TABLE OF CONTENTS

List of Tables

TABLE OF CONTENTS (cont.)

List of Figures

List of Appendices

5.4.15 Invertebrates

5.4.15.1 Introduction

This section assesses the potential effects of the Project on the invertebrates Valued Component (VC). The indicator species are jutta Arctic (*Oeneis jutta*) and American emerald (*Cordulia shurtleffii*). The assessment is described in the subsections below and will be conducted for these species. This introduction describes the information sources of the assessment and the applicable regulatory framework for the assessment of the VC (**Section 5.4.15.1.1**). The spatial, temporal, administrative, technical boundaries and assessment approach is described in (**Section 5.4.15.3**).

Butterflies and odonates (dragonflies and damselflies) represent the invertebrate groups considered for inventory in the study areas. They are representative invertebrates that the BC Conservation Data Centre (BC CDC) lists as potentially occurring in ecosystems (Vanderhoof, Quesnel, and Chilcotin Forest Districts) similar to those found in the study areas. There are no published records of any species at risk in these two invertebrate groups in the study areas (BC CDC, 2013).

Two species of invertebrates were selected as indicators due to their representative habitat requirements found within the study areas and relative potential for impacts from the Project: the Blue-listed butterfly jutta arctic (*Oeneis jutta chemocki*), which requires black spruce bog wetlands as habitat, and the dragonfly American emerald (*Cordulia shurtleffii*), which requires open wetland and riparian habitats for breeding and aquatic life stages (**Appendix 5.4.15A** and **Appendix 5.4.15B**). As a result, this study focuses on potential impacts to invertebrates from wetland loss and disturbance.

5.4.15.1.1 Regulatory Considerations

None of the invertebrate species present in the study areas are subject to provincial wildlife regulations, other related legislation or are federal species at risk.

5.4.15.2 Valued Component Baseline

The 2011 to 2013 baseline field studies consisted of visually searching for adult butterflies and dragonflies along transects through selected habitat patches; locations and routes of transects were chosen within each patch of habitat to maximize coverage. Roads were usually selected as transect routes because roadside clearances typically contain a representative selection of butterflies and dragonflies living in nearby natural habitats, and access is efficient. Habitat patches were both undisturbed (e.g., forests, wetlands, lakeshores) and disturbed (e.g., roadsides, clearcuts). In the study areas, primarily non-forested areas (including roadsides, clearcuts, wetlands, and rock outcrops) are suitable habitat for butterflies and dragonflies, although open-canopy upland forest and open-canopy forested wetlands are also suitable for some butterfly species.

During the baseline field surveys, 45 species of butterflies and 40 species of dragonflies/damselflies were found, including three species that are provincially listed. There were

few previous records for any species of butterflies or dragonflies/damselflies from the study areas, all of which were near Highway 16 (**Appendix 5.1.3.4A**).

The jutta arctic, *Oeneis jutta* n.ssp, is Blue-listed under the name *Oeneis jutta* ssp. *chermocki*, and is widespread in forested wetlands at lower elevations in the study areas. The central BC populations of jutta arctic, although considered the same as the Rocky Mountain subspecies *chermocki* in existing publications, are an undescribed subspecies (C. Guppy, pers. comm.). The species is biennial (i.e., takes two years to grow from egg to adult), and in the study areas adults are thought to be more abundant in odd-numbered years, with only low population adult densities in even-numbered years (C. Guppy, pers. comm.). The Blue-listed conservation status of this subspecies is primarily due to relatively few records of the species in central BC. This lack of records appears to be due to lack of butterfly inventory in black spruce wetlands; the butterfly is apparently common and widely distributed in this habitat in central BC (C. Guppy, pers. comm. 2013).

The Red-listed Mandan skipper (*Carterocephalus palaemon Mandan*) was found in two wet grass/sedge hollows near a deactivated Forest Service Road (FSR). The distribution and abundance of the Mandan skipper is too poorly known to assess its conservation status in central BC (C. Guppy, pers. comm., 2013).

The Blue-listed Hagen's blue (*Enallagma hageni*) was found in two sedge wetlands at lower elevations and may occur in other wet sedge wetlands in the area (AMEC, 2013). The American emerald was one of the most common dragonflies encountered with 53 observations.

5.4.15.2.1 Past, Present, or Future Project and Activities

Other projects or activities considered in the assessment are in the Project Inclusion List (PIL). The PIL identifies those projects or human activities that may overlap spatially or temporally with the Project as summarized in (**Table 4.3-11**). **Appendix 4C** presents the detailed Project Inclusion List and descriptions of various projects and activities used for assessing potential environmental effects**.**

Pre-existing habitat loss and fragmentation due to logging and road development has altered invertebrate habitat within the study areas. The mountain pine beetle has infested large areas of mature pine forest in the region including the LSA and RSA, some of which has been harvested while remaining stands are in various stages of degeneration. Mineral exploration in the area has increased the number of access roads. Baseline information collected on invertebrates was conducted in areas that have been altered by these past and present activities. Future activities in the study areas are expected to include the same activities.

