented for potential areas of concern (typically, but not limited to, areas where fuel and chemicals have been stored, dispensed, and/or handled) to satisfy reclamation success objectives and water quality requirements, as per M-243 Condition E.6. Pending results of the assessment, Part 4 of the E*nvironmental Management Act* (2003) may apply.

3.5 DISPOSAL OF TOXIC CHEMICALS, REAGENTS, HAZARDOUS MATERIALS, CONTAMINATED MATERIALS

3.5.1 Hydrocarbon Contaminated Soil

Most infrastructure and equipment at the mine is near new; the fuel storage and handling facilities are modern facilities with lined control areas; and there is rigorous implementation of stringent hydrocarbon and other spill prevention, management, clean-up and proper disposal procedures following Pretivm's Spill Response Plan, Chemicals and Materials Storage and Handling Plan and Waste Management Plan (Appendix 4-1), and Refuse Incinerator Management Plan (Appendix 4-2).

Hydrocarbon spills during mine operations are immediately addressed following Pretivm's Spill Response Plan, with the hydrocarbon contaminated materials removed, contained and shipped off site to a licensed facility, or remediated in place and tested as appropriate. Any operational spills within containment areas are prevented or limited from migration outside of the containment area. These measures reduce the potential quantity of contaminated soil to be addressed at closure. Additionally, there is very little soil or overburden present at the Brucejack site, the site being largely constructed on bedrock and rockfill.

Any hydrocarbon contaminated soil materials identified at mine closure will be excavated and transported off site for disposal at a licensed facility in accordance with regulatory requirements and the above referenced management plans or, as appropriate, remediated on site.

3.5.2 Hazardous Wastes

Hazardous wastes are managed following Pretivm's Chemicals and Materials Storage and Handling Plan, and any spills are addressed following Pretivm's Spill Response Plan and Waste Management Plan (refer to Appendix 4-1).

At mine closure, any reagents and chemicals no longer needed for the mine will be packaged according to regulatory requirements and returned to the supplier or disposed of at a licensed off site facility following Pretivm's Waste Management Plan (Appendix 4-1). The on site inventory of hazardous wastes will be actively managed through the later stages of mine operation to result in low quantities on site at the cessation of operations. Items that can be returned to the supplier or sold at cost will be returned/sold.

3.6 GROUNDWATER WELL DECOMMISSIONING

Groundwater wells at the Brucejack mine site include groundwater monitoring wells used for the hydrogeology assessment and monitoring and a potable water well that supplies the mine site camp and mine infrastructure.

At mine closure, selected groundwater monitoring wells will be left intact for closure and post-closure monitoring purposes. When groundwater wells are no longer required, they will be sealed as is the

standard practice in BC according to the Groundwater Protection Regulation (BC Reg. 152/2016), *BC Water Sustainability Act* (2014).

3.7 RECLAMATION AND CLOSURE PRESCRIPTIONS

3.7.1 Summary

3.7.1.1 Sequence and Schedule

Brucejack Mine closure activities are planned for implementation in a sequential manner such that infrastructure needed to the end of mine closure remains in place and all other reclamation activities occur in a logical progression. Key infrastructure to remain in place until confirmed to no longer be necessary are the WTP and infrastructure required to support it, including power supply, emergency generators, housing for WTP operators and support personnel and transportation infrastructure.

Final closure is expected to take approximately three years, including approximately two years of closure and reclamation activities within the M-243 disturbance area (primarily the mine site area), and an additional year of closing and reclaiming off-site ancillary infrastructure outside of the M-243 permitted area (Table 3.7-1). The latter includes the southern LOO portion of the transmission line, and closing and reclaiming the BJAR and adjacent camps and infrastructure from km 59 to the BJAR and Highway 37 intersection.

Reclamation activities within this period are planned and designed to provide for long term stable landforms and site conditions, and acceptable post-closure water quality in the Brucejack Creek aquatic receiving environment downstream of the mine. Underground mine reclamation, including removal of underground mobile equipment and completion of other pre-flooding preparatory measures, and flooding will begin immediately following closure (Table 3.7-2). Removal of surface equipment, buildings and infrastructure not required for water treatment and ongoing reclamation activities will occur during the first summer season of the closure phase. Surface reclamation will then be conducted as described below, including recontouring to prevent barriers or hazards to wildlife, establishment of stable post-closure surface drainage, and decompaction as appropriate.

Mine flooding is estimated to be complete within seven months based on accelerated flooding accomplished by water withdrawal from the WRTSF; the withdrawal rate will be to the current licensed rate during the winter low flow period, and at accelerated rates during the freshet high flow period. Water treatment of the underground mine pool will continue throughout the active flooding period, predicted to be an additional eight months (total 15 months) [(refer also to the Closure Underground Water Quality Adaptive Management Plan (Appendix 4-2)]. Bulkheads will be installed in the West Zone (WZ) portal and the VOK portal during the first year of the closure phase, to allow underground mine flooding to its ultimate flooding elevation, currently predicted to be approximately 1400 masl (seasonal variation from 1394 to 1410 masl). The WTP and related facilities will be removed when water treatment is no longer required. Mine openings to surface (portals and raises) will be sealed within the first two summer seasons of the closure phase. Remaining surface reclamation will be completed by the end of the second summer, along with removal of remaining surface infrastructure and equipment, including the transmission line. Monitoring and reporting will continue throughout the closure phase and for five years following completion of site reclamation.

Table 3.7-1. Brucejack Mine Reclamation and Closure Schedule

	2032				2033				2034				2035				2036				2037				2038				2039			
Mine Operations																																
Closure Period					SITE RECLAMATION								OFF-SITE COMPLETION																			
Post-Closure Period																																

Table 3.7-2. Brucejack Mine Site Area Reclamation and Closure Schedule - Detail

	2033				2034				2035				2036				2037				2038				2039			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
UG* Mine Reclamation																												
UG Flooding & WT**																												
Buildings & Equipment Removal																												
Surface Reclamation																												
Monitoring & Reporting																												

**UG = underground mine*
***WT = water treatment*

The Brucejack mine site roads and the BJAR will be closed during the closure phase, therefore access for post-closure monitoring will be by helicopter. Post-closure monitoring will be carried out for site stability, surface and groundwater quality, aquatic resources, and reclamation success (including natural encroachment into facility areas by endemic vegetation. Geotechnical inspections will be conducted as required.

