5.3 Terrestrial Wildlife and Vegetation

5.3.1 Terrestrial Wildlife

5.3.1.1 Introduction

This section of the Environmental Assessment Certificate (EAC) Application/Environmental Impact Statement (EIS) (hereafter referred to as the EA) has been prepared by Golder Associates Ltd. (Golder). It addresses the effects of the Proposed BURNCO Aggregate Project (hereafter referred to as the 'Proposed Project') identified in the construction, operation, reclamation and closure phases on VCs related to wildlife. Consideration has been given to mitigation measures proposed to mitigate any identified effects to acceptable levels and any residual effects have been characterized.

This section should be read in conjunction with the following technical baseline report(s) provided in Volume 4, Part G - Section 22.0:

- Appendix 5.3-A – BURNCO Aggregate Project: Wildlife Baseline Report.

5.3.1.2 Regulatory and Policy Setting

This section (Table 5.3-1) provides a summary of the regulatory and policy settings of the Proposed Project as it relates to wildlife.

Table 5.3-1: Regulatory and Policy Setting: Terrestrial Wildlife

Legislative Mandate	Agency	Descriptions and Prohibitions
Provincial		
B.C. *Wildlife Act* (1996)	Ministry of Forests, Lands and Natural Resource Operations	Protects wildlife and wildlife habitat in the province of BC by identifying wildlife areas, defining human interactions with wildlife, and regulating hunting, trapping and angling. It is an offence to capture wildlife, alter wildlife habitat, deposit substances into wildlife habitat or destroy eggs or nests under this Act (1996).
Forest and Range Practices Act (2002)	Ministry of Forests, Lands and Natural Resource Operations	Sets requirements for planning, road building, logging, reforestation and grazing on forest and range licensees. The Identified Wildlife Management Strategy (IWMS), established under this Act, provides direction, policies and procedures for managing Identified Wildlife (Species at Risk or Regionally Important Wildlife) and are managed through the application of general wildlife measures (GWMs) in wildlife habitat areas (WHAs). This strategy applies to Crown forest and range land, as well as private land subject to tree farm or woodlot licences (*Forest and Range Practices Act 2002*).
Guidelines and Best Management Practices (BC MoE 2013a)	Ministry of Forests, Lands and Natural Resource Operations	Guidelines and best management practice (BMPs) documents for many at-risk species and species of management concern in BC (BC MoE 2013a): ▪ *Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia* (BC MoE 2013b); ▪ *Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia (BC MoE 2014a); and* ▪ *British Columbia Urban Ungulate Conflict Analysis (BC MoE 2010).*
Federal		
Canada Wildlife Act (1985)	Environment and Climate Change Canada	Protects migratory birds, wildlife and habitat in National Wildlife Areas (NWAs). The Regulations prohibit hunting, fishing, farming, recreational activities, industrial activities, domestic animals, disturbing soil, damaging plants or dumping waste in NWAs without appropriate permits (*Canada Wildlife Act* 1985).

Legislative Mandate	Agency	Descriptions and Prohibitions
Migratory Birds Convention Act (1994)	Environment and Climate Change Canada	Implements an internationally recognized convention between Canada and the United States to protect various species of migratory game birds, migratory insectivorous birds, and migratory non-game birds. This Act prohibits the deposit of substances harmful to migratory birds. The Migratory Birds Regulations and the *Migratory Birds Sanctuary Regulations* protect migratory birds under this Act (*Migratory Birds Convention Act* 1994).
Species at Risk Act (2002)	Environment and Climate Change Canada	Protects Canadian indigenous species, subspecies, and distinct populations from becoming extirpated or extinct, provides for the recovery of endangered or threatened species, and encourages the management of other species to prevent them from becoming at-risk. To kill, harm, harass, capture or take wildlife listed as Extirpated, Endangered or Threatened is prohibited. The Act prohibits damage to residences or critical habitat of listed species and applies only on federal land with the exception of aquatic species and migratory birds listed in the federal *Migratory Birds Convention Act*, 1994. In some circumstances, the federal prohibitions can be applied to other species on private or provincial Crown land if it is deemed that provincial or voluntary measures do not adequately protect a species and its residence (*Species at Risk Act* 2002)

5.3.1.3 Assessment Methodology

This section provides a description of the assessment methodology used in preparing the EA related to wildlife.

5.3.1.3.1 Valued Component Selection and Rationale

This section describes the Valued Components (VCs) and measureable indicators identified for this assessment related to wildlife and provides rationale for excluding VCs. The selected VCs reflect issues and guidelines, potential Aboriginal concerns, issues identified by BC EAO and CEA Agency, other stakeholders, professional judgment and key sensitive resources, species or social and heritage values. VC were excluded for the following reasons:

- The candidate VC is not known to be present (based on information review) or has not been observed (based on field work) in the study areas;
- The Proposed Project does not have the potential to interact with the candidate VC; and/or
- The candidate VC is better represented by another VC or can be effectively considered within the assessment of another VC (e.g., is it already duplicated by another species, economic activity).

Additional details regarding the methods used to exclude VCs is provided in Part B, Volume 2 – Section 4.2.4. Wildlife VCs were selected based on:

- Regulatory status - federal and provincial Species at Risk (SAR) designations;
- Ecological importance – role in food chain and regionally important species;

- Socio-economic importance – affecting socio-economic conditions of local individuals or First Nations;
- Provincial Integrated Wildlife Management Strategy (IWMS);
- Information available and distribution within the Proposed Project Area, Local Study Area (LSA) and Regional Study Area (RSA) (Volume 4, Part G – Section 22.0: Appendix 5.3-A). There areas are defined in Section 5.3.1.3.2.1 below; and
- Input from government agencies.

Eight wildlife VCs were identified for the Proposed Project using the criteria outlined above. A summary of identified VCs, rationale for their inclusion in the assessment and measureable parameters and endpoints are presented in Table 5.3-2.

Table 5.3-2: Valued Components and Measureable Indicators: Terrestrial Wildlife

Valued Component	Rationale[a]	Measurable Parameters/Endpoints
Amphibian species at risk (i.e., red-legged frog [*Rana aurora*], western toad [*Anaxyrus boreas*], Pacific tailed frog [*Ascaphus truei*])	▪ Blue-listed (BC CDC) – red-legged frog, western toad and Pacific tailed frog ▪ SC (COSEWIC) – red-legged frog, western toad and Pacific tailed frog ▪ SC-1 (*SARA)* - red-legged frog, western toad and Pacific tailed frog ▪ Identified Wildlife (IWMS) - coastal tailed frog ▪ Aquatic indicator species	▪ Change in the areal extent of suitable habitat within the LSA and RSA ▪ Change in presence of species at risk ▪ Changes in ambient noise levels in suitable habitat within the LSA ▪ Changes to natal pond water quality for red-legged frog and western toad (i.e., pH, Total Suspended Solids, Temperature)
Western screech-owl *Megascops kennicottii kennicottii*	▪ Blue-listed (BC CDC) ▪ Threatened (COSEWIC) ▪ SC-1 (SARA) ▪ Avian indicator of mature forest	▪ Change in the areal extent of suitable habitat within the LSA and RSA ▪ Changes in ambient noise levels in suitable habitat within the LSA and RSA ▪ Change in presence in the LSA
Common nighthawk *Chordeiles minor*	▪ Yellow-listed (BC CDC) ▪ Threatened (COSEWIC) ▪ T-1 (SARA) ▪ Avian indicator of open and shrub habitat (insectivorous species)	▪ Change in the areal extent of suitable habitat within the LSA and RSA ▪ Changes in ambient noise levels in suitable habitat within the LSA and RSA ▪ Change in presence in the LSA
Northern goshawk (*laingi* subspecies) *Accipiter gentilis laingi*	▪ Red-listed (BC CDC) ▪ Threatened (COSEWIC) ▪ T-1 (SARA) ▪ Raptor indicator of mature forest Identified Wildlife – IWMS	▪ Change in the areal extent of suitable habitat within the LSA and RSA ▪ Changes in ambient noise levels in suitable habitat within the LSA and RSA ▪ Change in presence in the LSA
Band-tailed pigeon *Patagioenas fasciata*	▪ Blue-listed (BC CDC) ▪ Special Concern (COSEWIC) ▪ SC-1 (SARA) ▪ Avian indicator of shrub habitat	▪ Change in the areal extent of suitable habitat within the LSA and RSA ▪ Changes in ambient noise levels in suitable habitat within the LSA and RSA ▪ Change in presence in the LSA

Valued Component	Rationale[a]	Measurable Parameters/Endpoints
Marbled murrelet *Brachyramphus marmoratus*	▪ Blue-listed (BC CDC) ▪ Threatened (COSEWIC) ▪ T-1 (SARA) ▪ Identified Wildlife - IWMS ▪ Avian indicator of mature coastal forest ▪ Recovery Strategy developed in 2014 (Environment Canada 2014a)	▪ Change in the areal extent of suitable habitat within the LSA and RSA ▪ Changes in ambient noise levels in suitable habitat within the LSA and RSA
Roosevelt elk *Cervus Canadensis roosevelti*	▪ Blue-listed (BC CDC) ▪ Ungulate indicator of coastal forest and early seral vegetation ▪ Socio-economic importance (includes hunting, wildlife viewing, etc.)	▪ Change in the areal extent of suitable habitat within the LSA and RSA ▪ Changes in disturbance levels in suitable habitat within the LSA and RSA ▪ Change in presence in the LSA
Grizzly bear *Ursus arctos*	▪ Blue-listed (BC CDC) ▪ Special Concern (COSEWIC) ▪ Identified Wildlife - IWMS ▪ Carnivore indicator of sea level to high elevation habitat (omnivorous species) ▪ Socio-economic importance (includes hunting and wildlife viewing)	▪ Change in the areal extent of suitable habitat within the LSA and RSA ▪ Changes in disturbance levels in suitable habitat within the LSA and RSA

a. SC = Special Concern, T = Threatened, 1 = listed under Schedule 1 of SARA, COSEWIC = Committee on the Status of Endangered Wildlife in Canada, IWMS = Identified Wildlife Management Strategy (COSEWIC 2016; BC CDC 2016)

Seventeen candidate wildlife VCs were identified for the Proposed Project but were excluded from the assessment based on the criteria outlined above. A summary of candidate VCs and rationale for their exclusion in the assessment is presented in Table 5.3-3.

Table 5.3-3: Rationale for the Exclusion of Valued Components: Terrestrial Wildlife

Issue	Candidate VCs	Rationale for Exclusion
Terrestrial Wildlife	Barn swallow	Common nighthawk is assessed as a surrogate species for the barn swallow as it is a representative of aerial feeding insectivorous avian species; therefore, barn swallow was not specifically included as a VC. Notwithstanding, all species at-risk identified for the Proposed Project Area will be discussed in the EAC Application/EIS, with a more detailed level of analysis being provided for selected VCs which may be representative of other species.
	Great blue heron (*fannini)*	Great blue heron have occasionally been observed foraging near the mouth of McNab Creek. However, no nesting has been recorded within the Proposed Project Area. Nesting is colonial and typically occurs in Sitka spruce (*Picea sitchensis*), western redcedar (*Thuga plicat*a), western hemlock (*Tsuga heterophylla*), red alder (*Alnus rubra*), and black cottonwood (*Populus trichocarpa*) (COSEWIC 2008). The *fannini* subspecies of the great blue heron was excluded as a VC as nesting is not known to occur within the Proposed Project Area. Potential interaction with great blue heron food sources (i.e., fish) will be assessed as part of the fisheries and freshwater habitat VCs and the marine resources VCs.
	Bald Eagle	Northern goshawk and western screech-owl were selected as surrogate raptor species for the bald eagle as they inhabit similar habitats (i.e., mature and old-growth forest habitat). In general, potential effects to raptors and their nests will be considered in the assessment under northern goshawk and western screech-owl VCs.
	Osprey	Osprey nesting has not been documented in the Proposed Project Area. Potential interaction with osprey food sources (i.e. fish) will be assessed as part of the fisheries and freshwater habitat VCs and the marine resources VCs. In general, potential effects to raptors and their nests will be considered in the assessment under northern goshawk and western screech-owl VCs.

	Sooty grouse	Northern goshawk, western screech-owl and marbled murrelet were selected as surrogate species for forest dwelling avian species. Band-tailed pigeon have been selected as a surrogate avian species that occurs in open/ cleared habitat.
	Green heron	Green heron occur within a variety of aquatic habitats including wetlands, riparian areas of sloughs, rivers, ponds and lakes, estuaries and beaches. Habitat use is generally dependent on the availability of slow moving or shallow water for foraging and dense trees or tall shrubs for nesting. In BC, green heron typically nests in deciduous trees and shrubs, although they have been recorded nesting in Douglas-fir (*Pseudotsuga menziesii*; Fraser and Ramsey 1996). Highly suitable green heron nesting and foraging habitat does not occur within the Project area.
	Olive-sided flycatcher	Olive-sided flycatchers are associated with forest openings in montane coniferous forests including natural openings (i.e. meadows, burns, rivers) or anthropogenic opens (cut blocks). Nesting occurs in natural and anthropogenic forest openings with survivalship rates in natural openings approximately double that of nests in harvested forest (Robertson and Hutto 2007). The Proposed Project Area mostly consists of pole sapling forests in the early stages of re-generation post logging. As such, is not considered highly suitable olive-sided flycatcher habitat based on research reported in Robertson and Hutto (2007). Band-tailed pigeon has been selected as a surrogate species for the olive-sided flycatcher to represent an avian species that occurs in open habitat and forest edges.
	Double-crested cormorant	*Has been assessed under the marine bird VC.*
	Purple martin	Not present in the Proposed Project Area. In BC, purple martins are only currently known to breed at marine sites. No active breeding areas are known to occur at or adjacent to the Proposed Project Area. In addition, the Proposed Project Area does not occur within the active range of extent or historical range of extent identified by Cousens and Lee (2012). Common nighthawk is assessed as a surrogate species representative of aerial feeding insectivorous avian species.
	Moose	Not present in the Proposed Project Area. Moose range in British Columbia does not include the South Coast environment (Blood 2000). Roosevelt Elk have been included as a VC and are considered to represent other ungulate species.
	Columbia black-tailed deer	*Roosevelt Elk have been included as a VC and are considered to represent other ungulate species.*
	Townsend's big-eared bat	Townsend's big-eared bat occur in the region; however, its' presence is typically associated with drier habitats and/or significant freshwater riparian areas. No day-roosting habitat was observed in the LSA (e.g., caves or mines), and foraging habitat typically associated with the species is limited in the LSA (e.g., open forest types or riparian areas). The Project is not expected to interact with important or unique habitat such as maternity colonies or hibernacula. Townsends' big-eared bat could forage in the riparian habitat associated with McNab Creek; however, this is outside of the Proposed Project Area. Effects to riparian habitat will be assessed as a component of the sensitive ecosystem VC.
	Keen's myotis	The distribution of Keen's myotis appears to be limited to dense mature forest in temperate coastal areas. Low elevation ponds and riparian areas provide the most important foraging habitat for this species due to high insect productivity in these areas. Keen's long-eared myotis are not known to roost or forage in clear-cut areas or second growth forests.

		The Proposed Project is not expected to interact with important or unique habitat such as maternity colonies or hibernacula. Keen's myotis may forage and roost in mature and old growth forest within the LSA and RSA. Western screech-owl, marbled murrelet and northern goshawk have been selected as a surrogate species representing forest dwelling species. Effects to mature and old growth forest will be assessed as a component of the sensitive ecosystem VC.
	Wolverine	Wolverines generally occur at higher elevations and are mobile and travel long distances to search out food sources. Foraging habitat is selected based on availability of food source (carrion, small – medium size mammals and ungulates) rather than access to thermorgulatory or shelter features; as such, this species tends to be a habitat generalist. Denning occurs in bowls at high elevation and they mostly range in mountainous terrain along the coast (COSEWIC 2003b). The Proposed Project Area does not support unique or important wolverine habitat such as denning habitat. Wolverines may occasionally move through and hunt in the Proposed Project Area; however, it is predicted that wolverine use of this area is rare and therefore, Proposed Project related effects, if any, are expected to be minimal. Grizzly bear has been assessed as a surrogate species representing mobile and wide-ranging mammals.
	Fisher	Fishers have flexible habitat requirements for foraging while requiring specific habitat types for rearing young. In BC, Fishers select large diameter black cottonwood or balsam poplar (*P.b. balsamifera*) for whelping (Weir, 2003). The Proposed Project LSA and RSA do not provide suitable fisher habitat due to lack of suitable tree cover, therefore they are not expected to occur in or adjacent to the Proposed Project Area.
	Black bear	Grizzly bear has been assessed as a surrogate species representing omnivorous and wide-ranging mammals.
	Terrestrial invertebrates	Effects to terrestrial invertebrate species habitat that may be present in the area will be covered in the assessment of other terrestrial VCs.

5.3.1.3.2 Assessment Boundaries

5.3.1.3.2.1 Spatial Boundaries

The spatial boundaries for the EA have been selected to take into account the physical extent of the Proposed Project, physical extent of Project-related effects and the physical extent of any key environmental systems. The specific study areas for wildlife are provided in Table 5.3-4 and shown in Figure 5.3-1.

Table 5.3-4: Spatial Boundaries: Terrestrial Wildlife

Study Area	Description
Local Study Area (LSA)	The LSA for terrestrial wildlife and vegetation VCs includes the cadastral property boundaries DL6612, DL667, DL667A and DL667B owned by the Proponent. The wildlife LSA extends approximately 250 m to 500 m from the property boundary edge to the west, north and east to represent the area within which the majority of the indirect effects of the Project are expected to occur. The wildlife LSA boundary was further adjusted based on available mapping and ground truthing to align with the ecological conditions of the delta basin where changes in vegetation and slope were observed. The LSA extends approximately 1.8 km to the north of the property boundaries to where the McNab River changes from a delta river system to a canyon. The southern boundary of the wildlife LSA is bounded by the Thornbrough Channel (at the high tide mark). The LSA encompasses topographical features and habitat within the McNab Valley similar to the Proposed Project Area to facilitate the study of comparable habitat types. The wildlife LSA is contained within the McNab Creek watershed and the Coastal Western Hemlock (very wet maritime [CWHvm1]) biogeoclimatic zone. The vegetation and wildlife VCs will use the same LSA of 569 ha due to their ecological interdependence. The wildlife LSA encompasses the area in which the majority of direct and indirect measurable Project effects on vegetation and wildlife are expected during construction, operations and decommissioning.
Regional Study Area (RSA)	The wildlife RSA comprises 15 watersheds that empty in Howe Sound. The wildlife RSA is bounded by the Rainy River watershed to the west, by McNab Creek watershed to the north, by Mill Creek and SQAMWSD000058 watersheds to the northeast, and by Thornbrough Channel to the south (at the high tide mark). The vegetation and wildlife VCs will use the same RSA of 30,092 ha (301 km2) due to their ecological interdependence. The wildlife RSA is large enough to assess direct and indirect Project-related effects, as well as cumulative effects on vegetation and wildlife VCs. The wildlife RSA is used to provide a regional, ecologically relevant context for the distribution of VCs, and the ecosystems they depend on. The wildlife RSA was selected to include: ▪ general environmental features present in the wildlife LSA to facilitate a comparison of habitat types; ▪ topographical breaks and watersheds that provide natural landscape barriers; and ▪ the home range of the largest fauna in the study area (i.e., 22,000 ha or 220 km2 for a coastal male grizzly bear [MacHutchon et al. 1993]) which covers a scale appropriate for assessing the effects of the Proposed Project on wildlife.

5.3.1.3.2.2 Temporal Boundaries

Based on the Proposed Project schedule, the temporal boundaries for the effects assessment for wildlife are as follows:

- Project construction – 2 years;
- Project operations – 16 years; and
- Project reclamation and closure – on-going and 1 year beyond operations.

5.3.1.3.2.3 Administrative Boundaries

There are no administrative boundaries for the assessment of terrestrial wildlife.

5.3.1.3.2.4 Technical Boundaries

Predicting the effects of a Project and proposed mitigation measures on complex environmental systems is limited by our understanding of how wildlife and wildlife habitat responds to various environmental changes. Limitations on prediction confidence include:

- Adequacy of baseline data for understanding current conditions and future changes unrelated to the Proposed Project (e.g., extent of future developments, climate change, catastrophic events);
- Model inputs (e.g., disturbance coefficients from development);
- Understanding of Proposed Project-related impacts on complex ecosystems that contain interactions across different scales of time and space; and
- Knowledge of the effectiveness of environmental design features and mitigation for reducing or removing impacts (e.g., revegetation of wildlife habitat).

The baseline data collected provides information on current species composition and habitat use; however, it does not provide sufficient information on a timescale required to predict species response to factors such as other regional developments and climate change.

Habitat Suitability Index (HSI) models use known species-habitat associations and requirements to assess the suitability of habitat at a landscape level. Habitat suitability modelling is limited in part by the scale and accuracy of land cover data available, and therefore does not account for microhabitat features such as available tree cavities or course woody debris cover, which may play an important role in habitat selection by wildlife.

5.3.1.3.3 Assessment Methods

5.3.1.3.3.1 Existing Conditions

An assessment of baseline terrestrial wildlife conditions was conducted by reviewing existing information including historical and current studies completed within the LSA and RSA, scientific literature and background information source for at-risk species. Field surveys were conducted within the LSA to obtain data on species occurrence, habitat use and to supplement existing information on provincially and/or federally listed species at risk. Breeding birds, marbled murrelet, western screech-owl, nocturnal owls, and northern goshawk surveys were conducted in 2012, amphibian breeding surveys were conducted in 2012 and 2014 and remote camera data were collected from 2009 to 2012.

Baseline habitat suitability in the LSA and RSA for wildlife VCs was determined through the application of HSI models. Habitat suitability index models were developed for western screech-owl, common nighthawk, Roosevelt elk and grizzly bear. Habitat suitability modeling was completed by Golder for western screech-owl (kennicottii subspecies) nesting habitat, common nighthawk nesting habitat, Roosevelt elk winter habitat and grizzly bear spring, summer and fall forage habitat. The Roosevelt elk (roosevelti subspecies) HSI model was developed with consultation and review by Darryl Reynolds (Senior Wildlife Biologist, MFLNRO, Sechelt, BC). One life requisite was modeled for each species model based on the most limiting habitat requirement of that species, with the exception of grizzly bear because no one season is of dominant importance for grizzly bear populations.

Additional details on the methodology used to define and classify wildlife resources can be found in Volume 4, Part G – Section 22.0: Appendix 5.3-A.

5.3.1.3.3.2 Identifying Project Interactions

A preliminary evaluation of identified interactions between the various physical works and activities and the selected VCs across all spatial and temporal phases of the Proposed Project was undertaken to characterize interactions as:

a) Positive, none or negligible, requiring no further consideration; or

b) Potential effect requiring further consideration and possibly additional mitigation.

Rationale is provided for determinations with no or negligible interaction. For Project-VC interactions that may result in potential effects requiring further consideration, the nature of the effects (both adverse and positive) arising from those interactions are described. Potential effects include direct, indirect and induced effects. This evaluation is presented in Section 5.3.1.5.

Knowledge of wildlife in the LSA and RSA (as outlined in the *BURNCO Aggregate Project Wildlife Baseline Technical Report*), professional judgment, and changes in habitat were used to classify the effects of the Proposed Project on wildlife abundance, habitat and movement during the construction, operational and reclamation/closure phases. Previously approved and comparable EAs were also referenced.

Activities during all stages of the Proposed Project (i.e., construction, operational and reclamation/closure phases) were examined to identify those activities that could to result in potential environmental effects. An assessment of interactions of the Proposed Project with selected VCs was based on a comprehensive review of the literature, an appraisal of the environmental setting, expert knowledge, professional judgment, and information provided by the Proponent including a summary of Proposed Project activities. Planned and unplanned (accidental) events were assessed as Proposed Project activities. Proposed Project activities with no potential Project-environment interaction were not considered further in the assessment. Potential Project-environment interactions carried forward in the assessment are listed in Table 5.3-5.

Table 5.3-5: Identification of Proposed Project-Related Effects to Terrestrial Wildlife VCs

Valuable Component	Baseline Assessment	Effects Assessment
Amphibian species at risk	▪ Species surveys ▪ Habitat surveys	▪ Habitat loss ▪ Barriers to movement ▪ Change in mortality
Western screech-owl	▪ Species surveys ▪ HSI Model	▪ Habitat loss ▪ Barriers to movement ▪ Change in mortality
Common nighthawk	▪ Species surveys ▪ HSI model	▪ Habitat loss ▪ Barriers to movement ▪ Change in mortality
Northern goshawk	▪ Species surveys	▪ Habitat loss ▪ Barriers to movement ▪ Change in mortality
Band-tailed pigeon	▪ Species surveys	▪ Habitat loss

Valuable Component	Baseline Assessment	Effects Assessment
		▪ Barriers to movement ▪ Change in mortality
Marbled murrelet	▪ Species surveys	▪ Habitat loss ▪ Barriers to movement ▪ Change in mortality
Roosevelt elk	▪ Remote camera survey ▪ HSI model	▪ Habitat loss ▪ Barriers to movement ▪ Change in mortality
Grizzly bear	▪ Remote camera survey ▪ HSI model	▪ Habitat loss ▪ Barriers to movement ▪ Change in mortality

Pond/stream breeding habitat was identified for designated pond/stream breeding amphibian species within the Proposed Project Area during 2012 and 2014 field surveys. Direct loss of suitable aquatic habitat was measured by overlaying the Proposed Project Area over identified known breeding habitat and calculating the area of breeding habitat predicted to be removed. A qualitative assessment of potential effects to amphibian movement patterns was completed by reviewing the locations of adult amphibians identified during field surveys and incidental observations in conjunction with the layout of the Proposed Project features which could affect movement patterns (i.e., roadways).

Habitat loss was quantified for those species for which HSI modelling was conducted. Habitat suitability modeling quantified the proportion of suitable nesting habitat (moderate and high suitability) within the Proposed Project Area, LSA and RSA for western screech-owl and common nighthawk, as well as suitable winter range habitat for Roosevelt elk, and spring, summer and fall grizzly bear habitat. These models are used to assess potential effects caused by the Proposed Project construction, operational and reclamation phases on wildlife habitat based on accepted methodologies applied in EAs across the province, as well as nationally and internationally. Changes to available habitat were assessed at the RSA scale, which is an ecologically relevant scale.

Qualitative assessments are provided for assessing the effects of habitat loss on band-tailed pigeon and marbled murrelet using baseline survey results, literature reviews, habitat inferences and professional judgement.

During the construction phase the loudest activity will be pile driving with elevated noise levels reaching >90 dBA in the marine environment. The highest noise level predicted in the LSA during construction is 80 dBA. Noise levels during Year 1 of the operational phase will be highest at the processing area (90 dBA) and the southwest corner of the minable area (>90 dBA). The highest noise level in the LSA during Year 1 is 70 dBA. The highest noise levels during Year 12 are predicted to occur at the processing area and the northern edge of the minable area (90 dBA). The highest noise level within the LSA during Year 12 of the operational phase is expected to be 80 dBA. For comparison, noise levels of 45 dBA correspond with indoor residential areas at night and 55 dBA corresponds to outdoor residential areas during the day (Ouis 2001).

Effects related to noise were estimated by overlaying the output of noise models with species-specific habitat suitability mapping and summarizing the change in habitat for VCs for which noise thresholds were defined in literature (i.e., amphibian species at risk, northern goshawk, western screech-owl, marbled murrelet, and common nighthawk). Noise thresholds beyond which habitat loss is expected are defined for each VC in Section 5.3.1.5.2. Noise contours were predicted for marine pile driving during the construction phase (the period of greatest noise

emissions), and noise in *Years 1* and *12* of the operational phase of the Proposed Project. Due to the paucity of literature regarding noise thresholds for Roosevelt elk and grizzly bear, effects of noise and other sensory disturbance were measured using published zones of influence (ZOI). A ZOI represents the distance at which avoidance of certain anthropogenic disturbances has been observed.

5.3.1.3.3.3 Evaluating Residual Effects

Potential Project-related residual effects were characterized as the basis for determining the significance of potential residual adverse effects for each VC. The characterization of effects was undertaken following application of appropriate mitigation measures. Mitigation measures are summarized in Section 5.3.1.5.4.

Potential residual effects were characterized using the following standard residual effects criteria:

- **Context** – the current and future sensitivity and resilience of the VC population in the RSA to change caused by the Proposed Project;
- **Magnitude** – the expected size or severity of the residual effect;
- **Geographic Extent** – the spatial scale over which the residual effect is expected to occur;
- **Duration** – the length of time the residual effect persists;
- **Reversibility** - indicating whether the effect is full reversible, partially reversible or irreversible; and
- **Frequency** – how often the residual effect occurs.

The criteria defined in Table 5.3-6 have been used to characterise and determine the significance of potential effects of Wildlife VCs. A description of criteria used to characterise potential effects for all disciplines are presented in Volume 2, Part B - Section 4.0.

The likelihood of potential residual effects occurring was characterized for Terrestrial Wildlife and Vegetation using appropriate quantitative or qualitative terms, with sufficient description of how conclusions were reached. The following scale was used for the assessment of likelihood:

- Low - likelihood of occurrence (0 to 40%) – Residual effect is possible but unlikely;
- Medium - likelihood of occurrence (41 to 80%) - Residual effect may occur, but is not certain to occur; and
- High - Likelihood of occurrence (81% to 100%) - Residual effect is likely to occur or is certain to occur.

Likelihood may be influenced by a variety of factors, such as the likelihood of a causal disturbance occurs or the likelihood of mitigation being successful.

5.3.1.3.3.4 Evaluating the Significance of Residual Effects

The significance of potential residual adverse effects were determined for each VC based on the residual effects criteria and the likelihood of a potential residual effect occurring (Section 5.3.1.3.3.3), a review of background information and available field study results, consultation with government agencies and other experts, and professional judgement.

The rationale and determinations of the significance of potential residual effects on VCs are provided in Section 5.3.1.5.

5.3.1.3.3.5 Level of Confidence

The level of confidence for each predicted effect is discussed to characterize the level of uncertainty associated with both the significance and likelihood determinations. Level of confidence is typically based on expert judgement and is characterized as:

- Low: Limited evidence is available, models and calculations are highly uncertain, and/or evidence about potential effects is contradictory.
- Moderate: Sufficient evidence is available and generally supports the prediction.
- High: Sufficient evidence is available and most or all available evidence supports the prediction.

Confidence in the assessment of environmental significance is related to the following elements:

- adequacy of baseline data for understanding current conditions and future changes unrelated to the Proposed Project (e.g., extent of future developments, climate change, catastrophic events);
- model inputs (e.g., noise modeling);
- understanding of the Proposed Project-related impacts on complex ecosystems that contain interactions across different scales of time and space (e.g., exactly how the Proposed Project will influence Roosevelt elk); and
- Knowledge of the effectiveness of the environmental design features and mitigation for reducing or removing impacts (e.g., re-vegetation of wildlife habitat).

Ecosystems are complex and are characterized by interactions across multiple scales, nonlinearity, self-organization, and emergent properties (Boyce 1992; Holling 1992; Levin 1998; Wu and Marceau 2002). These characteristics can confound our understanding of ecosystem processes and limit the accuracy of predictions on the effects of development on wildlife populations. To be scientifically defensible, residual impact predictions must be tempered with uncertainty associated with the data and knowledge of the ecosystem. To reduce uncertainty associated with changes in habitat quantity, conservative estimates of the Proposed Project Area were applied to calculate the area of habitat directly affected.

The magnitude of indirect habitat loss due to sensory disturbance is difficult to estimate because of a paucity of available information regarding species threshold tolerance levels and the influence of indirect effects on populations. Therefore, conservative thresholds were defined based on the available literature and were applied to predict indirect habitat loss due to sensory disturbance.

It is understood that development activities will directly and indirectly affect wildlife habitat, abundance and movement. However, long-term, comprehensive monitoring studies documenting the resilience of wildlife to development, the effectiveness of mitigation and the time required to reverse these impacts are lacking. Uncertainty remains surrounding the degree to which some effects may occur and in the effectiveness of revegetation techniques for wildlife habitat.

Table 5.3-6: Criteria for Characterizing Potential Residual Effects: Terrestrial Wildlife

VC	Context	Magnitude	Geographic Extent	Duration	Reversibility	Frequency
All Terrestrial Wildlife VCs	**Resilient:** A high natural resilience to imposed stresses; **Moderately Resilient:** A moderate natural resilience to imposed stresses; or **Sensitive:** Low natural resilience to imposed stresses.	**Negligible:** Proposed Project will have no measurable (<1%) change in measurement endpoint; **Low:** Proposed Project will result in small (1% to <10%) change in measurement endpoint; **Medium:** Proposed Project will result in moderate (10% to 20%) change in measurement endpoint; or **High:** Proposed Project will result in large (>20%) change in measurement endpoint.	**Local:** effect restricted to LSA; **Regional:** effect extends beyond the LSA into the RSA; or **Beyond Regional:** effect extends beyond the RSA.	**Short-term**: <1 year; **Medium-term**: 1 year to life of Proposed Project; or **Long-term**: >life of Proposed Project.	**Fully reversible:** Effect reversible with reclamation and/or over time; **Partially Reversible:** Effect can be reversed partially; or **Irreversible:** Effect irreversible and cannot be reversed with reclamation and/or over time.	**Low:** Occurs rarely or during a specific period; **Medium:** Occurs intermittently; or **High:** Occurs continuously.

5.3.1.4 Baseline Conditions

he wildlife technical baseline report for the Proposed Project Area is located in Volume 4, Part G – Section 22.0: Appendix 5.3-A. A summary of the baseline report is summarized here. Approved Wildlife Habitat Areas (WHAs) or Ungulate Winter Ranges (UWRs) do not occur within the Proposed Project Area or LSA. The nearest approved WHAs are found to the north of the LSA and were established for marbled murrelet (Brachyramphus marmoratus), while the nearest UWR was established for mountain goat (*Oreamnos americanus*) in high elevation habitat approximately 900 m northeast of the LSA (Government of BC 2016).

Three amphibian species, northern Pacific treefrog (*Pseudacris regilla*), northern red-legged frog (*Rana aurora*) and coastal tailed frog (*Ascaphus truei*), were confirmed to occur within the LSA. Two reptiles, northern alligator lizard (*Elgaria coerulea)* and common garter snake were observed incidentally within the Proposed Project Area and LSA.

Forty-eight bird species were recorded in the LSA during breeding bird surveys and incidental sightings. Seven species of diurnal raptors were incidentally recorded in the LSA during 2012 field surveys and three species of owl were recorded. Common merganser (*Mergus merganser*) was the only waterfowl species observed and great blue heron (*Ardea herodias fannini*) was the only heron or similar species observed in the LSA. Ruffed grouse (*Bonasa umbellus*) and sooty grouse (*Dendragapus fuliginosus*) were recorded within the Proposed Project Area and the broader LSA.

Eight mammal species were observed by remote cameras; Columbian black-tailed deer (*Odocoileus hemionus columbianus)*, Roosevelt elk (*Cervus canadensis roosevelti*), black bear (*Ursus americanus*), cougar (*Puma concolor*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), and Douglas' squirrel (*Tamiasciurus douglasii*).

Twelve provincially and/or federally listed species were recorded within the LSA during field surveys; two amphibian, nine bird, and one mammal species (Table 5.3-7).

Table 5.3-7: SAR Confirmed in the LSA

Common Name	Scientific Name	BC CDC[a]	SARA[b]	COSEWIC[c]	Identified Wildlife[d]
Coastal tailed frog	*Ascaphus truei*	Blue	SC-1	SC	Yes
Northern red-legged frog	*Rana aurora*	Blue	SC-1	SC	No
Great blue heron	*Ardea herodias fannini*	Blue	SC-1	SC	Yes
Black swift	*Cypseloides niger*	Blue	NA	E	No
Northern goshawk	*Accipiter gentilis laingi*	Red	T-1	T	Yes
Marbled murrelet	*Brachyramphus marmoratus*	Blue	T-1	T	Yes
Band-tailed pigeon	*Patagioenas fasciata*	Blue	SC-1	SC	No
Western screech-owl	*Megascops kennicottii kennicottii*	Blue	SC-1	T	No
Common nighthawk	*Chordeiles minor*	Yellow	T-1	T	No
Olive-sided flycatcher	*Contopus cooperi*	Blue	T-1	T	No
Barn swallow	*Hirundo rustica*	Blue	NA	T	No
Roosevelt elk	*Cervus canadensis roosevelti*	Blue	NA	NA	No

a. Red = Extirpated, Endangered or Threatened; Blue = Special Concern; Yellow = Not at Risk.
b. T = Threatened, SC = Special Concern, NA = Not Assessed, 1 = Schedule 1.
c. T = Threatened: A species that is likely to become endangered if limiting factors are not reversed, SC = Special Concern: A species of special concern because of characteristics that make it is particularly sensitive to human activities or natural events, NA = Not assessed.
d. Yes = Species is listed as Identified Wildlife in the Identified Wildlife Management Strategy (IWMS), No = Species is not listed as Identified Wildlife in the IWMS.

The majority (i.e., 72%) of habitat within the LSA is ranked nil suitability for western screech-owl nesting, while 7% (39 ha) is ranked high suitability. A larger proportion of the RSA is ranked as high suitability nesting habitat (19%) than in the LSA (7%). Therefore, the LSA is predicted to provide proportionately less nesting habitat for western screech owl than the RSA. Proposed Project Area has no high suitability nesting habitat and 4 ha (7%) of moderate suitability nesting habitat which is likely insufficient habitat for nesting pairs of western screech owl which typically require an average of a 20 ha home range per breeding pair (Davis and Weir 2010). Two western screech-owls were recorded during nocturnal call playback surveys on the western periphery of the LSA.

The majority (i.e., 55%) of habitat within the LSA is ranked nil suitability for common nighthawk nesting, while 6% is ranked high suitability nesting habitat. A greater proportion of the RSA is ranked as high suitability nesting habitat (8%) than in the LSA (6%). Therefore, the LSA is predicted to provide proportionately less nesting habitat for common nighthawk than the RSA. Two incidental observations of common nighthawk were recorded during the 2012 breeding bird surveys.

Based on the HSI modelling, 37% of habitat within the LSA was ranked moderate suitability winter habitat for Roosevelt elk, while 23% was ranked high suitability. This proportion is considerably higher than the RSA, which contains 9.4% moderate suitability and 4.7% high suitability winter habitat. This can be partially explained by the preference by elk for lower elevation habitat during winter months. Within the LSA, the majority of high suitability winter habitat is along the McNab foreshore and along McNab Creek north of the Proposed Project Area. Additional high suitability habitat exists east of McNab Creek on the eastern side of the LSA. The majority (61%) of the Proposed Project Area contains moderate and high suitability habitat. High suitability winter habitat is located at the north end of the Proposed Project Area adjacent to McNab Creek, and at the south end of the Proposed Project Area along the marine foreshore. Moderate suitability winter habitat is located on all sides of, and within, the Proposed Project Area. Roosevelt elk were recorded on multiple occasions on remote wildlife cameras.

The majority of the LSA (56%) was ranked as high suitability grizzly bear forage habitat which is proportionally higher than the amount of high suitability habitat within the RSA (15%). This can be attributed to the LSA and Proposed Project Area's proximity to McNab Creek, a salmon bearing watercourse. Within the LSA the majority of high and moderate suitable habitat is situated in the valley basin, in the centre of the LSA. The Proposed Project Area is predominately composed of high suitability habitat (85%) which is located on the north and east of the Proposed Project Area grizzly bears were recorded during the field surveys.

5.3.1.4.1 Traditional Ecological and Community Knowledge Incorporation

TEK/CK information was gathered from a Project-specific study undertaken by Skwxwú7mesh (Squamish Nation) and from publicly-available sources. The TEK/CK information available at the time of writing was used to inform existing conditions and this effects assessment.

TEK/CK informed BURNCO's understanding of terrestrial wildlife and vegetation. The main sources of this information include:

- Occupation and Use Study (OUS) undertaken by *Sḵwx̱wú7mesh* (Traditions 2015 a,b)
- An expert report produced on behalf of Tsleil-Waututh Nation for another project (Morin 2015)
- Regulatory documents for other projects in close proximity to the Proposed Project Area (e.g., Eagle Mountain – WGP 2015 a,b; PMV 2015; WLNG 2015).

TEK/CK sources available at the time of writing provided no specific information on harvest locations, abundance or quality of terrestrial wildlife and vegetation, or other environmental knowledge regarding terrestrial wildlife and vegetation harvested in the RSA, including changes to these resources over time. Following is a general discussion of Aboriginal Groups' harvesting of terrestrial wildlife and vegetation within Howe Sound.

Skwxwú7mesh eport Howe Sound as an important area for harvesting terrestrial wildlife and vegetation. Deer, elk and moose were hunted in the lower reaches of the valley, while mountain goats were hunted at higher elevations (Kennedy and Bouchard 1976b in Millennia 1997, SN 2001). *Skwxwú7mesh* eport that the elk population was extirpated from the territory shortly after industrial development commenced. Although reintroduction of this species c. 2007 has been successful to date, abundance remains far from historic or desired levels to sustain *Skwxwú7mesh* Nation culture and sustenance.

Other important wildlife resources included black bears and small terrestrial mammals, such as hares, and blue grouse and ruffed grouse (Eagle Mountain – WGP 2015b, Kennedy and Bouchard 1976b in Millennia 1997, SN 2001). Species such as marmots were harvested in montane, parkland environments (AMEC 2010). *Skwxwú7mesh* currently harvest elk in the fall in the McNab Creek valley. Tsleil-Waututh Nation report harvesting grouse in Howe Sound (Eagle Mountain – WGP 2015b).

For a full summary of Aboriginal Group use and occupancy of Howe Sound refer to Part C of this Application.

5.3.1.5 Effects Assessment

5.3.1.5.1 Project-Valued Component Interactions

A preliminary evaluation of identified interactions between the various physical works and activities and the selected VCs across all spatial and temporal phases of the Proposed Project is presented in Table 5.3-8 to Table 5.3-10. Potential Project-VC interactions are characterized as:

a) Positive, none or negligible, requiring no further consideration; or

b) Potential effect requiring further consideration and possibly additional mitigation.

Rationale is provided for all determinations that there is no or negligible interaction and that no further consideration is required.

For those Project-VC interactions that may result in potential direct, indirect and/or induced effects requiring further consideration, the nature of the effects (both adverse and positive) are described. These interactions are described generally in Section 5.3.1.5.2 and specifically for each VC in Section 5.3.1.5.3.

Table 5.3-8: Project-Valued Components Interaction Table: Terrestrial Wildlife VC - Amphibian Species at Risk

Project Activities	Description	VC: Amphibian Species at Risk	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
Construction			
1. Crew and equipment transport	▪ Daily water taxi ▪ Tug and barge transport of machinery/materials (est. 8 loads) ▪ Barge household and industrial solid waste barged off-site	O	▪ No interaction between Proposed Project activity and VC
2. Site preparation, including construction of the berms and dyke	▪ Logging, clearing and grubbing ▪ Grading ▪ Construction of the berms and dyke ▪ Compaction and laying of gravel base ▪ Limited improvements to existing on-site road infrastructure	●	▪ Direct habitat loss ▪ Indirect habitat loss (Potential for alteration of habitat quality due to an accidental spill) ▪ Barriers to movement (e.g., logging trucks on main road) ▪ Direct mortality during clearing ▪ Vehicle-wildlife collisio
3. Processing area installation, including conveyors and materials handling system)	▪ Installation and use of portable concrete batch plant for construction ▪ Installation of concrete foundations ▪ Installation of screens, crushers, wash plant, conveyor system and automated materials-handling system (i.e., reclaim tunnels) ▪ Installation of groundwater well as a source of make-up water for the wash plant	●	▪ Indirect habitat loss (Potential for alteration of habitat quality due to an accidental spill) ▪ Vehicle-wildlife collision
4. Substation construction and connection	▪ Construct electrical substation adjacent to existing BC Hydro transmission line ▪ Construct outdoor switchyard, electric building, and 100 m transmission line	●	▪ Indirect habitat loss ▪ Vehicle-wildlife collision
5. Marine loading facility installation	▪ Remove existing mooring dolphins ▪ Steel pile installation ▪ Installation of conveyor, barge movement winch and mooring dolphins	O	▪ No interaction between Proposed Project activity and VC
6. Pit development	▪ Dry excavation to remove overburden/topsoil ▪ Installation of clamshell and floating conveyor	●	▪ Indirect habitat loss ▪ Vehicle-wildlife collision ▪ Direct mortality

Project Activities	Description	VC: Amphibian Species at Risk	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
7. Other ancillary land-based construction works	▪ Temporary construction infrastructure set up (trailers, temporary power, etc.) ▪ Upgrades to the existing heavy equipment maintenance shop and warehouse ▪ Upgrades to the existing fuelling facility for the storage of diesel and gasoline for on-site equipment ▪ Construct site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility and helipad ▪ Install contained washroom facilities ▪ Construct pump room for well/stream intake water distribution and fire-fighting	●	▪ Indirect habitat loss ▪ Vehicle-wildlife collision ▪ Direct Mortality
8. Other ancillary marine construction works	▪ Removal of existing small craft dock; install temporary dock for worker access ▪ Construct new floating small craft dock, with tie-up area for a float plane, serviced with 30 amp (A) 125 volt (V) shore power ▪ Barge household and industrial solid waste off-site	O	▪ No interaction between Proposed Project activity and VC
Operations			
9. Crew transport	▪ Daily water taxi	O	▪ No interaction between Proposed Project activity and VC
10. Aggregate mining	▪ Use of electric powered floating clamshell dredge ▪ Primary screening and conveyance of extracted material to processing area ▪ Install channel plug in WC 2	●	▪ Indirect habitat loss ▪ Barriers to movement
11. Processing (screening, crushing, washing)	▪ Screening to separate aggregate sizes ▪ Oversized gravels crushed ▪ Operation of wash plant fed using recycled water from two large storage tanks, supplemented with make-up water by a groundwater well. ▪ Drying and storage of fines and silt	●	▪ Indirect habitat loss

Project Activities	Description	VC: Amphibian Species at Risk	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
12. Progressive reclamation	▪ Ongoing earth works (including site clearing, surface material removal) ▪ Fines and silt mixed with organic overburden material and used for infilling, re-vegetation and landscaping	●	▪ Indirect habitat loss ▪ Vehicle-wildlife collision
13. Stockpile storage	▪ Processed sand and gravel conveyed to stockpile area ▪ Storage of processed materials in stockpiles	●	▪ Barriers to movement ▪ Vehicle-wildlife collision
14. Marine loading	▪ Transfer of stored material using marine conveyor system ▪ Barge loading ▪ Site and navigational lighting	●	▪ Barriers to movement
15. Shipping	▪ Barge traffic (delivery/collection) in Howe Sound, Ramillies Channel, Thornbrough Channel, and Queen Charlotte Channel ▪ Tug and barge transport of fuel and consumables ▪ Navigational lighting	O	▪ No interaction with Proposed Project activity and VC
16. Refueling and maintenance	▪ Refueling and maintenance of on-site equipment	●	▪ Indirect habitat loss
Reclamation and Closure			
17. Crew and equipment transport	▪ Daily water taxi movements ▪ Tug and barge transport of machinery/materials ▪ Barge household and industrial solid waste barged off-site	O	▪ No interaction between Proposed Project activity and VC

Project Activities	Description	VC: Amphibian Species at Risk	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
18. Removal of land-based infrastructure	▪ Remove surface facilities, including clamshell dredge, conveyor system, screens, crushers, wash plant, automated materials-handling system, heavy equipment maintenance shop and warehouse, fuelling facility, site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility, helipad and contained washroom facilities	●	▪ Indirect habitat loss ▪ Vehicle-wildlife collision ▪ Barrier to movement
19. Removal of marine infrastructure	▪ Remove marine facilities, in marine load out facility, jetty, conveyors and piles	O	▪ No interaction between Proposed Project activity and VC
20. Site reclamation	▪ Final completion of the pit lake, landscaping and re-vegetation to develop a functional ecosystem in the freshwater pit ▪ Landscaping and re-vegetation of processing area, berms and dyke	●	▪ Positive effect through re-establishment of amphibian habitat

Notes:
O = Potential effect of Proposed Project activity on VC is positive, none or negligible; no further consideration warranted.
● = Potential effect of Proposed Project activity on VC that may require mitigation/benefit enhancement; warrants further consideration

Table 5.3-9: Project-Value Component Interaction Table: Terrestrial Wildlife VC - Birds

Project Activities	Description	VC: Birds	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
Construction			
1. Crew and equipment transport	▪ Daily water taxi ▪ Tug and barge transport of machinery/materials (est. 8 loads) ▪ Barge household and industrial solid waste barged off-site	O	▪ No interaction between Proposed Project activity and VC
2. Site preparation, including construction of the berms and dyke	▪ Logging, clearing and grubbing ▪ Grading ▪ Construction of the berms and dyke ▪ Compaction and laying of gravel base ▪ Limited improvements to existing on-site road infrastructure	●	▪ Direct loss of habitat ▪ Indirect habitat loss ▪ Barriers to movement
3. Processing area installation, including conveyors and materials handling system)	▪ Installation and use of portable concrete batch plant for construction ▪ Installation of concrete foundations ▪ Installation of screens, crushers, wash plant, conveyor system and automated materials-handling system (i.e., reclaim tunnels) ▪ Installation of groundwater well as a source of make-up water for the wash plant	●	▪ Indirect habitat loss
4. Substation construction and connection	▪ Construct electrical substation adjacent to existing BC Hydro transmission line ▪ Construct outdoor switchyard, electric building, and 100 m transmission line	●	▪ Indirect habitat loss ▪ Indirect mortality
5. Marine loading facility installation	▪ Remove existing mooring dolphins ▪ Steel pile installation ▪ Installation of conveyor, barge movement winch and mooring dolphins	O	▪ No interaction between Proposed Project activity and VC
6. Pit development	▪ Dry excavation to remove overburden/topsoil ▪ Installation of clamshell and floating conveyor	●	▪ Indirect habitat loss

