TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

List of Tables

TABLE OF CONTENTS (cont.)

List of Figures

5.4.5 Ecosystem Composition

5.4.5.1 Introduction

The Ecosystem Composition valued component (VC) and five corresponding indicators were selected for inclusion in the assessment, taking into consideration the baseline study findings, conservation status, and inputs from local stakeholders, government agencies, and regulators. Indicator selection was based on ecosystems that have intrinsic ecological or social value, are representative of overall ecosystem conditions, and are sensitive to Project activities. The identification and selection process involved in selecting VCs and their indicators can be found in **Section 4.2** and **Section 5.4.1**. The five indicators selected were:

1. Ecosystem distribution;
2. Riparian areas;
3. Old-growth forest;
4. Sparsely vegetated areas; and
5. Traditional use plants.

Key interactions that have greater potential to result in significant adverse residual effects on ecosystem composition are limited to within the mine site (**Section 5.4.5.3.4.1**) where the alteration of baseline ecosystems will be disturbed such that baseline conditions cannot be reclaimed and will be lost. Such is a key interaction related to the mine site project component.

The linear components will have relatively moderate or negligible interactions with composition compared to the mine site. The linear components have smaller footprints with effects that are less concentrated, and the application of Best Management Practices (BMPs) and avoidance measures during construction will minimize effects on ecosystem composition. Ongoing vegetation management during the operations and closure phases will continue to inhibit vegetative growth. However, the removal of the transmission line and subsequent closure and post-closure reclamation activities are expected to restore disturbances to baseline ecosystems.

The indicators used to evaluate potential key effects on the Ecosystem Composition VC include ecosystem distribution, riparian ecosystems, old growth forest, sparsely vegetated ecosystems and traditional plant use. Note: Wetlands are discussed exclusively within **Section 5.3.7**.

5.4.5.1.1 Relevant Legislation and Legal Framework

The vegetation section is included as a requirement of both the BC *Environmental Assessment Act* (*EAA)* (Government of BC, 2002a) and the *Canadian Environmental Assessment Act (CEA Act)* (Government of Canada, 2012). The baseline report for this Project meets the criteria of the BC *EAA* to support this assessment. Assessment of vegetation is also considered in the *Mines Act* (Government of BC, 1996a), which requires the development of an environmental management and reclamation plan to support the decommissioning/closure of the Project.

Legal protection for riparian areas in BC is included in the BC *EAA*, and the *Forest and Range Practices Act* (Government of BC, 2002b; Stevens, 1995).

Invasive plant designation and legislation are addressed by the BC Ministry of Agriculture's *Weed Control Act* (Government of British Columbia, 2011), and invasive plant regulation is a provision of the *Forest and Range Practices Act*, SBC 2002b, c. 69, relevant to the enactment of this regulation: sections 47 and 141.

5.4.5.2 Valued Components Baseline

5.4.5.2.1 Information Sources

Any land altering activities associated with development of the Project have the potential to affect Ecosystem Composition. These include recreational activities, forestry activities, transportation and access, mining activity, trapping and guide outfitting, traditional land use, and other projects such as the Nulki Hills Wind Project.

This section provides a summary of the baseline program for vegetation; please refer to the Vegetation Baseline Report (**Appendix 5.1.3.3A**).

Baseline information was used to characterize the pre-Project, or baseline conditions specifically upland vegetation resources. The only pre-existing data for the Project area was Predictive Ecosystem Mapping (PEM) and Vegetation Resources Inventory (VRI). An ecosystem map was completed for the Project area, taking into account PEM and VRI information. Baseline information was assembled from a number of sources, including:

- BC Species and Ecosystem Explorer (BC Conservation Data Centre (BC CDC), 2013);
- E-Flora BC (Klinkenberg, 2013);
- PEM (Timberline 2001a, 2001b);
- Biogeoclimatic (BGC) Line Work Version 8 (Data BC, 2012);
- Endangered Species And Ecosystems – Non-Confidential Occurrences (DataBC, 2013a);
- Endangered Species and Ecosystems – Masked (Confidential) Occurrences (DataBC, 2013b);
- Digital Terrain Resource Information Management (TRIM) (DataBC, 2013c);
- Vanderhoof Land and Resource Management Plan (LRMP) (BC Ministry of Environment, Lands and Parks [BC MELP], 1997);
- Ecological Reports Catalogue (BC Ministry of Environment [BC MOE], 2013a);
- Cross-Linked Information Resources (BC MOE, 2013b);

- The Invasive Alien Plant Program (BC Ministry of Forests, Lands and Natural Resource Operations [BC MFLNRO], 2013a);
- Vegetation resource inventory (BC MFLNRO, 2013b);
- Field Guide to Noxious and Other Selected Weeds of BC (Ministry of Agriculture, 2013);
- Northwest Invasive Plant Council 2012 Strategic Plan and Plant Profiles (Northwest Invasive Plant Council, 2012); and
- Cariboo Chilcotin Coast Invasive Plant Committee (CCCIPC) 2012 Regional Strategic Plan (CCCIPC, 2012).

5.4.5.2.2 Spatial Boundaries

The Project study area is the collective term for the Local Study Areas (LSAs) and Regional Study Area (RSA) of the proposed mine site and associated components: the mine site access road, freshwater supply system, airstrip, transmission line (including the potential Mills Ranch and Stellako re-routes), and the existing Kluskus Forest Service Road (FSR).

The AIR describes the LSA as follows (**Table 4.3-1** of the **Section 4**):

- Mine Site: 500 m from the proposed Project mine site boundary; and
- Transmission line, mine access road, airstrip, freshwater supply pipeline, and Kluskus FSR: 100 m beyond the proposed linear component boundary.

The rationale in the AIR for the LSA is as follows (**Table 4.3-1** of the **Section 4**):

- Includes the entire mine site where soil and vegetation will be removed and considers a buffer to take into account potential edge effects and particulate matter deposition; and
- Includes entire linear components and a buffer to take into account potential edge effects and particulate matter deposition. The buffer for the linear components is smaller given that vegetation or soil removal will be conducted in lower quantities.

The LSAs of the mine site access road, freshwater supply system, airstrip, transmission line, and Kluskus FSR extend 100 metres (m) beyond their corridors in either direction. The corridor is the area defined as the right-of-way (ROW) plus a 50 m buffer. The ROW for all linear features is 20m with the exception of the transmission line, which is 40 m; the freshwater supply line and airstrip access is 10m; and the airstrip is 200 m corridor (100 m corridor with 50 m buffer each side). The mine site LSA includes the proposed footprint and a buffer zone of 500 m around the proposed mine site. The combined total area of all LSAs is approximately 14,000 ha. The various LSAs are meant to circumscribe the boundaries of the effects of the Project components, including a buffer zone. The LSAs encapsulate any predicted contiguous effects from activities that may cause disturbance to the natural vegetation surrounding the proposed mine footprint and other Project components.

The AIR describes the RSA as follows (**Table 4.3-1** of the **Section 4**):

- Mine Site: 3,000 m from the proposed Project mine site boundary; and
- Transmission line, mine access road, airstrip, freshwater supply pipeline and Kluskus FSR: 500 m beyond their proposed linear component boundary.

The rationale in the AIR for the RSA is as follows (**Table 4.3-1** of the **Section 4**):

- Considers an additional buffer around the LSA to take into account potential interactions with other projects or activities.

The regional study area (RSA) is one continuous boundary surrounding all of the proposed features of the Project and totals approximately 31,000 ha exclusive of the LSA. **Figure 5.4.5-1** shows summaries and the Project LSAs and RSAs.

A Cumulative Effects Assessment (CEA) includes past, present, and reasonably foreseeable future human activities likely to result in residual effects or effects on each VC; only those human activities having residual effects, which have a temporal and spatial overlap with the Project's residual effects, are considered. The spatial limits of the CEA are consistent with the RSA.

5.4.5.2.3 Temporal Boundaries

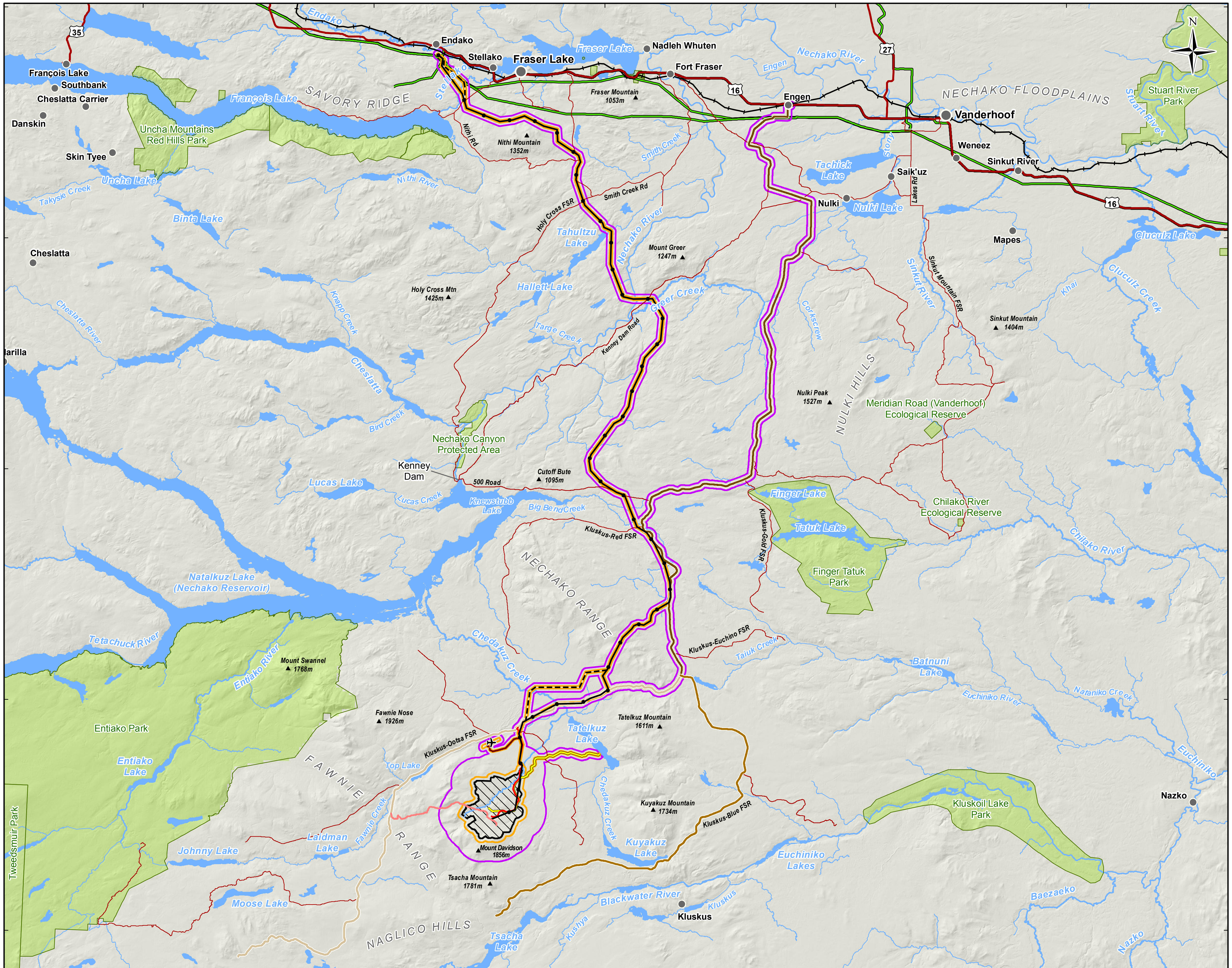
Temporal boundaries were based on a reasonable expectation of the time over which the Project could affect the selected VCs. Temporal considerations are described based on the four proposed phases of the Project: construction, operations, closure, and post-closure.

Preliminary timeframes of the four temporal phases, contingent on permitting, are as follows:

1. Construction phase – estimated 24-month period, to start immediately following receipt of the required permits.
2. Operations phase – estimated to extend for approximately 17 years, starting once the plant site is constructed, commissioned, and ready for ore processing.
3. Closure phase – estimated to occur following the cessation of the mining and ore processing activities, when the mine site buildings and infrastructure will no longer be needed.
4. Post-closure phase – to start immediately after completion of the closure activities.

5.4.5.2.4 Administrative Boundaries

The project falls within three administrative regions: Region 5, Cariboo; Region 6, Skeena; and Region 7A, Omineca. It is also administrated by the Vanderhoof Land and Resource Management Plan (LRMP) (British Columbia Ministry of Environment, Lands and Parks, 1997). Refer to **Section 7** for detailed land use management and zoning.



Legend

- Populated Place
- Highway
- Railway
- Existing Transmission Line
- Parks and Protected Areas

Forestry Service Roads

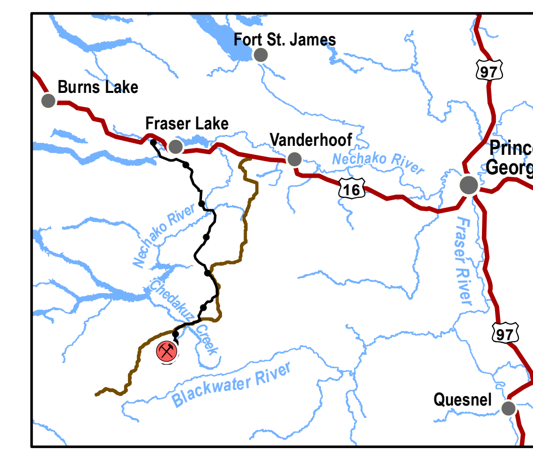
- Kluskus FSR
- Kluskus-Ootsa FSR
- Kluskus-Blue FSR
- Other

Project Components

- Proposed Airstrip
- Proposed Airstrip Access Road
- Proposed Mine Access Road
- Exploration Road
- Proposed Transmission Line
- Proposed Transmission Line Reroutes
- Proposed Fresh Water Pipeline
- Proposed Mine Site

Terrain, Soils, and Vegetation

- Local Study Area
- Regional Study Area



Scale: 1:500,000

0 5 10 20

Kilometres

Reference

BC Government GeoBC Data Distribution
NRCAN Geobase
Ministry of Forests, Lands and Natural Resource Operations

CLIENT: newgold

PROJECT: Blackwater Gold Project

Terrain Soils and Vegetation Study Area

DATE: February, 2014	ANALYST: WR	Figure 5.4.5-1
JOB No: VE52277	QA/QC: MY	PDF FILE: 06-200-033_Veg_SA_v2.pdf
GIS FILE: 06-200-033_Veg_SA_v2.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

Y:\GIS\Projects\VE\VE52095_Richfield_Blackwater\Mapping\06_vegetation\EIA\06-200-033_Veg_SA_v2.mxd

5.4.5.2.5 Technical Boundaries

Knowledge of the ecosystems potentially affected by the Project is based on ecosystem maps prepared for the Project, field surveys, and the professional judgement of the study team. Ecosystem maps prepared for the Project were designed to meet the specific standards regarding mapping scale and survey intensity needed to support the planned uses. Field surveys were based on provincial standards and protocols. Information and spatial data sources used in the assessment included BC VRI Mapping, PEM of the Vanderhoof Forest District, and Land Management Handbook 24 (LMH) (DeLong et al., 1993). Plant species and ecosystems at risk were identified using the BC CDC database, both the Element Occurrence Records and BC Species and Ecosystem Explorer. The ecological setting was described using two hierarchical classification systems: Ecoregions of BC (Demarchi, 2011) and the Biogeoclimatic Ecosystem Classification (BEC) (DeLong et al., 1993).

5.4.5.2.6 Methods

Ecosystem mapping was completed for the entire Project's LSAs and RSA. Terrestrial ecosystem mapping (TEM) to provincial standards (Resource Inventory Committee, 1998), based on three-dimensional (3D) aerial photograph interpretation and bioterrain, was completed for the mine site, mine site access road, freshwater supply system, and airstrip. A modified TEM was completed for the transmission line, based on 2D aerial photograph interpretation and bioterrain. The existing Kluskus FSR was mapped using existing PEM data, and cross-referenced with available 2D imagery and VRI data where available.

Field data was collected over a three-year period, from 2011 through 2013. Three types of survey data were included: TEM, plant species at risk, and select wetland plots. Wetland survey data conducted within the upland LSA were added to the overall dataset. In total, 492 plots were completed, 363 within the combined LSAs, and 71 within the RSA. Due to Project footprint changes, 58 plots were located outside of the upland RSA. Further details can be found in the Vegetation Baseline Report (**Appendix 5.1.3.3A**); however, for convenience some are included below.

5.4.5.2.6.1.1 Field Surveys

Based on the Standards for Terrestrial Ecosystem Mapping in British Columbia (RIC, 1998), three different survey intensity levels (SIL) were used to assist the ecosystem mapping process (**Table** 5.4.5-1). The mine site was given the highest SIL due to the degree of disturbance anticipated in the area; SIL-3 or 26% to 50% of polygon inspection. Whereas for linear components, such as the water pipeline and transmission line, where less disturbance was anticipated, SIL-5 or 5% to 14% polygon inspection. For existing linear components such as the Kluskus Forest Service Road (FSR) where very limited disturbance was anticipated due to a possible re-alignment upgrade, reconnaissance level survey or 0% to 4% of polygon inspection. Ecosystem mapping was completed at a scale of 1:5,000 for all project components with the exception of the existing Kluskus FSR, which used 1:20,000 scale Predictive Ecosystem Mapping (PEM).

The actual number of inspections or plots established were based on the number of polygons mapped. Average polygon size was determined to be approximately 5 ha. Generally polygons were restricted to a minimum of 0.5 ha unless a specific feature, such as a sensitive ecosystem, needed to be captured. In the minesite LSA a total of 237 plots were completed at a ratio of 9 fulls: 183 grounds and 45 visuals.

Table 5.4.5-1: Target Sampling Intensity Levels for Ecosystem Mapping

Sampling Intensity Level	Percentage of Polygons Inspected
3	26% to 50%
5	5% to 14%
R	0% to 4%

5.4.5.2.6.2 Ecosystem Distribution

Ecosystem distribution is based on an ecosystem map. Due to the complexity and extent of the Project area, the method of ecosystem mapping varied depending on the Project component. The mine site and water pipeline were mapped using a standard TEM approach based on bioterrain and 3D aerial photograph interpretation. The transmission line and access road were mapped using a modified TEM approach. The Kluskus FSR was mapped using a combination of PEM and VRI with available imagery. In all instances, the BEC (Meidinger and Pojar, 1991) and Land Management Handbook 24 (DeLong et al., 1993) provided a framework for organizing ecological data, and assisted the classification of ecosystems into site series. Detailed methods are provided in the Vegetation Baseline Report (**Appendix 5.1.3.3A**).

Mine Site, Mine Site Access Road, Fresh Water Supply System, and Airstrip

The most current (2011) high resolution digital aerial photography and laser imaging detection and ranging (LIDAR) were available for the entire extent of the mine site, fresh water supply system, airstrip and mine site access road LSAs and RSAs. The chosen mapping method (TEM) was followed to provincial standards and guidelines.

Map units were delineated with 3D aerial photograph interpretation using a 3D software program (DAT/EM's Summit Evolution). Digital aerial photograph models are processed and loaded into the 3D mapping program, which allows the photo interpreter to see the landscape in 3D and delineate ecosystems into polygons.

The first step delineates geomorphological terrain features using high resolution LIDAR imagery. Examples of terrain features include morainal blanket (Mb), glaciofluvial terrace ($F^{G}t$), and colluvial veneer (Cv). Once the terrain mapper has delineated and attributed the bioterrain polygons, an ecosystem mapper views the aerial photographs in 3D to further refine the polygons based on ecological features such as slope, aspect, soil moisture, soil nutrient, slope position, and vegetation. Each polygon is attributed with up to three ecosystem components each represented by a decile to indicate percent cover. BGC zone lines are refined based on plot data collected in the field. The TEM map legend is provided in Annex 1 of **Appendix 5.1.3.3A**.

Transmission Line

Modified ecosystem mapping was completed for the proposed transmission line study area, using the best available imagery; satellite imagery with digital 50 cm colour precision ortho photo, 1 m digital elevation model (DEM) and 1 m digital terrain model (DTM) per km^2, (August 2012). Satellite imagery does not provide a 3D platform for photo interpretation; therefore, ecosystem mapping was completed in a 2D setting using ArcMap. To provide a visual representation of relief in order to verify slope position, slope, and aspect, a model was created. The slope-aspect model provides a visual representation of relief using colour hues and saturation to depict aspect and slope on a 2D map (Brewer and Marlow, 1993). Three slope categories were mapped with differences in saturation, and near flat slopes were mapped with gray for all aspects. Lightness sequences were used to approximate relief shading. The detailed mapping procedure is outlined as follows.

Current high-resolution digital aerial photography was not available; however, older (1953 and 2000) low-resolution hardcopy photography was available. A draft bioterrain map was created using the hardcopy photography to manually delineate bioterrain features. The bioterrain line work was then transferred digitally to ArcMap.

Existing Predictive Ecosystem Mapping (PEM) conducted by Timberline (2001a; 2001b) covered all of the proposed transmission line. Using the bioterrain polygons as a polygon base, the polygons were attributed and labelled using PEM as a guide. Vegetation resource inventory (VRI) (BC MFLNRO, 2013b) data, such as age class, were used to determine the structural stage associated with forested polygon ecosystems. The VRI data also provided information on tree species and presence of wetlands, herb, and shrub communities. The satellite imagery provided sufficient detail to distinguish non-forested, forested, vegetated, non-vegetated, herbaceous, and shrub-dominated sites.

Kluskus Forest Service Road

The proposed mine site access road departs from the main Kluskus FSR at approximately the 120 km post, and heads directly south to the proposed mine site. The majority of the Kluskus FSR was mapped using existing PEM in combination with satellite and web-based imagery where available and VRI data. With respect to PEM reliability, the Timberline report states "average knowledge base accuracy of all BGC units was 94.5%" based on 355 point samples (Timberline, 2001). For the portions of the road where PEM was not available (i.e, the last 20 km at the north end of the Kluskus FSR), polygon lines were delineated and digitized in 2D using ArcMap, and attributed using the imagery and VRI data.

5.4.5.2.6.3 Riparian Areas

Riparian areas are corridors that occupy the borders of streams, lakes, and wetlands, which develop a typically rich and diverse array of vegetation. In addition to contributing to biodiversity, riparian areas provide bank stability, connective corridors within a landscape, and are an important source of coarse woody debris and nutrient input for aquatic ecosystems (Banner and MacKenzie, 1998). Riparian areas rely on adjacent upland habitat to support these important ecological functions. Because these functions are generally found within one tree height of a stream (Stevens et al., 1995), a buffer of 30 m (assumed average tree height) in the LSA was applied. For the purposes of depicting riparian areas on the ecosystem maps, TEM and PEM polygons containing greater than 50% wetland ecosystems were buffered by 30 m, as were TRIM features (i.e., rivers, streams, lakes, marshes, and swamps). Riparian areas also included the following riparian floodplain associations: Drummond's willow–Bluejoint, Black cottonwood–Dogwood–Prickly rose, low bench shrub floodplain and low bench sedge herb floodplain.

5.4.5.2.6.4 Old-Growth Forest

The age of old-growth forests varies from one BGC unit to another (**Table 5.4.5-2**). Forests that occur in areas where stand-initiating events are frequent have shorter intervals since their last disturbance, and old-growth forests in these areas are generally older than 140 years. The time since last disturbance in stands with infrequent stand-initiating events is greater, and old-growth forests in these areas are generally older than 250 years old. The amount of old-growth forest in each of the Project components was calculated based on the ecosystem map. In TEM, structural Stage 7 represents old forest; therefore, ecosystem units mapped as structural Stage 7 were selected to represent old-growth forest. Structural stages were cross-referenced with VRI to validate the structural stage attributes.

Table 5.4.5-2: Relationship between BGC Unit and Old-Growth Forest

Group	BGC Unit	Old-Growth Forest
A	SBSdk, SBSdw3, SBSmc2, SBSmc3	>140 years
B	ESSFmv1, ESSFmv1p	>250 years

Note: BGC = Biogeoclimatic Unit; SBSdk = Dry Cool Sub-Boreal Spruce; SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant; SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant; ESSFmv1p = Nechako Very Cold Engelmann Spruce-Subalpine Fir Parkland variant

The Kluskus FSR mapping was based on PEM, not TEM; as a result, structural stage designations were not available for each ecosystem unit. The structural stage for the PEM portion was determined by intersecting each PEM polygon with a VRI polygon, thus linking the required age class attribute. In VRI, age Class 8 represents 141 to 250 years, and age Class 9 represents over 251 years. Once age classes were associated with each polygon, each age class was verified using the latest imagery available and converted to a structural stage, to provide a seamless map product.

5.4.5.2.6.5 Sparsely Vegetated

Sparsely vegetated ecosystems are defined as areas where rock or talus limits vegetation establishment; vegetation cover is discontinuous and interspersed with bedrock or rock outcrops (Iverson et al., 2008). These include talus, cliff, and rock outcrops.

5.4.5.2.6.6 Traditional Use Plant Habitat

Traditional, ecological, or community knowledge is built up by a group of people through generations of living in close contact with nature. This knowledge includes unique information about the local environment and native plant uses. Gathering information on how plants have and are being used in order to better assess potential Project effects is ongoing. Based on information from local Aboriginal groups regarding plant harvesting (**Section 14.2**), berry-producing plants were selected to represent traditional use plants. Traditional use plant habitat information was derived from baseline plot data that included plant species presence and abundance. Plant species that were berry-producing and occurred within the Project area were selected and correlated to site series. Using the ecosystem map, potential berry-producing areas were identified.

A total of 19 upland berry-producing species were chosen to represent traditional use and were confirmed to occur in the Project area by the baseline field program. All are upland plant species and are listed in **Table 5.4.5-3**. The leaves, stems, and roots are used for food, medicine, or tea. (Young and Hawley, 2010; Turner, 1997).

Table 5.4.5-3: Traditional Use Plant Species

Scientific Name	Common Name
Amelanchier alnifolia	Saskatoon
Arctostaphylos uva-ursi	kinnickinnick
Fragaria virginiana	wild strawberry
Prunus pensylvanica	pin cherry
Ribes glandulosum	skunk currant
Ribes hudsonianum	northern black currant
Ribes lacustre	black gooseberry
Ribes sp.	currant or gooseberry
Ribes triste	red swamp currant
Rubus idaeus	red raspberry
Rubus parviflorus	thimbleberry
Rubus pedatus	five-leaved bramble
Rubus pubescens	dwarf red-raspberry
Shepherdia canadensis	soopolalie
Vaccinium caespitosum	dwarf blueberry
Vaccinium membranaceum	black huckleberry
Vaccinium myrtilloides	velvet-leaved blueberry
Vaccinium scoparium	grouseberry
Viburnum edule	highbush cranberry

In total, 247 plots and 40 ecosystems recorded berry-producing plants that occur at upland sites. Total percent cover was calculated for each plot, and these values were used to calculate mean percent cover for each of the 40 ecosystems. Certain ecosystems were discarded as berry-producing habitat, based on their mean percent cover. Ecosystems with less than four percent berry cover were removed from the analysis as being too low to provide adequate berry picking opportunities. A standard survey plot is 400 m^2; four percent is equivalent to 16 m^2. Ecosystems providing four percent or greater berry-producing plant cover were carried forward into the analysis: 236 plots, and 32 ecosystems.

The table below (**Table 5.4.5-4**) shows the list of 32 ecosystems that are likely to have sufficient berry – producing plants and berry picking potential.

Table 5.4.5-4: Ecosystems Likely to Have Berry Picking Potential

BGC Unit	Site Series	Map code	Mean Percent Cover of Berry-Producing Plants	Number of Plots
SBSdk	01	SP	18	5
SBSdk	02	LJ	16	3
SBSdk	03	LC	50	1
SBSdk	05	SF	17	1
SBSdk	06	ST	16	6
SBSdk	08	CD	4	5
SBSdw3	01	SP	11	2
SBSdw3	03	LC	18	2
SBSdw3	04	SR	25	9
SBSdw3	07	ST	7	5
SBSdw3	81	SW	55	1
SBSmc2	01	SB	15	8
SBSmc2	02	PH	19	1
SBSmc2	04	HB	27	3
SBSmc2	05	TC	20	1
SBSmc2	09	SD	9	2
SBSmc3	01	SB	19	26
SBSmc3	02	LJ	11	6
SBSmc3	03	LF	24	38
SBSmc3	04	SS	4	3
SBSmc3	05	BH	26	12
SBSmc3	06	BF	12	7
SBSmc3	07	ST	24	5
ESSFmv1	00	VG	15	1
ESSFmv1	01	FR	31	35
ESSFmv1	02	LC	9	10
ESSFmv1	03	FF	20	16
ESSFmv1	04	FG	28	13
ESSFmv1p	00	PC	21	5
ESSFmv1p	00	KC	20	1
ESSFmv1p	00	FC	15	1
ESSFmv1p	00	FH	6	2

Note: BGC = biogeoclimatic; SBSdk = Dry Cool Sub-Boreal Spruce; SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant; SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant; ESSFmv1p = Nechako Very Cold Engelmann Spruce-Subalpine Fir Parkland variant

5.4.5.2.7 Results

An environmental baseline summary for vegetation is presented in **Section 5.1.3.3**, and the complete baseline can be found in Vegetation Baseline **Appendix 5.1.3.3A**. A brief summary of results is provided below (**Table 5.4.5-5**).

The Project area spans two ecoregions (the Fraser Plateau and Fraser Basin), and three ecosections (the Nazko Upland, Bulkley Basin and Nechako Lowland). Six BGC units occur within the LSA area:

- SBSdk (Dry Cool Sub-Boreal Spruce subzone);
- SBSdw3 (Stuart Dry Warm Sub-Boreal Spruce variant);
- SBSmc2 (Babine Moist Cold Sub-Boreal Spruce variant);
- SBSmc3 (Kluskus Moist Cold Sub-Boreal Spruce variant);
- ESSFmv1 (Nechako Moist Very Cold Engelmann Spruce-Subalpine Fir variant); and
- ESSFmv1p (Nechako Moist Very Cold Engelmann Spruce-Subalpine Fir Parkland variant).