3.7.1.2 Mine Site Surface Reclamation

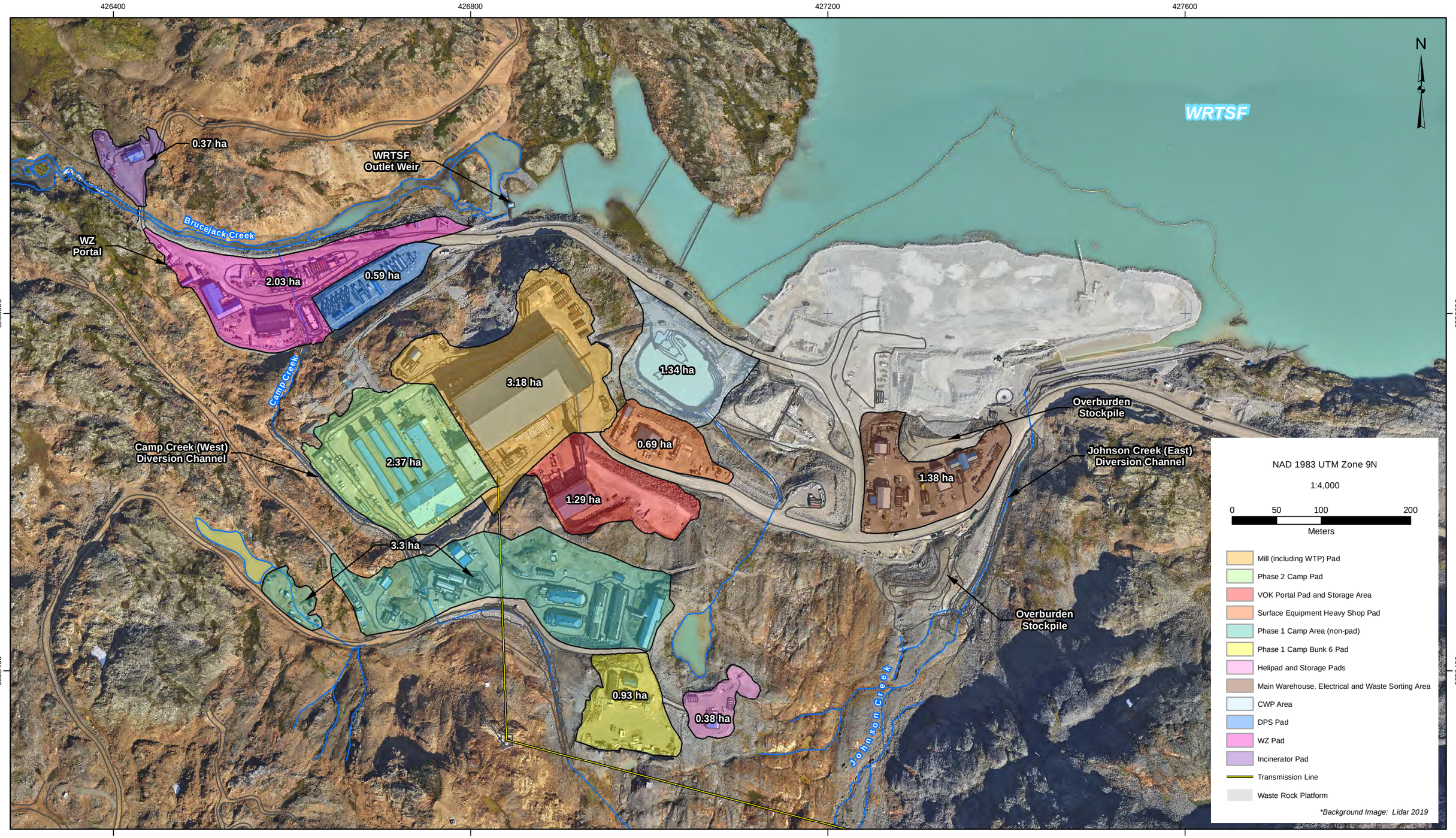
Mine reclamation at closure will begin with orderly and methodical removal of structures and equipment as described in detail in Section 3.7.2, except that required to support mine flooding and water treatment.

Most buildings and other infrastructure at the Brucejack mine site are located on constructed pads (Table 3.7-3; Figure 3.7-1). The pads are stable, constructed with a combination of bedrock cuts (with excavated PAG surface material deposited into the WRTSF) and fill methods using NPAG quarried rock, or through placement of fill only. Off-pad facilities at the mine site include the phase 1 camp area (including various offices and other, mostly modular, structures) CWP, site roads, contact water management infrastructure, overburden stockpiles, WRTSF outlet weir, WRD, and the warehouse, electrical services building and other structures located in the low lying area between the surface heavy shop and the Johnson Creek (East) diversion channel. Infrastructure within the phase 1 camp area and warehouse and vicinity areas is mainly constructed on in-situ overburden, with many of these structures having been placed or constructed during advanced exploration.

Table 3.7-3. Mine Site Constructed Pads and Infrastructure Areas.

Surface Infrastructure Pad	Area (ha)
Mill (including STPs) pad*	3.18
Phase 2 camp pad*	2.37
VOK portal pad and storage *	1.29
Surface equipment heavy shop pad	0.69
Phase 1 camp area (non-pad)	3.3
Phase 1 camp bunk 6 pad*	0.93
Helipad and storage pads**	0.38
Main warehouse, electrical and waste sorting area	1.38
Diesel power station pad*	0.59
WZ portal pad**	2.03
Incinerator Pad**	0.37
CWP	1.34
Total	**17.85**

*Combination cut and fill
**Fill only


426400
426800
427200
427600
6258800
6258400
N
WRTSF
0.37 ha
WRTSF Outlet Weir
Brucejack Creek
WZ Portal
2.03 ha
0.59 ha
Camp Creek
3.18 ha
1.34 ha
Overburden Stockpile
Camp Creek (West) Diversion Channel
2.37 ha
0.69 ha
1.29 ha
1.38 ha
Johnson Creek (East) Diversion Channel
3.3 ha
Overburden Stockpile
0.93 ha
0.38 ha
Johnson Creek
NAD 1983 UTM Zone 9N
1:4,000
0 50 100 200
Meters
Mill (including WTP) Pad
Phase 2 Camp Pad
VOK Portal Pad and Storage Area
Surface Equipment Heavy Shop Pad
Phase 1 Camp Area (non-pad)
Phase 1 Camp Bunk 6 Pad
Helipad and Storage Pads
Main Warehouse, Electrical and Waste Sorting Area
CWP Area
DPS Pad
WZ Pad
Incinerator Pad
Transmission Line
Waste Rock Platform
*Background Image: Lidar 2019

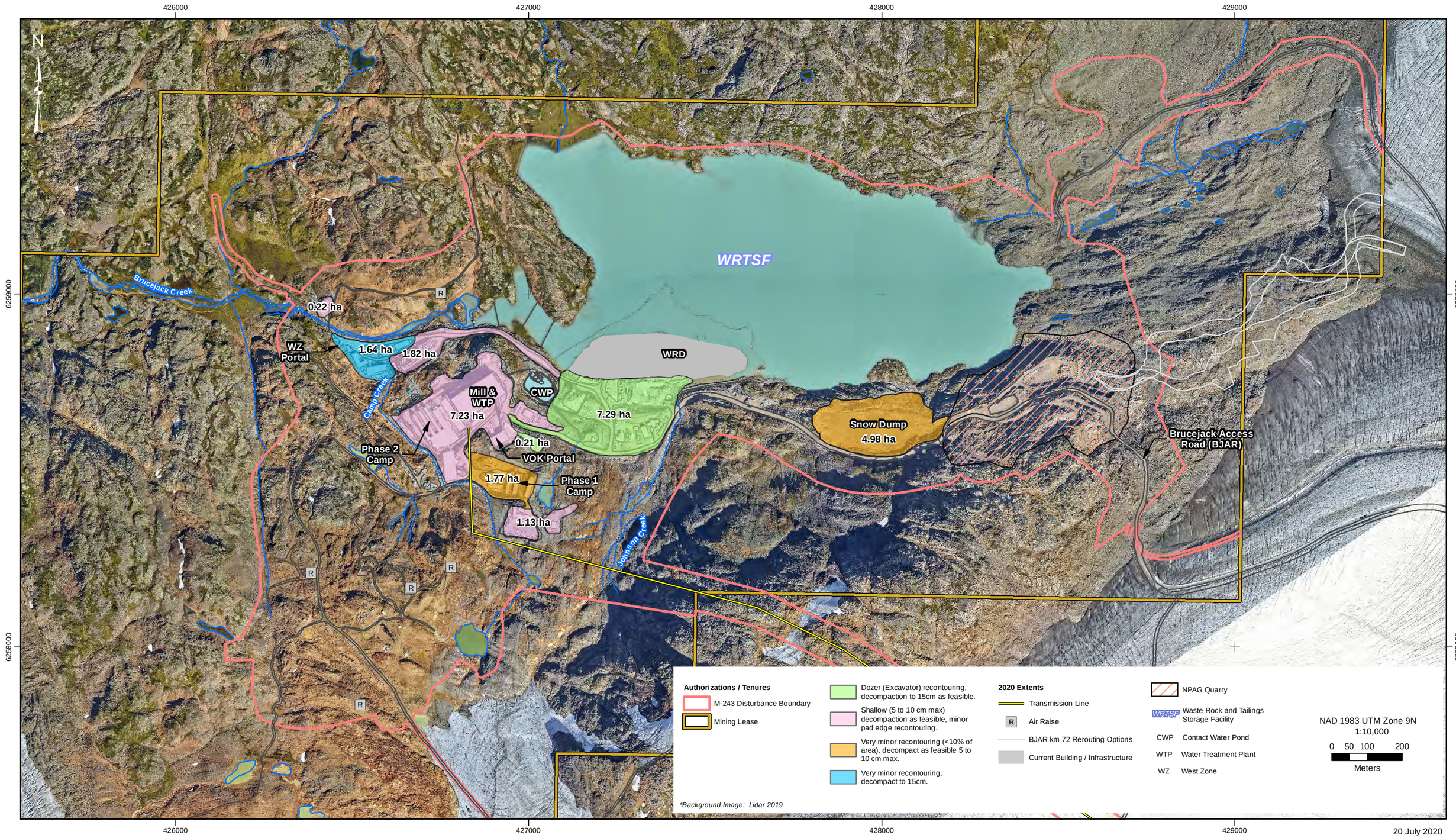
Facilities pads within the mine site will be left in place at mine closure following removal of structures and equipment, with some recontouring of NPAG rock fill materials to reduce any potential for slumping and erosion and to support achievement of the end land use objective. In preparation for final reclamation, the mine site road surfaces, NPAG crushed rock cover on the pads, and low gradient areas near the Johnson Creek Diversion will be shallow ripped to reduce surface compaction, minimize surface erosion, allow for downward water infiltration, and create the conditions for such passive natural revegetation as may occur. Culverts will be removed from the roads and cross-drains and water bars will be established to create stable drainage. Figure 3.7-2 summarizes mine site area surface reclamation treatments at closure.