Project Activities	Description	VC: Birds	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
7. Other ancillary land-based construction works	▪ Temporary construction infrastructure set up (trailers, temporary power, etc.) ▪ Upgrades to the existing heavy equipment maintenance shop and warehouse ▪ Upgrades to the existing fuelling facility for the storage of diesel and gasoline for on-site equipment ▪ Construct site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility and helipad ▪ Install contained washroom facilities ▪ Construct pump room for well/stream intake water distribution and fire-fighting	●	▪ Indirect habitat loss ▪ Indirect mortality
8. Other ancillary marine construction works	▪ Removal of existing small craft dock; install temporary dock for worker access ▪ Construct new floating small craft dock, the with tie-up area for a float plane, serviced with 30 amp (A) 125 volt (V) shore power ▪ Barge household and industrial solid waste off-site	O	▪ No interaction between Proposed Project activity and VC
Operations			
9. Crew transport	▪ Daily water taxi	O	▪ No interaction between Proposed Project activity and VC
10. Aggregate mining	▪ Use of electric powered floating clamshell dredge ▪ Primary screening and conveyance of extracted material to processing area ▪ Install channel plug in WC 2	●	▪ Indirect habitat loss
11. Processing (screening, crushing, washing)	▪ Screening to separate aggregate sizes ▪ Oversized gravels crushed ▪ Operation of wash plant fed using recycled water from two large storage tanks, supplemented with make-up water by a groundwater well. ▪ Drying and storage of fines and silt	●	▪ Indirect habitat loss

Project Activities	Description	VC: Birds	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
12. Progressive reclamation	▪ Ongoing earth works (including site clearing, surface material removal) ▪ Fines and silt mixed with organic overburden material and used for infilling, re-vegetation and landscaping	●	▪ Indirect habitat loss
13. Stockpile storage	▪ Processed sand and gravel conveyed to stockpile area ▪ Storage of processed materials in stockpiles	●	▪ Indirect mortality
14. Marine loading	▪ Transfer of stored material using marine conveyor system ▪ Barge loading ▪ Site and navigational lighting	●	▪ Indirect habitat loss
15. Shipping	▪ Barge traffic (delivery/collection) in Howe Sound, Ramillies Channel, Thornbrough Channel, and Queen Charlotte Channel ▪ Tug and barge transport of fuel and consumables ▪ Navigational lighting	O	▪ No interaction between Proposed Project activity and VC
16. Refueling and maintenance	▪ Refueling and maintenance of on-site equipment	O	▪ No interaction between Proposed Project activity and VC
Reclamation and Closure			
17. Crew and equipment transport	▪ Daily water taxi ▪ Tug and barge transport of machinery/materials ▪ Barge household and industrial solid waste barged off-site	O	▪ No interaction between Proposed Project activity and VC

Project Activities	Description	VC: Birds	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
18. Removal of land-based infrastructure	▪ Remove surface facilities, including clamshell dredge, conveyor system, screens, crushers, wash plant, automated materials-handling system, heavy equipment maintenance shop and warehouse, fuelling facility, site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility, helipad and contained washroom facilities	●	▪ Indirect habitat loss
19. Removal of marine infrastructure	▪ Remove marine facilities, in marine load out facility, jetty, conveyors and piles	O	▪ No interaction between Proposed Project activity and VC
20. Site reclamation	▪ Final completion of the pit lake, landscaping and re-vegetation to develop a functional ecosystem in the freshwater pit ▪ Landscaping and re-vegetation of processing area, berms and dyke	●	▪ Reclamation of natural habitat

Notes:
O = Potential effect of Proposed Project activity on VC is positive, none or negligible; no further consideration warranted.
● = Potential effect of Proposed Project activity on VC that may require mitigation/benefit enhancement; warrants further consideration

Table 5.3-10: Project-Valued Components Interaction Table: Terrestrial Wildlife VC - Mammals

Project Activities	Description	VC: Terrestrial Mammals	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
Construction			
1. Crew and equipment transport	▪ Daily water taxi ▪ Tug and barge transport of machinery/materials (est. 8 loads) ▪ Barge household and industrial solid waste barged off-site	O	▪ No interaction between Proposed Project activity and VC
2. Site preparation, including construction of the berms and dyke	▪ Logging, clearing and grubbing ▪ Grading ▪ Construction of the berms and dyke ▪ Compaction and laying of gravel base ▪ Limited improvements to existing on-site road infrastructure	●	▪ Direct habitat loss ▪ Indirect habitat loss ▪ Barriers to movement ▪ Direct mortality ▪ Indirect mortality (Vehicle-wildlife collisions, hunting)
3. Processing area installation, including conveyors and materials handling system)	▪ Installation and use of portable concrete batch plant for construction ▪ Installation of concrete foundations ▪ Installation of screens, crushers, wash plant, conveyor system and automated materials-handling system (i.e., reclaim tunnels) ▪ Installation of groundwater well as a source of make-up water for the wash plant	●	▪ Indirect habitat loss ▪ Barriers to movement
4. Substation construction and connection	▪ Construct electrical substation adjacent to existing BC Hydro transmission line ▪ Construct outdoor switchyard, electric building, and 100 m transmission line	●	▪ Indirect habitat loss ▪ Barriers to movement
5. Marine loading facility installation	▪ Remove existing mooring dolphins ▪ Steel pile installation ▪ Installation of conveyor, barge movement winch and mooring dolphins	O	▪ No interaction between Proposed Project activity and VC
6. Pit development	▪ Dry excavation to remove overburden/topsoil ▪ Installation of clamshell and floating conveyor	●	▪ Indirect habitat loss ▪ Barriers to movement

Project Activities	Description	VC: Terrestrial Mammals	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
7. Other ancillary land-based construction works	▪ Temporary construction infrastructure set up (trailers, temporary power, etc.) ▪ Upgrades to the existing heavy equipment maintenance shop and warehouse ▪ Upgrades to the existing fuelling facility for the storage of diesel and gasoline for on-site equipment ▪ Construct site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility and helipad ▪ Install contained washroom facilities ▪ Construct pump room for well/stream intake water distribution and fire-fighting	●	▪ Indirect habitat loss ▪ Barriers to movement
8. Other ancillary marine construction works	▪ Removal of existing small craft dock; install temporary dock for worker access ▪ Construct new floating small craft dock, the with tie-up area for a float plane, serviced with 30 amp (A) 125 volt (V) shore power ▪ Barge household and industrial solid waste off-site	O	▪ No interaction between Proposed Project activity and VC
Operations			
9. Crew transport	▪ Daily water taxi	●	▪ Indirect mortality
10. Aggregate mining	▪ Use of electric powered floating clamshell dredge ▪ Primary screening and conveyance of extracted material to processing area ▪ Install channel plug in WC 2	●	▪ Indirect habitat loss ▪ Barriers to movement

Project Activities	Description	VC: Terrestrial Mammals	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
11. Processing (screening, crushing, washing)	▪ Screening to separate aggregate sizes ▪ Oversized gravels crushed ▪ Operation of wash plant fed using recycled water from two large storage tanks, supplemented with make-up water by a groundwater well. ▪ Drying and storage of fines and silt	●	▪ Indirect habitat loss
12. Progressive reclamation	▪ Ongoing earth works (including site clearing, surface material removal) ▪ Fines and silt mixed with organic overburden material and used for infilling, re-vegetation and landscaping	●	▪ Indirect habitat loss ▪ Reclamation of natural habitat
13. Stockpile storage	▪ Processed sand and gravel conveyed to stockpile area ▪ Storage of processed materials in stockpiles	●	▪ Indirect habitat loss ▪ Barriers to movement
14. Marine loading	▪ Transfer of stored material using marine conveyor system ▪ Barge loading ▪ Site and navigational lighting	●	▪ Indirect habitat loss ▪ Indirect mortality
15. Shipping	▪ Barge traffic (delivery/collection) in Howe Sound, Ramillies Channel, Thornbrough Channel, and Queen Charlotte Channel ▪ Tug and barge transport of fuel and consumables ▪ Navigational lighting	O	▪ No interaction between Proposed Project activity and VC
16. Refueling and maintenance	▪ Refueling and maintenance of on-site equipment	O	▪ No interaction between Proposed Project activity and VC
Reclamation and Closure			
17. Crew and equipment transport	▪ Daily water taxi ▪ Tug and barge transport of machinery/materials ▪ Barge household and industrial solid waste barged off-site	O	▪ No interaction between Proposed Project activity and VC

Project Activities	Description	VC: Terrestrial Mammals	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
18. Removal of land-based infrastructure	▪ Remove surface facilities, including clamshell dredge, conveyor system, screens, crushers, wash plant, automated materials-handling system, heavy equipment maintenance shop and warehouse, fuelling facility, site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility, helipad and contained washroom facilities	●	▪ Indirect habitat loss ▪ Indirect mortality
19. Removal of marine infrastructure	▪ Remove marine facilities, in marine load out facility, jetty, conveyors and piles	O	▪ No interaction between Proposed Project activity and VC
20. Site reclamation	▪ Final completion of the pit lake, landscaping and re-vegetation to develop a functional ecosystem in the freshwater pit ▪ Landscaping and re-vegetation of processing area, berms and dyke	●	▪ Reclamation of natural habitat ▪ Barriers to movement

Notes:
O = Potential effect of Proposed Project activity on VC is positive, none or negligible; no further consideration warranted.
● = Potential effect of Proposed Project activity on VC that may require mitigation/benefit enhancement; warrants further consideration

5.3.1.5.2 Potential Project-Related Effects

Potential Project-related effects are habitat loss, barriers to movement and mortality. Direct habitat loss may occur due to site clearing, and indirect habitat loss may occur due to sensory disturbance and habitat fragmentation. Barriers to movement may be complete or partial, and may occur due to physical barriers or avoidance due to sensory disturbance. Direct and indirect mortality can result from site clearing, removal of nuisance wildlife, vehicle-wildlife collisions, hunting and trapping, and interactions with infrastructure. In general, disturbance effects on wildlife are most detrimental at key times of the year, such as the reproductive season (spring/early summer) when wildlife are raising young, and during the late-winter periods when wildlife tend to be in poor physical condition (Kuck et al. 1985; Yarmoloy et al. 1988). Proposed Project effects that may occur during construction are similar to those that may occur during operations. Therefore, to facilitate discussion, Proposed Project interactions occurring during the operational phase which are similar to the construction phase have been amalgamated under the construction phase heading. A discussion of effects specific to VCs is provided in Section 5.3.1.5.3.

5.3.1.5.2.1 Habitat Loss

5.3.1.5.2.1.1 Direct Habitat Loss

Site clearing is one of the most visible effects of the Proposed Project. Clearing and grubbing of 59 ha of terrestrial vegetation during the construction and operational phases of the Proposed Project will be required to accommodate the installation of Proposed Project infrastructure (i.e. conveyor systems, out buildings and an electrical substation). The removal of vegetation reduces the landscape's capability to support wildlife. Direct habitat loss will result from vegetation clearing for construction of facilities (e.g., processing facilities, stockpiles) and aggregate mining (e.g., removal of aggregate, creation of pit-lake). The effects of site clearing on habitat loss for each VC will vary with the time of year and the characteristics of the habitat being cleared.

Although habitat is required for wildlife to exist, it is unlikely that there will be a linear relationship between population abundance. The relationship between population density and the availability of habitat is influenced by many factors that may operate independently of habitat, including population densities of the target species and other species in the study area, and the effects of predation pressure, competition and harvest (Garshelis 2000). Effects related to habitat loss are estimated by overlaying the Proposed Project Area with species-specific habitat mapping and are discussed in VC specific sections below. It is expected that direct habitat loss will affect all VCs and therefore this effect has been carried forward in the assessment for all VCs (Section 5.3.1.5.3).

5.3.1.5.2.1.2 Indirect Habitat Loss

5.3.1.5.2.1.2.1 Sensory Disturbance

Wildlife habitat containing suitable cover and forage may be used less by wildlife as a result of sensory disturbance caused by nearby human activities (Bayne et al. 2008). The decline in the use of otherwise suitable habitat by wildlife results in a reduction of habitat effectiveness (i.e., indirect habitat loss). Noise effects on wildlife will vary across the Proposed Project Area over time during construction and operational phases.

Noise will be created from equipment excavating, crushing, and transporting aggregate, as well as Project-related traffic. Increases in noise are expected to vary in intensity and duration depending on work activity.

Noises above certain levels tend to alter wildlife behaviour, potentially increasing their metabolic rate and stress level (Manci et al. 1988). Noise disturbances can also contribute to increased energy expenditures due to increased movement around infrastructure (Bradshaw et al. 1997). Depending on the timing and level of stress, potential stresses to animals from noise could include interference with communication and reduced reproductive success (Habib et al. 2007). For example, noise may cause changes in the frequency and duration of amphibian calling effort (Lengagne 2008), and may result in a reduction in the pairing success of birds due to interference with communication (Habib et al. 2007).

Wildlife species that are hunted are more likely to flee because of noise (Bommer and Bruce 1996). Hunted ungulate populations show significantly greater flight response to disturbance than non-hunted populations, as do females and groups with young offspring (Stankowich 2008). Alienation effects can vary in intensity, and can be short- or long-term depending on the nature of the facilities and available mitigation techniques.

There is a paucity of literature available examining the effects of light on wildlife. It is often difficult to separate the combined influence of industrial noise, artificial light and edge effect on wildlife species. Artificial light has the potential to affect the timing of reproductive behaviour of wildlife species (Kempenaers et al. 2010). Activities during the Proposed Project construction and operational phases are planned during daylight hours and so effects of light on wildlife are not expected. Therefore, the focus of the sensory disturbance effects assessment will be on noise. Potential sensory disturbance due to noise has been carried forward in the assessment for all VCs in Section 5.3.1.5.3.

Habitat Fragmentation

Habitat fragmentation occurs when extensive, continuous tracts of habitat are dissected into smaller, more isolated patches (Meffe and Carroll 1994; St-Laurent et al. 2009). Small, dispersed habitat patches may be less effective at providing the requisites of life, compared to larger continuous tracts for many wildlife species. Fragmentation increases the amount of habitat edge, decreases the amount of interior habitat and increases the distance between habitat patches, thereby affecting the quality and availability of habitat.

Forest edge differs from forest interior in both microclimatic and biotic aspects. A transition in microclimatic variables such as light intensity, temperature, wind and humidity occurs from an edge to a forest interior. These microclimatic differences can be advantageous for some species and detrimental for others, and both vegetation and wildlife respond to these differences. The potential effects of habitat fragmentation have been carried forward in the assessment for amphibian species at risk, marbled murrelet, band-tailed pigeon, western screech-owl and Roosevelt elk in Section 5.3.1.5.3 Habitat fragmentation is not expected to affect common nighthawk, northern goshawk and grizzly bear, with rationale provided in Section 5.3.1.5.3.

Release of Deleterious Substances

Releases of deleterious substances into aquatic habitat may reduce the suitability of the receiving environments for aquatic and semi-aquatic species. Introduction of deleterious substances (i.e., hydrocarbon spill, herbicides, hazardous materials) or silt into aquatic habitat could result in a loss of habitat for aquatic species with low mobility such as amphibians. The potential effect of a release of deleterious substance into the aquatic environment has been considered an interaction with amphibian species at risk due to their dependence on aquatic breeding sites

and low mobility and is carried forward in the assessment. Bird and mammal VCs are expected to be able to access alternate water sources and are not reliant on aquatic habitat for breeding; therefore, potential effects from a release of deleterious substances into aquatic habitat is not expected to interact with the bird and mammal VCs and is therefore not carried forward in the assessment.

5.3.1.5.2.2 Barriers to Movement

Barriers to movement have been widely discussed (e.g., Berger 1995; Bromley 1985; Jalkotzy et al. 1997) and literature reviews have been completed for several species (e.g., Jalkotzy et al. 1997). There is considerably more information for large mammals and furbearers than for other wildlife species. Barrier effects on wildlife can be relatively short-term and limited to the construction period, or can be long-term over the life of a Project until reclamation occurs. Vehicle traffic and construction activities can also result in barriers to movement on a daily or seasonal scale. Proposed Project activities may obstruct the movement of the following wildlife species; amphibian species at risk, marbled murrelet, band-tailed pigeon, western screech-owl, and Roosevelt elk and has been carried forward in the assessment in Section 5.3.1.5.3. Barriers to movement are not expected to affect common nighthawk, northern goshawk and grizzly bear with rationale provided in Section 5.3.1.5.3

5.3.1.5.2.3 Change in Mortality

5.3.1.5.2.4 Direct Mortality

Site clearing could cause direct mortality of animals that are less mobile, particularly early nesting fledgling birds, microtines [e.g., voles], and amphibians. Hibernating animals in dens are particularly sensitive to mortality through site clearing (e.g., grizzly bear). Adult breeding bird VCs will be able to move away from clearing activities but their young may not be able to if clearing is conducted prior to fledging. Birds may abandon nests and direct mortality may occur if clearing is conducted during the bird nesting season. According to the BC Ministry of Environment, the nesting season for raptors extends from March 1 to September 30, and the nesting season for passerines extends from March 1 to August 31 (BC MoE 2014b). According to Environment Canada (2014b), the nesting activities of more than 95% of migratory bird species that may breed in the LSA occur from March 19 to August 17.

Potential effects of direct mortality has been considered for species with low mobility, birds with nesting habitat within the Proposed Project Area and mammals breeding within the Proposed Project Area and has therefore been considered for amphibian species at risk, band-tailed pigeon, western screech owl, and Roosevelt elk (See Section 5.3.1.5.3). As no suitable nesting habitat for northern goshawk will not be lost during the Proposed Project, direct mortality is not assessed further (See Section 5.3.1.5.3). As there is no suitable denning habitat for grizzly bears within the Proposed Project Area direct mortality to denning bears as a result of site clearing is not assessed further (See Section 5.3.1.5.3).

5.3.1.5.2.5 Indirect Mortality

Vehicle-Wildlife Collisions

Road mortalities are generally site-specific, and frequencies depend on the species and circumstances such as location, traffic volume and speed (Jalkotzy et al. 1997; Oxley et al. 1974). Road-killed wildlife studies in Yellowstone National Park indicate that vehicle-speed was the main influence on vehicle-wildlife collisions (Gunther et al. 1998). Increased traffic will increase the likelihood of vehicle-wildlife collisions. Road use associated with the construction and operation of the Proposed Project is expected to be limited to movements of heavy machinery and daily pick-up truck movement predominately at the start and end of work shifts. Traffic volumes are expected to be lower during the operational phase than during the construction phase.

Amphibians are susceptible to vehicle-wildlife collisions, especially during migrations associated with the breeding season (Fukumoto and Herrero 1998). Roadways bisecting amphibian habitat may result in vehicle-related mortality affecting population size and viability (Kambourova-Ivanova et al. 2012; Eigenbrod et al. 2008).

Birds are often killed on roads (Jalkotzy et al. 1997). While bird species whose habitat is bisected with roads are vulnerable to some extent, specific levels of the effect are not commonly reported. Raptors (i.e., hawks and falcons) and owls are susceptible to road kills because of their propensity for hunting small mammals within road allowances and scavenging road-killed animals.

Increased use of roads in the Proposed Project Area may result in greater collisions between vehicles and wildlife. Studies on elk-vehicle collisions indicate that male, sub-adults have the greatest probability of being involved in a vehicle collision, which are consistent with collision data on moose and deer (Gunson et al. 2004). Furthermore, elk killed by vehicle collisions were overall in better physical condition than those killed by predators, likely because vehicle collisions do not discriminate based on physical health of the animal (Gunson et al. 2004). Studies suggest collisions with elk in Banff may be most frequent at dusk and night (Gunson et al. 2004). The potential effect of indirect mortality has been considered for amphibian species at risk, northern goshawk, band-tailed pigeon, western screech-owl, common nighthawk, Roosevelt elk and grizzly bear as these VCs are either less mobile, or may nest, hunt or travel along roadways (Section 5.3.1.5.3). Marbled murrelet are not expected to nest or move along roadways within the Proposed Project Area; therefore, Project vehicles are not expected to interact with this VC and are not assessed further.

Hunting

Increased access due to road and wharf improvements can result in increased mortality from human hunters and poachers (Brody and Pelton 1989; McLellan 1988; Stuart-Smith et al. 1997). The increase in human use of the area results in an elevated hunting risk to grizzly bear and Roosevelt elk. Limited entry hunting of elk is authorized within the LSA although grizzly bear hunting is not permitted. The potential effect of hunting has been considered for Roosevelt elk and grizzly bear in Section 5.3.1.5.3. Amphibian and bird species at risk are not typically targeted by hunters; therefore potential effects related to increased hunting efforts on amphibian species at risk, northern goshawk, western screech-owl, marbled murrelet, band-tailed pigeon or common nighthawk and are not considered further in the assessment.

Removal of Nuisance Wildlife

Nuisance wildlife are occasionally relocated or destroyed, which reduces their abundance. Grizzly bears can become a problem when they are attracted to food odours and have access to human food sources (BC MoE 2013c). Habituated bears tend to become aggressive and can be a threat to human life and property. When this occurs, bears are usually either relocated or destroyed. Bear relocation tends to be very expensive, requires considerable effort and is often unsuccessful (Miller and Ballard 1982; Rogers 1986; Tietje and Ruff 1983). The removal of nuisance wildlife is typically the result of poor waste management practices. The potential effect of removal of nuisance wildlife has been considered for grizzly bear in Section 5.3.1.5.3. Amphibian species at risk, bird species at risk and Roosevelt elk are not expected to become nuisance wildlife; therefore removal of these VC species will not be required and no interactions are considered in the assessment.

Interactions with Infrastructure

Wildlife interactions with infrastructure may result in mortality. These effects are difficult to predict due to a lack of available data (Berger 1995; Lehman et al. 2010). The type of interactions that wildlife may have with Proposed Project infrastructure is variable and may include strikes with towers, poles, wires, and buildings. The potential effect of wildlife interactions with infrastructure has been considered for all bird and mammal VCs in Section 5.3.1.5.3. Amphibian mortality as a result of interaction with Project infrastructure is not expected and therefore has not been considered further in this assessment.

5.3.1.5.3 Potential Project-Related Effects – Valued Component-Specific

5.3.1.5.3.1 Amphibian Species at Risk

5.3.1.5.3.1.1 Construction

5.3.1.5.3.1.1.1 Habitat Loss

Direct Habitat Loss

Wetlands and ponds where amphibian breeding activity was confirmed were overlaid with the Project footprint to predict the area of amphibian breeding habitat that may be removed. , A loss of 0.12 ha of potentially suitable wetland habitat for pond breeding amphibians is predicted to occur during Project construction and operation.

Construction of the Proposed Project will result in the direct loss of red-legged frog aquatic breeding sites and adult upland habitat. Construction of the processing area and material stockpiles, south of the mineable area, will result in the removal of two red-legged frog breeding ponds (i.e., Ponds 2 and 6) which represents approximately 22% (0.1 ha) of red-legged frog breeding habitat recorded in the LSA.

The Proposed Project will remove approximately 3.3% (4 ha) of mature coniferous forest for the marine conveyor belt system in the LSA. Red-legged frogs are terrestrial in their adult life phase and were recorded in mature coniferous forest adjacent to the processing plant, material stockpile areas and the marine conveyor system. The majority (67 %) of adult amphibians recorded in the LSA were documented around Pond 1 and in mature forest south of the Proposed Project Area. Potential effects related to direct loss of amphibian species at risk habitat have been carried forward in the assessment.

Indirect Habitat Loss

Sensory Disturbance

Noise created during the amphibian breeding season may interfere with calling and mate location. Increases in noise while adults are calling can disturb calling patterns (Sun and Narins 2005), length of calling (Barrass 1986; Kaiser et al. 2011) and call assemblages (Sun and Narins 2005; Kaiser et al. 2011). Increased noise during breeding can also affect a female's ability to locate calling males (Bee and Swanson 2007). Red-legged frogs call quietly underwater; therefore, the effect of increased ambient noise levels may affect calling patterns. Little information is available on noise thresholds above which impacts are observed in red-legged frogs. However, a review of available literature on effects of noise levels on various amphibian species provides some insight. In European tree frogs (Hyla arbora), increased noise intensity above 88 dBA resulted in a 50% reduction in calling effort due to changes in the frequency and duration of amphibian calling, while noise intensity above 72dBA resulted in a 29% reduction in calling effort (Lengagne 2008). Spadefoot toads (Scaphiopus couchi) emerged from burrows when exposed to recorded motorcycle noises of 95 dBA. Noise intensity of 120 dBA has resulted in immobilization of northern leopard frogs (Lithobates pipiens; Nash et al. 1970). Noise levels resulting in emergence from burrows (95 dBA) and immobilization (120 dBA) are considered above threshold levels. Noise levels resulting in a 50% reduction in calling effort (88 dBA) were considered to be a suitable threshold for amphibian species at risk. For the purpose of the Proposed Project, the noise threshold was rounded up to 90 dBA to accommodate modeled noise contours.

Pond 2 and 6 will be removed during construction activity (i.e., direct habitat loss). The remaining breeding ponds recorded within the LSA (Ponds 1, 3, 5, and 7) contain 68% of amphibian habitat found within the LSA and will experience noise level increases from 50 to 70 dBA during the construction phase. Pond 4 will experience a noise level increase to 40 to 50 dBA during construction. As noise levels during construction are not expected to exceed the 90 dBA threshold at recorded breeding ponds, sensory disturbance to amphibians caused by construction noise is not considered further in the assessment.

Habitat Fragmentation

The construction phase will result in the removal of two breeding sites to accommodate the processing and sorting facility. This feature will create a linear corridor from the sorting facility to the marine wharf. This will further fragment breeding areas west of the access road from upland habitat east of the processing facility. Therefore, construction activities could interact with amphibian habitat causing habitat fragmentation and has been carried forward in the assessment.

Accidents and Malfunctions - Release of Deleterious Substances

Release of deleterious substances could affect amphibian VCs due to changes in water quality in natal ponds in the event of an accidental spill or release of sediment. Clearing of the Proposed Project Area, road upgrade works and use of mechanical equipment in and near amphibian breeding ponds may result in changes to water quality (i.e., temperature, pH, total suspended solids) in natal ponds. Potential effects on amphibians resulting from changes to water and air quality include both acute and chronic effects to health. Hydrocarbon spills from operating equipment and the use of herbicides pose a risk to amphibians. Spills of oil adjacent to amphibian breeding ponds could alter water quality in natal ponds affecting egg mass and larval survivorship (Melvin and Trudeau 2012). Air

pollution caused by dust and fuel emissions may alter localized reduced air quality. Amplified production of dust may result from increased road use and fugitive dust from the conveyor system. Ponds 1, 2, 3 and 4 are expected to experience an increase in dust deposition, especially in summer months, due to proximity to the main access road. Increased sedimentation reduces food quality for tadpoles affecting tadpole development and recruitment (Gillespie 2002). The potential for the introduction of deleterious substances, associated with the Proposed Project, is associated with accidents or malfunctions, and therefore are considered to have a low likelihood of occurrence. However, given the limited mobility of amphibian species at risk and the species' dependency on aquatic breeding habitat, the potential effect from a release of deleterious substance has been carried forward in the assessment.

5.3.1.5.3.1.1.2 Barriers to Movement

Availability of non-breeding amphibian habitat, such as forest upland and non-natal ponds, is important to the persistence of these amphibian populations (Fellers and Kleenman 2007). Connectivity between these habitats are particularly important in landscapes and are frequently lost or modified by forestry, roadways and other land development (Rothermel 2004; Chan-McLeod 2003). Red-legged frogs are susceptible to desiccation in upland environments and use temporary ponds and wet depressions for thermoregulation during dry summer months. Non-breeding waterbodies also provide "stepping stones" for juvenile frogs during dispersal and are important for colonization/ re-colonization of new habitat (Mazerolle and Desrochers 2005).

Ponds 2 and 6 will be removed during the construction phase and the groundwater-fed watercourse (WC 2) will be incorporated into the pit-lake during the operational phase, thereby removing three wetted areas of amphibian habitat. Pond 2 is located between Pond 1 and 3 and its removal may affect amphibian dispersal from these ponds.

Roadways, and resulting traffic, which bisect amphibian habitat, can restrict amphibian movement between seasonal habitats (i.e. natal ponds, foraging habitat, and hibernation sites) due to roadway avoidance and mortality during crossings (Bouchard et al. 2009; Eigenbrod et al. 2009). The additional traffic on the upgraded main road will decrease permeability for amphibian movement and decrease access to adjacent pond and upland habitat. Additionally, additional traffic will increase the risk of vehicle mortality (discussed in subsequent section). Potential effects related to barriers to amphibian movement over roadways have been carried forward in the assessment.

5.3.1.5.3.1.1.3 Change in Mortality

Direct Mortality

Habitat clearing may result in direct mortality of small, less mobile species such as amphibians. Site clearing that includes soil disturbance during winter months may result in mortality of hibernating amphibians. Site clearing for the processing area and material stockpiles will remove Pond 2, where 66% of red-legged frog egg masses were also encountered during surveys in the LSA. Direct mortality of amphibian species as a result of Project Area clearing considered further in the assessment.

Indirect Mortality

Vehicle-Wildlife Collisions

Amphibians are susceptible to vehicle-wildlife collisions, especially when moving between habitat types to seek mates and breeding habitat, during migration to and from breeding sites, and dispersal of emerging young (BC MoE 2014a; Fukumoto and Herrero 1998; RIC 1998). Red-legged frog migration and dispersal correspond with temperature and weather conditions, and timing may vary annually (COSEWIC 15); however, adult migrations to breeding habitat generally occur between February to April (BC CDC 2016; BC MoE 2014a) with tadpoles present in late spring and summer, and metamorphosis and dispersal of young occurring in late summer or early fall (September to October) (Matsuda et al. 2006). Roadways bisecting amphibian habitat may result in vehicle-related mortality affecting population size and viability (Kambourova-Ivanova et al. 2012; Eigenbrod et al. 2008). The frequency of successful movements over roadways depends on traffic density, weather conditions and time of day (Bouchard et al. 2009). The majority of amphibian habitat within the Proposed Project Area is found adjacent to the main access road connecting the marine loading area to the mining area, thereby putting amphibians utilizing Ponds 1, 2, 3, and 4 at an elevated risk of vehicle collisions.

Indirect mortality associated with interactions between Project vehicles and amphibians are considered further in the assessment.

Hunting

The effect of hunting pressure is not applicable to amphibian species at risk.

Removal of Nuisance Wildlife

The effect of removal of nuisance wildlife is not applicable to amphibian species at risk.

Interactions with Infrastructure

The effect of interactions with infrastructure is not applicable to amphibian species at risk.

5.3.1.5.3.1.2 Operations

5.3.1.5.3.1.2.1 Habitat Loss

Direct Habitat Loss

No additional breeding pond habitat or upland mature forest habitat will be removed during the operational phase of the Proposed Project. Ponds adjacent to the Proposed Project Area (Ponds 1, 3, 5, and 7) are predicted to experience similar or slightly elevated water levels during the operational phase depending on the degree of groundwater input (Volume 4, Part G – Section 22.0: Appendix 5.5-A). Water levels at Pond 4 are expected to remain similar following Proposed Project construction and during operations as they are fed by a stream from the west which will not be affected by the Proposed Project.

Mature forest, which provides suitable terrestrial habitat for adult and non-breeding amphibians, within the Proposed Project Area will be removed during construction and direct habitat loss will continue through the operational phase of the Proposed Project.

Approximately 0.1 of habitat in Pond 2 and 6 that may be providing breeding habitat for amphibians is predicted to be lost during the construction phase. However, the Fish Habitat Offset Plan (Volume 4, Part G – Section 22.0 Appendix 5.1-B) will likely provide effective compensatory breeding habitat during operations. Ponds will be constructed to provide suitable conditions for amphibian breeding and will exclude fish to prevent fish feeding on the amphibian eggs and tadpoles. The potential effects related to habitat loss during operations have been carried forward in the assessment.

Indirect Habitat Loss

Sensory Disturbance

Ponds remaining during the operational phase of the Proposed Project are not expected to experience noise levels over 90 dBA. Ponds 1, 5 and 7 are expected to experience noise levels between 70 and 80 dBA Year 1 and Year 12. Pond 4 is expected to experience noise levels between 50 – 60 dBA during Years 1 and 12. As noise levels at recorded natal ponds are not expected to exceed the 90 dBA threshold during Proposed Project operations, potential effect related to habitat loss as a result of increased noise levels from Project operations are not considered further in the assessment.

Habitat Fragmentation

No additional habitat fragmentation is expected to occur in the operational phase of the Proposed Project. The interaction with the Proposed Project has been discussed under construction (Section 5.3.1.5.3.1.1). The potential effects of habitat fragmentation will continue through the operational phase of the Proposed Project, therefore, this effect has been carried forward in the assessment.

Accidents and Malfunctions - Release of Deleterious Substances

Release of deleterious substances could affect amphibian VCs due to changes in water quality in natal ponds in the event of an accidental spill or release of sediment. Road grading during Proposed Project operations and use of mechanical equipment near amphibian breeding ponds may result in changes to water quality in natal ponds (i.e., pH, total suspended solids). The effects of a release of a deleterious substance are described in Section 5.3.1.5.3.1.1. Given the limited mobility of amphibian species at risk and their dependency on aquatic breeding habitat the potential effects related to the loss of habitat as a result of a release of deleterious substance are considered further in the assessment.

5.3.1.5.3.1.2.2 Barriers to Movement

Barriers to amphibian movement to and from natal ponds are expected to continue through the operations phase. Potential effects related to barriers to amphibian movement have been discussed under construction (Section 5.3.1.5.3.1.1) and will be considered in the assessment for both construction and operations.

5.3.1.5.3.1.2.3 Change in Mortality

Direct Mortality

No additional breeding habitat or mature upland forest terrestrial habitat amphibian species at risk will be removed during the operational phase; therefore, direct mortality to amphibian species at risk as a result of habitat loss is not considered during the operational phase.

Indirect Mortality

Indirect amphibian mortality due to vehicle-collisions is expected to continue through the operations phase. The interaction of Proposed Project vehicles and wildlife has been discussed under the construction phase (Section 5.3.1.5.3.1.1) and is also considered an interaction during Project operations.

5.3.1.5.3.1.3 Reclamation and Closure

Reclamation of vegetation communities and ponds is predicted to result in the recovery of wildlife populations that experienced declines due to construction and operation of the Proposed Project. Species that vacated all or part of the LSA during construction and operation phases are expected to utilize reclaimed areas to satisfy requirements for forage, shelter, and breeding thereby facilitating wildlife population growth.

Approximately 28 ha of the Proposed Project Area will be converted to a lake which may provide amphibian breeding habitat within the lentic zone. The remaining 31 ha of the Proposed Project Area will be reclaimed and vegetated, and will provide upland habitat.

Progressive reclamation will be undertaken during the operational phase. Over time, reclamation is expected to return wildlife habitat to at least a capability equivalent to baseline conditions. Reclamation planning and implementation will incorporate microhabitat features such as coarse woody debris, shaped lake littoral zones for amphibian breeding, and snags to enhance the area's capacity for wildlife.

After reclamation, amphibians are predicted to recover from disturbance effects experienced during construction and operational phases.

5.3.1.5.3.2 Northern Goshawk

5.3.1.5.3.2.1 Construction

5.3.1.5.3.2.1.1 Habitat Loss

Direct Habitat Loss

Northern goshawks generally avoid building or using nests near forest edges. Data from 148 northern goshawk nests on Vancouver Island indicate that the majority of nests (79%) are located more than 200 m from an edge, whereas 14% are located 100 to 200 m from an edge, and 7% are located less than 100 m from an edge (Mahon et al. 2008). None of the mature forest that occurs in the Project Area and that may be subject to clearing is more than 100 m away from forest edge; therefore, the Project Area is unlikely to contain suitable northern goshawk nesting habitat. Suitable nesting habitat is likely to be present elsewhere in the LSA and in the broader RSA. Given that suitable nesting habitat for northern goshawk will not be lost during the Proposed Project, potential effects related to site clearing for this species have not been carried forward in the assessment.

Indirect Habitat Loss

Sensory Disturbance

Noise created during the northern goshawk nesting season may contribute to nest failure. Northern goshawks in North America are generally considered to be sensitive to noise during the nesting period, and may abandon nests with nestlings if disturbed by human activities (Squires and Reynolds 1997). Territories and nest areas are rarely located in areas of high human use (Mahon 2009) and nests located in areas of high human use have lower nest occupancy and success (Morrison et al. 2011). However, northern goshawks occasionally nest and winter near rural and urban areas (Cooper and Stevens 2000), and in northern Arizona, Grubb et al. (1998) found that logging trucks passing within 500 m of two active nests did not elicit responses from a brooding adult. These results indicate that this species may habituate to some forms of sensory disturbance.

In northern Arizona, 27% of northern goshawks displayed an alert response (i.e., looking in the direction of the stimuli) in response to test logging trucks producing noise that measured 62 dBA at northern goshawk nests (Grubb et al. 2013). At this noise level, birds were not observed to be agitated, and did not flush from nests (Grubb et al. 2013). A noise level of 62 dBA is therefore assumed to be well below the noise threshold for northern goshawk habitat loss. Noise has been shown to affect raptor behaviour at 80 to 85 dBA (Awbrey and Bowles 1990, as cited in US FWS 2006). For the purpose of the Proposed Project, the noise threshold for northern goshawk was set at 80 dBA.

Northern goshawks actively forage in forests during the day and are most susceptible to noise disturbance when breeding and when young are fledging. During the construction phase, the majority of noise will be produced along the marine foreshore of the Proposed Project Area. Northern goshawk habitat predicted to be moderate suitability will be exposed to thresholds at or above 80 dBA during construction (Table 5.3-11). This excludes the amount of suitable habitat that will be removed to accommodate development of the Proposed Project Area (i.e., direct loss).

Noise increases due to the Proposed Project are not predicted to exceed the estimated northern goshawk noise threshold (i.e., 80 dBA) within habitat that may be suitable for nesting in the LSA during the construction phase. Therefore, potential effects related to sensory disturbance to northern goshawk is not considered further in the assessment.

Habitat Fragmentation

Edge can have a negative effect on species that require extensive tracts of undisturbed habitat (Hobson and Bayne 2000; Weaver et al. 1996). Northern goshawk nest in forest interiors and require connected tracks of undisturbed forest habitat. Landscape fragmentation may increase the incidence of nest predation and brood parasitism, and subsequent population declines in avian species (Chalfoun et al. 2002; Schmiegelow and Monkkonen 2002). Species identified as predatory or parasitic on bird nests often thrive in or near disturbed habitat (Benson et al. 2010) and some bird species avoid nesting near edges due to the increased risk of nest predation and brood parasitism associated with such habitats (Hobson and Bayne 2000).

The Project Area is unlikely to contain suitable northern goshawk nesting habitat. Therefore, clearing due to the Proposed Project is unlikely to result in fragmentation of northern goshawk nesting habitat during construction of the Proposed Project. Potential effects related to habitat fragmentation have not been carried forward in the assessment.

5.3.1.5.3.2.1.2 Barriers to Movement

Suitable habitat for northern goshawk is distributed around the LSA and additional barriers to movement from the baseline case are not expected as a result of the Proposed Project; barriers to northern goshawk movement as a result of the Proposed Project are not considered further in the assessment

5.3.1.5.3.2.1.3 Change in Mortality

Direct Mortality

Suitable northern goshawk nesting habitat is not expected to be lost during the Proposed Project (Section 5.3.1.5.3.2.1.1). Therefore, the potential effect of direct mortality on northern goshawk has not been carried forward in the assessment.

Indirect Mortality

Vehicle-Wildlife Collisions

Northern goshawk typically forage and nest in forested habitat; however, will use open areas as travel corridors and less frequently to forage (Squires and Reynolds 1997). Collisions between vehicles and northern goshawk could occur when birds move over roadways adjacent to suitable nesting and foraging habitat. Therefore, indirect mortality as a result of vehicle-wildlife collisions has been carried forward in the assessment.

Hunting

The effect of hunting pressure is not applicable to northern goshawk.

Removal of Nuisance Wildlife

The effect of removal of nuisance wildlife is not applicable to northern goshawk.

Interactions with Infrastructure

Although bird strikes and electrocutions may occur (interactions with infrastructure) the effect to northern goshawk is predicted to be negligible; as such, has not been carried forward in the assessment.

5.3.1.5.3.2.2 Operations

The effects of the operational phase of the Proposed Project are predicted to be generally similar to those predicted to occur during the construction phase, although indirect habitat loss during operations is predicted to be less.

5.3.1.5.3.2.2.1 Habitat Loss

Direct Habitat Loss

The direct loss of suitable northern goshawk nesting habitat has been discussed under the construction phase (Section 5.3.1.5.3.2.1). Given that suitable nesting habitat for northern goshawk will not be lost during the Proposed Project, potential effects related to site clearing for this species have not been carried forward in the assessment.

Indirect Habitat Loss

Sensory Disturbance

Indirect habitat loss due to noise influences were calculated for Operational Years 1 and 12. Taking into consideration the area lost from direct disturbance during construction, none of the remaining moderate and high suitability northern goshawk nesting habitat within the LSA will be affected by noise levels at or above 80dBA during Year 1 or 12. Therefore, potential effects related to sensory disturbance to northern goshawk during Project operation is not considered further in the assessment.

Habitat fragmentation

No additional habitat fragmentation is expected during the operational phase. Potential effects related to northern goshawk habitat fragmentation is not considered further in the assessment.

5.3.1.5.3.2.2.2 Barriers to Movement

No additional barriers to movement are expected during the operational phase. Potential effects related to barriers to northern goshawk movement are not considered further in the assessment.

5.3.1.5.3.2.2.3 Change in Mortality

Direct Mortality

Suitable northern goshawk nesting habitat within the Proposed Project Area will not be cleared during the operational phase; therefore, no direct mortality due to clearing is expected during the operational phase. Direct mortality of northern goshawk is not considered in the assessment for the operational phase.

Indirect Mortality

The effects of indirect mortality on northern goshawk during Project operation is expected to be similar to those in the construction phase (See Section 5.3.1.5.3.2.1). Potential effect related to indirect mortality of the northern goshawk related to vehicle collissions has been carried forward in the assessment.

5.3.1.5.3.2.3 Reclamation and Closure

Reclamation of vegetation communities is predicted to result in the recovery of wildlife populations that experienced declines due to Proposed Project construction and operation. Species that vacated all or part of the LSA during construction and operational phases are expected to utilize reclaimed areas to satisfy requirements for forage, shelter, and breeding.

Approximately 28 ha of the Proposed Project Area will be converted to a lake. The remaining 31 ha of the Proposed Project Area will be reclaimed and vegetated. Trees will be planted to return mature forest habitat over-time and will provide upland habitat.

Progressive reclamation will be undertaken during the operational phase. Over time, reclamation is expected to return wildlife habitat to at least a capability equivalent to baseline conditions. Reclamation planning and implementation will incorporate microhabitat features such as coarse woody debris and snags to enhance the area's capacity for wildlife. After reclamation, northern goshawks are predicted to recover from any disturbance effects experienced during the construction and operational phases.

5.3.1.5.3.3 Marbled Murrelet

5.3.1.5.3.3.1 Construction

5.3.1.5.3.3.1.1 Habitat Loss

Direct Habitat Loss

A Recovery Strategy was developed for marbled murrelet in 2014 although an action plan is yet to be released (Environment Canada 2014a). Nesting habitat management is the primary focus of the marbled murrelet recovery and critical nesting habitat was identified based on potentially suitable habitat, known nest sites and known detections (Environment Canada 2014a). Critical nesting habitat has been identified within the LSA but not within the Proposed Project Area, and therefore no direct loss of critical marbled murrelet nesting habitat is expected. Critical marine habitat has not yet been identified.

Mature (i.e., 80 to 250 years) forest accounts for 20% (114 ha) of the LSA. The Proposed Project will remove approximately 3.5% of mature coniferous forest in the LSA, which represents approximately 0.1% of mature forest

within the RSA. No old growth forest occurs in the LSA or the Proposed Area, but comprises 18.5% of the RSA. Marbled murrelet is not expected to breed within the Proposed Project Area because the limited mature forest is unlikely to be suitable, and no old growth forest is present. Therefore, direct loss of marbled murrelet habitat has not been carried forward in the assessment.

Indirect Habitat Loss

Sensory Disturbance

Noise may disturb murrelets, flushing adults and/or chicks from nest sites (US FWS 2006). Noise created during the marbled murrelet nesting season may reduce nesting success by causing adults to delay or abort the feeding of nestlings (US FWS 2006). When feeding of young fails, adults may have to complete additional trips to obtain more food, increasing the risk of predation of adults, eggs or nestlings (Nelson and Hamer 1995; US FWS 2006). The major cause of nest failure is predation during the egg and nestling stages, which is most likely to occur when an incubating adult abandons or neglects a nest (Nelson and Hamer 1995).

The US Fish and Wildlife Service established noise thresholds for marbled murrelets for activities that have potential to harass this species (US FWS 2006). The sound-only injury threshold (i.e., the threshold at which a murrelet was injured due to an adult flushing from a nest or missing a feeding) was calculated to be 92 dBA, and the disturbance threshold (i.e., the threshold at which a bird appeared to avoid the sound by moving, hiding, defending itself, or postponing a feeding) was estimated at 70 dBA (US FWS 2006). For the purpose of the Proposed Project, the noise threshold for marbled murrelet was set at 70 dBA.

Noise levels in critical marbled murrelet habitat within the LSA are not expected to exceed 70 dBA. During the construction phase, noise levels in critical habitat polygons south of the Proposed Project Area and north of the Proposed Project Area is expected to be 40 dBA to 50 dBA and less than 40 dBA, respectively.

Noise levels in marbled murrelet Wildlife Habitat Areas during the construction and operational phases will remain below 40 dBA and thus below the noise threshold. As such, it is expected that marbled murrelet nesting within the WHAs will not be affected by Project-related noise. Mature forest in the marine foreshore and the McNab Creek riparian area to the east of the LSA may be used by marbled murrelet when travelling to or from nesting habitat in the WHA and will experience noise levels below 70 dBA. Marbled murrelet movements to and from nest sites are typically conducted during crepuscular hours. As Project construction and operation will be limited to daylight hours, noise produced by the Proposed Project is not expected to affect crepuscular movements. Therefore, sensory disturbance is not expected to affect marbled murrelet habitat and has not been carried forward in the assessment.

Habitat Fragmentation

Marbled murrelet are expected to travel from the ocean to breeding sites in critical habitat and WHAs north of the Proposed Project Area. The Proposed Project Area was previously cleared and the Proposed Project is not expected to further fragment marbled murrelet habitat. Therefore, marbled murrelet habitat fragmentation due to the Proposed Project is not considered further in the assessment.

5.3.1.5.3.3.1.2 Barriers to Movement

During the breeding season, marbled murrelets display site fidelity to flyways used to access nest locations (Peery et al. 2004); flyways most commonly occur along creeks and rivers or other openings in forest canopy (Burger 2002; Haynes et al. 2008). Marbled murrelets breeding within suitable habitat north of the Proposed Project Area are expected to follow McNab Creek to access this habitat.

Inland flight by marbled murrelets peaks in the crepuscular periods of dawn and dusk (Burger 1996). However, Project construction and operation will occur during daylight hours, thereby avoiding peak marbled murrelet movement periods. As such, barriers to marbled murrelet movement are not considered further in the assessment.

5.3.1.5.3.3.1.3 Change in Mortality

Direct Mortality

The Proposed Project will not require the removal of identified critical marbled murrelet habitat although mature forest will be cleared to accommodate the conveyor system. Therefore clearing activities could result in direct mortality of marbled murrelets during the nesting season. As such, potential effects related to direct mortality of marbled murrelets has been carried forward in the assessment.

Indirect Mortality

Vehicle-Wildlife Collisions

Marbled murrelet are not expected to nest or travel along roadways within the Proposed Project Area; therefore, vehicle collision with marbled murrelet is not considered further in the assessment.

Hunting

The effect of hunting pressure is not applicable to marbled murrelet.

Removal of Nuisance Wildlife

The effect of removal of nuisance wildlife is not applicable to marbled murrelet.

Interactions with Infrastructure

Artificial lighting may affect birds by drawing them to the light source where they become “trapped” in its lighted area. This may result in mortality due to collisions with lighted towers or other birds (Longcore and Rich 2004). However, Project construction and operation will be limited to daylight hours, avoiding peak marbled murrelet movement periods. Furthermore, artificial lighting will be limited to facility lights for safety and security. The risk of indirect mortality (e.g., interactions with Project infrastructure and/or vehicles) is expected to be negligible for marbled murrelet and is not considered further in the assessment.

5.3.1.5.3.3.2 Operations

The effects of the operational phase of the Proposed Project are predicted to be generally similar to those predicted to occur during the construction phase.

5.3.1.5.3.3.2.1 Habitat Loss

Direct Habitat Loss

No additional direct loss of marbled murrelet habitat will occur during the operational phase; however, the effects of direct habitat loss are expected to persist through the operational phase of the Proposed Project. Therefore, direct loss of marbled murrelet habitat during the operational phase has been carried forward in the assessment.

Indirect Habitat Loss

Sensory Disturbance

Noise levels within identified marbled murrelet critical nesting habitat during the operational phase of the Proposed Project are expected to reach a maximum of 60 dBA in the southern polygon situated between the Proposed Project Area and marine foreshore and 50 dBA in the polygon north of the Proposed Project Area. Noise levels within WHAs within the McNab Creek valley are expected to be <40 dBA. Therefore, noise levels in marbled murrelet habitat within the LSA are not expected to exceed the noise threshold of 70 dBA. The Proposed Project will only be operational during daylight hours and is not expected to coincide with peak marbled murrelet movements to and from nesting habitat that typically occurs during crepuscular hours. Therefore, sensory disturbance to marbled murrelet during Project is not considered further in the assessment.

Habitat fragmentation

No fragmentation of marbled murrelet nesting habitat is expected during the operational phase of the Proposed Project. Therefore, marbled murrelet habitat fragmentation during the operational phase is not considered further in the assessment.

5.3.1.5.3.3.2.2 Barriers to Movement

Barriers to marbled murrelet movement to and from nesting habitat during the operational phase of the Proposed Project are expected to be similar to the construction phase (See Section 5.3.1.5.3.3.1). Barriers to marbled murrelet movement are not considered further in the assessment.

5.3.1.5.3.3.2.3 Change in Mortality

Direct Mortality

No additional marbled murrelet nesting habitat is expected to be removed during the operational phase of the Proposed Project; therefore, direct marbled murrelet mortality is not considered further in the assessment.

Indirect Mortality

The effects of indirect mortality on marbled murrelet during Project operation is expected to be similar to those in the construction phase (See Section 5.3.1.5.3.3.1). Indirect mortality of marbled murrelets is not considered further in the assessment.

5.3.1.5.3.3.3 Reclamation and Closure

Reclamation of vegetation communities is predicted to result in the recovery of wildlife populations that experienced declines due to construction and operation of the Proposed Project. Species that vacated all or part of the LSA during the construction and operational phases are expected to utilize reclaimed areas to satisfy requirements for forage, shelter, and breeding.