The combined Project LSAs (the mine site, mine site access road, freshwater supply system, airstrip, transmission line, and Kluskus FSR) total approximately 14,300 ha. Of that, 6,122 ha forms the mine site LSA, with the remaining 8,178 ha forming the linear components' LSAs (mine site access road, freshwater supply system, airstrip, transmission line, and Kluskus FSR).

Most of the Project area lies within the SBSmc3 BGC unit, totalling 5,263 ha (37%). The BGC representing the second highest area is the ESSFmv1, which totals approximately 4,443 ha (31%), followed in decreasing order by the SBSdk, SBSdw3, SBSmc2, and ESSFmv1p units. The proposed mine site LSA is represented by three BGC units: listed from highest to lowest area, they are ESSFmv1, SBSmc3, and ESSFmv1p.

Upland forest and other categories occupy 90% of the combined LSAs while the remaining 10% is wetland. The latter is described and assessed in **Section 5.3.7**.

The dominant ecosystem by BGC unit is the Subalpine fir–Rhododendron–Feathermoss (ESSFmv1 01/FR), with a total of 2,010 ha (14%). The second most common unit is the Hybrid white spruce–Huckleberry (SBSmc3 01/SB), with a total of 1,981 ha (14%); the Hybrid white spruce–Purple peavine (SBSdk 01/SP) occupies a total of 990 ha (7%) (**Table 5.4.5-6**).

Table 5.4.5-5: Baseline Distribution of BGC Units in the LSAs

Project Component/ BGC Unit	Mine Site		Mine Site Access Road		Freshwater Supply System		Airstrip		Transmission Line		Mills Ranch		Stellako		Kluskus FSR		Total Area	Total Percent
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
SBSdk	0	0	0	0	34	0	0	0	1,690	39	143	28	0	0	715	29	2,582	18
SBSdw3	0	0	0	0	0	0	0	0	818	19	0	0	200	100	238	10	1,256	9
SBSmc2	0	0	0	0	0	0	57	27	339	8	0	0	0	0	160	7	556	4
SBSmc3	1,788	0	195	100	338	91	151	73	1,286	30	362	72	0	0	1,143	47	5,263	37
ESSFmv1	4,115	1	0	0	0	0	0	0	158	4	0	0	0	0	171	7	4,443	31
ESSFmv1p	220	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	220	2
Total BGC	**6,123**	**1**	**195**	**100**	**372**	**91**	**208**	**100**	**4,290**	**100**	**505**	**100**	**200**	**100**	**2,427**	**100**	**14,320**	**100**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSdk = Dry Cool Sub-Boreal Spruce; SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant; SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant; ESSFmv1p = Nechako Very Cold Engelmann Spruce-Subalpine Fir Parkland variant; FSR = Forest Service Road

Table 5.4.5-6: Baseline Distribution of Ecosystems in the LSAs

BGC Unit	Site Series Name	Site Series	Map Code	Area (ha)	Percent Area (%)
SBSdk	Saskatoon–Slender wheatgrass	81	SW	1	<1
SBSdk	Hybrid white spruce–Purple peavine	01	SP	990	7
SBSdk	Lodgepole pine–Juniper–Ricegrass	02	LJ	28	<1
SBSdk	Lodgepole pine–Feathermoss–Cladina	03	LC	221	2
SBSdk	Douglas–fir–Soopolallie–Feathermoss	04	DS	5	<1
SBSdk	Hybrid white spruce–Spirea–Feathermoss	05	SF	167	1
SBSdk	Hybrid white spruce–Twinberry–Coltsfoot	06	ST	513	4
SBSdk	Black cottonwood–Dogwood–Prickly rose	08	CD	4	<1
SBSdk	Drummond's willow–Bluejoint	00	Fl05	1	<1
Total Upland				**1,929**	**13**
SBSdk	Cultivated field	00	CF	160	1
SBSdk	Gravel pit	00	GP	1	<1
SBSdk	Pond	00	PD	2	<1
SBSdk	River	00	RI	9	<1
SBSdk	Rural	00	RW	6	<1
SBSdk	Exposed soil	00	ES	2	<1
SBSdk	Road surface	00	RZ	189	1
Total Non-Vegetated, Sparsely Vegetated, and Anthropogenic				**369**	**3**
Total SBSdk				**2,298**	**16**
SBSdw3	Saskatoon–Slender wheatgrass	82	SW	3	<1
SBSdw3	Hybrid white spruce–Douglas fir–Pinegrass	01	SP	505	4
SBSdw3	Douglas fir–Lodgepole pine–Cladonia	02	DC	12	<1
SBSdw3	Lodgepole pine–Feathermoss–Cladina	03	LC	58	<1
SBSdw3	Hybrid white spruce–Ricegrass	04	SR	105	1
SBSdw3	Lodgepole pine–Black spruce–Feathermoss	05	BF	38	<1
SBSdw3	Hybrid white spruce–Pink Spirea–Prickly rose	06	SS	12	<1
SBSdw3	Hybrid white spruce–Twinberry	07	ST	310	2
SBSdw3	Hybrid white spruce–Oakfern	08	SO	14	<1
SBSdw3	Drummond's willow–Bluejoint	00	Fl05	2	<1
Total Upland				**1,061**	**7**
SBSdw3	Cultivated field	00	CF	10	<1
SBSdw3	Gravel pit	00	GP	7	<1
SBSdw3	River	00	RI	3	<1
SBSdw3	Rural	00	RR	0	0
SBSdw3	Road surface	00	RZ	68	<1
SBSdw3	Urban	00	UR	3	<1
Total Non-Vegetated, Sparsely Vegetated and Anthropogenic				**91**	**1**
Total SBSdw3				**1,151**	**8**

BGC Unit	Site Series Name	Site Series	Map Code	Area (ha)	Percent Area (%)
SBSmc2	Hybrid white spruce–Huckleberry	01	SB	304	2
SBSmc2	Lodgepole pine–Huckleberry–Cladonia	02	PH	53	<1
SBSmc2	Black spruce–Lodgepole pine–Feathermoss	03	BM	27	<1
SBSmc2	Hybrid white spruce–Huckleberry–Dwarf blueberry	04	HB	29	<1
SBSmc2	Hybrid white spruce–Twinberry–Coltsfoot	05	TC	8	<1
SBSmc2	Hybrid white spruce–Oak fern	06	SO	44	<1
SBSmc2	Hybrid white spruce–Twinberry–Oak fern	08	ST	12	<1
SBSmc2	Hybrid white spruce–Devil's club	09	SD	13	<1
SBSmc2	Hybrid white spruce–Horsetail	10	SH	3	<1
Total Upland				**494**	**3**
SBSmc2	River	00	RI	1	<1
SBSmc2	Road surface	00	RZ	23	<1
Total Non-Vegetated, Sparsely Vegetated and Anthropogenic				**23**	**<1**
Total SBSmc2				**517**	**4**
SBSmc3	Hybrid white spruce–Huckleberry	01	SB	1,981	14
SBSmc3	Lodgepole pine–Juniper–Dwarf huckleberry	02	LJ	49	<1
SBSmc3	Lodgepole pine–Feathermoss–Cladina	03	LF	912	6
SBSmc3	Hybrid white-spruce–Huckleberry-Soopolallie	04	SS	180	1
SBSmc3	Black spruce–Huckleberry–Spirea	05	BH	547	4
SBSmc3	Black spruce–Lodgepole pine–Feathermoss	06	BF	95	1
SBSmc3	Hybrid white-spruce–Twinberry	07	ST	598	4
Total Upland				**3,583**	**25**
SBSmc3	Pond	00	PD	9	<1
SBSmc3	Gravel pit	00	GP	3	<1
SBSmc3	Lake	00	LA	1	<1
SBSmc3	Exposed soil	00	ES	4	<1
SBSmc3	River	00	RI	<1	<1
SBSmc3	Road surface	00	RZ	342	2
SBSmc3	Urban	00	UR	2	<1
Total Non-Vegetated, Sparsely Vegetated, and Anthropogenic				**358**	**2**
Total SBSmc3				**3,941**	**28**
ESSFmv1	Subalpine fir–Rhododendron–Feathermoss	01	FR	2,011	14
ESSFmv1	Lodgepole pine–Huckleberry–Cladonia	02	LC	366	3
ESSFmv1	Subalpine fir–Huckleberry–Feathermoss	03	FF	834	6
ESSFmv1	Sitka valerian–Globeflower moist meadow	00	VG	0	<1
ESSFmv1	Subalpine fir–Huckleberry–Gooseberry	04	FG	558	4
Total Upland				**3,769**	**26**
ESSFmv1	Exposed soil	00	ES	112	1
ESSFmv1	Road surface	00	RZ	46	<1
ESSFmv1	Mine	00	MI	9	<1

BGC Unit	Site Series Name	Site Series	Map Code	Area (ha)	Percent Area (%)
ESSFmv1	River	00	RI	0	<1
ESSFmv1	Rock outcrop	00	RO	0	<1
ESSFmv1	Gravel pit	00	GP	4	<1
ESSFmv1	Talus	00	TA	2	<1
Total Non-Vegetated, Sparsely Vegetated, and Anthropogenic				**174**	**1**
Total ESSFmv1				**3,942**	**28**
ESSFmv1p	Subalpine fir–Dwarf blueberry–Dicranum parkland	00	FB	6	<1
ESSFmv1p	Altai fescue–Cladonia grassland	00	FC	10	<1
ESSFmv1p	Subalpine fir–Indian Hellebore	00	FH	36	<1
ESSFmv1p	Subalpine fir–Heather parkland	00	FM	2	<1
ESSFmv1p	Kinnikinnick–Cladonia	00	KC	1	<1
ESSFmv1p	Mountain-heather–Slender hawkweed	00	MH	2	<1
ESSFmv1p	Subalpine fir–Whitebark Pine–Crowberry parkland	00	PC	80	1
ESSFmv1p	Scrub birch–Altai fescue shrub steppe	00	SF	17	<1
ESSFmv1p	Sitka valerian–Globeflower moist meadow	00	VG	19	<1
ESSFmv1p	Whitebark pine krummholtz	00	WK	16	<1
ESSFmv1p	Whitebark pine–White mountain avens	00	WW	28	<1
Total Upland				**218**	**2**
ESSFmv1p	Moraine	00	MN	0	0
ESSFmv1p	Talus	00	TA	1	0
Total Non-Vegetated, Sparsely Vegetated, and Anthropogenic				**1**	**0**
Total ESSFmv1p				**220**	**2**
Total Upland				**11,846**	**83**
Total Non-Vegetated, Sparsely Vegetated, and Anthropogenic				**1,019**	**7**
Subtotal				**12,865**	**90**
Total LSA				**14,320**	

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSdk = Dry Cool Sub-Boreal Spruce; SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant; SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant; ESSFmv1p = Nechako Very Cold Engelmann Spruce-Subalpine Fir Parkland variant

The RSA is one continuous boundary surrounding all the proposed features of the Project, with a total area of approximately 45,000 ha. This section describes and quantifies the portion of the RSA that lies outside of the LSAs, which totals approximately 31,000 ha. The RSA contains seven BGC units, the same as those described above for the LSAs, with the addition of the Undifferentiated Boreal Altai Fescue Alpine subzone (BAFAun).

The SBSmc3 unit covers the most area in the RSA, with a total of 12,274 ha (40%) (**Table 5.4.5-7**). The SBSdk and ESSFmv1 are similar in size, with totals of 6,595 ha (22%) and 6,493 ha (21%), respectively. The SBSdw3 is the fourth largest unit in area, with a total of 3,210 ha (10%). The

SBSmc2 is the fifth largest BGC unit, with a total of 1,257 ha (4%), followed by the ESSFmv1p, with a total of 777 ha (3%), and the BAFAun, which, with a total of 43 ha (<1%) occupies the smallest area. Annex 3.2 of **Appendix 5.1.3.3A** includes a map book showing Ecosystem Mapping.

Table 5.4.5-7: Baseline Distribution of BGC Units in the RSA

BGC Unit	Area (ha)	Percent (%)
SBSdk	6,595	22
SBSdw3	3,210	10
SBSmc2	1,257	4
SBSmc3	12,274	40
ESSFmv1	6,493	21
ESSFmv1p	777	3
BAFAun	43	<1
Total	**30,649**	**100**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSdk = Dry Cool Sub-Boreal Spruce; SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant; SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant; ESSFmv1p = Nechako Very Cold Engelmann Spruce-Subalpine Fir Parkland variant; BAFAun = Undifferentiated Boreal Altai Fescue Alpine subzone

5.4.5.2.8 Past, Present and Future Projects and Activities

The Ecosystem Composition VC potentially interacts with other projects or activities in the RSA as a result of spatial or temporal overlap. These include recreational activities, forestry activities, transportation and access, mining activity, trapping and guide outfitting, traditional land use, and other projects. **Table 4.3-11** in **Section 4** shows the Summary Project Inclusion List developed for cumulative effects assessment. Some of these can be quantified, including the Nulki Hills Wind Project, mining activity (quarries and prospecting), forestry cutblocks and woodlots, and forestry-related roads. **Section 5.4.5.5** describes in detail the cumulative effects on the Ecosystem Composition VC.

5.4.5.2.9 Traditional Knowledge

Ecosystem composition and protection of plants species are important objectives for local residents and Aboriginal groups, and members of these groups have expressed interest in the Project's effects on ecosystem composition. These groups' comments during the engagement and consultation process have provided insights into traditional, ecological, or community knowledge, which is defined as a body of knowledge built up by a group of people through generations of living in close contact with nature.

Aboriginal groups value ecosystem composition and the plants it supports. Plants play an important role as a food source for Aboriginal groups. Ethnobotanical studies demonstrate that the traditional Dakelh (Carrier) diet was varied, and included seasonal plant foods such as green shoots, fruits, and roots (Cole and Lockner, 1989). Typically, plant gathering occurred in spring and early summer. Dakelh peoples would harvest edible roots from cow parsnip, wild rhubarb, and fireweed. Plant bulbs were eaten fresh, or roasted in the ground using hot rocks and various barks. The inner cambium bark was harvested from pine trees, and sometimes from poplar trees as well (Hall, 1992). Traditionally, berries were considered crucial in trade and potlatch ceremonies.

Berry picking and plant gathering still occurs today. Interviews conducted with members from Saik'uz First Nation, Stellat'en First Nation, Ulkatcho First Nation and Lhoosk'uz Dene Nation demonstrate reliance on plants for food. Summer season is when berries are picked. Representatives from the First Nation groups noted they consume soapberries, huckleberries, raspberries, strawberries, and blueberries.

5.4.5.3 Potential Effects of the Proposed Project and Proposed Mitigation

This subsection identifies and analyzes potential adverse effects on the ecosystem composition VC resulting from the proposed Project's construction, operations, closure and post-closure phases.

Potential effects of the Project on Ecosystem Composition were assessed by superimposing the ecosystem map produced for the Vegetation Baseline Report (**Appendix 5.1.3.3A**) over the Project footprint and LSAs to calculate spatial effects on all indicators of the VC.

Mitigation measures to reduce or eliminate potential effects of the Project on ecosystem composition were identified for each phase of the Project and described in each indicator section (**Section 5.4.5.3.6.5**; **Section 5.4.5.3.7.5**; **Section 5.4.5.3.8.5**; **Section 5.4.5.3.9.5**; **Section 5.4.5.3.10.5**). These include mitigation measures already included in the Project Description (**Section 2.2**), mitigation measures included in the Environmental Management Plan (EMP) (**Section 12**), and mitigation measures identified in this effects assessment that will become commitments once the Project is approved and permitted.

5.4.5.3.1 Identification and Description of Potential Adverse Effects from Other Past, Present, and Certain or Reasonably Foreseeable Future Project or Activities

Table 4.3-11 in **Section 4** shows the Summary Project Inclusion List developed for cumulative effects assessment. A number of projects and human activities contain spatial overlap with the proposed features of the Project. These include recreational activities, forestry activities, transportation and access, mining activity, trapping and guide outfitting, traditional land use, and other projects. Some of these can be quantified, including the Nulki Hills Wind Project, mining activity (quarries and prospecting), forestry cutblocks and woodlots, and forestry-related roads. The RSA is a total of 45,000 ha (including the LSA), of which 14,689 ha interacts with these other projects or activities. **Section 5.4.5.5** describes in detail the cumulative effects on the Ecosystem Composition VC.

The MPB infestation has affected large areas of mature pine forest in the region, some of which were harvested. Stands with a low proportion of pine affected by MPB and not harvested remain as altered but functioning ecosystems on the landscape.

5.4.5.3.2 Assessment Cases

The LSAs' boundaries were used to assess the Ecosystem Composition VC. Assessment included potential cumulative effects of the Project, along with other past, present, or reasonably foreseeable projects in the CESA.

The following sections present the assessment of how each phase of the Project—construction, operation, closure, and post-closure—may affect the three indicators: whitebark pine habitat, potential plant species-at-risk habitat, and ecosystems at risk. Mitigation measures to reduce or eliminate potential effects of the Project on plant species and ecosystems at risk were identified during each Project Case.

Because environmental effects on vegetation resources are primarily concentrated in the construction phase, with little change in conditions anticipated during the operations and closure phases, these three phases will be treated as a single scenario and defined as the Project case. Assessment Cases will include the baseline, Project, and post-closure cases, and are described in more detail below.

- The baseline case represents vegetation conditions prior to Project-specific developments. The baseline for vegetation incorporates the environmental effects of existing human-caused disturbances (e.g., forest harvesting, roads, other mine footprints, etc.);
- The Project case represents the baseline case with the addition of the Project footprint for the construction, operations, and closure phases. While recognizing that development, decommissioning, and reclamation will be progressive throughout the Project, the Project case represents the maximum disturbance scenario; and
- The post-closure case represents conditions forecast into the future at the end of closure (i.e., following decommissioning and closure of the mine). This scenario assumes implementation of all mitigation recommendations and components of the Conservation and Reclamation Plan and that measures of success have been met.

5.4.5.3.3 Key Effects

Four key effects were identified for the Ecosystem Composition VC: ecosystem loss, dust deposition, nitrogen deposition, and spread of invasive species. The degree to which each of these effects will influence ecosystem composition indicators will vary between Project components. Irreversible Project effects will occur within the mine site facilities, corresponding with mine-related landforms, such as the open pit, tailings storage facility (TSF), waste rock dumps, and Site C borrow area (**Section 2.6**, Reclamation and Closure).

The majority of the potential Project effects will occur during the construction phase. The operations phase will have limited ongoing disturbances, with the exception of features such as the open pit, TSF, and waste rock dumps, which will be continually altered during the operations phase. Reclamation of mine site facilities will be progressive during all phases, but most activity will occur during the closure phase.

Six Project components have the potential to adversely affect vegetation resources: the mine site; mine site access road; freshwater supply system; airstrip; transmission line; and Kluskus FSR. Planned Project activities associated with the Kluskus FSR are limited to relatively minor upgrades, involving little additional clearing or disturbance. Approximately 3 km of new access road construction is required for realignment purposes.

5.4.5.3.3.1 Ecosystem Loss

The largest effect on the Ecosystem Composition VC will be the loss of baseline ecosystems, referred to as ecosystem loss. Ecosystem loss is due to the removal of existing vegetation during the construction phase, which includes site clearing, salvage and stripping of surface soil, site grading and stockpiling of salvaged materials, and the removal and alteration of overburden. After decommissioning, reclamation and remediation will likely restore most of the areas affected, although the composition and structure of the restored habitat will be substantially different from what existed before mining.

During operations, further vegetation disturbance is expected to be limited. Soil redistribution will take place during the closure phase, and will involve the placement of salvaged soil as a cap on top of the overburden material to facilitate reclamation and revegetation of the site; refer to the Reclamation and Closure Plan (RCP) (**Section 2.6**).

Vegetation disturbance and alteration is expected to occur where Project-related activities cut and remove vegetation but leave active soil layers. This type of activity will result in a temporary and reversible loss particularly along linear corridors where reclamation is expected to restore the baseline condition ecosystems over time; in some cases a minimum of 80 years post-closure to reach a mature forest stage.

5.4.5.3.3.2 Dust Deposition

Dust deposition may result in degradation of individual plants and ecosystems. The main Project activities producing dust (particulate matter or PM) will be land clearing, excavating, and grading during construction, and mine fleet operations, material handling and vehicular traffic during operations (**Section 5.2.4**). This includes fixed and mobile internal combustion engines sources of dust.

Fugitive dust emissions may be elevated during times of high winds and dry weather (US Environmental Protection Agency [US EPA], 1995). A number of variables influence the effect of dust on vegetation: the concentration of dust particles in the ambient air; deposition rates; size distribution of dust particles; dust chemistry; meteorological and local microclimate conditions; the degree of penetration of dust into vegetation; and plant morphology, such as leaf surface roughness and wetness. Plant species vary in their susceptibility to dust. Low-growing species such as bryophytes and lichens have been found to be particularly sensitive to dust deposition (Walker and Everett, 1987; Farmer, 1993).

The amount of dust deposited on a particular area depends also on composition and moisture condition of the road surface, number, and type of vehicles, topographic setting, wind characteristics, and vegetation structure (Walker and Everett, 1987; Meininger and Spatt, 1988; Farmer, 1993; Edvardsson and Magnusson, 2009). Information on how the total amount of dust per area per temporal scenario might affect the specific ecosystems in the Project area is unknown. However, dust deposition studies suggest that 70% to 75% of the dust is deposited within 10 m of the road, 93% by 30 m, and 97% by 125 m (Walker and Everett, 1987).

5.4.5.3.3.3 Spread of Invasive Plants

Invasive plants are plants that are not native to BC and have the potential to pose a threat to the natural environment (BC MOFR, 2010). Invasive plants are extremely aggressive, and can out-compete native vegetation, leading to dense, widespread infestations of invasive plants. Through competition for water, nutrients, and space, invasive plants displace native species and can disrupt natural ecosystem function. Lacking natural pathogens or predators, invasive plants can quickly spread and potentially negatively affect species and ecosystems at risk. As a result, the diversity of native plant communities is reduced, and ecosystem composition changes.

The disturbance of soil and movement of machinery and equipment in such areas as the mine site, mine site access road, airstrip, freshwater supply system, and transmission line can introduce invasive plants into the ecosystems of the Project area. Once invasive plants are introduced, disturbance can spread them further where soils have been disturbed and equipment is mobile from one area to another. In total, 232 records of 24 invasive plant species identified by the Invasive Alien Plant Program (IAPP, 2013) were located within 20 km of the RSA, primarily along access roads. Invasive plants are a potential effect and a management concern. The area has experienced forestry operations for several decades, and access roads built to support these activities have provided a route for the spread of invasive plants.

5.4.5.3.3.4 Nitrogen Deposition

Nitrogen (N) deposition was considered a key effect as a result of air emissions modelling, which predicted nitrogen exceedances within the mine site LSA. Mining construction and operations will produce air emissions from a number of sources, with internal combustion engines as the primary output (**Section 5.2.4**). Linear corridors, such as unpaved roads, did not predict N exceedances.

Nitrogen deposition represents the sum of nitrogen species (e.g., NO, NO_2, HNO_3, and NO_3^-). As nitrogen is a nutrient, the deposition of nitrogen substances can influence aquatic and terrestrial ecosystems. As different plant species in these ecosystems respond to nitrogen loading differently, nitrogen deposition can potentially change ecosystem composition.

Nitrogen is one of the most limiting elements for plant growth, particularly in nutrient-poor habitats. Plants growing in these ecosystems are adapted to low nutrient conditions, and are typically not able to compete with other plants when nutrient levels increase, which can result in changes to species composition (Bobbink et al., 1998; Bobbink et al., 2002). Increased soil nitrogen can also lead to a change in the allocation of carbohydrates from roots to shoots (i.e., smaller root systems), making trees in the affected area, including the *SARA*-listed whitebark pine, potentially more susceptible to blowdown or drought stress (Grulke et al., 1998; Margolis and Waring, 1986). In addition, susceptibility to insect attack and/or white pine blister rust infection may be heightened if trees produce more needles or needles with different properties as a result of exposure to increased nitrogen levels (Throop and Lerdau, 2004).

Ecosystems and plant species vary in their sensitivity to nitrogen deposition. In general, sensitive ecosystems are those that occur in cold climates with long frost periods, and on dry soils with low base cation activity (Bobbink et al., 1998). Wetlands, alpine, and bog communities, and lichens and bryophyte species, have been shown to be especially sensitive to air emissions (Bobbink et al., 2002).

5.4.5.3.4 Effects Assessment

Potential Project effects on ecosystem composition were evaluated by examining how key effects are expected to affect the five indicators. These effects were analyzed in terms of the likelihood of occurrence in relation to Project activities during the Project and post-closure cases. There are six Project components carried into the effects assessment: the mine site, mine site access road, freshwater supply system, airstrip, transmission line, and Kluskus FSR (**Table 5.4.5-8**). For each of the six components, only those Project activities that were deemed likely to affect the indicators are shown. Details regarding the extent of Project effects for each of the Project components are provided in the effects assessment for each VC.

Table 5.4.5-8: Potential Environmental Effects from the Project on Ecosystem Composition by Project Phase and Component

Project Component	Potential Environmental Effect/Issue	Pathways for Effects	Project Phase			
			Project Case			Post-Closure Case
			Construction	Operations	Closure	Post-Closure
Site	Ecosystem loss	• Land clearing, excavating and grading • Surface water diversion, ditching, and sediment pond development	√	√		
	Dust deposition	• Land clearing, excavating and grading • Vehicular traffic and machinery operating at mine site	√	√		
	Nitrogen deposition	• Land clearing, excavating and grading • Mining operations and removal of soils/ore • Vehicular traffic • Other combustion engine emissions	√	√		
	Spread of invasive plants	• Land clearing, excavating, and grading • Stabilization, re-contouring, and/or cover placement and revegetation	√	√	√	√

Project Component	Potential Environmental Effect/Issue	Pathways for Effects	Project Phase – Project Case – Construction	Project Phase – Project Case – Operations	Project Phase – Project Case – Closure	Project Phase – Post-Closure Case – Post-Closure
		• Monitoring and maintenance of soil stability and vegetation				
Mine Site Access Road	Ecosystem loss	• Road construction, clearing of ROWs	√	√		
	Dust deposition	• Land clearing, excavating, and grading • Road construction • Vehicular traffic	√	√		
	Spread of invasive plants	• Land clearing, excavating, and grading • Stabilization, re-contouring, and/or cover placement, and revegetation • Monitoring and maintenance of soil stability and vegetation	√	√	√	√
Freshwater Supply System	Ecosystem loss	• Land clearing, excavating, and grading	√	√		
	Dust Deposition	• Vehicular traffic along access road	√	√		
	Spread of invasive plants	• Land clearing, excavating, and grading • Facility maintenance	√	√	√	√
Airstrip	Ecosystem loss	• Land clearing, excavating, and grading	√	√		
	Dust deposition	• Vehicular traffic along airstrip road	√	√		
	Spread of invasive plants	• Land clearing, excavating, and grading • Facility maintenance	√	√	√	√
Transmission Line	Ecosystem loss	• ROW clearing and tower construction/installation • Ongoing vegetation management	√	√		
	Dust deposition	• Vehicular traffic during along access roads	√	√		
	Spread of invasive plants	• Land clearing, excavating, and grading • Facility maintenance	√	√	√	√
Kluskus FSR	Ecosystem loss	• Rerouting and widening road	√	√		
	Dust deposition	• Vehicular traffic	√	√		
	Spread of invasive plants	• Vegetation clearing and road widening • Vehicular traffic	√	√	√	√

5.4.5.3.4.1 Mine Site

Within the mine site, baseline conditions will undergo varying degrees of alteration. Some areas designated as mine-related landforms in the RCP (**Section 2.6**) will be disturbed in ways that novel ecosystems, not present naturally, will be present post-closure. In such areas, baseline conditions cannot be reclaimed and will be lost. Mine-related landforms include the open pit, waste rock dumps, and TSF. In contrast, areas categorized as natural landforms will be affected to a lesser extent. At closure, these natural landforms will be reclaimed using native species mixes similar to baseline ecosystem species, and with mitigation measures implemented are expected to return to similar ecosystem types over time. Natural landforms will occur in association with the low-grade ore stockpiles, construction camp and associated facilities, processing plant, heavy equipment maintenance shop, warehouse and administration building, and assay lab.

The reclamation approach for the Project includes the incorporation of mine-related landforms into the landscape, and the re-establishment of natural landforms in the remaining sites.

Mine-related landforms, derived from mining activities (i.e., open pit, TSF, waste rock dumps), will be reclaimed into rocky slopes, slopes with upland beaches, wetlands, permanent ponds, and a pit lake.

Natural landforms, will have characteristics and reliefs similar to the pre-mining conditions. These include the areas of decommissioned mine buildings and infrastructure, the transmission line, and the freshwater system, including the water pipeline.

The reclamation design of mine-related and natural landforms will target the reclamation of pre-disturbance ecosystems on natural landforms, and establishing whitebark pine forest on the waste rock piles.

Mine activities are the main source for dust and nitrogen deposition. Species and/or ecosystems within dust deposition distances and/or areas predicted for nitrogen deposition will be affected during the construction and operations phases, with levels dropping off as the Project moves into the closure phase.

The large amount of soil disturbance associated with mine site activities will create conditions conducive to invasive species colonization and proliferation. Vulnerability to invasive species will continue until disturbed areas are dominated by targeted native species. This effect occurs from construction through post-closure, and for any vegetation indicators occurring in the mine site footprint.

5.4.5.3.4.2 Mine Site Access Road

Mine site access road construction and upgrades may potentially interact with Ecosystem Composition. Both clearing and ground disturbance could potentially result in the loss of ecosystems and individual plants, and changes in the structure and composition of plant communities. Use of the mine site access road during construction, operations, and closure may interact with vegetation indicators. Subsequent maintenance of the ROW may affect vegetation by mechanical or chemical means. Traffic on the road during construction, operations, and closure may affect indicators by depositing dust; however, this can be effectively mitigated through the use of dust control measures. Similar to the mine site, soil disturbances and vehicular traffic will increase the likelihood of invasive species proliferation. The mine site access road is not slated for reclamation, and will remain post-closure.