5.4.15.2.2 Traditional Ecological and Community Knowledge

Community and traditional knowledge did not specifically identify invertebrates. The comments and issues raised by Aboriginal groups are further discussed in **Section 3**, which contains the public and Aboriginal issues tracking tables for the Project. **Sections 14** through **Section 16** provide a summary of the Aboriginal background, rights, and interests for the Project.

5.4.15.3 Potential Effects of the Proposed Project and Proposed Mitigation

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

It first describes the features of the study area, temporal, administrative, and technical boundaries. (**Section 5.4.15.3.1** to **Section 5.4.15.3.4**).

Then, **Section 5.4.15.3.6** details the assessment approach used in the assessment followed by **Section 5.4.15.3.10** Mitigation Measures.

The assessment considers the following:

- Terrestrial habitat, including the quality and quantity of any lost habitat for relevant species;
- Feeding, or breeding habitats;
- Any wetland habitat alteration or loss;
- Barriers to wildlife, including the roads developed as part of the mine and their potential effects on wildlife movements;
- Disturbance of daily or seasonal wildlife movements (e.g., migration and home ranges), which would include potential hazards and conflicts associated with mine access and travel corridors of terrestrial wildlife;
- Any species of invertebrate that are Rare, Vulnerable, Endangered, Threatened, or of Special Concern as listed under provincial Blue and Red lists, *SARA*, COSEWIC, as well as, any species of international significance (**Section 5.4.15.1.1**);
- Wildlife habitat is being rated for suitability as a surrogate for wildlife productivity; and
- Implications of the proposed Project acting as an attractant for particular species.

A range of potential effects on invertebrates can be associated with a project involving a mine site, linear features including roads, pipelines and transmission line. Assessment boundaries define the scope or limits of the assessment. These boundaries encompass the areas and time periods during which the Project is expected to interact with invertebrates (spatial and temporal boundaries), any constraints placed on the assessment of those interactions due to political, social, and/or economic realities (administrative boundaries), and any limitations in predicting or measuring changes (technical boundaries). Each of these boundaries is defined in the subsections below.

Activities occurring during each phase of the proposed Project could potentially interact with invertebrates. A change in habitat availability and potential mortality are the predicted key and moderate interactions of the proposed Project related to invertebrates. Taking a conservative approach, both key and moderate interactions are combined and considered jointly in assessment of project and cumulative effects.

5.4.15.3.1 Study Area Boundaries

Two geographic scales were defined for considering Project effects on invertebrates and invertebrate habitat, as shown on **Figure 5.4.15-1** and described below. These areas were used for collecting baseline information. The Project area encompasses the Local Study Area (LSA) and the Regional Study Area (RSA) as described below. Past, present, and future activities that may affect invertebrates within these areas were identified and assessed within the RSA.