Approximately 28 ha of the Proposed Project Area will be converted to a lake. The remaining 31 ha of the Proposed Project Area will be reclaimed and vegetated. Trees will be planted to return forest habitat, which may provide suitable marbled murrelet nesting habitat over time.

Progressive reclamation will be undertaken during the operational phase. Over time, reclamation is expected to return wildlife habitat to at least a capability equivalent to baseline conditions. After reclamation, marbled murrelet are predicted to recover from disturbance effects experienced during the construction and operational phases.

5.3.1.5.3.4 Band-tailed Pigeon

5.3.1.5.3.4.1 Construction

5.3.1.5.3.4.1.1 Habitat Loss

Direct Habitat Loss

Band-tailed pigeons are not expected to breed within the majority of the Proposed Project Area because suitable closed-canopy coniferous forest is limited to the marine foreshore; however, breeding may occur within closed-canopy coniferous forest in the LSA. Approximately 3.4% of potential breeding habitat (mature forest) available within the LSA will be lost due to the construction of the conveyor system and processing area.

Band-tailed pigeon forage on berries, fruit and seeds in riparian, suburban and residential areas, in open conifer near farmland and near mineral sites (COSEWIC 2008). The Proposed Project Area provides foraging habitat for band-tailed pigeon by supporting dense shrub growth with perch sites adjacent to riparian habitat. Most of the direct loss of band–tailed pigeon foraging habitat within the Proposed Project Area will occur during the operational phase of the Project (See Section 5.3.1.5.3.4.2). Potential effects on the band-tailed pigeon as a result of site clearing have been carried forward in the assessment.

Indirect Habitat Loss

Sensory disturbance

Noise produced during the band-tailed pigeon breeding season may interfere with nesting success. Noise is known to reduce abundance of passerines (Dooling and Popper 2007; Bayne et al. 2008) and reduce pairing success of birds nesting in proximity to noise (Habib et al. 2007). There is limited research on sensitivity of band-

tailed pigeons to disturbance. However, a study in Iowa on mourning doves (*Zenaida macroura)* found disturbance from researchers caused incubating adults to flush and reduced nesting success by 50% (Westmoreland and Best 1985). Soutiere and Bolen (1976) reported that nest abandonment was the cause of up to 18% of nest failures in mourning doves, and half of these losses were attributed to researcher disturbance.

Physiological responses to noise in pigeons and other avian species begin to appear at noise levels of 55 to 60 dBA (Dooling and Popper 2007), and the disturbance threshold for band-tailed pigeons is likely comparable. For the purpose of the Proposed Project, the noise threshold for band-tailed pigeon was rounded down to 50 dBA to accommodate modeled noise contours.

Band-tailed pigeon are expected to forage in dense shrub areas of the Proposed Project Area and nest in mature forest within the LSA. There is potential for band-tailed pigeon to nest in mature forest along the marine foreshore where noise levels are anticipated to reach 60 dBA during the construction phase. It is expected that 11.9% (13 ha) of mature forest within the LSA will be exposed to noise levels above 50 dBA during the construction phase of the Proposed Project. Sensory disturbance during construction of the Project is predicted to affect band-tailed pigeon and therefore has been carried forward in the assessment.

Habitat Fragmentation

Band-tailed pigeon have been observed foraging and perching in the forest edge on the northern periphery of the Proposed Project Area and are expected to move between forest and shrub habitat to access breeding and foraging habitat. As band-tailed pigeon can use mature and regenerating habitat it is not expected that Project construction or operation will further fragment band-tailed pigeon foraging or nesting habitat. As such, fragmentation of band-tailed pigeon habitat is not considered further in the assessment.

5.3.1.5.3.4.1.2 Barriers to Movement

Suitable habitat for band-tailed pigeon is distributed around the LSA and band-tailed pigeon are expected to move around the Proposed Project Area to access adjacent habitat; therefore, movement barriers are not expected to result due to the Proposed Project development. Potential effects on the band-tailed pigeon related to barriers to movement are not considered further in the assessment.

5.3.1.5.3.4.1.3 Change in Mortality

Direct Mortality

Clearing of suitable band-tailed pigeon nesting habitat during the breeding season prior to young fledging could result in mortality of chicks. The potential effect of direct mortality on band-tailed pigeon has been carried forward in the assessment.

Indirect Mortality

Vehicle-wildlife Collisions

Suitable band-tailed pigeon foraging habitat occurs on both sides of the Project access road and collisions between vehicles and band-tailed pigeon could occur when birds move between these habitats. Given that no new roadways will be constructed and additional traffic associated with the Proposed Project is expected to be minimal the potential for vehicle-band-tailed pigeon collisions is considered low. Therefore, vehicle-wildlife collisions have been carried forward in the assessment.

Hunting

The effect of hunting pressure is not applicable to band-tailed pigeon.

Removal of Nuisance Wildlife

The effect of removal of nuisance wildlife is not applicable to band-tailed pigeon.

Interactions with Infrastructure

Bird strikes and electrocutions may occur (interactions with infrastructure) where infrastructure is located near suitable band-tailed pigeon habitat. The Project infrastructure will be situated adjacent to suitable band-tailed pigeon nesting and foraging habitat and therefore could be struck by bird. As such, interactions with infrastructure have been carried forward in the assessment.

5.3.1.5.3.4.2 Operations

The effects of the operational phase of the Proposed Project are predicted to be similar to those predicted to occur during the construction phase.

5.3.1.5.3.4.2.1 Habitat Loss

Direct Habitat Loss

Suitable band-tailed pigeon foraging habitat will be removed from the minable area during the operational phase of the Proposed Project. It is expected that 45% (44 ha) of shrub habitat available in the LSA will be removed during the operational phase of the Project. This habitat will be removed in 16 stages through the duration of the operational phase with reclamation occurring concurrently. Logging in the RSA has resulted in the creation of shrub dominated regenerating habitat which provides suitable band-tailed pigeon foraging habitat. As such, foraging habitat is not expected to be limited in the RSA. Reclaimed habitat will be planted with native trees and shrubs re-establishing a portion of the band-tailed pigeon habitat lost during operation. Direct habitat loss of the band-tailed pigeon is expected during operations and has been carried forward in the assessment.

Indirect Habitat Loss

Sensory Disturbance

Noise effects during the operational phase of the Proposed Project are expected to be similar to those during the construction phase. Noise during Project operation may reduce available nesting habitat during the operation of the Project. Potential effects related to sensory disturbance to the band-tailed pigeon have been carried forward in the assessment.

Habitat Fragmentation

No additional fragmentation for the band-tailed pigeon is expected to occur during the operational phase of the Proposed Project (see Section 5.3.1.5.3.4.2) and is therefore not carried forward in the assessment.

5.3.1.5.3.4.2.2 Barriers to Movement

Barriers to band-tailed pigeon movement during the operational phase of the Proposed Project are expected to be similar to the construction phase (See Section 5.3.1.5.3.4.1). Potential effect related to barriers to band-tailed pigeon movements during the operational phase are not considered further in the assessment.

5.3.1.5.3.4.2.3 Change in Mortality

Direct Mortality

No band-tailed pigeon nesting habitat is expected to be removed during the operational phase of the Proposed Project; therefore, direct band-tailed pigeon mortality during the operational phase is not considered a Project interaction.

Indirect Mortality

The effects of indirect mortality on band-tailed pigeon during Project operation is expected to be similar to those in the construction phase (See Section 5.3.1.5.3.4.1). Potential effects related to indirect mortality of band-tailed pigeons has been carried forward in the assessment.

5.3.1.5.3.4.3 Reclamation and Closure

Reclamation of vegetation communities is predicted to result in the recovery of wildlife populations that experienced declines due to construction and operation of the Proposed Project. Species that vacated all or part of the LSA during the construction and operational phases are expected to utilize reclaimed areas to satisfy requirements for forage, shelter, and breeding.

Approximately 28 ha of the Proposed Project Area will be converted to a lake. The remaining 31 ha of the Proposed Project Area will be reclaimed and vegetated. Trees will be planted to return mature forest habitat over-time and will provide upland habitat.

Progressive reclamation will be undertaken during the operational phase. Over time, reclamation is expected to return wildlife habitat to at least a capability equivalent to baseline conditions. Reclamation planning and implementation will incorporate microhabitat features such as coarse woody debris, shaped lake littoral zones for amphibian breeding, and snags to enhance the area's capacity for wildlife.

5.3.1.5.3.5 Western Screech-owl

5.3.1.5.3.5.1 Construction

5.3.1.5.3.5.1.1 Habitat Loss

Direct Habitat Loss

The construction phase is predicted to remove 4 ha of moderate suitability nesting habitat for western screech-owl, which represents 0.1% of the combined moderate and high suitability habitat available in the RSA (Table 5.3-11). Western screech-owl is associated with mature coniferous forests and the majority of habitat loss is attributed to the loss of mature forest due to construction of the marine conveyor system. Direct habitat loss is considered further in the assessment for western screech-owl.

Indirect Habitat Loss

Sensory disturbance

Noise produced during the western screech-owl breeding season may interfere with nesting success. Sensory disturbance to other species of owls has been shown to change parental behaviour in a way that may affect the health of the adults and nestlings, and decrease reproductive success (Swarthout and Steidl 2003). The US Fish and Wildlife Service established noise thresholds for northern spotted owls (Strix occidentalis caurina; US FWS 2006). The sound-only injury threshold (i.e., the threshold at which a northern spotted owl was injured due to an adult flushing from a nest or missing a feeding) was calculated to be 92 dB, and the disturbance threshold (i.e., the threshold at which a bird appeared to avoid the sound by moving, hiding, defending itself, or postponing a feeding) was estimated to be 70 dB (US FWS 2006). For the purpose of the Proposed Project, the noise threshold for western screech-owl was assumed to be similar to that of northern spotted owl, and was set at 70 dBA.

Noise levels due to the Proposed Project are expected to occur during the day when owls are not actively foraging or hunting. The proportion of moderate western screech-owl habitat in the LSA that will be affected by noise levels above 70 dBA is 0.7% (<1 ha) during the construction phase, but no high suitable habitat will be affected. The maximum noise emission expected within western screech-owl habitat is 70 to 80 dBA in the mature forest of the marine foreshore during the construction phase. Sensory disturbance is predicted to affect western screech-owl during construction of the Proposed Project and has been carried forward in the assessment.

Table 5.3-11: Disturbance to Western Screech-Owl Habitat during Construction

Study Area	Habitat Suitability Class[a]	Baseline	Direct Habitat Change due to Construction		Indirect Change due to Sensory Disturbance		Total Area Changed from Construction	
		Area (ha)	Area (ha)	Area (%)	Area ≥70 dBA (ha)	Area ≥70 dBA (%)	Area (ha)	Area (%)
Proposed Project Area	Nil	55	60	+9.1	0	0.0	60	+9.1
	Low	1	1	-100.0	0	0.0	1	-100.0
	Moderate	4	4	-100.0	0	0.0	4	-100.0
	High	0	0	0.0	0	0.0	0	0.0
LSA	Nil	408	60	+1.3	1	+0.1	60	+14.8
	Low	36	1	-2.8	0	0.0	1	-2.8
	Moderate	87	4	-4.9	<1	-0.7	5	-5.6
	High	39	0	0.0	0	0.0	0	0.0
RSA	Nil	16,132	60	+<0.1	1	0.0	0	+<0.1
	Low	5,090	1	0.0	0	0.0	1	0.0
	Moderate	3,238	4	-0.1	<1	-<0.1	5	-0.1
	High	5,632	0	0.0	0	0.0	0	0.0

a. Definitions of habitat suitability class are provided in Volume 4, Part G – Section 22.0: Appendix 5.3-A.

Habitat Fragmentation

Moderate and high suitability western screech-owl habitat comprised 22% (126 ha) of the LSA and is predominately situated along the marine foreshore area south of the Proposed Project Area and along the McNab Creek drainage. The construction of the processing area and conveyor system will result in a direct loss of habitat on the western extent of suitable habitat along the marine foreshore but is not expected to further fragment suitable habitat. Therefore, habitat fragmentation is not considered further in the assessment.

5.3.1.5.3.5.1.2 Barriers to Movement

Noise and human presence associated with the construction and operation of the Proposed Project could deter western screech-owl from accessing mature forest along the marine foreshore; however, construction and operational activities will be limited to daylight hours when western screech-owl are not active. As such, site construction is not expected to create barriers to western screech-owl movement. Therefore, barriers to movement are not considered further in the assessment.

5.3.1.5.3.5.1.3 Change in Mortality

Direct Mortality

Clearing of suitable western screech-owl nesting habitat during the breeding season prior to young fledging could result in mortality of chicks. The potential effect of direct mortality on western screech-owl has been carried forward in the assessment.

Indirect Mortality

Vehicle-Wildlife Collisions

Collisions between vehicles and western screech-owl could occur when birds move over roadways adjacent to suitable nesting and foraging habitat. Given that no new roadways will be constructed, additional traffic associated with the Proposed Project is expected to be minimal, and western screech-owl are active at night outside of the Proposed Project hours of operation the potential for vehicle-western screech-owl collisions is considered low. Therefore, vehicle-wildlife collisions are not considered further in the assessment.

Hunting

The effect of hunting pressure is not applicable to western screech-owl.

Removal of Nuisance Wildlife

The effect of removal of nuisance wildlife is not applicable to western screech-owl.

Interactions with Infrastructure

Bird strikes and electrocutions may occur (interactions with infrastructure) where infrastructure is located near suitable western screech-owl habitat. The processing area will be situated adjacent to high and moderate suitable western screech-owl habitat and therefore could interact with birds using those habitat patches. As such, interaction with infrastructure has been carried forward in the assessment.

5.3.1.5.3.5.2 Operations

The effects of the operational phase of the Proposed Project are predicted to be generally similar to those predicted to occur during the construction phase. However, sensory disturbance effects during operations are predicted to be greater than those during construction.

5.3.1.5.3.5.2.1 Habitat Loss

Direct Habitat Loss

The direct loss of suitable western screech-owl nesting habitat has been calculated and discussed under the construction phase (Section 5.3.1.5.3.5.1) and has been carried forward in the assessment.

Sensory Disturbance

Noise during the operational phase will be limited to daylight hours and will not occur during the time of day when western screech-owls forage and hunt. When comparing amount of indirect habitat by year, Year 1 of operation has higher indirect habitat loss than Year 12 from sensory disturbance. During the first year of operation, noise will be concentrated within the processing area and the southwest corner of the minable area. During year 1

operational phase, sensory disturbance is predicted to affect 0.4% of moderately suitable habitat in the LSA and less than 0.1% in the RSA No high suitability habitat will be affected by noise 70 dBA or higher. Sensory disturbance is considered further in the assessment for the western screech-owl.

Habitat Fragmentation

No additional fragmentation of western screech-owl habitat is expected to occur during the operational phase of the Proposed Project (see Section 5.3.1.5.3.5.2) and is not considered further in the assessment.

5.3.1.5.3.5.2.2 Barriers to Movement

No additional barriers to western screech-owl movement are expected to occur during the operational phase of the Proposed Project (see Section 5.3.1.5.3.5.2). Barriers to movement are not considered further in the assessment.

5.3.1.5.3.5.2.3 Change in Mortality

Direct Mortality

No additional western screech-owl nesting habitat is expected to be removed during the operational phase of the Proposed Project; therefore, direct western screech-owl mortality during the operational phase is not considered further in the assessment.

Indirect Mortality

The effects of indirect mortality on western screech-owl during Project operation is expected to be similar to those in the construction phase (See Section 5.3.1.5.3.5.1). Indirect mortality of western screech-owl has been carried forward in the assessment.

5.3.1.5.3.5.3 Reclamation and Closure

Reclamation of vegetation communities is predicted to result in the recovery of wildlife populations that experienced declines due to construction and operation of the Proposed Project. Species that vacated all or part of the LSA during construction and operational phases are expected to utilize reclaimed areas to satisfy requirements for forage, shelter, and breeding.

Approximately 28 ha of the Proposed Project Area will be converted to a lake. The remaining 31 ha of the Proposed Project Area will be reclaimed and vegetated. Trees will be planted to return mature forest habitat over-time and will provide upland habitat.

Progressive reclamation will be undertaken during the operational phase. Over time, reclamation is expected to return wildlife habitat to at least a capability equivalent to baseline conditions. Reclamation planning and implementation will incorporate microhabitat features such as coarse woody debris, shaped lake littoral zones for amphibian breeding, and snags to enhance the area's capacity for wildlife.

After reclamation, western screech-owls are predicted to recover from disturbance effects experienced during construction and operational phases.

5.3.1.5.3.6 Common Nighthawk

5.3.1.5.3.6.1 Construction

5.3.1.5.3.6.1.1 Habitat Loss

Direct Habitat Loss

An estimated 2% (>1 ha) of moderately suitable common nighthawk habitat available within the LSA will be lost during the construction phase of the Proposed Project, which represents a less than 1% loss of the moderately suitable habitat available within the RSA. Therefore, the loss of suitable common nighthawk nesting habitat has been carried forward in the assessment.

Indirect Habitat Loss

Sensory Disturbance

Common nighthawk sensitivity to disturbance decreases from egg laying to hatching, and increases again as young develop (Gramza 1967). Noise created during the common nighthawk breeding season (May to August; COSEWIC 2007) may interfere with nesting success. Response of incubating birds to disturbance by researchers includes agitation, vocalizations, and flushing off nests (Gramza 1967). On Vancouver Island, common nighthawks have been shown to abandon nests due to human disturbance such as vehicle traffic (Campbell et al. 2006). Traffic noise has been characterized as ranging from 60 to 90 dBA (US FWS 2006). There is little additional information on the sensitivity of common nighthawks to noise. However, the species frequently nests on gravel rooftops in urban areas (Brigham 1989; Gramza 1967) and therefore is likely to habituate to noise disturbance.

Physiological responses to noise in a variety of passerines begin to appear at noise levels of 55 to 60 dBA (Dooling and Popper 2007), and noise begins to disturb raptors around 80 to 85 dBA (Awbrey and Bowles 1990, as cited in US FWS 2006). For the purpose of the Proposed Project, the noise threshold for common nighthawk was assumed to be similar to that of raptors, and was set at 80 dBA.

The maximum noise emission expected within common nighthawk habitat is 70 to 80 dBA. During the construction phase, noise levels above 80 dBA are not predicted to occur in the LSA (Table 5.3-12). Therefore, sensory disturbance effects on common nighthawk are not considered further in the assessment.

Table 5.3-12: Disturbance to Common Nighthawk Habitat during Construction

Study Area	Habitat Suitability Class[a]	Baseline	Direct Habitat Change due to Construction		Indirect Change due to Sensory Disturbance		Total Area Loss from Construction	
		Area (ha)	Area (ha)	Area (%)	Area ≥80 dBA (ha)	Area ≥80 dBA (%)	Area (ha)	Area (%)
Proposed Project Area	Nil	52	+8	+15.2	0	0.0	+8	+15.2
	Low	8	-8	-100.0	0	0.0	-8	-100.0
	Moderate	<1	-<1	-100.0	0	0.0	-<1	-100.0
	High	0	0	0.0	0	0.0	0	0.0
LSA	Nil	311	+8	+2.5	0	0.0	+8	+2.5
	Low	212	-8	-3.6	0	0.0	-8	-3.6
	Moderate	14	-<1	-2.5	0	0.0	-<1	-2.5
	High	32	0	0.0	0	0.0	0	0.0
RSA	Nil	7,419	+8	+0.1	0	0.0	+8	+0.1
	Low	14,661	-8	-0.1	0	0.0	-8	-0.1
	Moderate	5,542	-<1	0.0	0	0.0	-<1	0.0
	High	2,470	0	0.0	0	0.0	0	0.0

a. Definitions of habitat suitability class are provided in Volume 4, Part G – Section 22.0: Appendix 5.3-A

Habitat Fragmentation

Eight percent (46 ha) of the LSA is predicted to be suitable common nighthawk nesting habitat; however, 0.6% (>1 ha) of suitable habitat occur within the Proposed Project Area and will be removed during Project construction and operation. Given the limited amount of suitable nesting habitat within the proposed Project Area, the Project is not predicted to result in further fragmentation of common nighthawk nesting habitat. Therefore, habitat fragmentation is not considered further in the assessment.

5.3.1.5.3.6.1.2 Barriers to Movement

As the majority of the LSA is not ranked as suitable habitat, site construction is not expected to create barriers to common nighthawk movement. Therefore, barriers to nighthawk movement are not considered further in the assessment.

5.3.1.5.3.6.1.3 Change in Mortality

Direct Mortality

Clearing of suitable common nighthawk nesting habitat during the breeding season prior to young fledging could result in mortality of chicks. The potential effect of direct mortality on common nighthawk has been carried forward in the assessment.

Indirect Mortality

Vehicle-Wildlife Collisions

Common nighthawk nest on gravel surfaces (e.g., Brigham 1989; Gramza 1967) and occasionally forage close to the ground (Campbell et al. 2006). As such, common nighthawk may be killed due to collisions with vehicles. Potential direct mortality of common nighthawk has been carried forward in the assessment.

Hunting

The effect of hunting pressure is not applicable to common nighthawk.

Removal of Nuisance Wildlife

The effect of removal of nuisance wildlife is not applicable to common nighthawk.

Interactions with Infrastructure

Bird strikes and electrocutions may occur (interactions with infrastructure) where infrastructure is located near suitable common nighthawk habitat. The processing area will be situated adjacent to high and moderate suitable common nighthawk habitat and therefore could interact with birds using those habitat patches. As such, interaction with infrastructure has been carried forward in the assessment.

5.3.1.5.3.6.2 Operations

The effects of the operational phase of the Proposed Project are predicted to be generally similar to those predicted to occur during the construction phase.

5.3.1.5.3.6.2.1 Habitat Loss

Direct Habitat Loss

An estimated 2% (>1 ha) of moderately suitable common nighthawk habitat available within the LSA will continue to be lost during the operational phase of the Proposed Project, which represents a less than 1% loss of the moderately suitable habitat available within the RSA. Therefore, the loss of suitable common nighthawk nesting habitat has been carried forward in the assessment.

Indirect Habitat Loss

Sensory disturbance

The operational phase of the Proposed Project is not expected to produce noise levels above 80 dBA in moderate and high suitability common nighthawk habitat. Therefore, common nighthawk sensory disturbance during the operational phase is not considered further in the assessment.

Habitat Fragmentation

No additional fragmentation of common nighthawk habitat is expected to occur during the operational phase of the Proposed Project (see Section 5.3.1.5.3.6.2) and is not considered further in the assessment.

5.3.1.5.3.6.2.2 Barriers to Movement

No additional barriers to movement for common nighthawk are expected to occur during the operational phase of the Proposed Project (see Section 5.3.1.5.3.6.2) and are not considered further in the assessment.

5.3.1.5.3.6.2.3 Change in Mortality

Direct Mortality

Common nighthawk nest on exposed ground and may nest on roadways and exposed stockpiled material during the operational phase of the Proposed Project. Nests built in active areas of operation, such as access roads and the processing areas, could be destroyed during the operational phase. Therefore, direct mortality of common nighthawk during the operational phase of the Proposed Project has been carried forward in the assessment.

Indirect Mortality

The potential effects of common nighthawk mortality due to vehicle collisions are expected to be similar to the construction phase (See Section 5.3.1.5.3.6.1) and have been carried forward in the assessment.

5.3.1.5.3.6.3 Reclamation and Closure

Reclamation of vegetation communities is predicted to result in the recovery of wildlife populations that experienced declines due to construction and operation of the Proposed Project. Species that vacated all or part of the LSA during construction and operational phases are expected to utilize reclaimed areas to satisfy requirements for forage, shelter, and breeding.

Approximately 28 ha of the Proposed Project Area will be converted to a lake. The remaining 31 ha of the Proposed Project Area upland habitat.

Progressive reclamation will be undertaken during the operational phase. Over time, reclamation is expected to return wildlife habitat to at least a capability equivalent to baseline conditions. Reclamation planning and

implementation will incorporate microhabitat features such as coarse woody debris, shaped lake littoral zones for amphibian breeding, and snags to enhance the area's capacity for wildlife. The baseline condition for the majority of the Proposed Project Area consists of regenerating pole sapling habitat.

After reclamation, common nighthawks are predicted to recover from disturbance effects experienced during construction and operational phases.

5.3.1.5.3.7 Roosevelt Elk

5.3.1.5.3.7.1 Construction

5.3.1.5.3.7.1.1 Habitat Loss

Direct Habitat Loss

Of the habitat predicted to be moderate and high suitability for elk winter range within the LSA, 18.6% (36 ha) will be lost due to site clearing for the Proposed Project (Table 5.3-13). Roosevelt elk winter range habitat will be removed from the mineable area (moderate suitability) and the marine conveyor area (high suitability). Direct loss of Roosevelt elk habitat has been carried forward in the assessment.

Indirect Habitat Loss

Sensory Disturbance

Habitat selection in proximity to human disturbances is expected to decrease during the construction and operational phases. Elk may demonstrate aversion to roads and natural gas wells during daylight hours, as well as suitable surrounding habitat (Van Dyke et al. 2012). Noise created during the winter may indirectly reduce Roosevelt elk foraging habitat. During the winter, elk are in poor physical condition due to inclement climatic conditions and limited and nutritionally inadequate forage, and as a result are less capable of coping with stresses (Poole and Mowat 2005; Wilson 2012). Elk response to human disturbance is variable in terms of type and magnitude of response (Van Dyke et al. 2012). Elk have been known to modify their daily or overall movement patterns in response to activities such as logging, which may effectively reduce available suitable habitat (Edge and Marcum 1985). In addition, during the winter or calving season increased energy expenditures through movement due to sensory disturbance may be particularly harmful.

In some cases wildlife may habituate to noise if it is predictable and is always found in the same general location. Elk have been shown to habituate to predictable human disturbance, with level of habituation varying with habitat, season, previous exposure to humans, and types and persistence of disturbance (Lyon and Ward 1982). For example, hunting pressure can reduce elk habituation (Thompson and Henderson 1998). Elk may habituate to the operation of the clamshell mining, conveyor system and processing of aggregate over time.

Elk have been shown to avoid roads by about 200 m and active gas and well sites by about 500 m (Hebblewhite 2008). The LSA covers an area greater than 500m from Proposed Project infrastructure to the west, north and east (Figure 5.3-1) and contains moderate and high suitability habitat for elk. The use of habitat adjacent to Proposed Project infrastructure may increase over time for some individuals, but not all are expected to habituate to sensory disturbance produced by the Proposed Project. As there is paucity in the noise threshold for elk, a ZOI of 500 m was used around the Proposed Project Area.

Approximately 39.5% (52 ha) and 36.2% (76 ha) of high and moderate suitability Roosevelt elk habitat, respectively, available within the LSA is located within the 500 m ZOI, excluding the amount of moderate and high suitability habitat that will be directly removed to accommodate the construction and operation of the Proposed Project (Table 5.3-13). This represents approximately 6.3% of available high and moderate suitable Roosevelt elk habitat in the RSA. However, this conservative approach assumes the complete loss of habitat due to sensory disturbance. Habitat within the ZOI will not be removed and the effects of sensory disturbance will be partial and temporary. In addition, the habitat gains through ongoing reclamation of the Proposed Project Area during operation are not included in this calculation. Sensory disturbance has been carried forward in the assessment.

Table 5.3-13: Disturbance to Roosevelt Elk Habitat during Construction

Study Area	Habitat Suitability Class[a]	Baseline	Direct Habitat Change due to Construction		Indirect Change due to Sensory Disturbance		Total Area Lost	
		Area (ha)	Area (ha)	Area (%)	Area within ZOI (ha)	Area within ZOI (%)	Area (ha)	Area (%)
Proposed Project Area	Nil	10	+50	+492	0	0.0	+50	+492
	Low	13	-13	-100	0	0.0	-13	-100
	Moderate	32	-32	-100	0	0.0	-32	-100
	High	4	-4	-100	0	0.0	-4	-100
LSA	Nil	112	+50	+44.4	+163	+145.6	+213	+190
	Low	115	-13	-11.4	-35	-30.6	-48	-42.1
	Moderate	211	-32	-15.4	-76	-36.2	-109	-51.6
	High	133	-4	-3.2	-52	-39.2	-56	-42.5
RSA	Nil	21,167	+50	+0.2	+163	+0.7	+213	+1.0
	Low	4,684	-13	-0.3	-35	-0.7	-50	-1.0
	Moderate	2,817	-32	-1.2	-76	-2.7	-109	-3.9
	High	1,421	-4	-0.3	-52	-3.6	-56	-4.0

a. Definitions of habitat suitability class are provided in Volume 4, Part G – Section 22.0: Appendix 5.3-A

Habitat Fragmentation

Edge habitat that may be produced through habitat fragmentation is predicted to provide suitable foraging habitat for elk. Elk prefer browse species which will flourish within new cleared areas while nearby forested areas will provide shelter for elk. Habitat fragmentation resulting from the Proposed Project has been carried forward in the assessment.

5.3.1.5.3.7.1.2 Barriers to Movement

Barriers to Roosevelt elk movement will occur due to Project construction. Roosevelt elk movement, especially during winter months, will be restricted due to Project construction activities within winter range. Roosevelt elk will no longer be able to move directly between the high suitability habitats north of the Proposed Project Area to high suitability habitat in the marine foreshore, and will need to travel around the Proposed Project Area to the east or west to access these areas. Increased barriers to movement have been carried forward in the assessment.

5.3.1.5.3.7.1.3 Change in Mortality

Direct Mortality

Generally, Roosevelt elk are able to avoid clearing and grubbing activities; however, mortality could occur should elk occur within the Proposed Project Area. Therefore, direct mortality of Roosevelt elk has been carried forward in the assessment.

Indirect Mortality

Vehicle-Wildlife Collisions

Roosevelt elk were observed using the Proposed Project access road during baseline studies. Increased road use may result in increased collisions between vehicles and Roosevelt elk. Vehicle-wildlife collisions have been carried forward in the assessment.

Hunting

Limited entry hunting of elk is authorized within the LSA. However, increased access to the backcountry may occur due to road and wharf improvements as a result of the Proposed Project, resulting in increased hunting pressure. Although the management of elk populations is the responsibility of the Province of BC and release of hunting permits will not be affected by the Proposed Project; the Project may improve hunting access and therefore hunting have been carried forward in the assessment.

Removal of Nuisance Wildlife

The effect of removal of nuisance wildlife is not applicable to Roosevelt elk.

Interactions with Infrastructure

Browse surrounding the pit-lake infrastructure may attract Roosevelt elk and result in drowning if lake slopes are not remediated. Therefore, interaction with infrastructure has been considered for further in the assessment.

5.3.1.5.3.7.2 Operations

Project related effects to Roosevelt elk during the operational phase of the Proposed Project are expected to be similar to those identified for construction.

5.3.1.5.3.7.2.1 Habitat Loss

Direct Habitat Loss

The direct loss of suitable Roosevelt elk winter range habitat has been calculated and discussed under the construction phase (Section 5.3.1.5.3.7.1). Progressive reclamation during the operational phase is expected to provide elk foraging habitat. Direct habitat loss has been carried forward in the assessment.

Indirect Habitat Loss

Sensory Disturbance

No change in ZOI from the construction phase is expected during the operational phase (See Section 5.3.1.5.3.7.2). Sensory disturbance to Roosevelt elk has been carried forward in the assessment.

Habitat Fragmentation

Habitat fragmentation resulting from the Proposed Project will continue through operations and is carried forward in the assessment (see Section 5.3.1.5.3.7.2).

5.3.1.5.3.7.2.2 Barriers to Movement

Increased barriers to movement will carry through to operations and are carried forward in the assessment.

5.3.1.5.3.7.2.3 Change in Mortality

Direct Mortality

The effect of potential direct mortality of Roosevelt elk during the operational phase are expected to be similar to the construction phase (See Section 5.3.1.5.3.7.1) have been carried forward in the assessment.

Indirect Mortality

The potential effect of Roosevelt elk mortality due to interactions with Project infrastructure and vehicle collisions are expected to be similar to the construction phase (See Section 5.3.1.5.3.7.1) and have been carried forward in the assessment.

5.3.1.5.3.7.3 Reclamation and Closure

Reclamation of vegetation communities is predicted to result in the recovery of wildlife populations that experienced declines due to construction and operation of the Proposed Project. Species that vacated all or part of the LSA during construction and operational phases are expected to utilize reclaimed areas to satisfy requirements for forage, shelter, and breeding.

Approximately 28 ha of the Proposed Project Area will be converted to a lake. The remaining 31 ha of the Proposed Project Area will be reclaimed and vegetated. Trees will be planted to return mature forest habitat over-time and will provide upland habitat.

Progressive reclamation will be undertaken during the operational phase. Over time, reclamation is expected to return wildlife habitat to at least a capability equivalent to baseline conditions. Reclamation planning and implementation will incorporate microhabitat features such as coarse woody debris, shaped lake littoral zones for amphibian breeding, and snags to enhance the area's capacity for wildlife.

Elk experience reduced reproductive success during human-induced disturbance; however, disturbance removal has been shown to result in the recovery of reproductive success to pre-disturbance levels (Hebblewhite 2008; Shively et al. 2005). After reclamation, Roosevelt elk are predicted to recover from disturbance effects experienced during the construction and operational phases.

5.3.1.5.3.8 Grizzly Bear

5.3.1.5.3.8.1 Construction

5.3.1.5.3.8.1.1 Habitat Loss

Direct Habitat Loss

Of the habitat predicted to be high suitability for grizzly bear spring, summer and fall forage habitat within the LSA, 16% (51 ha) will be lost due to site clearing for the Proposed Project (Table 5.3-14). This represents approximately 1% of high suitability habitat available in the RSA. No direct loss of moderate suitability habitat is expected during the construction phase. Direct grizzly bear habitat loss has been carried forward in the assessment.

Indirect Habitat Loss

Sensory Disturbance

As grizzly bear typically den at higher elevations, noise produced by the Proposed Project is not expected to affect grizzly overwintering habitat. Noise produced in the spring, summer and fall may interfere with grizzly bear foraging. Cover in the form of ground vegetation reduced responses of grizzly bears to moving vehicles and people walking (McLellan and Shackleton 1989). Depending on previous experiences, a bear may habituate, particularly to predictable events such as noise from industrial sites and vehicles on roads (McLellan 1990). However, as bears habituate, they begin to enter areas of human development and may damage property and threaten human safety (Follmann and Hechtel 1990) thereby increasing the risk of bear mortality.

Mattson et al. (1987) found that avoidance patterns around human developments were complex, but that a disruption of foraging was apparent within approximately 3 km of human facilities in all seasons. Gunther (1990) reported that grizzlies avoided occupied campsites by 400 m, and Gibeau (1998) defined an 800 m zone of influence (ZOI) around campgrounds, lodges, and other human developments with motorized access in the Rocky Mountains. As there is paucity of information regarding noise thresholds for grizzly bears, a ZOI of 800 m was used as a threshold.

Approximately 85.8% (271 ha) and 51.5% (48 ha) of high and moderate suitable grizzly bear foraging habitat available within the LSA is located within the ZOI, excluding the amount of moderate and high suitability habitat directly lost. This represents 2.2 % of available highly and moderately suitable grizzly bear foraging habitat in the RSA.

Grizzly bear have not been recorded in the Proposed Project Area or LSA during the field surveys, but may occasionally move through the area or forage in McNab Creek. Bears entering the LSA during the construction and operational stages of the Proposed Project may be affected by noise and human presence; although, grizzly bear presence is expected to be infrequent. Sensory disturbance from the Proposed Project to grizzly bear has been carried forward in the assessment.

Table 5.3-14: Disturbance to Grizzly Bear Habitat during Construction

Study Area	Habitat Suitability Class [(a)]	Baseline	Direct Habitat Change due to Construction		Indirect Change due to Sensory Disturbance		Total Area Lost from Construction	
		Area (ha)	Area (ha)	Area (%)[1]	Area within ZOI (ha)	Area within ZOI (%[1])	Area (ha)	Area (%) [(b)]
Proposed Project Area	Nil	9	+51	+566.7	0	0.0	+51	+566.7
	Low	0	0	0.0	0	0.0	0	0.0
	Moderate	0	0	0.0	0	0.0	0	0.0
	High	51	-51	-100	0	0.0	-51	-100
LSA	Nil	78	+51	+65.1	+324	+416.2	+375	+481.3
	Low	82	0	0.0	-56	-67.9	-56	-67.9
	Moderate	93	0	0.0	-48	-51.5	-48	-51.5
	High	316	-51	-16.0	-221	-69.8	-271	-85.8
RSA	Nil	6,362	+51	+0.8	+364	+5.7	+415	+6.5
	Low	7,933	0	0.0	-60	-0.8	-60	-0.8
	Moderate	11,087	0	0.0	-57	-0.5	-57	-0.5
	High	4,709	-51	-1.1	-248	-5.3	-299	-6.3

a) Definitions of habitat suitability class are provided in Volume 4, Part G – Section 22.0: Appendix 5.3-A
b) Represents the percent change in similar habitat suitability class

Habitat Fragmentation

Ongoing resource based Projects (i.e., forestry, run-of river power Project) in the LSA create sources of existing habitat fragmentation. The Proposed Project Area and parts of the LSA have been previously cleared, and the Proposed Project Area is used to sort logs. The Proposed Project is not expected to further fragment grizzly bear habitat from the current condition; therefore, fragmentation of grizzly bear habitat is not considered further in the assessment.

5.3.1.5.3.8.1.2 Barriers to Movement

Grizzly bear may move through the LSA on occasion although their presence was not recorded during field surveys or three years of remote camera surveys. Ongoing resource based Projects (i.e., forestry, run-of river power Project) in the LSA create sources of existing noise and human activity. Should grizzly bear move through the LSA, movement patterns may be disrupted during the construction and operational phases of the Proposed Project. However, given that grizzly bear movement in the LSA is expected to be rare, and that existing resource

Projects in the LSA create a baseline barrier to grizzly bear movement, barriers to movement is not considered further in the assessment.

5.3.1.5.3.8.1.3 Change in Mortality

Direct Mortality

Grizzly bear are expected to move away from clearing and grubbing activity. Grizzly bear denning habitat does not occur within the Proposed Project Area; therefore, direct grizzly bear mortality is not considered further in the assessment.

Indirect Mortality

Vehicle-Wildlife Collisions

Increased use of roads in the Proposed Project Area may result in more collisions between vehicles and grizzly bear. However, the rare occurrence of grizzly bear in the Proposed Project Area reduces the likelihood of a collision event. Indirect grizzly bear mortality due to increased potential for vehicle-wildlife collisions has been carried forward in the assessment.

Hunting

Although grizzly bear hunting is not permitted within the LSA, an increase in hunting pressure on grizzly bear may occur due to increased access to the backcountry and accidental mortality due to hunter-grizzly encounters. Access to the backcountry via the Proposed Project Area will be restricted due to public safety in an industrial area. Therefore, the Proposed Project will not contribute to increased hunting pressure and this is not considered an interaction with the Proposed Project.

Removal of Nuisance Wildlife

Grizzly bears can become a nuisance when they are attracted to food odours and have access to human food sources due to poor waste management practices. Habituated bears tend to become aggressive and can be a threat to life and property (BC MoE 2013c). When this occurs, bears are usually either relocated or destroyed. Removal of nuisance bears has been carried forward in the assessment.

Interactions with Infrastructure

Grizzly bears are not expected to frequently occur within the Proposed Project Area and thus are not expected to interact with infrastructure. Therefore, grizzly bear interactions with infrastructure are not considered further in the assessment.

5.3.1.5.3.8.2 Operations

Project related effects to grizzly bear during the operational phase of the Proposed Project are expected to be similar to those identified as potentially occurring during construction.

5.3.1.5.3.8.2.1 Habitat Loss

Direct Habitat Loss

The effects of direct habitat loss were considered to occur during the construction phase (See Section 5.3.1.5.3.8.1). Direct grizzly bear habitat loss is considered has been carried forward in the assessment.

Indirect Habitat Loss

Sensory Disturbance

The effects of sensory disturbance on grizzly bear during the operation of the Proposed Project are expected to be similar to the construction phase (See Section 5.3.1.5.3.8.1). Sensory of grizzly bear has been carried forward in the assessment.

Habitat Fragmentation

The effects of habitat fragmentation are expected to be similar during the operational phase as during the construction phase (See Section 5.3.1.5.3.8.1) and are not considered further in the assessment.

5.3.1.5.3.8.2.2 Barriers to Movement

The effects of barriers to movement are expected to be similar during the operational phase as during the construction phase (See Section 5.3.1.5.3.8.1) and are not considered further in the assessment

5.3.1.5.3.8.2.3 Change in Mortality

Direct Mortality

Effects of direct mortality are expected to be similar during the operational phase as during the construction phase (See Section 5.3.1.5.3.8.1) and are not considered further in the assessment

Indirect Mortality

Effects of indirect mortality are expected to be similar during the operational phase as during the construction phase (See Section 5.3.1.5.3.8.1) and have been carried forward in the assessment.

5.3.1.5.3.8.3 Reclamation and Closure

Reclamation of vegetation communities is predicted to result in the recovery of wildlife populations that experienced declines due to construction and operation of the Proposed Project. Species that vacated all or part of the LSA during construction and operational phases are expected to utilize reclaimed areas to satisfy requirements for forage, shelter, and breeding.

Approximately 28 ha of the Proposed Project Area will be converted to a lake. The remaining 31 ha of the Proposed Project Area will be reclaimed and vegetated. Trees will be planted to return mature forest habitat over-time and will provide upland habitat.

Progressive reclamation will be undertaken during the operational phase. Over time, reclamation is expected to return wildlife habitat to at least a capability equivalent to baseline conditions. Reclamation planning and implementation will incorporate microhabitat features such as coarse woody debris, shaped lake littoral zones for amphibian breeding, and snags to enhance the area's capacity for wildlife.

After reclamation, grizzly bear are predicted to recover from disturbance effects experienced during construction and operational phases. Proposed Project Area reclamation will include re-planting berry producing shrubs and reclamation plans will be designed to enhance salmonid habitat thus improve forage resources for grizzly bear.

5.3.1.5.4 Mitigation

5.3.1.5.4.1 Introduction

This section provides a description of the mitigation measures which will be applied to minimize the Proposed Project effects on wildlife VCs. The suite of measures proposed to mitigate wildlife effects is presented in Table 5.3-15. Additional mitigation measures designed to reduce effects on vegetation communities are described in Section 5.3.2.5.3 and are supplemental to the measures described below for wildlife mitigation.

The mitigation strategy outlined below forms the basis for the commitments that the Proposed Project is making with respect to terrestrial wildlife. A detailed list of all commitments of the Proposed Project are provided in Volume 3, Part F – Section 19.

5.3.1.5.4.2 Construction

The following mitigation measures will be implemented during the construction phase of the Proposed Project to reduce Project-related effects to various wildlife VCs. A Wildlife Management Plan will be developed prior to the initiation of Project construction to provide details on wildlife mitigation measures, implementation methods and schedule (Volume 3, Part E - Section 16.0). The Wildlife Management Plan will include provisions for a wildlife monitoring program with the objective of measuring the effectiveness of mitigation and restoration measures on wildlife VCs within the LSA. The results of the wildlife monitoring program will be evaluated annually to determine if changes in abundance for wildlife VCs are within acceptable limits. If the Proposed Project is determined to be having an effect on listed species for which adequate data are available, BURNCO will work with regulators to determine appropriate methods for applying additional mitigation or avoidance measures or to reduce these effects, where possible. BURNCO will consult with MFLNRO during the development of the wildlife monitoring program. Wildlife monitoring data and results collected by BURNCO will be provided to MFLNRO to supportt

regional wildlife management efforts. The implementation and execution of the Wildlife Management Plan will be the responsibility of the Project Environmental Coordinator.

5.3.1.5.4.2.1 Habitat Loss

- Limit clearing in mature forest and riparian forest to the Proposed Project Area.
- Prior to site clearing, wildlife habitat features (e.g., ponds, wetlands and wildlife trees) will be demarcated with no-go fencing and signage where they are to be retained, or where the features occur outside of the clearing footprint. Habitat features to be field identified and retained and will be included on Project Environmental Management Plan mapping.
- Existing cleared areas such as right-of-ways (RoW), roads and disturbed areas will be used as much as possible to reduce vegetation clearing and ground disturbance.
- Prior to and during site clearing, wildlife habitat features, such as woody debris and wildlife trees, will be identified and evaluated for potential use during the reclamation/closure phase. Where feasible, these features will be collected and stockpiled for installation during progressive reclamation during the operational phase. Amphibian habitat features within the clearing footprint, such as downed logs, bark, and other coarse woody debris in various stages of decay will be retained or collected and set aside for re-installation during reclamation (BC MoE 2014a).
- Timber clearing will be limited to what is approved and required for Project development.
- An Invasive Plant Species Management Plan will be developed and implemented (Volume 3, Part E - Section).
- Spill Prevention and Emergency Response Plan (Volume 3, Part E - Section 16.0 for details) will be developed in line with BC Guidelines for Industrial Emergency Response Contingency Plans (BC MWLAP 1992). Emergency spill kits should be maintained on site. Refueling will not be done adjacent to environmental buffers or waterways.
- Siltation of streams and waterbodies will be avoided through appropriate erosion control methods outlined in the Erosion and Sediment Control Plan (Volume 3, Part E - Section 16.0 for details).
- Habitat clearing and construction activities in and adjacent to identified amphibian breeding sites will be scheduled as to avoid sensitive amphibian breeding and migration/ dispersal windows (generally late winter [January] to early fall [September] [BC MoE 2014a]).
- Proposed Project activities will follow Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments in BC (BC MoE 2014a).
- Where feasible, buffers of undisturbed native vegetation, a minimum of 30 m in width (BC MoE 2014a; BC MWLAP 2002), will be maintained around Ponds 1, 3, 4, 6, and 7, as well as ephemeral streams. These buffer areas act as key terrestrial habitat for adult amphibians including provincially and federally listed species. Vegetated buffers also reduce noise emissions and habitat fragmentation.
- Trees will not be felled into wetlands, ponds and/or known amphibian habitat.

- Snags, wildlife trees and mature trees will be retained wherever possible.
- Establish and retain vegetative buffers around raptor nests in accordance with "*Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia (2013)*" (BC MoE 2013b).
- Avoid clearing during nesting season (see Mortality section below).
- Habitat clearing within Roosevelt elk winter range during winter months (November to March [Nyberg and Janz 1999]) will be minimized to the extent practical.
- Maintain/provide habitat linkages and vegetation buffers to minimize habitat fragmentation between winter ranges for elk. These buffer areas act as travel corridors for wildlife.
- Progressive reclamation will include replanting suitable browse plant species.
- Construction activities will be restricted to daylight hours.
- Access to the Proposed Project Area will be restricted using a security gate on the dock and workers will be educated as to why it is important to limit access to, and through, the Proposed Project Area.
- Noise will be managed during the construction and operational phases according to the Environmental Objectives and Best Management Practices for Aggregate Extraction in BC (BC MWLAP 2002). Noise mitigation measures are detailed in Volume 2, Part B - Section 9.2 and include:
  - Maintaining vegetation and trees around the active work areas to act as a noise buffer;
  - Reducing the height aggregate falls along conveyors and within the crushing facility;
  - Enclosing conveyors which will assist in reducing noise emissions;
  - Minimizing speed on roadways;
  - Operating equipment within specifications and maintaining level roads; and
  - Reducing idling time.
- Efforts will be made to restrict noises to below 50dBA within 500m from the Proposed Project Area (i.e., within the ZOI for elk, see Section 5.3.1.5.3.7.1.1).
- Air and noise emissions will be minimized through the use of electrically powered equipment as much as possible.
- Habitat clearing within high suitability grizzly bear habitat will be minimized to the extent practical.
- Mature forest to be cleared will be surveyed for tree cavities that may provide suitable nesting opportunities for western screech-owl. A density of potentially suitable nest trees will be estimated for the mature forest that will be cleared, using conservative assumptions. Western screech-owls will readily use nest boxes, particularly if natural cavities are lacking (Cannings and Angell 2001, COSEWIC 2012b). Therefore, nest boxes will be built and placed in nearby forest habitat that is likely to be appropriate for western screech-owl based on expert knowledge, but that may have limited nest cavity availability. To be conservative, this habitat enhancement will establish two nest boxes for every natural suitable nest tree estimated to be lost.

5.3.1.5.4.2.2 Barriers to Movement

- Habitat linkages and vegetation buffers will be maintained/provided where feasible, to minimize barriers to amphibian movement between breeding ponds and adult upland habitat. Amphibian breeding ponds will have 30 m vegetation buffers maintained to facilitate habitat connectivity (as well as noise reduction and migratory movements). These buffer areas provide important terrestrial habitat for adult amphibians including provincially and federally listed species.
- Bury linear features such as conveyor system.
- Equipment will be stored in designated areas to avoid obstructing wildlife movements.
- Special amphibian road-crossing structures will be established in appropriate locations to facilitate amphibian movement to and from breeding ponds, based on knowledge of target species (BC MoE 2014a).

5.3.1.5.4.2.3 Change in Mortality

- Harassment of wildlife, eggs, nests, dens, burrows or the like will be prohibited at all times.
- Feeding wildlife or bringing pets on site will be prohibited at all times.
- A Material Storage, Handling and Waste Management Plan (Volume 3, Part E - Section 16.0) will be developed to ensure appropriate collection, storage, transportation and/or disposal of waste to minimize environmental effects and meet appropriate regulations. Expected waste includes industrial waste, domestic waste and sewage effluent. Waste will be reduced, re-used and recycled as much as feasibly possible. Appropriate food storage (bear bins) will be used to avoid attracting wildlife into the Proposed Project Area.
- Littering will be prohibited.
- Wildlife entering the worksite, acting aggressively, or feeding on food wastes will be reported to the Site Manager.
- Any injured species of wildlife will be reported to the Site Manager.
- Staff will be trained on appropriate behaviour with wildlife, including Bear Aware™, prior to working on site.
- BC Ministry of Environment (BC MoE) personnel will be contacted to assist with nuisance wildlife. Only appropriately trained staff will respond to nuisance wildlife or bear safety concerns.
- Signs will be posted to remind staff of appropriate behaviour around wildlife.
- A wildlife monitoring program will be developed and maintained for the duration of the Proposed Project with clear short- and long-term objectives to prevent nuisance wildlife.
- Traffic will be restricted to designated access roads and to daytime hours.
- Traffic volumes will be restricted and speeds will be maintained below 40 km/hr. Signs will be posted on the access road.