5.4.5.3.4.3 Freshwater Supply System

Most effects associated with the freshwater supply system will occur during clearing and earthmoving for the installation of the pipeline and other components. Until the disturbed soil is revegetated, this pipeline area will be vulnerable to invasive species colonization and proliferation. The freshwater supply system and associated access road will be reclaimed as part of closure activities. Portions of the system that were vegetated prior to the Project will be reclaimed to baseline ecosystems. Reclaimed road areas are anticipated to become upland forest.

5.4.5.3.4.4 Airstrip

Effects associated with the airstrip include land clearing, excavating, and grading associated with construction, dust deposition from vehicular and air traffic, and the potential spread of invasive species. The airstrip and associated access road will be reclaimed as part of closure activities. Portions of the system that were vegetated prior to the Project will be reclaimed to baseline ecosystems. Reclaimed airstrip areas are anticipated to become upland forest.

5.4.5.3.4.5 Transmission Line

The clearing of the transmission line will result in cutting of mature trees and other vegetation for the ROW. This activity will change the structure and composition of plant communities and ecosystem structure. Construction of the transmission line will involve the transportation of poles and cables, development of access roads and placement of poles and potential ecosystem loss for tower locations and access road areas. Associated ground disturbance and incremental vegetation clearing will remove some vegetation and cause changes in structure and composition in other areas.

Ongoing vegetation management during the operations and closure phases will continue to inhibit vegetative growth. Soil disturbance and vehicular traffic may promote invasive species proliferation. The removal of the transmission line and subsequent closure and post-closure reclamation activities are expected to restore disturbances to baseline ecosystems. The two alignment alternatives (the Mills Ranch and Stellako re-routes) are expected to have similar environmental effects, but are being evaluated separately for the ecosystem distribution indicator to quantify and qualify any differences in extent and magnitude.

5.4.5.3.4.6 Kluskus FSR

The Kluskus FSR is an existing road primarily used for forestry-related activities, and will be the primary Project access road. Effects from Project-related road use may include ecosystem loss due to road widening and realignment during the construction phase, increased dust during operations, and serving as a source of invasive species propagules.

5.4.5.3.5 Methods for Quantifying Effects

5.4.5.3.5.1 Ecosystem Loss

The magnitude of Project effects on ecosystem loss was calculated by superimposing the Project case footprint over the terrestrial ecosystem map (baseline case) for each Project component. The areas in hectares and percent affected by the Project compared to the baseline were then calculated to show the immediate effects of project construction. Next, the baseline case was compared to the post-closure case (at year 35), assuming successful reclamation, to determine the extent of any residual Project effects. The assessment of project effects is based upon this residual affected area.

5.4.5.3.5.2 Dust Deposition

The results of this Air Quality assessment (**Section 5.2.4**) show that the maximum predicted ground-level concentrations (including ambient background) for all contaminants are below the relevant regulatory objectives, except for the total suspended particulates (TSP), PM_{10}, and $PM_{2.5}$ predictions, which exceeded the applicable objectives. The maximum predicted TSP and inhalable particulate matter with aerodynamic diameter less than 10 µm (PM_{10}) concentrations will be adjacent to roads, and the predicted concentrations will decrease rapidly with distance from the roads. The maximum respirable particulate matter with aerodynamic diameter less than 2.5 µm ($PM_{2.5}$) concentrations are predicted to occur along the southern edge of the Project property (towards the peak of Mt. Davidson), and predicted concentrations will decrease rapidly with distance from the Project site.

Air emission results show that the highest level of dust generation and subsequent deposition in the LSAs is expected to occur during the construction and operations phases, with the majority of the total dust generated per day being within the mine site, and lesser amounts along unpaved roads (mine access road, Kluskus FSR, and airstrip access road). For example, total project emissions predicted for PM_{10} are approximately 6.90 tonnes per day (t/d) in the mine site and 0.28 t/d along unpaved roads (**Appendix 5.2.4A**) after mitigation measures are implemented.

Several mitigation actions to reduce fugitive dust are planned for the Project, including wetting soil surfaces and using coarse aggregate materials for road surfacing. Based on these factors, a 50 m buffer distance from roads was selected to assess the effects of dust on vegetation. Given that the highest volume of fugitive dust (t/d) is predicted for the mine site, and that the particle size is more likely to include fine materials (**Section 5.2.4**, Air Quality), a 125 m buffer was used to assess dust effects in the mine area. Existing roads and other anthropogenic features (e.g., cultivated fields, gravel pits, exposed soil, etc.) were not included in the dust assessment.

5.4.5.3.5.3 Nitrogen Deposition

Based on data from air emissions modelling (**Section 5.2.4**; **Appendix 5.2.4A**), areas where N deposition exceedances were predicted to occur were overlain on baseline ecosystems. A qualitative assessment of effects was based on a literature review of published effects of N deposition on indicators occurring in the Project area.

Nitrogen deposition was calculated using the CALPUFF model. The chemistry module, together with the wet and dry deposition scheme in the model, predicts the rate of generation and deposition of sulphates and nitrates from precursor pollutants. All sources from the mine site facility emitting NO_x were modelled to calculate hourly deposition rates of HNO_3 and other nitrogen species. Results were then converted into annual average nitrogen deposition in kg/ha/year (y) at each receptor.

Critical nitrogen deposition load levels were based on recommendations in Bobbink et al. (2002) for arctic, alpine, and scrub (5 kg to 10 kg $N/ha^{-1}/y^{-1}$) and boreal forest (10 kg to 20 kg $N/ha^{-1}/y^{-1}$). Also taken into consideration for establishing a critical load level for the assessment was the recommendation of a critical threshold of 6 kg $N/ha^{-1}/y^{-1}$ for boreal forests (Nordin et al., 2005). Given that the ecosystems and species in the Project area are adapted to cool, low-fertility conditions, and therefore more sensitive to N deposition, a value of 5 kg $N/ha^{-1}/y^{-1}$, representing the most conservative critical load for alpine and scrub, was chosen for determining exceedances. The predicted level of N deposition for a portion of the Project at the southern edge of the mine site is expected to exceed critical load levels for boreal forests, and arctic, alpine, and scrub habitats (Bobbink et al., 2002; Cumulative Environmental Management Association [CEMA], 2008).

Nitrogen deposition will cease after operations; however, the accumulated N will still exceed the level of 5 kg $N/ha^{-1}/y^{-1}$. A period of time will be required for N accumulation in existing plants and soil bacteria to decline to background levels; how long this will take is unclear.

5.4.5.3.5.4 Spread of Invasive Plants

Vegetation removal and/or soil disturbance associated with various Project activities are expected to create conditions conducive to the colonization and proliferation of invasive plant species. These conditions will likely occur for all Project phases and components.

The potential for invasive species colonization and subsequent effects on VCs is based on the interaction of many variables, and cannot be predicted based on current scientific knowledge or methods. Therefore, in order to mitigate potential effects due to the introduction of invasive plant species, an Invasive Species Management Plan (ISMP) (**Section 12**) will be implemented.

Practices provided in the Landscape, Soils and Vegetation Management and Restoration Plan (LSVMRP) (**Section 12.2.1.18.4.4**) and RCP (**Section 2.6**) also describe measures to manage invasive species for relevant Project phases or activities.

5.4.5.3.6 Indicator 1: Ecosystem Distribution

Ecosystem distribution was included because of the important role ecosystems play in providing habitat for species and ecosystem-level biodiversity.

5.4.5.3.6.1 Ecosystem Loss

The six Project components (mine site, mine site access road, freshwater supply system, airstrip, transmission line and Kluskus FSR) will experience variable degrees of potential ecosystem loss. Project-related ecosystem loss considered two categories based on the degree of disturbance. Highly disturbed areas are termed mine-related landforms in the RCP (**Section 2.6**), and occur where vegetation is cleared, active soil layers are removed, and topography is substantially altered from baseline conditions. These include the open pit, TSF, and waste rock dumps. Where possible, mine-related landforms will be reclaimed to native species, but will be substantially different from that which existed before mining. Facilities such as the open pit and portions of the TSF are considered permanent features and will not be reclaimed. Substantial changes to ecosystem distribution following mine reclamation were considered a permanent loss of those baseline ecosystems, and therefore a residual effect.

For Project components and activities where vegetation will be cleared, but where landforms are expected to remain relatively intact (“natural landforms” in the RCP), ecosystems are predicted to return to conditions similar to baseline over time, provided reclamation and mitigation measures are implemented.

A comparison of the baseline, Project, and post-closure cases for each of the relevant Project effects is presented. The last column (in **Table 5.4.5-9**) represents the change in area for each ecosystem from baseline to the reclaimed vegetation cover at post-closure. Where appropriate each of the six mine components is presented and discussed separately, including a discussion of the area and percentage of ecosystems in the LSA potentially lost due to the mine facilities. In order to rank residual effects, ecosystem loss was categorized by BGC unit and general cover type categories, including: upland; non-vegetated, sparsely vegetated, or anthropogenic; mine-related landform; reclaimed upland forest; and TSF and open pit.

5.4.5.3.6.1.1 Mine Site

The mine site LSA contains 5,132 ha of upland ecosystems and 172 ha of non-vegetated, sparsely vegetated, or anthropogenic cover mapped at baseline, for a combined total baseline area of 5,304 ha (**Table 5.4.5-9**).

During the Project case, a total of 2,514 ha (47% change) of upland ecosystems (mine-related and natural landforms) will be disturbed. Most of the effects will occur in the ESSFmv1 variant.

Post-closure and after reclamation, 1,495 ha occurring on mine-related landforms will be permanently lost resulting in a 28% ecosystem loss within the LSA. Reclamation will result in novel ecosystems where possible, with the exception of the open pit and TSF; however, reclaimed areas will differ substantially from baseline condition, and 1,495 ha is therefore considered a permanent loss. Of the 1,100 ha occurring on natural landform types, these will be reclaimed to baseline conditions over time, provided reclamation and mitigation measures are implemented.

Of the SBSmc3, 692 ha will be affected during the Project case. After reclamation, 348 ha will be reclaimed to baseline ecosystems, provided reclamation and mitigation measures are implemented. While 344 ha (mine-related landforms) will be permanently lost (open pit and TSF) or reclaimed to new ecosystems substantially different from baseline.

Of the ESSFmv1, 1,798 ha will be altered by mine site construction. After reclamation, 664 ha occurring in the natural landform type will be reclaimed to baseline ecosystems over time, and 1,134 ha (mine-related landform types) will either be permanently lost (open pit and TSF) or reclaimed to new ecosystems substantially different from baseline conditions.

Of the ESSFmv1p, 24 ha will be affected during the Project case. After reclamation, 7 ha will be reclaimed to baseline conditions, and 18 ha will be converted to something different from baseline (mine-related landform types).

Table 5.4.5-9: Ecosystem Distribution: Mine Site Effects on Ecosystem Loss in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSmc3	Hybrid white spruce–Huckleberry	01	SB	570	390	-180	-32	501	-69	-12
SBSmc3	Lodgepole pine–Juniper–Dwarf huckleberry	02	LJ	31	2	-29	-94	6	-25	-82
SBSmc3	Lodgepole pine–Feathermoss–Cladina	03	LF	615	249	-366	-60	427	-188	-31
SBSmc3	Hybrid white spruce–Huckleberry–Soopolallie	04	SS	57	8	-50	-87	21	-36	-63
SBSmc3	Black spruce–Huckleberry–Spirea	05	BH	36	31	-5	-15	35	-1	-2
SBSmc3	Black spruce–Lodgepole pine–Feathermoss	06	BF	7	2	-5	-67	5	-2	-30
SBSmc3	Hybrid white spruce–Twinberry	07	ST	115	66	-49	-43	96	-19	-16
Total SBSmc3 Upland				**1,431**	**747**	**-683**	**48**	**1,**091	**-340**	**-24**
SBSmc3	Road surface	00	RZ	22	14	-8	-38	18	-4	-19
Total SBSmc3 Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**22**	**14**	**-8**	**-38**	18	**-4**	**-19**
Mine-related landforms				0	0	0	0	344	344	100
Total SBSmc3 Reclamation				**0**	**0**	**0**	**0**	**344**	**344**	**100**
Total SBSmc3				**1,453**	**761**	**-692**	**-48**	**1,109**	**-344**	**-24**
ESSFmv1	Subalpine fir–Rhododendron–Feathermoss	01	FR	1,829	1,014	-815	-45	1,345	-484	-26
ESSFmv1	Lodgepole pine–Huckleberry–Cladonia	02	LC	363	150	-214	-59	201	-162	-45
ESSFmv1	Subalpine fir–Huckleberry–Feathermoss	03	FF	754	384	-369	-49	558	-196	-26
ESSFmv1	Subalpine fir–Huckleberry–Gooseberry	04	FG	538	273	-265	-49	374	-163	-30
ESSFmv1	Sitka valerian–Globeflower moist meadow	00	VG	<1	<1	0	0	<1	0	0
Total ESSFmv1 Upland				**3,483**	**1,820**	**-1,663**	**-48**	**2,478**	**-1,005**	**-29**

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
ESSFmv1	Exposed soil	00	ES	112	0	-112	-100	1	-111	-100
ESSFmv1	Mine	00	MI	9	0	-9	-100	1	-8	-91
ESSFmv1	Rock	00	RO	<1	<1	0	0	<1	0	0
ESSFmv1	Road surface	00	RZ	26	12	-15	-56	17	-9	-36
ESSFmv1	Talus	00	TA	2	2	0	0	2	0	0
Total ESSFmv1 Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**148**	**13**	**-135**	**-91**	20	**-128**	**-86**
Mine-related landforms				0	0	0	0	1,134	1134	100
Total ESSFmv1 Reclamation				**0**	**0**	**0**	**0**	**1,134**	**1,134**	**100**
Total ESSFmv1				**3,632**	**1,834**	**-1,798**	**-50**	**2,498**	**-1,134**	**-31**
ESSFmv1p	Subalpine fir–Dwarf blueberry– Dicranum parkland	00	FB	6	6	<-1	-6	6	<-1	-2
ESSFmv1p	Altai fescue –Cladonia grassland	00	FC	10	10	0	0	10	0	0
ESSFmv1p	Subalpine fir–Indian hellebore	00	FH	36	33	-3	-8	35	-2	-5
ESSFmv1p	Subalpine fir–Heather parkland	00	FM	2	2	0	0	2	0	0
ESSFmv1p	Kinnikinnick–Cladonia	00	KC	1	1	0	0	1	0	0
ESSFmv1p	Mountain-heather–Slender hawkweed	00	MH	2	2	0	0	2	0	0
ESSFmv1p	Subalpine fir–Whitebark pine–Crowberry parkland	00	PC	80	71	-10	-12	73	-7	-9
ESSFmv1p	Scrub birch–Altai fescue shrub steppe	00	SF	17	17	0	0	17	0	0
ESSFmv1p	Sitka valerian–globeflower moist meadow	00	VG	19	15	-4	-21	16	-3	-15
ESSFmv1p	Whitebark pine krummholtz	00	WK	16	16	0	0	16	0	0
ESSFmv1p	Whitebark pine–White mountain avens	00	WW	28	21	-7	-25	22	-5	-19
Total ESSFmv1p Upland				**218**	**194**	**-24**	**-11**	**201**	**-18**	**-8**

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case: Remaining (ha)	Project Case: Area Change (ha)	Project Case: Percent Change (%)	Post-Closure Case: Remaining and Reclaimed (ha)	Post-Closure Case: Area Change (ha)	Post-Closure Case: Percent Change (%)
ESSFmv1p	Moraine	00	MN	0	0	0	0	0	0	0
ESSFmv1p	Talus	00	TA	1	1	<-1	-1	1	<-1	-1
Total ESSFmv1p Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**1**	**1**	**0**	**0**	**1**	**0**	**0**
Mine-related landforms				0	0	0	0	18	18	100
Total ESSFmv1p Reclamation				**0**	**0**	**0**	**0**	**18**	**18**	**100**
Total ESSFmv1p				**220**	**196**	**-24**	**-11**	**202**	**-18**	**-8**
Total ESSF				**3,851**	**2,029**	**-1,822**	**-47**	**2,700**	**-1,151**	**-30**
Total Upland				**5,132**	**2,762**	**-2,370**	**-46**	**3,770**	**-1,363**	**-27**
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**172**	**28**	**-144**	**-83**	**39**	**-132**	**-77**
Total Mine Related Landforms				**0**	**0**	**0**	**0**	**1,495**	**1,495**	**100**
Total Area				**5,304**	**2,790**	**-2,514**	**-47**	**5,304**	**-1,495**	**-28**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant; ESSFmv1p = Nechako Very Cold Engelmann Spruce-Subalpine Fir Parkland variant
Numbers have been rounded up, and as a result totals may not equal the sum of the individual columns.
Mine-related reclamation (mine-related landforms, TSF, and pit lake) are Project-generated, and hence do not occur at baseline.

5.4.5.3.6.1.2 Mine Site Access Road

The mine site access road LSA contains 159 ha of upland ecosystems and 24 ha of non-vegetated, sparsely vegetated, or anthropogenic land for a total of 183 ha in the Project area.

During the Project case, construction and operation of the mine site access road will result in the clearing of 22 ha (14% change) of upland, all within the SBSmc3 BGC unit (**Table 5.4.5-10**). The largest amount of upland ecosystem lost because of the road during the Project case will occur in the Hybrid white spruce–Huckleberry (01/SB) (10 ha, 14%), Black spruce–Huckleberry–Spirea (05/BH) (3 ha, 11%), and Lodgepole pine–Feathermoss–Cladina (03/LF) (3 ha, 11%) site series.

The mine site access road ROW will overlay 4 ha of existing road surface; in addition, 22 ha of vegetation ecosystems will be converted to road, resulting in 26 ha of road surface post-closure. Post-closure, the mine site access road will be retained to allow access to the site, and therefore the ecosystem loss of 22 ha (14%) will be permanent.

5.4.5.3.6.1.3 Freshwater Supply System

The freshwater supply system contains 298 ha of upland ecosystems and 50 ha of existing road surface for a total of 347 ha in the LSA (**Table 5.4.5-11**). Construction and operation of the freshwater supply system will result in the clearing of 10 ha (3% change) of upland ecosystems. The largest area affected (4 ha, 4%) will occur in the SBSmc3 Hybrid white spruce–Huckleberry (01/SB) ecosystem, while the largest percent change (5%) will occur in the SBSmc3 Lodgepole pine–Juniper–Dwarf huckleberry (02/LJ) ecosystem.

Following initial construction, and continuing through decommissioning, Project-related disturbances will be reclaimed to conditions similar to baseline. Reclamation efforts will also include revegetating the road surface that was present at baseline to Upland Forest ecosystems, resulting in a 50 ha net gain of upland vegetation. The reclaimed road surface will vary substantially from baseline conditions, as baseline conditions are unknown; however, reclamation from a road surface to upland forest ecosystems will be considered a positive effect.

5.4.5.3.6.1.4 Airstrip

The airstrip Project component contains 173 ha of upland ecosystems and 19 ha of road for a total of 193 ha in the LSA (**Table 5.4.5-12**).

During the Project Case, construction and operation of the airstrip will result in the clearing of 21 ha (11% change). The largest areas affected will occur in the SBSmc3 Lodgepole pine–Feathermoss–Cladina (03/LF) (8 ha, 20%) and SBSmc2 Hybrid white spruce–Huckleberry (01/SB) (4 ha, 16%).

Table 5.4.5-10: Ecosystem Distribution: Mine Site Access Road Effects on Ecosystem Loss in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining (ha)	Area Change (ha)	Percent Change (%)
SBSmc3	Hybrid white spruce - Huckleberry	01	SB	72	62	-10	-14	62	-10	-14
SBSmc3	Lodgepole pine - Feathermoss - Cladina	03	LF	27	24	-3	-11	24	-3	-11
SBSmc3	Hybrid white spruce - Huckleberry - Soopolallie	04	SS	3	2	<-1	-4	2	<-1	-4
SBSmc3	Black spruce - Huckleberry - Spirea	05	BH	44	37	-7	-15	37	-7	-15
SBSmc3	Black spruce - Lodgepole pine - Feathermoss	06	BF	7	6	-1	-11	6	-1	-11
SBSmc3	Hybrid white spruce - Twinberry	07	ST	8	6	-1	-16	6	-1	-16
Total Upland				**159**	**138**	**-22**	**-14**	**138**	**-22**	**-14**
SBSmc3	Road surface	00	RZ	24	19	-4	-18	19	-4	-18
Total Non-Vegetated, Sparsely Vegetated or Anthropogenic				**24**	**19**	**-4**	**-18**	**19**	**-4**	**-18**
Total SBSmc3				**183**	**157**	**-26**	**-14**	**157**	**-26**	**-14**
Total Upland				**159**	**138**	**-22**	**-14**	**138**	**-22**	**-14**
Total Non-Vegetated, Sparsely Vegetated or Anthropogenic				**24**	**19**	**-4**	**-18**	**19**	**-4**	**-18**
Total Area				**183**	**157**	**-26**	**-14**	**157**	**-26**	**-14**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant
Numbers are rounded for presentation purposes, and as a result it may appear that the totals do not equal the sum of the individual values.
Mine-related landforms are generated by the Project and do not occur at baseline.
Total area sum for Post-Closure Case is for upland and non-vegetated, sparsely vegetated, or anthropogenic to show total baseline upland loss

Table 5.4.5-11: Ecosystem Distribution: Freshwater Supply System Effects on Ecosystem Loss in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case: Remaining (ha)	Project Case: Area Change (ha)	Project Case: Percent Change (%)	Post-Closure Case: Remaining and Reclaimed (ha)	Post-Closure Case: Area Change (ha)	Post-Closure Case: Percent Change (%)
SBSdk	Hybrid white spruce–Purple peavine	01	SP	27	26	-1	-3	27	0	0
SBSdk	Hybrid white spruce–Twinberry–Coltsfoot	06	ST	7	7	<1	-3	7	0	0
Total Upland				**34**	**33**	**-1**	**-3**	**34**	**0**	**0**
Total SBSdk				**34**	**33**	**-1**	**-3**	**34**	**0**	**0**
SBSmc3	Hybrid white spruce–Huckleberry	01	SB	105	101	-4	-4	105	0	0
SBSmc3	Lodgepole pine–Juniper–Dwarf huckleberry	02	LJ	2	2	<1	-5	2	0	0
SBSmc3	Lodgepole pine–Feathermoss–Cladina	03	LF	43	42	-1	-3	43	0	0
SBSmc3	Black spruce–Huckleberry–Spirea	05	BH	70	68	-2	-3	70	0	0
SBSmc3	Black spruce–Lodgepole pine–Feathermoss	06	BF	13	12	<1	-3	13	0	0
SBSmc3	Hybrid white spruce–Twinberry	07	ST	30	29	-1	-3	30	0	0
Total Upland				**263**	**255**	**-9**	**-3**	**263**	**0**	**0**
SBSmc3	Road surface	00	RZ	50	48	-2	-4	0	-50	-100
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**50**	**48**	**-2**	**-4**	**0**	**-50**	**-100**
SBSmc3	Reclaimed upland forest			0	0	0	0	50	50	100
Total SBSmc3				**313**	**302**	**-11**	**-3**	**313**	**0**	**0**
Total Upland				**298**	**288**	**-10**	**-3**	**298**	**0**	**0**
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**50**	**48**	**-2**	**-4**	**0**	**-50**	**-100**
Total Reclaimed Upland Forest				**0**	**0**	**0**	**0**	**50**	**50**	**100**
Total Area				**347**	**335**	**-12**	**-3**	**347**	**0**	**0**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSdk = Dry Cool Sub-Boreal Spruce; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant
Numbers have been rounded up, and as a result totals may not equal the sum of the individual values.

Table 5.4.5-12: Ecosystem Distribution: Airstrip Effects on Ecosystem Loss in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSmc2	Hybrid white spruce - Huckleberry	01	SB	27	23	-4	16	27	0	0
SBSmc2	Lodgepole pine - Huckleberry - Cladonia	02	PH	2	2	0	0	2	0	0
SBSmc2	Hybrid white spruce - Huckleberry - Dwarf blueberry	04	HB	14	13	-1	6	14	0	0
SBSmc2	Hybrid white spruce - Twinberry - Oak fern	08	ST	4	4	0	0	4	0	0
Total Upland				**47**	**42**	**-5**	**11**	**47**	**0**	**0**
Total SBSmc2				**47**	**42**	**-5**	**11**	**47**	**0**	**0**
SBSmc3	Hybrid white spruce - Huckleberry	01	SB	35	35	-1	1	35	0	0
SBSmc3	Lodgepole pine - Juniper - Dwarf huckleberry	02	LJ	1	1	0	0	1	0	0
SBSmc3	Lodgepole pine - Feathermoss - Cladina	03	LF	41	33	-8	20	41	0	0
SBSmc3	Black spruce - Huckleberry - Spirea	05	BH	33	33	0	1	33	0	0
SBSmc3	Black spruce - Lodgepole pine - Feathermoss	06	BF	1	1	<-1	<-1	1	0	0
SBSmc3	Hybrid white spruce - Twinberry	07	ST	16	15	-2	10	16	0	0
Total Upland				**127**	**116**	**-11**	**8**	**127**	**0**	**0**
SBSmc3	Road surface	00	RZ	19	14	-5	27	0	-19	-100
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**19**	**14**	**-5**	**27**	**0**	**0**	**0**
SBSmc3	Reclaimed Upland Forest			0	0	0	0	19	19	100
Total SBSmc3				**146**	**130**	**-16**	**11**	**146**	**0**	**0**

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
Total Upland				**173**	**158**	**-16**	**9**	**173**	**0**	**0**
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**19**	**14**	**-5**	**27**	**0**	**-19**	**-100**
Total Reclaimed Upland Forest				**0**	**0**	**0**	**0**	**19**	**19**	**100**
Total Area				**193**	**172**	**-21**	**11**	**193**	**0**	**0**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant
Numbers have been rounded up, and as a result totals may not equal the sum of the individual values.

Beginning at post-closure, Project-related disturbances will be reclaimed to conditions similar to baseline. Reclamation efforts will also include revegetating the road surface present at baseline to Upland Forest ecosystems, resulting in a 19 ha net increase of upland vegetation.

5.4.5.3.6.1.5 Transmission Line and Re-routes

One main route and two re-routes were examined for the transmission line, with the potential effects of each on ecosystem loss presented separately. The main transmission line ROW covers 3,979 ha, and Project activities will affect a total of 508 ha of ecosystems (**Table 5.4.5-13**).

During the Project case, 508 ha (13%) of the ecosystems will be cleared for the transmission line ROW and access roads. The largest amount of ecosystem area removed (85 ha, 12%) will occur in the SBSdk Hybrid white spruce–Purple peavine (01/SP) ecosystem. Next in amount lost will be the SBSmc3 Hybrid white spruce–Huckleberry (01/SB) and SBSdk Hybrid white spruce–Twinberry–Coltsfoot (06/ST) site series, with 63 ha (12%) and 55 ha (13%) removed, respectively. The largest percent change will occur in the SBSdk Douglas fir–Soopolallie–Feathermoss (04/DS), with a total change of <1 ha (17%), and in the SBSmc2 Hybrid white spruce–Twinberry–Oakfern (08/ST), with a total change of 2 ha (17%).

Note: ecosystems at risk are discussed and assessed in **Section 5.4.6**. Ecosystems at risk have very specific ecological requirements, and it is therefore assumed that where ecosystems at risk cannot be avoided, reclamation to baseline conditions is not possible.

Post-closure, 7 ha (<1%) of the area representing ecosystems at risk will be lost, identified by an asterisk in **Table 5.4.5-13,** and described in detail in **Section 5.4.6**. All other affected areas will be reclaimed to native species and expected to eventually return to upland ecosystems similar to those present at baseline, provided reclamation and mitigation measures are implemented.

For the Mills Ranch transmission line alignment option, a total of 52 ha (12%) of ecosystems will be lost during the Project case (**Table 5.4.5-14**). The largest amount of baseline area affected will be in the SBSmc3 Hybrid white spruce–Huckleberry (01/SB) ecosystem (23 ha, 12%), while the largest percent lost will be in the SBSdk Hybrid white spruce–Spirea–Feathermoss (05/SF) ecosystem (<1 ha, 20%).

Post-closure, less than 1 ha (<1%) of the SBSdk Lodgepole pine–Juniper–Ricegrass ecosystem will be permanently lost, as it is classified as an ecosystem at risk. Following reclamation and mitigation, all other ecosystems will be reclaimed to their baseline conditions over time. No effect will occur where this alignment co-occurs with existing roads (3 ha).