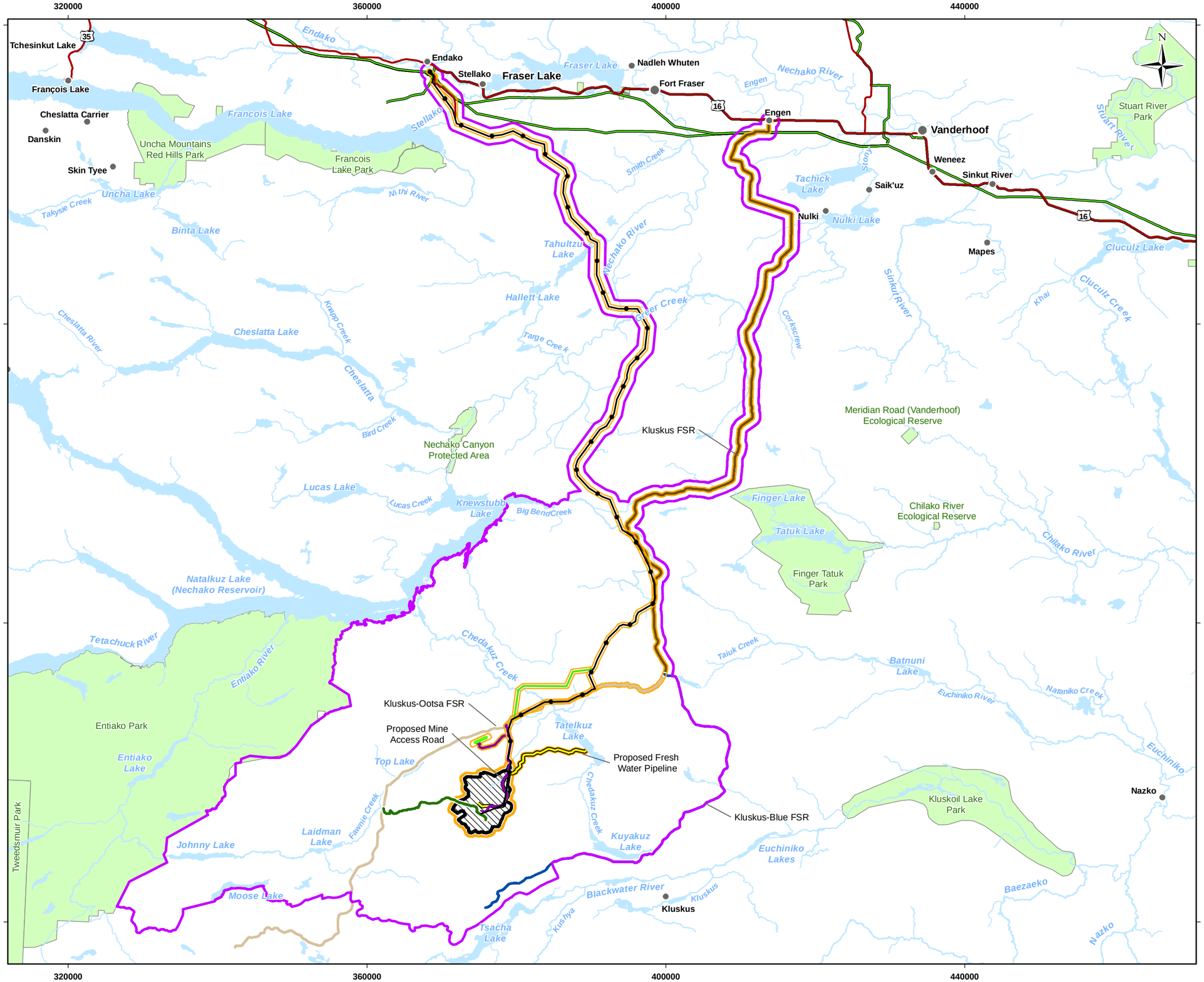
Local Study Area: The AIR describes the LSA as follows (**Table 4.3-1** of **Section 4**):

- Mine Site: Approximate 500 m buffer around the proposed mine site facilities; and
- Transmission line, mine access road, airstrip, freshwater supply pipeline, and Kluskus FSR: approximately 250 m buffer from each side of the linear component boundary.

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

- The LSA includes the entire mine site where habitat will be removed and considers a buffer to take into account sensory disturbance; and
- The LSA includes all linear components and a buffer to take into account sensory disturbance. The buffer along the linear corridors varies because activities along those corridors varies from an access road that may have greater sensory disturbance to a transmission line with limited human activity or traffic after construction.

The LSA for the purpose of the invertebrate VC comprises 22,509 ha and includes 7,032 ha for the Project footprints (**Table 5.4.15-1**). The LSA includes the proposed mine site area (the mine site footprint plus a 500 m buffer), and all linear components areas (linear components with 250 m buffer on each side of linear component boundary, except for the airstrip which is 300 m buffer on each side). The linear component boundary, also referred to as the footprint, is comprised of the feature's right-of-way (ROW) and an additional buffer. The linear component boundary widths are as follows: existing Kluskus FSR is 20 m (20 m ROW with no buffer), proposed mine access road is 120 m (20 m ROW with 50 m buffer each side), proposed transmission line is 140 m (40 m ROW with 50 m buffer on each side), proposed freshwater supply pipeline is 110 m (10 m ROW with 50 m buffer on each side), proposed airstrip is 200 m (100 m ROW with 50 m buffer each side), and the proposed airstrip access road is 10 m (10 m ROW, with no buffer). The FSR re-alignment and Transmission Line access roads are included in the LSA area for these features. The transmission line includes a mainline route and two potential re-routes, the Mills Ranch and Stellako options. The final location of the transmission line access roads will be determined during the detailed engineering and permitting stage, and will consider traditional knowledge and traditional use information provided by Aboriginal groups as appropriate. Its design will follow the same principles of using existing roads avoiding sensitive habitat to the extent possible.