- All employees and contractors will be prohibited from hunting, including Roosevelt elk and grizzly bear, within the LSA.
- A salvage of red-legged frog and other amphibians will be conducted in and within 20 m of known breeding ponds that are to be cleared prior to initiation of clearing activities occurring between February and September. Isolation fencing will be installed around the ponds to prevent amphibians from entering them prior to construction.
- Isolation fencing will be installed along active roadways adjacent to known amphibian breeding ponds to deter migrating/ dispersing amphibians from crossing roadways.
- Harm to wildlife will be prohibited and employees/contractors will be instructed and educated on wildlife issues.
- Proposed Project Area clearing and grubbing will be timed to occur during avifauna least risk windows outlined in "Develop with Care 2012" (BC MoE 2014b):
  - Raptors, other than bald eagle or osprey, (VC: Northern goshawk, western screech-owl): October 1 to February 28
  - Passerines (VC: common nighthawk and band-tailed pigeon): September 1 to February 28
- Pre-clearing bird nest surveys will be undertaken if the aforementioned least risk windows cannot be achieved. Acceptable no-disturbance buffers will be established around active nests following provincial and federal guidance.
- Small distribution lines are expected to be visible to birds as poles are in close proximity. On larger systems conductors will be placed far apart to avoid electrocution and power lines will be marked to enhance visibility for avian VCs.
- Pre-clearing surveys will be conducted to check for wildlife and reasonable efforts will be made to avoid mortality.
- Habitat clearing will avoid calving from mid-May to mid-July for Roosevelt elk (Brunt 1990). Habitat clearing within Roosevelt elk winter range during winter months (November to March [Nyberg and Janz 1999]) will be minimized to the extent practical.
- Bears will be reported to the Site Manager.
- Public access to the Proposed Project Area will be restricted. The public will not be permitted to access the backcountry via the wharf or through the Proposed Project Area.

5.3.1.5.4.3 Operations

The following mitigation measures will be implemented during the operational phase of the Proposed Project to reduce potential Project-related effects to wildlife VCs. The majority of the mitigation measures identified for the construction phase will be continued through the operational phase of the Project. A Wildlife Management Plan

will be developed prior to the initiation of the operational phase. The Wildlife Management Plan will include and expand on the mitigation measures summarized below.

5.3.1.5.4.3.1 Habitat Loss

- Develop and implement a progressive Reclamation and Effective Closure Plan including a re-planting plan identifying the quantity and species of plants that will be planted (Volume 4, Part G – Section 22.0: Appendix 4). Planted species should include ample berry producing species which provide a food source for several birds and mammals.
- Progressive reclamation will be undertaken including the re-establishment of forest habitat (i.e., suitable over time for northern goshawk, marbled murrelet, Roosevelt elk) and shrub habitat (i.e., suitable for band-tailed pigeon, Roosevelt elk, grizzly bear).
- Appropriate containment berms will be established and vegetated around the freshwater pit-lake perimeter to establish wildlife habitat.
- An Invasive Plant Species Management Plan will be developed and implemented (Volume 3, Part E - Section 16.0) for details).
- A wildlife monitoring program will be developed and implemented, including monitoring of amphibians, birds and mammals will be conducted within the LSA to track species presence, abundance and habitat use.
- Operational activities will occur during daylight hours.
- Access to the site will be restricted using a security gate on the dock and workers will be educated as to why.
- Noise will be managed according during the construction and operational phases according to the Environmental Objectives and Best Management Practices for Aggregate Extraction in BC (BC MWLAP 2002). Vegetation and trees will be maintained around the pit lake to act as a noise buffer. Reduce the height aggregate falls when relocating. Enclosed conveyors will assist in reducing noise emissions. Minimize speed, operate equipment within specifications and maintain level roads. Turn off equipment when not in use.
- Efforts will be made to restrict noises to below 50dBA within 500m from the Proposed Project Area (i.e., the ZOI for elk, see Section 5.3.1.5.3.7.1.1).
- Air emissions will be minimized through the use of electrically powered equipment as much as possible.
- Fugitive dust from exposed soil, mobile equipment and traffic will be minimized. Enclosed conveyor systems will be utilized. Aggregate will be washed prior to being stockpiled. High rainfall is expected to limit dust emissions. Speed limits of 40km/hr will assist in reducing fugitive dust.
- A Spill Prevention and Emergency Response Plan (Volume 3, Part E - Section 16.0) will be developed in line with BC Guidelines for Industrial Emergency Response Contingency Plans (BC MWLAP 1992). Emergency spill kits will be maintained on site. Refueling locations will be established more than 30 m from important wildlife features and wetted areas.

- Water quality within the pit lake will be monitored for typical parameters such as temperature, pH, and, suspended solids.
- Siltation of streams and water bodies will be avoided through appropriate erosion control methods outlined in the Erosion and Sediment Control Plan (Volume 3, Part E - Section 16.0).
- Spills of hydrocarbons, herbicides or hazardous material will be responded to, and recorded, according to the Spill Prevention and Emergency Response Plan to avoid contamination of environmental receptors.
- A water quality monitoring program will be developed and implemented which includes monitoring temperature, pH and total suspended solids (at a minimum) in retained amphibian breeding locations.
- Night time facility lighting will be limited to where required for facility safety and security.
- Night time lighting (e.g., lamp poles, building lights) will be affixed with shades to direct light towards the ground and targeted location. Nighttime lighting will be directed away from amphibian breeding ponds, and forested habitat where it could interfere with normal behaviour of nocturnal species.
- The feasibility of, and appropriate locations for, the establishment of amphibian breeding habitat to compensate for the loss of Ponds 2 and 6 will be determined (described in Fish Habitat Offset Plan provided in Volume 4, Part G – Section 22.0 Appendix 5.1-B).
- Vegetation will be maintained or established around the mineable area and the Proposed Project Area to facilitate elk movement around the Proposed Project Area.
- Progressive reclamation will be undertaken including the re-establishment and shrub habitat utilized by Roosevelt elk.
- Appropriate containment berms will be established and vegetated around the freshwater pit-lake perimeter to establish wildlife habitat.

5.3.1.5.4.3.2 Barriers to Movement

- Mitigation measures for barriers to amphibian movement during the operational phase are the same as the construction phase.
- Potential wildlife movement corridors between moderate and high suitability Roosevelt elk habitat within the LSA will be identified prior to the initiation of the operational phase of the Proposed Project. Movement corridors will be retained and sensory disturbances to these areas will be minimized.

5.3.1.5.4.3.3 Change in Mortality

- All employees and contractors will be prohibited from hunting, including Roosevelt elk and grizzly bear, within the LSA.
- Possessing firearms or bows will be prohibited from the Proposed Project Area by employees at all times.

- Employees and contractors will be instructed and educated on wildlife issues.
- Any injured species of wildlife will be reported to the Site Manager.
- Traffic will be restricted to designated access roads and to daytime hours.
- Traffic volumes will be restricted and speeds will be maintained below 40 km/hr.
- Roads will be monitored for wildlife road kill and mortality logs will be kept to identify trends that require correction.
- Project personnel will be prohibited from using off-road vehicles (e.g., ATV, UTV) for recreational purposes while in the Proposed Project Area.
- Full or partial fencing around the pit-lake and Proposed Project infrastructure during the operational phase will be considered if bank slopes are not sufficient to prevent wildlife from falling into the active operational area.
- A yearly permit under the BC *Wildlife Act* will be obtained to relocate incidental encounters with amphibians from within the active mining area and processing facilities as needed.
- Special amphibian road-crossing structures (1 m diameter with <50 m intervals) in appropriate locations, based on knowledge of target species, will be considered (BC MoE 2014a).
- Common nighthawk may be attracted to gravel, open areas and roads for roosting which may lead to mortality by vehicles and moving equipment. This will be addressed by covering stockpiles when not in use and by reporting all observations of at-risk avifauna.
- Yearly clearing and brushing activities will be conducted outside of the migratory bird nesting window (March 19 to August 17) (Environment Canada 2014b).
- Vegetative buffers will be established around active nests. Species specific vegetative buffers will be outlined in the Wildlife Management Plan (Volume 3, Part E - Section 16.0).
- To minimize vehicle-wildlife collisions, extra caution will be taken during dawn and dusk and defensive driving techniques will be followed. Elk crossing signs will be posted if necessary.
- The perimeter of the pit-lake will be designed to allow elk an escape route.
- A Material Storage, Handling and Waste Management Plan (Volume 3, Part E - Section 16.0) will be developed to reduce wildlife attractants in the Proposed Project Area thereby reducing potential wildlife conflicts.

5.3.1.5.4.4 Reclamation and Closure

A Reclamation and Effective Closure Plan will be developed which will outline the goals associated with habitat restoration, method of rehabilitating wildlife habitat, and parameters to gauge the success of reclamation (Volume 4, Part G – Section 22.0: Appendix 4).

- Ecological units will be created during the reclamation phase similar to those present prior to construction of the Proposed Project. Approved native vegetation and trees will be used to reclaim disturbed areas and re-establish mature forest.
- A vegetation and wildlife monitoring program will be designed and implemented to assess the success of mine reclamation.
- Habitat offsetting for amphibians will be developed and implemented prior to and during the reclamation and closure phase of the Project, with specific recommendations to address habitat compensation for amphibian species at risk, including the creation of a pit lake.
- The reclamation design will include installing important habitat features for avifauna VCs such as planting suitable tree species to provide nesting and foraging habitat, planting berry producing shrubs which provide a food source to a variety of birds, and installing snags which may be used as wildlife trees or perch poles.
- The reclamation design will include planting suitable elk browse species along berms. The edges of the pit lake will be designed to allow for wildlife escape routes and travel.
- A Habitat Compensation Plan for Roosevelt elk will be developed and implemented prior to and during the reclamation and closure phase of the Project, with specific recommendations to address habitat compensation for Roosevelt elk.
- Fish habitat may be improved through the creation of the pit lake providing a food source for grizzly bear.

Table 5.3-15: Identified Mitigation Measures: Terrestrial Wildlife

Potential Effect	Mitigation	Anticipated effectiveness
Construction		
Habitat Loss (VC: Amphibian species at risk, avifauna, Roosevelt elk and grizzly bear)	▪ Identify and retain, where feasible, wildlife habitat features ▪ Utilize existing disturbed areas ▪ Maintain riparian vegetation, vegetation buffers and other important habitat features ▪ Minimize clearing through Project planning ▪ Develop a Vegetation Management Plan including an Invasive Plant Species Management Plan (Volume 3, Part E - Section 16.0). ▪ Avoid clearing wildlife habitat during sensitive wildlife periods such as breeding and calving periods, bird nesting periods, and Roosevelt elk overwintering ▪ Restrict construction to daylight hours ▪ Limit Proposed Project Area access to a single point, and to employees and contractors ▪ Manage noise through implementation of BMPs and mitigation outlined in Volume 2, Part B - Section 9.2 ▪ Maintain vegetation linkages and buffers ▪ Demarcate habitat features to be retained. ▪ Identify habitat feature (i.e., woody debris) to retain ▪ Develop a Spill Prevention and Emergency Response Plan (Volume 3, Part E - Section 16.0). ▪ Develop an Erosion and Sediment Control Plan (Volume 3, Part E - Section 16.0). ▪ Follow appropriate BMPs	Anticipated to be effective for avifauna and grizzly bear VCs Amphibian species at risk habitat will be temporarily lost in the Proposed Project Area during construction. It is likely that the Fish Habitat Offset Plan will provide effective compensatory breeding habitat during operations. The creation of a pit lake during the reclamation and closure phase will provide additional potential habitat for amphibian breeding. 36.7 ha of Roosevelt elk winter habitat will be permanently lost due to the creation of the pit lake after closure and reclamation.

Potential Effect	Mitigation	Anticipated effectiveness
	▪ Fall trees away from sensitive habitat ▪ Develop a Wildlife Management Plan (Volume 3, Part E - Section 16.0). ▪ Mature forest to be cleared will be surveyed for tree cavities that may provide suitable nesting opportunities for Western screech-owl. A density of potentially suitable nest trees will be estimated for the mature forest that will be cleared. ▪ Construct and install nest boxes for Western screech-owl in nearby forest habitat, where appropriate.	
Barriers to movement (VC: Amphibian species at risk, and Roosevelt elk)	▪ Store equipment in designated areas ▪ Design and establish amphibian passageways, where appropriate ▪ Maintain vegetation linkages and buffers ▪ Bury linear features.	Mitigation measures are anticipated to be effective and include the application of standard provincial best management practices.
Change in Mortality (VC: Amphibian species at risk, avifauna, Roosevelt elk and grizzly bear)	▪ Develop Erosion and Sediment Control Plan and Material Storage, Handling and Waste Management Plan and a Erosion and Sediment Control Plan (Volume 3, Part E - Section 16.0) ▪ Prohibit harassment and feeding of wildlife by Project employees ▪ Report wildlife observations ▪ Develop a Wildlife Management Plan (Volume 3, Part E - Section 16.0). ▪ All employees and contractors will be prohibited from hunting, including Roosevelt elk and grizzly bear, within the LSA. ▪ Install amphibian isolation fencing along roadways ▪ Clear during avifauna least risk windows; avoid clearing during sensitive wildlife periods ▪ Control traffic speeds on roads ▪ Develop and implement a wildlife monitoring program with the objective of measuring the effectiveness of mitigation and restoration measures on wildlife VCs within the LSA. Train staff to be Bear Aware™ ▪ Post educational signage ▪ Conduct a pre-clearing salvage of amphibians in amphibian ponds within the Proposed Project Area ▪	Mitigation measures are anticipated to be effective and include the application of standard provincial best management practices.
Operations		
Habitat Loss (VC: Amphibian species at risk, avifauna, Roosevelt elk and grizzly bear)	▪ Maintain mitigation measures implemented during construction ▪ Develop and implement a progressive Reclamation and Effective Closure Plan (Volume 4, Part G – Section 22.0: Appendix 4) ▪ Develop and implement a water quality monitoring program in remaining amphibian breeding ponds ▪ Develop and implement a wildlife monitoring program with the objective of measuring the effectiveness of mitigation and restoration measures on wildlife VCs within the LSA. ▪ Minimize fugitive dusts from exposed soil, equipment and Project facilities ▪ Monitor water quality in the pit lake	Anticipated to be effective for avifauna and grizzly bear VCs Amphibian species at risk habitat will be temporarily lost in the Proposed Project Area during construction. It is likely that the Fish Habitat Offset Plan will provide effective compensatory breeding habitat during operations. The creation of a pit lake during the reclamation and closure phase will provide additional potential habitat for amphibian breeding Roosevelt elk winter habitat (36.7 ha) will be permanently lost due to the

Potential Effect	Mitigation	Anticipated effectiveness
	▪ Limit operational hours to daylight hours. Limit nighttime lighting to where lighting is required for safety and security ▪ Night time lights will be fitted with shades to direct light towards the ground ▪ Monitor water quality in the Pit Lake and other water bodies in and around the Proposed Project Area	creation of the pit lake after closure and reclamation.
Barriers to movement (VC: Amphibian species at risk, and Roosevelt elk)	▪ Maintain mitigation measures implemented during construction	Mitigation measures are anticipated to be effective and include the application of standard provincial best management practices.
Change in Mortality (VC: Amphibian species at risk, avifauna, Roosevelt elk and grizzly bear)	▪ Maintain mitigation measures implemented during construction ▪ Restrict public access to the Proposed Project Area ▪ Develop a wildlife mortality reporting program ▪ Obtain a yearly permit to salvage amphibians ▪ Limit nighttime road travel ▪ Maintain vegetative buffers around all raptor nests and other active bird nests ▪ Design the perimeter of the pit lake to allow for an escape route for large mammals ▪ Develop a Material Storage, Handling and Waste Management Plan (Volume 3, Part E - Section 16.0)	Mitigation measures are anticipated to be effective and include the application of standard provincial best management practices.
Reclamation and Closure		
Habitat Loss (VC: Amphibian species at risk, avifauna, Roosevelt elk and grizzly bear)	▪ Develop and implement a Habitat Compensation Plan to address the loss of amphibian breeding habitat and Roosevelt elk habitat ▪ Reclaim the Proposed Project Area to enhance wildlife habitat ▪ Develop and implement a progressive Reclamation and Effective Closure Plan (Volume 4, Part G – Section 22.0: Appendix 4)	Mitigation measures are anticipated to be effective and include the application of standard provincial best management practices.

5.3.1.5.5 Residual Effects Assessment

Potential Project-related residual effects have been characterized using the criteria for each VC identified in Table 5.3-6. The characterization of potential residual effects (i.e., following application of appropriate mitigation measures) is described below and presented in Table 5.3-16. Residual effects have been characterized at the regional scale (RSA) as this scale provides a regional, ecologically relevant context for the distribution of VCs, and the ecosystems they depend on.

5.3.1.5.5.1 Construction and Operation

5.3.1.5.5.1.1 Amphibian Species at Risk

5.3.1.5.5.1.1.1 Habitat Loss

The mitigation measures proposed to reduce loss of potential amphibian species at risk due to direct and indirect habitat loss are expected to be effective. Approximately 0.12 ha of habitat in Pond 2 and 6 that may be providing

breeding habitat for amphibians is predicted to be lost during the construction phase. However, to compensate for this loss of wetland habitat, a total of 0.125 ha of amphibian breeding habitat will be established during the construction phase of the Project in four shallow ponds, as described in the Fish Habitat Offset Plan (Volume 4, Part G – Section 22.0 Appendix 5.1-B). Ponds will be constructed to provide suitable conditions for amphibian breeding and will exclude fish to prevent fish feeding on the amphibian eggs and tadpoles. Therefore, no spatial loss of amphibian breeding habitat is predicted to occur, and the temporal loss of habitat is expected to be very brief because wetland compensation habitat will be constructed before the operations phase of the Project. An accidental release of deleterious substances (i.e., hydrocarbons) or sediment could occur when machinery is operated near aquatic breeding habitat.

To be conservative due to uncertainty regarding the extent and effectiveness of wetland compensation as breeding habitat for amphibian species at risk, the magnitude of the potential loss of amphibian species at risk habitat is predicted to be low at the RSA scale and limited to the Proposed Project Area. The predicted effect is local in extent, medium-term, continues until reclamation (high frequency) and has a medium likelihood of occurrence. The habitat removed will be replaced during the operation and reclamation phases of the Project through habitat compensation, and habitat loss is therefore partially reversible (Table 5.3-16). Confidence that the effect will not be greater than predicted is high due to conservative assumptions that have likely resulted in an overestimation of the amount of habitat loss that will occur due to the Proposed Project.

5.3.1.5.5.1.1.2 Barriers to Movement

The mitigation measures proposed to reduce barriers to Amphibian species at risk movement are expected to be effective. The Proposed Project has been designed to re-use existing roadways and rights-of-way where feasible. The one new linear feature that will be built as part of the Proposed Project, the conveyor system, will be buried and will thus reduce potential physical barriers to amphibian movement. The magnitude of the residual effect of barriers to movement is predicted to be negligible and limited to the Proposed Project Area. The predicted effect is local, medium-term, continuous over the duration of the Project (high frequency) and low likelihood of occurrence (Table 5.3-16). The conveyor will be removed during the reclamation and closure phase and habitat linkages will be re-established by restoring the Proposed Project Area, therefore, barriers to movement are fully reversible. Confidence that the effect will not be greater than predicted is high due to the predicted effectiveness of mitigation measures and Project design, which includes burying the conveyor system.

5.3.1.5.5.1.1.3 Change in Mortality

Mitigation measures proposed to reduce Project-related amphibian mortality are expected to be effective. No new roads through amphibian habitat will be installed as part of the Proposed Project, and any increase in road traffic within the LSA is expected to be incremental from baseline conditions. However, although amphibian salvages will be planned prior to disturbing potential breeding ponds, some mortality may occur. Therefore, the magnitude of the potential change in amphibian mortality due to construction activities and vehicle collisions is predicted to be low and limited to the Proposed Project Area during construction and operation. The predicted effect is local, medium-term, occurring seasonally when amphibians migrate and disburse from natal habitat (medium frequency), and with a high likelihood of occurrence (Table 5.3-16). Amphibian populations are predicted to recover from Project-related mortality and therefore change in mortality is considered fully reversible. Confidence that the effect will not be greater than predicted is high due to the proposed mitigation measures.

5.3.1.5.5.1.1.4 Characterization of Net Effects

Net effects consider combined effects of the Project on a VC. Loss of habitat, barriers to movement and change in mortality are predicted to result in high, negligible, and low magnitude residual effects, respectively, based on the discussion above. Therefore, the magnitude of net effects of the Proposed Project on amphibian species at risk is predicted to be low. The predicted effects are local in extent, medium-term, high frequency (continuous over the life of the Project) and with a high likelihood of occurrence (Table 5.3-16). The effects of the Project are considered partially reversible with reclamation and closure. Confidence that the effect will not be greater than predicted is high due to conservative assumptions that are likely to overestimate the amount of habitat loss that will occur, and the likely effectiveness of mitigation measures such as burying the conveyor system.

5.3.1.5.5.1.2 Northern Goshawk

5.3.1.5.5.1.2.1 Change in Mortality

Mitigation measures proposed to reduce Project-related northern goshawk mortality are expected to be effective. Direct mortality due to clearing is not predicted to occur because suitable nesting habitat is not likely to be affected, and clearing will be conducted outside of the nesting season. Northern goshawks will be able to avoid clearing activities outside of the nesting season. However, indirect mortality due to collisions with vehicles may occur. The magnitude of the effect of the Project on northern goshawk mortality is predicted to be negligible and localized to the Proposed Project Area. The predicted effect is local in extent, medium-term in duration, continuous over the life of the Project (high frequency) and low likelihood of occurrence (Table 5.3-17). Northern goshawk populations are predicted to recover from Project-related mortality, if any, and therefore change in mortality is considered fully reversible. Confidence that the effect will not be greater than predicted is high due to the timing of clearing activities outside of the northern goshawk breeding season.

5.3.1.5.5.1.2.2 Characterization of Net Effects

No loss of suitable northern goshawk nesting habitat is predicted to occur. Change in mortality is predicted to result in a negligible magnitude residual effect on northern goshawk; therefore the magnitude of the net effect of the Proposed Project is predicted to be negligible. The predicted net effects are local in extent, medium-term and continuous over the life of the Proposed Project (Table 5.3-17). The effects are expected to have a low likelihood of occurrence because mortaility events for northern goshawk will occur rarely, if at all. The effects of the Proposed Project are considered fully reversible with reclamation and closure. Confidence that the effect will not be greater than predicted is high due to mitigation such as timing clearing activities to occur outside of the northern goshawk breeding season.

5.3.1.5.5.1.3 Marbled Murrelet

5.3.1.5.5.1.3.1 Change in Mortality

Mitigation measures proposed to reduce Project-related effects to marbled murrelet are expected to be effective. Direct mortality due to clearing is not predicted to occur because suitable nesting habitat is not likely to be affected, and clearing will be conducted outside of the nesting season. However, indirect mortality due to interactions with infrastructure may occur. The magnitude of the effect of the Proposed Project on marbled murrelet mortality is predicted to be negligible and localized to the Proposed Project Area. The predicted effect is local in extent, medium-term in duration, expected to occur mostly during the marbled murrelet nesting season when adults are moving to and from terrestrial habitat outside of the Proposed Project Area (medium frequency), and low likelihood of occurrence (Table 5.3-18). Marbled murrelet populations are predicted to recover from Project-related mortality, if any, and therefore change in mortality is considered fully reversible. Confidence that the effect will not be greater than predicted is high due to the timing of clearing activities outside of the marbled murrelet breeding season, and that the Proposed Project Area does not coincide with critical nesting habitat for this species.

5.3.1.5.5.1.3.2 Characterization of Net Effects

No loss of suitable marbled murrelet nesting habitat is predicted to occur. Change in mortality is predicted to result in a negligible magnitude residual effect on marbled murrelet; therefore the magnitude of the net effect of the Proposed Project is predicted to be negligible. The predicted effects are local in extent, long-term in duration, continuous over the life of the Proposed Project (high frequency; Table 5.3-18). The effects are expected to have a low likelihood of occurrence because mortaility events for northern goshawk will occur rarely, if at all. The effects of the Proposed Project are considered fully reversible with reclamation and closure. Confidence that the net effects will not be greater than predicted is high because clearing activities will be timed to occur outside of the marbled murrelet breeding season.

5.3.1.5.5.1.4 Band-tailed pigeon

5.3.1.5.5.1.4.1 Habitat loss

The mitigation measures proposed to reduce the loss of band-tailed pigeon foraging and nesting habitat loss are expected to be effective. Clearing of the Proposed Project Area during the construction phase will result in the loss of 4 ha of mature forest that may provide potential nesting habitat for band-tailed pigeon. The Proposed Project will also result in the loss of shrub-dominated habitat that provides suitable foraging habitat for band-tailed pigeon during the operational phase. The Project design mitigations, including re-use of existing disturbed areas (i.e., roadways) thereby limiting the removal of natural vegetation, and progressive mine reclamation, are predicted to reduce the effect of habitat loss for band-tailed pigeon. During the construction phase, 13 ha of mature forest within the LSA will be exposed to noise levels that have been shown to elicit a response in columbiforms. The magnitude of the potential loss of band-tailed pigeon habitat is predicted to be negligible and limited to the LSA. The predicted effect is local in extent, long-term, continuous over life of the Project (high frequency), and high likelihood of occurrence (Table 5.3-19). The habitat removed may be replaced at the end of the life of the Proposed Project by reclaiming the Proposed Project Area; industrial noise will not persist beyond life of the Proposed Project. Therefore, habitat loss is predicted to be fully reversible. Confidence that the effect will not be greater than predicted is high due to conservative assumptions that have likely resulted in an overestimation of the amount of habitat loss that will occur due to the Proposed Project.

5.3.1.5.5.1.4.2 Change in Mortality

Mitigation measures proposed to reduce Project-related band-tailed pigeon mortality are expected to be effective. Direct mortality due to clearing is not predicted to occur because clearing will be conducted outside of the nesting season, and at a time when birds will be able to avoid clearing activities. However, indirect mortality due to interactions with infrastructure may occur. The magnitude of the effect of the Proposed Project on band-tailed pigeon mortality is predicted to be negligible and localized to the Proposed Project Area. The predicted effect is local in extent, medium-term in duration, continuous over life of the Project (high frequency), and low likelihood of occurrence (Table 5.3-19). Band-tailed pigeon populations are predicted to recover from Project-related mortality, if any, and therefore change in mortality is considered fully reversible. Confidence that the effect will not be greater than predicted is high due to timing of clearing activities outside of the band-tailed pigeon breeding season.

5.3.1.5.5.1.4.3 Characterization of Net Effects

The net effects of habitat loss and change in mortality are predicted to result in negligible magnitude effects based on the discussion outlined above. Therefore, the magnitude of net effects of the Proposed Project is predicted to be negligible. The predicted effects are local in extent, long-term, continuous over life of the Proposed Project (high frequency), and high likelihood of occurrence (Table 5.3-19). The effects of the Proposed Project are considered fully reversible with reclamation and closure. Confidence that the effect will not be greater than predicted is high due to conservative assumptions that have likely resulted in an overestimation of habitat loss and mitigation such as timing clearing activities to occur outside of the band-tailed pigeon breeding season.

5.3.1.5.5.1.5 Western screech-owl

5.3.1.5.5.1.5.1 Habitat loss

The mitigation measures proposed to reduce the loss of western screech-owl habitat, such as habitat enhancement through the placement of nest boxes (Section 5.3.1.5.4.2.1), are expected to be effective. The Proposed Project has been designed to re-use the existing infrastructure (i.e., roadways) and will limit removal of natural vegetation where feasible. Clearing of the Proposed Project Area during the construction phase will result in loss of 4 ha of moderate suitability western screech-owl habitat, which represents a reduction of approximately 0.1% of available moderate and high (combined) suitability habitat within the RSA. No high suitability habitat will be removed. Sensory disturbance is predicted to affect less than 0.1% of moderate and high suitability habitat within the RSA.

Western screech-owls will readily use nest boxes, particularly if natural cavities are lacking (Cannings and Angell 2001, COSEWIC 2012b), as they likely are in the mature coniferous forest in and around the LSA. Therefore, no adverse residual effects from habitat loss are predicted after nest boxes are installed in appropriate habitat at a ratio of two for every suitable nest tree estimated to be impacted by the Proposed Project (Section 5.3.1.5.4.2.1). The density of potentially suitable nest trees will be estimated based on conservative assumptions and the results of a pre-clearing survey for potential nest trees that may be impacted in the LSA. The area of mature forest impacted is sufficiently small that this mitigation is likely to be effective.

5.3.1.5.5.1.5.2 Change in Mortality

Mitigation measures proposed to reduce Project-related western screech-owl mortality are expected to be effective. Direct mortality due to clearing is not likely to occur because western screech owls were not detected in the mature forest proposed to be cleared, although barred owl was. Barred owls are likely an important source of western screech owl mortality, and it is unlikely that both species would coexist in the same mature forest patch. However, although unlikely, to be precautionary it is assumed that mortality due to clearing may occur. Indirect mortality due to interactions with infrastructure may also occur. Due to the small amount of habitat affected (4 ha), the combined effects of clearing and interactions with infrastructure on western screech-owl mortality are predicted to be negligible at the population (i.e., RSA) scale and localized in the Proposed Project Area. The predicted effect is medium-term in duration, continuous over the life of the Proposed Project (high frequency), and low likelihood of occurrence (Table 5.3-20). Western screech-owl populations are predicted to recover from Project-related mortality, if any, and therefore change in mortality is considered fully reversible. Confidence that the effect will not be greater than predicted is moderate because the magnitude is predicted to be negligble at the population scale, which likely overestimates the impact of the Project on western screech-owl mortality.

5.3.1.5.5.1.5.3 Characterization of Net Effects

Net effects consider the combined effects of the Project on a VC. There is no net effect on habitat loss after mitigation, but the change in mortality is predicted to result in a negligible magnitude residual effect. The magnitude of net effects of the Proposed Project on western screech-owl is predicted to be negligible. The predicted effects are local in extent, long-term, continuous over life of the Proposed Project (high frequency), and high likelihood of occurrence (Table 5.3-20). The effects of the Proposed Project are considered fully reversible with reclamation and closure. Confidence that the effect will not be greater than predicted is moderate because mitigation for habitat loss is likely to be effective, and western-screech owl mortality events are likely to be very rare, but adverse effects to habitat and more frequent mortality events are possible.

5.3.1.5.5.1.6 Common Nighthawk

5.3.1.5.5.1.6.1 Habitat Loss

The mitigation measures proposed to reduce the loss of common nighthawk habitat due to direct and indirect habitat loss are expected to be effective. The Proposed Project has been designed to re-use the existing infrastructure (i.e., roadways) and thereby limit removal of natural vegetation where feasible. It is predicted that less than 1 ha of moderate suitability and no high suitability nesting habitat will be removed due to the Proposed Project, representing less than 0.1% of available habitat within the RSA. The magnitude of potential loss of common nighthawk habitat is predicted to be negligible and limited to the Proposed Project Area. The predicted effect is local in extent, medium-term, continuous over life of the Propose Project (high frequency), and high likelihood of occurrence (Table 5.3-21). The habitat removed may be replaced at the end of life of the Proposed Project by restoring the Proposed Project Area; industrial noise and light will not persist beyond life of the Proposed Project. Furthermore, common nighthawk nest on open ground and the Proposed Project may provide additional nesting habitat. Therefore, habitat loss for common nighthawk is predicted to be fully reversible. Confidence that the effect will not be greater than predicted is high due to conservative assumptions that have likely resulted in an overestimation of the amount of habitat loss that will occur due to the Proposed Project.

5.3.1.5.5.1.6.2 Change in Mortality

Mitigation measures proposed to reduce Project-related common nighthawk mortality are expected to be effective. Direct mortality due to clearing is not predicted to occur as clearing will be conducted outside of the nesting season, and at a time when birds will be able to avoid clearing activities. However, indirect mortality due to interactions with infrastructure may occur. The magnitude of effect of the Proposed Project on common nighthawk mortality is predicted to be negligible and localized to the Proposed Project Area. The predicted effect is local in extent, medium-term, continuous over life of the Proposed Project (high frequency), and low likelihood of occurrence (Table 5.3-21). Common nighthawk populations are predicted to recover from Project-related mortality, if any, and therefore change in mortality is considered fully reversible. Confidence that the effect will not be greater than predicted is high due to timing of clearing activities outside of the common nighthawk breeding season.

5.3.1.5.5.1.6.3 Characterization of Net Effects

The net effect of loss of common nighthawk habitat and change in common nighthawk mortality are predicted to result in negligible magnitude effects based on the discussion above. Therefore the magnitude of net effects of the Proposed Project on common nighthawk is also predicted to be negligible. The predicted effects are local in extent, medium-term, continuous over life of the Proposed Project (high frequency), and high likelihood of occurrence (Table 5.3-21). Effects of the Proposed Project are considered fully reversible with reclamation and closure. Confidence that the effect will not be greater than predicted is high due to conservative assumptions that have likely resulted in an overestimation of habitat loss and the timing of clearing activities outside of the common nighthawk breeding season.

5.3.1.5.5.1.7 Roosevelt Elk

5.3.1.5.5.1.7.1 Habitat Loss Habitat

The effects of removing Roosevelt elk winter range habitat from the mineable area (moderate suitability) and the marine conveyor area (high suitability) will be reduced by minimizing the area to be cleared, and progressive reclamation through the operational phase of the Proposed Project. Of the elk winter range available (moderate and high suitability) within the RSA, 0.8% will be permanently lost due to creation of the pit-lake and this is considered to be of negligible magnitude. Loss of Roosevelt elk winter range habitat will be limited to the Proposed Project Area and will be fully reversible through progressive reclamation and replanting after Project completion (with the exception of the pit-lake). Sensory disturbance produced by operation of the Proposed Project has been conservatively estimated to affect 3% of the moderate and high suitability habitat within the RSA and is considered of low magnitude. It is unknown whether local elk populations will habituate to increased noise associated with the Proposed Project. It is assumed that effects of indirect habitat loss are limited to the temporal bounds of the Proposed Project (16 years). Therefore, loss of Roosevelt elk habitat is predicted to be of low magnitude, local in extent, long-term, continuous over duration of the Proposed Project (high frequency), and with a high likelihood of occurrence (Table 5.3-23). Elk experience reduced reproductive success during human-induced disturbance; however, disturbance removal has been shown to result in the recovery of reproductive success to pre-disturbance levels (Hebblewhite 2008; Shively et al. 2005). After reclamation, Roosevelt elk are predicted to recover from disturbance effects experienced during the construction and operational phases; therefore, the effects are considered to be fully reversible. Confidence that the effect will not be greater than predicted is moderate due to the unknown extent of elk habituation to noise disturbance in the Proposed Project Area.

5.3.1.5.5.1.7.2 Barriers to Movement

The mitigation measures proposed to reduce barriers to Roosevelt elk movement are expected to be effective. The Proposed Project has been designed to re-use existing disturbed areas, roadways and rights-of-way where feasible. The magnitude of the effect of barriers to movement is predicted to be negligible and limited to the Proposed Project Area. The predicted effect is local in extent, medium-term, continuous over duration of the Project (high frequency), and high likelihood of occurrence (Table 5.3-23). Project components (i.e., the conveyor system) will be removed during the reclamation and closure phase and habitat linkages will be re-established by restoring the Proposed Project Area, therefore, barriers to movement are fully reversible. Confidence that the effect will not be greater than predicted is high due to predicted effectiveness of mitigation measures and Project design which includes burying the conveyor system and removing it during reclamation and closure.

5.3.1.5.5.1.7.3 Change in Mortality

Mitigation measures proposed to reduce Project-related Roosevelt elk mortality are expected to be effective. Direct mortality due to clearing is not predicted to occur as clearing will be conducted outside of the Roosevelt elk calving season; further, elk are expected to vacate the active work area which would limit their exposure to mortality factors from the Project. However, indirect mortality due to interactions with infrastructure and incidental take by hunters may occur. The magnitude of effect of the Project on Roosevelt elk mortality is predicted to be negligible and localized to the Proposed Project Area. The predicted effect is local in extent, medium-term, continuous over life of the Proposed Project (high frequency), and low likelihood of occurrence (Table 5.3-23). Roosevelt elk populations are predicted to recover from Project-related mortality, if any, and therefore change in mortality is considered fully reversible. Confidence that the effect will not be greater than predicted is high due to timing of clearing activities to occur outside of the Roosevelt elk calving season.

5.3.1.5.5.1.7.4 Characterization of Net Effects

The net effect of loss of Roosevelt elk habitat, barriers to movement and change in Roosevelt elk mortality are predicted to result in low and negligible magnitude. Therefore the magnitude of net effects of the Proposed Project on Roosevelt elk is also predicted to be low. The predicted effects are local in extent, long-term, continuous over the life of the Proposed Project (high frequency), and high likelihood of occurrence (Table 5.3-23). The effects of the Proposed Project are considered fully reversible with reclamation and closure. Confidence that the effect will not be greater than predicted is moderate because of uncertainty related to the extent of elk habituation to noise disturbance in the Proposed Project Area.

5.3.1.5.5.1.8 Grizzly Bear

5.3.1.5.5.1.8.1 Habitat Loss

The mitigation measures proposed to reduce the loss of grizzly bear habitat are expected to be effective. The Proposed Project has been designed to re-use the existing infrastructure (i.e., roadways) and limit removal of natural vegetation where feasible. Clearing of the Proposed Project Area during the construction phase will result in the direct and indirect loss of 6.3% of suitable habitat within the RSA. It is unknown whether local bear populations will habituate to the sensory disturbance effects of the Proposed Project. The magnitude of the potential loss of grizzly bear habitat is predicted to be low and limited to the Proposed Project Area. The predicted

effect is local in extent, long-term, continuous over life of the Proposed Project (high frequency), and high likelihood of occurrence (Table 5.3-24). The habitat removed may be replaced at the end of life of the Proposed Project by restoring the Proposed Project Area; further, sensory disturbance will not persist beyond life of the Proposed Project. Therefore, habitat loss is predicted to be fully reversible. Confidence that the effect will not be greater than predicted is moderate due to conservative assumptions that have likely overestimated the amount of habitat loss that will occur due to the Proposed Project, and uncertainty related to the extent of habituation to sensory disturbance effects.

5.3.1.5.5.1.8.2 Change in Mortality

Mitigation measures proposed to reduce Project-related grizzly bear mortality are expected to be effective. Mortality due to clearing is not predicted to occur as grizzly bear denning habitat does not occur within the Proposed Project Area and bears within the Proposed Project Area, outside of the denning season, will be able to avoid clearing activities. Mortality due to interactions with workers may occur, but is likely to be of negligible magnitude, and with a low likelihood of occurrence after mitigations have been applied (Table 5.3-24). The predicted effect is local in extent, medium-term, would occur rarely, if ever, over the life of the Proposed Project (low frequency). Regional grizzly bear populations are sensitive to mortality and may not fully recover from Project-related mortality. Therefore, change in mortality is considered partially reversible. Confidence that the effect will not be greater than predicted is high because grizzly bear denning habitat is not predicted to occur within the Proposed Project Area and the frequency of interactions with grizzly bear is expected to be low.

5.3.1.5.5.1.8.3 Characterization of Net Effects

The net effects of loss of grizzly bear habitat and change in grizzly bear mortality are predicted to result in low and negligible magnitude effects, respectively, based on the discussion above. The magnitude of net effects of the Proposed Project on grizzly bear is predicted to be low. The predicted effects are local in extent, long-term, continuous over life of the Proposed Project (high frequency), and high likelihood of occurrence (Table 5.3-24). The effects of the Proposed Project are considered partially reversible with reclamation and closure. The fish offsetting habitat which will be developed for the Proposed Project may increase available foraging habitat and food (Fish Habitat Offset Plan provided in Volume 4, Part G – Section 22.0 Appendix 5.1-B). Confidence that the effect will not be greater than predicted is moderate because, although conservative assumptions have likely overestimated the amount of habitat loss that will occur and mitigations to prevent grizzly bear mortality are likely to be effective (e.g., Material Storage, Handling and Waste Management Plan [Volume 3, Part E - Section 16.0]), a mortality event could occur.

Table 5.3-16: Characterization of Potential Project-Related Residual Effects: Terrestrial Wildlife VC - Amphibian Species at Risk

Potential Residual Effect	Residual Effect Assessment Criteria					
	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Construction and Operation						
Habitat Loss	-	L	L	MT	PR	H
Barriers to Movement	-	N	L	MT	PR	H
Change in Mortality	-	L	L	MT	FR	M
Net Effect	**Moderately Resilient**	**L**	L	**MT**	**PR**	**H**

Table 5.3-17: Characterization of Potential Project-Related Residual Effects: Terrestrial Wildlife VC - Northern Goshawk

Potential Residual Effect	Residual Effect Assessment Criteria					
	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Construction and Operation						
Change in Mortality	-	N	L	MT	FR	H
Net Effect	**Sensitive**	N	L	**MT**	**FR**	**H**

Table 5.3-18: Characterization of Potential Project-Related Residual Effects: Terrestrial Wildlife VC - Marbled Murrelet

Potential Residual Effect	Residual Effect Assessment Criteria					
	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Construction and Operation						
Change in Mortality	-	N	L	MT	FR	M
Net Effect	**Moderately Resilient**	**N**	**L**	**MT**	**FR**	**H**

Table 5.3-19: Characterization of Potential Project-Related Residual Effects: Terrestrial Wildlife VC - Band-tailed Pigeon

Potential Residual Effect	Residual Effect Assessment Criteria					
	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Construction and Operation						
Habitat Loss	-	N	L	LT	FR	H
Change in Mortality	-	N	L	MT	FR	H
Net Effect	**Sensitive**	**N**	**L**	**LT**	**FR**	**H**

Table 5.3-20: Characterization of Potential Project-Related Residual Effects: Terrestrial Wildlife VC - Western Screech-Owl

Potential Residual Effect	Residual Effect Assessment Criteria					
	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Construction and Operation						
Habitat Loss	-	-	-	-	-	-
Change in Mortality	-	N	L	MT	FR	H
Net Effect	**Sensitive**	N	**L**	**LT**	**FR**	**H**

Table 5.3-21: Characterization of Potential Project-Related Residual Effects: Terrestrial Wildlife VC - Common Nighthawk

Potential Residual Effect	Residual Effect Assessment Criteria					
	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Construction and Operation						
Habitat Loss	-	N	L	MT	FR	H
Change in Mortality	-	N	L	MT	FR	H
Net Effect	**Moderately Resilient**	**N**	**L**	**MT**	**FR**	**H**

Table 5.3-22: Characterization of Potential Project-Related Residual Effects: Terrestrial Wildlife VC - Roosevelt Elk

Potential Residual Effect	Residual Effect Assessment Criteria					
	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Construction and Operation						
Direct Habitat Loss	-	L	L	LT	FR	H
Barriers to Movement	-	N	L	MT	FR	H
Change in Mortality	-	N	L	MT	FR	H
Net Effect	**Resilient**	**L**	**L**	**LT**	**FR**	**H**

Table 5.3-23: Characterization of Potential Project-Related Residual Effects: Terrestrial Wildlife VC - Grizzly Bear

Potential Residual Effect	Residual Effect Assessment Criteria					
	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Construction and Operation						
Direct Habitat Loss	-	L	L	LT	FR	H
Mortality	-	N	L	MT	PR	L
Net Effect	**Sensitive**	**L**	**L**	**LT**	**PR**	**H**

Assessment Criteria:
Context: R – Resilient, MR – Moderately Resilient; S - Sensitive;
Magnitude: N – Negligible, L – Low, M – Medium, H – High;
Geographic Extent: L – Local, R – Regional, BR – Beyond Regional;
Duration: ST – Short-tern, MT – Medium-term, LT – Long-term;
Reversibility: FR – Fully Reversible, PR - Partially Reversible, IR - Irreversible;
Frequency: L – Low, M – Medium, H – High.

Table 5.3-24: Likelihood of Occurrence of Potential Residual Effects: Terrestrial Wildlife VCs

VC	Residual Effect	Likelihood	Rationale
Construction and Operation			
Amphibian species at risk	Habitat Loss	Medium	Amphibian species at risk habitat will be temporarily lost in the Proposed Project Area during construction. It is likely that the Fish Habitat Offset Plan will provide effective compensatory breeding habitat during operations. However, there is some uncertainty regarding the extent and effectiveness of wetland compensation as breeding habitat for amphibian species at risk.
Amphibian species at risk	Barriers to Movement	Low	One new linear feature will be developed during construction and will be buried, thereby reducing barriers to amphibian species at risk movement.
Amphibian species at risk	Change in Mortality	High	Mitigation measures are expected to be effective in reducing or eliminating amphibian mortality; however, some mortality may still occur.
Northern goshawk	Change in Mortality	Low	Mitigation measures are predicted to be effective and northern goshawk is not expected to interact with the Proposed Project infrastructure.
Marbled murrelet	Change in Mortality	Low	Mitigation measures are predicted to be effective and marbled murrelet are not expected to interact with the Proposed Project infrastructure.
Band-tailed pigeon	Habitat Loss	High	Suitable band-tailed pigeon nesting and foraging habitat will be removed during the construction phase.
Band-tailed pigeon	Change in Mortality	Low	Mitigation measures are predicted to be effective and band-tailed pigeon are not expected to interact with the Proposed Project infrastructure.
Western screech-owl	Change in Mortality	Low	Mitigation measures are predicted to be effective and western screech-owl mortality is not expected to occur due to clearing or interaction with the Proposed Project infrastructure.
Common nighthawk	Habitat Loss	High	Suitable common nighthawk nesting habitat will be removed during the construction phase.
Common nighthawk	Change in Mortality	Low	Mitigation measures are predicted to be effective and common nighthawk are not expected to interact with the Proposed Project infrastructure.
Roosevelt elk	Habitat Loss	High	High suitability elk winter habitat within the processing and minable areas will be removed.
Roosevelt elk	Barriers to Movement	High	It is unknown if Roosevelt elk herds within the RSA will habituate to noise produced by the Proposed Project; therefore, barriers to movement, at least temporarily, are likely to occur.
Roosevelt elk	Change in Mortality	Low	Mitigation measures are predicted to be effective and Roosevelt elk are not expected to interact with the Proposed Project infrastructure. Furthermore, increased hunting pressure is not expected to occur due to the Proposed Project due to Provincial management of the resource.

VC	Residual Effect	Likelihood	Rationale
Grizzly bear	Habitat Loss	High	Suitable grizzly bear foraging habitat will be removed during the construction phase.
Grizzly bear	Change in Mortality	Low	Mitigation measures are predicted to be effective and grizzly bear are not expected to interact with the Proposed Project infrastructure or workers.
Accidents and Malfunctions			
Amphibian species at risk	Indirect Loss of Habitat - Accidental hazardous material spills or accidental discharge of sediment into watercourses	Low	Mitigation measures are expected to be effective in reducing the potential for an accidental release of hazardous material or sediments into watercourses near sensitive amphibian at risk habitat.

5.3.1.5.6 Significance of Residual Effects

The significance of potential residual adverse effects will be determined for each VC based on the residual effects criteria and the likelihood of a potential residual effect occurring, a review of background information and available field study results, consultation with government agencies, First Nations, and other experts, and professional judgement. A summary of significance determinations is presented in Table 5.3-26.

The determination of significance of residual adverse effects is rated as negligible-not significant, non-significant, or significant, which are generally defined as follows:

- Negligible (and not significant): Negligible significance is defined, for the purposes of this assessment, as a residual effect with a negligible magnitude and/or not likely to occur. However, adverse residual effects of negligible magnitude may still be significant if they contribute to the factors limiting a population that is not self-sustaining or maintaining its ecological function in the baseline case. Negligible effects will not be carried forward to the cumulative effects assessment.
- Not significant: Effects determined to be not significant are residual effects greater than negligible that do not meet the definition of significant. Residual effects that are not significant will be carried forward to the cumulative effects assessment.
- Significant: A significant effect is defined, for the purposes of this assessment, as a residual effect that is predicted to exceed the resilience and adaptability limits of the population and result in a population that is not self-sustaining or maintaining its ecological function. An effect is also significant for a population that is not self-sustaining or maintaining its ecological function in the baseline case and is adversely affected by the project in a way that contributes to the factors limiting the population. Significant residual effects will be carried forward to the cumulative effects assessment.

5.3.1.5.6.1 Construction and Operation

5.3.1.5.6.1.1 Amphibian Species at Risk

Northern red-legged frog is the only amphibian species at risk predicted to be affected by the Proposed Project. The species is on the provincial Blue List (BC CDC 2016) and is federally listed as Special Concern by COSEWIC and Special Concern on Schedule 1 of SARA (Government of Canada 2016). Red-legged frog population trends in BC are not well understood but are believed to have been in decline since the 1970s due to habitat loss and degradation from expanding land development and urbanization (COSEWIC 20015; Maxcy 2004). In BC, the range of northern red-legged frog is restricted to coastal and southern parts of the province where it is vulnerable to habitat fragmentation caused by urban and suburban development (COSEWIC 2015; BC CDC 2016). Although the long-term status is difficult to predict, many populations are believed to be viable and the species is still common in parts of its range (COSEWIC 2015; BC CDC 2016). The northern red-legged frog population in the RSA is likely to be self-sustaining and maintaining its ecological function because of limited development. Therefore, the northern red-legged frog population is determined to have moderately resilient to imposed stresses.

Approximately 0.1 of habitat in Pond 2 and 6 that may be providing breeding habitat for amphibians is predicted to be lost during the construction phase. However, the Fish Habitat Offset Plan (Volume 4, Part G – Section 22.0 Appendix 5.1-B) will likely provide effective compensatory breeding habitat during operations. Ponds will be constructed to provide suitable conditions for amphibian breeding and will exclude fish to prevent fish feeding on

the amphibian eggs and tadpoles. Although the Proposed Project will temporarily remove two known breeding sites, it will not affect the majority of known breeding habitats within the LSA. An additional pit lake will be produced at reclamation (Volume 4, Part G – Section 22.0: Appendix 4). Salvaging of amphibians within natal and upland habitat affected by the Proposed Project will reduce potential Project-related mortality. The net residual effects of the Proposed Project on amphibian species at risk during construction and operations are predicted to be of low magnitude (Section 5.3.1.5.5.1.1; Table 5.3-16). After reclamation, amphibians are predicted to recover from disturbance effects experienced during construction and operational phases. The effects of the Proposed Project are not expected to exceed ecological thresholds or compromise the resilience of the regional population of the northern red-legged frog, and are determined to be not significant.