Recontouring and decompaction work during closure will be aimed primarily at preventing hazards or barriers to wildlife movement to achieve the end land use objective of wildlife matrix habitat (movement areas) particularly for mountain goat, grizzly bear, and hoary marmot (Permit M-243, Condition E.3). These animals will be able to move across the mine site post-closure to access foraging areas or other habitat that provides life requisites. Reclamation work during closure will be secondarily aimed, to the extent feasible and suitable, at creating conditions for passive revegetation via propagules from local endemic vegetation species in adjacent areas. The Brucejack reclamation liability costing includes seeding much of the mine site using Pretivm's high elevation native seed mixture, however a passive reclamation approach is preferred (refer to Section 3.3.5.1).

Contact water management infrastructure will remain in place until surface water collection and treatment is no longer required, at which time ditches not required for post-closure water management will be backfilled, pipeline and pumping infrastructure will be removed, and manholes will either be removed or rendered inactive. The CWP, which is constructed in bedrock, will remain in place and be allowed to spill passively via its spillway. The non-contact diversion channels will remain in place.

Waste rock dump development is planned such that most PAG rock will be placed subaqueously in the WRTSF during mine operations. At mine closure, remaining sections of exposed PAG rock on the dump pad will be placed subaqueously in a retreat manner, such that there will be a shallow ponded area over much of the pad and exposed NPAG rock on surface near the shore of the WRTSF.

Figure 3.7-2. Mine Site Area Reclamation Treatments at Closure



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3.7.1.3 Transmission Line

The Brucejack transmission line will remain in operation until this power supply is no longer required at the mine site; this is expected to follow the scheduled 15 months of closure phase water treatment. When no longer required, the Brucejack transmission line towers and conductor will be removed using helicopter support as necessary. Substation equipment and components will be removed using ground access. All transmission line and substation components will be transported off site for recycling or disposal as appropriate.

Within the southernmost 6.7 km section of the M-243 portion transmission line that is below treeline, there may be some disturbance of surficial materials in the areas around the tower bases during the dismantling of the towers. Any growth media that are disturbed will be seeded with either the high or low elevation seed mixture, as appropriate. Removal of transmission line structures over most of the M-243 transmission line section is not expected to result in significant ground disturbance nor effects on landforms, as these are anchored in rock. Post- transmission line and tower removal, all portions of the transmission line are expected to meet the wildlife matrix habitat end land use objective.

3.7.2 Closure Prescriptions for Buildings and Equipment

This section describes the approaches that will be used to close the various mine structures, facilities, and equipment, including a description of decommissioning activities. Figure 3.7-3 depicts the mine site surface infrastructure at EOM (2032). Figure 3.7-4 provides a detailed view of the current mine site (2020) surface infrastructure.

Figure 3.7-3. Mine Site Area Surface Plan End of 2032 (EOM)

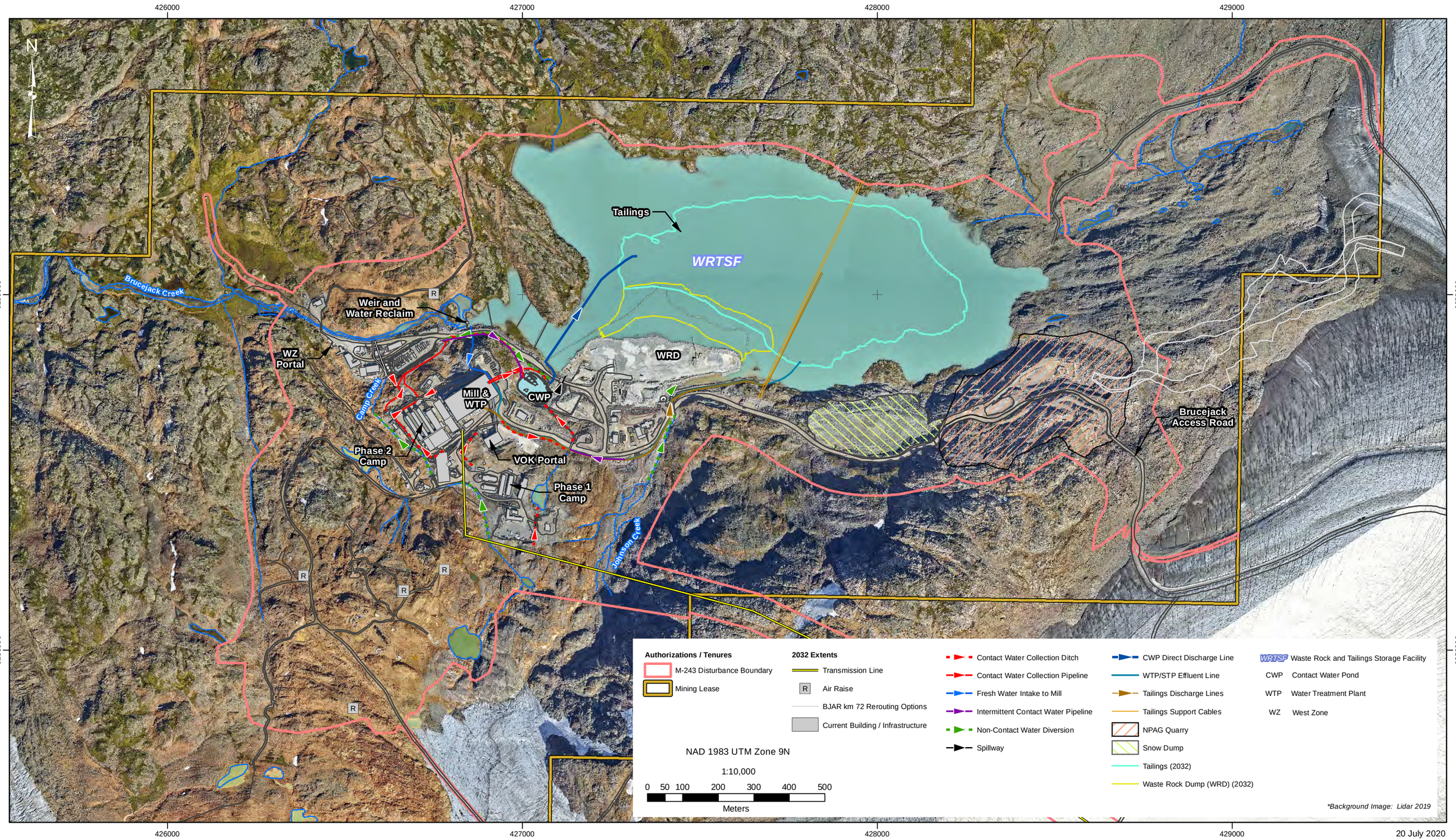

Figure 3.7-4 Brucejack Mine Site 2020 - Detailed Infrastructure Plan

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6258800 6258400

Weir & Water Reclaim
Incinerator
WZ Warehouse
Brucejack Creek
Propane
WZ Offices
WZ Portal
Fuel
WZ Air, Electrical
WZ Fuel
Generators
Cold Storage
DPS Sump
STP
WZ Heavy Shop
Potable Water
Mill & WTP
Seepage Collection
Camp Creek
Lift Station
Propane Station
Surface Heavy Shop
Phase 2 Camp
Camp Creek (West) Diversion Channel
VOK Portal
Offices
Lift Station
Fire Hall
Office
H&S Training
Propane
Bunk 4
Bunk 5
Bunk 3
Bunk 2
Phase 1 Camp
Carpentry Shop
Offices & Storage
Heli-pad
Bunk 6
Communications
Plumbing Storage
VR 3
VR 2
VR 1
Johnson Creek
WRTSF
Sediment Curtain
WRD
CWP
Electrical Shop and Storage
Overburden Stockpile
Primary Waste Sorting
Warehouse Coverall Storage
Main Warehouse
Overburden Stockpile
Johnson Creek (East) Diversion Channel