Reference
BC Government GeoBC Data Distribution

CLIENT: newgold™

PROJECT: Blackwater Gold Project

Regional Study Area Boundaries for Invertebrates and Associated Habitat

DATE:	ANALYST:	**Figure** 5.4.15-1
September, 2015	MY	
JOB No: VE52277	QA/QC: MB	PDF FILE: 04-03-001_study_area_5.4.15-1.pdf
GIS FILE: 04-03-001_study_area_5.4.15-1.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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Table 5.4.15-1: Project Component Footprint Areas

Component	Area (ha)
Mine Site	4,430
Access Road	95
Existing Kluskus Forest Service Road	253
Airstrip	50
Freshwater Pipeline	132
Main Transmission Line	1,806
Mills Ranch Transmission Line	202
Stellako Transmission Line	62
Total Project Footprint	**7,032**

Note: ha = hectare; m = metre

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

- Mine Site: Includes ungulate winter range established for the Tweedsmuir-Entiako caribou herd (U-7-012). The western and southern edges of the RSA outline these winter ranges. The southwestern boundary follows the Upper Blackwater Management Zone where the RSA then follows the Blue Road until it reaches the Ootsa – Kluskus FSR and follows this north until it reaches the Nechako Reservoir. The northern boundary of the RSA follows the shoreline of the Nechako Reservoir. The northern boundary of the RSA follows the shoreline of the Nechako Reservoir; and
- Transmission Line and Kluskus FSR. Approximate 1 km buffer from the linear component boundary.

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

- Extends beyond the mine site LSA to consider natural barriers for wildlife such are large water bodies or watershed divides.

The RSA for the purpose of the invertebrate VC comprises 291,714 ha and is large enough to assess the seasonal home range movements and important seasonal habitats of most invertebrate species considered, some of which have long distance movement patterns. The RSA was selected to include a wide variety of habitat types also found in the LSA, allowing the assessment of relative abundance of habitat within the LSA relative to the greater region where the Project is situated (**Figure 5.4.15-1**).

5.4.15.3.2 Temporal Boundaries

Preliminary temporal boundaries of the Project, which are contingent on permitting, include four primary phases:

- **Construction phase:** The construction phase of the Project will occur over 2 years and will likely start following receipt of the required permits;
- **Operations phase:** The operations phase of the Project will extend for approximately 17 years;
- **Closure phase:** The closure phase is estimated to last approximately 18 years (ending in Year 35); and
- **Post-closure phase:** The post-closure phase starts in Year 35.

In terms of duration of effects, the following terms are used in this effects assessment: Short-term effects occur during the construction phase; Medium-term effects are not applicable for invertebrate as they were considered long term to provide a conservative assessment; Long-term effects occurs throughout operations and closure; and Chronic effects extend into post-closure or beyond.

5.4.15.3.3 Administrative Boundaries

The Vanderhoof Land Resource Management Plan (LRMP) (ILMB, 1997) identified smaller Resource Management Zones (RMZs) that have different resource development and conservation objectives. Each RMZ has a selection of species of management concerns and objectives to guide land use decisions and management, although none directly pertain to invertebrate management. The mine site and associated Project infrastructure including the roads and transmission line are located within the following RMZs: Nechako Valley, Nechako West, Upper Nechako River, Vanderhoof South, Crystal Lake, Kluskus, Chedakuz, Davidson Creek, and Laidman Lake. The Project is located within five Wildlife Management Units (WMUs): 5-12, 5-13, 6-1, 7-11, and 7-12. Each WMU is the primary designation tool for conservation lands under section 4 of the *Wildlife Act*. Conservation and management of fish, wildlife, and their habitats are priority in a WMU and are used to set hunting regulations (BC MFLNRO, 2014).

5.4.15.3.4 Technical Boundaries

Technical boundaries for the assessment are established by the accuracy of the wildlife habitat model predictions used in the effects assessment. There is an uncertainty/margin of error associated with the use of habitat suitability models; however, Resource Inventory Standards Committee (RISC) standards for ratings and suitability classes were followed (RISC, 1999). Therefore, these standards are considered acceptable levels of uncertainty for an assessment. Surveys were completed within the LSA and RSA.

5.4.15.3.5 Potential Project Effects

The named projects from the PIL in **Table 4.3-11** that represent present and future projects will not have interactions with the Project however the listed activities from the list will. Pre-existing habitat loss and fragmentation due to logging and road development has altered invertebrate habitat within the study areas. The mountain pine beetle has infested large areas of mature pine forest in the region including the LSA and RSA, some of which has been harvested while remaining stands are in various stages of degeneration. Mineral exploration in the area has increased the number of access roads. Baseline information collected on invertebrates was conducted in areas that have been altered by these past and present activities. Future activities in the study areas are expected to include the same activities.

Project effects consider both the key and moderate interactions defined and identified in **Section 4, Table 4.3-2** (Project Component and Activity Interaction Matrix). In order to conservatively assess interactions of the project with invertebrate and invertebrate habitat, both key and moderate interactions were combined and included in the modeling and effects assessment. The interactions are further identified using a ranking table **Table 5.4.15-2** to identify different Project phases and whether the resulting effect can be managed to acceptable levels through standard operating practices through the application of best management practices (BMPs) or codified practices or if the resulting effect may exceed acceptable levels without implementation of specified mitigation. The table is used to guide specific mitigation and monitoring needed for this VC. **Table 5.4.15-3** presents several measurable categories of assessment for Project effects defined and the rationale for the selection of each category of assessment.