Table 5.4.5-13: Ecosystem Distribution: Transmission Line Effects on Ecosystem Loss in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSdk	Saskatoon–Slender wheatgrass	81*	SW	1	1	0	0	1	0	0
SBSdk	Hybrid white spruce– Purple peavine	01	SP	685	601	-85	-12	685	0	0
SBSdk	Lodgepole pine–Juniper–Ricegrass	02*	LJ	24	21	-3	-11	21	-3	-11
SBSdk	Lodgepole pine–Feathermoss–Cladina	03	LC	153	135	-18	-12	153	0	0
SBSdk	Douglas fir–Soopolallie–Feathermoss	04*	DS	1	1	<-1	-17	1	<-1	-17
SBSdk	Hybrid white spruce–Spirea–Feathermoss	05	SF	125	110	-15	-12	125	0	0
SBSdk	Hybrid white spruce–Twinberry–Coltsfoot	06	ST	430	375	-55	-13	430	0	0
SBSdk	Black cottonwood–Dogwood–Prickly rose	08*	CD	3	3	0	-10	3	3	0
SBSdk	Drummond's willow–Bluejoint	00*	Fl05	1	1	<-1	-3	1	<-1	-3
Total Upland				**1,422**	**1,246**	**-175**	**-12**	**1,419**	**-3**	**<-1**
SBSdk	Cultivated field	00	CF	3	3	0	0	3	0	0
SBSdk	Gravel pit	00	GP	1	1	0	0	1	0	0
SBSdk	Road surface	00	RZ	88	72	-16	-18	88	0	0
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**92**	**76**	**-16**	**-17**	**92**	**0**	**0**
Total SBSdk				**1,514**	**1,323**	**-191**	**-13**	**1,514**	**0**	**0**

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSdw3	Saskatoon–Slender wheatgrass	81*	SW	3	3	<-1	-10	3	<-1	-10
SBSdw3	Hybrid white spruce–Douglas fir–Pinegrass	01	SP	338	295	-43	-13	338	0	0
SBSdw3	Douglas fir–Lodgepole pine–Cladonia	02*	DC	11	9	-1	-12	9	-1	-12
SBSdw3	Lodgepole pine–Feathermoss–Cladina	03	LC	36	32	-4	-10	36	0	0
SBSdw3	Hybrid white spruce–Ricegrass	04	SR	69	61	-9	-12	69	0	0
SBSdw3	Lodgepole pine–Black spruce–Feathermoss	05*	BF	22	20	-2	-9	20	-2	-9
SBSdw3	Hybrid white spruce–Pink spirea–Prickly rose	06*	SS	10	8	-1	-12	8	-1	-12
SBSdw3	Hybrid white spruce–Twinberry	07	ST	207	180	-27	-13	207	0	0
SBSdw3	Hybrid white spruce–Oakfern	08	SO	29	26	-3	-11	29	0	0
SBSdw3	Drummond's willow–Bluejoint	00*	Fl05	2	2	<-1	-10	2	<-1	-10
Total Upland				**727**	**637**	**-90**	**-12**	**723**	**-4**	**<-1**
SBSdw3	Cultivated field	00	CF	1	1	0	0	1	0	0
SBSdw3	Gravel pit	00	GP	0	0	0	0	0	0	0
SBSdw3	Rural	00	RR	<1	<-1	<-1	-23	<1	0	0
SBSdw3	Road surface	00	RZ	32	30	-2	-6	32	0	0
SBSdw3	Urban	00	UR	3	3	<-1	0	3	0	0
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**36**	**34**	**-2**	**-5**	**36**	**0**	**0**
Total SBSdw3				**763**	**671**	**-92**	**-12**	**763**	**0**	**0**

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSmc2	Hybrid white spruce–Huckleberry	01	SB	218	191	-27	-12	218	0	0
SBSmc2	Lodgepole pine–Huckleberry–Cladonia	02	PH	6	5	-1	-9	6	0	0
SBSmc2	Black spruce–Lodgepole pine–Feathermoss	03	BM	12	10	-1	-12	12	0	0
SBSmc2	Hybrid white spruce–Huckleberry–Dwarf blueberry	04	HB	15	13	-2	-13	15	0	0
SBSmc2	Hybrid white spruce–Twinberry–Coltsfoot	05	TC	4	4	-1	-14	4	0	0
SBSmc2	Hybrid white spruce–Oak fern	06	SO	34	30	-4	-12	34	0	0
SBSmc2	Hybrid white spruce–Twinberry–Oak fern	08	ST	9	7	-2	-17	9	0	0
SBSmc2	Hybrid white spruce–Devil's club	09	SD	13	11	-1	-9	13	0	0
SBSmc2	Hybrid white spruce–Horsetail	10	SH	2	2	0	0	2	0	0
Total Upland				**312**	**274**	**-38**	**-12**	**312**	0	**0**
SBSmc2	Road surface	00	RZ	11	12	-1	-8	11	0	0
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**11**	**12**	**-1**	**-8**	**11**	0	**0**
Total SBSmc2				**323**	**286**	**-39**	**-12**	**323**	0	**0**
SBSmc3	Hybrid white spruce–Huckleberry	01	SB	506	444	-63	-12	506	0	0
SBSmc3	Lodgepole pine–Juniper–Dwarf huckleberry	02	LJ	8	7	-1	-14	8	0	0
SBSmc3	Lodgepole pine–Feathermoss–Cladina	03	LF	97	84	-13	-13	97	0	0
SBSmc3	Hybrid white spruce–Huckleberry–Soopolallie	04	SS	43	38	-5	-11	43	0	0
SBSmc3	Black spruce–Huckleberry–Spirea	05	BH	189	165	-25	-13	189	0	0
SBSmc3	Black spruce–Lodgepole pine–Feathermoss	06	BF	36	31	-5	-14	36	0	0
SBSmc3	Hybrid white spruce–Twinberry	07	ST	240	214	-26	-11	240	0	0
Total Upland				**1,120**	**983**	**-137**	**-12**	**1,120**	**0**	**0**
SBSmc3	Road surface	00	RZ	100	71	-30	-29	100	0	0
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**100**	**71**	**-30**	**-29**	**100**	**0**	**0**
Total SBSmc3				**1,221**	**1,054**	**-167**	**-14**	**1,221**	**0**	**0**

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
ESSFmv1	Subalpine fir–Rhododendron–Feathermoss	01	FR	93	80	-13	-14	93	0	0
ESSFmv1	Lodgepole pine–Huckleberry–Cladonia	02	LC	2	2	0	0	2	0	0
ESSFmv1	Subalpine fir–Huckleberry–Feathermoss	03	FF	49	43	-5	-11	49	0	0
ESSFmv1	Subalpine fir–Huckleberry– Gooseberry	04	FG	11	10	-1	-7	11	0	0
Total Upland				**154**	**135**	**-19**	**-12**	**154**	**0**	**0**
ESSFmv1	Road surface	00	RZ	3	3	<-1	<-1	3	0	0
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				3	**3**	**0**	**0**	**3**	**0**	**0**
Total ESSFmv1				**157**	**138**	**-19**	**-12**	**157**	**0**	**0**
Total Upland				**3,735**	**3,276**	**-459**	**-12**	**3,735**	**-7**	**<-1**
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**243**	**197**	**-49**	**-20**	**243**	**0**	**0**
Total Area				**3,979**	**3,473**	**-508**	**-13**	**3,979**	**-7**	**<-1**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSdk = Dry Cool Sub-Boreal Spruce; SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant; SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant
Numbers are rounded for presentation purposes, and as a result it may appear that the totals do not equal the sum of the individual values.
* = Ecosystems at Risk: reclamation of ecosystems at risk is not considered possible

Table 5.4.5-14: Ecosystem Distribution: Transmission Line - Mills Ranch Alignment Effects on Ecosystem Loss in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSdk	Hybrid white spruce–Purple peavine	01	SP	39	33	-5	-13	39	0	0
SBSdk	Lodgepole pine–Juniper–Ricegrass	02*	LJ	3	3	<-1	-11	3	<-1	-11
SBSdk	Lodgepole pine–Feathermoss–Cladina	03	LC	39	34	-5	-14	39	0	0
SBSdk	Hybrid white spruce–Spirea–Feathermoss	05	SF	1	1	<-1	-20	1	0	0
SBSdk	Hybrid white spruce–Twinberry–Coltsfoot	06	ST	11	10	-1	-10	11	0	0
Total Upland				**93**	**81**	**-12**	**-13**	**93**	**<-1**	**<-1**
SBSdk	Road surface	00	RZ	1	1	<-1	-15	1	0	0
Total Non-Vegetated, Sparsely Vegetated, and Anthropogenic				**1**	**1**	**<-1**	**-15**	**1**	**0**	**0**
Total SBSdk				**94**	**82**	**-12**	**-13**	**94**	**<-1**	**<-1**
SBSmc3	Hybrid white spruce–Huckleberry	01	SB	200	176	-23	-12	200	0	0
SBSmc3	Lodgepole pine–Juniper–Dwarf huckleberry	02	LJ	5	5	-1	-13	5	0	0
SBSmc3	Lodgepole pine–Feathermoss–Cladina	03	LF	38	34	-4	-10	38	0	0
SBSmc3	Hybrid white spruce–Huckleberry–Soopolallie	04	SS	13	12	-2	-11	13	0	0
SBSmc3	Black spruce–Huckleberry–Spirea	05	BH	43	38	-5	-12	43	0	0
SBSmc3	Black spruce–Lodgepole pine–Feathermoss	06	BF	1	1	<-1	-10	1	0	0
SBSmc3	Hybrid white spruce–Twinberry	07	ST	43	38	-5	-12	43	0	0
Total Upland				**343**	**304**	**-39**	**-11**	**343**	**0**	**0**

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remainin g and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSmc3	Road surface	00	RZ	2	2	<-1	-10	2	0	0
Total Non-Vegetated, Sparsely Vegetated, and Anthropogenic				**2**	**2**	**<-1**	**-10**	**2**	**0**	**0**
Total SBSmc3				**345**	**306**	**-40**	**-11**	**345**	**0**	**0**
Total Upland				**436**	**385**	**-51**	**-12**	**436**	**<-1**	**<-1**
Total Non-Vegetated, Sparsely Vegetated, and Anthropogenic				**3**	**3**	**<-1**	**-12**	**3**	**0**	**0**
Total Area				**440**	**388**	**-52**	**-12**	**440**	**<-1**	**<-1**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSdk = Dry Cool Sub-Boreal Spruce; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant;
* = Ecosystems at Risk: reclamation of ecosystems at risk is not considered possible
Numbers have been rounded up, and as a result totals may not equal the sum of the individual values.

For the Stellako Alignment option, a total of 23 ha (12%) of upland ecosystems will be lost during the Project case (**Table 5.4.5-15**). The largest amount of baseline area affected will be in the SBSdw3 Hybrid white spruce–Douglas fir–Pinegrass (01/SP) ecosystem (9 ha, 12%), and the Hybrid white spruce–Twinberry (07/ST) ecosystem (8 ha, 13%). The largest percent area affected will be in the SBSdw3 Hybrid white spruce–Ricegrass (04/SR) ecosystem (4 ha, 14%). SBSdw3 Douglas fir–Lodgepole pine–Cladonia (02/DC) is an ecosystem at risk (**Section 5.4.6**), and will experience a loss of <1 ha (<1%): it is not expected to be reclaimed to baseline conditions.

No effect will occur where this alignment co-occurs with existing roads (<1 ha). Following closure, reclamation, and revegetation, the net loss is expected to be less than 1%.

5.4.5.3.6.1.6 Kluskus FSR

The Kluskus FSR will primarily follow the existing road, except for an area where the road will be re-routed and widened. The existing road alignment was used for the assessment, as it traverses ecosystems (including old-growth forest and riparian) similar to those in the proposed realignment, and mapping for this realignment was available at the time of baseline field surveys and report preparation. The realignment will result in the permanent conversion of 3 ha (<1%) of upland vegetation to road, while the existing road will be reclaimed (**Table 5.4.5-16**).

5.4.5.3.6.1.7 Combined Project Component Effects on Ecosystem Loss in the LSA

The combined Project components include both the mine site and all linear components (mine site access road, fresh water supply system, airstrip, transmission line, and Kluskus FSR).

During the Project case, 3,080 ha (25%) of upland baseline ecosystems will be cleared during construction. Post-closure and after reclamation, 1,495 ha occurring on mine-related landforms will be lost (**Table 5.4.5-17**). Reclamation will result in novel ecosystems where possible, with the exception of the open pit and TSF; however, reclaimed areas will differ substantially from baseline conditions, and thus 1,495 ha (12%) is considered a permanent loss. An additional 7 ha will be lost due to clearing of ecosystems at risk along the transmission line. Where possible, ecosystems at risk will be avoided by the transmission line ROW. Reclaimed road surface will total 69 ha, and will be converted to Upland Forest.

Table 5.4.5-15: Ecosystem Distribution: Transmission line – Stellako Alignment Effects on Ecosystem Loss in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case: Remaining (ha)	Project Case: Area Change (ha)	Project Case: Percent Change (%)	Post-Closure Case: Remaining and Reclaimed (ha)	Post-Closure Case: Area Change (ha)	Post-Closure Case: Percent Change (%)
SBSdw3	Hybrid white spruce–Douglas fir–Pinegrass	01	SP	71	62	-9	-12	71	0	0
SBSdw3	Douglas fir–Lodgepole pine–Cladonia	02*	DC	<1	<1	<1	<-1	<1	<1	<1
SBSdw3	Lodgepole pine–Feathermoss–Cladina	03	LC	11	10	-1	-11	11	0	0
SBSdw3	Hybrid white spruce–Ricegrass	04	SR	30	26	-4	-14	30	0	0
SBSdw3	Lodgepole pine–Black spruce–Feathermoss	05*	BF	<1	<1	<1	<-1	<1	0	0
SBSdw3	Hybrid white spruce–Pink spirea–Prickly rose	06*	SS	2	2	<1	-11	2	0	0
SBSdw3	Hybrid white spruce–Twinberry	07	ST	61	53	-8	-13	61	0	0
SBSdw3	Hybrid white spruce–Oakfern	08	SO	<1	<1	<1	<-1	<1	0	0
Total Upland				**175**	**197**	**-22**	**13**	**175**	**0**	**0**
SBSdw3	Cultivated field	00	CF	9	8	-1	-6	9	0	0
SBSdw3	Road surface	00	RZ	2	2	<-1	-6	2	0	0
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**10**	**11**	**-1**	**-6**	**10**	**0**	**0**
Total SBSdw3				**186**	**163**	**-23**	**-12**	**186**	**<1**	**<1**
Total Area				**186**	**163**	**-23**	**-12**	**186**	**<1**	**<1**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant
* = Ecosystems at Risk: reclamation of ecosystems at risk is not considered possible
Numbers have been rounded up, and as a result totals may not equal the sum of the individual values.

Table 5.4.5-16: Ecosystem Distribution: Kluskus FSR Effects on Ecosystem Loss in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSdk	Hybrid white spruce–Purple peavine	01	SP	240	240	0	0	240	0	0
SBSdk	Lodgepole pine–Juniper–Ricegrass	02*	LJ	1	1	0	0	1	0	0
SBSdk	Lodgepole pine–Feathermoss–Cladina	03	LC	29	29	0	0	29	0	0
SBSdk	Douglas fir–Soopolallie–Feathermoss	04*	DS	4	4	0	0	4	0	0
SBSdk	Hybrid white spruce–Spirea–Feathermoss	05	SF	41	41	0	0	41	0	0
SBSdk	Hybrid white spruce–Twinberry–Coltsfoot	06	ST	64	64	0	0	64	0	0
SBSdk	Black cottonwood–Dogwood–Prickly rose	08*	CD	1	1	0	0	1	0	0
Total Upland				**381**	**381**	**0**	**0**	**381**	**0**	**0**
SBSdk	Cultivated field	00	CF	156	156	0	0	156	0	0
SBSdk	Exposed soils	00	ES	2	2	0	0	2	0	0
SBSdk	Rural	00	RW	6	6	0	0	6	0	0
SBSdk	Road surface	00	RZ	100	100	0	0	100	0	0
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**264**	**264**	**0**	**0**	**264**	**0**	**0**
Total SBSdk				**645**	**645**	**0**	**0**	**645**	**0**	**0**
SBSdw3	Hybrid white spruce–Douglas fir–Pinegrass	01	SP	97	97	0	0	97	0	0
SBSdw3	Douglas fir–Lodgepole pine–Cladonia	02*	DC	1	1	0	0	1	0	0
SBSdw3	Lodgepole pine–Feathermoss–Cladina	03	LC	11	11	0	0	11	0	0
SBSdw3	Hybrid white spruce–Ricegrass	04	SR	6	6	0	0	6	0	0
SBSdw3	Lodgepole pine–Black spruce–Feathermoss	05*	BF	16	16	0	0	16	0	0
SBSdw3	Hybrid white spruce–Pink spirea–Prickly rose	06*	SS	1	1	0	0	1	0	0
SBSdw3	Hybrid white spruce–Twinberry	07	ST	42	42	0	0	42	0	0
SBSdw3	Hybrid white spruce–Oakfern	08	SO	1	1	0	0	1	0	0
Total Upland				**174**	**174**	**0**	**0**	**174**	**0**	**0**

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case	Project Case			Post-Closure Case		
					Remainin g (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSdw3	Gravel pit	00	GP	7	7	0	0	7	0	0
SBSdw3	Road surface	00	RZ	34	34	0	0	34	0	0
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**41**	**41**	**0**	**0**	**41**	**0**	**0**
Total SBSdw3				**215**	**215**	**0**	**0**	**215**	**0**	**0**
SBSmc2	Hybrid white spruce–Huckleberry	01	SB	61	59	-2	-2	59	-2	-2
SBSmc2	Lodgepole pine–Huckleberry–Cladonia	02	PH	46	45	<-1	-1	45	<-1	-1
SBSmc2	Black spruce–Lodgepole pine–Feathermoss	03	BM	16	16	<-1	-3	16	<-1	-3
SBSmc2	Hybrid white spruce–Twinberry–Coltsfoot	05	TC	4	4	<-1	-5	4	<-1	-5
SBSmc2	Hybrid white spruce–Oakfern	06	SO	10	10	<-1	-4	10	<-1	-4
SBSmc2	Hybrid white spruce–Horsetail	10	SH	1	1	0	0	1	<-1	0
Total Upland				**138**	**135**	**-3**	**-2**	**135**	**-3**	**-2**
SBSmc2	Road surface	00	RZ	9	12	3	35	12	3	35
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				9	**12**	**3**	**35**	**12**	**3**	**35**
Total SBSmc2				**147**	**146**	**0**	**0**	**146**	**0**	**0**
SBSmc3	Hybrid white spruce–Huckleberry	01	SB	493	493	0	0	493	0	0
SBSmc3	Lodgepole pine–Juniper–Dwarf huckleberry	02	LJ	2	2	0	0	2	0	0
SBSmc3	Lodgepole pine–Feathermoss–Cladina	03	LF	51	51	0	0	51	0	0
SBSmc3	Hybrid white spruce–Huckleberry–Soopolallie	04	SS	64	64	0	0	64	0	0
SBSmc3	Black spruce–Huckleberry–Spirea	05	BH	132	132	0	0	132	0	0
SBSmc3	Black spruce–Lodgepole pine–Feathermoss	06	BF	30	30	0	0	30	0	0
SBSmc3	Hybrid white spruce–Twinberry	07	ST	146	146	0	0	146	0	0
Total Upland				**917**	**917**	**0**	**0**	**917**	**0**	**0**

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case	Project Case			Post-Closure Case		
					Remainin g (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSmc3	Exposed soils	00	ES	4	4	0	0	4	0	0
SBSmc3	Gravel pit	00	GP	3	3	0	0	3	0	0
SBSmc3	Road surface	00	RZ	125	125	0	0	125	0	0
SBSmc3	Urban	00	UR	2	2	0	0	2	0	0
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**133**	**133**	**0**	**0**	**133**	**0**	**0**
Total SBSmc3				**1,050**	**1,050**	**0**	**0**	**1,050**	**0**	**0**
ESSFmv1	Subalpine fir–Rhododendron–Feathermoss	01	FR	88	88	0	0	88	0	0
ESSFmv1	Lodgepole pine–Huckleberry–Cladonia	02	LC	1	1	0	0	1	0	0
ESSFmv1	Subalpine fir–Huckleberry–Feathermoss	03	FF	31	31	0	0	31	0	0
ESSFmv1	Subalpine fir–Huckleberry–Gooseberry	04	FG	10	10	0	0	10	0	0
Total Upland				**131**	**131**	**0**	**0**	**131**	**0**	**0**
ESSFmv1	Exposed soils	00	ES	1	1	0	0	1	0	0
ESSFmv1	Gravel pit	00	GP	4	4	0	0	4	0	0
ESSFmv1	Road surface	00	RZ	16	16	0	0	16	0	0
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**22**	**22**	**0**	**0**	**22**	**0**	**0**
Total ESSFmv1				**152**	**152**	**0**	**0**	**152**	**0**	**0**
Total Upland				**1,741**	**1,738**	**-3**	**<-1**	**1,738**	**-3**	**<-1**
Total Non-Vegetated, Sparsely Vegetated, or Anthropogenic				**468**	**471**	**3**	**1**	**471**	**3**	**1**
Total Area				**2,209**	**2,209**	**3**	**<1**	**2,209**	**3**	**<1**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSdk = Dry Cool Sub-Boreal Spruce, SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant, SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant
* = Ecosystems at Risk: reclamation of ecosystems at risk is not considered possible.
Numbers have been rounded up, and as a result totals may not equal the sum of the individual values.

Table 5.4.5-17: Ecosystem Distribution: Combined Project Components Effects on Ecosystem Loss in the LSA

BGC Unit	Category	Baseline Case (ha)	Project Case			Post-Closure		
			Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSdk	Upland vegetation	1,837	1,660	-177	-10	1,837	-3	<-1
SBSdk	Non-vegetated, Sparsely vegetated, or Anthropogenic	356	340	-16	-4	356	0	0
Total SBSdk		**2,193**	**2,000**	**-193**	**-9**	**2,193**	**-3**	**<-1**
SBSdw3	Upland vegetation	901	811	-90	-10	901	-4	<-1
SBSdw3	Non-vegetated, Sparsely vegetated, or Anthropogenic	77	75	-2	-3	77	0	0
Total SBSdw3		**979**	**887**	**-92**	**-9**	**979**	**-4**	**<-1**
SBSmc2	Upland vegetation	497	451	-46	-9	494	-3	-1
SBSmc2	Non-vegetated, Sparsely vegetated, or Anthropogenic	20	23	2	11	22	3	15
Total SBSmc2		**516**	**474**	**-44**	**-8**	**516**	**0**	**0**
SBSmc3	Upland vegetation	4,017	3,156	-861	-21	3,656	-362	-9
SBSmc3	Non-vegetated, Sparsely vegetated, or Anthropogenic	349	299	-49	-14	297	-78	-22
SBSmc3	Mine-related landforms	0	0	0	0	344	344	100
SBSmc3	Reclaimed upland forest	0	0	0	0	69	69	100
Total SBSmc3		**4,366**	**3,456**	**-910**	**-21**	**4,366**	**-26**	**-1**
ESSFmv1	Upland vegetation	3,769	2,087	-1,682	-45	2,763	-1,005	-27
ESSFmv1	Non-vegetated, Sparsely vegetated, or Anthropogenic	174	38	-135	-78	45	-128	-74
ESSFmv1	Mine-related landforms	0	0	0	0	1,134	1,134	100
Total ESSFmv1		**3,942**	**2,125**	**-1,817**	**-46**	**3,942**	**0**	**0**

BGC Unit	Category	Baseline Case (ha)	Project Case			Post-Closure		
			Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
ESSFmv1p	Upland vegetation	218	194	-24	-11	201	-17	-8
ESSFmv1p	Non-vegetated, Sparsely vegetated, or Anthropogenic	1	1	0	0	1	0	0
ESSFmv1p	Mine-related landforms	0	0	0	0	18	18	100
Total ESSFmv1p		**220**	**196**	**-24**	**-11**	**220**	**0**	**0**
Total Upland Vegetation		**11,239**	**8,360**	**-2,879**	**-26**	**9,852**	**-1,402**	**-12**
Total Non-vegetated, Sparsely vegetated, or Anthropogenic		**543**	**362**	**-182**	**-34**	**366**	**-203**	**-37**
Total Reclaimed Upland Forest		**0**	**0**	**0**	**0**	**69**	**69**	**100**
Total Mine-related landforms		**0**	**0**	**0**	**0**	**1,495**	**1,495**	**100**
Total Area		**12,216**	**9,138**	**-3,080**	**-25**	**10,721**	**1,502**	**12**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSdk = Dry Cool Sub-Boreal Spruce; SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant, SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant
Numbers have been rounded up, and as a result totals may not equal the sum of the individual values.
Mine-related landforms are generated by the Project and do not occur at baseline.

5.4.5.3.6.2 Dust Deposition

5.4.5.3.6.2.1 Mine Site

Given that the highest volume of fugitive dust (t/d) is predicted for the mine site during both construction and operations (**Appendix 5.2.4A**), and 97% falls within 125 m (Walker and Everett, 1987), a 125 m buffer was used to assess dust effects in the mine area. **Figure 5.4.5-2** shows the interaction between ecosystems and the 125 m dust zone in the mine site LSA.

Potential dust deposition effects on vegetation within the 125 m zone surrounding the mine site will affect 706 ha (14%) (**Table 5.4.5-18**). In the ESSFmv1 BGC unit, the Subalpine fir–Rhododendron–Feathermoss (01/FR) and Subalpine fur–Huckleberry–Feathermoss site series (03/FF) (240 ha, 13% and 98 ha, 13%, respectively) were estimated to be affected by dust. In the SBSmc3 BGC unit, the two site series with the largest amount of area in the dust deposition zone were the Hybrid white spruce–Huckleberry (01/SB) (105 ha, 18%) and the Lodgepole pine–Feathermoss–Cladina (03/LF) (93 ha, 15%). In terms of total percent affected, the SBSmc3 Black spruce–Huckleberry–Spirea (05/BH) had 9 ha or 26% of the area potentially affected by dust.

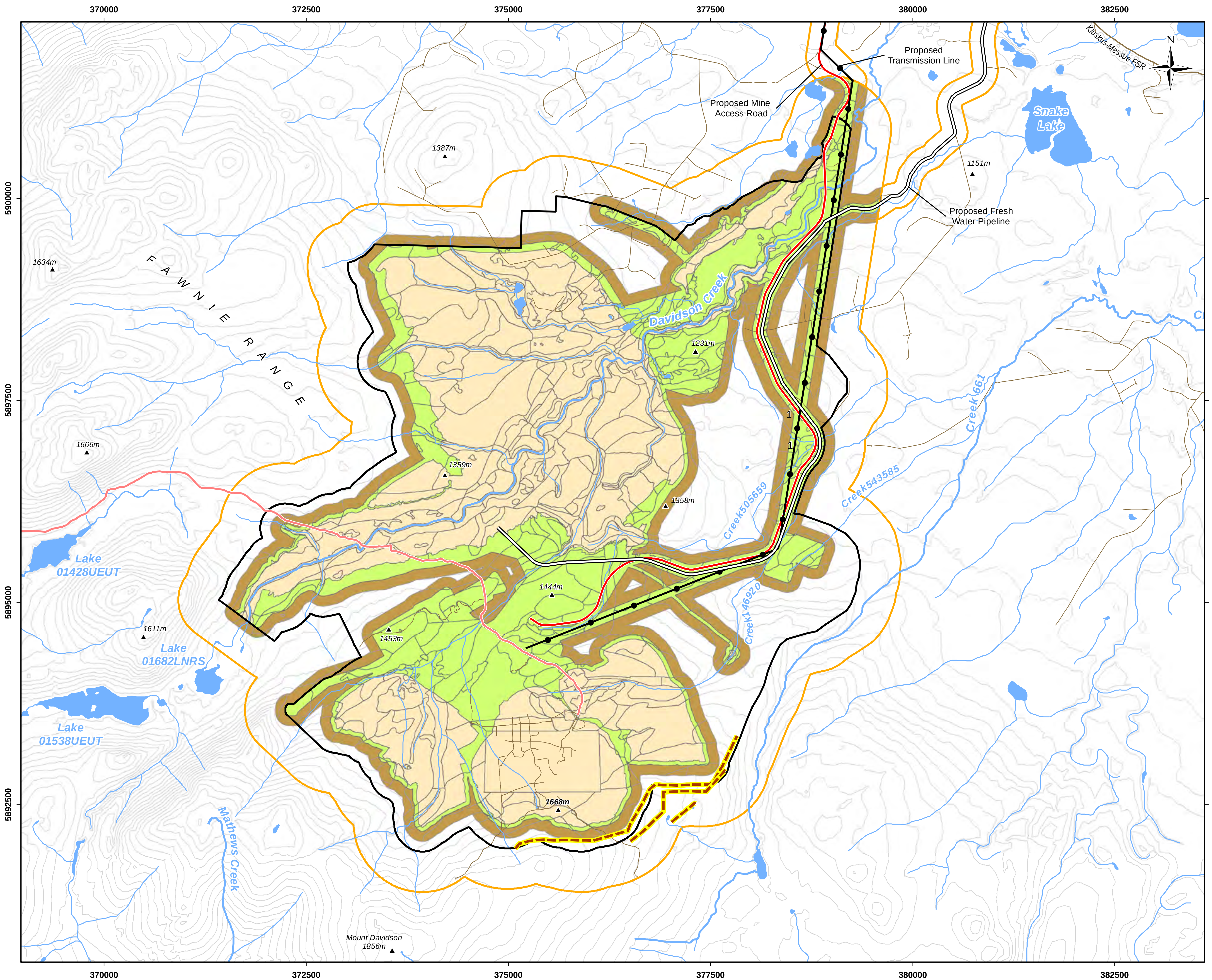
During the post-closure case, the amount of dust generated will be a small fraction of the level predicted for the Project case. Dust coating leaf surfaces will be removed by precipitation and re-growth of new leaves.

5.4.5.3.6.2.2 Linear Project Components

Air emissions study show total dust emissions will be highest within the mine site, and lower along unpaved roads (**Section 5.2.4**). Dust deposition studies suggest 93% of dust generated falls within 30 m, and 97% within 125 m (Walker and Everett, 1987). Given that several mitigation actions to reduce fugitive dust are planned (**Section 5.2.4**), including wetting soil surfaces and using coarse aggregate materials for road surfacing, as well as lesser amounts of overall dust deposition, a 50 m buffer distance from roads was selected to assess the effects of dust on vegetation alongside linear project components (mine site access road, freshwater supply system, airstrip, transmission line, and Kluskus FSR).

Dust deposition associated with linear Project components will affect 2,137 ha, 35% of the vegetated ecosystems (**Table 5.4.5-19**). The majority of these effects occur within the SBSdk BGC, with 608 ha (33%) affected, of which 322 ha (34%) occurs in the Hybrid white spruce–Purple peavine (01/SP) ecosystem. The next greatest effect occurs in the SBSmc3 Hybrid white spruce–Huckleberry (01/SB) ecosystem, with 460 ha (38%) affected. In terms of percentage area affected, the highest occurs in the SBSmc2 Lodgepole pine–Huckleberry–Cladonia (02/PH), with 21 ha (40%).

During the post-closure case, the amount of dust generated will be a small fraction of the level predicted for the Project case provided dust control mitigation measures are implemented.