N

1:4,000

NAD 1983 UTM Zone 9N

0 25 50 100
Meters

Authorizations / Tenures

- M-243 Disturbance Boundary
- Mining Lease
- Current Building / Infrastructure

2020 Extents

- Transmission Line
- R VR (Vent Raise)
- Culvert
- Current Building / Infrastructure
- Waste Rock Platform
- WRTSF Waste Rock and Tailings Storage Facility
- CWP Contact Water Pond
- WRD Waste Rock Dump
- WTP Water Treatment Plant
- WZ West Zone

*Background Image: Lidar 2019

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P01_BJ_1000_Mine_Site_4K_11x17_20200715

3.7.2.1 Underground Mine

Description

There are two portals: the VOK portal, located east of the mill building, and the WZ portal, located at the western end of the WZ pad (Figure 3.7-4). Four vent air raises are currently located within the mine site and one additional vent raise is planned during mine life, with the possible addition of a fresh air intake raise (Figure 3.7-3). Figure 3.7-5 shows a typical surface structure for a vent raise. The four existing raises are located in high elevation terrain southwest of the mine site and above the VOK zone, and the planned raise is located north of Brucejack Creek, east of the incinerator. The potential fresh air intake is located proximal to vent raise #1, which is the northernmost of the existing vent raises above the VOK zone (Figure 3.7-3).

Major underground mine infrastructure includes a grizzly, crusher, conveyor belts, ventilation fans, an electric air heating system (supplemented by propane heaters when required), electrical cables, transformers, pumping stations, water pipelines, paste backfill pipelines, water tanks, electrical substations, explosive magazines, refuge areas, mine communications, and other ancillary installations. Two 20,000 kg tanks store bulk emulsion at the explosives magazine loop, along with a third 20,000 kg mobile tank.

Figure 3.7-5. Surface Structure for Vent Raise.

Closure

At closure, all underground tanks including the fuel and emulsion tanks will be emptied and both the tanks and their contents taken off site for use by others or proper disposal following Pretivm's Chemicals and Materials Storage and Handling Plan and Waste Management Plan (Appendix 4-1).

Hazardous materials, fuels, oils and glycol from fixed equipment that is not being removed will be drained and/or removed, and then transported to surface for off site shipment to licensed facilities for disposal following the above referenced plans. Fixed underground equipment suitable for re-use will be removed and transported off site. All mobile equipment and supplies will be removed from the underground mine and shipped off site for re-use or disposal as appropriate.

Most stopes will be backfilled with waste rock and paste tailings during operations. Flooding and water treatment during mine closure is described in the Closure Underground Water Quality Adaptive Management Plan (Appendix 4-2), in Section 5.4.4.2, and in Appendices 5.1-4 and 5.1-5. At closure, the underground mine workings will be flooded over a period of approximately seven months. Flooding will be via natural groundwater recharge and water withdrawal from the WRTSF at the currently licensed rate (70 m^3/h) during the winter low flow months, augmented by accelerated water withdrawal from the WRTSF via pumping or siphoning into the portals during the freshet period. Water treatment of the underground mine pool is planned to continue for 15 months.

Portals and raises will be sealed with concrete plugs when no longer required for access. The WZ and VOK portal plugs will be designed and constructed to withstand the water pressure from flooding to the predicted elevation of approximately 1400 masl elevation (varying seasonally between 1394 and 1410 masl; Appendix 5.1-3, Section 6.1.3). The VOK portal is at 1407 masl elevation. Any seepage from the portal plugs will be allowed to drain to Brucejack Creek.

3.7.2.2 Surface Buildings and Equipment

3.7.2.2.1 General Closure and Reclamation Methods

This section describes general methods for closure and reclamation of surface buildings and other infrastructure. Current mine site surface buildings and infrastructure are shown on Figure 3.7-4 and listed in Appendix 3.7-1; the latter includes key information pertinent to building deconstruction or demolition, and reclamation of building locations. Additional planned buildings are shown on the mine progression drawings for the relevant years (refer to Section 2.3).

Surface buildings and infrastructure not required for water treatment and ongoing reclamation activities will be removed during the first summer season of the closure phase. Phase 1 camp trailer units (bunks 4 through 6) will be retained through the closure phase while other camp structures (and other mine site structures and equipment) are removed and the mine site is reclaimed. As the camp population declines, bunks 4 and 5 will be removed first, with bunk 6 and its adjacent communications infrastructure retained until water treatment and site reclamation are complete and final demobilization from the mine site is to take place. Temporary modifications will be made to the mill building to enable safe and efficient operation of the internal water treatment facilities while most of the building is removed.

Wastes generated through building deconstruction, demolition and related mine site closure activities will be handled and disposed in accordance with regulatory requirements and Pretivm's Waste Management Plan (Appendix 4-1) and Refuse Incinerator Management Plan (Appendix 4-2). Table 3.7-4 summarizes waste types and disposal methods.

Table 3.7-4. Brucejack Mine Waste Types and Disposal Methods

Waste Type	Disposal				
	On site Incineration	Burn Pit	On site Disposal	Off site Facility[a]	Off site Recycling
Aerosol containers[b]				X	
Batteries[b]				X	X
Appliances					X
Clean cardboard (recyclable)					X
Concrete, bentonite and shotcrete[b]			X		
Conveyor belts (rubber/steel)				X	
Copper/brass pipe and fittings					X
Demolition debris (general, non-hazardous)				X	
Electric motors					X
Electronics					X
Fluorescent light ballasts and other lights (halogen, LED)					X
First Aid waste (bandages, etc.)[b]	X			X	
General refuse from camp (i.e., spent toiletries)	X			X	
Glycol[b]				X	
HDPE pipe[c]			X	X	
Hose (air, water, hydraulic)	X			X	
Incinerator ash			X	X	
Insulation/fibreglass				X	
Waste lead[b]				X	
Mattresses				X	
Metal culverts				X	X
Non-ferrous metals (aluminum cans, tin, etc.)					X
Oily rags (<3% oil by weight)[d]	X			X	
Paint (coatings, adhesive and waste paint)[b]				X	
Paper and cardboard (non-recyclable)	X	X		X	
Plastic containers (beverages)					X
Plastic (tarps, shrink wrap, etc.)				X	
Plastic pipe (PVC, ABS and PEX)[e]			X	X	
Putrescible food waste, packaging and plastics	X			X	
PVC lake curtain[f]			X	X	
Scrap metal (rebar, steel balls, vehicles, old parts)				X	X
Sewage sludge	X			X	
Steel structural cladding[g]					X
Storage tanks				X	
Styrofoam	X			X	
Tires					X
Tools (electric/pneumatic/hand)				X	X
Transformers					X
Transmission line conductor				X	X
Transmission line steel					X
Used air filters	X			X	
Used oil/fuel filters[b]					X
Used, empty plastic containers for bulk WTP chemicals[b, h]	X			X	X
Vent bags					X
Waste fuel (gasoline, diesel)[b]				X	
Waste oil[b]	X				
Wiring					X
Wood (pallets, lumber)	X	X		X	X

Notes:
[a] Such as a landfill or other licenced facility appropriate for the waste.
[b] Hazardous waste
[c] HDPE lines in the WRTSF will be removed as feasible and placed in the underground mine or disposed off site. Pipe will remain in place in the WRTSF if it cannot be removed.
[d] Oil contaminated rags containing less than 3% of oil by weight are permitted to be incinerated provided they do not exceed 0.2% of the total waste incinerated per year (EMA Air Permit PA-107025 Condition 1.7.5).
[e] Polyvinylchloride (PVC) plastic pipe will not be incinerated and will be disposed in the underground mine or landfilled off site. Combustion of plastics will be minimized through waste reduction and recycling programs where feasible.
[f] Curtain material will be removed as feasible and otherwise disposed in the underground mine or off site.
[g] Insulation foam is removed from the cladding on site and disposed separately off site.
[h] Empty totes will be sent off site for recycling or returned to the supplier. Spent chemical reagent bags will be incinerated or disposed of off site depending on the type of chemical reagent and all other plastic chemical containers will be incinerated.