Evidence suggests that below certain thresholds of habitat cover, species may decline more rapidly than would be expected from habitat loss alone (Andrén, 1994). When remaining functional habitat is greater than 10% to 30% in a region, species are still affected by habitat loss (Andrén, 1994; Fahrig, 1997; Swift and Hannon, 2010) but are not necessarily at risk of regional extirpation. For instance, higher thresholds have been reported for some species (e.g., Gibbs, 1998; Homan et al., 2004), which may reflect sensitivity to fragmentation after only moderate habitat loss. Depending on taxa and landscape, residual habitat thresholds ranging from 10% to as high as 60% may be required to avoid rapid population declines (Bennett and Ford, 1997; Villard et al., 1999; Swift and Hannon, 2010). However, most threshold evidence supports a minimum 30% residual habitat threshold at a landscape level to avoid rapid declines that may lead to regional extirpation (Swift and Hannon, 2010).

Table 5.4.15-2: Potential Interaction of the Project with Invertebrates

Project Activities	Potential Key and Moderate Interactions
Construction of Mine, Airstrip, Access Roads, Freshwater Supply Pipeline, and Transmission Line	
Clearing and grubbing	2
Open pit preparation	1
General earthworks (moving surface soil)	2
Equipment operation	1
Road upgrading and construction	2
Borrow pit excavation	2
Road and airstrip use	1
Operations of Mine, Airstrip, Access Roads, Freshwater Supply Pipeline, and Transmission Line	
Open pit mining	1
Process plant	1
Transportation system preparation	2
Temporary waste rock stockpiles	1
Tailings storage facility	1
Camp	1
Road use	2
Water collection pond	2
Decommissioning Closure and Post-Closure Mine, Airstrip, Access Roads, Freshwater Supply Pipeline, and Transmission Line	
Roads	2
Reclamation	2

Note: 0 = No interaction.
1 = Moderate Interaction occurs; however, based on past experience and professional judgment, the resulting effect can be managed to acceptable levels through standard operating practices and/or through the application of best management or codified practices.
2 = Key Interaction occurs. The resulting effect may exceed acceptable levels without implementation of mitigation. Further assessment and monitoring is warranted.

Table 5.4.15-3: Categories of Assessment for Invertebrates

Category of Assessment	Notes or Rationale for Selection
Habitat Loss and Alteration	Effects on population abundance and distribution are directly affected by habitat availability and displacement from effective habitat. Vegetation clearing for the Project, and sensory disturbance from Project activities during construction and operations, may affect habitat availability and quality. This analysis included ranking habitat quality for invertebrates, so that the relative quantitative and qualitative loss of moderate- to high-quality versus lower-quality habitat was assessed in relation to regional availability of suitable habitat measured as percentage and hectares lost.
Change in Invertebrate Population Dynamics	For some species, predation may be affected by changes in prey abundance/habitat availability, resulting in differential mortality of key species. The Project may indirectly alter predator-prey relationships among some species and contribute to cumulative landscape changes. This relies on provincial data and potential monitoring data of invertebrates over the life of the Project, including species, features and occurrences based on field surveys and BC CDC records. For invertebrates, the focus is on relative abundance and presence/absence distribution in areas of potential impact and measures of known mortality.
Mortality Risk	Mortality related to transport options could alter species abundance. This requires assessment of the potential effects of roads, pits, and other structural features on invertebrates, migration and movement, reproductive behaviour and success, and direct mortality. This is primarily a qualitative assessment, in the absence of area-specific baseline data and predictive tools, based on characteristics of the species or species group and context of Project components. For invertebrates, this is a qualitative estimate based on risk of vehicle collisions related to the Project.
Change in Invertebrate Movement Patterns	Changes in movement patterns may affect species breeding and survival rates, and may increase predation/mortality. This is a qualitative discussion based on information from habitat mapping, existing knowledge on wildlife movement patterns, and characteristics and context of Project components. Aspects such as noise, light, odours, and human presence may affect use of habitats close to Project components. For invertebrates, this is a qualitative assessment of potential attraction to light and associated mortality.
Change in Invertebrate Health	Contaminant loading may affect invertebrate health. Assessment of the potential effects of identified contaminants of potential concern on invertebrate feeding, migration and movement, reproductive behaviour and success, and direct mortality. This is a qualitative measure that relies on water quality, reporting of animal health and provincial data.

Note: Includes input from consultation with regulators, Aboriginal organizations, affected stakeholders and the public, as well as EA guidelines, other regulatory drivers, policies and/or programs.