Legend

- Spotheights
- Forestry Service Road
- Existing road
- Contour (20 m)
- Stream
- Waterbody

Project Components

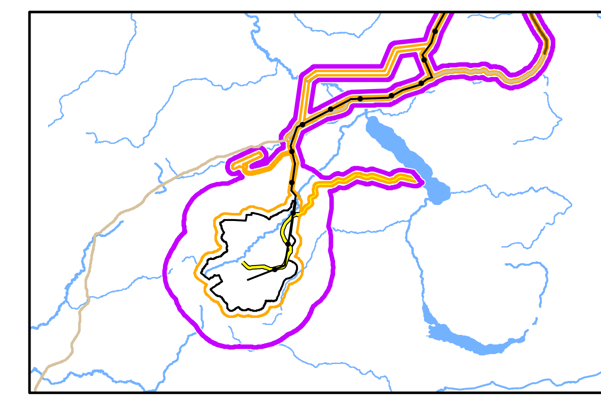
- Exploration Road
- Proposed Mine Access Road
- Proposed Transmission Line
- Proposed Fresh Water Pipeline
- Proposed Mine Site

Terrain, Soils, and Vegetation

- Local Study Area

Ecosystem Distribution in Relation to Dust and Nitrogen Deposition

- Nitrogen Deposition
- 125m Dust Buffer
- Mine Related Landform
- Natural Landform



Scale:1:46,000

0 1 2 3

Kilometres

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Ecosystem Distribution in Relation to Dust and Nitrogen Deposition

DATE: February, 2014	ANALYST: WR	**Figure 5.4.5-2**
JOB No: VE52277	QA/QC: MY	PDF FILE: 06-200-032_EcoDist_Effects_Dust.pdf
GIS FILE: 06-200-032_EcoDist_Effects_Dust.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

V:\Mapping\06_vegetation\EIA\06-200-032_EcoDist_Effects_Dust.mxd

Table 5.4.5-18: Ecosystem Distribution: Mine Site Effects of Dust Deposition in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case	
					Dust Zone (ha)	Percent of Baseline (%)
SBSmc3	Hybrid white spruce–Huckleberry	01	SB	570	105	18
SBSmc3	Lodgepole pine–Juniper–Dwarf huckleberry	02	LJ	31	2	6
SBSmc3	Lodgepole pine–Feathermoss–Cladina	03	LF	615	93	15
SBSmc3	Hybrid white spruce–Huckleberry–Soopolallie	04	SS	57	5	8
SBSmc3	Black spruce–Huckleberry–Spirea	05	BH	36	9	26
SBSmc3	Black spruce–Lodgepole pine–Feathermoss	06	BF	7	<1	<1
SBSmc3	Hybrid white spruce–Twinberry	07	ST	115	17	15
Total Upland				**1,431**	**230**	**16**
Total SBSmc3				**1,431**	**475**	**33**
ESSFmv1	Subalpine fir–Rhododendron–Feathermoss	01	FR	1,829	240	13
ESSFmv1	Lodgepole pine–Huckleberry–Cladonia	02	LC	363	37	10
ESSFmv1	Subalpine fir–Huckleberry–Feathermoss	03	FF	754	98	13
ESSFmv1	Subalpine fir–Huckleberry–gooseberry	04	FG	538	81	15
ESSFmv1	Sitka valerian–globeflower moist meadow	00	VG	<1	<1	0
Total Upland				**3,484**	**456**	**13**
ESSFmv1	Rock	00	RO	<1	<1	0
ESSFmv1	Talus	00	TA	2	<1	1
Total Non-Vegetated and Sparsely Vegetated				**2**	**0**	**0**
Total ESSFmv1				**3,486**	**456**	**13**
ESSFmv1p	Subalpine fir–Dwarf blueberry–Dicranum parkland	00	FB	6	1	16
ESSFmv1p	Altai fescue–Cladonia grassland	00	FC	10	0	0
ESSFmv1p	Subalpine fir–Indian hellebore	00	FH	36	3	9
ESSFmv1p	Subalpine fir–Heather parkland	00	FM	2	0	0
ESSFmv1p	Kinnikinnick–Cladonia	00	KC	1	0	0
ESSFmv1p	Mountain-heather–Slender hawkweed	00	MH	2	0	0
ESSFmv1p	Moraine	00	MN	0	0	0
ESSFmv1p	Subalpine fir–Whitebark pine–Crowberry parkland	00	PC	80	9	11
ESSFmv1p	Scrub birch–Altai fescue shrub steppe	00	SF	17	<1	1
ESSFmv1p	Two-toned sedge–Dwarf snow willow	00	TW	0	0	0
ESSFmv1p	Sitka valerian–Globeflower moist meadow	00	VG	19	3	18
ESSFmv1p	Whitebark pine–Krummholtz	00	WK	16	0	0
ESSFmv1p	Whitebark pine–White mountain avens	00	WW	28	3	11

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case Dust Zone (ha)	Project Case Percent of Baseline (%)
Total Upland				**218**	**20**	**9**
ESSFmv1p	Talus	00	TA	1	1	100
Total Non-Vegetated and Sparsely Vegetated				**1**	**1**	**100**
Total ESSFmv1p				**220**	**20**	**9**
Total ESSF				**3,705**	**475**	**13**
Total Upland				**5,133**	**705**	**14**
Total Non-Vegetated and Sparsely Vegetated				**3**	**0**	**0**
Total Area				**5,136**	**706**	**14**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant
Numbers have been rounded up, and as a result totals may not equal the sums of the individual values.
Mine-related landforms are generated by the Project and do not occur at baseline.

Table 5.4.5-19: Ecosystem Distribution: Linear Project Component Effects of Dust Deposition in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline LSA (ha)	Dust Zone (ha)	Percent of Baseline (%)
SBSdk	Drummond's willow–Bluejoint	00	Fl05	1	0	0
SBSdk	Hybrid white spruce–Purple peavine	01	SP	953	322	34
SBSdk	Lodgepole pine–Juniper–Ricegrass	02	LJ	25	7	28
SBSdk	Lodgepole pine–Feathermoss–Cladina	03	LC	182	63	34
SBSdk	Douglas fir–Soopolallie–Feathermoss	04	DS	5	2	38
SBSdk	Hybrid white spruce–Spirea–Feathermoss	05	SF	166	57	34
SBSdk	Hybrid white spruce–Twinberry–Coltsfoot	06	ST	501	157	31
SBSdk	Black cottonwood–Dogwood–Prickly rose	08	CD	4	1	29
Total SBSdk				**1,836**	**608**	33
SBSdw3	Drummond's willow–Bluejoint	00	Fl05	2	1	40
SBSdw3	Saskatoon–Slender wheatgrass	81	SW	3	1	26
SBSdw3	Hybrid white spruce–Douglas fir–Pinegrass	01	SP	434	146	34
SBSdw3	Douglas fir–Lodgepole pine–Cladonia	02	DC	12	4	35
SBSdw3	Lodgepole pine–Feathermoss–Cladina	03	LC	47	14	30
SBSdw3	Hybrid white spruce–Ricegrass	04	SR	75	24	32
SBSdw3	Lodgepole pine–Black spruce–Feathermoss	05	BF	38	13	34
SBSdw3	Hybrid white spruce–Pink spirea–Prickly rose	06	SS	11	3	31
SBSdw3	Hybrid white spruce–Twinberry	07	ST	249	82	33
SBSdw3	Hybrid white spruce–Oakfern	08	SO	30	9	31
Total SBSdw3				**901**	**298**	33

BGC Unit	Site Series Name	Site Series	Map Code	Baseline LSA (ha)	Dust Zone (ha)	Percent of Baseline (%)
SBSmc2	Hybrid white spruce–Huckleberry	01	SB	305	103	34
SBSmc2	Lodgepole pine–Huckleberry–Cladonia	02	PH	54	21	40
SBSmc2	Black spruce–Lodgepole pine–Feathermoss	03	BM	28	10	38
SBSmc2	Hybrid white spruce–Huckleberry–Dwarf blueberry	04	HB	29	9	31
SBSmc2	Hybrid white spruce–Twinberry–Coltsfoot	05	TC	9	3	38
SBSmc2	Hybrid white spruce–Oakfern	06	SO	45	16	36
SBSmc2	Hybrid white spruce–Twinberry–Oak fern	08	ST	12	4	31
SBSmc2	Hybrid white spruce–Devil's club	09	SD	13	4	30
SBSmc2	Hybrid white spruce–Horsetail	10	SH	3	1	23
Total SBSmc2				**497**	**171**	34
SBSmc3	Hybrid white spruce–Huckleberry	01	SB	1,211	460	38
SBSmc3	Lodgepole pine–Juniper–Dwarf huckleberry	02	LJ	13	5	37
SBSmc3	Lodgepole pine–Feathermoss–Cladina	03	LF	259	89	34
SBSmc3	Hybrid white spruce–Huckleberry–Soopolallie	04	SS	109	43	39
SBSmc3	Black spruce–Huckleberry–Spirea	05	BH	468	174	37
SBSmc3	Black spruce–Lodgepole pine–Feathermoss	06	BF	87	31	35
SBSmc3	Hybrid white spruce–Twinberry	07	ST	440	153	35
ESSFmv1	Subalpine fir–Rhododendron–Feathermoss	01	FR	182	70	39
ESSFmv1	Lodgepole pine–Huckleberry–Cladonia	02	LC	3	1	23
ESSFmv1	Subalpine fir–Huckleberry–Feathermoss	03	FF	80	28	35
ESSFmv1	Subalpine fir–Huckleberry–Gooseberry	04	FG	21	7	32
Total ESSFmv1				**2,872**	**1,060**	**37**
Total Area				**6,106**	**2,137**	**35**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSdk = Sub-Boreal Spruce Dry Cool variant; SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant, SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant
Numbers have been rounded up, and as a result totals may not equal the sums of the individual values.

5.4.5.3.6.3 Nitrogen Deposition

Nitrogen deposition was considered a key effect as a result of air emissions modelling that predicted nitrogen exceedances within the mine site LSA. Mining construction and operations will produce air emissions from a number of sources, with internal combustion engines as the primary output (**Section 5.2.4**). Linear corridors such as unpaved roads models did not predict N exceedances.

The average level of nitrogen deposition predicted for the LSA was 0.047 kg N/ha^{-1}/y^{-1}—well below the critical load value of 5 kg N/ha^{-1}/y^{-1}. However, there are 61 ha at the south to southeastern edge of the mine site for which predicted levels exceed the critical load level, and in which there is potential for change in species composition. Nitrogen deposition may affect the balance of species composition by changing the soil nutrient regime, allowing certain species to outcompete existing species, thereby altering the existing ecosystem. This 61 ha is only 1% of the 5,305 ha total of terrestrial ecosystems that occur in the LSA. **Figure 5.4.5-2** shows the overlap between ecosystems and nitrogen deposition in the mine site LSA.

5.4.5.3.6.4 Spread of Invasive Plants

The disturbance of soil and movement of machinery and equipment within the mine site and linear components can introduce invasive plants. Once invasive plants are introduced, disturbance can spread them further where soils have been disturbed and equipment is mobile from one area to another.

Field surveys found one invasive plant species within the mine site LSA, yellow salsify (*Tragopogon dubius*), which is listed as an alien invasive species under Section 1 of the Schedule of the *Community Charter Act* (2004). Two invasive plant species, namely Canada thistle (CT) and orange hawkweed (OH), were recorded at three locations within the transmission line LSA. Four invasive plant species were recorded in the Kluskus FSR LSA, namely CT, common tansy (TC), yellow hawkweed (YH), and butter-and-eggs (YT), consisting of a total of seven plants.

5.4.5.3.6.5 Mitigation

The potential effect on ecosystems within the combined Project area is the potential loss of 1,495 ha (12%) and the temporal loss of an additional 1,585 ha. The most direct methods to mitigate ecosystem loss are: avoiding or minimizing the loss of ecosystem extent within the mine site and linear components; applying erosion and sediment control measures; and implementing progressive reclamation, using local native vegetation wherever possible, or appropriate commercially grown, weed-free native species. Project effects on ecosystems will be further minimized through implementation of management plans to reduce dust deposition, nitrogen deposition, and spread of invasive plants, and by reclaiming disturbed areas post-closure.

A brief summary of mitigation measures applicable to reducing ecosystem loss is provided below. The following effects assessment report sections or management plans should be consulted for relevant mitigation details: the LSVMRP (**Section 12.2.1.18.4.4**), ISMP (**Section 12.2.1.18.4.5**), RCP (**Section 2.6**), Air Quality and Emissions Management Plan (AQEMP) (**Section 12.2.1.18.4.9**), Water Quality and Liquid Discharges Management Plan (WQLDMP) (**Section 12.2.1.18.4.10**), Transportation and Access Management Plan (TAMP) (**Section 12.2.1.18.4.14**), and Sediment and Erosion Control Plan (SECP) (**Section 12.2.1.18.4.1**).

5.4.5.3.6.5.1 Minimize Disturbance

Minimize ground disturbance and damage to vegetation by:

- Minimizing the mine footprint: the mine footprint design has taken into account minimizing the mine footprint where possible, and thus areas to be cleared of vegetation;
- Minimizing the clearing of linear ROWs and access: the planning and design phase of linear features has taken into account ways to minimize the area to be cleared for each

ROW. For example, the use of existing roads, clearings, and disturbance areas for constructing new or upgraded ROWs and access roads;

- Minimize areas of disturbance outside or adjacent to areas targeted for clearing (i.e. movement of machinery and equipment, or extent of grubbing and stripping); and
- In areas requiring clearing only (e.g. the transmission line), retain the topsoil and vegetation root mat whenever and wherever possible.

5.4.5.3.6.5.2 Salvage Soil for Reclamation

During the construction phase, topsoil will be salvaged where feasible, and stored for use during the reclamation and closure phase. Details regarding soil salvage are provided in the LSVMRP (**Section 12.2.1.18.4.4**), the SECP (**Section 12.2.1.18.4.1**), and the RCP (**Section 2.6**).

5.4.5.3.6.5.3 Dust Suppression Measures

Most dust emissions occur from vehicle travel on non-paved roads (e.g. mine haul roads), and from materials handling (bulldozers, graders, truck dumping) (refer to Air Quality, **Section 5.2.4**). Dust effects will be mitigated using a combination of administrative, design, and emission control strategies:

- Administrative: road dust emissions are directly related to vehicle speed, which will be controlled throughout the mine site;
- Design: road dust emissions are directly related to road silt content, and haul road surfaces will be constructed of coarse aggregate with very low silt content;
- Control: unpaved road surfaces will be wetted as needed to control dust emissions when conditions are not wet or frozen, and the wetting agent may include a chemical to extend and improve dust control over using water alone. The specific chemical has not yet been selected, and it is anticipated that a number of chemicals will be tried to ensure optimum performance. This is common practice at mine sites, and chemical selection will be informed by experiences at other mines in similar climate. Wetting with dust suppressant chemical addition is anticipated to reduce road dust emission by 90%; and
- Control: materials handling (dumping, bulldozing, grading) generates PM emissions, and wetting of the material before handling dramatically reduces PM emissions. Much of the material coming from the pit is saturated as it is excavated from below the water table and a 50% reduction in material handling PM emissions is anticipated due to material wetting prior to handling.

5.4.5.3.6.5.4 Manage Nitrogen Deposition

Emissions mitigation measures described in the AQEMP (**Section 12.2.1.18.4.9**) will be implemented, including:

- Reducing vehicle emissions through enforcing speed limits, fuel selection, using vehicles that meet emission standards, and regular vehicle and equipment maintenance;
- Ensuring the incinerator and other emissions sources meet all relevant Canadian emission requirements; and
- Limiting vehicle and equipment idling.

5.4.5.3.6.5.5 Mitigate Against Spread of Invasive Plants

The spread of invasive plants will be mitigated by following BMPs identified by the Invasive Species Council of BC and by implementing the ISMP (**Section 12.2.1.18.4.5**); examples of these are:

- Preventing the initial introduction of invasive plants;
- Minimizing all soil disturbances (roads and machinery activity);
- Reclaiming and re-establishing appropriate vegetation on disturbed areas as soon as possible;
- Using weed-free seed for reclamation, and weed-free bales for erosion control;
- Cleaning earth moving vehicles prior to entering the mine site area;
- Early Detection and Rapid Response: determine the priority invasive plant species within the operating area and maintain awareness of species new to the area;
- Ensuring environmental monitors are able to identify species of concern; and
- Conducting invasive plant monitoring.

5.4.5.3.6.5.6 Reclamation

The RCP (**Section 2.6)** provides methods for decommissioning and details closure activities for the Project. The primary objective of the RCP is to return areas disturbed by mining operations to an acceptable end land use and capability wherever practical. The end land use capability objectives are based on pre-development site conditions. Reclamation and closure activities will employ well known and proven closure approaches and technologies to facilitate the establishment of self-sustaining vegetation communities and foster the return of functional ecosystems. Adaptive management techniques can be implemented during the proposed lifespan to respond to reclamation requirements.

5.4.5.3.6.5.7 Effectiveness of Mitigation

Table 5.4.5-20 provides ratings for effectiveness of mitigation measures to avoid or reduce potential effects on ecosystem distribution during mine site development. Mitigation measures will be based on site-specific information and construction engineering and are therefore preliminary at this stage.

Table 5.4.5-20: Mitigation Measures and Effectiveness of Mitigation to Avoid or Reduce Potential Effects on Ecosystem Distribution during Mine Site Development

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
Ecosystem loss	Construction, Operations, Closure, Post-closure	Minimize the mine footprint	Moderate
	Construction	Minimize areas of disturbance outside or adjacent to areas targeted for clearing (i.e. movement of machinery and equipment, or extent of grubbing and stripping)	Moderate
		Minimizing the clearing of linear ROWs and access	Moderate
		In areas requiring clearing only (e.g., the transmission line), retain the topsoil and vegetation root mat whenever and wherever possible	Moderate
		Topsoil will be salvaged where feasible, and stored for use during the reclamation and closure phase as described in the LSVMRP (**Section 12.2.1.18.4.4**), the SECP (**Section 12.2.1.18.4.1**), and the RCP (**Section 2.6**)	Moderate
Dust deposition	Construction, Operations, Closure, Post-closure	Vehicle speed will be controlled throughout the mine site as described in the TAMP (**Section 12.2.1.18.4.14**)	High
		Haul road surfaces will be constructed of coarse aggregate with very low silt content	High
		Unpaved road surfaces will be wetted as needed to control dust emissions when conditions are not wet or frozen, and the wetting agent may include a chemical to extend and improve dust control over using water alone	High
		Materials will be wetted prior to handling	High
Nitrogen deposition	Construction, Operations, Closure, Post-closure	Reducing vehicle emissions through enforcing speed limits, fuel selection, using vehicles that meet emission standards, and regular vehicle and equipment maintenance as described in the TAMP (**Section 12.2.1.18.4.14**)	Moderate
		Ensuring the incinerator and other emissions sources meet all relevant Canadian emission requirements	Moderate

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
		Limiting vehicle and equipment idling as described in the TAMP (**Section 12.2.1.18.4.14**)	Moderate
Spread of invasive plants	Construction, Operations, Closure, Post-closure	Preventing the initial introduction of invasive plants	Moderate
		Minimizing all soil disturbances (roads and machinery activity)	High
		Reclaiming and re-establishing appropriate vegetation on disturbed areas as soon as possible	Moderate
		Using weed-free seed for reclamation, and weed-free bales for erosion control	Moderate
		Cleaning earth moving vehicles prior to entering the mine site area	Moderate
		Early Detection and Rapid Response: determine the priority invasive plant species within the operating area and maintain awareness of species new to the area	Moderate
		Ensuring environmental monitors are able to identify species of concern	Moderate
		Conducting invasive plant monitoring	Moderate

Note: LSVMRP = Landscape, Soils and Vegetation Management and Restoration Plan; RCP = Reclamation and Closure Plan; ROW = right-of-way; SECP = Sediment and Erosion Control Plan; TAMP = Transportation and Access Management Plan

The mitigation success ratings shown in **Table 5.4.5-20** are incorporated into the confidence ratings defined in **Section 4.3.5** and summarized in **Table 5.4.5-41**, **Table 5.4.5-42**, and **Table** 5.4.5-43**.** In summary, low success rating means mitigation has not been proven successful, moderate success rating means mitigation has been proven successful elsewhere, and high success rating means mitigation has been proven effective.

The mitigation success of ecosystem loss is rated moderate overall because reclamation success has proven successful elsewhere; however, the uncertainty lies is restoring areas to baseline condition. The mitigation success of dust deposition is rated high overall because implementing mitigation measures such as dust suppression techniques have proven successful. The mitigation success of nitrogen deposition is rated moderate overall because implementing air quality mitigation measures will reduce the overall amount of N deposition. However, the effect is considered long-term, as it is uncertain how long excess nitrogen will persist in affected areas. The mitigation success of spreading invasive plants is rated moderate overall because by mitigation measures are consistent with BMPs identified by the Invasive Species Council of BC and BC MFLNRO, which have shown success in other areas.

5.4.5.3.7 Indicator 2: Riparian Areas

Riparian areas were included because they are sensitive to disturbance, have high potential to contain plant species at risk, provide important wildlife habitat, and contribute to stand- and landscape-level biodiversity.

5.4.5.3.7.1 Ecosystem Loss

Ecosystem loss here refers to loss of riparian ecosystems. Riparian areas include the area within a 30 m buffer around all TRIM water features, as well as riparian floodplain ecosystems. Wetlands proper are discussed and assessed in **Section 5.3.7**; only the riparian buffer, around wetlands were included in this analysis.

5.4.5.3.7.1.1 Mine Site

Riparian areas cover 679 ha (11%) of the terrestrial mine site LSA (5,305 ha) at baseline (**Table 5.4.5-21**). During the Project case, 381 ha or 56% of the riparian area will be affected by Project activities. Most of the effects occur within the ESSFmv1 BGC unit (249 ha, 61%), followed by the SBSmc3 (131 ha, 50%). At post-closure, the 134 ha of riparian areas that were located in the natural landform category will be reclaimed to ecosystems similar to baseline. Of the 247 ha which occur on mine-related landforms, 200 ha will be reclaimed, but will not resemble baseline riparian conditions; therefore, the loss is considered permanent. Forty-seven hectares will be permanently lost to the TSF and open pit. Overall, a 36% change will occur from baseline riparian conditions.

Table 5.4.5-21: Riparian: Mine Site Effects on Ecosystem Loss in the LSA

BGC Unit	Baseline Case (ha)	Project Case			Post-Closure Case		
		Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSmc3	263	132	-131	-50	193	-70	-27
ESSFmv1	406	157	-249	-61	230	-176	-43
ESSFmvp	11	9	-1	-13	10	-1	-9
Total Riparian	**679**	**298**	**-381**	**-56**	**679**	**-247**	**-36**

Note: BGC = biogeoclimatic unit; ha = hectare; % = percent
Some numbers have been rounded up, and as a result totals may not equal the sums of the individual values. Total change at post-closure is the sum of riparian area loss as a result of Project activities and subsequent conversion to mine-related landforms, TSF, and pit lake pond.

5.4.5.3.7.1.2 Linear Components

A total of 566 ha of riparian area occurs in linear components (mine site access road, freshwater supply system, airstrip, transmission line, and Kluskus FSR), for a total of 7% of the combined linear LSAs (8,178 ha) (**Table 5.4.5-22**). Sixty-eight hectares (12%) of this riparian area will be affected by Project activities. Most of the hectares affected occur in the SBSdk and SBSmc3 BGC units, with 29 ha (13%) and 22 ha (12%) affected, respectively. Most of the linear features, except for the mine site access road and Kluskus FSR portion decommissioned for upgrade, will be reclaimed, and at post-closure only 2 ha (<1%) of riparian ecosystems will have long-term to permanent effects.

Table 5.4.5-22: Riparian Ecosystems: Linear Component Effects on Ecosystem Loss in the LSA

		Project Case			Post-Closure Case		
BGC Unit	**Baseline Case (ha)**	**Remaining (ha)**	**Area Change (ha)**	**Percent Change (%)**	**Remaining and Reclaimed (ha)**	**Area Change (ha)**	**Percent Change (%)**
SBSdk	226	197	-29	-13	226	0	0
SBSdw3	110	98	-12	-11	110	0	0
SBSmc2	47	42	-5	-11	47	<-1	-1
SBSmc3	183	161	-22	-12	182	-2	-1
ESSFmv1	1	1	0	0	1	0	0
Total Riparian	**566**	**498**	**-68**	**-12**	**564**	**-2**	**<-1**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSdk = Sub-Boreal Spruce Dry Cool variant; SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant; SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant
Numbers have been rounded up, and as a result totals may not equal the sums of the individual values.

5.4.5.3.7.1.3 Combined Project Components

The combined project component LSAs total 14,300 ha, of which 1,246 ha (8.7%) are riparian areas. When the combined effects of Project components (mine site and linear) are examined, a total of 449 ha (36%) of riparian areas are affected during the Project case (**Table 5.4.5-23**). At post-closure, 249 ha (20%) of baseline has been converted to anthropogenic cover types (mine-related landforms, TSF, and pit lake).

Table 5.4.5-23: Riparian Ecosystems: Combined Project Component Effects on Ecosystem Loss in the LSA

BGC Unit	Baseline Case (ha)	Project Case			Post-Closure Case		
		Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSdk	226	197	-29	-13	226	0	0
SBSdw3	110	98	-12	-11	110	0	0
SBSmc2	47	42	-5	-11	47	<-1	-1
SBSmc3	446	293	-153	-34	375	-72	-16
ESSFmv1	406	158	-249	-61	231	-176	-43
ESSFmv1p	11	9	-1	-13	10	-1	-9
Total Riparian	**1,246**	**797**	**-449**	**-36**	**997**	**-249**	**-20**

Note: BGC = Biogeoclimatic unit; ha = hectares; % = percent; SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant; SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant
Numbers have been rounded up, and as a result totals may not equal the sums of the individual values.

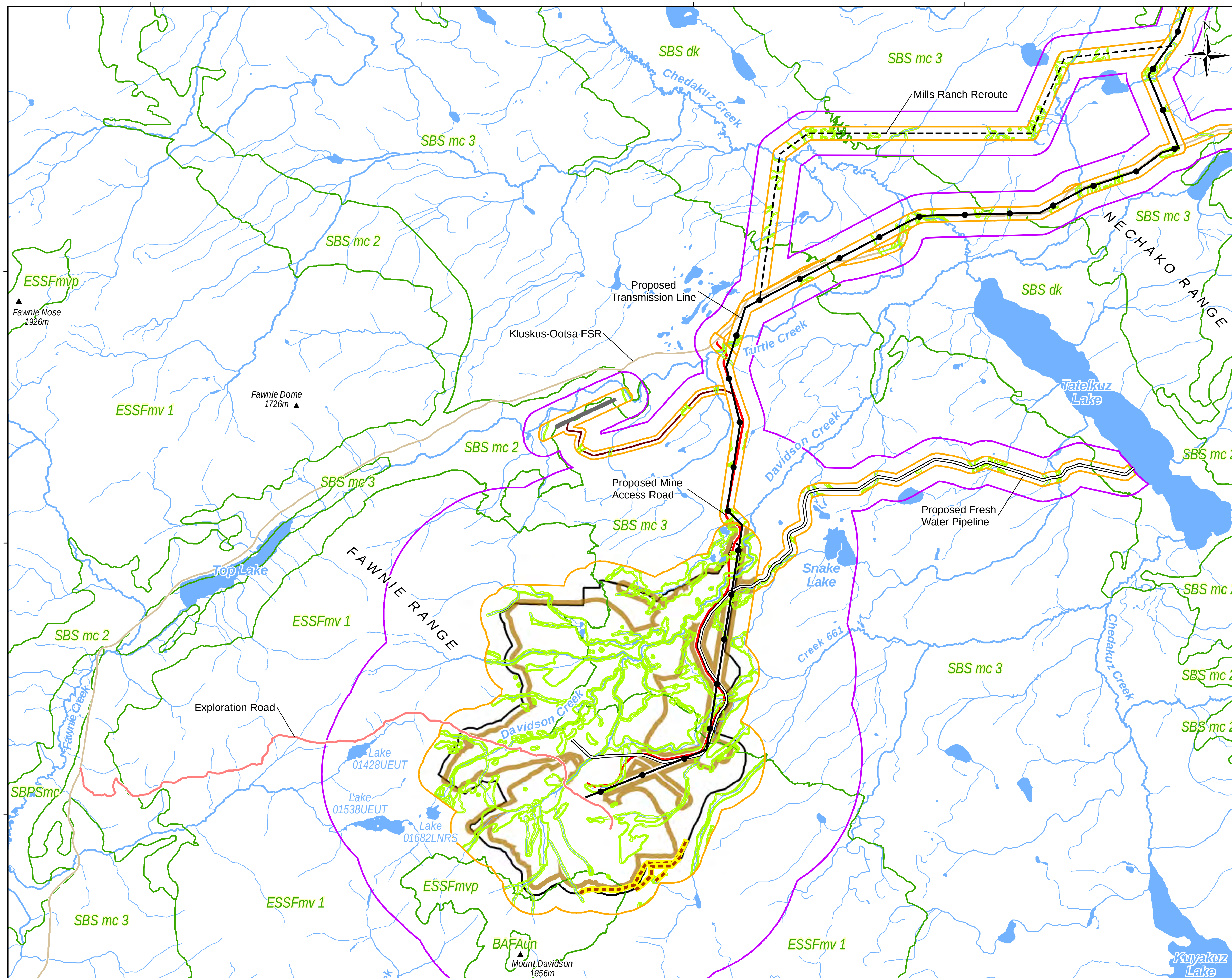
5.4.5.3.7.2 Dust Deposition

The main Project activities producing dust will be land clearing, excavating, and grading during construction, and mine fleet operations, material handling, ore processing, and vehicular traffic during operations (**Section 5.2.4**). A total of 80 ha (12%) of the mine site riparian ecosystems will be affected by dust deposition (**Table 5.4.5-24**). The highest levels of dust effects were predicted to occur in the SBSmc3 and ESSFmv1 BGC units, with 46 ha (17%) and 33 ha (8%) affected, respectively. **Figure 5.4.5-3** shows the riparian area and overlap with the 125 m dust zone in the mine site LSA.

Table 5.4.5-24: Riparian Ecosystems: Mine Site Effects of Dust Deposition in the LSA

BGC Unit	Baseline Case (ha)	Project Case	
		Dust Zone (ha)	Percent of Baseline (%)
SBSmc3	263	46	17
ESSFmv1	406	33	8
ESSFmvp	11	1	12
Total Riparian	**679**	**80**	**12**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant
Numbers have been rounded up, and as a result, totals may not equal the sums of the individual values.