5.3.1.5.6.1.2 Northern Goshawk

Northern goshawk *laingi* subspecies is provincially red-listed, designated as Threatened by COSEWIC, and federally designated as Threatened under SARA (Government of Canada 2016; BC CDC 2016). Population trends in BC are unknown; however, are presumed to have declined due to continued loss of suitable habitat (COSEWIC 2013). Goshawk populations are expected to continue to decline due to continued harvest of mature and old growth forest in coastal BC, which is associated with suitable nesting habitat, and is the main limiting factor for the population. Due to a lack of evidence to the contrary, to be conservative the northern goshawk population in the RSA is assumed to be no longer self-sustaining or maintaining its ecological function. Therefore, the northern goshawk population is determined to be sensitive to imposed stresses. However, the Proposed Project is not predicted to result in the loss of northern goshawk nesting habitat.

The net residual effects of the Proposed Project on northern goshawk during construction and operations are predicted to be of negligible magnitude due to the risk of mortality due to interactions with infrastructure (Section 5.3.1.5.5.1.2; Table 5.3-17). After reclamation, the northern goshawk population is predicted to recover from disturbance effects experienced during the construction and operational phases. Although the northern goshawk population may be sensitive to imposed stresses, the project after mitigation is not likely to contribute to the factors limiting the population. The effects of the project are determined to be negligible – not significant for the northern goshawk population in the RSA.

5.3.1.5.6.1.3 Marbled Murrelet

Marbled murrelet is provincially blue-listed, designated as Threatened by COSEWIC, and is federally designated as Threatened under *SARA* (Government of Canada 2016; BC CDC 2016). Population trends in BC are poorly understood but appear to show generally stable populations with localized evidence of declines (COSEWIC 2012a; EC 2014a). The marbled murrelet remains common and widespread along the B.C. coast (COSEWIC 2012a; EC 2014a) Therefore, it is likely that the marbled murrelet population in the RSA remains self-sustaining and is maintaining its ecological function. Marbled murrelet populations are determined to have moderately resilient to imposed stresses.

The Proposed Project is predicted to result in no loss of suitable marbled murrelet nesting habitat, and a negligible impact on mortality due to the potential for interactions with infrastructure. The net residual effects of the Proposed Project on marbled murrelet during construction and operations are predicted to be of negligible magnitude (Section 5.3.1.5.5.1.3; Table 5.3-18). After reclamation, marbled murrelet are predicted to recover from

disturbance effects experienced during construction and operational phases. The effects of the Proposed Project are not expected to exceed ecological thresholds and compromise the resilience of the regional population of marbled murrelet, and are determined to be negligible – not significant.

5.3.1.5.6.1.4 Band-tailed Pigeon

Band-tailed pigeon is provincially blue-listed and has been designated Special Concern on Schedule 1 of *SARA* and by COSEWIC (BC CDC 2016; Government of Canada 2016). An analysis of breeding bird survey data by Environment Canada indicates an average annual population decline of 3.9% in BC from 1970 to 2012 (Environment Canada 2014d), suggesting an 81% decline during that period. This decline appears to be due primarily to a combination of disease (Girard et al. 2014) and a dependence on the availability of mineral sites (COSEWIC 2008). To be conservative, the band-tailed pigeon population in the RSA is determined to be sensitive to imposed stresses under baseline conditions because it may be declining to extirpation and therefore may not be self-sustaining.

The net residual effects of the Proposed Project on band-tailed pigeon during construction and operations are predicted to be of negligible magnitude (Section 5.3.1.5.5.1.4; Table 5.3-19). Construction of the Proposed Project will result in the loss of suitable band-tailed pigeon nesting and foraging habitat; however, will not contribute to the loss of mineral sites or the proliferation of disease. Progressive reclamation through the operational phase will replace band-tailed pigeon foraging habitat as the Proposed Project proceeds. Although the band-tailed pigeon population may be sensitive to imposed stresses, the project after mitigation is not likely to contribute to the factors limiting the population. The effects of the project are determined to be negligible – not significant for the band-tailed pigeon population in the RSA.

5.3.1.5.6.1.5 Western Screech-owl

The *kennicottii* ubspecies of western screech-owl is provincially blue-listed and has been designated as Special Concern on Schedule 1 of SARA and as Threatened by COSEWIC (BC CDC 2016, internet site; Government of Canada 2016, internet site). Although data on population and population trends is lacking, the kennicottii subspecies of western screech-owl is presumed to be declining. The presumed decline of the species is believed to be due to a combination of the effects of the loss of suitable nesting habitat in mature and old growth forest and predation by barred owls (COSEWIC 2012b). To be precautionary in the absence of sufficient data, the western screech-owl population is determined to be sensitive to imposed stresses in the baseline case because it may be declining to extirpation in the RSA and may not be self-sustaining. The Proposed Project will remove mature forest habitat that may contain suitable nesting trees for western screech-owl. To mitigate this loss, nest boxes will be installed in appropriate habitat at a ratio of two for every suitable nest tree estimated to be impacted by the Proposed Project (Section 5.3.1.5.4.2.1). Western screech-owls will readily use nest boxes, particularly if natural cavities are lacking (Cannings and Angell 2001, COSEWIC 2012b), as they likely are in the mature coniferous forest in and around the LSA. Therefore, no adverse residual effects from habitat loss are predicted after mitigation has been implemented, and net residual effects are predicted to be of negligible magnitude (Section 5.3.1.5.5.1.5; Table 5.3-20). After reclamation, western screech-owl are predicted to recover from disturbance effects experienced during construction and operational phases. Although the western screech-owl population may be sensitive to imposed stresses, the project after mitigation is not likely to contribute to the factors limiting the

population. The effects of the project are determined to be negligible – not significant for the western screech-owl population in the RSA.

5.3.1.5.6.1.6 Common Nighthawk

Common nighthawk is provincially yellow-listed and has been designated Threatened on Schedule 1 of SARA and by COSEWIC (BC CDC 2016, internet site; Government of Canada 2016, internet site). Available data from breeding bird surveys suggest that the BC population of common nighthawk has declined by 68% from 1970 to 2012 (average of 2.7% per year; Environment Canada 2015). However, breeding bird survey data are not designed for surveying for common nighthawks, and the accuracy of trends estimated from those data are therefore unknown (Environment Canada 2015). Reasons for the apparent decline of common nighthawk populations are not well understood, but may be due in part to diminishing populations of insect prey (Environment Canada 2015). Although population declines are likely, common nighthawks remain common and widespread, and the population in the RSA is likely to be self-sustaining and maintaining its ecological function. Therefore, the common nighthawk within the RSA is determined to have a moderately resilient to imposed stresses.

The Proposed Project will require removal of less than 0.1% of potential nesting habitat in the RSA, and net residual effects are predicted to be of negligible magnitude (Section 5.3.1.5.5.1.6; Table 5.3-21). After reclamation, common nighthawk populations are predicted to recover from disturbance effects experienced during construction and operational phases. The effects of the Proposed Project are not expected to exceed ecological thresholds or compromise the resilience of the regional population of common nighthawk, and are determined to be negligible – not significant.

5.3.1.5.6.1.7 Roosevelt Elk

Roosevelt elk is provincially blue-listed and has not been designated by COSEWIC or under *SARA* (BC CDC 2016, internet site; Government of Canada 2016, internet site). The population of Roosevelt elk within the RSA has been re-introduced and is predicted to be stable or increasing (Quayle and Brunt 2003). The available evidence suggests that the Roosevelt elk population in the RSA is self-sustaining and maintaining its ecological function. Therefore, the Roosevelt elk population within the RSA is determined to be resilient to imposed stresses.

Noise from the Proposed Project will affect approximately 3% of suitable Roosevelt elk winter habitat within the RSA and less than 1% of suitable habitat will be lost due to clearing. Net residual effects of the Proposed Project on elk are predicted to be of low magnitude (Section 5.3.1.5.5.1.7; Table 5.3-22). Well planned and executed reclamation of the Proposed Project Area will support restoration of suitable Roosevelt elk winter range habitat. After reclamation, Roosevelt elk populations are predicted to recover from disturbance effects experienced during construction and operational phases. The effects of the Proposed Project are not expected to exceed ecological thresholds and compromise the resilience of the regional population Roosevelt elk, and are therefore determined to be not significant..

5.3.1.5.6.1.8 Grizzly Bear

Grizzly bears are provincially blue-listed and the western populations are designated as a species of Special Concern by COSEWIC but are not listed under *SARA* (BC CDC 2016, internet site; COSEWIC 2002; Government of Canada 2016, internet site). Western populations of grizzly bear are thought to be stable; however, populations occurring at the southern extent of the Canadian range are in decline (COSEWIC 2002). The LSA occurs in the Squamish-Lillooet grizzly bear population unit, in which the grizzly bear population is listed as Threatened because it is estimated to be at less than 50% of the habitat's carrying capacity (BC MOE 2012). Therefore, to be precautionary, the grizzly bear population is determined to be sensitive to imposed stresses in the baseline case because it may be declining to extirpation in the RSA and may not be self-sustaining or ecologically effective. Grizzly bears are sensitive to human disturbance, and are directly threatened by factors that may result in mortality, such as any interactions with humans or traffic, as well as hunting or poaching. Hunting of grizzly bears is not authorized in the LSA, but poaching has been documented in the past in the Squamish-Lillooet population unit and may occur again (BC MOE 2012).

The Proposed Project will affect 6% of moderate and high suitability habitat (combined) within the RSA. Net residual effects of the Proposed Project on grizly bear are predicted to be of low magnitude (Section 5.3.1.5.5.1.8; Table 5.3-23). After reclamation, suitable grizzly bear habitat is predicted to recover from disturbance effects experienced during construction and operational phases. FLNRO is managing the habitat within the RSA for future population growth not current population presence and the closest known grizzly occurrence to the Proposed Project Area was recorded from the Squamish Estuary (Hamilton 2012, pers. comm.). No grizzly bears were recorded within the Proposed Project Area over three years of intensive survey data collection. As grizzly bears are not expected to occur within the Proposed Project Area, the Proposed Project is not predicted to contribute to the potential mortality of this species. The effects of the Proposed Project are not expected to contribute to the factors limiting the population of grizzly bears in the RSA, and are therefore determined to be not significant.

Table 5.3-25: Significance of Potential Residual Effects: Terrestrial Wildlife

VC	Residual Effect	Significance	Rationale
Construction and Operation			
Amphibian species at risk	Net residual effects from habitat loss, barriers to movement, and change in mortality.	Not significant	The northern red-legged frog population in the RSA at baseline conditions is likely to be self-sustaining and maintaining its ecological function because of limited development. The net effects of the Proposed Project on the northern red-legged frog population are predicted to be low in magnitude and are not expected to exceed ecological thresholds and compromise the resilience of the population.
Northern goshawk	Net residual effects from change in mortality.	Negligible - Not Significant	To be conservative, the northern goshawk population in the RSA is determined to be sensitive to imposed stresses under baseline conditions because it may be declining to extirpation and therefore may not be self-sustaining. The adverse effects of the Proposed Project are not likely to contribute to the factors limiting the population. The net effects of the Proposed Project on the northern goshawk population are predicted to be negligible in magnitude.

VC	Residual Effect	Significance	Rationale
Marbled murrelet	Net residual effects from change in mortality.	Negligible - Not Significant	The marbled murrelet population in the RSA at baseline conditions is likely to be self-sustaining and maintaining its ecological function. The net effects of the Proposed Project on the marbled murrelet population are predicted to be negligible in magnitude.
Band-tailed pigeon	Net residual effects from habitat loss and change in mortality.	Negligible - Not Significant	To be conservative, the band-tailed pigeon population in the RSA is determined to have be sensitive to imposed stresses under baseline conditions because it may be declining to extirpation and therefore may not be self-sustaining. The adverse effects of the Proposed Project are not likely to contribute to the factors limiting the population. The net effects of the Proposed Project on the band-tailed pigeon population are predicted to be negligible in magnitude.
Western screech-owl	Net residual effects from change in mortality.	Negligible- Not Significant	To be conservative, the western screech-owl population in the RSA is determined to be sensitive to imposed stresses under baseline conditions because it may be declining to extirpation and therefore may not be self-sustaining. After mitigation, the adverse effects of the Proposed Project are not likely to contribute to the factors limiting the population. The net effects of the Proposed Project on the western screech owl population are predicted to be negligible in magnitude.
Common nighthawk	Net residual effects from habitat loss and change in mortality.	Negligible - Not Significant	The common nighthawk population in the RSA at baseline conditions is likely to be self-sustaining and maintaining its ecological function. The net effects of the Proposed Project on the common nighthawk population are predicted to be negligible in magnitude.
Roosevelt elk	Net residual effects from habitat loss, barriers to movement, and change in mortality.	Not significant	The Roosevelt elk population in the RSA at baseline conditions is likely to be self-sustaining and maintaining its ecological function. The net effects of the Proposed Project on the Roosevelt elk population are predicted to be low in magnitude and are not expected to exceed ecological thresholds and compromise the resilience of the population.
Grizzly bear	Net residual effects from habitat loss and change in mortality.	Not significant	To be conservative, the grizzly bear population in the RSA is determined to be sensitive to imposed stresses under baseline conditions because it may be declining to extirpation and therefore may not be self-sustaining. After mitigation, the adverse effects of the Proposed Project are not likely to contribute to the factors limiting the population.

5.3.1.5.7 Level of Confidence

The level of confidence of predicted residual effects is provided in Table 5.3-26. The prediction confidence of the assessment on each VC is based on the effects assessment analysis, professional judgement and predicted effectiveness of mitigation.

Table 5.3-26: Level of Confidence in Potential Residual Effect Predictions: Terrestrial Wildlife

Residual Effect	Level of Confidence in Residual Effect Prediction	Level of Confidence Rationale
Construction and Operation		
Amphibian species at risk net effect	High	Conservative assumptions likely overestimate Project effects and mitigations are likely to be effective.
Northern goshawk net effect	High	Conservative assumptions likely overestimate Project effects and mitigations are likely to be effective.
Marbled murrelet net effect	High	Conservative assumptions likely overestimate Project effects and mitigations are likely to be effective.
Band-tailed pigeon net effect	High	Conservative assumptions likely overestimate Project effects and mitigations are likely to be effective.
Western screech-owl net effect	Moderate	Conservative assumptions likely overestimate Project effects and mitigations are likely to be effective. However, although unlikely, nesting habitat loss may occur, and mortality events may be more frequent than predicted.
Common nighthawk net effect	High	Conservative assumptions likely overestimate Project effects and mitigations are likely to be effective.
Roosevelt elk net effect	High	Conservative assumptions likely overestimate Project effects and mitigations are likely to be effective.
Grizzly bear net effect	Moderate	Conservative assumptions likely overestimate Project effects and mitigations are likely to be effective. However, although unlikely, a mortality event could occur.

5.3.2 Terrestrial Vegetation

5.3.2.1 Introduction

This section of the Environmental Assessment Certificate (EAC) Application/Environmental Impact Statement (EIS) (hereafter referred to as the EA) has been prepared by Golder Associates Ltd. (Golder). This EA addresses the effects of the Proposed BURNCO Aggregate Project (hereafter referred to as the Proposed Project) identified in the construction, operation, reclamation and closure phases on Value Components (VCs) related to terrestrial vegetation. Consideration has been given to mitigation measures proposed to mitigate any identified effects to acceptable levels, and any residual effects after mitigation have been characterized. Consideration has also been given to cumulative effects of other reasonable foreseeable future Projects in combination with the residual effects of the Proposed Project.

This section should be read in conjunction with the following technical baseline report(s) provided in Volume 4, Part G - Section 22.0.

- Appendix 5.3-B – BURNCO Aggregate Project: Vegetation Baseline Report.

5.3.2.2 Regulatory and Policy Setting

Table 5.3-27 provides a summary of the regulations and policies applicable to the Proposed Project as it relates to terrestrial vegetation.

Table 5.3-27: Regulatory and Policy Setting: Terrestrial Vegetation

Legislative Mandate	Agency	Descriptions and Prohibitions
Provincial		
Forest and Range Practices Act (2002)	Ministry of Forests, Lands and Natural Resource Operations	Sets requirements for planning, road building, logging, reforestation and grazing on forest and range licensees. This strategy applies to Crown forest and range land, as well as private land subject to tree farm or woodlot licences (*Forest and Range Practices Act* 2002).
B.C. Environmental Management Act (2003)	Ministry of Environment	Provides guidelines for the regulation of activities which introduce waste into the environment, store special waste, and treat or recycle special waste. This Act establishes, among others *Hazardous Waste Regulation*, Clean Air Provision, and the *Spill Reporting Regulation* and provides a permitting system to enable the authorized discharge of effluent to water, disposal of solid waste to land, and discharge of emissions to the atmosphere (*Environmental Management Act* 2003).
B.C. Weed Control Act (1996)	Ministry of Agriculture	Lists noxious weeds found in the province of BC and within specific regional districts. Individuals responsible for, or in possession of, land must control noxious weeds on their premises (*B.C. Weed Control Act* 1996).
Guidelines and Best Management Practices (BC MoE 2013)	Ministry of Environment	Guidelines and best management practice (BMPs) documents for many at-risk species and species of management concern in BC include: ▪ *Guidelines for Translocation of Plant Species at Risk in British Columbia* (2009) (BC MoE 2009a); and ▪ *Interim Guidelines for Wetland Protection and Conservation in British Columbia* (2009) (Wetland Stewardship Partnership 2009).
Federal		
Species at Risk Act (2002)	Environment and Climate Change Canada	Protects Canadian indigenous species, subspecies, and distinct populations from becoming extirpated or extinct, provides for the recovery of endangered or threatened species, and encourages the management of other species to prevent them from becoming at-risk. The Act prohibits damage to residences or critical habitat of listed species and applies only on federal land with the exception of aquatic species and migratory birds listed in the federal *Migratory Birds Convention Act*, 1994. In some circumstances, the federal prohibitions can be applied to other species on private or provincial Crown land if it is deemed that provincial or voluntary measures do not adequately protect a species and its residence (*Species at Risk Act* 2002).
Canadian Environmental Protection Act (1999)	Environment and Climate Change Canada	Prevents pollution and protects environment and human health. The Act assesses risks to environment and human health, and provides timeframes and tools for managing toxic substances. The disposal of wastes and other matter at sea within Canadian jurisdiction is prohibited unless the disposal is done under conditions of a permit issued by the Minister of Environment. The Environmental Registry, established under the Act, provides information on relevant policies, guidelines, permits and regulations and provides citizens with the opportunity to participate in public consultation and decision-making processes (*Canadian Environmental Protection Act* 1999).

5.3.2.3 Assessment Methodology

This section provides a description of the assessment methodology used in preparing the EA related to vegetation. The assessment methodology is presented in Volume 2, Part B - Section 4.0.

5.3.2.3.1 Valued Component Selection and Rationale

The VCs and measureable indicators identified for this assessment related to terrestrial vegetation have been identified to reflect issues and guidelines; potential Aboriginal concerns; issues identified by the BC Environmental Assessment Office (BC EAO) and CEA Agencies, other stakeholders; professional judgment and key sensitive resources; and species or social and heritage values. All identified candidate terrestrial vegetation VCs were carried forward in the effects assessment (e.g., no terrestrial vegetation VCs were excluded from the assessment). Additional details regarding the methods used to select VCs is provided in Part B, Volume 2 – Section 4.2.4.

Vegetation VCs were selected based on the following criteria:

- Regulatory status - federal and provincial Species at Risk (SAR) designations;
- Ecological importance – role in food chain, and regionally important species;
- Ecological vulnerability – uncommon or sensitive vegetation community;
- Provincial Integrated Wildlife Management Strategy (IWMS);
- Socio-economic importance – affecting socio-economic conditions of local individuals or First Nations; and
- Input from government agencies.

Three vegetation VCs were identified for the Proposed Project using the criteria outlined above. A summary of identified VCs, rationale for their inclusion in the assessment, and measureable parameters and endpoints are provided in Table 5.3-28 below.

Table 5.3-28: Valued Components and Measureable Indicators: Terrestrial Vegetation

Valued Component	Rationale	Measurable Parameters/Endpoints
Environmentally sensitive ecosystems (wetlands, riparian ecosystems, old growth forest)	*Wetlands:* Sensitive to disturbance, high potential for rare plant occurrence, important contributor to community- and landscape-level biodiversity, influence stream flow, water quality and water temperature and provide important habitat for a wide variety of wildlife. *Riparian ecosystems:* Sensitive to disturbance, high potential for rare plant occurrence, important contributor to community- and landscape-level biodiversity, provide important wildlife habitat, and important inputs to stream productivity, moderate water temperature, stabilize soil on wetland edges. *Old growth forest:* Important role in conserving species- and ecosystem-level biodiversity, wildlife habitat value, slow recovery time post-disturbance.	Change in areal extent within the Local Study Area (LSA) and Regional Study Area (RSA).
Ecosystems at risk	Limited provincial extent and distribution for these ecosystems make them important contributors to landscape-level biodiversity. High sensitivity to disturbance. Conservation status.	Change in areal extent within the LSA and RSA.
Plant species at risk	Limited provincial extent and distribution for these species make them important contributors to biodiversity. High sensitivity to disturbance. Conservation status.	Point locations affected by construction and operations.

5.3.2.3.1.1 Environmentally Sensitive Ecosystems

Three sub-VCs are included in this category to simplify the assessment. They are briefly defined below.

Wetlands are defined as "…land that is saturated with water long enough to promote wetlands or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activities which are adapted to a wet environment" (National Wetlands Working Group 1988). The primary hydrologic functions of wetlands include water flow regulation, groundwater recharge, and shoreline and erosion protection (Hanson et al. 2008). Other functions include filtration of water, nutrient exchange, climate regulation, and carbon sequestration and storage (Hanson et al. 2008). Wetlands are among the most productive systems and are of high socio-economic and ecological importance (Halls 1997). Wetlands are critical ecosystems for maintaining biodiversity (Halls 1997) and have high value for rare plants.

Riparian ecosystems are "…three-dimensional zones of direct physical and biotic interactions between terrestrial and aquatic ecosystems; boundaries of the riparian zone extend outward to the limits of flooding and upward into the canopy of streamside vegetation" (Kauffman et al. 2001). Riparian ecosystems provide valuable functions, including:

- Terrestrial and aquatic habitat for plants, invertebrates, fish, amphibians, birds and mammals;
- Streambank and floodplain stabilization;
- Attenuation and filtration of water;
- Temperature regulation (i.e., shading) of terrestrial and stream microclimates; and
- Stream nutrient inputs.

Riparian ecosystems are highly productive habitats that typically contain a high diversity of plant and animal species and contribute to local biodiversity. Riparian ecosystems are often sensitive to disturbance due to their characteristic soils (e.g., hygric moisture regime), which are susceptible to degradation by activities such as forest harvesting, resulting in increased erosion and stream sedimentation.

Old growth forests in coastal BC are defined as stands greater than 250 years old (BC MOFR and BC MoE 2010), which are important for maintaining biodiversity, providing wildlife habitat, and for their aesthetic and social value (MacKinnon 1998; Spies and Turner 1999). Old growth forests are structurally complex ecosystems characterized by multiple tree layers, canopy gaps, patchiness, wide tree spacing, an abundance of large woody debris, presence of wildlife trees (i.e. standing dead or decaying), trees with loose or furrowed bark, and trees with basal hollows (DeLong et al. 2004; Kneeshaw and Gauthier 2003). These forests provide a niche for specialized plants and animals (Franklin and Spies 1991); therefore, maintaining this seral stage on the landscape can help sustain biodiversity.

5.3.2.3.1.2 Ecosystems at Risk

Ecosystems at risk are evaluated by the BC Conservation Data Center and assigned a risk rating (i.e., red, blue, or yellow listed) based on the BC Conservation Framework (MoE 2009b). Within this framework, an ecosystem is defined as per the plant associations of the Biogeoclimatic Ecosystem Classification (BEC) system. Ecosystems at Risk, for the purposes of this assessment, are those listed with a provincial red or blue status.

Red-listed ecosystems include “any ecological community that is Extirpated, Endangered, or Threatened” in British Columbia. Extirpated ecological communities no longer exist in British Columbia, but do occur elsewhere. Endangered ecological communities are facing imminent extirpation or elimination. Threatened ecological communities are likely to become endangered if limiting factors are not reversed. Placing ecological communities on these lists flags them as being “at risk and requiring investigation” (BC CDC 2016).

Blue-listed ecosystems include “any ecological community considered to be of Special Concern (formerly Vulnerable) in British Columbia. Ecological communities of Special Concern have characteristics that make them particularly sensitive or vulnerable to human activities or natural events. Blue-listed ecological communities are at risk, but are not Extirpated, Endangered or Threatened” (BC CDC 2016).

5.3.2.3.1.3 Plant Species at Risk

Plant species at risk include provincially red and blue listed species as defined above for ecosystems as well as those designated federally on Schedule 1 of the *Species at Risk Act* (SARA).

5.3.2.3.2 Assessment Boundaries

5.3.2.3.2.1 Spatial Boundaries

The spatial boundaries for the EA have been selected to take into account the physical extent of the Proposed Project, physical extent of Project-related effects, and physical extent of any key environmental systems. The specific study areas for terrestrial vegetation are provided in Table 5.3-29 and Figure 5.3-1.

Table 5.3-29: Spatial Boundaries: Terrestrial Vegetation

Study Area	Description
Local Study Area (LSA)	The LSA for terrestrial wildlife and vegetation VCs includes the cadastral property boundaries DL6612, DL667, DL667A and DL667B owned by the Proponent. The wildlife LSA extends approximately 250 m to 500 m from the property boundary edge to the west, north and east to represent the area within which the majority of the indirect effects of the Project are expected to occur. The wildlife LSA boundary was further adjusted based on available mapping and ground truthing to align with the ecological conditions of the delta basin where changes in vegetation and slope were observed. The LSA extends approximately 1.8 km to the north of the property boundaries to where the McNab River changes from a delta river system to a canyon. The southern boundary of the wildlife LSA is bounded by the Thornbrough Channel (at the high tide mark). The LSA encompasses topographical features and habitat within the McNab Valley similar to the Proposed Project Area to facilitate the study of comparable habitat types. The wildlife LSA is contained within the McNab Creek watershed and the Coastal Western Hemlock (very wet maritime [CWHvm1]) biogeoclimatic zone. The vegetation and wildlife VCs will use the same LSA of 569 ha due to their ecological interdependence. The wildlife LSA encompasses the area in which the majority of direct and indirect measurable Project effects on vegetation and wildlife are expected during construction, operations and decommissioning.
Regional Study Area (RSA)	The wildlife RSA comprises 15 watersheds that empty in Howe Sound. The wildlife RSA is bounded by the Rainy River watershed to the west, by McNab Creek watershed to the north, by Mill Creek and SQAMWSD000058 watersheds to the northeast, and by Thornbrough Channel to the south (at the high tide mark). The vegetation and wildlife VCs will use the same RSA of 30,092 ha (301 km^2) due to their ecological interdependence. The wildlife RSA is large enough to assess direct and indirect Project-related effects, as well as cumulative effects on vegetation and wildlife VCs. The wildlife RSA is used to provide a regional, ecologically relevant context for the distribution of VCs, and the ecosystems they depend on. The wildlife RSA was selected to include: ▪ general environmental features present in the wildlife LSA to facilitate a comparison of habitat types; ▪ topographical breaks and watersheds that provide natural landscape barriers; and ▪ the home range of the largest fauna in the study area (i.e., 22,000 ha or 220 km2 for a coastal male grizzly bear [MacHutchon et al. 1993]) which covers a scale appropriate for assessing the effects of the Proposed Project on wildlife.

5.3.2.3.2.2 Temporal Boundaries

Based on the Proposed Project schedule, the temporal boundaries for the effects assessment for terrestrial vegetation are as follows:

- Project construction – 2 years;
- Project operations – 16 years; and
- Project reclamation and closure – on-going and 1 year beyond operations.

5.3.2.3.2.3 Administrative Boundaries

There are no administrative boundaries for the assessment of terrestrial vegetation.

5.3.2.3.2.4 Technical Boundaries

There are no technical boundaries for the assessment of terrestrial vegetation.

5.3.2.3.3 Assessment Methods

The Proposed Project's residual and cumulative effects for vegetation VCs are characterized based on the direction, magnitude, geographic extent, duration, frequency, reversibility, and ecological context at the LSA and RSA scales (Table 5.3-30). These parameters are used to define a residual effect as negligible-not significant, not significant or significant according to the assessment methodology defined in Volume 2, Part B - Section 4.0.

The baseline case is defined as the surveyed or pre-Project condition of the site which serves as a reference point against which effects are measured.

The condition of vegetation and ecosystems in the LSA and RSA (as outlined in the Vegetation Baseline Technical Report) were used to classify the effects of the Proposed Project on vegetation VCs during the construction, operational and reclamation/closure phases.

A Terrestrial Ecosystem Map (TEM) was prepared for the RSA (which includes the LSA). Working with GIS, this allows for the Proposed Project Area to be overlain on detailed ecosystem information in order to quantitatively assess net changes in vegetation as a result of the Proposed Project and contextualize the change at the RSA and LSA scales.

5.3.2.3.3.1 Existing Conditions

The information and methods used in this assessment for baseline characterisation of terrestrial vegetation have been obtained from the Vegetation Baseline Report (Volume 4, Part G – Section 22.0: Appendix 5.3-A).

Vegetation resources were investigated and described through a combination of a desktop review of existing information, field surveys, and development of GIS TEM product. Field studies included data collection in support

of TEM, rare plant surveys, and ecosystems at risk surveying. Two days of field surveys were conducted in May of 2010. An additional six field survey days were conducted in 2012: one in May, two in June, and three in August.

Timberline Natural Resources Group (Timberline) completed TEM for the RSA in 2007 and 2008 (Timberline 2007, 2008). The Timberline TEM field programs consisted of a combination of ground inspections (30%) and visual plots (70%) at a targeted sampling intensity of approximately one plot per 100 ha of Timberline TEM study area, equating to Survey Intensity Level 4 (RIC 1998). The Timberline mapping protocol generally followed the RIC (1998) standard with the following notable exceptions:

- Structural stage attributes were not mapped, as they were provided in a concurrent Vegetation Resource Inventory (VRI) program;
- The sampling intensity targets applied to productive forest land base because the TEM was completed for use in future timber supply reviews;
- The Coastal Mountain-heather Alpine zone was neither mapped nor classified; and
- Private lands were excluded from the mapped areas.

To meet the information requirements of the Proposed Project, the VRI dataset was updated in a GIS environment to reflect recent forestry activity by overlaying the BC Forest Tenure Cutblock dataset (FTA 4.0), which is available from the Land Resource Data Warehouse (LRDW). VRI polygon stand height and stand age classifications where updated where discrepancies were noted. Cutblocks that were apparent in Google Earth© imagery, but not reflected in the FTA 4.0 dataset, were hand-digitized and their attributes were updated accordingly.

Project-specific TEM was conducted within the LSA at a scale of 1:5,000 following the methods set out in the *Standards for Terrestrial Ecosystem Mapping in British Columbia* (RIC 1998). A Level 1 Survey Intensity Level (75 to 100% of vegetation polygons inspected) was chosen as per the guidelines set out in RIC (1998), with a resultant minimum survey effort of 2 full plots, 15 ground inspections, and 83 visual plots to meet sampling intensity requirements. Data collected during field surveys were used as the foundation for interpreting ecological units. Colour, ortho-rectified imagery obtained in 2008 was loaded into ArcGIS® 9.3 software for interpretation.

Background information on species and ecosystems at risk was compiled from available provincial databases (i.e., BC Conservation Data Centre). This includes regional occurrences as well as mapped known occurrence records.

Field surveys for plant species and communities at risk were carried out in conjunction with the TEM fieldwork. Systematic meandering surveys were carried out while traversing the site between TEM field plots as well as in the general vicinity of the plots. As no BC provincial standard currently exists for rare plant surveying, methods generally followed those laid out by Penny and Klinkenberg (2012) and the Alberta Native Plant Council (ANPC) (2012). As the fieldwork spanned eight separate trips over multiple years through different seasons, good coverage was considered to be achieved to account for varying phenology of plant species at risk with the potential to occur in the LSA.

5.3.2.3.3.2 Identifying Project Interactions

A preliminary evaluation of identified interactions between the various physical works and activities and the selected VCs across all spatial and temporal phases of the Proposed Project was undertaken to characterize interactions as one of the following:

a) Positive, none or negligible, requiring no further consideration; or
b) Potential effect requiring further consideration and possibly additional mitigation.

This evaluation is presented in Section 5.3.2.5.1. Rationale is provided for all determinations where there is no or negligible interaction and therefore no further consideration is required. For those Project-VC interactions that may result in a potential effect requiring further consideration, the nature of the effects (both adverse and positive) arising from those interactions is described. Potential effects include direct, indirect and induced effects.

Activities during all stages of the Proposed Project (i.e., construction, operational and reclamation/closure phases) were examined to identify those activities most likely to result in potential effects to terrestrial vegetation and ecosystems. An assessment of interactions of the Proposed Project with selected VCs was based on a comprehensive review of the literature, an appraisal of the environmental setting, professional judgment, and information provided by the Proponent including a summary of Proposed Project activities. Assessed Proposed Project activities included planned and unplanned (accidental) events.

5.3.2.3.3.3 Evaluating Residual Effects

Potential Project-related residual effects are characterized for the basis of determining the significance of potential residual adverse effects for each VC. The characterization of effects is undertaken in consideration of appropriate mitigation measures which are outlined in Section 5.3.2.5.3.

The Proposed Project's residual and cumulative effects for vegetation VCs are characterized based on the direction, magnitude, geographic extent, duration, frequency, reversibility, and ecological context at the LSA and RSA scales, as appropriate. These parameters are used to define a residual effect as Negligible-Not Significant, Not Significant or Significant according to the assessment methodology defined in Volume 2, Part B - Section 4.0. Potential residual effects were characterized using the following standard residual effects criteria (Table 5.3-30):

- **Magnitude** – the expected size or severity of the residual effect
- **Geographic Extent** – the spatial scale over which the residual physical, biological and/or social effect is expected to occur
- **Duration** – the length of time the residual effect persists
- **Frequency** – how often the residual effect occurs
- **Reversibility** - indicating whether the effect is fully reversible, partially reversible, or irreversible
- **Context** – the current and future sensitivity and resilience of the VC to change caused by the Proposed Project

The likelihood of potential residual effects occurring was characterized for Terrestrial Wildlife and Vegetation using appropriate quantitative or qualitative terms, with sufficient description of how conclusions were reached. The following scale was use for the assessment of likelihood:

- Low - likelihood of occurrence (0 to 40%) – Residual effect is possible but unlikely;
- Medium - likelihood of occurrence (41 to 80%) - Residual effect may occur, but is not certain to occur; and
- High - Likelihood of occurrence (81% to 100%) - Residual effect is likely to occur or is certain to occur.

Likelihood may be influenced by a variety of factors, such as the likelihood of a causal disturbance occurs or the likelihood of mitigation being successful.

5.3.2.3.3.4 Evaluating Significance of Residual Effects

The significance of potential residual adverse effects was determined for each VC based on the residual effects criteria and the likelihood of a potential residual effect occurring (Section 5.3.2.3.3.3), a review of background information and available field study results, consultation with government agencies and other experts, and professional judgement.

The rationale and determinations of the significance of potential residual effects on VCs are provided in Section 5.3.2.5.

5.3.2.3.3.5 Level of Confidence

The level of confidence for each predicted effect is discussed to characterize the level of uncertainty associated with both the significance and likelihood determinations. Level of confidence is typically based on expert judgement and is characterized as:

- Low: Limited evidence is available, models and calculations are highly uncertain, and/or evidence about potential effects is contradictory.
- Moderate: Sufficient evidence is available and generally supports the prediction.
- High: Sufficient evidence is available and most or all available evidence supports the prediction.

Professional judgement is based on factors such as local experience and the extent and anticipated effectiveness of mitigation. Effects that are well understood, but lack quantification, are rated as moderate in terms of confidence.

Table 5.3-30: Criteria for Characterizing Potential Residual Effects: Terrestrial Vegetation

VC	Context	Magnitude	Geographic Extent	Duration	Reversibility	Frequency
All Vegetation VCs	**Resilient:** A high natural resilience to imposed stresses; **Moderately Resilient:** A moderate natural resilience to imposed stresses; or **Sensitive:** Low natural resilience to imposed stresses.	**Negligible**: No measurable effect to <1%; **Low:** 1% to <10% change in measurement endpoint; **Medium:** 10% to 20% change in measurement endpoint; or **High:** >20% change in measurement endpoint.	**Local:** Effect restricted to LSA; **Regional:** Effect extends beyond the LSA into the RSA; or **Beyond Regional:** Effect extends beyond the RSA.	**Short-term:** <5 years; **Medium-term:** 5 years to life of Proposed Project; or **Long-term:** >life of Proposed Project.	**Fully reversible:** Effect reversible with reclamation and/or over time; Partially **Reversible:** Effect can be reversed partially; or **Irreversible:** Effect irreversible and cannot be reversed with reclamation and/or over time.	**Low:** Occurs rarely or during a specific period; **Medium:** Occurs intermittently; or **High:** Occurs continuously.

5.3.2.4 Baseline Conditions

Refer to the Vegetation Baseline Report provided in Volume 4, Part G – Section 22.0: Appendix 5.3-B of this EA for a complete description of baseline conditions; a summary is provided below.

The terrestrial RSA is 30,034 ha in size and spans three biogeoclimatic zones, dominated by the Coastal Western Hemlock (CWH) zone which occurs between sea level and mid-elevation areas. The CWH zone transitions, with increased elevation, to the Mountain Hemlock (MH) zone, which in turn transitions to the Coastal Mountain-heather Alpine (CMA) zone. Ecosystems within the terrestrial RSA are composed of the following:

- 18.5% (5,555.2 ha) old growth forests;
- 12.7% (3,818.3 ha) mature forest;
- 0.3% (82.4 ha) wetlands;
- 43.9% (13,194.3 ha) shrub-dominated, sapling forest, and young forest structural stages; and
- 15.9% (4,783 ha) unvegetated or sparsely vegetated areas. These include alpine areas, waterbodies, avalanche debris tracks, as well as developed and disturbed lands (i.e., roads).

Structural stage information (from the VRI data) was unavailable for 8.7% (2,601 ha) of the RSA. These areas are four scattered patches of unclassified land along the shoreline of Howe Sound north of the Proposed Project Area.

The terrestrial LSA is 569.1 ha in size and is completely within the CWH submontane very wet maritime biogeoclimatic variant (CWHvm1). Much of the LSA has previously been disturbed by logging, resulting in a broad range of structural stages throughout the area. Ecosystems within the terrestrial LSA are composed of the following:

- 0% (0 ha) old growth forest;
- 0.4% (2.5 ha) wetlands;
- 6% (34.1 ha) riparian forest;
- 20% (113.9 ha) mature forest;
- 45% (256.1 ha) shrub-dominated, sapling forest, and young forest structural stages; and
- 33.5% (190.7 ha) unvegetated or sparsely vegetated areas (as described above).

Mature forest occurs mainly on the east side of McNab Creek and at the upper elevations of the LSA. Forty-five percent (256.1 ha) of the LSA is in various stages of regeneration following logging; this includes areas dominated by shrubs, sapling forests, and young forests between 40 and 80 years old. Forestry data indicates that 26.8% of the LSA has been harvested since 1972.

The Proposed Project Area evaluated during the baseline assessment was approximately 70 ha in size; subsequent refinement of the Project equates to a footprint of 59.9 ha. The footprint is primarily situated within previously harvested areas.

Desktop review of existing information indicated 11 listed vascular plant species with the potential to occur within the LSA (BC CDC 2016); these are listed in Table 5.3-31. Rare plant surveying did not identify rare plants in the Proposed Project Area.

Table 5.3-31: Listed Vascular Plants with Potential to Occur in the Local Study Area

Scientific Name	English Name	BC List	Provincial/ Global Status*	COSEWIC Status	SARA Rank
Allium amplectens	slimleaf onion	Blue	S3/G4	Not Listed	Not Listed
Eleocharis kamtschatica	Kamchatka spike-rush	Blue	S2S3/G4	Not Listed	Not Listed
Eleocharis parvula	small spike-rush	Blue	S2S3/G5	Not Listed	Not Listed
Hypericum scouleri ssp. *nortoniae*	western St. John's-wort	Blue	S2S3/G5T?	Not Listed	Not Listed
Jaumea carnosa	fleshy jaumea	Blue	S2S3/G4G5	Not Listed	Not Listed
Malaxis brachypoda	white adder's-mouth orchid	Blue	S2S3/G4	Not Listed	Not Listed
Ophioglossum pusillum	northern adder's-tongue	Blue	S2S3/G5	Not Listed	Not Listed
Polemonium elegans	elegant Jacob's-ladder	Blue	S3?/G4	Not Listed	Not Listed
Rubus nivalis	snow bramble	Blue	S3?/G4?	Not Listed	Not Listed
Sanguisorba menziesii	Menzies' burnet	Blue	S2S3/G3G4	Not Listed	Not Listed
Toxicodendron diversilobum	poison oak	Blue	S3?/G5	Not Listed	Not Listed

Source: BC CDC (2016); *S = Provincial; G = Global; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; ? = Not Certain

Desktop review of existing information indicated 13 listed ecosystems with the potential to occur within the LSA. A review of BC MoE Sensitive Ecosystem Mapping Projects (BC MoE 2012) indicated that sensitive ecosystem mapping has not been previously conducted within the LSA. Terrestrial Ecosystem Mapping identified seven listed ecosystems in the LSA, occupying 34.8% (197.7 ha) of the LSA (Table 5.3-32). These listed ecosystems were not formally evaluated as element occurrences due to their disturbed nature within the LSA resulting from forest harvesting.

The most extensive listed ecosystem within the LSA is the Western hemlock – amabilis fir – deer fern (HD) which encompasses 16.8% (95.4 ha) of the LSA (Table 5.3-32). The second and third most prevalent are the Western hemlock – Western redcedar – Salal (HS) and the Sitka spruce – Salmonberry (SS), which encompass 12.9% (73.5 ha) and 4.1% (23.2 ha), respectively. Other listed ecosystems occur in trace amounts (Table 5.3-32).

Table 5.3-32: Distribution and designations of listed ecosystems within the LSA

Map code/ Site Series	Ecosystem Unit Name	BC List	Prov./Global Status*	Area within LSA (ha)	Percent of LSA (%)
Upland Forested Ecosystems					
HS/03	Western hemlock – Western redcedar – Salal	Blue	S3/G3	73.5	12.9
HD/06	Western hemlock – Amabilis fir – Deer fern	Blue	S3/GNR	95.4	16.8
Wetland and Riparian Ecosystems					
GS/Ed02	Tufted hairgrass – Douglas' aster estuarine meadow	Red	S2/G3	1.3	0.2
SP/00	Sitka spruce – Pacific crabapple	Blue	S3/GNR	4.4	0.8
SS/09	Sitka spruce – Salmonberry	Red	S2/G3	23.2	4.1
CD/10	Black cottonwood – Red-osier dogwood	Blue	S3/GNR	4.7	0.8
RC/ 14/Ws54	Western red cedar – Sitka spruce – Skunk cabbage	Blue	S3?/GNR	0.9	0.2
Total				**203.4**	**35.8**

Source: BC CDC (2016); *S = Provincial; G = Global; 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 =Secure; ? = Not Certain; NR = Not Ranked

5.3.2.4.1 Traditional Ecological and Community Knowledge Incorporation

TEK/CK information was gathered from a Project-specific study undertaken by *Sḵwx̱wú7mesh* (Squamish Nation) and from publicly-available sources. The TEK/CK information available at the time of writing was used to inform existing conditions and this effects assessment.

TEK/CK informed BURNCO's understanding of terrestrial wildlife and vegetation. The main sources of this information include:

- Occupation and Use Study (OUS) undertaken by *Sḵwx̱wú7mesh* (Traditions 2015 a,b)
- An expert report produced on behalf of Tsleil-Waututh Nation for another project (Morin 2015)
- Regulatory documents for other projects in close proximity to the Proposed Project Area (e.g., Eagle Mountain – WGP 2015 a,b; PMV 2015; WLNG 2015).

TEK/CK sources available at the time of writing provided no specific information on harvest locations, abundance or quality of terrestrial wildlife and vegetation, or other environmental knowledge regarding terrestrial wildlife and vegetation harvested in the RSA, including changes to these resources over time. Following is a general discussion of Aboriginal Groups' harvesting of terrestrial wildlife and vegetation within Howe Sound.

Sḵwx̱wú7mesh report availability of a wide variety of vegetation resources in their traditional territory, including elderberries, chokecherries, deerberries, huckleberries, salal berries, blueberries, wild crab-apples, salmonberries, trailing blackberries, horsetail, lady fern, fireweed, blackcap, cow-parsnip and arrow-grass. Edible roots include skunk cabbage, blue camas, chocolate lily, bracken fern, licorice fern, wild carrot, arrow-head, wild onion, yew wood, oceanspray wood (ironwood), broad-leafed maple wood, Douglas-fir, western birch, bitter cherry, and red and yellow cedar trees (Kennedy and Bouchard 1976b in Millennia 1997).

For a full summary of Aboriginal Group use and occupancy of Howe Sound refer to Part C.

5.3.2.5 Effects Assessment

5.3.2.5.1 Project-VC Interactions

A preliminary evaluation of identified interactions between the various physical works and activities and the selected VCs across all spatial and temporal phases of the Proposed Project is presented in Table 5.3-33, Table 5.3-34 and Table 5.3-35. Potential Project-VC interactions are characterized as:

a) Positive, none or negligible, requiring no further consideration; or

b) Potential effect requiring further consideration and possibly additional mitigation.

Rationale is provided for all determinations that there is no or negligible interaction and that no further consideration is required.

For those Project-VC interactions that may result in a potential direct, indirect and induced effects requiring further consideration, the nature of the effects (both adverse and positive) arising from those interactions is described in Section 5.3.1.5.3 below.

Table 5.3-33: Project-VC Interaction: Terrestrial Vegetation VC - Environmentally Sensitive Ecosystems

Project Activities	Description	VC – Environmentally Sensitive Ecosystems	
		Potential Interaction*	Potential Effect / Rationale for Exclusion
Construction			
1. Crew and equipment transport	▪ Daily water taxi ▪ Tug and barge transport of machinery/materials (est. 8 loads) ▪ Barge household and industrial solid waste barged off-site	●	▪ Potential for the introduction of invasive species, which can degrade sensitive ecosystems. ▪ A barge spill could result in the introduction of deleterious substances to sensitive ecosystems both on and off of the site.
2. Site preparation, including construction of the berms and dyke	▪ Logging, clearing and grubbing ▪ Grading ▪ Construction of the berms and dyke ▪ Compaction and laying of gravel base ▪ Limited improvements to existing on-site road infrastructure	●	▪ Potential for the introduction of airborne dust from nearby working machinery, vehicle traffic, and exposed soils. ▪ Potential for the introduction of sediment from surface runoff from soils exposed during construction.
3. Processing area installation, including conveyors and materials handling system)	▪ Installation and use of portable concrete batch plant for construction ▪ Installation of concrete foundations ▪ Installation of screens, crushers, wash plant, conveyor system and automated materials-handling system (i.e., reclaim tunnels) ▪ Installation of groundwater well as a source of make-up water for the wash plant	●	▪ Potential for the introduction of dust from working machinery. ▪ Potential for the introduction of sediment from surface runoff. ▪ Loss of extent of riparian ecosystem will occur where the conveyor will cross a stream within a transmission line RoW. ▪ Loss of extent of wetlands and riparian ecosystem will occur during clearing and construction of the processing area.
4. Substation construction and connection	▪ Construct electrical substation adjacent to existing BC Hydro transmission line ▪ Construct outdoor switchyard, electric building, and 100 m transmission line	O	▪ This activity is not expected to have any interaction with the VC; construction is entirely within an existing RoW and no sensitive ecosystems exist within the immediate vicinity.

Project Activities	Description	VC – Environmentally Sensitive Ecosystems	
		Potential Interaction*	Potential Effect / Rationale for Exclusion
5. Marine loading facility installation	▪ Remove existing mooring dolphins ▪ Steel pile installation ▪ Installation of conveyor, barge movement winch and mooring dolphins	●	▪ Loss of extent of wetlands and riparian ecosystem will occur during construction of the marine loading conveyor.
6. Pit development	▪ Dry excavation to remove overburden/topsoil ▪ Installation of clamshell and floating conveyor	●	▪ Potential for the introduction of dust from working machinery. ▪ Potential for the introduction of sediment from surface runoff. ▪ Potential for physical effects due to soil disturbance during stripping and soil handling may impact the establishment of riparian during reclamation. ▪ The permanent establishment of the pit area may result in an increased risk of windthrow to mature forest in the riparian area of McNab Creek.
7. Other ancillary land-based construction works	▪ Temporary construction infrastructure set up (trailers, temporary power, etc.) ▪ Upgrades to the existing heavy equipment maintenance shop and warehouse ▪ Upgrades to the existing fuelling facility for the storage of diesel and gasoline for on-site equipment ▪ Construct site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility and helipad ▪ Install contained washroom facilities ▪ Construct pump room for well/stream intake water distribution and fire-fighting	●	▪ Potential for the accidental introduction of deleterious substances to nearby riparian and wetland areas should a spill occur.
8. Other ancillary marine construction works	▪ Removal of existing small craft dock; install temporary dock for worker access ▪ Construct new floating small craft dock, the with tie-up area for a float plane, serviced with 30 amp (A) 125 volt (V) shore power ▪ Barge household and industrial solid waste off-site	●	▪ Potential for the accidental introduction of deleterious substances to the VC both on and off site as a result of a spill.