For this assessment, precautionary thresholds have been identified for species where specific thresholds do not exist. A precautionary threshold is defined as the point before a resource would be expected to undergo an unacceptable change, either from an ecological, regulatory, or social perspective. This definition allows the Proponent and regulators to enact mitigation measures with sufficient time to prevent the particular resource from reaching or exceeding the true ecological threshold. The following precautionary thresholds are used in this assessment: 70% residual habitat (30% loss) for species not identified as a conservation concern (e.g., moose, forest birds); and 80% residual habitat (20% loss) for species of conservation concern (e.g., invertebrates, caribou, furbearers (wolverine), grizzly bear, northern myotis, water birds). The precautionary

threshold of 20% loss is used for assessment of the effects within the RSA because some invertebrates are species of conservation concern with the BC Conservation Data Centre (CDC).

The next step was to assess each of these relative interactions for the Project phases and activities with invertebrates to examine which categories of assessment may be expected in different areas and times (**Table 5.4.15-4**).

Table 5.4.15-4: Project Interactions on Categories of Assessment for Invertebrates

Project Activities	Category of Assessment				
	Changes in Habitat Availability	**Changes in Invertebrate Population Dynamics**	**Changes in Invertebrate Mortality Risk**	**Changes in Invertebrate Movement Patterns**	**Changes in Invertebrate Health**
Construction of Mine, Airstrip, Access Roads, Freshwater Supply Pipeline, and Transmission Line					
Clearing and grubbing	2	1	1	2	0
Open pit preparation	1	1	1	1	0
General earthworks (moving surface soil)	2	0	0	2	1
Equipment operation	1	1	1	1	1
Road upgrading and construction	2	1	2	2	1
Borrow pit excavation	2	2	1	2	1
Road and airstrip use	1	1	1	1	1
Operations of Mine, Airstrip, Access Roads, Freshwater Supply Pipeline, and Transmission Line					
Open pit mining	1	1	1	1	1
Process plant	1	1	1	1	1
Transportation system preparation	2	1	1	2	1
Temporary waste rock stockpiles	1	1	1	1	1
Tailings storage facility	1	1	1	1	1
Camp	1	1	1	1	1
Road use	2	1	1	2	1
Water collection pond	2	2	2	2	2
Decommissioning Closure and Post-Closure Mine, Airstrip, Access Roads, Freshwater Supply Pipeline, and Transmission Line					
Roads	2	1	1	2	2
Reclamation	2	2	1	2	1

Note: 0 = No interaction.
1 = Moderate Interaction occurs; however, based on past experience and professional judgment, the resulting effect can be managed to acceptable levels through standard operating practices and/or through the application of best management or codified practices.
2 = Key Interaction occurs. The resulting effect may exceed acceptable levels without implementation of mitigation. Further assessment and monitoring is warranted.

Potential key and moderate interactions are linked to the temporal scale of the Project phases and vary in the time needed to return to baseline conditions (**Table 5.4.15-5**). For instance, sensory disturbance effects tend to be short-lived and transient, and effects may be related to frequency of disturbance and duration, but recovery may be very quick once disturbances stop. Conversely, habitat loss due to Project construction may require significant amounts of time to recover to baseline conditions.

Table 5.4.15-5: Temporal Boundaries

Category of Assessment	Temporal Boundary
Habitat Loss and Alteration	Construction and operations to closure
Changes in Invertebrate Population Dynamics	Construction and operations
Mortality Risk	Construction and operations
Changes in Invertebrate Movement Patterns	Construction and operations
Changes in Invertebrate Health	Construction and operations

Anticipated Project effects include habitat loss (i.e., cleared vegetation, changes to wetland quantity and quality) and some potential degradation, mortality risk and health impacts. The construction of the proposed mine site, access roads, transmission line, freshwater supply pipeline, and airstrip expansion will require the removal of vegetation and will affect wetlands suitable for the focal invertebrate species. Some vegetation will be lost permanently (greater than 100 years), while the majority of areas will be reclaimed progressively or during closure. Wherever vegetation is removed, the remaining adjacent vegetation communities experience edge effects, which may result in potential degradation of the remaining habitats but may enhance habitat conditions for others (e.g., enhancement for some edge/opening species).

In addition to direct habitat loss, activity on the mine site, airstrip, and road may reduce effective use of habitat, and road use may result in a minor amount of direct mortality from vehicle collisions. Chemical hazards and attractants may affect invertebrates that frequent the mine site, transmission line, or access roads, and result in mortality or health risk changes.