Legend

- Kluskus-Ootsa FSR
- Stream
- Waterbody

Project Components

- Exploration Road
- Proposed Mine Access Road
- Proposed Transmission Line
- Mills Ranch Reroute
- Proposed Fresh Water Pipeline
- Proposed Airstrip Access Road
- Proposed Airstrip
- Proposed Mine Site

Terrain, Soils, and Vegetation

- Local Study Area
- Regional Study Area

Riparian in Relation to Dust and Nitrogen Deposition

- Nitrogen Deposition
- 125m Dust Buffer
- Biogeoclimatic Zone
- Riparian

Scale:1:100,000

0 1 2 4 6

Kilometres

Reference
BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Riparian in Relation to Dust and Nitrogen Deposition

DATE: February, 2014	ANALYST: WR	Figure 5.4.5-3
JOB No: VE52277	QA/QC: MY	PDF FILE: 06-200-034_Riparian_Effects_Dust.pdf
GIS FILE: 06-200-034_Riparian_Effects_Dust.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

V:\Mapping\06_vegetation\EIA\06-200-034_Riparian_Effects_Dust.mxd

Compared to the mine site, a smaller percent of the total dust emissions per day are predicted to occur on linear components associated with roads (**Section 5.2.4**). Given several mitigation actions to reduce fugitive dust are planned (**Section 5.2.4**), including wetting soil surfaces and using coarse aggregate materials for road surfacing, a 50 m buffer distance was selected to assess the effects of dust on vegetation for all linear components.

A total of 296 ha (34%) of the combined linear Project components will be affected by dust deposition (**Table 5.4.5-25**). The two BGC units with the most area affected are the SBSdk unit (111 ha, 35%) and the SBSmc3 unit (103 ha, 33%).

During the post-closure case, the amount of dust generated will be a small fraction of the level predicted for the Project case. Dust coating leaf surfaces will be removed by precipitation and re-growth of new leaves.

Table 5.4.5-25: Riparian Ecosystems: Linear Project Component Effect on Dust Deposition in the LSA

BGC Unit	Baseline Case (ha)	Project Case	
		Dust Zone (ha)	Percent of Baseline (%)
SBSdk	321	111	35
SBSdw3	132	42	32
SBSmc2	76	29	39
SBSmc3	310	103	33
ESSFmv1	25	10	39
Total Riparian	**863**	**296**	**34**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSdk = Sub-Boreal Spruce Dry Cool variant; SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant; SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant
Numbers have been rounded up, and as a result totals may not equal the sums of the individual values.

5.4.5.3.7.3 Nitrogen Deposition

Air emissions modelling predicted nitrogen exceedances within the mine site LSA. Mine construction and operations will produce air emissions from a number of sources, with internal combustion engines as the primary output (**Section 5.2.4**). Linear corridors, such as unpaved roads, were not predicted to have N exceedances. Nitrogen deposition will cease after operations, but the exceedances will continue for some time. **Figure 5.4.5-3** shows the overlap between riparian areas and nitrogen deposition in the mine site LSA.

Nitrogen deposition exceedances occur at the southeastern edge of the mine site, and a small amount (2 ha) of riparian area in the ESSFmv1 BGC unit is affected.

5.4.5.3.7.4 Spread of Invasive Plants

There is no overlap with known locations of invasive plant species and mapped riparian areas. However, invasive plants from adjacent areas may be spread to areas where soils have been disturbed and equipment is mobile from one area to another.

5.4.5.3.7.5 Mitigation

In the post-closure phase, riparian areas will be reclaimed; however, a permanent loss of 249 ha is expected in the mine site as a result of project facilities and mine-related landforms, including the open pit, TSF and waste rock dumps. Dust deposition will result in 376 ha of riparian area affected, and 2 ha will potentially be affected by nitrogen deposition. The spread of invasive species is a concern, especially where riparian areas intersect with access road corridors.

The primary way of mitigating potential effects on riparian areas will be by implementing the mitigation measures described in the Ecosystem Distribution mitigation section (**Section 5.4.5.3.6.5**). The following effects assessment report sections or management plans should be consulted for relevant mitigation details: AQEMP (**Section 12.2.1.18.4.9**), Water Quality and Liquid Discharges Management Plan (WQLDMP) (**Section 12.2.1.18.4.10**), Transportation and Access Management Plan (TAMP) (**Section 12.2.1.18.4.14**), LSVMRP (**Section 12.2.1.18.4.4**), Sediment and Erosion Control Plan (SECP) (**Section 12.2.1.18.4.1**), Aquatic Resources Management (ARMP) (**Section 12.2.1.18.4.2**), ISMP (**Section 12.2.1.18.4.5**), and the RCP (**Section 2.6**).

Mitigation measures specific to riparian ecosystems include:

- Avoiding riparian areas where possible as part of the initial mine design process, thereby minimizing riparian losses;
- Including well-demarcated no-work zones and management work zones (with restrictions such as no heavy machinery, etc.) and setbacks in accordance with *Forest and Range Practices Act* BMPs for linear project components such as the transmission line, mitigating loss and degradation of riparian areas;
- Implementing construction BMPs to mitigate for altered hydrology. For example, installing appropriate culverts where required, and maintaining functioning water tables and drainage throughout all phases from construction to post-closure;
- Following the Approved Work Practices for Managing Riparian Vegetation (BC Hydro, 2003) for transmission line construction;
- Implementing BMPs designed by BC Timber Sales (Zielke et al. 2010) to minimize windthrow in the forested areas of the road alignment. Minimizing windthrow includes appropriately designing boundaries, conducting edge stabilization treatments (e.g. topping, and pruning and feathering edges), and follow-up monitoring to address any necessary adaptive management techniques; and

- Maintaining natural drainage patterns by minimizing the linear extent of roads crossing or paralleling riparian areas.

Table 5.4.5-26 provides ratings for effectiveness of mitigation measures to avoid or reduce potential effects on riparian areas during mine site development. Mitigation measures will be based on site-specific information and construction engineering and are therefore preliminary at this stage.

Table 5.4.5-26: Mitigation Measures and Effectiveness of Mitigation to Avoid or Reduce Potential Effects on Riparian Areas of Mine Site Development

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
Ecosystem loss	Construction, Operations, Closure, Post-closure	Avoiding riparian areas where possible	Moderate
		Including well-demarcated no-work zones and management work zones (with restrictions such as no heavy machinery, etc.) and setbacks in accordance with *Forest and Range Practices Act* BMPs for linear project components such as the transmission line	Moderate
		Implementing construction BMPs to mitigate for altered hydrology. For example, installing appropriate culverts where required, and maintaining functioning water tables and drainage	Moderate
		Following the Approved Work Practices for Managing Riparian Vegetation (BC Hydro, 2003)	Moderate
		Maintaining natural drainage patterns by minimizing the linear extent of roads crossing or paralleling riparian areas	Moderate
Dust deposition	Construction, Operations, Closure, Post-closure	Implementing BMPs designed by BC Timber Sales (Zielke et al. 2010) to minimize windthrow in the forested areas of the road alignment. Minimizing windthrow includes appropriately designing boundaries, conducting edge stabilization treatments (e.g., topping, and pruning and feathering edges), and follow-up monitoring to address any necessary adaptive management techniques	High
		Haul road surfaces will be constructed of coarse aggregate with very low silt content	High
		Unpaved road surfaces will be wetted as needed to control dust emissions when conditions are not wet or frozen, and the wetting agent may include a chemical to extend and improve dust control over using water alone	High
		Materials will be wetted prior to handling	High

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
Nitrogen deposition	Construction, Operations, Closure, Post-closure	Reducing vehicle emissions through enforcing speed limits, fuel selection, using vehicles that meet emission standards, and regular vehicle and equipment maintenance as described in the TAMP (**Section 12.2.1.18.4.14**)	Moderate
		Ensuring the incinerator and other emissions sources meet all relevant Canadian emission requirements	Moderate
		Limiting vehicle and equipment idling as described in the TAMP (**Section 12.2.1.18.4.14**)	Moderate

Note: BMP = Best Management Practice; TAMP = Transportation and Access Management Plan

The mitigation success ratings shown in **Table 5.4.5-26** are incorporated into the confidence ratings defined in **Section 4.3.5** and summarized in **Table 5.4.5-41**, **Table 5.4.5-42**, and **Table** 5.4.5-43. In summary, low success rating means mitigation has not been proven successful, moderate success rating means mitigation has been proven successful elsewhere, and high success rating means mitigation has been proven effective.

The mitigation success of ecosystem loss is rated moderate overall because most mitigation measures are consistent with those proposed by BC MFLNRO and BC Hydro's approved work practices for managing riparian vegetation for the protection of riparian areas and demonstrated as moderate in effectiveness in other locations. The mitigation success of dust deposition is rated high because implementing mitigation measures such as dust suppression techniques have proven successful. The mitigation success of nitrogen deposition is rated moderate because implementing the mitigation measures these measures will reduce the overall amount of N deposition. However, the effect is considered long-term, as it is uncertain how long excess nitrogen will persist in affected areas. The mitigation success of spreading invasive plants is rated moderate overall because mitigation measures are consistent with BMPs identified by the Invasive Species Council of BC and BC MFLNRO which have shown success in other areas.

5.4.5.3.8 Indicator 3: Old-Growth Forest

Old-growth forests were included because of their diverse tree-related structures, such as multi-layered canopies and canopy gaps, greatly varying tree heights and diameters, and diverse species and classes of coarse woody debris. All of these elements provide important wildlife habitat and increase the biodiversity of the forested ecosystem.

5.4.5.3.8.1 Ecosystem Loss

Because of the extended time periods required for the development of old-growth forest replacement of old-growth forest conditions will require a minimum of 140 years for SBSmc3, and 250 years for ESSF BGC units.

5.4.5.3.8.1.1 Mine Site

Old-growth forests in the mine site are primarily subalpine fir (*Abies lasiocarpa*)-dominant ecosystems that are over 250 years old, and to a lesser extent lodgepole pine (*Pinus contorta*) or hybrid white spruce (*Picea glauca x engelmannii*) ecosystems that are over 140 years old. Mountain pine beetle (MPB) infestation was noted in the mine footprint during data collection, and most of the mature and old pine in the mine site were standing dead trees. Based on the terrestrial ecosystem map and VRI, it was estimated that a total of 510 ha (8%) of the mine site LSA is represented by old-growth forest. A total of 311 ha (5%) occur in the ESSFmv1 unit, 190 ha (3%) in the SBSmc3, and 12 ha (0.2%) in the ESSFmv1p.

During the Project case, 183 ha of old-growth forest (36% of 510 ha) in the mine site will be affected by Project activities (**Table 5.4.5-27**). The largest area affected occurs in the ESSFmv1 Subalpine fir–Huckleberry–Feathermoss (03/FF) ecosystem, with 42 ha lost (55%). However, the highest percent lost (89%, 2 ha) will be in the SBSmc3 Lodgepole pine–Juniper–Dwarf huckleberry ecosystem (02/LJ).

During the post-closure case, project areas within natural landforms will be reclaimed to ecosystems that can be expected to produce similar old-growth forest types as those occurring at baseline, given sufficient time. In the mine-related landform areas, where soils and habitat conditions have been substantially altered, reclaimed ecosystems will be substantially different from baseline conditions, and will be considered a permanent loss. Therefore, the 108 ha (21%) converted to mine-related landforms is considered a long-term to permanent old-growth forest loss.

Table 5.4.5-27: Old-Growth Forest: Mine Site Effects on Ecosystem Loss in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSmc3	Hybrid white spruce–Huckleberry	01	SB	46	27	-18	-40	38	-8	-17
SBSmc3	Lodgepole pine–Juniper–Dwarf huckleberry	02	LJ	3	<1	-2	-89	<1	-2	-77
SBSmc3	Lodgepole pine–Feathermoss–Cladina	03	LF	105	73	-32	-30	90	-15	-14
SBSmc3	Hybrid white spruce–Huckleberry–Soopolallie	04	SS	1	1	<-1	-3	1	<-1	-3
SBSmc3	Black spruce–Huckleberry–Spirea	05	BH	12	11	-1	-8	11	-1	-5
SBSmc3	Black spruce–Lodgepole pine–Feathermoss	06	BF	5	2	-2	-52	5	0	0
SBSmc3	Hybrid white spruce–Twinberry	07	ST	19	12	-7	-37	16	-3	-18
Total SBSmc3				**190**	**126**	**-63**	**-33**	**161**	**-28**	**-15**
ESSFmv1	Subalpine fir–Rhododendron–Feathermoss	01	FR	142	112	-30	-21	129	-13	-9
ESSFmv1	Lodgepole pine–Huckleberry–Cladonia	02	LC	41	14	-27	-66	16	-25	-62
ESSFmv1	Subalpine fir–Huckleberry–Feathermoss	03	FF	76	34	-42	-55	47	-29	-38
ESSFmv1	Subalpine fir–Huckleberry–Gooseberry	04	FG	49	28	-21	-42	36	-13	-27
Total ESSFmv1				**308**	**188**	**-119**	**-39**	**228**	**-80**	**-26**
ESSFmv1p	Subalpine fir–Indian hellebore	00	FH	12	12	0	0	12	0	0
Total ESSFmv1p				**12**	**12**	**0**	**0**	**12**	**0**	**0**
Total Old Growth Forest				**510**	**327**	**-183**	**-36**	**401**	**-108**	**-21**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant
Numbers have been rounded up, and as a result totals may not equal the sums of the individual values.

5.4.5.3.8.1.2 Linear Components

Linear components include the mine access road, freshwater supply system, airstrip and airstrip road, transmission line, and Kluskus FSR. Forestry activities and MPB have reduced the amount of old-growth forest in the Project landscape. Based on ecosystem mapping, PEM, VRI, and 2012 satellite imagery, it was estimated that a total of 688 ha of old-growth forest occurs along linear Project components, roughly 8% out of a total of 8,178 ha. The Project will therefore result in a loss of old-growth forest along linear components due to clearing activities. This effect will last for a minimum of 140 years (250 years for the ESSFmv1 variant) after decommissioning, but will be restored over time as existing mature and maturing forest stands are recruited to old-growth forest.

Effects on old-growth forest associated with linear components during the Project case total approximately 76 ha, or 11% of the 688 ha (**Table 5.4.5-28**). The greatest area lost is for the SBSdk Hybrid white spruce–Purple peavine (01/SP) ecosystem (11 ha, 11%); while the SBSmc2 Hybrid white spruce–twinberry–Coltsfoot (05/TC) unit only lost less than 1 ha, it accounts for 100% of the baseline old-growth for that ecosystem.

At post-closure, 6 ha (1%) of old-growth forest will have experienced a permanent loss due to clearing activities.

5.4.5.3.8.1.3 Combined Project Components

The combined Project effects on old-growth forest ecosystems in the LSA will result in a loss of 115 ha or 10% of existing old-growth forest (**Table 5.4.5-29**). Substantial alteration of reclaimed ecosystems from baseline conditions will occur. Most of this effect will occur in the ESSFmv1 BGC unit (80 ha, 22%).

Table 5.4.5-28: Old-Growth Forest: Linear Component Effects on Ecosystem Loss in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSdk	Hybrid white spruce – Purple peavine	01	SP	103	91	-11	-11	103	0	0
SBSdk	Lodgepole pine – Juniper – Ricegrass	02	LJ	0	0	0	0	0	0	0
SBSdk	Lodgepole pine – Feathermoss – Cladina	03	LC	8	7	-2	-18	8	0	0
SBSdk	Hybrid white spruce – Spirea – Feathermoss	05	SF	9	8	-1	-13	9	0	0
SBSdk	Hybrid white spruce – Twinberry – Coltsfoot	06	ST	78	69	-9	-11	78	0	0
Total SBSdk				**198**	**175**	**-23**	**-12**	**198**	**0**	**0**
SBSdw3	Hybrid white spruce – Douglas fir - Pinegrass	01	SP	51	45	-7	-13	51	0	0
SBSdw3	Douglas fir – Lodgepole pine - Cladonia	02	DC	1	1	0	-7	1	0	0
SBSdw3	Lodgepole pine – Feathermoss - Cladina	03	LC	3	3	0	0	3	0	0
SBSdw3	Hybrid white spruce – Ricegrass	04	SR	17	14	-2	-14	17	0	0
SBSdw3	Hybrid white spruce - Twinberry	07	ST	54	46	-7	-14	54	0	0
SBSdw3	Hybrid white spruce – Oakfern	08	SO	5	5	0	-8	5	0	0
Total SBSdw3				**130**	**114**	**-17**	**-13**	**130**	**0**	**0**
SBSmc2	Hybrid white spruce – Huckleberry	01	SB	53	47	-6	-11	53	<-1	-1
SBSmc2	Lodgepole pine – Huckleberry – Cladonia	02	PH	1	0	0	-59	0	<-1	-59
SBSmc2	Black spruce – Lodgepole pine – Feathermoss	03	BM	2	2	0	-19	2	<-1	-12

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSmc2	Hybrid white spruce – Huckleberry – Dwarf blueberry	04	HB	6	6	0	0	6	0	0
SBSmc2	Hybrid white spruce – Twinberry – Coltsfoot	05	TC	<1	<1	<1	-100	0	<-1	-100
SBSmc2	Hybrid white spruce – Oak fern	06	SO	1	1	0	-21	1	<-1	-15
SBSmc2	Hybrid white spruce – Twinberry - Oak fern	08	ST	4	4	0	0	4	0	0
SBSmc2	Hybrid white spruce – Devil's club	09	SD	4	3	-1	-13	4	0	0
SBSmc2	Hybrid white spruce – Horsetail	10	SH	2	2	0	0	2	0	0
Total SBSmc2				**73**	**66**	**-7**	**-10**	**72**	**0**	**0**
SBSmc3	Hybrid white spruce – Huckleberry	01	SB	73	68	-5	-7	71	-2	-3
SBSmc3	Lodgepole pine – Juniper – Dwarf huckleberry	02	LJ	0	0	0	0	0	0	0
SBSmc3	Lodgepole pine – Feathermoss – Cladina	03	LF	19	17	-2	-13	18	-2	-8
SBSmc3	Hybrid white spruce - Huckleberry – Soopolallie	04	SS	15	13	-2	-12	15	<-1	0
SBSmc3	Black spruce – Huckleberry – Spirea	05	BH	20	19	-2	-9	19	-2	-9
SBSmc3	Black spruce – Lodgepole pine – Feathermoss	06	BF	13	12	-1	-9	13	<-1	-4
SBSmc3	Hybrid white spruce – Twinberry	07	ST	89	79	-9	-10	88	-1	-1
Total SBSmc3				**230**	**208**	**-22**	**-9**	**223**	**-6**	**-3**
ESSFmv1	Subalpine fir - Rhododendron – Feathermoss	01	FR	36	30	-5	-15	36	0	0
ESSFmv1	Lodgepole pine - Huckleberry – Cladonia	02	LC	0	0	0	0	0	0	0
ESSFmv1	Subalpine fir - Huckleberry – Feathermoss	03	FF	21	18	-2	-11	21	0	0

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
ESSFmv1	Subalpine fir - Huckleberry – Gooseberry	04	FG	1	1	0	0	1	0	0
Total ESSFmv1				**57**	**49**	**-8**	**-13**	**57**	**0**	**0**
Total Old-Growth Forest				**688**	**612**	**-76**	**-11**	**680**	**-6**	**-1**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSdk = Dry Cool Sub-Boreal Spruce; SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant, SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant

Table 5.4.5-29: Old-Growth Forest: Combined Project Components Effects on Ecosystem Loss in the LSA

BGC Unit	Baseline Case	Project Case			Post-Closure Case		
		Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSdk	198	175	-23	-12	198	0	0
SBSdw3	130	114	-17	-13	130	0	0
SBSmc2	73	66	-7	-10	72	0	0
SBSmc3	419	334	-85	-20	384	-35	-8
ESSFmv1	365	238	-127	-35	285	-80	-22
ESSFmv1p	12	12	0	0	12	0	0
Total Old-Growth Forest	**1,198**	**939**	**-259**	**-22**	**1,081**	**-115**	**-10**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant; ESSFmv1p = Nechako Very Cold Engelmann Spruce-Subalpine Fir Parkland variant
Numbers have been rounded up, and as a result totals may not equal the sums of the individual values.

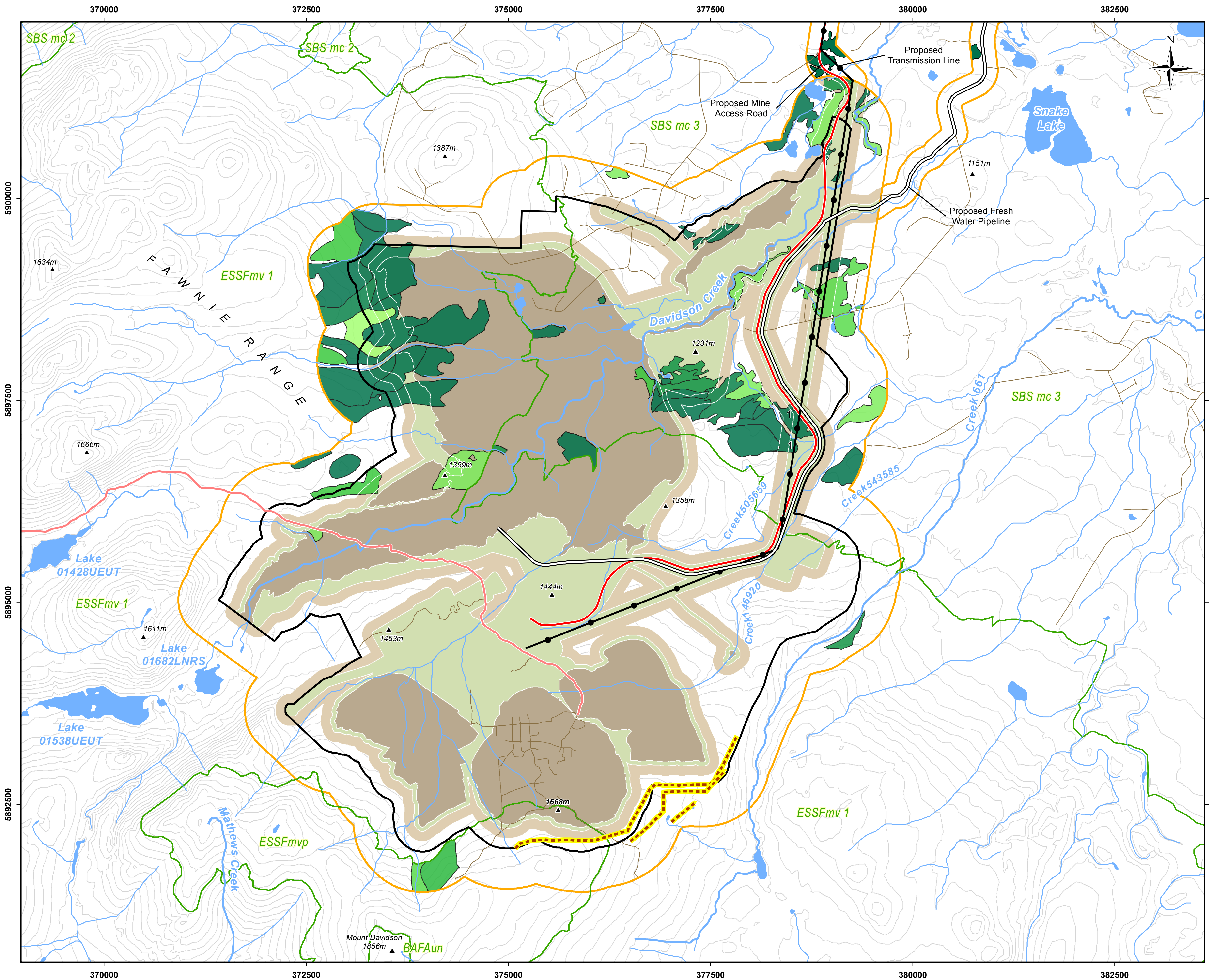
5.4.5.3.8.2 Dust Deposition

5.4.5.3.8.2.1 Mine Site

The main Project activities producing dust will be land clearing, excavating, and grading during construction, and mine fleet operations, material handling, ore processing, and vehicular traffic during operations (**Section 5.2.4**). **Figure 5.4.5-4** shows the overlap between old-growth forests and the 125 m dust zone in the mine site LSA.

Fifty-nine hectares (12%) of old-growth forest in the mine site LSA is expected to be affected by dust during the Project case (**Table 5.4.5-30**). The largest area affected will occur in the SBSmc3 Lodgepole line–Feathermoss–Cladina (03/LF) and ESSFmv1 Subalpine fir–Rhododendron–Feathermoss (01/FR) ecosystems, with 19 ha (18%) and 15 ha (10%) affected, respectively.

During the post-closure case, the amount of dust generated will be a small fraction of the level predicted for the Project case. Dust coating leaf surfaces will be removed by precipitation and re-growth of new leaves.



Legend

- Existing road
- Contour (20 m)
- Stream
- Waterbody

Project Components

- Exploration Road
- Proposed Mine Access Road
- Proposed Transmission Line
- Proposed Fresh Water Pipeline
- Proposed Mine Site

Terrain, Soils, and Vegetation

- Local Study Area

Old Growth Forest in Relation to Dust and Nitrogen Deposition

- Nitrogen Deposition
- 125m Dust Buffer
- Biogeoclimatic Zone

Minesite Year 17 Maximum Disturbance

- Natural Landform
- Mine-related Landform

Old Growth Forest

- 10
- 20
- 40
- 50
- 60
- 70
- 80
- 90
- 100

Scale:1:46,000

0 1 2 3

Kilometres

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Old Growth Forest in Relation to Dust and Nitrogen Deposition

DATE: February, 2014	ANALYST: WR	**Figure 5.4.5-4**
JOB No: VE52277	QA/QC: MY	PDF FILE: 06-200-035_OldGrowFor_Effects_Dust.pdf
GIS FILE: 06-200-035_OldGrowFor_Effects_Dust.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

V:\Mapping\06_vegetation\EIA\06-200-035_OldGrowFor_Effects_Dust.mxd

Table 5.4.5-30: Old-Growth Forest: Mine Site Effects of Dust Deposition in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case	
					Dust Zone (ha)	Percent of Baseline (%)
SBSmc3	Hybrid white spruce–Huckleberry	01	SB	46	8	18
SBSmc3	Lodgepole pine–Juniper–Dwarf huckleberry	02	LJ	3	0	9
SBSmc3	Lodgepole pine–Feathermoss–Cladina	03	LF	105	19	18
SBSmc3	Hybrid white spruce–Huckleberry–Soopolallie	04	SS	1	1	79
SBSmc3	Black spruce–Huckleberry–Spirea	05	BH	12	0	2
SBSmc3	Black spruce–Lodgepole pine–Feathermoss	06	BF	5	0	0
SBSmc3	Hybrid white spruce–Twinberry	07	ST	19	2	12
Total SBSmc3				**190**	**31**	**16**
ESSFmv1	Subalpine fir–Rhododendron–Feathermoss	01	FR	142	15	10
ESSFmv1	Lodgepole pine–Huckleberry–Cladonia	02	LC	41	1	3
ESSFmv1	Subalpine fir–Huckleberry–Feathermoss	03	FF	76	8	10
ESSFmv1	Subalpine fir–Huckleberry–Gooseberry	04	FG	49	5	10
ESSFmvp	Subalpine fir–Indian hellebore	00	FH	12	0	0
Total ESSFmvp				**320**	**28**	**9**
Total Old-Growth Forest				**510**	**59**	**12**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant
Numbers have been rounded up, and as a result totals may not equal the sums of the individual values.

5.4.5.3.8.2.2 Linear Components

Dust deposition along linear components is expected to affect 281 ha (32%) of the old growth forest in the LSAs. The greatest number of hectares affected will occur in the SBSmc3 Hybrid white spruce–Huckleberry (01/SB) and Hybrid white spruce–Twinberry (07/ST) ecosystems, with 51 ha (33%) and 40 ha (35%) affected, respectively. The third greatest amount of area affected will be in the SBSdk Hybrid white spruce–Purple peavine (01/SP) ecosystem (36 ha, 30%) (**Table** 5.4.5-31).

Table 5.4.5-31: Old-Growth Forest: Linear Component Effects of Dust Deposition in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Dust Zone (ha)	Percent of Baseline (%)
SBSdk	Hybrid white spruce–Purple peavine	01	SP	120	36	30
SBSdk	Lodgepole pine–Juniper–Ricegrass	02	LJ	0	0	0
SBSdk	Lodgepole pine–Feathermoss–Cladina	03	LC	8	3	34
SBSdk	Hybrid white spruce–Spirea–Feathermoss	05	SF	9	3	32
SBSdk	Hybrid white spruce–Twinberry–Coltsfoot	06	ST	80	24	30
Total SBSdk				**217**	**65**	**30**
SBSdw3	Hybrid white spruce–Douglas fir–Pinegrass	01	SP	52	15	29
SBSdw3	Douglas fir–Lodgepole pine–Cladonia	02	DC	1	0	21
SBSdw3	Lodgepole pine–Feathermoss–Cladina	03	LC	3	0	9
SBSdw3	Hybrid white spruce–Ricegrass	04	SR	17	5	32
SBSdw3	Lodgepole pine–Black spruce–Feathermoss	05	BF	1	0	43
SBSdw3	Hybrid white spruce–Twinberry	07	ST	55	17	31
SBSdw3	Hybrid white spruce–Oakfern	08	SO	5	1	28
Total SBSdw3				**133**	**40**	**30**
SBSmc2	Hybrid white spruce–Huckleberry	01	SB	57	18	32
SBSmc2	Lodgepole pine–Huckleberry–Cladonia	02	PH	2	0	5
SBSmc2	Black spruce–Lodgepole pine–Feathermoss	03	BM	4	1	24
SBSmc2	Hybrid white spruce–Huckleberry–Dwarf blueberry	04	HB	6	1	15
SBSmc2	Hybrid white spruce–Twinberry–Coltsfoot	05	TC	0	0	37
SBSmc2	Hybrid white spruce –Oak fern	06	SO	2	1	39
SBSmc2	Hybrid white spruce–Twinberry–Oak fern	08	ST	4	1	21
SBSmc2	Hybrid white spruce–Devil's club	09	SD	4	1	30
SBSmc2	Hybrid white spruce–Horsetail	10	SH	2	0	11
Total SBSmc2				**82**	**24**	**29**
SBSmc3	Hybrid white spruce–Huckleberry	01	SB	153	51	33
SBSmc3	Lodgepole pine–Juniper–Dwarf huckleberry	02	LJ	0	0	25

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Dust Zone (ha)	Percent of Baseline (%)
SBSmc3	Lodgepole pine–Feathermoss–Cladina	03	LF	32	12	36
SBSmc3	Hybrid white spruce–Huckleberry–Soopolallie	04	SS	18	7	36
SBSmc3	Black spruce–Huckleberry–Spirea	05	BH	40	15	38
SBSmc3	Black spruce–Lodgepole pine–Feathermoss	06	BF	19	6	31
SBSmc3	Hybrid white spruce–Twinberry	07	ST	116	40	35
Total SBSmc3				**379**	**131**	**35**
ESSFmv1	Subalpine fir–Rhododendron–Feathermoss	01	FR	42	15	35
ESSFmv1	Lodgepole pine–Huckleberry–Cladonia	02	LC	1	0	32
ESSFmv1	Subalpine fir–Huckleberry–Feathermoss	03	FF	21	6	29
ESSFmv1	Subalpine fir–Huckleberry–Gooseberry	04	FG	2	1	37
Total ESSFmv1				**65**	**22**	**33**
Total Old-Growth				**876**	**281**	**32**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant
Numbers have been rounded up, and as a result totals may not equal the sums of the individual values.