Skirting, add-on roofs, and framed entrances will be removed and services disconnected from trailers, and then the modules will be transported off site for re-use or disposal as appropriate. Modular buildings (e.g. phase 2 camp complex, Figure 3.7-6; Appendix 3.7-1) will be disassembled and the modules will be transported off site for sale and re-use. Structural steel, cladding, wood and other additions to trailers and modular structures will be handled as described below for non-modular buildings.

Steel cladding, structural steel and steel framing will be removed as feasible and transported off site for recycling, and otherwise be included with general non-hazardous demolition debris and transported off site for land-filling (see Table 3.7-4). Clean wood suitable for burning in accordance with the requirements of PA-107025 will be burned in the approved burn pits. Other re-usable and recyclable materials/equipment and will be transported off site (Table 3.7-4).

Figure 3.7-6. Modular Phase 2 Camp Complex During Construction in 2016.

Soil investigations will be conducted to satisfy Ministry of Environment and Climate Change Strategy (MECCS) and MEMPR requirements with respect to remediating residual hydrocarbon contamination. Hydrocarbon contaminated soil will be transported off site for disposal at a licensed facility or, as appropriate, remediated on site. Hazardous wastes will be transported off site for disposal at a licensed facility.

Buried services will be cut off below grade and the exposed materials removed from site for recycling or landfilling as appropriate. Building footprints on fill or overburden will be recontoured as appropriate for stability and achieving the end land use, and decompacted as feasible and appropriate.

Concrete foundations and/or pads will remain in place with adjacent pad materials or overburden graded to or near pad level to prevent barriers to wildlife movement, or hazards. Reclamation treatments at closure are summarized on Figure 3.7-2.

The subsections below describe methods specific to the main buildings, and infrastructure with additional reclamation considerations.

3.7.2.2.2 Building-Specific Methods

3.7.2.2.2.1 Mill

Description

The mill building (Figure 3.7-4 and Figure 3.7-7) is constructed with metal roof and wall cladding and installed on concrete grade beams and pedestals. It includes the facilities and equipment for ore processing, concentrate storage and load-out, WTP, paste plant, reagents storage, lab, warehouse, offices, and other associated equipment and supplies storage. An exterior conveyor carries crushed ore the VOK portal building to the mill building.

The WTP, housed at the northern end of the mill building, treats groundwater seepage and surface contact water collected in the CWP as per M-243 and PE-107835 requirements, along with process water. The WTP includes processing equipment, a chemical dosing system, storage tanks, agitators, and dosing pumps. The WTP equipment and process are described in Section 2.5.

Figure 3.7-7. Mill, Conveyor to VOK Portal and VOK Portal.

Closure

All equipment except the WTP and pipelines and other connections required for its function will be removed from the mill building at closure. Reagents will be properly secured and removed off site to appropriate facilities unless required for WTP operations. Lubricants and oils will be drained from equipment and packaged for disposal at a designated off site facility. Equipment will be transported off site and sent for recycling or reuse. Conveyors will be dismantled, and the metal components removed off site for sale or recycling. Conveyor belts will be disposed in the underground mine or transported off site for disposal at a licensed facility (landfill). Remaining supplies will be used for various closure activities, as required. Any remaining reagents (i.e., that are not required for the WTP) will be taken off site for resale or disposal. The motors and pumps and other equipment will be removed and taken off site for reuse or recycling. Wiring and electrical equipment not required for WTP operations will be removed off site and taken to appropriate facilities for disposal. Any hazardous materials will be removed for disposal at off site licensed facilities.

Temporary modifications will be made to the mill building to enable safe and efficient operation of the internal water treatment facilities while most of the building is removed. The WTP and remaining mill building will remain in place for the 15 month water treatment period or until it has been confirmed that water treatment is no longer necessary. WTP sludge produced during closure will be transported off site and disposed at a licensed facility.

When water treatment is no longer needed, the water treatment plant equipment and other remaining interior equipment and structures will be removed from site for re-use or disposal. The remaining mill building will be dismantled and the metal siding and roofing will be removed off site for recycling or disposal. In the unlikely event of any spills being present around the building, the contaminated materials will be removed and disposed off site at licensed facilities; hydrocarbons may be treated on site as appropriate. The concrete floor of the mill will be left in place and surrounding pad materials will be graded onto it to prevent any barriers to movement.

3.7.2.2.2.2 Portal Structures

Description

The VOK portal is located east of the mill building (Figure 3.7-4 and Figure 3.7-8). The portal structure building contains an access portal, conveyor portal, mine air heaters, ventilation fans, the conveyor drive motor and mechanism, an electrical substation, and a monorail located in the ceiling of the building for the mine air fan motor and components. The roof and the sides of the building are constructed with metal cladding. The building is located on a concrete pad.

The WZ portal was originally developed in the 1980's by the Granduc-Newcana joint venture (with Newhawk as the operator), and is located near the western end of the WZ pad (Figure 3.7-9). It is the primary personnel and equipment access and is the waste rock haulage egress location. Infrastructure includes an access portal, mine air heaters, and ventilation fans.

Figure 3.7-8. VOK Portal Building, Tower and Conveyor Gallery (Photo July 2020).

Figure 3.7-9. West Zone Portal (Photo July 2020).

Closure

At closure, the conveyor connection from the VOK building to the mill will be removed and dis-assembled. If still suitable for use, the conveyor structure will be removed from site for re-use. If there is no re-purposing potential, the conveyor belt will be removed from site and appropriately disposed or may be placed in the underground mine. Re-usable components such as the mine air heaters, ventilation fans, conveyor mechanism and other equipment will be removed and transported off site for re-use; otherwise they will be disposed off site as appropriate. Building and conveyor steel structural components and cladding will be transported off site for re-use, recycling or disposal as appropriate. Demolition debris will be transported off site for disposal as appropriate. The same approach will be used for the WZ portal infrastructure, as appropriate.

Concrete pads will remain in place and be addressed as described in Section 3.7.2.2.1.

3.7.2.2.2.3 Phase 2 Camp Complex

Description

The phase 2 camp complex (Figure 3.7-4) is a multi-storey modular building with metal clad walls and roofs that was initially constructed to house 330 persons and is being expanded (between the phase 2 camp and the mill building) to provide additional housing and other services (Figure 3.7-10). The phase 2 camp complex includes accommodations and associated facilities such as kitchen and dining, medical, reception, offices, recreational facilities, and laundry. The original phase 2 camp complex houses a mine dry, and the expansion includes a mill dry. The phase 2 camp complex building and its expansion are constructed on steel platforms placed on top of pedestals anchored to bedrock or piles. Modules for the original phase 2 camp complex were placed on top of the steel platform, whereas the expansion has been framed in place.

Figure 3.7-10. Phase 2 Camp Complex (Photo July 2020).

Closure

All contents of the phase 2 camp complex will be removed and shipped off site for re-use, recycling or disposal as appropriate. Exterior steel staircases, and steel roofing and cladding will be removed and transported off site for recycling or disposal as appropriate. The phase 2 camp trailer modules will be disassembled and removed from site to be sold or disposed. The structural steel bases of the main phase 2 camp building and steel floor and building frames for the expansion will be removed and shipped off site for recycling or disposal. The concrete building pedestals will be cut off at their bases and buried in the rock fill portion of the pad. Electrical and piping service connections will be cut off below grade and portions on surface removed and recycled or disposed off site. Materials that can be recycled will be separated and taken off site for recycling. Materials suitable for landfilling will be taken off site to a licensed facility. Clean unpainted wood (e.g. from phase 2 complex roof trusses) will be burned in the burn pits.

3.7.2.2.2.4 Heavy Shops

Description

The current surface equipment heavy shop (Figure 3.7-4) is a wood frame and steel clad building constructed during advanced exploration (Figure 3.7-11). A second heavy shop, for underground mine equipment, is located on the WZ pad. The WZ heavy shop (Figure 3.7-4) is a mainly steel frame and clad building on a concrete slab (Figure 3.7-12). Based on preliminary design information, the Brucejack complex tentatively planned to be constructed in 2021/2022 (refer to Section 2.3) will include repair bays for surface trucks and equipment, bays for fire and emergency response equipment, a wood shop, and offices on the second storey. It will be connected to the phase 2 camp complex by an overhead walkway. The building is currently expected to be mainly steel framed and clad.