Project Activities	Description	VC – Environmentally Sensitive Ecosystems	
		Potential Interaction*	Potential Effect / Rationale for Exclusion
Operations			
9. Crew transport	▪ Daily water taxi	●	▪ Potential for the introduction of invasive species to the site which can degrade sensitive ecosystems.
10. Aggregate mining	▪ Use of electric powered floating clamshell dredge ▪ Primary screening and conveyance of extracted material to processing area ▪ Install channel plug in WC 2	●	▪ The permanent establishment of the pit area may result in an increased risk of windthrow to mature forest in adjacent downwind areas such as the riparian area of McNab Creek.
11. Processing (screening, crushing, washing)	▪ Screening to separate aggregate sizes ▪ Oversized gravels crushed ▪ Operation of wash plant fed using recycled water from two large storage tanks, supplemented with make-up water by a groundwater well. ▪ Drying and storage of fines and silt	●	▪ Potential for the introduction of dust to adjacent riparian and wetland areas from working machinery, clearing, and the storage and drying of fine materials. ▪ Potential for the introduction of sediment from surface runoff.
12. Progressive reclamation	▪ Ongoing earth works (including site clearing, surface material removal) ▪ Fines and silt mixed with organic overburden material and used for infilling, re-vegetation and landscaping	●	▪ Potential for the introduction of dust to adjacent riparian and wetland areas from working machinery during site clearing. ▪ Potential for physical effects due to soil disturbance due to soil handling during progressive reclamation which may impact the establishment of riparian during reclamation and landscaping. ▪ Potential for increased prevalence of invasive species due to exposed soil and disturbance.
13. Stockpile storage	▪ Processed sand and gravel conveyed to stockpile area ▪ Storage of processed materials in stockpiles	●	▪ Potential for the accidental introduction of deleterious substances from the conveyor into the modified riparian area within the transmission RoW.
14. Marine loading	▪ Transfer of stored material using marine conveyor system ▪ Barge loading ▪ Site and navigational lighting	O	▪ This activity is not expected to have any interaction with the VC.

Project Activities	Description	VC – Environmentally Sensitive Ecosystems	
		Potential Interaction*	Potential Effect / Rationale for Exclusion
15. Shipping	▪ Barge traffic (delivery/collection) in Howe Sound, Ramillies Channel, Thornbrough Channel, and Queen Charlotte Channel ▪ Tug and barge transport of fuel and consumables ▪ Navigational lighting	●	▪ Potential for the accidental introduction of deleterious substances into sensitive ecosystems on and off of the site in the event of a spill.
16. Refueling and maintenance	▪ Refueling and maintenance of on-site equipment	●	▪ Potential for the accidental introduction of deleterious substances into adjacent riparian areas and wetlands as a result of a spill.
Reclamation and Closure			
17. Crew and equipment transport	▪ Daily water taxi ▪ Tug and barge transport of machinery/materials ▪ Barge household and industrial solid waste barged off-site	●	▪ Potential for the introduction of invasive species to the site which can degrade sensitive ecosystems.
18. Removal of land-based infrastructure	▪ Remove surface facilities, including clamshell dredge, conveyor system, screens, crushers, wash plant, automated materials-handling system, heavy equipment maintenance shop and warehouse, fuelling facility, site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility, helipad and contained washroom facilities	●	▪ Removal of the conveyor system may result in impacts to the modified riparian area in the transmission RoW. ▪ Potential for the accidental introduction of deleterious substances into adjacent riparian areas and wetlands as a result of a spill.
19. Removal of marine infrastructure	▪ Remove marine facilities, in marine load out facility, jetty, conveyors and piles	O	▪ This activity is not expected to have any interaction with the VC.
20. Site reclamation	▪ Final completion of the pit lake, landscaping and re-vegetation to develop a functional ecosystem in the freshwater pit ▪ Landscaping and re-vegetation of processing area, berms and dyke	●	▪ New riparian areas will be created as a component of the Reclamation and Effective Closure Plan (Volume 4, Part G - Section 22.0: Appendix 4). Potential for the introduction of invasive species. ▪ Potential for the introduction of dust to adjacent riparian and wetland areas from working machinery during reclamation works. ▪ Soil disturbance during all handling of soil may negatively affect the physical and chemical properties thereby impacting the establishment of riparian during reclamation.

Notes:
O = Potential effect of Proposed Project activity on VC is positive, none or negligible; no further consideration warranted.
● = Potential effect of Proposed Project activity on VC that may require mitigation/benefit enhancement; warrants further consideration

Table 5.3-34: Project-VC Interaction Table: Terrestrial Vegetation VC - Ecosystems at Risk

Project Activities	Description	Ecosystems at Risk	
		Potential Interaction*	Potential Effect / Rationale for Exclusion
Construction			
1. Crew and equipment transport	▪ Daily water taxi ▪ Tug and barge transport of machinery/materials (est. 8 loads) ▪ Barge household and industrial solid waste barged off-site	●	▪ Potential for the introduction of invasive species to the site which can degrade ecosystems at risk. ▪ A barge spill during transport could result in the introduction of deleterious substances to ecosystems at risk both on and off of the site.
2. Site preparation, including construction of the berms and dyke	▪ Logging, clearing and grubbing ▪ Grading ▪ Construction of the berms and dyke ▪ Compaction and laying of gravel base ▪ Limited improvements to existing on-site road infrastructure	●	▪ Permanent loss of extent of one red-listed ecosystem and one blue-listed ecosystem will occur. ▪ Potential for the introduction of dust from working machinery and vehicle traffic into adjacent VC areas. ▪ Potential for the introduction of sediment from surface runoff.
3. Processing area installation, including conveyors and materials handling system)	▪ Installation and use of portable concrete batch plant for construction ▪ Installation of concrete foundations ▪ Installation of screens, crushers, wash plant, conveyor system and automated materials-handling system (i.e., reclaim tunnels) ▪ Installation of groundwater well as a source of make-up water for the wash plant	●	▪ Loss of extent of one blue-listed ecosystem will occur as result of the conveyor construction for the duration of the Project as well as the time required for re-establishment, post reclamation. ▪ Loss of extent of one red-listed ecosystem and two blue-listed ecosystems will occur during clearing and construction of the processing area for the duration of the Project as well as the time required for re-establishment, post reclamation.
4. Substation construction and connection	▪ Construct electrical substation adjacent to existing BC Hydro transmission line ▪ Construct outdoor switchyard, electric building, and 100 m transmission line	O	▪ This activity is expected to have no interaction with the VC; the construction is entirely within an existing RoW and no sensitive ecosystems exist within the immediate vicinity.
5. Marine loading facility installation	▪ Remove existing mooring dolphins ▪ Steel pile installation ▪ Installation of conveyor, barge movement winch and mooring dolphins	●	▪ Installation of the conveyor will result in a loss in the extent of a mature blue-listed ecosystem for the duration of the Project as well as the time required for re-establishment, post reclamation.

Project Activities	Description	Ecosystems at Risk	
		Potential Interaction*	Potential Effect / Rationale for Exclusion
6. Pit development	▪ Dry excavation to remove overburden/topsoil ▪ Installation of clamshell and floating conveyor	●	▪ Potential for the introduction of dust from working machinery into adjacent VC areas. ▪ Potential for the introduction of sediment from surface runoff. ▪ Potential for physical effects due to soil disturbance during stripping and soil handling may impact the reestablishment of natural ecosystems on the site. ▪ The permanent establishment of the pit area may result in an increased risk of windthrow to mature listed-ecosystems in adjacent downwind areas. ▪ Pit excavation will result in a loss of extent to one blue-listed ecosystem during the initial pit development and the ensuing 3 years of operation.
7. Other ancillary land-based construction works	▪ Temporary construction infrastructure set up (trailers, temporary power, etc.) ▪ Upgrades to the existing heavy equipment maintenance shop and warehouse ▪ Upgrades to the existing fuelling facility for the storage of diesel and gasoline for on-site equipment ▪ Construct site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility and helipad ▪ Install contained washroom facilities ▪ Construct pump room for well/stream intake water distribution and fire-fighting	●	▪ Potential for the accidental introduction of deleterious substances into adjacent ecosystems at risk in the case of a spill.
8. Other ancillary marine construction works	▪ Removal of existing small craft dock; install temporary dock for worker access ▪ Construct new floating small craft dock, the with tie-up area for a float plane, serviced with 30 amp (A) 125 volt (V) shore power ▪ Barge household and industrial solid waste off-site	●	▪ Potential for the accidental introduction of deleterious substances to the VC both on and off site as a result of a spill.

Project Activities	Description	Ecosystems at Risk	
		Potential Interaction*	Potential Effect / Rationale for Exclusion
Operations			
9. Crew transport	▪ Daily water taxi	●	▪ Potential for the introduction of invasive species to the site which can degrade ecosystems at risk.
10. Aggregate mining	▪ Use of electric powered floating clamshell dredge ▪ Primary screening and conveyance of extracted material to processing area ▪ Install channel plug in WC 2	●	▪ Through the 16-year lifespan of the Project, there will be a loss of extent to a portion of one red-listed ecosystem and two blue-listed ecosystems.
11. Processing (screening, crushing, washing)	▪ Screening to separate aggregate sizes ▪ Oversized gravels crushed ▪ Operation of wash plant fed using recycled water from two large storage tanks, supplemented with make-up water by a groundwater well. ▪ Drying and storage of fines and silt	●	▪ Potential for the introduction of dust to adjacent VC areas from working machinery, clearing, and the storage and drying of fine materials. ▪ Potential for the introduction of sediment from surface runoff.
12. Progressive reclamation	▪ Ongoing earth works (including site clearing, surface material removal) ▪ Fines and silt mixed with organic overburden material and used for infilling, re-vegetation and landscaping	●	▪ Potential for the introduction of dust to adjacent VC areas from working machinery during site clearing. ▪ Potential for physical effects due to soil disturbance during stripping and soil handling which may impact the establishment of natural ecosystems during reclamation. ▪ The development of the pit area and general clearing for site construction may result in a continued risk of windthrow to adjacent ecosystems at risk. ▪ Potential for increased prevalence of invasive species due to exposed soil and disturbance which can have a negative effect on natural ecosystems.
13. Stockpile storage	▪ Processed sand and gravel conveyed to stockpile area ▪ Storage of processed materials in stockpiles	●	▪ Potential for the introduction of dust to adjacent VC areas from stored stockpiles. ▪ Potential for the introduction of sediment to adjacent VC areas from surface runoff.
14. Marine loading	▪ Transfer of stored material using marine conveyor system ▪ Barge loading ▪ Site and navigational lighting	●	▪ Spillage along the conveyor may constitute an introduction of deleterious substances into a mature blue-listed ecosystem. ▪ Potential for the introduction of dust to adjacent VC areas from stored stockpiles.

Project Activities	Description	Ecosystems at Risk	
		Potential Interaction*	Potential Effect / Rationale for Exclusion
15. Shipping	▪ Barge traffic (delivery/collection) in Howe Sound, Ramillies Channel, Thornbrough Channel, and Queen Charlotte Channel ▪ Tug and barge transport of fuel and consumables ▪ Navigational lighting	●	▪ Potential for the accidental introduction of deleterious substances into listed ecosystems on and off of the site in the event of a spill.
16. Refueling and maintenance	▪ Refueling and maintenance of on-site equipment	●	▪ Potential for the accidental introduction of deleterious substances into adjacent VC areas in the event of a spill.
Reclamation and Closure			
17. Crew and equipment transport	▪ Daily water taxi ▪ Tug and barge transport of machinery/materials ▪ Barge household and industrial solid waste barged off-site	●	▪ Potential for the introduction of invasive species to the site which can degrade ecosystems at risk.
18. Removal of land-based infrastructure	▪ Remove surface facilities, including clamshell dredge, conveyor system, screens, crushers, wash plant, automated materials-handling system, heavy equipment maintenance shop and warehouse, fuelling facility, site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility, helipad and contained washroom facilities	●	▪ Potential for the accidental introduction of deleterious substances into adjacent VC areas in the event of a spill.
19. Removal of marine infrastructure	▪ Remove marine facilities, in marine load out facility, jetty, conveyors and piles	O	▪ This activity is not expected to have any interaction with the VC.
20. Site reclamation	▪ Final completion of the pit lake, landscaping and re-vegetation to develop a functional ecosystem in the freshwater pit ▪ Landscaping and re-vegetation of processing area, berms and dyke	●	▪ Potential for the introduction of invasive species. ▪ The permanent establishment of the pit area may result in an increased risk of windthrow to mature forest ecosystems downwind. ▪ Potential for the introduction of dust to adjacent VC areas from working machinery during reclamation works. ▪ Soil disturbance during all handling of soil may negatively affect the physical and chemical properties thereby impacting the establishment of natural ecosystems during reclamation.

Notes:
O = Potential effect of Proposed Project activity on VC is positive, none or negligible; no further consideration warranted.
● = Potential effect of Proposed Project activity on VC that may require mitigation/benefit enhancement; warrants further consideration

Table 5.3-35: Project-VC Interaction Table: Terrestrial Vegetation VC - Plant Species at Risk

Project Activities	Description	Plant Species at Risk	
		Potential Interaction*	Potential Effect / Rationale for Exclusion
Construction			
1. Crew and equipment transport	▪ Daily water taxi (12 PT) ▪ Tug and barge transport of machinery/materials (est. 8 loads) ▪ Barge household and industrial solid waste barged off-site	●	▪ Potential for the accidental introduction of deleterious substances into adjacent VC areas in the event of a spill. Must be considered beyond the boundary of the RSA.
2. Site preparation, including construction of the berms and dyke	▪ Logging, clearing and grubbing ▪ Grading ▪ Construction of the berms and dyke ▪ Compaction and laying of gravel base ▪ Limited improvements to existing on-site road infrastructure	●	▪ The potential for loss of extent of species that were not detected during the rare plant surveys.
3. Processing area installation, including conveyors and materials handling system)	▪ Installation and use of portable concrete batch plant for construction ▪ Installation of concrete foundations ▪ Installation of screens, crushers, wash plant, conveyor system and automated materials-handling system (i.e., reclaim tunnels) ▪ Installation of groundwater well as a source of make-up water for the wash plant	●	▪ The potential for loss of extent of species that were not detected during the rare plant surveys.
4. Substation construction and connection	▪ Construct electrical substation adjacent to existing BC Hydro transmission line ▪ Construct outdoor switchyard, electric building, and 100 m transmission line	O	▪ This activity is not expected to have any interaction with the VC.
5. Marine loading facility installation	▪ Remove existing mooring dolphins ▪ Steel pile installation ▪ Installation of conveyor, barge movement winch and mooring dolphins	O	▪ This activity is not expected to have any interaction with the VC.
6. Pit development	▪ Dry excavation to remove overburden/topsoil ▪ Installation of clamshell and floating conveyor	●	▪ The potential for loss of extent of species that were not detected during the rare plant surveys.

Project Activities	Description	Plant Species at Risk	
		Potential Interaction*	Potential Effect / Rationale for Exclusion
7. Other ancillary land-based construction works	▪ Temporary construction infrastructure set up (trailers, temporary power, etc.) ▪ Upgrades to the existing heavy equipment maintenance shop and warehouse ▪ Upgrades to the existing fuelling facility for the storage of diesel and gasoline for on-site equipment ▪ Construct site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility and helipad ▪ Install contained washroom facilities ▪ Construct pump room for well/stream intake water distribution and fire-fighting	●	▪ The potential for loss of extent of species that were not detected during the rare plant surveys.
8. Other ancillary marine construction works	▪ Removal of existing small craft dock; install temporary dock for worker access ▪ Construct new floating small craft dock, the with tie-up area for a float plane, serviced with 30 amp (A) 125 volt (V) shore power ▪ Barge household and industrial solid waste off-site	O	▪ This activity is not expected to have any interaction with the VC.
Operations			
9. Crew transport	▪ Daily water taxi	O	▪ This activity is not expected to have any interaction with the VC.
10. Aggregate mining	▪ Use of electric powered floating clamshell dredge ▪ Primary screening and conveyance of extracted material to processing area ▪ Install channel plug in WC 2	O	▪ This activity is not expected to have any interaction with the VC.
11. Processing (screening, crushing, washing)	▪ Screening to separate aggregate sizes ▪ Oversized gravels crushed ▪ Operation of wash plant fed using recycled water from two large storage tanks, supplemented with make-up water by a groundwater well. ▪ Drying and storage of fines and silt	O	▪ This activity is not expected to have any interaction with the VC.

Project Activities	Description	Plant Species at Risk	
		Potential Interaction*	Potential Effect / Rationale for Exclusion
12. Progressive reclamation	▪ Ongoing earth works (including site clearing, surface material removal) ▪ Fines and silt mixed with organic overburden material and used for infilling, re-vegetation and landscaping	O	▪ This activity is not expected to have any interaction with the VC.
13. Stockpile storage	▪ Processed sand and gravel conveyed to stockpile area ▪ Storage of processed materials in stockpiles	O	▪ This activity is not expected to have any interaction with the VC.
14. Marine loading	▪ Transfer of stored material using marine conveyor system ▪ Barge loading ▪ Site and navigational lighting	O	▪ This activity is not expected to have any interaction with the VC.
15. Shipping	▪ Barge traffic (delivery/collection) in Howe Sound, Ramillies Channel, Thornbrough Channel, and Queen Charlotte Channel ▪ Tug and barge transport of fuel and consumables ▪ Navigational lighting	●	▪ Potential for the accidental introduction of deleterious substances can impact listed plant species on and off of the site in the event of a spill.
16. Refueling and maintenance	▪ Refueling and maintenance of on-site equipment	●	▪ Potential for the accidental introduction of deleterious substances may impact listed plant species on and off of the site in the event of a spill.
Reclamation and Closure			
17. Crew and equipment transport	▪ Daily water taxi ▪ Tug and barge transport of machinery/materials ▪ Barge household and industrial solid waste barged off-site	●	▪ Potential for the accidental introduction of deleterious substances may impact listed plant species on and off of the site in the event of a spill.
18. Removal of land-based infrastructure	▪ Remove surface facilities, including clamshell dredge, conveyor system, screens, crushers, wash plant, automated materials-handling system, heavy equipment maintenance shop and warehouse, fuelling facility, site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility, helipad and contained washroom facilities	O	
19. Removal of marine infrastructure	▪ Remove marine facilities, in marine load out facility, jetty, conveyors and piles	O	▪ This activity is not expected to have any interaction with the VC.

Project Activities	Description	Plant Species at Risk	
		Potential Interaction*	Potential Effect / Rationale for Exclusion
20. Site reclamation	▪ Final completion of the pit lake, landscaping and re-vegetation to develop a functional ecosystem in the freshwater pit ▪ Landscaping and re-vegetation of processing area, berms and dyke	O	▪ This activity is not expected to have any interaction with the VC.

Notes:
O = Potential effect of Proposed Project activity on VC is Positive, positive, none or negligible; no further consideration warranted.
● = Potential effect of Proposed Project activity on VC that may require mitigation/benefit enhancement; warrants further consideration

5.3.2.5.2 Potential Project-Related Effects

5.3.2.5.2.1 General Description of Effects

Loss of Extent

Site clearing associated with the construction and operation phases of the Proposed Project will result in a direct loss in the areal extent of wetlands, riparian ecosystems, ecosystems at risk and potential habitat for plant species at risk. No old growth ecosystems will require clearing as a result of the Proposed Project. The reclamation phase of the Project (including progressive reclamation during operation) should result in a net gain of the sensitive ecosystem VC as well as a permanent loss of extent of the listed-ecosystem VC. Specifically, an estimated increase in the total area of riparian habitat within the LSA is anticipated as a result of reclaiming the banks and shoreline of the pit lake that will be formed over the operation of the mine. The pit lake will replace the mapped ecosystems at risk modified by forest harvesting, which currently exist on the site. Details are provided in the Residual Effects Assessment (Section 5.3.2.5.4).

The Proposed Project design aimed to reduce the amount of vegetation that would require clearing by siting the Project within areas of existing disturbance. The majority of the Proposed Project Area is sited within areas that have been previously disturbed by forest harvesting; 75.8% of the Proposed Project Area has been harvested since 1972.

Windthrow

Windthrow and wind damage occurs when vegetation (mostly trees) are exposed to high winds, which can greatly reduce the crown and stem quality (MoF 1999). Windthrow can impact wildlife habitat and may compromise the effectiveness of riparian buffer areas. Tree mortality occurs when the tree is toppled or crowns are broken off. The Project may increase exposure to wind along newly formed treeline edges (i.e., along new cleared areas) where trees were previously buffered by adjacent vegetation and are suddenly exposed to higher winds. The majority of areas with the potential for an increased risk of windthrow as a result of the Proposed Project are located along watercourses. Windthrow induced mass wasting is not expected based on relatively low relief topography.

The effects of windthrow are very difficult to quantify as they depend on numerous factors including the species, vigour, rooting depth, and soil characteristics as well as the physical effects of trees falling into the receiving environment. The effects are difficult to characterize as they may adversely impact streams due to increases in sedimentation and erosion, as well as the potential positive effects of increased coarse woody debris. However, and to be conservative, the impacts of windthrow on the areal extent of a sensitive ecosystem (i.e., primarily riparian) are considered to be adverse.

Surface Runoff

Surface runoff from disturbed areas (i.e., exposed soil) can contain suspended solids which may affect soil quality and vegetation. Low levels of sedimentation are not expected to have adverse effects to plant populations and ecosystems; however, high sedimentation levels have the potential to influence physical and chemical parameters, which may affect ecosystem function and vegetation quality. Sedimentation may affect vegetation both directly on the surface of the plant or indirectly through soil processes, and may result in reduced photosynthesis and

repressed growth. Wetlands and areas of low growing structure (i.e., grasslands, sedge meadows) are particularly sensitive to sedimentation where physical effects can include reduced germination (Jurik et al. 1994).

Deposition of Dust

Increases in ambient dust may result from site preparation and clearing activities as well as operational activities, such as crushing, processing, conveying and storage of materials. Dust deposition may have similar physical effects when surface runoff results in changes to the quality and quantity of vegetation in the receiving environment. Dust can coat vegetation, resulting in reduced photosynthesis and blocked stomata (Farmer 1991), which can lead to reduced growth and vigour and change the competitive balance of a vegetation community. Dust from the Project may be deposited into adjacent sensitive ecosystems and ecosystems at risk.

Invasive Species

All phases of the Project have the potential to introduce and encourage the spread of invasive species (including noxious weeds). Invasive species tend to be highly competitive pioneering species which will readily establish and persist on exposed soil. The primary vectors for the introduction of invasive species into the site include vehicles and equipment. Invasive plants have the potential to alter the competitive dynamics in a vegetation community, which may supress native species, change community structure, alter nutrient cycling and reduce biodiversity (ECCC 2014c).

Soil Disturbance

Soil disturbance, such as stripping and stockpiling, may result in physical changes to soil structure, which in turn may result in a loss of organic matter and changes to bulk density, porosity, microbial community structure and resistance to erosion (Wick et al. 2009). These changes may decrease the capacity of soils to support the growth and development of plant communities.

Introduction of Deleterious Substances

The introduction of deleterious substances to the environment in the event of a spill may affect vegetation in numerous ways, such as direct mortality, loss of vigour, and increased susceptibility to other forest pathogens. Impacts may be long term if soil chemistry is altered. The potential for the introduction of deleterious substances, associated with the Proposed Project, is associated with accidents or malfunctions, and therefore are considered to have a low likelihood of occurrence. Potential effects are also considered outside of the assessment areas, as barge transportation of equipment and fuel has the potential to effect areas along the transportation route.

5.3.2.5.2.2 Environmentally Sensitive Ecosystems

5.3.2.5.2.2.1 Construction

There are seven potential effects to the Environmentally Sensitive Ecosystems VC associated with construction being carried forward in this assessment:

- **Loss of extent:** Site clearing and construction of the mine area, conveyor, processing area, and marine loading conveyor will result in a loss of extent of riparian and wetland ecosystems (Table 5.3-36).

Table 5.3-36: Loss of Extent of Sensitive Ecosystems as a Result of the Proposed Project

Map Code/ Site Series	Ecosystem Unit Name	Total Area Impacted (ha)
Riparian Ecosystems		
AS/07	Amabilis fir – Western Redcedar – Salmonberry upland forest	0.1
SS/09	Sitka spruce – Salmonberry high fluvial bench forest	0.6
Wetland Ecosystems		
RC/ 14/Ws54	Western redcedar – Sitka spruce – Skunk cabbage swamp forest	0.8
SP/00	Sitka spruce – Pacific crabapple	0.3
GS/Ed02	Tufted hairgrass – Douglas' aster estuarine meadow	0.1

Clearing and removal of overburden for mine site preparation will result in the permanent loss of extent of a riparian ecosystem, consisting of 0.2 ha of Sitka Spruce – Salmonberry high fluvial bench forest (SS).

Disturbance of approximately 0.1 ha of riparian area will occur in Amabilis fir – Western Redcedar - Salmonberry upland forest (AS) along stream WC5 for the conveyor between the pit and the processing area. The conveyor has been located to minimize clearing requirements by utilizing the modified riparian area within a transmission RoW where the vegetation is managed. The conveyor has also been positioned adjacent to the western road to minimize the footprint and allow for maintenance access.

Clearing and construction of the processing area will result in the temporary loss of riparian forest, consisting of 0.4 ha of Sitka spruce – Salmonberry high fluvial bench forest (SS) and 0.3 ha of Sitka spruce – Pacific crabapple riparian forest (SP). Clearing and construction of the processing area will also require the removal of 0.8 ha of wetland area, consisting of Western red cedar – Sitka spruce- Skunk cabbage swamp forest (RC/ Ws54) and two associated vernal pools (Ponds 2 and 6).

Construction of the marine loading conveyor will result in the disturbance of 0.04 ha of Sitka spruce – Pacific crabapple riparian forest (SP), 0.03 ha of Sitka spruce – Salmonberry high fluvial bench forest (SS), and the disturbance and shading of 0.08 ha of wetland area, consisting of Tufted hairgrass – Douglas' aster estuarine meadow (GS/ Ed02).

- **Surface runoff:** Surface runoff during clearing, grubbing and stripping for the construction of the processing area and berm may introduce sediment-laden water into the riparian area of the stream between the mine pit and the processing facility.

- **Introduction of dust:** Clearing and grubbing associated with site preparation, pit development and road upgrades may result in an increase in ambient dust which can drift into adjacent areas including the riparian zone of the stream between the pit and processing area, McNab Creek, and the wetland (Pond 1) southwest of the processing area.
- **Invasive species:** Invasive plant species may be introduced to the site from residue containing seeds or propagules on crew and equipment being transported from an affected area.
- **Soil disturbance:** Soil disturbance may result from improper handling of soil during pit development, particularly during sorting and stock piling of topsoil. This may have implications for reclamation.
- **Windthrow:** Windthrow may impact the riparian areas along McNab Creek with the permanent development of the pit lake.
- **Accidents and Malfunctions - Introduction of deleterious substances:** Deleterious substances may be introduced to sensitive ecosystems as a result of an accidental spill in the vicinity of these resources. Spills may occur from any mechanical equipment, during refuelling, and during transportation of fuels and solid waste. As waste, equipment and fuel will be transported on and off of the site by barge the assessment of spill potential and extent must include a geographic area beyond the Project LSA and RSA.

5.3.2.5.2.2.2 Operations

There are six potential effects to the Environmentally Sensitive Ecosystems VC associated with the operation phase of the Project which are outlined below and are carried forward in this assessment.

- **Surface runoff:** Surface runoff from stored fines and silts may introduce sediment-laden water into the riparian area of the stream between the mine pit and the processing facility.
- **Introduction of dust:** Material screening and crushing during processing creates the risk of increasing ambient dust which can drift into adjacent areas that include the riparian zone of the stream between the pit and processing area, riparian forest east of the processing area, McNab Creek, and the wetland (Pond 1) southwest of the processing area. Earthworks during progressive reclamation may also introduce dust into riparian areas.
- **Invasive species:** Invasive species may be introduced to the site from residue containing seeds or propagules on crew and equipment being transported from an affected area. Progressive reclamation will require exposing soils which are vulnerable to colonization by invasive species.
- **Soil Disturbance:** Soil disturbance may result from improper handling of soil during progressive reclamation.
- **Windthrow:** Windthrow may impact the riparian forest east of the processing area, and riparian areas along McNab Creek as clearing associated with the pit development increases wind exposure along the treeline edge.
- **Accidents and Malfunctions - Introduction of deleterious substances**: Potential impacts to riparian areas may result from accidental spills, either from material spilling off of the conveyor into existing riparian habitat or as a result of an accidental spill during refueling or mechanical maintenance of equipment. As fuel and

consumables will be transported on and off of the site by barge, the assessment of spill potential and extent must include a geographic area beyond the Project LSA and RSA.

5.3.2.5.2.2.3 Reclamation and Closure

Reclamation should provide an increase (e.g., positive effect) in the measurable endpoint of the Environmentally Sensitive Ecosystems VC (i.e., an increase in the areal extent of riparian ecosystem within the LSA) as approximately 3.3 ha of new riparian habitat will be created as a result of site reclamation. The gain in riparian habitat is calculated as a 20 m buffer around the perimeter of the planned pit lake. The area calculation does not include areas where the new riparian buffer overlaps existing riparian habitat or where other non-riparian areas (i.e., roads) will remain post-reclamation.

Four potential effects to this VC associated with reclamation and closure are being carried forward in this assessment.

- **Introduction of dust:** Earthworks during reclamation may introduce dust into nearby riparian and wetland areas.
- **Invasive species:** Invasive plant species may be introduced to the site from residue containing seeds or propagules on crew and equipment being transported from an affected area. Reclamation will require exposing soils which are vulnerable to encroachment by invasive species.
- **Soil disturbance:** Soil disturbance may result from improper handling of soil during site reclamation; this may have implications for the establishment of vegetation, specifically, riparian areas along the edges of the pit lake.
- **Accidents and Malfunctions - Introduction of deleterious substances:** There is a potential for impacts to riparian areas as a result of accidental spills as a result of an accident spill during refueling or mechanical failure of equipment. As waste and fuel will be transported on and off of the site by barge, the risk of a spill must include a geographic area beyond the Project LSA and RSA.

5.3.2.5.2.3 Ecosystems at Risk

The primary effect to the Ecosystems at Risk VC is a loss of extent due to site clearing and pit development. The Project is located within an area that would naturally host listed ecosystems; however, due to forestry activities, this ecosystem is substantially modified and Project related effects are reduced as a result.

5.3.2.5.2.3.1 Construction

Seven potential effects to the Ecosystems at Risk VC associated with construction are being carried forward in this assessment. The effects are summarized below.

- **Loss of extent:** Five provincially listed ecosystems at risk occur within the Proposed Project Area. They are:
  - Blue-listed Western hemlock – Amabilis fir – Deer fern (HD);
  - Blue-listed Western red cedar – Sitka spruce – Skunk cabbage (RC/ Ws54);

- Blue-listed Sitka spruce – Pacific crabapple (SP);
- Red-listed Tufted hairgrass – Douglas' aster estuarine meadow (GS/ Ed02); and
- Red-listed Sitka spruce – Salmonberry (SS).

Site clearing associated with site preparation, dyke and berm construction and installation of the two conveyors will result in a direct loss in the areal extent of ecosystems at risk (Table 5.3-37). The mine design is phased so that much of the clearing will occur during the operation phase. However, to simplify this assessment, loss of extent as a result of clearing is considered under the construction phase. Therefore, the period of the impact may be delayed and shorter than described.

Table 5.3-37: Loss of Extent of Ecosystems at Risk as a Result of the Proposed Project

Map Code/ Site Series	Ecosystem Unit Name	BC List	Total Area Impacted (ha)	Total Area Within LSA (ha)	% Directly Impacted within the LSA[(a)]
HD/06	Western hemlock – Amabilis fir – Deer fern	Blue	44.3	95.4	46.4
RC/ 14/Ws54	Western redcedar – Sitka spruce – Skunk cabbage	Blue	0.8	0.9	88.9
SP/00	Sitka spruce – Pacific crabapple	Blue	0.3	4.4	6.8
GS/Ed02	Tufted hairgrass – Douglas' aster estuarine meadow	Red	0.08	1.3	6.2
SS/09	Sitka spruce – Salmonberry	Red	0.6	23.2	2.2

(a) %Directly Impacted within the LSA = (Total Area Impacted / Total Area within LSA) x 100

Clearing and removal of overburden for mine site preparation will result in a loss of extent of 41.3 ha of Western hemlock – Amabilis fir – Deer (HD) upland forest, and 0.2 ha of Sitka Spruce – Salmonberry high fluvial bench forest (SS).

The Proposed Project has been designed to reduce the amount of vegetation that would require clearing by siting the Project within areas of existing disturbance. For example, of the 44.3 ha of disturbance to the blue-listed Western hemlock – Amabilis fir – Deer (HD) fern ecosystem that dominates the Proposed Project Area, 32.9 ha (74%) has been previously modified by forest harvesting. This ecosystem is characterized by tall shrub structural stage with regenerating planted Douglas-fir (*Pseudotsuga menziesii*). Forestry records indicate that regenerating harvested areas make up 75.8% of the the Proposed Project Area.

Clearing and construction of the processing area will result in a temporary loss of 3 ha of Western hemlock – Amabilis fir – Deer fern (HD) upland forest, 0.8 ha of Western redcedar – Sitka spruce – Skunk cabbage (RC) swamp forest, 0.4 ha of Sitka spruce – Salmonberry high fluvial bench forest (SS), and 0.3 ha of Sitka spruce – Pacific crabapple riparian forest (SP). This represents a temporary loss for the life of the Proposed Project plus the time required to re-establish forest of similar age and structure (approximately 150 years until the forest is mature).

Construction of the marine loading conveyor will result in the disturbance of 0.01 ha of Western hemlock – Amabilis fir – Deer fern (HD) upland forest, 0.04 ha of Sitka spruce – Pacific crabapple riparian forest (SP),

0.03 ha of Sitka spruce – Salmonberry high fluvial bench forest (SS), and the disturbance and shading of 0.08 ha of Tufted hairgrass – Douglas' aster estuarine meadow (GS/ Ed02). This represents a temporary loss for the life of the Proposed Project plus the time required to re-establish forest of similar age and structure (approximately 150 years until the forest is mature).

- **Surface runoff:** Surface runoff during clearing, grubbing and stripping for the construction of the processing area, pit development, dyke and berms may introduce sediment-laden water into adjacent ecosystems at risk. Specifically, mature SS, HD, and RC ecosystems adjacent to the facilities area and SS ecosystem adjacent to the mine pit.
- **Introduction of dust:** Material screening and crushing during processing has the risk of increasing ambient dust, which can drift into adjacent areas including mature HD and SS ecosystems. Earthworks during progressive reclamation and improper storage of stocked soil may also introduce dust into adjacent ecosystems at risk.
- **Invasive species:** Invasive species may be introduced to the site from residue containing seeds or propagules on crew and equipment being transported from an affected area. Progressive reclamation will require exposing soils which are vulnerable to encroachment by invasive species. Invasive species can degrade natural ecosystems and hinder reclamation.
- **Soil disturbance:** Soil disturbance may result from improper handling of soil during grubbing and stripping for construction; this may have implications for the establishment of natural vegetation and recovery of ecosystems at risk on the site, post reclamation.
- **Windthrow:** Windthrow may impact mature ecosystems at risk with the development of the pit lake and other required site clearing. This effect is difficult to measure as it is difficult to link a windthrow event caused by strong winds to a direct result of clearing.
- **Accidents and Malfunctions - Introduction of deleterious substances:** A potential for impacts to ecosystems at risk exists as a result of accidental spills, either from material spilling off of the conveyor into existing riparian or as a result of an accidental spill during refueling or mechanical maintenance of equipment. As equipment and fuel will be transported on and off of the site by barge, the spill risk assessment considers a geographic area beyond the Project LSA and RSA.

5.3.2.5.2.3.2 Operations

Seven potential effects to the Ecosystems at Risk VC associated with the operations phase are being carried forward in this assessment and are outlined below.

- **Loss of extent:** The total loss of extent is described above under the Construction phase for this VC; however, pit development will be staged and the loss of extent to ecosystems at risk will be gradual over the 16-year life of the Project.
- **Surface runoff:** Surface runoff from stored fines and silts and areas of exposed soil (i.e., roads and facilities areas) may introduce sediment-laden water into the adjacent listed ecosystems.

- **Introduction of dust:** Clearing and grubbing associated with site preparation, pit development and road upgrades may result in an increase in ambient dust which can drift into adjacent areas, including ecosystems at risk.
- **Invasive species:** Invasive plant species may be introduced to the site from residue containing seeds or propagules on crew and equipment being transported from an affected area. Progressive reclamation will require exposing soils which are vulnerable to encroachment and colonization by invasive species.
- **Soil disturbance:** Soil disturbance may result from improper handling of soil during progressive reclamation; this may have implications for the establishment of natural vegetation and recovery of ecosystems at risk on the site, post reclamation.
- **Windthrow:** Windthrow may impact mature ecosystems at risk with the continued development of the pit lake and remains a potential risk as a result of previous clearing during construction. This effect is difficult to measure as it is difficult to link a windthrow event caused by strong winds as a direct result of clearing.
- **Accidents and Malfunctions - Introduction of deleterious substances:** There is a potential for impacts to ecosystems at risk as a result of accidental spills, either from material spilling from the marine conveyor into a mature blue-listed ecosystem or as a result of an accidental spill during refueling or mechanical maintenance of equipment. As waste, fuel and consumables will be transported on and off of the site by barge, the spill risk assessment must consider a geographic area beyond the Project LSA and RSA.

5.3.2.5.2.3.3 Reclamation and Closure

Five potential effects to the Ecosystems at Risk VC associated with reclamation and closure are being carried forward in this assessment.

- **Introduction of dust:** Earthworks during reclamation may introduce dust into adjacent ecosystems at risk.
- **Invasive species:** Invasive plant species may be introduced to the site from residue containing seeds or propagules on crew and equipment being transported from an affected area. Reclamation will require exposing soils that are vulnerable to encroachment and colonization by invasive species.
- **Soil disturbance:** Soil disturbance may result from improper handling of soil during site reclamation; this may have implications for the establishment of native vegetation, specifically, riparian areas along the edges of the pit lake.
- **Windthrow:** Windthrow may impact mature ecosystems at risk with the permanent development of the pit lake. This effect is difficult to measure as it is difficult to link a windthrow event caused by strong winds to a direct result of clearing.
- **Accidents and Malfunctions - Introduction of deleterious substances:** There is a potential for impacts to ecosystems at risk as a result of accidental spills during refueling or mechanical failure of equipment. As waste and fuel will be transported on and off of the site by barge, the spill risk assessment must include a geographic area beyond the Project LSA and RSA.

5.3.2.5.2.4 Plant Species at Risk

5.3.2.5.2.4.1 Construction

Two potential effects to the Plant Species at Risk VC associated with construction being carried forward in this assessment.

- **Loss of extent:** Though rare plant surveying did not detect any rare species, the potential that these species do exist on the site and where not detected during surveying should be considered. Therefore, the potential for a loss of extent of rare plant species is considered.
- **Accidents and Malfunctions - Introduction of deleterious substances:** There is potential for impacts to plant species at risk resulting from accidental spills or mechanical failure of equipment. As equipment and fuel will be transported on and off of the site by barge, the spill risk assessment considers a geographic area beyond the Project LSA and RSA.

5.3.2.5.2.4.2 Operations

One potential effect to the Plant Species at Risk VC associated with operations is being carried forward in this assessment.

- **Accidents and Malfunctions - Introduction of deleterious substances:** There is a potential for impacts to plant species at risk as a result of accidental spills or mechanical failure of equipment. As fuel and consumables will be transported on and off of the site by barge, the spill risk assessment considers a geographic area beyond the Project LSA and RSA.

5.3.2.5.2.4.3 Reclamation and Closure

One potential effect to the Plant Species at Risk VC associated with operations is being carried forward in this assessment.

- **Accidents and Malfunctions - Introduction of deleterious substances:** There is a potential for impacts to plant species at risk as a result of accidental spills or mechanical failure of equipment. As waste and fuel will be transported on and off of the site by barge, the spill risk assessment considers a geographic area beyond the Project LSA and RSA.

5.3.2.5.3 Mitigation

5.3.2.5.3.1 Introduction

This section provides a description of the proposed mitigation measures specifically related to the Proposed Project effects on VCs (Environmentally Sensitive Ecosystems, Ecosystems at Risk and Plant Species at Risk) for terrestrial vegetation. The suite of measures proposed to mitigate potential terrestrial vegetation effects are presented in Table 5.3-15.

The mitigation strategy outlined below forms the basis for the commitments that the Proposed Project is making with respect to terrestrial vegetation. A detailed list of all commitments of the Proposed Project are provided in Volume 3, Part F – Section 19.

5.3.2.5.3.2 Construction

- The Proposed Project design aims to utilize existing disturbed areas and avoid sensitive ecosystems (wetlands, riparian areas and old growth forests) where possible, thereby reducing the requirement for new clearing. The mine is situated within an existing cutblock area where the condition of ecosystems is modified.
- All proposed Project activities will be contained within the Proposed Project Area.
- Standing vegetation will be retained for as long as possible. During the construction phase, only areas required for infrastructure and preliminary mining will be cleared.
- A Fish Habitat Offset Plan (Volume 4, Part G – Section 22.0 Appendix 5.1-B) will be finalized and implemented for the Project. The plan will detail aquatic, riparian and wetland offsets to be created as compensation for loss of extent of these ecosystems as a result of the Proposed Project.
- An Erosion and Sediment Control Plan will be developed and implemented for the Project. The plan will identify areas prone to erosion and sedimentation and provide mitigation for these areas. Mitigation may include physical works such as sediment fencing, settling ponds and covers, as well as operational constraints (i.e., stop sensitive works during heavy rains). The Plan will also include effectiveness monitoring. Details of what will be provided in the Erosion and Sediment Control Plan are provided in Volume 3, Part E - Section 16.0.
- An Air Quality and Dust Control Management Plan will be prepared and implemented for the site. Jones (1999) and DeLuca et al. (2011) showed that road mitigation can effectively reduce the impacts of dust to the receiving environment. Details of what will be provided in the Air Quality and Dust Control Management Plan are described in Volume 3, Part E - Section 16.0.
- A site-specific Invasive Species Management Plan will be provided in the Vegetation Management Plan and will be developed to mitigate the introduction, transportation, and proliferation of invasive species (including noxious weeds) to and from the site, as required. The objectives of this plan will be to detect, control (remove), and monitor invasive species on the site. The implementation of this plan is anticipated to result in negligible residual effects to vegetation VCs as a result of invasive species. Details of what will be provided in the Vegetation Management Plan are described in Volume 3, Part E - Section 16.0.
- A Soil Management Plan will be developed within the Reclamation and Effective Closure Plan for the site prior to the commencement of construction. The objectives of this plan will be to prioritize soil replacement on the closure landscape, plan the stripping and sorting of topsoil, and mitigate potential changes to soil properties during storage. This will include maximizing the surface area of stockpiled soil and seeding it to minimize negative biological and chemical changes. Seeding stockpiles further reduce effects of wind and water erosion, promote soil structure formation, reduce nutrient leaching, and limit the potential for the establishment of invasive plants. The implementation of a Soil Management Plan is expected to result in a negligible change in the local soil quality as a result of soil handling and storage, and is expected to support reclamation and

assist in re-establishing the extent of riparian ecosystems within the LSA. Details of what will be provided in the Soil Management Plan are described in Volume 4, Part G - Section 22.0: Appendix 4.

- Trees susceptible to windthrow (i.e., leaning trees, standing dead, etc.) will be removed from treeline edges and newly created treeline edges will be feathered and irregular to reduce the impacts of wind. Buffer areas will be retained around potentially sensitive receptors of windthrow (i.e., streams) in order to minimize potential effects to receptors. Effectiveness monitoring will be employed to evaluate the severity and consequence of windthrow along treeline edges formed by the Proposed Project. Adaptive management (i.e., tree topping) will be employed, if necessary, to control any potential negative effects identified by the monitoring.
- A Construction Environment Management Plan (CEMP) will be developed for the construction phase of the Proposed Project. This plan will identify best practices to be followed during the construction phase. Specific requirements for fuel storage, containment, and refuelling will be provided in this plan. The plan will also specify scheduled equipment inspections and maintenance, as required.
- An independent Environmental Monitor (EM) will be onsite during sensitive works to provide mitigation advice and facilitate the implementation of the Erosion and Sediment Control Plan and the CEMP (Volume 3, Part E - Section 16.0).
- A Spill Prevention and Emergency Response Plan (Volume 3, Part E - Section 16.0) will be prepared for the site; this may be referred to in the CEMP for the construction phase. The Spill Prevention and Emergency Response Plan will identify hazardous materials on the site, prioritize contact and reporting requirements in the event of an emergency, identify spill prevention and clean up equipment requirements and provide a step by step approach to spill response.

5.3.2.5.3.3 Operations

- Progressive reclamation will be conducted during operation to minimize the disturbance footprint, reduce the risk of invasive species establishment, and reduce ambient dust from exposed soil. Reclamation planning will aim to re-establish functional listed ecosystems at the same proportion at which they were removed, where the final design allows.
- An Operational Environmental Management Plan (OEMP) will be prepared for the Project, which will include regular inspection and maintenance requirements for equipment being used on and off site.
- An Air Quality and Dust Control Management Plan (Section 5.3.2.5.3.2).
- An Erosion and Sediment Control Plan (Section 5.3.2.5.3.2).
- A Reclamation and Effective Closure Plan including a Soil Management Plan (Section 5.3.2.5.3.2).
- Removal of trees susceptible to windthrow and retention of buffer areas around sensitive receptors (Section 5.3.2.5.3.2).
- A Spill Prevention and Emergency Response Plan (Section 5.3.2.5.3.2).
- A site specific Invasive Plant Management Plan (Section 5.3.2.5.3.2).

5.3.2.5.3.4 Reclamation and Closure

- Develop and implement a vegetation monitoring program to assess the success of mine reclamation.
- An Air Quality and Dust Control Management Plan (Section 5.3.2.5.3.2).
- A site specific Invasive Plant Management Plan (Section 5.3.2.5.3.2).
- A Reclamation and Effective Closure Plan including a Soil Management Plan (Section 5.3.2.5.3.2).
- Removal of trees susceptible to windthrow (Section 5.3.2.5.3.2).
- A Spill Prevention and Emergency Response Plan (Section 5.3.2.5.3.2).
- A Fish Habitat Offset Plan (Section 5.3.2.5.3.2).
- Inspection of equipment being used on and off site will be continued through the reclamation phase as identified in the CEMP (Section 5.3.2.5.3.2).
- Reclaimed ecological units will be designed to be similar to those present prior to Project construction, where practicable. Approved native vegetation and trees will be used to reclaim disturbed areas and re-establish mature forest.

Table 5.3-38 Identified Mitigation Measures: Terrestrial Vegetation

Potential Effect	Mitigation	Anticipated effectiveness
Loss of Extent	▪ Project design aims to utilize disturbed areas and avoid sensitive ecosystems. ▪ Activities will be contained within surveyed Project boundary. ▪ Standing vegetation will be retained for as long as possible. ▪ Reclamation planning will aim to re-establish functional listed ecosystems at the same proportion at which they were removed, where final design allows. ▪ Ecological units will be created during the reclamation phase similar to those present prior to Project construction. ▪ Develop and implement a vegetation monitoring program to assess the success of mine reclamation.	Project design reduces the magnitude of the effect. Loss of riparian ecosystem and wetlands will occur. It is likely that the Fish Habitat Offset Plan will provide effective compensatory riparian and wetland habitat during operations. Riparian habitat will also be constructed around the pit lake during reclamation. Loss of extent of five ecosystems at risk will occur and will include temporary and permanent loss.
Surface Runoff	▪ An Erosion and Sediment Control Plan will be developed and implemented for the Project. ▪ An independent Environmental Monitor (EM) will be onsite during sensitive works.	Application of mitigation should control this effect.

Potential Effect	Mitigation	Anticipated effectiveness
Introduction of Dust	▪ An Air Quality and Dust Control Management Plan will be prepared and implemented during construction, operations and reclamation. ▪ Progressive reclamation to be conducted during operations to reduce ambient dust.	Mitigation is expected to reduce but not eliminate the effect.
Invasive Species	▪ A site specific Invasive Plant Management Plan will be developed. ▪ Progressive reclamation to be conducted during operation to reduce risk of invasive species establishment.	Application of mitigation should control this effect during construction and reclamation. Mitigation is expected to reduce but not eliminate the effect during operations.
Soil Disturbance	▪ A Soil Management Plan, including the Reclamation and Effective Closure Plan, will be developed and implemented during construction. The Soil Management Plan will be employed during reclamation and closure.	Mitigation is expected to reduce but not eliminate the effect.
Windthrow	▪ Trees susceptible to windthrow will be removed from treeline edges. ▪ Sensitive receptors (i.e., streams) will be buffered so that impacts are minimized. ▪ Monitoring of treeline edges will be conducted in order to evaluate potential windthrow effects and adaptive management will be employed, if necessary.	Mitigation is expected to reduce but not eliminate the effect.
Introduction of Deleterious Substances	▪ A Construction Environment Management Plan (CEMP) will be developed which will include regular inspections of equipment. ▪ A Spill Prevention and Response Plan will be prepared. ▪ An independent Environmental Monitor (EM) will be onsite. ▪ An Operation Environmental Management Plan will be prepared that includes regular scheduled equipment inspections.	Mitigation will reduce the likelihood of this effect.

5.3.2.5.4 Residual Effects Assessment

Potential Project-related residual effects have been characterized for each VC using the criteria identified in Table 5.3-30. The characterization of potential residual effects, following application of appropriate mitigation measures, to each VC are presented in Table 5.3-39, Table 5.3-40 and Table 5.3-41.