The greatest number of hectares affected will occur in the SBSmc3 Hybrid white spruce–Huckleberry (01/SB) and Hybrid white spruce–Twinberry (07/ST) ecosystems, with 51 ha (33%) and 40 ha (35%) affected, respectively. The third greatest amount of area affected will be in the SBSdk Hybrid white spruce–Purple peavine (01/SP) ecosystem (36 ha, 30%).

5.4.5.3.8.3 Nitrogen Deposition

Air emissions modelling predicted nitrogen exceedances within the mine site LSA. Mining construction and operations will produce air emissions from a number of sources, with internal combustion engines as the primary output (**Section 5.2.4**). Linear corridors, such as unpaved roads, were not predicted to have N exceedances. **Figure 5.4.5-4** shows the lack of overlap between old-growth forest areas and nitrogen deposition in the mine site LSA.

No old-growth forests occur in the area where nitrogen deposition is predicted to exceed critical loads.

5.4.5.3.8.4 Spread of Invasive Plants

There is no direct overlap between old-growth forests and documented invasive plants, but invasive plants do occur in close proximity, i.e. within 10 m. For example, common tansy (TC) occurs within 10 m of an old-growth forest polygon mapped as SBSmc3 01/SB and SBSmc3 04/SS. Yellow salsify occurs within approximately 200 m of an old-growth forest in the ESSFmv1p 00/FH unit within the mine site LSA. However, invasive plants from adjacent areas may be spread to areas where soils have been disturbed and equipment is mobile from one area to another.

5.4.5.3.8.5 Mitigation

In the post-closure phase, old-growth forests will be reclaimed; however, a permanent loss of 115 ha is expected due to clearing, primarily in the mine site, but also along linear Project components. The mountain pine beetle infestation is extensive throughout the Project area but most evident along the linear project components along lower elevations (SBS). Within the mine site and higher elevations (e.g., ESSFmv1), forests are mixed stands of subalpine fir, spruce and lodgepole pine. Regardless of beetle-killed pines, old forests are still functioning old growth ecosystems. Whereas along linear corridors and lower elevation where lodgepole pine is more common in the forest canopy, often forming pure stands of pine, old growth forests are affected to a much greater degree.

Dust deposition will result in 340 ha of old-growth forests being affected. Nitrogen deposition is not expected to have any effect on old-growth forests, as predicted exceedances will not overlap with old-growth forests. The spread of invasive species is a concern, especially where old-growth forests occur close to access corridors, such as the mine site access road or the existing Kluskus FSR.

With mitigation, the Project will result in a one-time decline in the area of old-growth forest for at least 140 years (250 years for ESSFmv1) following decommissioning. The loss of old-growth forest ecosystems in the mine site will be permanent, as a result of the construction of certain mine site facilities that will not be reclaimed to baseline conditions. The loss of old-growth forest ecosystems along the transmission line and other linear components will persist through to the end of the Project, due to vegetation management along the ROW. With the application of standard reforestation practices, and implementation of the prescribed mitigation measures, the effect is reversible in the far future. A large percentage of old growth forests have been naturally affected by mountain pine beetle infestations in the Project RSA. Specific mitigation measures for old-growth forests include:

- Avoiding and minimizing disturbance of old-growth forest in the mine site design where possible;
- Designing roads using existing roads and cleared areas where possible, maximise the use of existing areas of disturbance;
- Micro-rerouting of linear components (such as the transmission line) where possible to avoid existing old or mature forests, especially non-pine mature forest that is suitable for recruitment to old-growth forest status; and

- Implementing reforestation measures described in the RCP. These should include promptly reforesting the reclaimed mine site with tree species appropriate for site conditions.

Table 5.4.5-32 provides ratings for effectiveness of mitigation measures to avoid or reduce potential effects on old-growth forests during mine site development. Mitigation measures will be based on site-specific information and construction engineering and are therefore preliminary at this stage.

Table 5.4.5-32: Mitigation Measures and Effectiveness of Mitigation to Avoid or Reduce Potential Effects on Old-Growth Forests during Mine Site Development

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
Ecosystem loss	Construction, Operations, Closure, Post-closure	Avoiding and minimizing disturbance of old-growth forest in the mine site design where possible	Moderate
		Designing roads using existing roads and cleared areas where possible, maximize the use of existing areas of disturbance	Moderate
		Micro-rerouting of linear components (such as the transmission line) where possible to avoid existing old or mature forests, especially non-pine mature forest that is suitable for recruitment to old-growth forest status	Moderate
		Implementing reforestation measures described in the RCP. These should include promptly reforesting the reclaimed mine site with tree species appropriate for site conditions	Moderate
Spread of invasive plants	Construction, Operations, Closure, Post-closure	Preventing the initial introduction of invasive plants	Moderate
		Minimizing all soil disturbances (roads and machinery activity)	Moderate
		Reclaiming and re-establishing appropriate vegetation on disturbed areas as soon as possible	Moderate
		Using weed-free seed for reclamation, and weed-free bales for erosion control	Moderate
		Cleaning earth moving vehicles prior to entering the mine site area	Moderate
		Early Detection and Rapid Response: determine the priority invasive plant species within the operating area and maintain awareness of species new to the area	Moderate
		Ensuring environmental monitors are able to identify species of concern	Moderate
		Conducting invasive plant monitoring	Moderate

Note: RCP = Reclamation and Closure Plan

The mitigation success ratings shown in **Table 5.4.5-32** are incorporated into the confidence ratings defined in **Section 4.3.5** and summarized in **Table 5.4.5-41** and **Table 5.4.5-43**. In summary, low success rating means mitigation has not been proven successful, moderate success rating means mitigation has been proven successful elsewhere, and high success rating means mitigation has been proven effective.

The mitigation success of ecosystem loss is rated moderate overall because with the application of standard reforestation practices and the implementation of the prescribed mitigation measures, the effect is reversible in the far future. The mitigation success of spreading invasive plants is rated moderate overall because mitigation measure are consistent with BMPs identified by the Invasive Species Council of BC and BC MFLNRO which have shown success in other areas.

5.4.5.3.9 Indicator 4: Sparsely Vegetated Ecosystems

Sparsely vegetated ecosystems were included because they are sensitive to disturbance, have a high potential to contain plant species at risk, and contribute to stand- and landscape-level biodiversity.

5.4.5.3.9.1 Ecosystem Loss

Approximately 3 ha combined of talus (3 ha, <1%) and rock outcrops (<1 ha; <1%) occur in the LSA; however, neither the mine footprint or any of the mine activities overlap with these ecosystems. Thus, no permanent loss or alteration of sparsely vegetated ecosystems is predicted (**Table 5.4.5-9**).

5.4.5.3.9.2 Dust Deposition

In the mine site, where sparsely vegetated ecosystems occur, less than 0.1% of the ESSFmv1 Talus site series (00/TA) was in the dust deposition zone. Given the open structure and low stature of many of the plants characteristic of these ecosystems, it will be important that dust suppression measures be implemented to mitigate effects. **Figure 5.4.5-5** shows distribution of sparsely vegetated ecosystems in relation to the 125 m dust zone in the mine site LSA.

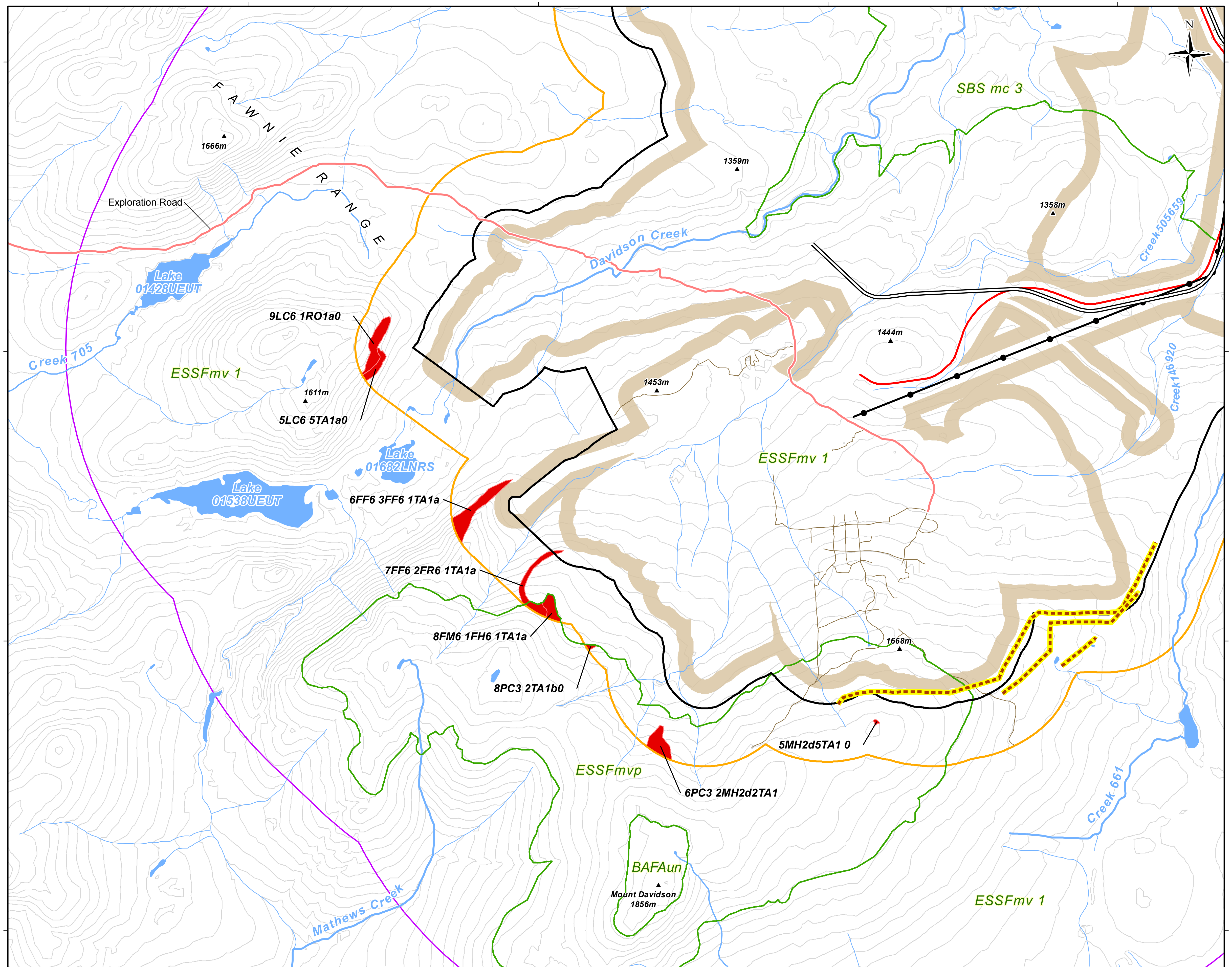
During the post-closure case, the amount of dust generated will be a small fraction of the level predicted for the Project case. Dust coating leaf surfaces will be removed by precipitation and re-growth of new leaves.

5.4.5.3.9.3 Nitrogen Deposition

Nitrogen deposition levels generated by the Project are not expected to exceed critical loads in areas where sparsely vegetated ecosystems occur (**Figure 5.4.5-5**).

5.4.5.3.9.4 Spread of Invasive Plants

There is no direct overlap between sparsely vegetated ecosystems and documented invasive plants. Sparsely vegetated ecosystems are likely to be vulnerable to invasive species proliferation. Because of the proximity to mine activities, it will be essential to implement the ISMP to control any weed species colonizing the mine site Project component.



Legend

- Existing Road
- Contour (20 m)
- Stream
- Waterbody

Project Components

- Exploration Road
- Proposed Mine Access Road
- Proposed Fresh Water Pipeline
- Proposed Mine Site

Terrain, Soils, and Vegetation

- Local Study Area
- Regional Study Area

Sparsely Vegetated Ecosystems in Relation to Dust and Nitrogen Deposition

- Nitrogen Deposition
- 125m Dust Buffer
- Biogeoclimatic Zone
- Sparsely Vegetated Ecosystems

Scale:1:33,000

0 1 2

Kilometres

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Sparsely Vegetated Ecosystems in Relation to Dust and Nitrogen Deposition

DATE: February, 2014	ANALYST: WR	**Figure 5.4.5-5**
JOB No: VE52277	QA/QC: MY	PDF FILE: 06-200-036_SparseVeg_Effects_Dust.pdf
GIS FILE: 06-200-036_SparseVeg_Effects_Dust.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

5.4.5.3.9.5 Mitigation

The primary way of mitigating any potential effects on sparsely vegetated ecosystems will be by implementing management recommendations aimed at reducing dust deposition and invasive species proliferation.

Invasive plant species can spread from adjacent roadsides and clear-cuts; with implementation of the ISMP, no residual effects are expected. The following effects assessment report sections or management plans should be consulted for relevant mitigation details: TAMP (**Section 12.2.1.18.4.14**), LSVMRP (**Section 12.2.1.18.4.4**), ISMP (**Section 12.2.1.18.4.5**), and the RCP (**Section 2.6**).

Table 5.4.5-33 provides ratings for effectiveness of mitigation measures to avoid or reduce potential effects on sparsely vegetated ecosystems during mine site development. Mitigation measures will be based on site-specific information and construction engineering and are therefore preliminary at this stage.

Table 5.4.5-33: Mitigation Measures and Effectiveness of Mitigation to Avoid or Reduce Potential Effects on Sparsely Vegetated Ecosystems during Mine Site Development

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
Dust deposition	Construction, Operations, Closure, Post-closure	Vehicle speed will be controlled throughout the mine site as described in the TAMP (**Section 12.2.1.18.4.14**)	High
		Haul road surfaces will be constructed of coarse aggregate with very low silt content	High
		Unpaved road surfaces will be wetted as needed to control dust emissions when conditions are not wet or frozen, and the wetting agent may include a chemical to extend and improve dust control over using water alone	High
		Materials will be wetted prior to handling	High
Spread of invasive plants	Construction, Operations, Closure, Post-closure	Preventing the initial introduction of invasive plants	Moderate
		Minimizing all soil disturbances (roads and machinery activity)	Moderate
		Reclaiming and re-establishing appropriate vegetation on disturbed areas as soon as possible	Moderate
		Using weed-free seed for reclamation, and weed-free bales for erosion control	Moderate
		Cleaning earth moving vehicles prior to entering the mine site area	Moderate

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
		Early Detection and Rapid Response: determine the priority invasive plant species within the operating area and maintain awareness of species new to the area	Moderate
		Ensuring environmental monitors are able to identify species of concern	Moderate
		Conducting invasive plant monitoring	Moderate

Note: TAMP = Transportation and Access Management Plan

The mitigation success ratings shown in **Table 5.4.5-33** are incorporated into the confidence ratings defined in **Section 4.3.5** and summarized in **Table 5.4.5-43**. In summary, low success rating means mitigation has not been proven successful, moderate success rating means mitigation has been proven successful elsewhere, and high success rating means mitigation has been proven effective.

The mitigation success of dust deposition is rated high because mitigation measures such as dust suppression techniques have proven successful. The mitigation success of spreading invasive plants is rated moderate overall because mitigation measure are consistent with BMPs identified by the Invasive Species Council of BC and BC MFLNRO which have shown success in other areas.

5.4.5.3.10 Indicator 5: Traditional Use Plant Habitat

Traditional use plant habitat was included because of the important roles that plants play for Aboriginal groups as food sources and for other purposes.

5.4.5.3.10.1 Ecosystem Loss

Thirty-two ecosystems that occur in the Project area are likely to have sufficient berry–producing plants and berry picking potential. These ecosystems were overlain with the Project footprint.

5.4.5.3.10.1.1 Mine Site

In the Project mine site there is a total of 5,042 ha of traditional use plant habitat (**Table 5.4.5-34**). Examples of berry-producing plants in the mine site are black gooseberry (*Ribes lacustre*), black huckleberry (*Vaccinium membranaceum*), dwarf blueberry (*Vaccinium caespitosum*), dwarf red raspberry (*Rubus pubescens*), and five-leaved bramble (*Rubus pedatus*).

Table 5.4.5-34: Traditional Use Plant Habitat: Mine Site Effects on Ecosystem Loss in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSmc3	Hybrid white spruce–Huckleberry	01	SB	570	390	-180	-32	501	-69	-12
SBSmc3	Lodgepole pine–Juniper–Dwarf huckleberry	02	LJ	31	2	-29	-94	6	-25	-82
SBSmc3	Lodgepole pine–Feathermoss–Cladina	03	LF	615	249	-366	-60	427	-188	-31
SBSmc3	Hybrid white spruce–Huckleberry–Soopolallie	04	SS	57	8	-50	-87	21	-36	-63
SBSmc3	Black spruce–Huckleberry–Spirea	05	BH	36	31	-5	-15	35	-1	-2
SBSmc3	Black spruce–Lodgepole pine–Feathermoss	06	BF	7	2	-5	-67	5	-2	-30
SBSmc3	Hybrid white spruce–Twinberry	07	ST	115	66	-49	-43	96	-19	-16
Total SBSmc3				**1,431**	**747**	**-683**	**48**	**1,091**	**-340**	**-24**
ESSFmv1	Subalpine fir–Rhododendron–Feathermoss	01	FR	1829	1014	-815	-45	1,345	-484	-26
ESSFmv1	Lodgepole pine–Huckleberry–Cladonia	02	LC	363	150	-214	-59	201	-162	-45
ESSFmv1	Subalpine fir–Huckleberry–Feathermoss	03	FF	754	384	-369	-49	558	-196	-26
ESSFmv1	Subalpine fir–Huckleberry–Gooseberry	04	FG	538	273	-265	-49	374	-163	-30
ESSFmv1	Sitka valerian–Globeflower moist meadow	00	VG	0	0	0	0	0	0	0
Total ESSFmv1				**3,484**	**1,821**	**-1,663**	**-48**	**2,478**	**-1,005**	**-29**
ESSFmv1p	Altai fescue–Cladonia grassland	00	FC	10	10	0	0	10	0	0
ESSFmv1p	Subalpine fir–Indian hellebore	00	FH	36	33	-3	-8	35	-2	-5
ESSFmv1p	Kinnikinnick–Cladonia	00	KC	1	1	0	0	1	0	0
ESSFmv1p	Subalpine fir–Whitebark pine–Crowberry parkland	00	PC	80	71	-10	-12	73	-7	-9
Total ESSFmv1p				**128**	**115**	**-13**	**-10**	**119**	**-9**	**-7**
Total Traditional Use Plant Habitat				**5,042**	**2,683**	**-2,359**	**-47**	**3,688**	**-1,354**	**-27**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant; ESSFmv1p = Nechako Very Cold Engelmann Spruce-Subalpine Fir Parkland variant;
Numbers have been rounded up, and as a result totals may not equal the sums of the individual values.

During the Project case, 2,359 ha (47%) of that habitat will be affected by activities. The majority of the effects will occur in the ESSFmv1 BGC unit, with a total of 1,663 ha (48%) affected by the Project. The next largest area of traditional use plant habitat affected by the Project is in the SBSmc3 BGC unit, in both the Hybrid white spruce–Huckleberry (01/SB) (180 ha, 32%) and Lodgepole pine–Feathermoss–Cladina (03/LF) ecosystems (366 ha, 60%).

Mine-related landforms will occupy 1,354 ha of this affected habitat (27% of the 5,042 ha); this will be permanently lost as a result of clearing for mine site facilities such as the open pit, TSF and waste rock dumps. The remaining 1,005 ha of traditional use plant habitat, occurring on natural landform types, will be reclaimed post-closure, and is expected to return to baseline conditions over time.

5.4.5.3.10.1.2 Linear Components

A total of 5,920 ha of traditional use plant habitat occurs within the approximately 8,178 ha occupied by linear components in the Project area (72%) (**Table 5.4.5-35**).

During the Project case, 493 ha of this habitat (8% of 5,920 ha) will be affected by clearing. Two ecosystems expected to experience the most effects are in the SBSdk BGC unit: Hybrid white spruce–Purple peavine 01/SP, with 85 ha (9%) lost, and Hybrid white spruce–Twinberry–Coltsfoot 06/ST, with 55 ha (11%) lost. The Hybrid white spruce–Huckleberry 01/SB ecosystem in the SBSmc3 BGC unit will have 77 ha (6%) affected.

Following reclamation in the post-closure phase, only 23 ha will be lost permanently along linear Project components, or less than 1%. Provided mitigation measures and reclamation measures are implemented, the remaining 470 ha are expected to return to baseline conditions with time.

Table 5.4.5-35: Traditional Use Plant Habitat: Linear Component Effects on Ecosystem Loss in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSdk	Hybrid white spruce–Purple peavine	01	SP	953	867	-85	-9	953	0	0
SBSdk	Lodgepole pine–Juniper–Ricegrass	02	LJ	25	22	-3	-10	25	0	0
SBSdk	Lodgepole pine–Feathermoss–Cladina	03	LC	182	164	-18	-10	182	0	0
SBSdk	Hybrid white spruce–Spirea–Feathermoss	05	SF	166	151	-15	-9	166	0	0
SBSdk	Hybrid white spruce–Twinberry–Coltsfoot	06	ST	501	446	-55	-11	501	0	0
SBSdk	Black cottonwood–Dogwood–Prickly rose	08	CD	4	4	<-1	-7	4	0	0
Total SBSdk				**1,831**	**1,654**	**-176**	**-10**	**1,831**	**0**	**0**
SBSdw3	Saskatoon–Slender wheatgrass	81	SW	3.1	2.8	-0.3	-10	3.1	0	0
SBSdw3	Hybrid white spruce–Douglas fir–Pinegrass	01	SP	434	392	-43	-10	434	0	0
SBSdw3	Lodgepole pine–Feathermoss–Cladina	03	LC	47	43	-4	-8	47	0	0
SBSdw3	Hybrid white spruce–Ricegrass	04	SR	75	67	-9	-11	75	0	0
SBSdw3	Hybrid white spruce–Twinberry	07	ST	249	222	-27	-11	249	0	0
Total SBSdw3				**809**	**727**	**-82**	**-10**	**809**	**0**	**0**
SBSmc2	Hybrid white spruce–Huckleberry	01	SB	305	273	-33	-11	304	-2	<-1
SBSmc2	Lodgepole pine–Huckleberry – Cladonia	02	PH	54	53	-1	-2	53	<-1	-1
SBSmc2	Hybrid white spruce–Huckleberry–Dwarf blueberry	04	HB	29	26	-3	-9	29	0	0
SBSmc2	Hybrid white spruce–Twinberry –Coltsfoot	05	TC	8	8	-1	-7	8	0	0
SBSmc2	Hybrid white spruce–Devil's club	09	SD	13	11	-1	-9	13	0	0
Total SBSmc2				**409**	**371**	**-38**	**-9**	**407**	**-2**	**0**

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case			Post-Closure Case		
					Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSmc3	Hybrid white spruce–Huckleberry	01	SB	1,211	1,134	-77	-6	1,201	-10	-1
SBSmc3	Lodgepole pine–Juniper–Dwarf huckleberry	02	LJ	13	12	-1	-10	13	0	0
SBSmc3	Lodgepole pine–Feathermoss–Cladina	03	LF	259	234	-25	-10	256	-3	-1
SBSmc3	Hybrid white spruce–Huckleberry–Soopolallie	04	SS	109	104	-5	-5	109	<-1	<-1
SBSmc3	Black spruce–Huckleberry–Spirea	05	BH	468	434	-34	-7	461	-7	-1
SBSmc3	Black spruce–Lodgepole pine–Feathermoss	06	BF	87	81	-6	-7	86	-1	-1
SBSmc3	Hybrid white spruce–Twinberry	07	ST	440	410	-30	-7	439	-1	<-1
Total SBSmc3				**2,587**	**2,409**	**-178**	**-7**	**2,565**	**-22**	**-1**
ESSFmv1	Subalpine fir–Rhododendron–Feathermoss	01	FR	182	169	-13	-7	182	0	0
ESSFmv1	Lodgepole pine–Huckleberry–Cladonia	02	LC	3	3	0	0	3	0	0
ESSFmv1	Subalpine fir–Huckleberry–Feathermoss	03	FF	80	75	-5	-7	80	0	0
ESSFmv1	Subalpine fir–Huckleberry–Gooseberry	04	FG	21	20	-1	-3	21	0	0
Total ESSFmv1				**285**	**266**	**-19**	**-7**	**285**	0	**0**
Total Traditional Use Plant Habitat				**5,920**	**5,427**	**-493**	**-8**	**5,897**	**-23**	**<-1**

Note: BGC = Biogeoclimatic; ha = hectares; % = Percent; SBSdk = Dry Cool Sub-Boreal Spruce variant; SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant; SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant
Numbers have been rounded up, and as a result totals may not equal the sums of the individual values.

5.4.5.3.10.1.3 Combined Components

When the Project components are combined (mine site and linear components), a total of 10,962 ha of traditional use plant habitat occurs within the LSAs, or 77% of the combined LSAs' total 14,300 ha. During the Project case, 2,852 ha (26%) of the traditional plant use habitat will be affected due to clearing. At post-closure and after reclamation has been successful, 1,377 ha (13%) will remain as a permanent, long-term loss (**Table 5.4.5-36**).

During the Project case, 2,852 ha (26%) of the traditional plant use habitat will be affected due to clearing. At post-closure and after reclamation has been successful, 1,377 ha (13%) will remain as a permanent, long-term loss.

Table 5.4.5-36: Traditional Use Plant Habitat: Combined Component Effects on Ecosystem Loss in the LSA

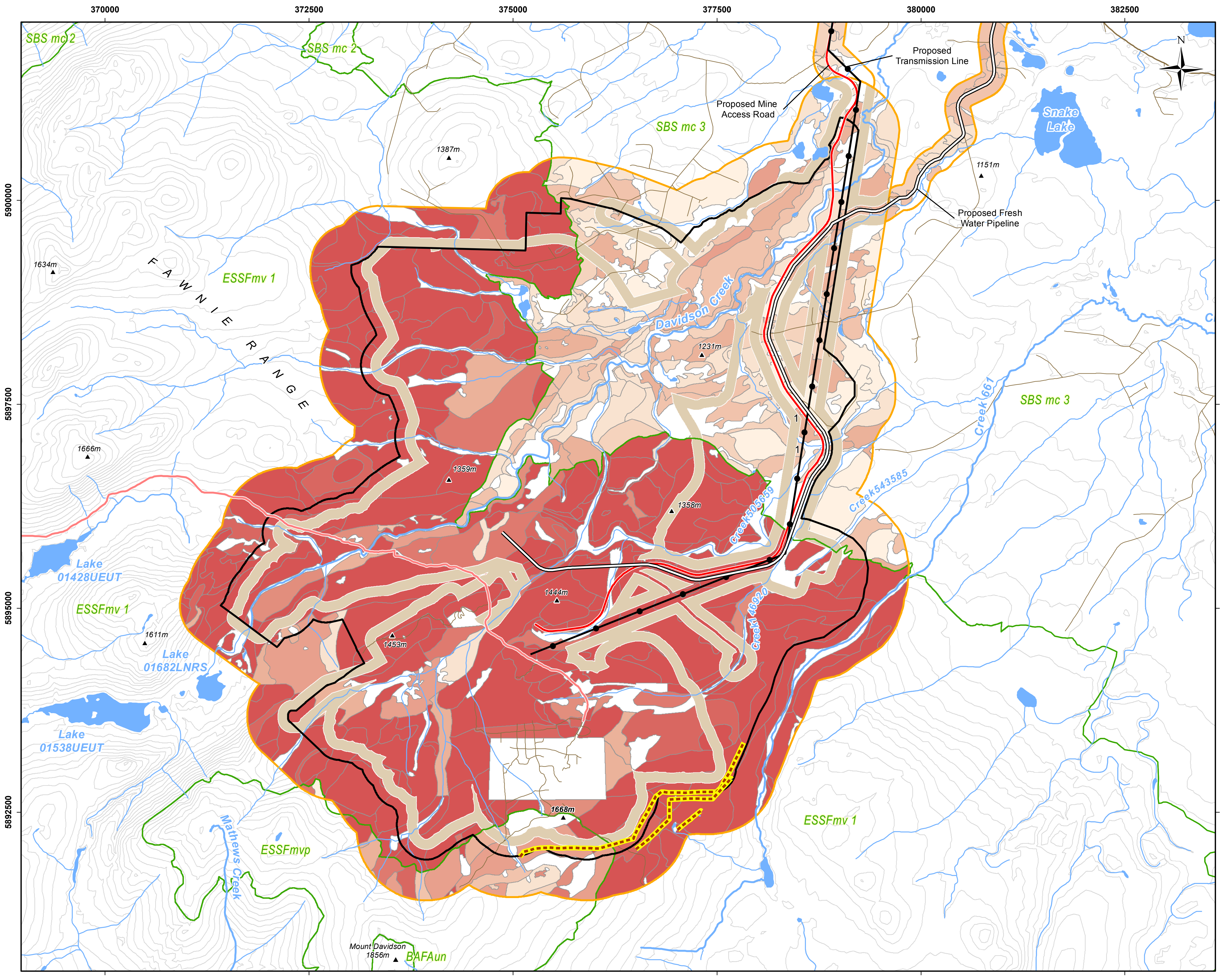
BGC Unit	Baseline Case (ha)	Project Case			Post-Closure Case		
		Remaining (ha)	Area Change (ha)	Percent Change (%)	Remaining and Reclaimed (ha)	Area Change (ha)	Percent Change (%)
SBSdk	1,831	1654	-176	-10	1,831	0	0
SBSdw3	809	727	-82	-10	809	0	0
SBSmc2	409	371	-38	-9	407	-2	0
SBSmc3	4,017	3,156	-861	-21	3,656	-361	-9
ESSFmv1	3,768	2,086	-1,682	-45	2,763	-1,005	-27
ESSFmv1p	128	115	-13	-10	119	-9	-7
Total Traditional Use Plant Habitat	**10,962**	**8,110**	**-2,852**	**-26**	**9,584**	**-1,377**	**-13**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant; ESSFmv1p = Nechako Very Cold Engelmann Spruce-Subalpine Fir Parkland variant
Numbers have been rounded up, and as a result totals may not equal the sums of the individual values.