Figure 3.7-11. Surface Heavy Shop (Photo July 2020).

Figure 3.7-12. West Zone Heavy Shop (Photo July 2020).

Closure

During closure, when no longer required, contents of the heavy shops, including all tools and equipment, will be removed from the mine site for reuse/resale. Oil, grease, and lubricants will be drained from the equipment and placed with other waste oils for removal from the site and recycling at a designated facility. Wiring and cables will be removed from the buildings and transported off site for disposal at an appropriate facility. Clean wood materials will be burned at the mine burn pit. The interior metal structures such as shelving will be dismantled and taken off site for resale or metal recycling.

Metal framing, building sheathing and roofing will be removed and sent off site for recycling or disposal. Non-burnable wastes from building demolition will be removed from the site and disposed in a designated landfill. Concrete flooring at ground level will be left in place and adjacent pad fill materials will be graded even with the concrete pad. Partial or complete pad covering will be completed if there are sufficient pad fill materials to accomplish this without compromising pad stability or causing other issues.

3.7.2.2.2.5 Waste Handling Facilities

Primary Waste Sorting and Staging Facility

The primary waste sorting and staging facility (Figure 3.7-4 and Figure 3.7-13) is a seacan and wood frame building, with exterior metal cladding and metal roofing, constructed on a concrete pad.

Figure 3.7-13. Primary Waste Sorting and Staging Facility (Photo July 2020).

Incinerator and Burn Pit

The Brucejack incinerator and waste sorting facility, and primary mine burn pit is located north of Brucejack Creek, northwest of the WZ pad (Figure 3.7-4). There is a bridge across Brucejack Creek to access the facility. The incinerator building is wood framed on a concrete pad with steel exterior cladding and roofing (Figure 3.7-14).

Figure 3.7-14. Incinerator and Waste Sorting Facility (Photo July 2020).

Closure

The waste handling facilities will not be removed until the final stages of building and facility removal during closure, as they are required to manage wastes produced during building deconstruction and other closure activities. As waste collection and handling receptacles and large bins are no longer required, they will be shipped off site for re-use, recycling or disposal as appropriate. The primary waste sorting and staging facility building will be deconstructed or demolished in the same manner as other similarly constructed buildings, with metal cladding removed and transported off site for

recycling or disposal, seacans removed and transported off site for re-use, clean burnable wood collected and burned in the burn pit, and insulation and other non-recyclable materials transported off site for landfilling. Adjacent surficial materials will be graded level with the concrete floor.

The incinerator will be removed off site once all demolition and clean-up has been completed and taken to a designated facility for disposal or sold for reuse. Remaining ash from the incinerator will be transported off site for disposal. The incinerator building will be de-constructed or demolished, with metal cladding removed and transported off site for recycling or disposal, insulation and any other non-recyclables transported off site and disposed as appropriate, and clean wood materials burned in the burn pit. The foundation and concrete floor of the incinerator will be left in place and adjacent pad materials will be graded level to it. The burn pit will be backfilled with pad/fill material.

3.7.3 Hydrocarbon Storage Facilities

Description

Hydrocarbons such as propane, diesel and gasoline are stored at several locations within the mine site area (Figure 3.7-4). Spill prevention, secondary containment and other measures are in place for these storage and dispensing facilities appropriate to the hydrocarbon types and quantities and in accordance with Pretivm's Chemicals and Materials Storage and Handling Plan and Spill Response Plan (Appendix 4-1).

The main hydrocarbon storage location is the Diesel Power Station (DPS), located at the eastern end of the WZ pad, down-gradient of the mill pad (3.7-4). Back-up generators and associated fuel storage are located on the DPS pad, along with fuel storage and dispensing for surface equipment and light vehicles (Figure 3.7-15).

Figure 3.7-15. DPS Pad Facilities (Photo July 2020).

The DPS fuel storage is a lined facility where the discharge passes through an oil water separator system before discharge into the DPS sump, which is connected to the contact water management system. Tankage includes diesel to supply the backup diesel power generation system, and diesel and

gasoline dispensing tanks for equipment, light vehicles, small mobile equipment (boats, snowmobiles, ATVs and RTVs), and miscellaneous gas engine equipment (mobile generators). Another diesel dispensing tank is located near the WZ portal to service underground mine equipment and vehicles; that tank is also connected to the DPS oil water separator system.

Propane tanks are positioned on the phase 2 camp and mill pads, and on the WZ pad to provide heat for surface buildings and the underground mine. An additional propane tank on the WZ pad supplies fuel for the incinerator and to heat the incinerator building.

Closure

At closure, the fuel tanks and any fuel remaining in the tanks will be collected and removed off site for recycling or repurposed. Precautions will be taken to minimize any potential for spills in accordance with Pretivm's Chemicals and Materials Storage and Handling Plan and Spill Response Plan (Appendix 4-1). Any spilled fuel on liner will be collected with the appropriate spill response materials and removed offsite for disposal at a licensed facility. Any hydrocarbon contaminated liner material will be removed and disposed offsite at a licensed facility. Clean liners will be cut and/or shredded and disposed of in the underground mine or shipped off site for disposal at a licensed facility. Underlying materials will be inspected for any signs of hydrocarbons contamination; in the unlikely event that such materials are identified they will be removed and disposed in accordance with Pretivm's Spill Response Plan (Appendix 4-1) and applicable regulatory requirements, or treated on site as appropriate. Clean crush or surficial materials from the pad location will be regraded over the formerly lined ground surface. The concrete pad for WZ pad diesel dispensing will be left in place, with surrounding concrete barriers removed and pad materials graded to the concrete surface. Smaller tank areas will be inspected for signs of drips/spills. Any materials affected by hydrocarbon spillage will be excavated and treated on site or removed offsite for treatment at an appropriate facility.

3.7.4 Contact Water Pond and Surface Water Management System

Description

Mine site water management infrastructure and function is described in detail in the Water Management Plan - Operations, Maintenance and Surveillance (OMS) Manual (Appendix 4-1); a summary is provided in Section 2.5.5. There are approximately 2.5 km total of non-contact diversion channels at the mine site. The Camp Creek (West) and Johnson Creek (East) diversion channels (Figure 3.7-4) intercept surface runoff from outside of the core mine infrastructure area and direct it to Brucejack Creek and the WRTSF, respectively. Both are engineered channels, partially constructed in bedrock and otherwise lined with geotextile and armored with riprap (Figure 3.7-16).

Figure 3.7-16. Camp Creek Diversion Channel (Photo July 2020).

The surface contact water management system collects surface runoff from areas of surface PAG rock excavation within the core mine facilities area located between the diversion channels, and directs it to the CWP (refer to the Water Management Plan – OMS Manual, Appendix 4-1, for details). Water collection and conveyance infrastructure includes several unlined ditches constructed in bedrock, lined and riprapped ditches in fill or overburden (approximately 1.2 km of collection ditches in total), High density polyethylene (HDPE) pipelines, two small concrete weirs down-gradient of the camp pad, several manholes and lined sumps, various pumps and culverts. The largest contact water management system pumps are located at the CWP. The 50,000 m^3 capacity CWP (Figure 3.7-17) is entirely excavated in bedrock, with no liner and a concrete covered bedrock spillway. Surface contact water is collected in the CWP and then piped to the WTP for treatment.

Figure 3.7-17. Contact Water Pond.

Closure

The non-contact diversion channels will remain in place for closure and post-closure. Most of the surface contact water collection system will be disassembled during the first two summers of the closure phase, after which surface drainage will be passive toward the WRTSF, CWP or Camp Creek. Pumps and HDPE pipes will be removed except as noted below. The HDPE pipe will be cut up and either disposed in the underground mine or transported off site for disposal at a licensed facility. Exposed liner in ditches will be removed and disposed similar to the HDPE pipe.

Contact water collection ditches will be backfilled during the closure phase when their function is no longer required. The small concrete collection weirs below the camp pad will remain in place as small check dams, with the small volumes of water will be allowed to drain passively to Camp Creek.

The CWP and its pumping systems to the WTP will remain in place until use of the WTP is no longer required, to allow continued availability of the CWP as emergency storage in case of WTP upset conditions. When no longer required, the pumps will be removed off site and re-purposed or disposed at an appropriate facility. Remaining HDPE pipe will be removed and cut into sections and either disposed in the underground mine or transported off site for disposal at a licensed facility. The CWP will remain in place, with the spillway remaining intact, and allowed to spill passively via the current emergency spillway, to the WRTSF. Safety berms installed around the mill pad and heavy shop up-gradient of the CWP, will remain in place.