Three of the five potential categories of assessment: habitat loss and alteration, change in invertebrate mortality risk, and change in invertebrate health are considered to have potential measurable residual effects and, therefore, carried through the effects assessment. The other two potential effects: changes in population dynamics, and wildlife movement patterns, will not be considered further in the assessment, due to the mitigation measures in place, a no net loss of wetlands plan for the Project area and the diurnal activity patterns of the indicator species. Landscape, Soils, and Vegetation Management and Restoration Plan (LSVMRP) (**Section 12.2.1.18.4.4**), Invasive Species Management Plan (ISMP) (**Section 12.2.1.18.4.5**), Wetlands Management Plan (WMP) (**Section 12.2.1.18.4.3**), Sediment and Erosion Control Plan (SECP) (**Section 12.2.1.18.4.1**), Reclamation and Closure Plan (RCP) (**Section 2.6**), and the Aquatic Resources Management Plan (ARMP) (**Section 12.2.1.18.4.2**) are predicted to limit potential effects on these categories to negligible levels. Consequently, changes in wildlife

movement patterns due to light disturbance are not considered further, but are included in habitat alteration considerations through incorporation into habitat suitability ratings (**Table 5.4.15-6**).

Table 5.4.15-6: Overview of Potential Project Effects on Invertebrates

Category of Assessment	Description	Project Phases	Project Components
Habitat Loss and Alteration	Areas that will be cleared of vegetation for Project infrastructure (e.g., facility direct footprint, road surface and cut/fill, borrow areas, etc.) light effects from infrastructure may result in temporary to long-term habitat loss.	Construction, operations, closure, and post-closure	Mine site, access roads, transmission line, freshwater supply pipeline, and airstrip
Mortality Risk	Direct mortality of invertebrates may result from wetland drainage or vehicles.	Construction, operations	Mine site, access roads, transmission line, freshwater supply pipeline, and airstrip
Invertebrate Health	Changes in water quality or dust may affect invertebrate health	Construction, operations	Mine site, access roads

5.4.15.3.6 Assessment Approach for Measuring Potential Effects

Both quantitative and qualitative approaches were used for the assessment of potential Project effects on invertebrates. A quantitative approach was used for determining the potential loss and alteration of habitat within the RSA and a qualitative approach was used for assessing an increase in mortality risk and invertebrate health changes.

5.4.15.3.6.1 Habitat Suitability Model Assumptions

Habitat suitability modeling is based on assumptions related to TEM and PEM habitat interpretations, professional judgment and experience related to invertebrates and invertebrates habitat, literature and traditional knowledge. Assumptions include the quantitative rating of TEM and PEM units for value to invertebrates during the growing season and are based on similar models used and tested throughout BC and assessed over time through population estimates and research. Specific assumptions related to habitat quality are described in each sub-model. Habitat suitability value is assumed to reflect the current value of habitat and not the future value.

Assumptions related to mortality, disturbance, displacement, predation and health are described in the effects sections related to these categories of assessment. Habitat ratings were interpreted to represent potential reductions in habitat quality and effectiveness related to mine infrastructure. Models assumed that all suitable habitat could be used and that habitat was included in calculations of habitat impacted by the Project.

5.4.15.3.6.2 Habitat Loss and Alteration

To identify the most critical habitats for invertebrate species, all wetlands and riparian habitats were selected as suitable quality habitat and buffered by 30 m (30 m on each side of streams and

outside of wetland polygons to protect microhabitat of habitats important for jutta artic and American emerald) to calculate potential areas affected by Project component footprints. TEM or PEM was used to identify wetland polygons containing suitable habitat, and the BC Watershed Atlas (GeoBC, 2014) was used to identify streams for use as riparian areas. Although the two invertebrate species indicators are not usually present in higher elevations, such as the mine site, all potential habitats were included to present a conservative measure of potential effects on habitats and species.

5.4.15.3.6.3 Invertebrate Mortality Risk

There are no measureable parameters in the Project area for the assessment of changes in mortality due to traffic, therefore the assessment is qualitative and based on professional judgment.

5.4.15.3.6.4 Changes in Invertebrate Health

There are no measureable parameters for the assessment of changes in invertebrate health due to Project effects, therefore the assessment is qualitative.

5.4.15.3.7 Habitat Suitability Model Development

As part of the environmental assessment, Project-related loss of moderate and high rated habitat for invertebrates was quantified to determine potential effects on invertebrates.

Invertebrates use a variety of terrestrial and aquatic habitats in the study areas during the various stages of their life cycle, e.g., spring and summer breeding and foraging. Each spring, invertebrates hatch from eggs or continue to develop as larvae to emerge as adults during summer to breed. Terrestrial habitats vary depending on invertebrate group. Butterflies generally prefer sunny open areas, such as clearcuts, meadows, and wetlands, with an abundance of flowers for foraging. Dragonflies are frequently found around wetlands and other waterbodies; however, adults may travel considerable distances away from water and may make use of many different open terrestrial habitats.