Table 5.3-39: Characterization of Potential Project-Related Residual Effects: Terrestrial Vegetation VC - Sensitive Ecosystems

Potential Effect	Residual Effect Assessment Criteria					
	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Construction and Operations						
Loss of Extent	Moderate natural resilience to imposed stresses	L	L	LT	FR	H
Surface Runoff	Moderate natural resilience to imposed stresses	N	L	MT	FR	L
Introduction of Dust	Resilient to imposed stresses	N	L	ST	FR	M
Invasive Species	Moderate natural resilience to imposed stresses	N	L	MT	FR	H
Soil Disturbance	Moderate natural resilience to imposed stresses	L	L	LT	FR	H
Windthrow	Moderate natural resilience to imposed stresses	N	L	MT	FR	L
Introduction of Deleterious Substances	Sensitive to imposed stresses	N	BR	MT	PR	L
Reclamation and Closure						
Introduction of Dust	Resilient to imposed stresses	N	L	ST	FR	M
Invasive Species	Moderate natural resilience to imposed stresses	N	L	MT	FR	H
Soil Disturbance	Moderate natural resilience to imposed stresses	N	L	LT	FR	L
Introduction of Deleterious Substances	Sensitive to imposed stresses	N	BR	MT	PR	L

Table 5.3-40: Characterization of Potential Project-Related Residual Effects: Terrestrial Vegetation VC - Ecosystems at Risk

Potential Effect	Residual Effect Assessment Criteria					
	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Construction and Operations						
Loss of Extent	Moderate natural resilience to imposed stresses	L	L	LT	PR	H
Surface Runoff	Moderate natural resilience to imposed stresses	N	L	MT	FR	L
Introduction of Dust	Resilient to imposed stresses	N	L	ST	FR	M
Invasive Species	Moderate natural resilience to imposed stresses	N	L	MT	FR	H
Soil Disturbance	Moderate natural resilience to imposed stresses	L	L	LT	FR	H
Windthrow	Moderate natural resilience to imposed stresses	N	L	MT	FR	L
Introduction of Deleterious Substances	Sensitive to imposed stresses	N	BR	MT	PR	L
Reclamation and Closure						
Introduction of Dust	Resilient to imposed stresses	N	L	ST	FR	Medium
Invasive Species	Moderate natural resilience to imposed stresses	N	L	MT	FR	High
Soil Disturbance	Moderate natural resilience to imposed stresses	N	L	LT	FR	Low
Windthrow	Moderate natural resilience to imposed stresses	N	L	MT	FR	Low
Introduction of Deleterious Substances	Sensitive to imposed stresses	N	BR	MT	PR	Low

Table 5.3-41: Characterization of Potential Project-Related Residual Effects: Terrestrial Vegetation VC – Plant Species at Risk

Potential Residual Effect	Residual Effect Assessment Criteria					
	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Construction and Operations						
Loss of Extent	Sensitive to imposed stresses	L	L	MT	PR	H
Introduction of Deleterious Substances	Sensitive to imposed stresses	N	BR	MT	IR	L
Reclamation and Closure						
Introduction of Deleterious Substances	Sensitive to imposed stresses	N	BR	MT	IR	L

Assessment Criteria:
Context: R – Resilient, MR – Moderately Resilient; S - Sensitive;
Magnitude: N – Negligible, L – Low, M – Medium, H – High;
Geographic Extent: L – Local, R – Regional, BR – Beyond Regional;
Duration: ST – Short-tern, MT – Medium-term, LT – Long-term;
Reversibility: FR – Fully Reversible, PR - Partially Reversible, IR - Irreversible;
Frequency: L – Low, M – Medium, H – High.

Table 5.3-42: Likelihood of Occurrence of Potential Residual Effects: Terrestrial Vegetation

VC	Residual Effect	Likelihood	Rationale
Construction and Operations			
Sensitive Ecosystems	Loss of Extent	High	Minimal clearing of sensitive ecosystems will occur, as per the Project design.
	Surface Runoff	High	Expected to be mostly controlled by mitigation.
	Introduction of Dust	High	Expected to be mostly controlled by mitigation.
	Invasive Species	High	Expected to be mostly controlled by mitigation.
	Soil Disturbance	High	Expected to be mostly controlled by mitigation.
	Windthrow	High	Effects should be limited to tree edge areas, few new windward edges will be created.
	Introduction of Deleterious Substances	Low	Mitigation is expected to reduce the likelihood of occurrence.
Ecosystems at Risk	Loss of Extent	High	n/a
	Surface Runoff	High	Expected to be mostly controlled by mitigation.
	Introduction of Dust	High	Expected to be mostly controlled by mitigation.
	Invasive Species	High	Expected to be mostly controlled by mitigation.
	Soil Disturbance	High	Expected to be mostly controlled by mitigation.
	Windthrow	High	Effects should be limited to tree edge areas, few new windward edges will be created.
	Introduction of Deleterious Substances	Low	Mitigation is expected to reduce the likelihood of occurrence.
Plant Species at Risk	Loss of Extent	Low	Rare plant surveys indicated that no rare plants are likely to be effected by the Proposed Project.
	Introduction of Deleterious Substances	Low	Mitigation is expected to reduce the likelihood of occurrence.
Reclamation and Closure			
Sensitive Ecosystems	Introduction of Dust	High	Expected to be mostly controlled by mitigation.
	Invasive Species	High	Expected to be mostly controlled by mitigation.
	Soil Disturbance	Low	Expected to be mostly controlled by mitigation.
	Introduction of Deleterious Substances	Low	Mitigation is expected to reduce the likelihood of occurrence.
Ecosystems at Risk	Introduction of Dust	High	Expected to be mostly controlled by mitigation.
	Invasive Species	High	Expected to be mostly controlled by mitigation.
	Soil Disturbance	Low	Expected to be mostly controlled by mitigation.
	Windthrow	Low	Reclaimed stands will develop wind firmness as they grow.
	Introduction of Deleterious Substances	Low	Mitigation is expected to reduce the likelihood of occurrence.
Plant Species at Risk	Introduction of Deleterious Substances	Low	Mitigation is expected to reduce the likelihood of occurrence.

5.3.2.5.4.1 Construction and Operations

5.3.2.5.4.1.1 Loss of Extent

Environmentally Sensitive Ecosystems

A permanent loss of 0.2 ha of Sitka Spruce – Salmonberry high fluvial bench forest (SS) will result from the clearing and removal of overburden for mine site preparation.

After reclamation, it is anticipated that there will be a net gain of 3.3 ha of riparian ecosystem due the construction of the pit lake and reclamation of the pit lake shoreline. The gain in riparian ecosystem is calculated as a 20 m buffer around the perimeter of the proposed pit lake. The calculation does not include areas where the riparian buffer overlaps existing riparian habitat or where other non-riparian areas (i.e., roads) will remain post-reclamation.

A temporary loss of the following riparian and wetland ecosystems will result from the construction of the conveyor, processing area, and marine loading conveyor:

- 0.4 ha of Sitka Spruce – Salmonberry high fluvial bench forest (SS);
- 0.3 ha of Sitka spruce – Pacific crabapple riparian forest (SP);
- 0.8 ha of wetland area, consisting of Western red cedar – Sitka spruce- Skunk cabbage swamp forest (RC/ Ws54) and two associated vernal pools (Ponds 2 and 6); and
- 0.08 ha of Tufted hairgrass – Douglas' aster estuarine meadow (GS/ Ed02).

The Fish Habitat Offset Plan (Volume 4, Part G – Section 22.0 Appendix 5.1-B) is likely to provide effective compensatory riparian and wetland habitat during operations for these temporary losses. The magnitude of this effect is considered low due to the small area of riparian and wetland habitat that will be affected by the Project. The potential effect is local in extent, medium-term, continuous over the duration of the Proposed Project (high frequency) and high likelihood of occurrence. The effect is fully reversible with reclamation.

Ecosystems at Risk

A permanent loss of extent of two ecosystems at risk will occur from the clearing and removal of overburden for mine site preparation, which will be reclaimed to the pit lake at closure:

- Provincially blue-listed Western hemlock – Amabilis fir – Deer fern upland forest (HD) – 23.7 ha (24.9% of HD ecosystem within the LSA, 4.8% of the RSA); and
- Provincially red-listed Sitka spruce – Salmonberry high fluvial bench forest (SS) – 0.2 ha (0.9% of SS ecosystem within the LSA, 0.5% of the RSA).

There will also be a temporary loss of ecosystems at risk during the construction and operation of the Proposed Project plus the time required for re-establishment, post-reclamation. Losses associated with mine site preparation, and construction of the processing area and marine loading conveyor are listed below. Re-establishment to its current condition is expected to occur within 150 years.

- Mine site preparation:
  - Provincially blue-listed Western hemlock – Amabilis fir – Deer fern upland forest (HD) – 17.6 ha (18.5% of HD ecosystem within the LSA, 3.5% of the RSA).
- Processing area and the marine conveyor:
  - Provincially blue-listed Western hemlock – Amabilis fir – Deer fern upland forest (HD) – 3 ha (3.2% of HD ecosystem within the LSA, 0.6% of the RSA);
  - Provincially blue-listed Western redcedar – Sitka spruce – Skunk cabbage swamp forest (RC/ Ws54) – 0.8 ha (88.9% of RC ecosystem within the LSA, 1.5% of the RSA);
  - Provincially blue-listed Sitka spruce – Pacific crabapple riparian forest (SP) – 0.3 ha (6.8% of SP ecosystem within the LSA, 6.8% of the RSA);
  - Provincially red-listed Tufted hairgrass – Douglas' aster estuarine meadow (GS/ Ed02) – 0.08 ha (6.2% of GS ecosystem the LSA, 1.6% of the RSA); and
  - Provincially red-listed Sitka spruce – Salmonberry high fluvial bench forest (SS) – 0.4 ha (1.7% of SS ecosystem within the LSA, 1.1% of the RSA).

The above estimates of percentage loss in the RSA are likely overestimations, because 8% of the RSA occurs over private land, parks and protected areas, where TEM was not conducted. To be precautionary, it was assumed that these ecosystems at risk are not present in areas of the RSA where TEM data are not available, thereby increasing estimates of percentage loss. In addition, the survey inspection level and mapping scale of the RSA TEM was not designed to identify ecosystems at risk; it was intended to be used for broad forestry planning. Therefore it is likely that listed ecosystems are underrepresented in the RSA TEM, and estimates of percentage loss are likely further overestimated.

The magnitude of the potential loss of ecosystems at risk is predicted to be low due to the predicted loss of less than 10% of the areal extent of these ecosystem types estimated to be present in the RSA. The effect is local in extent, long-term, high frequency (continuous through the life of the Project), and with a high likelihood of occurrence. The effect is partially reversible through reclamation with the exception of the areas of HD and SS ecosystems that will be replaced by the pit lake.

Plants Species at Risk

The likelihood of loss of extent to rare plants is considered low as rare plant surveys within the Project footprint did not identify populations that would be effected by the Project. However, surveys may not detect all occurrences and therefore, potential loss of rare plants is considered. The magnitude of the potential

loss of rare plants is predicted to be low and limited to the Project Area (local extent). The predicted effect is medium-term, continuous through the life of the Proposed Project (high frequency) and low likelihood of occurrence. The effect is considered partially reversible as plants can be salvaged or restored post-construction.

5.3.2.5.4.1.2 Surface Runoff

The effect of surface water runoff to sensitive ecosystems and ecosystems at risk is expected to be similar and therefore they are evaluated in combination within this section. The mitigation measures proposed to control surface water runoff are expected to be effective. After the implementation of mitigation measures the magnitude of the effect of surface runoff is predicted to be negligible. The potential effect is local in extent, medium-term, occurring infrequently (low frequency), and high likelihood of occurrence. The effect of runoff is predicted to be fully reversible.

5.3.2.5.4.1.3 Introduction of Dust

The potential effect of dust to sensitive ecosystems and ecosystems at risk is expected to be similar and therefore they are evaluated in combination within this section. Introduction of dust can be mostly controlled with mitigation (Jones 1999; DeLuca et at. 2011); however, it is expected that some increase in ambient dust will occur during the construction and operation phases. The Project operational design eliminates direct increases in dust from aggregate extraction (i.e., as this will be conducted under water). Increase in dust is expected to be localized along roadsides, site clearings and construction areas, and may affect small portions of the sensitive ecosystems and ecosystems at risk. The magnitude of the effect is predicted to be negligible after the implementation of mitigation measures. The potential effect is local in extent, short-term, occurring occasionally during Project construction (medium frequency), and high likelihood of occurrence. The effects of dust are predicted to be fully reversible.

5.3.2.5.4.1.4 Invasive Species

The potential effect of invasive species to sensitive ecosystems and ecosystems at risk is expected to be similar and therefore they are evaluated in combination within this section. Invasive species encroachment can be mostly controlled with mitigation. The magnitude of proliferation of invasive species is predicted to be negligible after the implementation of mitigation measures. The effects is predicted to be local in extent, medium-term, continuous over the duration of the Proposed Project (High frequency) and high likelihood of occurrence. The effect is predicted to be fully reversible with reclamation.

5.3.2.5.4.1.5 Soil Disturbance

Potential Project effects on soil and soil productivity have the potential to occur as a result of soil handling during Project construction, operation, and decommissioning and closure. The potential effects from Project interactions with soil quality are loss of soils to wind and water erosion; soil degradation from admixing or burial; soil compaction and rutting; and loss of soil productivity due to contamination. These effects are

typically related to site clearing earth works during construction, and soil salvage, stripping and stock pile storage during decommissioning and reclamation activities.

The potential effects of soil disturbance on sensitive ecosystems and ecosystems at risk are expected to be similar and therefore they are evaluated in combination within this section. Earthworks and site clearing can expose soils, resulting in water and wind removing potentially productive soils off site; and expose soils to compaction and rutting hazards, leading to degradation of soil quality. Admixing top soil (growth medium) with lower quality mineral soils (e.g., coarse textured, low nutrient holding capacity soils at depth) can also occur during both construction and reclamation activates. A reduction in soil quality of reclaimed soil (striped and stocked soil) may occur as a result of handling.

The potential for this effect will be mostly controlled with mitigation measures for soil handling, and will be described in the Reclamation and Effective Closure Plan (Volume 4, Part G – Section 22.0: Appendix 4). The loss of soil quality effects may negatively impact the re-establishment of sensitive ecosystems and ecosystems at risk, post reclamation. The magnitude of the potential effect of soil disturbance is predicted to be low. The potential effect is predicted to be local in extent, long-term, continuous throughout the duration of the Proposed Project (high frequency) and low likelihood of occurrence. The effect is expected to be fully reversible. The establishment of vegetation and the application of soil amelioration may be applied to reverse the effect, should it occur. Further, topsoil for reclamation is not expected to be limiting as there should be excess soil from the development of the pit lake.

5.3.2.5.4.1.6 Increased Windthrow

The potential effect of increased windthrow to sensitive ecosystems and ecosystems at risk is expected to be similar and therefore they are evaluated in combination within this section. Windthrow risk is the likelihood of damage from endemic winds based on the potential for biophysical hazards and treatment risks (Sathers et al, 1994). Biophysical hazard is the intrinsic stability of the stand in its pre-treatment or natural condition. Treatment risk is the way in which a particular treatment (e.g., orientation of newly exposed stand boundary from site clearing during construction) increases wind loading on residual trees. The risk of windthrow may increase post site clearing where newly opened stand boundaries may be subject to damaging winds. The potential for windthrow to occur is based on topographic exposure, stand characteristics, and soil conditions. Windfirming treatment mitigation measures are expected to reduce the biophysical hazard of the newly exposed boundary, but will not eliminate natural windthrow events.

Newly exposed windward treeline edge of mature riparian areas adjacent to newly cleared areas (i.e., along the northern boundary of the Project) may be susceptible to damaging winds. Potential effects include loss of forest stand and ecosystem, and possible sedimentation of watercourses due do disturbance along bank edges.

Monitoring will be employed in order to evaluate potential negative effects of windthrow prescription measures during Proposed Project construction and operation and adaptive management may be employed in order to control those effects, if necessary. Mitigation measures consist of a blowdown hazard assessment along boundaries planned for modification. This includes a pre site clearing field inspection by a qualified windthrow specialist, reporting with prescriptions for wind firming treatments, if required. The

effect is expected to be highly localized and therefore the magnitude is predicted to be negligible. The potential effect is predicted to be local in extent, medium-term, infrequent (low frequency) and high likelihood of occurrence. The effects of windthrow are expected to be fully reversible during Project remediation.

5.3.2.5.4.2 Reclamation and Closure

5.3.2.5.4.2.1 Introduction of Dust

The potential effect of dust to sensitive ecosystems and ecosystems at risk is expected to be similar and therefore they are evaluated in combination within this section. Introduction of dust can be mostly controlled with mitigation; however, it is expected that some increase in ambient dust will occur during the reclamation phase. This increase is expected to be localized along roadsides and areas where soil works are being conducted. This effect may impact small portions of the sensitive ecosystems and ecosystems at risk VCs, including those being reclaimed. Dust effects to vegetation is expected to be temporary and its effects reduced by frequent rain in the region. The magnitude of the effect is predicted to be negligible given the implementation of mitigation measures. The potential effect is predicted to be local in extent, short-term, occur occasionally throughout the reclamation phase (medium frequency), and high likelihood of occurrence. The effect is considered fully reversible.

5.3.2.5.4.2.2 Invasive Species

The potential effect of invasive species to sensitive ecosystems and ecosystems at risk is expected to be similar and therefore they are evaluated in combination within this section. Invasive species encroachment can be mostly controlled with mitigation. The magnitude of proliferation of invasive species is predicted to be negligible given the implementation of mitigation measures. The effects is predicted to be local in extent, medium-term, continuous over the reclamation phase of the Proposed Project (high frequency) and high likelihood of occurrence. The effect is predicted to be fully reversible through the reclamation and closure phase of the Proposed Project.

5.3.2.5.4.2.3 Soil Disturbance

A reduction in the quality of striped and stocked soil may occur as a result of handling. The potential for this effect should be mostly controlled with mitigation; however, a risk of reduced soil quality for reclamation purposes does exist. The magnitude of this effect during the reclamation and closure phase is predicted to be negligible. The effect will be local in extent, long-term, occur infrequently during this phase (low frequency) and is low likelihood of occurrence. The effect is considered fully reversible.

5.3.2.5.4.3 Accidents and Malfunctions - Introduction of Deleterious Substances

The potential effect of introduction of deleterious substances to sensitive ecosystems, ecosystems at risk, and rare plants is expected to be similar and therefore they are evaluated in combination within this section. Introduction of deleterious substances is considered in this assessment in the event of an accident or malfunction. The severity of a potential spill is difficult to determine but must include the region beyond the

Project assessment areas to account for barge transportation of equipment and crew. All three VCs may be impacted by this effect. Mitigation is applied in order to reduce the likelihood of an accident or malfunction that may result in a spill. The magnitude of this potential effect to VCs outside of the Proposed Project assessment areas is difficult to quantify, but is likely to be negligible at the scale of the RSA. The potential effect is predicted to extend beyond the RSA, be of medium-duration, infrequent of the life of the Proposed Project (low frequency) and low likelihood of occurrence. The effect is considered partially reversible.

5.3.2.5.5 Significance of Residual Effects

The significance of potential residual adverse effects will be determined for each VC based on the residual effects criteria and the likelihood of a potential residual effect occurring, a review of background information and available field study results, consultation with government agencies, First Nations, and other experts, and professional judgement. A summary of significance determinations is presented in Table 5.3-43.

The determination of significance of residual adverse effects is rated as negligible-not significant, not-significant, or significant, which are generally defined as follows:

- Negligible (and not significant): Negligible significance is defined, for the purposes of this assessment, as a residual effect with a negligible magnitude and/or not likely to occur, and do not meet the definition of significant. Adverse residual effects of negligible magnitude may still be significant if they contribute to the factors limiting a VC that is not self-sustaining or maintaining its ecological function in the baseline case. Negligible effects will not be carried forward to the cumulative effects assessment.
- Not significant: Effects determined to be not significant are residual effects greater than negligible that do not meet the definition of significant. Residual effects that are not significant will be carried forward to the cumulative effects assessment.
- Significant: A significant effect is defined, for the purposes of this assessment, as a residual effect that is predicted to exceed the resilience and adaptability limits of the VC such that it is not self-sustaining or maintaining its ecological function in the RSA. An effect is also significant for a VC that is not self-sustaining or maintaining its ecological function in the baseline case and is adversely affected by the project in a way that contributes to the factors limiting the VC. Significant residual effects will be carried forward to the cumulative effects assessment.

5.3.2.5.5.1 Construction and Operations

5.3.2.5.5.1.1 Loss of Extent

Sensitive Ecosystems

A total of 23.7 ha of regenerating harvested upland forest, 0.2 ha of high fluvial bench forest, and 7.7 ha of sparsely vegetated areas will be replaced by the 28.2 ha pit lake and associated 3.3 ha riparian area around its perimeter, totaling 31.5 ha post Project. Because the pit lake is entirely situated within an area modified by forest harvesting and other anthropogenic disturbance, the effect is determined to be not significant.

The temporary loss of approximately 0.7 ha of riparian ecosystem and 0.88 ha of wetland ecosystem resulting from construction of the conveyor, processing area, and marine loading conveyor has been minimized in area, and occurs adjacent to existing anthropogenic disturbance. A negligible change in ecosystem function from the current conditions is expected as a result. Riparian habitat is considered to be of moderate resilience because, although sensitive, it will re-establish in suitable conditions following reclamation. The effects of loss of extent to this VC are determined to be not significant because of the small and temporary nature of the impacts.

There will be a net positive gain in the extent of sensitive ecosystems in the LSA after reclamation. Specifically, the creation of the pit lake will result in an increase of 3.3 ha in riparian area.

Ecosystems at Risk

The Proposed Project is predicted to result in the permanent loss of 23.7 ha of modified Western hemlock – Amabilis fir – Deer fern (HD) upland forest and 0.2 ha of modified Sitka spruce – Salmonberry high fluvial bench forest (SS) ecosystems within the pit, berm areas, and overburden stockpile footprint.

The Proposed Project will also result in the temporary, long-term loss of 21.4 ha of ecosystems at risk during the construction and operation of the Proposed Project plus the time required for re-establishment, post-reclamation. Re-establishment to its current condition is expected to occur within 150 years.

The residual effect of loss of extent on ecosystems at risk is considered to have be low in magnitude for the all affected ecosystems at risk due to the predicted temporary loss of <10% of that estimated to be present in the RSA under baseline conditions. These estimates of percentage loss in the RSA are likely overestimations, because 8% of the RSA occurs in private land, parks and protected areas, where TEM mapping is not available, and listed ecosystems are likely underrepresented in the RSA TEM. To be precautionary, it was assumed that these ecosystems at risk are not present in areas of the RSA where TEM data are not available, thereby increasing estimates of percentage loss.

The loss of ecosystems at risk will be long-term (exceeding the lifetime of the Proposed Project) and will be confined to the LSA. Ecosystems at risk are considered to be of moderate resilience because, although sensitive, they can be re-established where suitable conditions exist. The reduction in the extent of these ecosystems within the RSA is primarily due to land development and forest harvesting. The majority of areas of ecosystems at risk likely to be impacted by the Project are already in a disturbed state due to past forest harvesting. The residual effects of the loss of ecosystems at risk is determined to be not significant for at risk ecosystems during construction and operations, and after reclamation.

Plant Species at Risk

No rare plants were identified during field surveys; although, potentially suitable habitat does exist within the LSA. The magnitude of the effect of loss of extent to rare plants is predicted to be negligible. The effect of loss of extent on rare plants is considered to have a low likelihood of occurrence, and the residual effect is predicted to be negligible-not significant.

5.3.2.5.5.1.2 Surface Runoff

The effects of surface runoff are expected to be completely controlled with mitigation; impacts may occur as a result of an accident or malfunction. Potential effects are expected to be restricted to areas adjacent to disturbed soils. Sensitive Ecosystems and ecosystems at risk are expected to have a moderate resilience to surface runoff as these areas are predominantly mature forests within the Project Area. Mature forest is less susceptible to the effects of surface runoff. This residual effect is considered to have a high likelihood of occurrence and determined to be negligible-not significant for the affected VCs.

5.3.2.5.5.1.3 Introduction of Dust

An increase in ambient dust and its associated potential effect to sensitive ecosystems and ecosystems at risk is expected to be mostly controlled through mitigation (i.e., Air Quality and Dust Control Management Plan). If impacts do occur, they are anticipated to be minor and temporary in nature. Regional climate produces considerable rain that can effectively remove the dust from leaf surfaces, thereby limiting adverse impacts. Potential effects are expected to be restricted to along roadways and in the vicinity of operating equipment during dry periods (likely only during the summer months). The resiliency of sensitive ecosystems and ecosystems at risk to the introduction of dust is considered high. As a result, the effects are determined to be negligible-not significant.

5.3.2.5.5.1.4 Invasive Species

The risk of invasive species is expected to be mostly controlled with mitigation. Potential effects are expected to be restricted to areas where soils are disturbed within the Proposed Project Area. Sensitive ecosystems and ecosystems at risk are expected to be moderately resilient to the effects of invasive species, which tend to be pioneering and are eventually outcompeted in natural forest succession. Where this is not the case and invasive species prevent natural succession, mitigation can be applied to re-establish a natural succession trajectory. The residual effect was considered to have a high likelihood of occurrence and was determined to be negligible-not significant for the affected VCs.

5.3.2.5.5.1.5 Soil Disturbance

Improper handling of soil can result in reduced soil quality. Mitigation (i.e., Soil Management Plan) is expected to reduce the magnitude and likelihood of this occurrence. The residual effects are local and fully reversible, with a predicted low magnitude. The resilience of the affected VC's is considered moderately resilient because natural soil processes should eventually reduce this effect. The effect has a high likelihood of occurrence, but is determined to be negligible-not significant for sensitive ecosystems and ecosystems at risk.

5.3.2.5.5.1.6 Windthrow

An increase in windthrown trees may occur within riparian areas (sensitive ecosystem VC) along the northern boundary of the Proposed Project. Mitigation is expected to reduce potential impacts. Impacts are

uncertain, localized and temporary. The resiliency of riparian ecosystems to windthrow is considered medium as the effects should be limited to tree edge areas and the resiliency of the ecosystem increases with time. The magnitude of potential effects is considered negligible, and with a high likelihood of occurrence. The effect is determined to be negligible-not significant for the sensitive ecosystem VC.

5.3.2.5.5.2 Reclamation and Closure

5.3.2.5.5.2.1 Introduction of Dust

An increase in ambient dust and its associated potential effect during operations are consistent with those described for construction in Section 5.3.2.5.5.1.3.

5.3.2.5.5.2.2 Soil Disturbance

Reduction in soil quality and its associated potential effect during operations are consistent with those described for construction in Section 5.3.2.5.5.1.5.

5.3.2.5.5.2.3 Invasive Species

The risk of invasive species and associated potential effects during reclamation and closure are consistent with those described for construction in Section 5.3.2.5.5.1.4.

5.3.2.5.5.2.4 Windthrow

Windthrow is less likely after reclamation (low likelihood), because residual trees will have had time to develop windfirmness during operations, and stands established during reclamation will develop windfirmness as the stand grows. The rationale and significance determination is otherwise as above for the construction and operations phases in Section 5.3.2.5.5.1.6.

5.3.2.5.5.3 Accidents and Malfunctions - Introduction of Deleterious Substances

The introduction of deleterious substances is considered only in the instance of an accident or malfunction. The application of mitigation is expected to reduce the likelihood of occurrence. However, as transportation of materials to site by barge is a component of the Proposed Project, the effects must be considered beyond the assessment areas. The resiliency of the vegetation VCs is considered sensitive because some pollutants can have long-term adverse effects. However, with implementation of mitigation the likelihood of occurrence is considered low, and the effect is determined to be negligible-not significant.

Table 5.3-43: Significance of Potential Residual Effects: Terrestrial Vegetation

VC	Residual Effect	Significance	Rationale
Construction and Operations			
Sensitive Ecosystems	Loss of Extent	Not Significant	The affected area is limited and the loss is temporary. Establishment of the pit lake after reclamation will result in an increase in sensitive ecosystems (riparian) in the LSA.
	Surface Runoff	Negligible - Not Significant	The implementation of mitigation is expected to reduce this effect. Any residual effect is local and reversible.
	Introduction of Dust	Negligible - Not Significant	The implementation of mitigation (i.e., Air Quality and Dust Control Management Plan) is expected to mostly mitigate this potential effect.
	Invasive Species	Negligible - Not Significant	Mitigation is expected to mostly mitigate this effect. Any residual effects are local and reversible.
	Soil Disturbance	Negligible - Not Significant	The implementation of mitigation (i.e., Soil Management Plan) is expected to mostly mitigate this effect. Any remaining residual effects can be reversed during reclamation.
	Windthrow	Negligible - Not Significant	Effects should be limited to tree edge areas.
	Accidents and Malfunctions - Introduction of Deleterious Substances	Negligible - Not Significant	The implementation of mitigation (i.e., environmental monitoring, CEMP, and spill response planning) reduces the likelihood of this effect as well as it's magnitude in the unlikely event of an accidental spill.
Ecosystems at Risk	Loss of Extent (RC /Ws54 swamp forest.)	Not Significant	The majority of the area that will be lost until after reclamation is currently in a disturbed state from forest harvesting. Reclamation will aim to replace these ecosystems.
	Loss of Extent (SS and HD ecosystem)	Not Significant	The magnitude of the area lost due to the conversion of terrestrial ecosystem to pit lake is reduced as these ecosystems are currently in a disturbed state due to forest harvesting. Reclamation will aim to replace these ecosystems.
	Surface Runoff	Negligible - Not Significant	The implementation of mitigation is expected to mostly mitigate this effect. Any residual effect is local and reversible.
	Introduction of Dust	Negligible - Not Significant	The implementation of mitigation (i.e., Air Quality and Dust Control Management Plan) is expected to mostly mitigate this potential effect.
	Invasive Species	Negligible - Not Significant	Mitigation is expected to mostly mitigate this effect. Any residual effects are local and reversible.
	Soil Disturbance	Negligible - Not Significant	The implementation of mitigation (i.e., Soil Management Plan) is expected to mostly mitigate this effect. Any remaining residual effects can be reversed during reclamation.

VC	Residual Effect	Significance	Rationale
	Windthrow	Negligible - Not Significant	This area that may be impacted by this effect is not considered significant within the context of the LSA.
	Accidents and Malfunctions - Introduction of Deleterious Substances	Negligible - Not Significant	The implementation of mitigation (i.e., environmental monitoring, CEMP, and spill response planning) reduces the likelihood of this effect as well as it's magnitude in the unlikely event of an accidental spill.
Plant Species at Risk	Loss of Extent	Negligible - Not Significant	No rare plants were identified during field surveys.
	Accidents and Malfunctions - Introduction of Deleterious Substances	Negligible - Not Significant	The implementation of mitigation (i.e., environmental monitoring, CEMP, and spill response planning) reduces the likelihood of this effect as well as it's magnitude in the unlikely event of an accidental spill.
Reclamation and Closure			
Sensitive Ecosystems	Introduction of Dust	Negligible - Not Significant	The implementation of mitigation (i.e., Air Quality and Dust Control Management Plan) is expected to mostly mitigate this potential effect.
	Invasive Species	Negligible - Not Significant	Mitigation is expected to mostly mitigate this effect. Any residual effects are local and reversible.
	Soil Disturbance	Negligible - Not Significant	The implementation of mitigation (i.e., Soil Management Plan) is expected to mostly mitigate this effect. Any remaining residual effects can be reversed during reclamation.
	Accidents and Malfunctions - Introduction of Deleterious Substances	Negligible - Not Significant	The implementation of mitigation (i.e., environmental monitoring, OEMP, and spill response planning) reduces the likelihood of this effect as well as it's magnitude in the unlikely event of an accidental spill.
Ecosystems at Risk	Introduction of Dust	Negligible - Not Significant	The implementation of mitigation (i.e., Air Quality and Dust Control Management Plan) is expected to mostly mitigate this potential effect.
	Invasive Species	Negligible- Not Significant	Mitigation is expected to mostly mitigate this effect. Any residual effects are local and reversible.
	Soil Disturbance	Negligible - Not Significant	The implementation of mitigation (i.e., Soil Management Plan) is expected to mostly mitigate this effect. Any remaining residual effects can be reversed during reclamation.
	Windthrow	Negligible - Not Significant	Effects should be limited to tree edge areas.
	Accidents and Malfunctions - Introduction of Deleterious Substances	Negligible - Not Significant	The implementation of mitigation (i.e., environmental monitoring, OEMP, and spill response planning) reduces the likelihood of this effect as well as it's magnitude in the unlikely event of an accidental spill.

VC	Residual Effect	Significance	Rationale
Plant Species at Risk	**Accidents and Malfunctions -** Introduction of Deleterious Substances	Negligible - Not Significant	The implementation of mitigation (i.e., environmental monitoring, OEMP, and spill response planning) reduces the likelihood of this effect as well as it's magnitude in the unlikely event of an accidental spill.

5.3.2.5.6 Level of Confidence

The level of confidence of predicted residual effects is provided in Table 5.3-44. The prediction of confidence for each residual effect was conducted for the assessment and is based on scientific information, professional judgement and the assumed effectiveness of mitigation (rated as high > 80% confidence, medium 40% to 80% confidence, and low < 40% confidence).

Table 5.3-44: Level of Confidence in Potential Residual Effect Predictions: Terrestrial Vegetation

Residual Effect	Level of Confidence (in Residual Effect Prediction	Level of Confidence Rationale
Construction and Operations		
Loss of Extent	High	Measurable and predictable endpoint
Invasive Species	Medium	Based on conservative professional judgement. Mitigation likely to be effective at reducing this effect.
Surface Runoff	Medium	Based on conservative professional judgement
Introduction of Dust	High	Based on scientific information, professional judgement and experience with similar Projects.
Windthrow	Medium	Based on conservative professional judgement.
Soil Disturbance	Medium	Soil Management Plan and reclamation are expected to reduce this effect.
Accidents and Malfunctions - Introduction of Deleterious Substances	Medium	Based on conservative professional judgement. Mitigation likely to be effective at reducing this effect.
Reclamation and Closure		
Introduction of Dust	High	Based on professional judgement and experience with similar Projects.
Invasive Species	Medium	Based on conservative professional judgement. Mitigation likely to be effective at reducing this effect.
Windthrow	Medium	Based on conservative professional judgement.
Soil Disturbance	Medium	Soil Management Plan and reclamation are expected to reduce this effect.
Accidents and Malfunctions - Introduction of Deleterious Substances	Medium	Based on conservative professional judgement. Mitigation likely to be effective at reducing this effect.

5.3.3 Cumulative Effects Assessment

Cumulative effects result from interactions between Proposed Project-related residual effects and incremental effects of past, present and reasonably foreseeable projects and activities. Potential effects from past and present projects were assessed as part of the baseline conditions. Cumulative effects assessment methodology is described in Volume 2, Part B - Section 4.6.

5.3.3.1 Cumulative Effects Assessment Boundaries

As described in Section 5.3.1.3.2 and 5.3.2.3.2, the spatial boundary of the cumulative effects assessment for Terrestrial Wildlife and Vegetation is the Terrestrial RSA, which is defined as a 30,034 ha area, comprising the McNab Creek watershed and 14 adjacent watersheds that empty into Howe Sound. The RSA is bounded by Thornbrough Channel of Howe Sound to the south, the Rainy River watershed to the southwest, the Mill Creek watershed to the northeast, and mountain ranges to the north. The spatial extent of the RSA for the cumulative effects assessment is the same as for the Project effects assessment and is described in Table 5.3-4 and shown in Figure 4-5 in Volume 2, Part B – Section 4.0.

5.3.3.2 Residual Effects Considered in Cumulative Effects Assessment

Residual effects of the Proposed Project that were considered for the cumulative effects assessment are provided in Table 5.3-45**.** Rationale is provided where residual Project effects were excluded from the cumulative effects assessment. Residual Project effects characterized as being of negligible magnitude are not predicted to make a measureable contribution to cumulative effects, and therefore were not carried forward to the cumulative effects assessment.

Table 5.3-45: Residual Effects Considered in Cumulative Effects Assessment

VC	Residual Project Effect	Considered in Cumulative Effects Assessment	Rationale
Amphibian species at risk (i.e., red-legged frog, western toad)	▪ Habitat loss ▪ Barriers to movement ▪ Change in mortality	Yes	Potential for cumulative effects
Northern goshawk	▪ Change in mortality	No	Effects of negligible significance are not carried forward
Marbled murrelet	▪ Habitat loss ▪ Change in mortality	No	Effects of negligible significance are not carried forward
Band-tailed pigeon	▪ Habitat loss ▪ Change in mortality	No	Effects of negligible significance are not carried forward
Western screech-owl	▪ Change in mortality	No	Effects of negligible significance are not carried forward

VC	Residual Project Effect	Considered in Cumulative Effects Assessment	Rationale
Common nighthawk	▪ Habitat loss ▪ Change in mortality	No	Effects of negligible significance are not carried forward
Roosevelt elk	▪ Habitat loss ▪ Change in mortality ▪ Barriers to movement	Yes	Potential for cumulative effects
Grizzly bear	▪ Habitat loss ▪ Change in mortality	Yes	Potential for cumulative effects
Environmentally sensitive ecosystems (wetlands, riparian ecosystems, old growth forest)	▪ Loss of extent	Yes	Potential for cumulative effects
Ecosystems at risk	▪ Loss of extent	Yes	Potential for cumulative effects

5.3.3.3 Effects of Other Projects and Activities

A list of past, present and reasonably foreseeable projects and activities with potential effects that could interact temporally and/or spatially with Proposed Project-related residual effect are provided in Table 4-5 in Section 4.5.5. Those that have potential to result in cumulative effects to Terrestrial Wildlife and Vegetation are provided in Table 5.3-46. All other projects were not considered to interact with this residual effect because:

- The project does not occur within the RSA identified for the Terrestrial Wildlife and Vegetation CEA.
- The project is not predicted to affect the VCs identified for the Proposed Project and therefore will not result in an interaction.
- The project is considered part of the baseline environmental conditions assessed for each of the VCs assessed.

Table 5.3-46: Potential Incremental Effects of Other Project and Activities on Terrestrial Wildlife and Vegetation VCs

Project	Timeline	Phase of the project overlaps with the Proposed Project[1]	Project Description	Rationale
Past, Present Reasonably and Reasonably Foreseeable Future Projects				
Retired and Active Forest Tenures (Various)	Ongoing	Operations	▪ Large scale logging near to and within the Proposed Project Area. ▪ The proposed material loading facility is located within the waterlot used by Canfor to store and boom logs	Historical and active logging has and continues to modify the landscape by changing ecosystem composition and wildlife habitat.
Road-building for forestry (Various)	Current and ongoing	Construction and Operations	▪ Current Howe LU road length: 355 km.	Roadway construction can result in loss or changes to ecosystems and wildlife habitat. Existing and new roadways introduce linear features and may create movement barriers for wildlife species. Existing and new roadways constructed for forestry introduce vehicle traffic increasing the risk of wildlife collisions and mortality.
Active and Pending Forest Tenures (Various)	Several. Exact timelines for tenures are unknown.	Construction and operations.	▪ Crown component of Timber Harvesting Forestry Land Base in Howe LU is 11,285 of 52,209 total gross hectares.	Future forest harvesting and associated activities (e.g., log transport) may affect habitat, mortality and movement for the selected wildlife VCs. Forest harvesting may also reduce or change the extent of vegetation VCs.

[1] When timelines are uncertain it was assumed that the Proposed Project would overlap with both construction and operations.

Project	Timeline	Phase of the project overlaps with the Proposed Project[1]	Project Description	Rationale
Box Canyon Hydro (Box Canyon Hydro Corp. (Sound Energy Inc.))	Proposed start in 2017.	Construction and Operations	▪ Temporary Use Permit issued in February of 2014 to construct concrete batch plant relating to the construction project. ▪ Planned future run-of-river hydroelectric project with a capacity of 15 MW and proposed start of 2017. ▪ Total project footprint will be 64.5 ha ▪ Electricity Purchase Agreement obtained from BC Hydro 2010 Clean Power Call ▪ Multiple water intakes in three McNab drainages: Box Canyon, Marty, and Cascara creeks are planned with total penstock length of 7,847 m. ▪ All intake water delivered to a powerhouse located on the Banks of McNab Creek ~1250 m upstream in existing cut block. ▪ A 2.8 km 138 kV timber pole overhead line will connect powerhouse to BC Hydro 1L31 138 kV transmission line along the McNab Ck FSR. ▪ Habitat compensation is planned for Box Canyon Creek (possibly Marty and Cascara) in the form of rearing habitat for juvenile Coho salmon and cutthroat trout.	Clearing required to construct and operate the Box Canyon Hydro Project may affect habitat, mortality and movement for the selected wildlife VCs. The overhead lines associated with the Box Canyon Project may increase the risk of mortality for avian VCs due to collisions. The project may also may also reduce or change the extent of vegetation VCs.

Project	Timeline	Phase of the project overlaps with the Proposed Project[1]	Project Description	Rationale
Woodfibre LNG (Woodfibre Natural Gas Ltd.)	Construction to start in 2015 Operations in the second quarter of 2017 Assumes permit issuance in 2015/early 2016	Operations	▪ Development of the former Western Forest Products Woodfibre Mill; an LNG facility has been proposed. ▪ Three to four times per month an LNG carrier will travel through well-established shipping lanes to the Woodfibre LNG terminal. Each carrier will travel at 8 to 10 knots in Howe Sound, be accompanied by at least three tugboats, at least one of which will be tethered to the carrier, and have two BC Coast Pilots on board, who are experts on BC's coast.	Clearing required to construct and operate the Woodfibre LNG Project may affect habitat, mortality and movement for the selected wildlife VCs. The Woodfibre LNG Project may also may also reduce or change the extent of vegetation VCs.
Eagle Mountain Woodfibre Gas Pipeline Project (Fortis BC)	Construction to begin Q3 2015. Operations starting in Q4 2016 to exceed 50 yrs.	Operations	▪ Fortis BC has proposed an approximately 52km long 20 inch diameter natural gas pipeline from the area north of the Coquitlam Watershed; additional compression at existing compressor stations at Eagle Mountain in Coquitlam and Port Mellon north of Gibson's; a new compressor station in Squamish; and metering facilities at the receipt and delivery points. ▪ The pipeline would deliver natural gas to the project. This project is currently in the EA process.	Clearing required to construct the Eagle Mountain Woodfibre Gas Pipeline Project may affect habitat, mortality and movement for the selected wildlife VCs. The Eagle Mountain Woodfibre Gas Pipeline Project may also may also reduce or change the extent of vegetation VCs.

5.3.3.4 Potential Interactions with Other Projects

Interactions between adverse effects from certain or reasonably foreseeable project activities and Proposed Project residual adverse effects that could result in cumulative adverse effects to Terrestrial Wildlife and Vegetation are summarized in Table 5.3-47.

Table 5.3-47 Activities Considered in the Cumulative Effects Assessment for Terrestrial Wildlife and Vegetation VCs

Activities	VC	Potential Effect	Potential for Interaction of Effects	Rationale
Retired, Active and Pending Forest Tenures (Various) Road-building for forestry (Various)	▪ Amphibian species at risk	▪ Habitat loss	Yes	Historical and active logging of mature and old growth forests may have and may continue to reduce the amount of suitable upland habitat available for amphibian species at risk. Forest roads may create barriers to amphibian movement and collisions with logging trucks may occur.
	▪ Roosevelt elk	▪ Habitat Loss	Yes	Historical and active logging of low elevation mature and old growth forests has and may continue to reduce the availability of Roosevelt elk wintering habitat. Collisions with logging trucks may occur.
	▪ Grizzly bear	▪ Habitat loss	No	Historical and active logging has and will continue to increase the amount of regenerating shrub-dominated ecosystems that provide suitable foraging habitat for grizzly bear. Conversion of forested and open habitat to permanent roadways may have resulted in a loss of grizzly bear habitat. Collisions with logging trucks may occur
	▪ Environmentally sensitive ecosystems ▪ Ecosystems at risk	▪ Loss of Extent	Yes	Historical and ongoing logging may have and may continue to reduce the amount and extent of sensitive ecosystems and ecosystems at risk.

Activities	VC	Potential Effect	Potential for Interaction of Effects	Rationale
Box Canyon Hydro (Box Canyon Hydro Corp. (Sound Energy Inc.)	▪ Amphibian species at risk	▪ Habitat loss	Yes	Clearing to construct and operate the Box Canyon Hydro Project may result in a reduction in the amount of available upland habitat for amphibian species at risk. The Box Canyon Hydro Project considered potential effects to coastal tailed-frog due to the Project layout and available habitat. Suitable red-legged frog breeding habitat is not present in the Box Canyon Hydro project area
	▪ Roosevelt elk	▪ Habitat loss	Yes	Clearing required to construct and operate the Box Canyon Hydro Project may require clearing suitable Roosevelt elk winter habitat. Collisions with logging trucks may occur.
	▪ Grizzly bear	▪ Habitat loss	Yes	Clearing required to construct and operate the Box Canyon Hydro Project may result in a loss of moderately suitable grizzly bear foraging habitat.
	▪ Environmentally sensitive ecosystems ▪ Ecosystems at risk	▪ Loss of extent	Yes	Clearing riparian and wetland ecosystems to construct and operate the Box Canyon Hydro Project may reduce the amount and extent of sensitive ecosystems and ecosystems at risk.
Woodfibre LNG (Woodfibre Natural Gas Ltd.)	▪ Amphibian species at risk	▪ Habitat loss	No	Red-legged frog is the only amphibian species at risk considered in the BURNCO assessment based on habitat within the LSA and field studies. Suitable coastal tailed frog habitat is not present in the Proposed Project Area. The Woodfibre LNG Project considered potential effects to coastal tailed-frog due to the Project layout and available habitat. Suitable red-legged frog habitat is not present in the Woodfibre LNG project area. Therefore no interaction is predicted between these projects for the amphibian species at risk VC.

Activities	VC	Potential Effect	Potential for Interaction of Effects	Rationale
	▪ Roosevelt elk ▪ Grizzly bear	▪ Habitat loss	Yes	Clearing required to construct the Woodfibre LNG Project may reduce the amount of suitable Roosevelt elk and grizzly bear habitat.
	▪ Environmentally sensitive ecosystems ▪ Ecosystems at risk	▪ Loss of extent	Yes	Clearing riparian forest to construct the Woodfibre LNG Project may reduce the amount and extent of sensitive ecosystems and ecosystems at risk.
Eagle Mountain Woodfibre Gas Pipeline Project (Fortis BC)	▪ Amphibian species at risk	▪ Habitat loss	Yes	Clearing of mature and old growth forest adjacent to the Eagle Mountain Woodfibre Gas Pipeline Project may result in loss of suitable amphibian upland habitat.
	▪ Roosevelt elk	▪ Habitat loss	Yes	Clearing required for the Eagle Mountain Woodfibre Gas Pipeline Project in the RSA may result in removal of suitable Roosevelt elk winter habitat.
	▪ Grizzly bear	▪ Habitat loss	Yes	Clearing required for the Eagle Mountain Woodfibre Gas Pipeline Project in the RSA may result in removal of suitable grizzly bear foraging habitat. However, it is expected that vegetation clearing associated with this project will result in regenerating shrub ecosystems which will provide suitable grizzly bear foraging habitat.
	▪ Environmentally sensitive ecosystems ▪ Ecosystems at risk	▪ Loss of extent	Yes	Clearing of vegetation adjacent to the Woodfibre Gas Pipeline Project may reduce the amount and extent of sensitive ecosystems and ecosystems at risk.

5.3.3.5 Cumulative Effects Related to Terrestrial Wildlife and Vegetation

The proposed Box Canyon Hydro Project, Eagle Mountain Woodfibre Gas Pipeline Project, Woodfibre LNG Project and ongoing logging within the RSA may result in the loss or change in available wildlife habitat in addition to the anticipated habitat loss due to the Proposed Project (Section 5.3.1.5). The Box Canyon Hydro Project involves building a 15 MW run-of-river hydroelectric project on Box Canyon, Marty and Cascara Creeks north of the Proposed Project Area. The Box Canyon Hydro Project will require installing 7,847 m of penstock that will carry water to a powerhouse near McNab Creek, approximately 1,250 m north of the BURNCO Proposed Project Area. Electricity will be carried from the powerhouse to BC Hydro's 1L31

transmission line via a 2,800 m 138 kV overhead line. The overhead line will follow the McNab forest service road. The total Box Canyon Hydro Project footprint size is 65 ha.

The Eagle Mountain Woodfibre Gas Pipeline Project involves twinning the existing FortisBC gas pipeline from Coquitlam to the proposed Woodfibre LNG Project. The pipeline will follow the Howe Sound Coast from Squamish to the Woodfibre LNG Project. Construction of the Eagle Mountain Woodfibre Gas Pipeline Project will require widening the existing right-of-way by approximately 18 m as well as any additional clearing that may be required to provide construction access and temporarily laydown. The Eagle Mountain Woodfibre Gas Pipeline Project Area within the RSA is estimated to be 4 ha.

The proposed Woodfibre LNG Project will be situated on the northwest shore of Howe Sound, approximately 6.5 km southwest of the community of Squamish. The terrestrial portion of the Woodfibre LNG Project will be predominately situated on a brownfield site with over a century of industrial use. The existing conditions of the Woodfibre LNG project area are described as mostly un-vegetated and dominated by old concrete and compact fill (Woodfibre LNG 2015). Vegetation that does exist in the Woodfibre LNG project area is described as dominated by pioneering species such as Himalayan blackberry. The Woodfibre LNG Project is predicted to result in the loss of 2 ha of mature forest and no old growth forest.

Logging is the most prevalent anthropogenic disturbance in the RSA. The Proposed Project Area and the portion of the RSA south of the Potlatch Creek Watershed are situated in the Sunshine Coast Forest District and managed through the Sunshine Coast Timber Supply Area (SC TSA). The portion of the RSA from the Potlatch Creek Watershed north to the Squamish River Watershed is located within the Soo Timber Supply Area (Soo TSA; MFLNRO 2015). The SC TSA covers 1.6 million ha, of which 426,000 ha (27%) is considered productive timber crown land (Snetsinger 2012). Of the productive land, 222,894 ha (14%) is available for timber harvesting. As of August, 2013, the allowable annual cut (AAC) is 1,204,808 m3 (Snetsinger, 2012). The Soo TSA covers approximately 909,519 ha, of which 266,646 ha (29%) is productive forest (Snetsinger 2011). The AAC in the Soo TSA is 480,000 m3 (Snetsinger 2011). Approximately 3% (890 ha) of the RSA falls within active forest tenures while 9% (2,647 ha) of the RSA falls within retired forest tenures (MFLNRO 2015).

5.3.3.5.1 Cumulative Effects to Wildlife

5.3.3.5.1.1 Habitat loss

Amphibian Species at Risk

Northern red-legged frog is the only amphibian species at risk predicted to be affected by the Proposed Project. Past, present and reasonably foreseeable projects and activities may result in the loss of northern red-legged frog upland and breeding habitat. The Box Canyon Hydro Project is expected to require clearing forest that could provide suitable upland habitat for red-legged frog.

The Eagle Mountain Woodfibre Gas Pipeline Project is predicted to result in the loss of 5 ha of suitable breeding habitat for pond-breeding amphibians (assessed using western toad for the Eagle Mountain Woodfibre Gas Pipeline Project Environmental Assessment) (Tera 2015a). In addition, the Eagle Mountain Woodfibre Gas Pipeline Project is predicted to result in a loss of 37 ha of suitable upland habitat along the alignment. Pond-dwelling amphibian surveys conducted for the Eagle Mountain Woodfibre Gas Pipeline

Project did not identify red-legged frog along the alignment and did not identify active breeding locations within the portion of the alignment in the RSA (Tera 2015b). Therefore, the Eagle Mountain Woodfibre Gas Pipeline Project is not predicted to contribute to adverse cumulative effects on northern red-legged frog in the RSA.