3.7.5 Pipelines

Description

External (not contained in buildings) surface pipelines at the mine site include HDPE pipelines for the contact water management system, tailings discharge (twin lines) (Figure 3.7-4), WTP/sewage treatment plant (STP) effluent discharge and direct emergency discharge from CWP, and fresh potable water supply from the potable water well. The tailings and effluent discharge lines also extend into the ponded portion of the WRTSF, where the tailings lines are suspended within the WRTSF by cable systems (Figure 3.1-3). The tailings lines are partly buried along their surface extents.

Closure

During closure, the tailings and WTP/STP/CWP effluent discharge pipelines will be disconnected from the mill building and the CWP. Effluent pipelines disconnection will not occur until water treatment has concluded, and the potable water pipeline will remain in place until potable water supply via pipeline is no longer required. Above ground pipeline sections will be cut up and taken off site for disposal in a landfill or placed in the underground mine. Areas around the cut pipe (i.e. at transitions from surface to buried sections) will be re-graded to provide stable slopes at the cut edges and to cover the pipe openings of the buried portions of the pipeline. The tailings pipeline cables will be removed via the winch systems, with the latter then removed from site for re-use or recycling. Pipeline sections within the WRTSF will removed to the extent feasible and disposed as described above; sections that cannot be removed will remain in the WRTSF. The other surface pipelines will be cut and taken off site to a landfill or placed in the underground mine.

3.7.6 WRTSF

Description

All mine surface and underground waste rock is managed as PAG in accordance with Permit M-243 and Pretivm's ML/ARD Management Plan (Appendix 4-1) and is required to be either backfilled in the underground mine below the ultimate flooding elevation or deposited subaqueously in the WRTSF (refer to M-243 Condition D.3.c.iii). WRTSF operations are conducted in accordance with applicable conditions in Permit M-243 and the Waste Rock and Tailings Storage Facility OMS Manual (Appendix 4-1). The mine progression drawings (refer to Sections 2.3 and 2.4) show the horizontal extents of the waste rock dump crest and toe for the years noted based on the current (2020) mine plan. Surface waste rock excavation from mine construction is complete and these materials have been placed in the WRTSF; subaqueous deposition of underground mine waste rock will be ongoing through mine life.

Most waste rock is deposited deep within the ponded portion of the WRTSF soon after reaching the WRD platform. Waste rock may be stored subaerially for up to two years. Some is temporarily stored in surface stockpiles at the WRD as part of facility management, and some is used temporarily to surface the WRD, with the latter then replaced with either 'fresh' PAG rock or NPAG rock excavated from the km 72 NPAG quarry within the two year period. There are also provisions to leave exposed

rock causeways on the WRD with shallow ponded sections in between; this approach has not been used to date and is more likely to occur late in mine life as the waste rock dump platform nears its maximum extent.

Tailings are NPAG and either piped into the underground mine where they are disposed as paste backfill in mined out stopes or discharged deep within the ponded portion of the WRTSF via the two tailings pipelines. Expected tailings extents throughout mine life, based on the 2020 mine plan, are also depicted on the Chapter 2 mine progression drawings.

Closure

Waste rock dump development is planned such that most PAG rock destined for the WRTSF will be placed subaqueously during mine operations. At mine closure, remaining sections of exposed PAG rock on the dump pad will be placed subaqueously in a retreat manner, such that there will be a shallow ponded area over much of the pad and exposed NPAG rock on surface near the shore of the WRTSF.

Tailings will remain submerged deep in the WRTSF. HDPE pipelines in the WRTSF and the tailings pipeline support cable system will be addressed as described above in Section 3.7.5. The WRTSF sediment curtain will be removed as feasible and these materials disposed off site at a licensed facility or within the underground mine. Curtain materials that cannot be recovered from the WRTSF will remain in place.

Most of the WRTSF will remain ponded and appear as a lake at mine closure.

3.7.7 WRTSF Outlet Weir and Reclaim Pump System

Description

An instream concrete and steel weir structure is located at the WRTSF outlet (Figure 3.1-3), with steel walkways and a steel building housing flow measurement equipment and the reclaim pump system (Figure 3.7-18). HDPE pipe and electrical service lines connect the weir to the mill building. The weir structure provides a means to accurately measure discharge rates from the WRTSF and a suitable location for water withdrawal and pumping from the WRTSF. Details of the weir are provided in the Water Management Plan - OMS Manual (Appendix 4-1).

Figure 3.7-18. WRTSF Outlet Weir (Photo July 2020).

Closure

The weir structure, building and water reclaim system will remain in place until the underground mine has flooded to its ultimate elevation and supplemental water withdrawal from the WRTSF is no longer required. The reclaim pumps and instrumentation will be removed from site for re-use or disposal at an appropriate facility. The weir building will be disassembled. Piping and unrecyclable building contents and components will be removed from site and disposed at appropriate facilities. The steel building and walkway components will be removed recycled or disposed at appropriate facilities. The concrete lock blocks that form a portion of the structure will be removed from site for re-use if they are still usable, and otherwise disposed within the exposed NPAG portion of the WRD pad. The central reinforced concrete portion of the weir will remain in place, where it is expected that it will be gradually covered by streambed sediments. Deconstruction and removal will be the opposite of construction, using a small temporary coffer dam structure to isolate the demolition activities from the flow in the stream.

3.7.8 Overburden Stockpiles

Approximately 30,000 m^3 of overburden is stockpiled at the mine site, in two stockpiles (Figure 3.7-4). As discussed in Section 3.3.2.1, this material is not currently recommended for use in final site reclamation. The current plan for these stockpiles at closure is to recontour them to lower profiles that are less likely to erode.

3.7.9 KM 72 NPAG Quarry

Description

The km 72 NPAG quarry is located near the east end of the WRTSF (Figure 3.7-2); it occupies approximately 14.36 ha, is excavated in rock, and is benched into a steep, bedrock slope (Figure 3.3-7).

The NPAG quarry will remain in place at closure (Figure 5.3-8). No reclamation measures are feasible.

3.7.10 Snow Dump

The snow dump is located outside of the gossanous area, between the km 72 NPAG quarry and mine site (Figure 3.1-3); it covers approximately 4.98 ha (Figure 3.7-2). The snow dump is where snow removed during mine site snow clearing activities is stockpiled due to lack of space for this within the mine site. Most of the material placed at the snow dump is snow and ice, however surficial road and pad materials are unavoidably mixed with the snow when surfaces are ploughed or excavated to the ground surface. This results in some accumulation of these materials at the snow dump site. The snow dump site is graded during the summer months to help accelerate melting.

Snow removal needs will decline significantly during closure, which is expected to allow remaining snow and ice in the snow dump to fully melt. Once snow and ice have melted to ground surface, the area will be decompacted as appropriate and the area will be seeded with Pretivm's high elevation seed mix (Table 3.3-2).

3.7.11 Road Reclamation

Description

The BJAR, of which the km 71.6 to 73.3 section is located within the M-243 area (Figure 3.1-3 and Figure 3.7-3), will remain in use during closure until water treatment is no longer required and mine site area reclamation activities are complete. Other mine site area roads will remain in use during closure until access to facilities are no longer required.

Closure

Mine site area roads will be decommissioned and reclaimed when the infrastructure to which they provide access is no longer required. The last site roads to be closed will be those providing mine site access to the underground mine and to the WTP. As roads are decommissioned, culverts will be removed and cross drains installed to restore natural drainage and provide for stable post-mine drainage. Steel culverts will be taken off site for recycling or disposal. The areas where the culverts have been removed will be graded to provide stable slopes at exposed cuts and riprapped as appropriate. Road surfaces will be decompacted up to 15 cm (Figure 3.7-2) as appropriate and feasible, to allow for surface drainage and to reduce the potential of road surface failure with time. Ditches will be backfilled and graded to provide surface stability and reduce erosion potential.