5.4.5.3.10.2 Dust Deposition

5.4.5.3.10.2.1 Mine Site

Dust deposition is expected to occur up to 125 m outside of the mine site footprint. Dust generated in association with Project activities in the mine site is expected to affect 698 ha (14%) of the traditional use plant habitat (**Table 5.4.5-37**). The ESSFmv1 BGC unit will receive most of the dust (456 ha, 13%). **Figure 5.4.5-6** shows the overlap between traditional use plant habitat and the 125 m dust zone in the mine site LSA. During the post-closure case, the amount of dust generated will be a small fraction of the level predicted for the Project case. Dust coating leaf surfaces will be removed by precipitation and re-growth of new leaves.



Legend

Existing road
Contour (20 m)
Stream
Waterbody

Project Components

Exploration Road
Proposed Mine Access Road
Proposed Transmission Line
Proposed Fresh Water Pipeline
Proposed Mine Site

Terrain, Soils, and Vegetation

Local Study Area

Traditional Plant Use Habitat in Relation to Dust and Nitrogen Deposition

125m Dust Buffer
Biogeoclimatic Zone
Nitrogen Deposition

Traditional Plant Use Habitat

10
20
30
40
50
60
70
80
90
100

Scale:1:46,000
0 1 2 3
Kilometres

Reference
BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Traditional Plant Use Habitat in Relation to Dust and Nitrogen Deposition

DATE: February, 2014	ANALYST: WR	**Figure 5.4.5-6**
JOB No: VE52277	QA/QC: MY	PDF FILE: 06-200-037_TradPlantUse_Effects_Dust.pdf
GIS FILE: 06-200-037_TradPlantUse_Effects_Dust.mxd		amec
PROJECTION: UTM Zone 10	DATUM: NAD83	

V:\Mapping\06_vegetation\EIA\06-200-037_TradPlantUse_Effects_Dust.mxd

Table 5.4.5-37: Traditional Use Plant Habitat: Mine Site Effects on Dust Distribution in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline Case (ha)	Project Case	
					Dust Zone (ha)	Percent of Baseline (%)
SBSmc3	Hybrid white spruce–Huckleberry	01	SB	570	105	18
SBSmc3	Lodgepole pine–Juniper–Dwarf huckleberry	02	LJ	31	2	6
SBSmc3	Lodgepole pine–Feathermoss–Cladina	03	LF	615	93	15
SBSmc3	Hybrid white spruce–Huckleberry–Soopolallie	04	SS	57	5	8
SBSmc3	Black spruce–Huckleberry–Spirea	05	BH	36	9	26
SBSmc3	Black spruce–Lodgepole pine–Feathermoss	06	BF	7	<1	0
SBSmc3	Hybrid white spruce–Twinberry	07	ST	115	17	15
Total SBSmc3				**1,431**	**230**	**16**
ESSFmv1	Subalpine fir–Rhododendron–Feathermoss	01	FR	1,829	240	13
ESSFmv1	Lodgepole pine–Huckleberry–Cladonia	02	LC	363	37	10
ESSFmv1	Subalpine fir–Huckleberry–Feathermoss	03	FF	754	98	13
ESSFmv1	Subalpine fir–Huckleberry–Gooseberry	04	FG	538	81	15
Total ESSFmv1				**3,483**	**456**	**13**
ESSFmv1p	Altai fescue–Cladonia grassland	00	FC	10	0	0
ESSFmv1p	Subalpine fir–Indian hellebore	00	FH	36	3	9
ESSFmv1p	Kinnikinnick–Cladonia	00	KC	1	0	0
ESSFmv1p	Subalpine fir–Whitebark pine–Crowberry parkland	00	PC	80	9	11
Total ESSFmv1p				**128**	**12**	**9**
Total Traditional Plant Habitat				**5,042**	**698**	**14**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant; ESSFmv1p = Nechako Very Cold Engelmann Spruce-Subalpine Fir Parkland variant
Numbers have been rounded up, and as a result totals may not equal the sums of the individual values.

5.4.5.3.10.2.2 Linear Components

Dust deposition from traffic along linear Project components (mine access road, freshwater supply system, airstrip, transmission line, and Kluskus FSR) is expected to affect 2,074 ha (37%) of traditional use plant habitat (**Table 5.4.5-38**). The greatest number of hectares affected will be in the SBSdk and SBSmc3 BGC units, with a total of 606 ha (33%) and 954 ha (37%) affected, respectively.

Table 5.4.5-38: Traditional Use Plant Habitat: Linear Component Effects on Dust Distribution in the LSA

BGC Unit	Site Series Name	Site Series	Map Code	Baseline LSA (ha)	Dust Zone (ha)	Percent of Baseline (%)
SBSdk	Hybrid white spruce–Purple peavine	01	SP	953	322	34
SBSdk	Lodgepole pine–Juniper–Ricegrass	02	LJ	25	7	28
SBSdk	Lodgepole pine–Feathermoss–Cladina	03	LC	182	63	34
SBSdk	Hybrid white spruce–Spirea–Feathermoss	05	SF	166	57	34
SBSdk	Hybrid white spruce–Twinberry–Coltsfoot	06	ST	501	157	31
SBSdk	Black cottonwood–Dogwood–Prickly rose	08	CD	4	1	29
Total SBSdk				**1,831**	**606**	**33**
SBSdw3	Saskatoon–Slender wheatgrass	81	SW	3	1	26
SBSdw3	Hybrid white spruce–Douglas fir–Pinegrass	01	SP	434	146	34
SBSdw3	Lodgepole pine–Feathermoss–Cladina	03	LC	47	14	30
SBSdw3	Hybrid white spruce–Ricegrass	04	SR	75	24	32
SBSdw3	Hybrid white spruce–Twinberry	07	ST	249	82	33
Total SBSdw3				**809**	**268**	**33**
SBSmc2	Hybrid white spruce–Huckleberry	01	SB	305	103	34
SBSmc2	Lodgepole pine–Huckleberry–Cladonia	02	PH	54	21	40
SBSmc2	Hybrid white spruce–Huckleberry–Dwarf blueberry	04	HB	29	9	31
SBSmc2	Hybrid white spruce–Twinberry–Coltsfoot	05	TC	9	3	38
SBSmc2	Hybrid white spruce–Devil's club	09	SD	13	4	30
Total SBSmc2				**409**	**140**	**34**
SBSmc3	Hybrid white spruce–Huckleberry	01	SB	1,211	460	38
SBSmc3	Lodgepole pine–Juniper–Dwarf huckleberry	02	LJ	13	5	37
SBSmc3	Lodgepole pine–Feathermoss–Cladina	03	LF	259	89	34
SBSmc3	Hybrid white spruce–Huckleberry–Soopolallie	04	SS	109	43	39
SBSmc3	Black spruce–Huckleberry–Spirea	05	BH	468	174	37
SBSmc3	Black spruce–Lodgepole pine–Feathermoss	06	BF	87	31	35
SBSmc3	Hybrid white spruce–Twinberry	07	ST	440	153	35
Total SBSmc3				**2,587**	**954**	**37**

BGC Unit	Site Series Name	Site Series	Map Code	Baseline LSA (ha)	Dust Zone (ha)	Percent of Baseline (%)
ESSFmv1	Subalpine fir–Rhododendron–Feathermoss	01	FR	182	70	39
ESSFmv1	Lodgepole pine–Huckleberry–Cladonia	02	LC	3	1	39
ESSFmv1	Subalpine fir–Huckleberry–Feathermoss	03	FF	80	28	23
ESSFmv1	Subalpine fir–Huckleberry–Gooseberry	04	FG	21	7	35
Total ESSFmv1				**285**	**106**	**32**
Total Traditional Use Plant Habitat				**5,920**	**2,047**	**37**

Note: BGC = Biogeoclimatic; ha = hectares; % = percent; SBSdk = Dry Cool Sub-Boreal Spruce variant; SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant; SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant
Numbers have been rounded up, and as a result totals may not equal the sums of the individual values.

5.4.5.3.10.3 Nitrogen Deposition

Air emissions modelling predicted nitrogen exceedances within the mine site LSA. Mining construction and operations will produce air emissions from a number of sources, with internal combustion engines as the primary output (**Section 5.2.4**). Linear corridors, such as unpaved roads, were not predicted to have N exceedances. **Figure 5.4.5-6** shows the overlap between traditional use plant habitat and nitrogen deposition in the mine site LSA.

Nitrogen deposition exceedances occur at the southeastern edge of the mine site, and 61 ha of traditional use plant habitat occurs in this area. The affected area is only 1% of the 5,042 ha of traditional plant habitat that occurs in the mine site.

5.4.5.3.10.4 Spread of Invasive Plants

There is overlap between traditional use plants and invasive species. Yellow salsify (*Tragopogon dubius*) occurs in the mine site. Two invasive plant species and three different lcoations occur within the transmission line LSA, namely CT and OH. Four invasive plant species (CT, TC, YH, and YT) occur at seven different sites in the Kluskus FSR LSA.

5.4.5.3.10.5 Mitigation

Effects on traditional use plant habitat will be mitigated by minimizing the Project footprint, by implementing management plans to reduce dust deposition, nitrogen deposition, and invasive species proliferation, and by including traditional use plant habitat in reclamation prescriptions. Replant with native plants, but ensure that these include plant species traditionally used by First Nations, as described in the RCP (**Section 2.6**).

Table 5.4.5-39 provides ratings for effectiveness of mitigation measures to avoid or reduce potential effects on traditional use plant habitat during mine site development. Mitigation measures will be based on site-specific information and construction engineering and are therefore preliminary at this stage.

Table 5.4.5-39: Mitigation Measures and Effectiveness of Mitigation to Avoid or Reduce Potential Effects on Traditional Use Plant Habitat during Mine Site Development

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
Ecosystem loss	Construction, Operations, Closure, Post-closure	Minimize the mine footprint	Moderate
	Construction	Minimize areas of disturbance outside or adjacent to areas targeted for clearing (i.e. movement of machinery and equipment, or extent of grubbing and stripping)	Moderate
		Minimizing the clearing of linear ROWs and access	Moderate
		In areas requiring clearing only (e.g. the transmission line), retain the topsoil and vegetation root mat whenever and wherever possible	Moderate
		Topsoil will be salvaged where feasible, and stored for use during the closure phase as described in the LSVMRP (**Section 12.2.1.18.4.4**), the SECP (**Section 12.2.1.18.4.1**), and the RCP (**Section 2.6**)	Moderate
Dust deposition	Construction, Operations, Closure, Post-closure	Vehicle speed will be controlled throughout the mine site as described in the TAMP (**Section 12.2.1.18.4.14**)	High
		Haul road surfaces will be constructed of coarse aggregate with very low silt content	High
		Unpaved road surfaces will be wetted as needed to control dust emissions when conditions are not wet or frozen, and the wetting agent may include a chemical to extend and improve dust control over using water alone	High
		Materials will be wetted prior to handling	High
Nitrogen deposition	Construction, Operations, Closure, Post-closure	Reducing vehicle emissions through enforcing speed limits, fuel selection, using vehicles that meet emission standards, and regular vehicle and equipment maintenance as described in the TAMP (**Section 12.2.1.18.4.14**),	Moderate
		Ensuring the incinerator and other emissions sources meet all relevant Canadian emission requirements	Moderate

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
		Limiting vehicle and equipment idling as described in the TAMP (**Section 12.2.1.18.4.14**)	Moderate
Spread of invasive plants	Construction, Operations, Closure, Post-closure	Preventing the initial introduction of invasive plants	Moderate
		Minimizing all soil disturbances (roads and machinery activity)	Moderate
		Reclaiming and re-establishing appropriate vegetation on disturbed areas as soon as possible	Moderate
		Using weed-free seed for reclamation, and weed-free bales for erosion control	Moderate
		Cleaning earth moving vehicles prior to entering the mine site area	Moderate
		Early Detection and Rapid Response: determine the priority invasive plant species within the operating area and maintain awareness of species new to the area	Moderate
		Ensuring environmental monitors are able to identify species of concern	Moderate
		Conducting invasive plant monitoring	Moderate

Note: LSVMRP = Landscape, Soils and Vegetation Management and Restoration Plan; RCP = Reclamation and Closure Plan; ROW = right-of-way; SECP = Sediment and Erosion Control Plan; TAMP = Transportation and Access Management Plan

The mitigation success ratings shown in **Table 5.4.5-39** are incorporated into the confidence ratings defined in **Section 4.3.5** and summarized in **Table 5.4.5-41**, **Table 5.4.5-42**, and **Table** 5.4.5-43. In summary, low success rating means mitigation has not been proven successful, moderate success rating means mitigation has been proven successful elsewhere, and high success rating means mitigation has been proven effective.

The mitigation success of ecosystem loss on traditional plants is rated moderate overall because reclamation success has proven successful elsewhere. BMPs such as no herbicide spraying in berry patches, replanting native plants including those species traditionally used by Aboriginal groups, and other measures are described in the RCP (**Section 2.6**). The mitigation success of dust deposition is rated high because mitigation measures such as dust suppression techniques have been proven successful. The mitigation success of nitrogen deposition is rated moderate because implementing mitigation measures will reduce the overall amount of N deposition. However, the effect is considered long term, as it is uncertain how long excess nitrogen will persist in affected areas. The mitigation success of spreading invasive plants is rated moderate overall because mitigation measures are consistent with BMPs identified by the Invasive Species Council of BC and BC MFLNRO which have shown success in other areas.

5.4.5.4 Residual Effects and their Significance

A residual effect is an environmental effect that remains, or is predicted to remain, even after mitigation measures have been applied (**Section 4.3.5**).

Table 5.4.5-40 summarizes the potential effects of the Project on the Ecosystem Composition VC, and identifies which effects will be carried forward in the assessment, namely ecosystem loss and nitrogen deposition.

Table 5.4.5-40: Summary of Potential Project Residual Effects to be Carried Forward into the Assessment of Ecosystem Composition

Project Effects	VC indicator	Project Phase				Potential for Residual Effects	Carried Forward
		Construction	Operations	Closure	Post-closure		
Ecosystem loss	Ecosystem distribution	√	√	X	X	Yes	Yes
	Riparian ecosystems	√	√	X	X	Yes	Yes
	Old growth forest	√	√	X	X	Yes	Yes
	Sparsely vegetated ecosystems	X	X	X	X	No	No
	Traditional use plant habitat	√	√	√	√	Yes	Yes
Dust deposition	Ecosystem distribution	√	√	X	X	No	No
	Riparian ecosystems	√	√	X	X	No	No
	Old growth forest	√	√	X	X	No	No
	Sparsely vegetated ecosystems	√	√	X	X	No	No
	Traditional use plant habitat	√	√	X	X	No	No
Spread of invasive plants	Ecosystem distribution	√	√	√	√	Yes	Yes
	Riparian ecosystems	√	√	√	√	Yes	Yes
	Old growth forest	√	√	√	√	Yes	Yes
	Sparsely vegetated ecosystems	X	X	X	X	No	No
	Traditional use plant habitat	√	√	√	√	Yes	Yes
Nitrogen deposition	Ecosystem distribution	√	√	√	√	Yes	Yes
	Riparian ecosystems	√	√	√	√	Yes	Yes
	Old growth forest	X	X	X	X	No	No
	Sparsely vegetated ecosystems	X	X	X	X	No	No
	Traditional use plant habitat	√	√	√	√	Yes	Yes

Note: √ - Potential effect likely, X – Potential effect unlikely No

5.4.5.4.1 Significance of Potential Residual Effect

5.4.5.4.1.1 Ecosystem Loss

Assessment of the significance of potential residual effects of ecosystem loss is provided in **Table** 5.4.5-41. The likelihood of occurrence and degree of certainty (level of confidence for likelihood) is high, as the effect of clearing is well known. The significance of the residual effect is rated moderate, because the site will remain cleared until the end of operations, and reclamation success is uncertain. The level of confidence for significance is moderate. The four indicators that were predicted to experience 10% to 20% loss during the post-closure case (ecosystem distribution, riparian ecosystems, old-growth forests, and traditional use plant habitat) were considered when assessing residual effects.

Table 5.4.5-41: Residual Effects Assessment for Ecosystem Loss (Ecosystem Distribution, Riparian Areas, Old-Growth Forests, and Traditional Use Plant Habitat)

Effect Attribute	Post-Closure
Context	medium
Magnitude	medium
Geographic Extent	local
Duration	long-term/chronic
Reversibility	Mine-related landforms (no) Natural landforms (yes)
Frequency	once
Likelihood Determination	high
Level of Confidence for Likelihood	high
Significance Determination	not-significant (moderate)
Level of Confidence for Significance	moderate

By the post-closure case, buildings and infrastructure will have been removed and reclamation measures initiated (**Table 5.4.5-41**). The likelihood and degree of certainty (level of confidence for likelihood) is high, as the effect of clearing is well known. The significance of the residual effect is rated moderate, because the site will remain cleared until the end of operations, and reclamation success is uncertain. The level of confidence for significance is moderate.

The context is medium, as the effect will result in some loss of species and ecosystem function of sensitive ecosystems. The magnitude is medium, because with reclamation only 10% to 20% of the area will be affected, and local in geographic extent, as the effects are limited to the LSA.

The duration of the effect is long-term to chronic. The Project will create novel landforms, and therefore identifying and implementing appropriate methods for restoring native species will be needed to facilitate the reclamation of native ecosystems on natural landforms. Chronic effects will occur on mine-related landforms, where baseline ecosystems will be permanently lost. The disturbance on natural landform features is potentially reversible, due to the regrowth of vegetation over time where reclamation and mitigation measures are implemented.

The likelihood of occurrence and level of confidence for likelihood is high, as the effect of clearing is well known. The significance of the residual effect is rated moderate, because the site will remain cleared until the end of operations, and reclamation success is uncertain. The level of confidence for significance is moderate.

5.4.5.4.1.2 Nitrogen Deposition

Nitrogen deposition will primarily come from mine fleet emissions, and as such, mitigation measures may not be sufficient to reduce the level of N deposition below the value of 5 kg $N/ha^{-1}/y^{-1}$ that represents the most conservative critical load. By the post-closure case, sources of nitrogen emissions, such as mining operations and associated vehicular activity, will have stopped. The context is rated low, as there is a high resilience of native ecosystems to the affects of N deposition (**Table 5.4.5-42**). The magnitude is low, and the geographic extent is local. The effect is still considered long-term, as it is uncertain how long excess nitrogen will persist in affected areas. The effect of nitrogen deposition is expected to be reversible over time. Nitrogen deposition will cease after operations. The likelihood determination is moderate and the confidence for likelihood is moderate, as the amount and distribution of nitrogen deposited is based on modelling. The significance determination is rated as not significant–minor. The level of confidence for significance is moderate.

Table 5.4.5-42: Nitrogen Deposition – Ecosystem Distribution, Riparian Areas and Traditional Use Plant Habitat

Effect Attribute	Post-Closure
Context	low
Magnitude	low
Geographic Extent	local
Duration	long-term
Reversibility	yes
Frequency	intermittent
Likelihood Determination	moderate
Level of Confidence for Likelihood	moderate
Significance Determination	not-significant (minor)
Level of Confidence for Significance	moderate

5.4.5.4.1.3 Spread of Invasive Plants

Vegetation removal and soil disturbance associated with various Project activities are expected to create conditions likely to introduce and facilitate the spread invasive plants. These conditions will likely occur for all Project phases and components and may persist even after mitigation measure are applied. Assessment of the significance of the spread of invasive plants is provided in (**Table** 5.4.5-43). The context is rated low because there is no direct overlap with plant or ecosystems at risk (**Section 5.4.6.3.7.3**). The magnitude is low because less than 10% of the area is affected. The geographic extent is regional because invasive plants are known to occur in the RSA. The duration is long-term given the potential for spread of invasive plants will continue well into closure until native vegetation is restored. With the implementation of mitigation measures the spread of invasive plants is reversible. The frequency is intermittent and the likelihood determination is moderate with a confidence level of moderate. The significance determination is not significant (minor). The level of confidence for significance for this determination is moderate.

Table 5.4.5-43: Spread of Invasive Plants – Ecosystem Distribution, Riparian Areas and Traditional Use Plant Habitat

Effect Attribute	Post-Closure
Context	low
Magnitude	low
Geographic Extent	regional
Duration	long-term
Reversibility	yes
Frequency	intermittent
Likelihood Determination	moderate
Level of Confidence for Likelihood	moderate
Significance Determination	not-significant (minor)
Level of Confidence for Significance	moderate

5.4.5.5 Cumulative Effects

The residual effect of ecosystem loss, nitrogen deposition and spread of invasive plants for the Ecosystem Composition VC will be carried forward into the Cumulative Effects Assessment (CEA). **Table 5.4.5-44** presents the rationale for carrying the effect forward into the CEA.

Table 5.4.5-44: Project-Related Residual Effects – Rationale for Carrying Forward into the CEA

			Historical Land Use				Representative Current and Future Land Use							Reasonably Foreseeable Projects		
Indicator	**Project Phase**	**Potential Residual Effect**	**Recreational (trails, fishing and lodges)**	**Forestry (cut blocks and woodlots)**	**Aboriginal Traditional Use**	**Trapping and Guide Outfitting**	**Mining (active, current prospecting, quarries)**	**Recreational (sites, trails, fishing and lodges)**	**Forestry (cut blocks and woodlots)**	**Aboriginal Traditional Use**	**Trapping and Guide Outfitting**	**Agriculture (Present)**	**Natural Disturbance (Fire and MPB)**	**Nulki Hills Wind Project**	**Agriculture (pending range tenures)**	**Carried Forward into CEA**
Ecosystem Distribution	C, O, CL, PC	Ecosystem Loss	I	I	I	I	I	I	KI	I	I	I	KI	I	NI	yes
		Nitrogen Deposition	NI	NI	NI	NI	I	NI	NI	NI	NI	NI	NI	NI	NI	yes
		Spread of Invasive Plants	I	I	NI	NI	I	I	KI	NI	NI	KI	I	I	KI	yes
Riparian	C, O, CL, PC	Ecosystem Loss	I	I	I	I	I	I	KI	I	I	I	KI	I	NI	yes
		Nitrogen Deposition	NI	NI	NI	NI	I	NI	NI	NI	NI	NI	NI	NI	NI	no
Old Growth Forest	C, O, CL, PC	Ecosystem Loss	I	I	NI	NI	I	I	KI	I	I	I	KI	I	NI	yes
Traditional Use Plant Habitat	C, O, CL, PC	Ecosystem Loss	I	I	NI	NI	I	NI	KI	I	I	I	KI	I	I	yes
		Nitrogen Deposition	NI	NI	NI	NI	I	NI	NI	NI	NI	NI	NI	NI	NI	no
		Spread of Invasive Plants	I	I	NI	NI	I	I	KI	NI	NI	KI	I	I	KI	yes

Note: C = construction, O = operation, CL = closure, PC = post-closure; I = interaction, KI = key interaction, NI = no interaction

5.4.5.5.1 Interactions between the Ecosystem Composition VC and Other Past, Present, or Future Projects or Activities

A number of projects and human activities contain spatial overlap with the proposed features of the Project. These include recreational activities, forestry activities, transportation and access, mining activity, trapping and guide outfitting, traditional land use, and other projects. Some of these can be quantified, including the Nulki Hills Wind Project, mining activity (quarries and prospecting), forestry cutblocks and woodlots, and forestry-related roads. The RSA is a total of 45,000 ha (including the LSA), of which 14,689 ha interacts with these other projects or activities (**Table** 5.4.5-45 and **Table 5.4.5-46**).

Table 5.4.5-45: Spatial Overlap by Project/Activity

Project	Spatial Overlap with Terrestrial RSA	Temporal Overlap with Terrestrial RSA	Amount of Overlap (ha)
Nulki Hills Wind Project	Yes	Yes	1,854
Mining activity	Yes	Yes	272(1)
Forestry (cutblocks and woodlots) past, present, and future	Yes	Yes	13,107
Forestry roads	Yes	Yes	1,102
Total			**14,689(2)**

Note: (1) Current prospecting = 178.19 ha, and quarries = 94.11 ha
(2) The total does not equal the sum of the Projects because of overlap

Table 5.4.5-46: Spatial Overlap by BGC Unit

BGC Unit	Spatial Overlap with Other Projects(1) (ha)
SBSdk	4,268
SBSdw3	2,365
SBSmc2	984
SBSmc3	5,785
ESSFmv1	1,285
ESSFmv1p	2
BAFAun	0
Total Spatial Overlap	**14,689**

Note: (1) Projects includes the Nulki Hills Wind Project, mining activity, forestry, and forestry roads.

Forestry-related and mining activities in the Project area will be removing and altering ecosystem composition including nitrogen deposition from vehicles and equipment. The primary means to mitigate the effects of forestry operations will be by continuing to follow forest harvest guidelines (including cut block and road design) to minimize erosion and maximize reforestation, and by implementing invasive plant control measures and monitoring systems. The primary means to mitigate the effects of mining activity will be to minimize the footprint and implement mitigation measures reducing the spread of invasive plants species. The mountain pine beetle infestation is widespread. Similar to forestry practices mitigation measures will maximize reforestation, encourage natural regeneration and implement invasive plant control measures. Stands with a low proportion of pine affected by MPB and not harvested remain as altered but functioning ecosystems on the landscape.

5.4.5.5.2 Significance of Potential Residual Cumulative Effects Qualitative Type of Description

Table 5.4.5-47 summarizes the residual cumulative effects on the ecosystem composition VC. The effect of ecosystem loss for the ecosystem distribution, riparian ecosystems, and traditional use plant indicators were combined and considered together for the assessment. In addition, the assessment considers all Project phases. The table shows the CEAs both with and without Project contribution. The context is medium in both, given that sensitive ecosystems and ecosystems at risk could be affected with or without the project. The magnitude of the residual cumulative effects without the Project is considered low where reclamation, reforestation, and mitigation measures are implemented. The effect of the MPB is being reduced by these various measures and will drop from infestation level down to low.

Table 5.4.5-47: Residual Cumulative Effects Assessment on Ecosystem Composition

Parameter	Current/Future Cumulative Environmental Effect(s) without Project	Project Contribution Cumulative Environmental Effect
Ecosystem Loss		
Effect Attribute		
Context	Medium	Medium
Magnitude	Low	Medium
Geographic Extent	Regional	Regional
Duration	Long-term	Chronic
Reversibility	Yes	Mine-related landforms (no) Natural landforms (yes)
Frequency	Once	Once
Likelihood determination	High	High
Level of confidence for likelihood	High	High
Significance Determination	Not Significant (Low)	Not Significant (Moderate)
Level of Confidence for Significance	Moderate	Moderate

Alternatively, with the Project, the magnitude is considered medium, due to some permanent loss of ecosystems. The widespread forestry activity in the Project area results in a regional effect in both cases. With reforestation, reclamation, and mitigation, the cumulative effects are considered reversible where sensitive ecosystems are avoided. Cumulative effects of the Project add permanent loss of ecosystems to the landscape, resulting in irreversible effects, a high likelihood, and a not significant (moderate) rating.

5.4.5.6 Limitations

Limitations are inherent with the production of an ecosystem map meant to represent the baseline condition that forms the foundation of the environmental assessment. Every attempt was made to produce a reliable and accurate ecosystem map following standard protocols and BMPs. The assumption is that sufficient information is available to assess the Project and to develop mitigation measures.

5.4.5.7 Conclusion

The Project will affect ecosystem distribution, riparian ecosystems, old-growth forests, and traditional plant use habitat during the Project case. The primary effect on ecosystem composition indicators will be the permanent loss of baseline ecosystems. Further Project-related disturbance was predicted from dust emissions, nitrogen deposition, and the potential spread of invasive plants. Mitigation measures to address these effects include: implementing relevant management plans, including the LSVMRP, ISMP, Erosions and Sediment Control Plan, AQEMP, Water Quality and Liquid Discharges Management Plan, Aquatic Resources Management Plan, TAMP, Wildlife Management Plan, and RCP, and reclaiming disturbed lands following operations using native species.

Following application of mitigation measures, ecosystem loss, nitrogen deposition and spread of invasive plants remained as residual effects. The key effect, ecosystem loss, will result in permanent loss of moderate magnitude due to a post-closure reduction of ecosystems (1,495 ha; 12%), riparian ecosystems (249 ha; 20%), old-growth forest (115 ha; 10%) and traditional use plant habitat (1,377 ha; 13%). The residual effect of ecosystem loss was rated not significant (moderate). The effect of nitrogen deposition was rated not significant (minor), because only a small area was expected to be affected, and the effects will likely diminish over time. The spread of invasive plants was determined to be not significant (minor) provided implementation of mitigation measures are implemented, the effect will remain of low magnitude.

Cumulative effects and mitigation measures of forestry activities, mining, and a wind project were assessed for the RSA. When considering the cumulative contribution of Project effects, permanent ecosystem composition loss was rated as not significant (moderate).