Historical forestry, assessed using retired forest tenures, accounts for 2,647 ha (9%) of the RSA. Forest harvesting is likely to occur in approximately 3% (890 ha) of the RSA. Mature and old growth forest may provide suitable upland living habitat for northern red-legged frog, and is likely to be targeted by logging. However, it is expected that logging will not occur in wetlands, and buffers around wetlands will be retained as per the "*Forest Practices Code: Riparian management Area Guidebook*" (MoF 1995). Therefore, it is expected that forestry will not result in a reduction in the amount of suitable northern red-legged breeding habitat.

Breeding habitat for northern red-legged frog is predicted to be lost during construction of the Proposed Project, although the Fish Habitat Offset Plan (Volume 4, Part G – Section 22.0 Appendix 5.1-B) will likely provide effective compensatory breeding habitat during operations. However, other past, present and reasonably foreseeable projects and activities may result in a reduction of available breeding or upland amphibian habitat. Wetlands comprise 0.3% (82 ha) of the RSA. Assuming that all of the wetland habitat in the RSA provides suitable red-legged frog breeding habitat, and that all of the potential amphibian breeding habitat predicted to be affected by the Eagle Mountain Project occurs in the RSA, the cumulative loss of red-legged frog breeding habitat is about 7% (6 ha) of the available breeding habitat in the RSA.

Roosevelt Elk

Past, present and reasonably foreseeable projects may result in the loss of low elevation mature and old growth forest habitat that may provide suitable Roosevelt elk overwintering habitat. Based on the alignment of the proposed penstocks and a 20 m disturbance area, it is estimated that the Box Canyon Hydro Project may result in a loss of approximately 6 ha (0.2%) of the high and moderate suitability Roosevelt elk habitat in the RSA.

The Eagle Mountain Woodfibre Gas Pipeline Project is predicted to clear approximately 4 ha in the RSA. With the conservative assumption that all the area to be cleared for the Eagle Mountain Project provides high or moderate suitability Roosevelt elk overwintering habitat, the Eagle Mountain Project may affect 0.1% (4 ha) of suitable Roosevelt elk overwintering habitat in the RSA.

The Woodfibre LNG Project environmental assessment did not consider effects to Roosevelt elk. The Woodfibre LNG Project may affect 2 ha of mature forest habitat. With the conservative assumption that this habitat could provide suitable Roosevelt elk winter habitat, this 2 ha loss represents approximately 0.1% of suitable Roosevelt elk winter habitat available within the RSA.

Historical logging, assessed using retired forest tenures, accounts for 2,647 ha (9%) of the RSA, some of which may have been suitable Roosevelt elk winter habitat. Forest harvesting is likely to occur in approximately 3% (890 ha) of the RSA. Of this 890 ha, 322 ha is predicted to affect high and moderate suitability Roosevelt elk winter habitat, representing 14% of similar habitat in the RSA.

Based on conservative assumptions regarding the extent of Roosevelt elk winter habitat that may be affected by reasonably foreseeable developments the RSA, 15% (334 ha) of suitable Roosevelt elk winter habitat in RSA may be lost. The Proposed Project is predicted to affect 36 ha (1.5%) of suitable winter habitat in the RSA. Therefore, the cumulative loss of high and moderate suitability Roosevelt elk winter habitat in the RSA is predicted to be 16% (370 ha).

Grizzly Bear

Past, present and reasonably foreseeable projects and activities may result in the loss of suitable grizzly bear foraging habitat. Based on the alignment of the proposed penstocks and a 20 m disturbance area, it is estimated that the Box Canyon Hydro Project may affect 11 ha (<0.1%) of the high and moderate suitability grizzly bear foraging habitat in the RSA.

The Eagle Mountain Woodfibre Gas Pipeline Project is predicted to require the clearing of approximately 4 ha in the RSA. The Environmental Assessment Application predicts that the Eagle Mountain Woodfibre Gas Pipeline Project will result in adverse effects to grizzly bear foraging habitat in the Squamish-Lillooet population; however, the extent of the affect within the RSA is unknown (Tera 2015a). Clearing will be temporary and cleared areas will regenerate after construction to provide berry producing shrubs that will likely support suitable grizzly bear foraging habitat. As such, the Eagle Mountain Woodfibre Gas Pipeline Project is expected to temporarily affect grizzly bear habitat during construction and maintenance operations.

The Woodfibre LNG Project environmental assessment application did not consider affects to grizzly bear (Woodfibre LNG 2015). The Woodfibre LNG Project is situated adjacent to salmon bearing streams and within shrub dominated habitat that may be suitable grizzly bear foraging habitat. The Woodfibre LNG Project is not expected to result in destruction or loss of fish habitat and riparian habitat will be re-established within currently paved areas. The Woodfibre LNG Project is predicted to result in the loss of less than 1 ha (<0.1%) of suitable grizzly bear foraging habitat in the RSA.

Historical forestry, assessed using retired forest tenures, accounts for 2,647 ha (8.8%) of the RSA. Forest harvesting is likely to occur in approximately 3% (890 ha) of the RSA. Of this, 462 ha (6%) overlaps moderate and high suitability foraging habitat. However, harvested areas are expected to regenerate into shrub habitat that provides suitable grizzly bear foraging habitat.

Based on conservative assumptions regarding the extent of grizzly bear foraging habitat that may be affected by past, present and reasonably foreseeable projects and future logging activity within the RSA, it is predicted that up to 6% (477 ha) of suitable grizzly bear habitat in the RSA may be affected. The Proposed Project is predicted to affect 51 ha (1%) of suitable grizzly bear foraging habitat in the RSA. Combined with the effects of other past, present and reasonably foreseeable projects and activities, 7% (528 ha) of suitable grizzly bear foraging habitat is predicted to be lost in the RSA.

5.3.3.5.1.2 Change in Mortality

Amphibians may not be able to vacate areas ahead of clearing, and therefore are susceptible to increased mortality due to clearing of upland habitat. The Proposed Project and past, present and reasonably foreseeable projects and activities in the RSA may contribute to the cumulative mortality of red-legged frog if the species occurs within the subject area. Furthermore, new and increased road traffic over red-legged frog migration/ disbursal routes may result in increased mortality due to collisions with vehicles. See Section 5.3.1.5.5 for an expanded discussion on change in red-legged frog mortality.

Past, present and reasonably foreseeable projects and activities may result in incidental mortality of western screech-owl if clearing occurs during the nesting season. With the exception of forestry, it is assumed that past, present and reasonably foreseeable projects and activities will avoid clearing during the bird nesting season to follow federal and provincial guidelines. However, late winter and early spring clearing may overlap with early western screech owl nesting. The risk of collisions with infrastructure may also increase mortality events for all avian VCs (Section 5.3.1.5.5).

Mortality due to clearing is not predicted to occur for Roosevelt elk, which will be able to vacate areas ahead of clearing. New roads and increased vehicle traffic on existing roads within the RSA may increase the risk of vehicle collisions with Roosevelt elk. New roads created by the forestry industry will provide additional access into Roosevelt elk habitat, which may result in increased mortality due to increased hunting and poaching. Public access to the McNab Valley FSR via the Proposed Project Area may be controlled or limited, which will reduce access to Roosevelt elk habitat by hunters and poachers. See Section 5.3.1.5.5 for an expanded discussion on change in Roosevelt elk mortality.

Grizzly bear mortality due to clearing is not predicted to occur because during most of the year grizzly bears can vacate areas ahead of clearing, and grizzly bear denning habitat is not predicted to occur in the Proposed Project Area. Other foreseeable projects and activities in the RSA are also not predicted to overlap with denning habitat, and are therefore not expected to contribute to grizzly bear mortality during clearing. Incidental mortality due to interactions with workers and vehicle collisions may occur for the Proposed Project and past, present and reasonably foreseeable projects and activities within the RSA. New roads created by the forestry industry will provide additional access into grizzly bear habitat, which may result in increased mortality due to increased poaching. See Section 5.3.1.5.5 for an expanded discussion on change in grizzly bear mortality.

5.3.3.5.1.3 Barriers to Movement

The availability of non-breeding amphibian habitat, such as forest upland and non-natal ponds, is important to the persistence of amphibian populations (Fellers and Kleenman 2007). Connectivity between these habitats are particularly important in landscapes and are frequently lost or modified by forestry, roadways and other land development (Rothermel 2004; Chan-McLeod 2003). As the Eagle Mountain Woodfibre Project is a widening of an existing linear disturbance it is not expected to contribute to barriers to amphibian movement. The Proposed Project, Box Canyon Hydro Project and forestry may contribute to barriers to red-legged frog movement by fragmenting upland habitat and creating barriers between natal ponds and upland habitat. Section 5.3.1.5.5 provides an expanded discussion regarding barriers to movement.

Habitat clearing and disturbance associated with the construction and operation of the Proposed Project and past, present and reasonably foreseeable projects and activities in the RSA may create movement barriers for western screech-owl. It is expected that most clearing and construction activities will occur during daylight hours when western screech-owl are not active. Furthermore, birds are expected to fly around modified habitat and disturbances. Section 5.3.1.5.5 provides an expanded discussion regarding barriers to movement.

Past, present and reasonably foreseeable projects and activities may create barriers to Roosevelt elk movement to and from winter range. Barriers created by Eagle Mountain Woodfibre Gas Pipeline Project are predicted to be temporary as vegetation will re-grow over the pipeline after installation. The Woodfibre LNG Project is predominately situated on a brownfield site and thus is not expected to increase barriers to movement. The Proposed Project is predominately situated in a cleared area that is used by Roosevelt elk. The design of the Proposed Project may include perimeter fencing during the construction and operations phases that may create a barrier to elk movement through the Proposed Project Area. However, riparian habitat along McNab Creek will be maintained, which should facilitate elk movement. The Box Canyon Hydro Project and forestry activity in the RSA, including road building, may increase Roosevelt elk movement barriers. Section 5.3.1.5.5 provides an expanded discussion regarding barriers to movement.

Past, present and reasonably foreseeable projects and activities that restrict grizzly bear access to foraging habitat may create barriers to movement. Barriers created by Eagle Mountain Woodfibre Gas Pipeline Project are predicted to be temporary as vegetation will re-grow over the pipeline after installation. The Woodfibre LNG Project is predominately situated on a brownfield site and thus is not expected to increase barriers to movement. The Proposed Project is predominately situated in a cleared area that is accessible to grizzly bear. The design of the Proposed Project may include perimeter fencing during the construction and operation phase that would limit access to Proposed Project Area. However, the Proposed Project will not impede grizzly bear access to McNab Creek. Grizzly bears are expected to moving freely through areas harvested by forestry and the Box Canyon Hydro Project after clearing and construction activities are complete. Section 5.3.1.5.5 provides an expanded discussion regarding barriers to movement.

5.3.3.5.2 Cumulative Effects to Vegetation

5.3.3.5.2.1 Loss of extent

Environmentally Sensitive Ecosystems

Past, present and reasonably foreseeable projects and activities may result in a reduction in the extent of sensitive ecosystems such as wetlands and riparian habitat. The Proposed Project is predicted to result in the permanent and temporary loss of riparian and wetland ecosystems (Section 5.3.2.5.4.1.1):

- Permanent loss of 0.2 ha of Sitka Spruce – Salmonberry high fluvial bench forest (SS);
- Temporary loss of 0.4 ha of Sitka Spruce – Salmonberry high fluvial bench forest (SS);
- Temporary loss 0.3 ha of Sitka spruce – Pacific crabapple riparian forest (SP);
- Temporary loss 0.8 ha of wetland area, consisting of Western red cedar – Sitka spruce- Skunk cabbage swamp forest (RC/ Ws54) and two associated vernal pools (Ponds 2 and 6); and
- Temporary loss of 0.08 ha of Tufted hairgrass – Douglas' aster estuarine meadow (GS/ Ed02).

The Box Canyon Hydro Project is predicted to require clearing of approximately 1 ha of SS high fluvial bench forest for the proposed penstocks and a 20 m disturbance area (BCHC 2011), representing 3% of the SS ecosystem type in the RSA.

The Eagle Mountain Woodfibre Gas Pipeline Project is predicted to require clearing of 4 ha in the RSA, a portion of which affects wetland ecosystems. Wetland ecosystems recorded in the Eagle Mountain Woodfibre Gas Pipeline Project area are:

- Western redcedar – Sword fern – Skunk cabbage swamp (Ws53);
- Red alder – Skunk cabbage swamp (Ws52);
- Sitka willow – Pacific willow – Skunk cabbage swamp (Ws51); and
- Lyngbye's sedge estuarine marsh (Em05).

The exact loss of extent of Ws51, Ws52 and Ws53 swamp forest ecosystems resulting from clearing is not known; therefore it is conservatively assumed that they occur over half of the area to be cleared, resulting in a loss of 2% (2 ha) of wetland ecosystems in the RSA.

The Woodfibre LNG Project is predicted to affect up to 2 ha of riparian ecosystem adjacent to Mill Creek. This represents approximately 2% of riparian ecosystem in the RSA. The Woodfibre LNG Project is proposing to restore riparian habitat at the outlet of Mill Creek, which will likely be equal to or greater than the extent lost upstream (Woodfibre 2015).

Historical forestry, assessed using retired forest tenures, accounts for 2,647 ha (9%) of the RSA. Active forestry is occurring in approximately 3% (890 ha) of the RSA, of which:

- 1.8 ha overlaps with riparian ecosystem (2% of riparian ecosystem in the RSA). This area includes 1.4 ha of SS high fluvial bench forest (4% of that occurring in the RSA); and
- 0.4 ha overlaps with wetland ecosystems (0.4% of wetland ecosystem in the RSA), consisting of RC/ Ws54 swamp forest (0.8% of that occurring in the RSA).

Table 5.3-48 displays the potential impacts to sensitive ecosystems by past, present and reasonably foreseeable projects and activities, based on conservative assumptions.

Table 5.3-48: Potential Impacts to Sensitive Ecosystems due to Past, Present and Reasonably Foreseeable Projects and Activities

Site Series	Ecosystem Name	Total Area Impacted (ha)	Proportion of Ecosystem in RSA (%)
Riparian Ecosystems		4.8	5.3
SS/09	Sitka spruce – Salmonberry	2.4	6.3
Wetland Ecosystems		2.4	2.3
RC/ Ws54	Western redcedar – Sitka spruce – Skunk cabbage	0.4	0.8

When the Proposed Project is combined with the effects of past, present and reasonably foreseeable projects and activities, the cumulative loss of extent of sensitive ecosystems is predicted to be 6.3% (5.7 ha) of riparian ecosystems and 3.1% (3.3 ha) of wetland ecosystems in the RSA may be lost (Table 5.3-49). To be conservative, these losses do not take into account the 3.3 ha of new riparian habitat surrounding the pit lake will be created during the closure and reclamation phase.

Table 5.3-49: Cumulative Impacts to Sensitive Ecosystems due to the Proposed Project and Past, Present and Reasonably Foreseeable Projects and Activities

Site Series	Ecosystem Name	Total Area Impacted (ha)	Proportion of Ecosystem in RSA (%)
Riparian Ecosystems		5.7	6.3
SS/09	Sitka spruce – Salmonberry	3	7.9
SP/00	Sitka spruce – Pacific crabapple	0.3	6.8
Wetland Ecosystems		3.3	3.1
RC/ Ws54	Western redcedar – Sitka spruce – Skunk cabbage	1.2	2.3
GS/ Ed02	Tufted hairgrass – Douglas' aster estuarine meadow	0.08	1.6

Ecosystems at Risk

Past, present and reasonably foreseeable projects and activities may result in the loss of extent of ecosystems at risk within the RSA. The Proposed Project is predicted to result in the permanent loss of extent of two ecosystems at risk, which will be reclaimed to the pit lake at closure (Section 5.3.2.5.4.1.1):

- Provincially blue-listed Western hemlock – Amabilis fir – Deer fern upland forest (HD) 23.7 ha (24.9% of HD ecosystem within the LSA, 4.1% of the RSA); and
- Provincially red-listed Sitka spruce – Salmonberry high fluvial bench forest (SS) – 0.2 ha (0.9% of SS ecosystem within the LSA, 0.5% of the RSA).

There will also be a temporary loss of ecosystems at risk during the construction and operation of the Proposed Project plus the time required for re-establishment, post-reclamation (150 years):

- Provincially blue-listed Western hemlock – Amabilis fir – Deer fern upland forest (HD) – 20.6 ha (21.6% of HD ecosystem within the LSA, 6.7% of the RSA);
- Provincially blue-listed Western redcedar – Sitka spruce – Skunk cabbage swamp forest (RC/ Ws54) – 0.8 ha (88.9% of RC ecosystem within the LSA, 1.5% of the RSA);
- Provincially blue-listed Sitka spruce – Pacific crabapple riparian forest (SP) – 0.3 ha (6.8% of SP ecosystem within the LSA, 6.8% of the RSA);
- Provincially red-listed Tufted hairgrass – Douglas' aster estuarine meadow (GS/ Ed02) – 0.08 ha (6.2% of GS ecosystem the LSA, 1.6% of the RSA); and
- Provincially red-listed Sitka spruce – Salmonberry high fluvial bench forest (SS) – 0.4 ha (1.7% of SS ecosystem within the LSA, 1.1% of the RSA).

The Box Canyon Hydro Project is predicted to require clearing of approximately 1 ha of HD upland forest and 1 ha of SS high fluvial bench forest and for the proposed penstocks and a 20 m disturbance area (BCHC 2011), representing 0.2% of HD and 3% of SS ecosystem types respectively in the RSA.

The Eagle Mountain Woodfibre Gas Pipeline Project is predicted to require clearing of 4 ha in the RSA, a portion of which affects provincially listed ecosystems. Ecosystems at risk recorded along the Eagle Mountain Woodfibre Gas Pipeline Project are:

- Blue-listed Western redcedar – Sword fern – Skunk cabbage swamp (Ws53);
- Red-listed Red alder – Skunk cabbage swamp (Ws52);
- Red-listed Sitka willow – Pacific willow – Skunk cabbage swamp (Ws51); and
- Red-listed Lyngbye's sedge estuarine marsh (Em05).

These listed ecosystems do not occur in the Proposed Project area; therefore the Proposed Project does not contribute to cumulative effects on these ecosystems at risk.

Based on the location of the Woodfibre LNG project area and site history, the Environmental Assessment Application determined that ecosystems at risk are unlikely to be affected by the Woodfibre LNG project (Woodfibre LNG 2015). Terrestrial Ecosystem Mapping available for the region does not extend into the Woodfibre LNG project area, but the habitat along Mill Creek, north of the proposed water intake and pipeline structure, is classified as the provincially blue-listed CWHdm/ Western hemlock – Flat moss (HM) ecosystem. This ecosystem does not occur in the Proposed Project Area.

Historical forestry, assessed using retired forest tenures, accounts for 2,647 ha (9%) of the RSA. Active forestry is occurring in approximately 3% (890 ha) of the RSA, of which:

- 30.2 ha overlaps with HD upland forest (6.1% of that occurring in the RSA);
- 1.4 ha overlaps SS high fluvial bench forest (4% of that occurring in the RSA); and
- 0.4 ha overlaps RC/ Ws54 swamp forest (0.8% of that occurring in the RSA).

Table 5.3-50 displays the potential impacts to sensitive ecosystems by past, present and reasonably foreseeable projects and activities, based on conservative assumptions.

Table 5.3-50: Potential Impacts to Ecosystems at Risk due to Past, Present and Reasonably Foreseeable Projects and Activities

Site Series	Ecosystem Name	Total Area Impacted (ha)	Proportion of Ecosystem in RSA (%)
HD/06	Western hemlock – Amabilis fir – Deer fern	31.2	6.3
SS/09	Sitka spruce – Salmonberry	2.4	6.3
RC/ Ws54	Western redcedar – Sitka spruce – Skunk cabbage	0.4	0.8

Table 5.3-51 displays the cumulative impacts to ecosystems at risk when the Proposed Project is combined with the effects of past, present and reasonably foreseeable projects and activities.

Table 5.3-51: Cumulative Impacts to Ecosystems at Risk due to the Proposed Project and Past, Present and Reasonably Foreseeable Projects and Activities

Site Series	Ecosystem Name	Total Area Impacted (ha)	Proportion of Ecosystem in RSA (%)
HD/06	Western hemlock – Amabilis fir – Deer fern	75.5	15.1
SS/09	Sitka spruce – Salmonberry	3	7.9
RC/ Ws54	Western redcedar – Sitka spruce – Skunk cabbage	1.2	2.3
SP/00	Sitka spruce – Pacific crabapple	0.3	6.8
GS/ Ed02	Tufted hairgrass – Douglas' aster estuarine meadow	0.08	1.6

5.3.3.5.2.2 Surface Runoff

The Proposed Project and other past, present and reasonably foreseeable projects and activities may produce run-off from roadways and soils exposed during construction.

5.3.3.5.2.3 Introduction of Dust

The Proposed Project and other past, present and easonably foreseeable projects and activities may produce dust from roadways and soils exposed during construction.

5.3.3.5.2.4 Invasive Species

The Proposed Project and other past, present and reasonably foreseeable projects and activities may introduce or promote the proliferation of invasive plant species during construction and operation.

5.3.3.5.2.5 Soil Disturbance

The Proposed Project and other past, present and reasonably foreseeable projects and activities may disturb soils during construction.

5.3.3.5.2.6 Windthrow

Clearing required for the Proposed Project and past, present and reasonably foreseeable projects and activities may increase windthrow.

5.3.3.6 Mitigation of Cumulative Effects

Mitigation measures that will assists in minimizing interactions between Proposed Project effects and similar environmental effects from other reasonably foreseeable project activities are described in Table 5.3-52. It is expected that other foreseeable projects and activities operating within the RSA will, at a minimum, implement provincially and federally recognized BMPs and industry standards.

Mitigation measures proposed to avoid and reduce the identified adverse cumulative effects of the Proposed Project on VCs carried through to the cumulative effects assessment are the same as measures presented in Section 5.3.1.5.4. In addition, the proponent will work with the Box Canyon Hydro Project and forestry companies holding logging tenures, where feasible, to identify additional measures that can be implemented in the McNab Valley to further minimize potential adverse cumulative effects.

Logging activities in the McNab Valley, as well as construction activity for the Box Canyon Hydro Project will predominately require access through the Proposed Project Area via the McNab Valley Forest Services Road. The proponent will work with industrial partners in the McNab Valley to develop access management plans to minimize and monitor wildlife collisions. The proponent will work with other operators in the McNab Valley, First Nations and other groups to determine what level of access will be maintained through the Proposed Project Area during construction and operation. Any controls on access that are implemented through the Proposed Project Area may reduce access by hunters and poachers, thereby reducing the risk of mortality to wildlife.

Table 5.3-52: Identified Mitigation Measures for Cumulative Effects: Terrestrial Wildlife and Vegetation VCs

VC	Potential Cumulative Effect	Mitigation	Responsibility for Implementation	Anticipated Effectiveness
Construction and Operation				
Amphibian species at risk (i.e., red-legged frog)	Habitat loss.	Communication and planning with other proponents within McNab Valley Access management planning with other proponents within the McNab Valley	BURNCO	Unknown: To be conservative, for the purpose of the assessment it is assumed that mitigation will not reduce habitat loss below what is stated in Section 5.3.3.5.1
	Barriers to movement.	Communication and planning with other proponents within McNab Valley	BURNCO	Unknown: To be conservative, for the purpose of the assessment it is assumed that mitigation will not reduce barriers to movement below what is stated in Section 5.3.3.5.1
	Change in mortality.	Communication and planning with other proponents within McNab Valley Access management planning with other proponents within the McNab Valley	BURNCO	Unknown: To be conservative, for the purpose of the assessment it is assumed that mitigation will not reduce mortality loss below what is stated in Section 5.3.3.5.1
	Change in mortality.	Communication and planning with other proponents within McNab Valley Access management planning with other proponents within the McNab Valley	BURNCO	Unknown: To be conservative, for the purpose of the assessment it is assumed that mitigation will not reduce mortality loss below what is stated in Section 5.3.3.5.1

VC	Potential Cumulative Effect	Mitigation	Responsibility for Implementation	Anticipated Effectiveness
Roosevelt elk	Habitat loss.	Communication and planning with other proponents within McNab Valley	BURNCO	Unknown: To be conservative, for the purpose of the assessment it is assumed that mitigation will not reduce habitat loss below what is stated in Section 5.3.3.5.1
	Barriers to movement.	Communication and planning with other proponents within McNab Valley Access management planning with other proponents within the McNab Valley	BURNCO	Unknown: To be conservative, for the purpose of the assessment it is assumed that mitigation will not reduce barriers to movement below what is stated in Section 5.3.3.5.1
	Change in mortality.	Communication and planning with other proponents within McNab Valley	BURNCO	Unknown: To be conservative, for the purpose of the assessment it is assumed that mitigation will not reduce mortality loss below what is stated in Section 5.3.3.5.1
Grizzly bear	Habitat loss.	Communication and planning with other proponents within McNab Valley Access management planning with other proponents within the McNab Valley	BURNCO	Unknown: To be conservative, for the purpose of the assessment it is assumed that mitigation will not reduce habitat loss below what is stated in Section 5.3.3.5.1
	Change in mortality.	Communication and planning with other proponents within McNab Valley	BURNCO	Unknown: To be conservative, for the purpose of the assessment it is assumed that mitigation will not reduce mortality loss below what is stated in Section 5.3.3.5.1

VC	Potential Cumulative Effect	Mitigation	Responsibility for Implementation	Anticipated Effectiveness
Environmentally Sensitive ecosystems (wetlands, riparian ecosystems, old growth forest) Ecosystems at risk	Loss of extent.	Communication and planning with other proponents within McNab Valley	BURNCO	Unknown: To be conservative, for the purpose of the assessment it is assumed that mitigation will not reduce ecosystem loss below what is stated in Section 5.3.3.5.2
Reclamation and Closure				
None				

5.3.3.7 Residual Cumulative Effects and their Significance

Potential residual cumulative effects and their significance were characterized using the same methods that were used to characterize residual effects (see Table 5.3-6 and Table 5.3-30). Potential residual cumulative effects are summarized in Table 5.3-53 through Table 5.3-57.

5.3.3.7.1 Amphibian Species at Risk

It is predicted that the cumulative residual effects of the Proposed Project, past, present and reasonably foreseeable projects and logging activities in the RSA may reduce the amount of upland habitat for amphibian species at risk. The Proposed Project, other past, present and reasonably foreseeable projects and logging activities may also contribute to the cumulative change in amphibian mortality and barriers to amphibian movement.

The magnitude of the potential cumulative residual effects on red-legged frog habitat loss, change in mortality, and barriers to movement are predicted to be low. The cumulative effects of habitat loss, mortality, and barriers to movement from the Proposed Project and past, present and reasonably foreseeable projects and activities within the RSA are considered regional in extent, long and medium duration, and continuous over the life of the project/ activity. Habitat removed and barriers created to accommodate the Proposed Project, and other past, present and reasonably foreseeable projects and activities within the RSA, may be replaced at the end of the project/ activity and forests may be restored and regrown over time. Therefore, these effects are considered partially reversible. Red-legged frog populations are predicted to recover from mortality events, and therefore change in mortality is also considered fully reversible.

Loss of habitat, change in mortality, and barriers to movement are predicted to result in low magnitude residual cumulative effects on red-legged frog based on the discussion above; therefore, the magnitude of the net cumulative residual effects of the Proposed Project, and past, present and reasonably foreseeable projects and activities on red-legged frog is predicted to be low. The predicted effects are regional, long term in duration, continuous over the life of the project/ activity and have a high likelihood to occur. The cumulative residual net effects are considered partially reversible with restoration and re-planting of forests. Confidence that the effects will not be greater than predicted is moderate due to the conservative assumptions that past, present and reasonably foreseeable projects and activities within the RSA will affect suitable red-legged frog upland habitat, barriers to movement and mortality.

Northern red-legged frog is on the provincial Blue List (BC CDC 2016) and is federally listed as Special Concern by COSEWIC and Special Concern on Schedule 1 of SARA (Government of Canada 2016). Northern red-legged frog range is restricted to coastal and southern parts of the province rendering it vulnerable to habitat fragmentation caused by urban and suburban development (BC CDC 2016). Although the long-term status is difficult to predict, many populations are believed to be viable and the species is still common in parts of its range (BC CDC 2016). The northern red-legged frog population in the RSA is likely to be self-sustaining and maintaining its ecological function because of limited development. Therefore, the northern red-legged frog population is determined to have moderate resilience in the RSA. Net cumulative effects are not expected to exceed ecological thresholds or compromise the resilience of the regional population of the northern red-legged frog, and are determined to be not significant.

5.3.3.7.2 Roosevelt Elk

It is predicted that the cumulative residual effects of past, present and reasonably foreseeable projects and logging activities within the RSA may reduce the amount of suitable Roosevelt elk winter habitat available in the RSA by 16.1%. Of this, 14.2% is attributed to logging activities, 0.4% to other reasonably foreseeable projects, and 1.5% to the Proposed Project.

The magnitude of the potential cumulative residual effects on Roosevelt elk winter habitat loss, mortality, and barriers to movement are predicted to be medium, negligible and negligible, respectively. The cumulative effects of habitat loss, barriers to movement and mortality from the Proposed Project and other past, present and reasonably foreseeable projects and activities within the RSA are considered regional in extent, long and medium duration respectively, continuous over the life of the project/ activity and have a high likelihood to occur. Habitat loss and movement barriers may be replaced at the end of the life of the project/ activity as forests may be restored and regrown over time. Cumulative effects on Roosevelt elk habitat are predicted to be partially reversible.

Loss of winter habitat, barriers to movement and change in mortality are predicted to result in medium and negligible magnitude residual cumulative effects on Roosevelt elk; therefore, the magnitude of the net cumulative residual effects of the Proposed Project and past, present and reasonably foreseeable projects and activities on Roosevelt elk is predicted to be medium. The predicted effects are regional, long duration, continuous over the life of the project and have a high likelihood to occur. The cumulative residual net effects are considered partially reversible with reclamation and re-planting of forests. Confidence that the effects will not be greater than predicted is moderate due to the conservative assumptions that past, present and reasonably foreseeable projects and activities within the RSA may affect suitable Roosevelt elk winter habitat, barriers to movement and mortality.

Roosevelt elk is provincially blue-listed and has not been designated by COSEWIC or under *SARA* (BC CDC 2016, internet site; Government of Canada 2016, internet site). The population of Roosevelt elk within the RSA has been re-introduced and is predicted to be stable or increasing (Quayle and Brunt 2003). The available evidence suggests that the Roosevelt elk population in the RSA is self-sustaining and maintaining its ecological function. Therefore, the Roosevelt elk population within the RSA is determined to be resilient to imposed stresses. The Proposed Project and past, present and reasonably foreseeable projects and activities are predicted to affect about 16% of Roosevelt elk winter habitat in the RSA. However, cumulative effects are not expected to exceed ecological thresholds and compromise the resilience of the regional population Roosevelt elk, and are therefore determined to be not significant.

5.3.3.7.3 Grizzly Bear

It is predicted that the cumulative residual effects of past, present and reasonably foreseeable projects and logging activities in the RSA may reduce the amount of suitable grizzly bear foraging habitat available in the RSA by 7%. Of this, 6% is attributed to logging activities and 1% to the Proposed Project, with less than 0.1% attributed to other reasonably foreseeable developments.

The magnitude of the potential cumulative residual effects on grizzly bear foraging habitat loss and mortality are predicted to be low. The cumulative effects of habitat loss and mortality from the Proposed Project, past, present and reasonably foreseeable projects and activities in the RSA are considered regional in extent, and medium duration. Loss of grizzly bear foraging habitat is considered continuous over the life of the project/ activity while

changes in mortality are predicted to occur infrequently, if at all. Cumulative effects are predicted to be partially reversible.

Habitat loss and change in mortality are predicted to result in low magnitude residual cumulative effects on grizzly bear; therefore, the magnitude of the net cumulative residual effects of the Proposed Project and past, present and reasonably foreseeable projects and activities on grizzly bear is also predicted to be low. The predicted effects are regional, medium duration, continuous over the life of the Project and have a high likelihood to occur. The cumulative residual net effects are considered partially reversible with habitat restoration and management of human-bear conflicts. Confidence that the effects will not be greater than predicted is moderate due to the conservative assumptions that past, present and reasonably foreseeable projects and activities within the RSA may affect suitable grizzly bear foraging habitat, barriers to movement and mortality.

Grizzly bears are provincially blue-listed and the western populations are designated as a species of Special Concern by COSEWIC but are not listed under *SARA* (BC CDC 2016, internet site; COSEWIC 2002; Government of Canada 2016, internet site). Western populations of grizzly bear are thought to be stable; however, populations occurring at the southern extent of the Canadian range are in decline (COSEWIC 2002). The LSA occurs in the Squamish-Lillooet grizzly bear population unit, in which the grizzly bear population is listed as Threatened because it is estimated to be at less than 50% of the habitat's carrying capacity (BC MOE 2012). Therefore, to be precautionary, the grizzly bear population is determined to be sensitive to imposed stresses in the baseline case because it may be declining to extirpation in the RSA and may not be self-sustaining or ecologically effective.

The Proposed Project and other past, present and reasonably foreseeable projects and activities are predicted to affect 7% of grizzly bear foraging habitat in the RSA; however, permanent loss of grizzly bear habitat is expected to be restricted to new roadways. Furthermore, it is expected that past, present and reasonably foreseeable projects and activities within the RSA will apply BMPs and other standards to minimize potential grizzly bear/ human conflicts and regulate gun use and presence within their work areas. Development of new logging roads within the RSA will increase permeability into potential grizzly bear habitat and potentially increase vehicle collisions. Hunting of grizzly bear within the Squamish-Lillooet GBPU is not permitted. As populations within the Squamish-Lillooet GBPU is considered threatened, the cumulative effects in the RSA are determined to be Significant due to the potential increase in mortality risk. FLNRO is managing the habitat within the RSA for future population growth not current population presence and the closest known grizzly occurrence to the Proposed Project Area was recorded from the Squamish Estuary (Hamilton 2012, pers. comm.). No grizzly bears were recorded within the Proposed Project Area over three years of survey data collection. As grizzly bears are not expected to occur within the Proposed Project Area, the Proposed Project is not predicted to contribute to the potential mortality of this species.

5.3.3.7.4 Environmentally Sensitive Ecosystems

It is predicted that the cumulative residual effects of the Proposed Project, past, present and reasonably foreseeable projects and logging activities may reduce the extent of riparian and wetland ecosystems in the RSA by approximately 5% (6 ha) and 3% (3 ha) respectively.

It is expected that past, present and reasonably foreseeable projects and activities in the RSA will apply provincial and industry standards and BMPs, at a minimum, to control erosion and runoff, introduction of dust, invasive plant species, soil disturbance and windthrow. It is predicted that these effects will be effectively mitigated at each

project / activity site and therefore will not contribute to cumulative effects. The magnitude of the potential cumulative residual effects to sensitive ecosystems from loss of extent is predicted to be low. The cumulative effect of loss of extent from the Proposed Project and past, present and reasonably foreseeable projects and activities within the RSA is considered regional in extent, long-term in duration, continuous over the life of the project / activity, and have a high likelihood to occur. Ecosystems removed to accommodate the Proposed Project and other past, present and reasonably foreseeable projects and activities within the RSA may be replaced at the end of the life of the project/ activity as forests may be restored and regenerate over time. Cumulative effects on sensitive ecosystems are therefore predicted to be partially reversible. Confidence that the effect will not be greater than predicted is moderate due to the conservative assumptions regarding the extent of sensitive ecosystems that may be affected.

Riparian and wetland ecosystems are considered to be of moderate resilience because, although sensitive, they will re-establish in suitable conditions follow reclamation. Although a measurable residual effect is likely to occur, residual cumulative effects are predicted not to exceed the resilience limits of sensitive ecosystems within the RSA. Therefore, cumulative effects on sensitive ecosystems in the RSA are predicted to be not significant.

5.3.3.7.5 Ecosystems at Risk

The cumulative residual effects of the Proposed Project and other past, present and reasonably foreseeable projects and activities may reduce the extent of ecosystems at risk in the RSA by 15.1%, 7.9%, 2.3%, 6.8%, and 1.6% for HD, SS, RC, SP, and GS ecosystems respectively. The Proposed Project and forestry are predicted to be the primarily contributing factors to these losses. However, the majority of the ecosystems at risk being impacted by the Proposed Project are already in a disturbed state due to historical forestry activity.

It is expected that past, present and reasonably foreseeable projects and activities within the RSA will apply provincial and industry standards and BMPs, at a minimum, to control erosion and runoff, introduction of dust, invasive plant species, soil disturbance and windthrow. This is likely be effective at mitigating the adverse effects of each project/ activity and therefore will not measurably contribute to cumulative effects.

The magnitude of the potential cumulative residual effects on ecosystems at risk from loss of extent is predicted to be medium based on the percentage of RSA area predicted to be lost. The cumulative effect of loss of extent from the Proposed Project and other past, present and reasonably foreseeable projects and activities in the RSA is considered regional in extent, long-term duration, continuous over the life of the Proposed Project, with a high likelihood to occur. Ecosystems removed to accommodate the Proposed Project and other past, present and reasonably foreseeable projects and activities within the RSA may be replaced at the end of the life of the project/ activity as forests may be restored and regenerate over time. Cumulative effects on ecosystems at risk are therefore predicted to be partially reversible. Confidence that the effect will not be greater than predicted is moderate due to the conservative assumptions regarding the extent of ecosystems at risk that may be affected.

Ecosystems at risk may be affected by the past, present and reasonably foreseeable projects and activities within the RSA. Given the ability of ecosystems to regenerate through natural and reclamation and restoration techniques, it is determined that ecosystems at risk have moderate resilience to imposed stresses. Although a measurable residual effect is likely to occur, primarily due to logging, residual cumulative effects are predicted not to exceed the resilience limits of ecosystems at risk within the RSA. As a result, cumulative effects on sensitive ecosystems in the RSA are predicted to be not significant.

Table 5.3-53: Summary of Residual Cumulative Effects Characterization for Amphibian Species at Risk

Residual Cumulative Effect	Residual Cumulative Effect Assessment Criteria						Significance	Likelihood	Level of Confidence
	Context	Magnitude	Extent	Duration	Reversibility	Frequency			
Construction and Operations									
Change in mortality	-	L	R	MT	FR	M	-	-	M
Habitat loss	-	L	R	LT	PR	H	-	-	M
Barriers to movement	-	L	R	MT	FR	H	-	-	M
Net effect	Moderate Resilience	L	R	LT	PR	H	NS	H	M
Reclamation and Closure									
None Identified									

Table 5.3-54: Summary of Residual Cumulative Effects Characterization for Roosevelt Elk

Residual Cumulative Effect	Residual Cumulative Effect Assessment Criteria						Significance	Likelihood	Level of Confidence
	Context	Magnitude	Extent	Duration	Reversibility	Frequency			
Construction and Operations									
Change in mortality	-	N	R	MT	FR	L	-	-	M
Habitat loss	-	M	R	LT	FR	H	-	-	M
Barriers to movement	-	N	R	MT	FR	H	-	-	M
Net effects	Resilient	M	R	LT	FR	H	NS	H	M
Reclamation and Closure									
None Identified									

Table 5.3-55: Summary of Residual Cumulative Effects Characterization for Grizzly Bear

Residual Cumulative Effect	Residual Cumulative Effect Assessment Criteria						Significance	Likelihood	Level of Confidence
	Context	Magnitude	Extent	Duration	Reversibility	Frequency			
Construction and Operations									
Change in mortality	-	L	R	MT	FR	L	-	-	M
Habitat loss	-	L	R	MT	FR	H	-	-	M
Net effects	Sensitive	L	R	MT	FR	H	S	H	M
Reclamation and Closure									
None Identified									

Table 5.3-56: Summary of Residual Cumulative Effects Characterization for Environmentally Sensitive Ecosystems

Residual Cumulative Effect	Residual Cumulative Effect Assessment Criteria						Significance	Likelihood	Level of Confidence
	Context	Magnitude	Extent	Duration	Reversibility	Frequency			
Construction and Operations									
Net effects/ Loss of extent	Moderate Resilience	L	R	LT	FR	M	NS	H	M
Reclamation and Closure									
None Identified									

Table 5.3-57: Summary of Residual Cumulative Effects Characterization for Ecosystems at risk

Residual Cumulative Effect	Residual Cumulative Effect Assessment Criteria						Significance	Likelihood	Level of Confidence
	Context	Magnitude	Extent	Duration	Reversibility	Frequency			
Construction and Operations									
Net effects/ Loss of extent	Moderate Resilience	M	R	LT	FR	H	NS	H	M
Reclamation and Closure									
None Identified									

Assessment Criteria:
Context: Resilient, Moderately Resilient, and Sensitive;
Magnitude: N – Negligible, L – Low, M – Medium, H – High;
Geographic Extent: L – Local, R – Regional, BR – Beyond Regional;
Duration: ST – Short-tern, MT – Medium-term, LT – Long-term;
Reversibility: FR – Full Reversible, PR - Partially Reversible, IR – Irreversible;
Frequency: L – Low, M – Medium, H – High
Significance: N – Negligible- Not Significance, NS – Not Significant, S – Significant
Likelihood: L- Low, M - Medium, H – High
Level of Confidence: L- Low, M - Medium, H – High

5.3.4 Conclusions

5.3.4.1 Terrestrial Wildlife

The Proposed Project is expected to interact with the following VCs:

- Amphibian Species at Risk;
- Northern goshawk;
- Marbled murrelet;
- Band-tailed pigeon;
- Western screech-owl;
- Common nighthawk;
- Roosevelt elk; and
- Grizzly bear.

The majority of the Project-related effects can be mitigated through Project planning, including a comprehensive Wildlife Management Plan, Spill Prevention and Emergency Response Plan, Erosion and Sediment Control Plan, habitat enhancement for western screech-owl through the installation of nest boxes, progressive reclamation, and habitat compensation during the operation and reclamation phases. Net residual effects after mitigations have been implemented are predicted to be negligible to not significant for all terrestrial wildlife VCs.

5.3.4.2 Terrestrial Vegetation

The Proposed Project will result in the temporary loss of 0.7 ha of riparian ecosystem and 0.88 ha of wetland ecosystem during the construction and operation of the Proposed Project plus the time required for re-establishment, post-reclamation. Re-establishment to its current condition is expected to occur within 150 years. There is expected to be a positive net effect to the sensitive ecosystems VC as a result of the creation of 3.3 ha of new riparian area around the pit lake, post reclamation.

The key residual effect to terrestrial vegetation associated with the Proposed Project is the permanent loss of 23.7 ha of the blue-listed Western hemlock – Amabilis fir – Deer fern upland forest (HD) (24.9% of its extent in the LSA, 4.1% of the RSA), and 0.2 ha of the provincially red-listed Sitka spruce – Salmonberry high fluvial bench forest (SS) (0.9% of its extent in the LSA, 0.5% in the RSA) due to the reclamation of the mine pit to a pit lake. The severity of this effect is mitigated by the Project design, which is sited entirely within areas previously disturbed by forest harvesting and other anthropogenic disturbance.

The Proposed Project will also result in the temporary loss of:

- 20.6 ha of Western hemlock – Amabilis fir – Deer fern upland forest (HD) (21.6% of its extent in the LSA, 6.7% in the RSA);

- 0.8 ha of Western red cedar – Sitka spruce – Skunk cabbage swamp forest (RC/ Ws54) (88.9% of its extent in the LSA, 1.5% in the RSA);
- 0.3 ha of Sitka spruce – Pacific crab apple riparian forest (SP) (6.8% of its extent in the LSA, 6.8% in the RSA);
- 0.08 ha of Tufted hair grass – Douglas' aster estuarine meadow (GS/ Ed02) (6.2% of its extent in the LSA, 1.6% in the RSA); and
- 0.4 ha of Sitka spruce – Salmonberry high fluvial bench forest (SS) (1.7% of its extent in the LSA, 1.1% in the RSA).

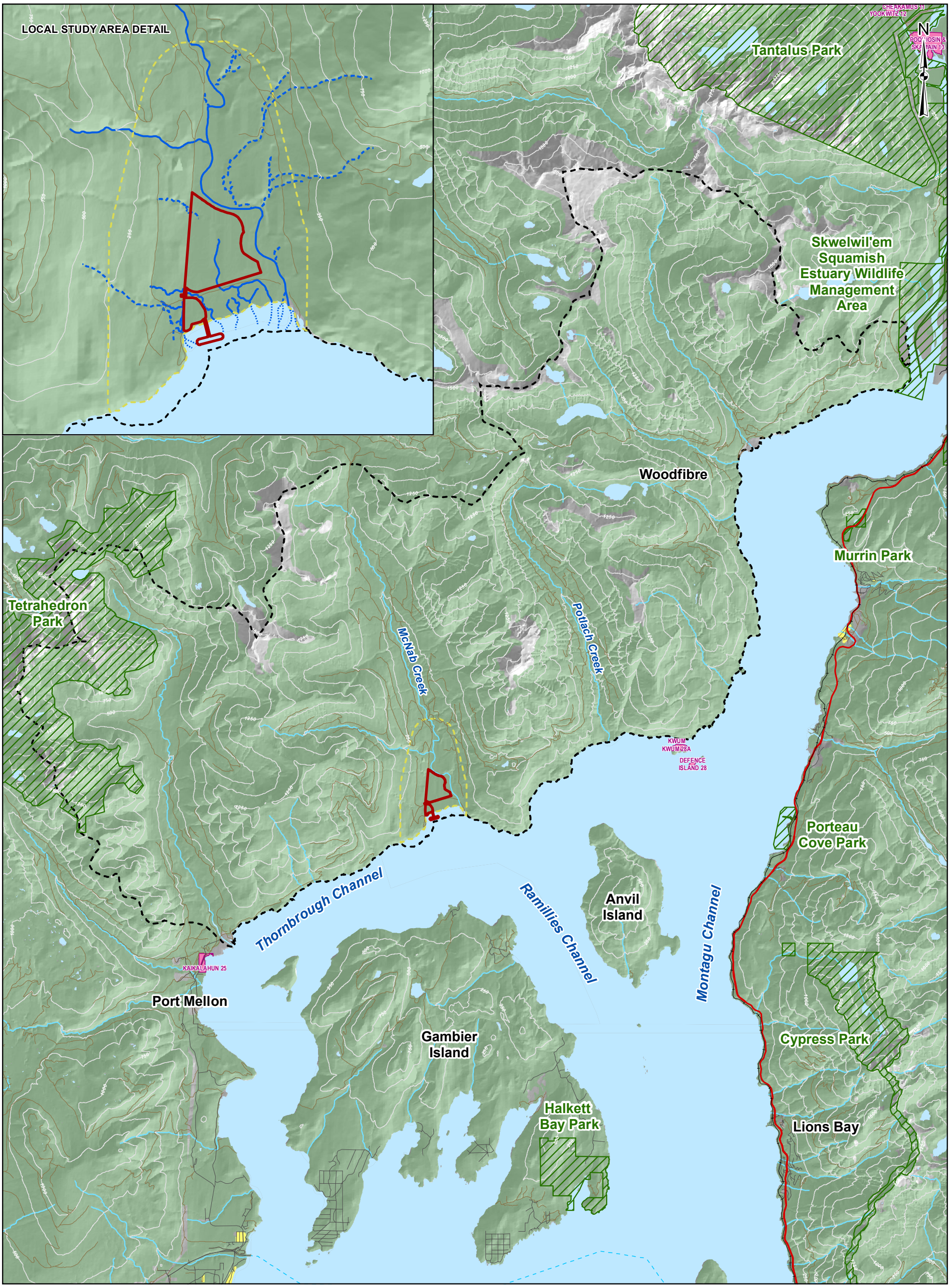
This loss is considered long-term, the construction and operation of the Proposed Project plus the time required for re-establishment, post-reclamation. The significance of this effect is considered not significant.

The potential risk for the introduction of deleterious substances will be controlled with the preparation of a Project specific CEMP and OEMP, on-site environmental monitoring, and scheduled equipment inspections and maintenance. These measures aim to reduce the likelihood of an accident or malfunction that would result in a spill. A Spill Prevention and Emergency Response Plan will also be prepared in order to address a spill emergency and reduce the harm of such an event. It is expected that mitigation will reduce the likelihood of this occurrence to low; therefore, the significance rating of this effect is negligible.

All remaining potential Project effects to terrestrial vegetation VCs (i.e., increased dust, surface runoff, invasive species, windthrow, and soil disturbance) considered in this assessment are rated as negligible with the application of mitigation.

5.3.4.3 Cumulative Effects Assessment

Cumulative effects were assessed for amphibian species at risk, western screech-owl, Roosevelt elk, grizzly bear, sensitive ecosystems, ecosystems at risk and plant species at risk. Net cumulative residual effects for grizzly bear are determined to be significant because they contribute to the factors limiting the population, which is likely sensitive to imposed stresses. However, the Proposed Project is unlikely to contribute to the factor limiting the grizzly bear population in the RSA (i.e., mortality). Net cumulative effects are determined to be not significant for all other terrestrial wildlife and vegetation VCs.



LEGEND

- Project Boundary
- Terrestrial Wildlife and Vegetation Local Study Area
- Terrestrial Wildlife and Vegetation Regional Study Area
- Park / Protected Area
- Vegetation
- Residential Area
- Indian Reserve
- Highway
- Road
- Resource Road
- Railway
- Ferry
- Permanent / Perennial Watercourse
- Intermittent Watercourse
- Intertidal Watercourse
- Watercourse
- Contour (250m)

REFERENCE

Elevation and indian reserves from Geobase. Vegetation and residential areas from CanVec. Watercourses from the Province of British Columbia and field data. Parks and protected areas and base data from the Province of British Columbia. All rights reserved.
Projection: UTM Zone 10 Datum: NAD 83

4,000 0 4,000

SCALE 1:120,000 METRES

PROJECT

BURNCO ROCK PRODUCTS LTD.
BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.

TITLE

TERRESTRIAL WILDLIFE AND VEGETATION STUDY AREAS

Golder Associates

PROJECT NO. 11-1422-0046			PHASE No.	
DESIGN	MD	2 Nov. 2012	SCALE AS SHOWN	REV. 1
GIS	DL	04 Mar. 2016	FIGURE 5.3-1	
CHECK	AS	10 Jun. 2014		
REVIEW	AC	10 Jun. 2014		

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