3.7.12 Brucejack Transmission Line

The Brucejack transmission line will be dismantled when its power supply is no longer required. The towers will be de-strung and the tower conductor will be removed. Helicopters will be used to re-spool and remove the conductors and to dismantle and remove the towers. Conductor and tower materials will be transported off site and recycled or disposed as appropriate. Substation equipment and components will be removed using ground access. All transmission line and substation components will be transported off site for recycling or disposal as appropriate. The substation fence

will be removed, and the pad area will be decompacted and seeded with Pretivm's low elevation seed mix (Table 3.3-1).

3.8 LONG-TERM STABILITY

The Brucejack Mine's surface development, such as the constructed pads, underground mine workings and surface openings, the WRTSF, and the km 72 NPAG quarry, has been designed and constructed following professional geotechnical and other engineering practices, and in accordance with M-243 and Code requirements. Stable landforms require a stable foundation. Pre-construction geotechnical field investigations were completed to support engineering designs and the regulatory approval application process. Mine facilities and post-closure surface landforms sites are designed to remain stable throughout mine life and beyond through closure and post-closure.

Geotechnical monitoring programs are in place for underground mine ground control and the WRD during mine operations. A Subsidence Monitoring and Management Plan (Appendix 4-2) has been prepared in accordance with M-243 Condition D.13, and will be implemented going forward through mine operations. A post-closure geotechnical monitoring program will be developed as mine closure approaches.

Closure of facilities will be planned and implemented such that final structures and landforms will have long-term stability during post-closure. Surface water will be managed to reduce its effect on the constructed landforms. Diversion channels will remain in place to direct water away from the infrastructure pads and in a manner that will not cause surface erosion in adjacent areas. Water from within the contact water catchment will be allowed to drain passively to the WRTSF and Camp Creek.

A bulkhead designed to be water retaining will be constructed in the WZ portal at closure. A bulkhead will also be installed in the VOK portal. All raises will be sealed. Both the bulkheads and the seals will be engineered and designed to be structurally sound. All designed landforms and structures will be monitored for stability during operations and following closure.

3.9 FIVE YEAR MINE RECLAMATION PLAN

As noted above, design of the Brucejack mine site has focussed on efficient and essential use of surface disturbances. This total surface disturbance area is small (terrestrial infrastructure area of 60.79 ha) (Section 3.1; Figure 3.7-1) and is needed for operations. Because of this small, intensively used footprint and the lack of NPAG mine wastes that could be sub-aerially disposed, revegetation has not been possible to date and there are no opportunities beyond those available at a small scale which will be used to support reclamation research (see Section 3.3.7) for progressive reclamation within the five year period covered by this plan (through 2025). Reclamation activities will be completed during the closure phase.

3.10 TEMPORARY CLOSURE

In the event of a temporary shutdown, irrespective of length, a small contingent of personnel will remain on site to implement care and maintenance activities, including ongoing mine dewatering and associated water treatment, and to maintain site security. This is necessary for environmental protection purposes and to protect the considerable investment in site infrastructure and equipment. Fuel will be removed from equipment that is not required and removed for off site disposal. The VOK portal building will be secured to prevent portal access, and the WZ portal will be gated and secured. All vent raises have metal screens to prevent access; therefore, no additional measures will be needed for these. Site security systems will remain operational.

Road and transmission line monitoring and maintenance will continue. The gate at the Bell-Irving River crossing near Highway 37 will be kept locked to prevent unauthorized access to the BJAR and the mine, and will be monitored for signs of unlawful entry. The gate at Wildfire security will be kept secured.

If an extended temporary shutdown of the mine occurs that lasts longer than one year, constructed pads and slopes will be checked for stability and erosion and any areas requiring maintenance will be treated as soon as possible. WRD operations will be continued until all subaerially exposed waste rock has been subaqueously disposed in accordance with M-243 requirements. A long-term care and maintenance plan will be prepared for regulatory approval.

At times of temporary halts to mine operations, ML/ARD management will be continued, including operation of the WTP. As well, the following will be implemented to reduce or mitigate potential ML/ARD risk:

- Subaqueous deposition of subaerially exposed rock will be continued;
- any remaining tailings will be disposed of in the WRTSF or underground; and
- any remaining WTP sludge that cannot be co-mingled with tailings for discharge to the WRTSF will be transported off site for disposal at a licensed facility.

In the event of temporary shut-down periods, access along the BJAR will continue to be managed to minimize indirect mortality (i.e., hunting) of wildlife and access will continue to be controlled by personnel at the security gate at Highway 37. Signs will be posted to indicate access closure warnings. The mine infrastructure will also be managed by removing all wildlife attractants and through continued implementation and enforcement of the other management plans.

3.11 POST-CLOSURE MONITORING AND MAINTENANCE

3.11.1 Overview

Monitoring is required under Section 10.7.21 of the Code to demonstrate that reclamation and environmental protection objectives including land use, productivity, water quality, and stability of structures are being achieved. Mine closure is estimated to be completed within three years, followed

by post-closure monitoring over the following five years. The results of the monitoring program are to be included in the Annual Reclamation Report (per Section 10.4.4 of the Code). The following is a description of conceptual post-closure monitoring plans planned for the Brucejack Mine. The length of time required for monitoring may be extended if the early results of the program indicate further monitoring is required. All facilities will be dismantled and/or removed from site during closure with site drainage and landforms contoured to a final closed state. As such, regular maintenance is not anticipated. Maintenance needs will be identified on an as-needed basis based on the monitoring and inspection programs described below.

Monitoring programs will be designed to address evolving needs and are anticipated to decrease in scope through the closure and post-closure periods. During the closure period, monitoring programs will focus on monitoring and management of reclamation activities. During the post-closure period, monitoring programs will focus on demonstrating reclamation success. The general scope of monitoring programs will include:

- Surface water quality, sediments, and aquatic biological resources;
- Groundwater quality and levels, including water chemistry and level in the underground mine as feasible;
- Structural integrity of portal bulkheads and raise seals at the mine site;
- Geotechnical assessment of post-mine landform and watercourse stability, including for the surface above the underground mine (subsidence); and
- Assessments of reclamation program success in meeting the end land use objectives.

Additional details are provided in the subsections below.

3.11.2 Surface Water Quality and Aquatic Biological Resources

Surface water quality, sediments and aquatic biological resources monitoring and sampling will continue to follow the requirements of PE-107835 through the closure period, with the exception of the reference site (L3) and discharges as these cease (first tailings, then mine water and CWP influents and WTP effluent once water treatment has concluded, and finally treated domestic wastewater once the site has been fully closed). Once there is no longer a presence at the Brucejack site, surface water quality monitoring will continue twice per year (spring/fall) and sediments and aquatic biological sampling will be sampled twice during the first five years (e.g., years 2 and 5) of the post-closure period.

3.11.3 Groundwater

Monitoring of select groundwater wells pertinent to closure and post-closure monitoring will continue quarterly through the active closure period. The program will be reviewed prior to the end of closure and adjusted as appropriate with MECCS and MEMPR approval. It is expected that annual monitoring of a reduced number of groundwater wells will continue for the first five years of the post-closure period.

The underground mine water level will be monitored as feasible during the course of flooding, and post-closure via the groundwater well monitoring program.

3.11.4 Mine Openings

The structural integrity of the WZ and VOK bulkheads and raise seals will be checked annually to the end of the first five years of the post-closure period, to ensure these are performing as required and designed. Repairs will be carried out if and as needed.

3.11.5 Geotechnical

Geotechnical monitoring, inspection and assessment of post-mine landforms will continue annually during closure and the first five years of post-closure. Implementation of the Subsidence Monitoring and Management Plan (Appendix 4-1) will continue through closure, and with a modified program appropriate to post-closure, and as approved by MEMPR, implemented during the first five years of post-closure. The CWP and its spillway, and post-mine watercourses (particularly the two diversion channels) will continue to be inspected annually for structural integrity and performance. Post-mine, pads, decommissioned roads (including drainage crossings), the km 72 NPAG quarry, the WRD pad, and other post-mine landscape features will be inspected for stability and performance. Repairs will be carried out if and as needed.

3.11.6 Reclamation Program

Monitoring and assessments of the reclamation program success in meeting the end land use objectives will be conducted annually during the first five years of post-closure. This will include monitoring for erosion, particularly any determined to affect surface water quality downstream of the WRTSF discharge, and remediation as appropriate. The mine site area will be inspected to confirm that closure measures implemented to achieve the end land use objective of matrix habitat remain intact, with remedial measures implemented as appropriate as necessary. Natural locally endemic vegetation species encroachment onto the mine site will be monitored and documented.