High quality habitat consists of lower elevation wet sedge, black spruce and willow peat wetlands, and riparian areas, which provide breeding and feeding habitat (generally lower in elevation than the mine site) (C. Guppy, pers. comm.).

5.4.15.3.8 Invertebrate Growing Habitat Model

Invertebrates were modelled based on habitat suitability for American emerald and jutta arctic. These species primarily use wetlands for living (e.g., breeding and foraging), and therefore all wetlands and waterbodies (e.g., ponds, streams), along with a 30 m buffer around these areas, were included as suitable habitat (**Figure 5.4.15-2**).

5.4.15.3.9 Model Results for Quantification of Potential Project Effects on Habitat

Table 5.4.15-7 and **Figure 5.4.15-2** show the potential overlap of Project component footprints on indicator invertebrate species' habitat. The areas shown represent the maximum potential habitat affected and do not account for existing disturbance or mitigation measures.

Table 5.4.15-7: Potential Invertebrate Habitat Area Affected Within Footprints, LSA, and RSA

	LSA Component	Invertebrate Habitat Area (ha)	Total Area (ha)	Habitat % of Total Area	% of RSA Habitat by Footprint Component*
Footprint or Corridor	Access Road	13	96	13	<1
	Airstrip	4	50	8	<1
	FSR	39	253	15	<1
	Mine Site	1,049	4,430	24	2
	Freshwater Supply Pipeline	18	132	13	<1
	Transmission Line - Main	310	1,806	17	<1
	Transmission Line - Mills Ranch	55	203	27	<1
	Transmission Line - Stellako	12	62	20	<1
	Total	**1,499**	**7,032**	**21**	**3**
LSA	Access Road	69.7	363	19	<1
	Airstrip	91.0	465	20	<1
	FSR	1,262	6,574	19	3
	Mine Site	1,457	6,123	24	3
	Freshwater Supply Pipeline	134	731	18	<1
	Transmission Line - Main	1,612	8,068	20	3
	Transmission Line - Mills Ranch	264.6	924	29	<1
	Transmission Line - Stellako	60.6	306	20	<1
	Total	**4,952**	**23,554**	**21**	**103**
RSA		**49,265**	291,714	17	-
Area	footprint % RSA	2	-	-	-
	footprint % LSA	30	-	-	-
Habitat	footprint % RSA habitat	3	-	-	-
	footprint % LSA habitat	30	-	-	-

Note: FSR = forest service road; ha = hectare; LSA = Local Study Area; RSA = Regional Study Area

360000 370000 380000 390000

5910000 5900000 5890000

Proposed Transmission Line

Proposed Transmission Line (Mills Ranch re-route)

Chedakuz Creek

Proposed Mine Access Road

Proposed Airstrip

Proposed Fresh Water Pipeline

Kluskus-Ootsa FSR

Proposed Airstrip Access Road

Tatelkuz Lake

Snake Lake

Top Lake

Davidson Creek

Exploration Road

Kuyakuz Lake

Kluskus-Blue FSR

N

Legend

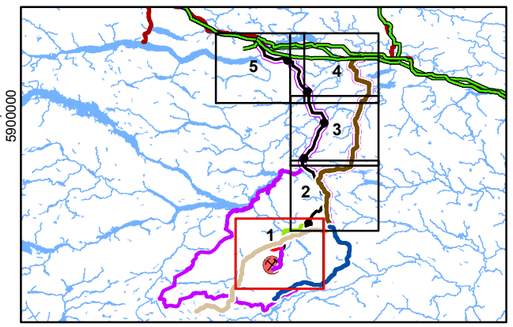
- Existing Road
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Exploration Road
- Proposed Airstrip Access Road
- Proposed Mine Access Road
- Proposed Fresh Water Pipeline
- Proposed Transmission Line
- Proposed Transmission Line (Mills Ranch re-route)
- Proposed Airstrip
- Proposed Site Facilities
- Stream (>=2nd Order)
- Waterbody (>= 4 Ha)
- Wetlands (within RSA)

Wildlife and Wildlife Habitat

- Local Study Area
- Regional Study Area

Wildlife Habitat Rating

- U - Useable
- X - Likely No Value



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0 1 2 4 6

Kilometres

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold™

PROJECT: Blackwater Gold Project

Wildlife Habitat Rating Invertebrates, 1 of 5

Life Stage/Season: = Living (LI) / Growing (G)

DATE:	ANALYST:	**Figure** 5.4.15-2
September, 2015	MY	
JOB No: VE52277	QA/QC: MB	PDF FILE: 04-03-032_WHR_Invertebrates_5.4.15-2.pdf
GIS FILE: 04-03-032_WHR_Invertebrates_5.4.15-2.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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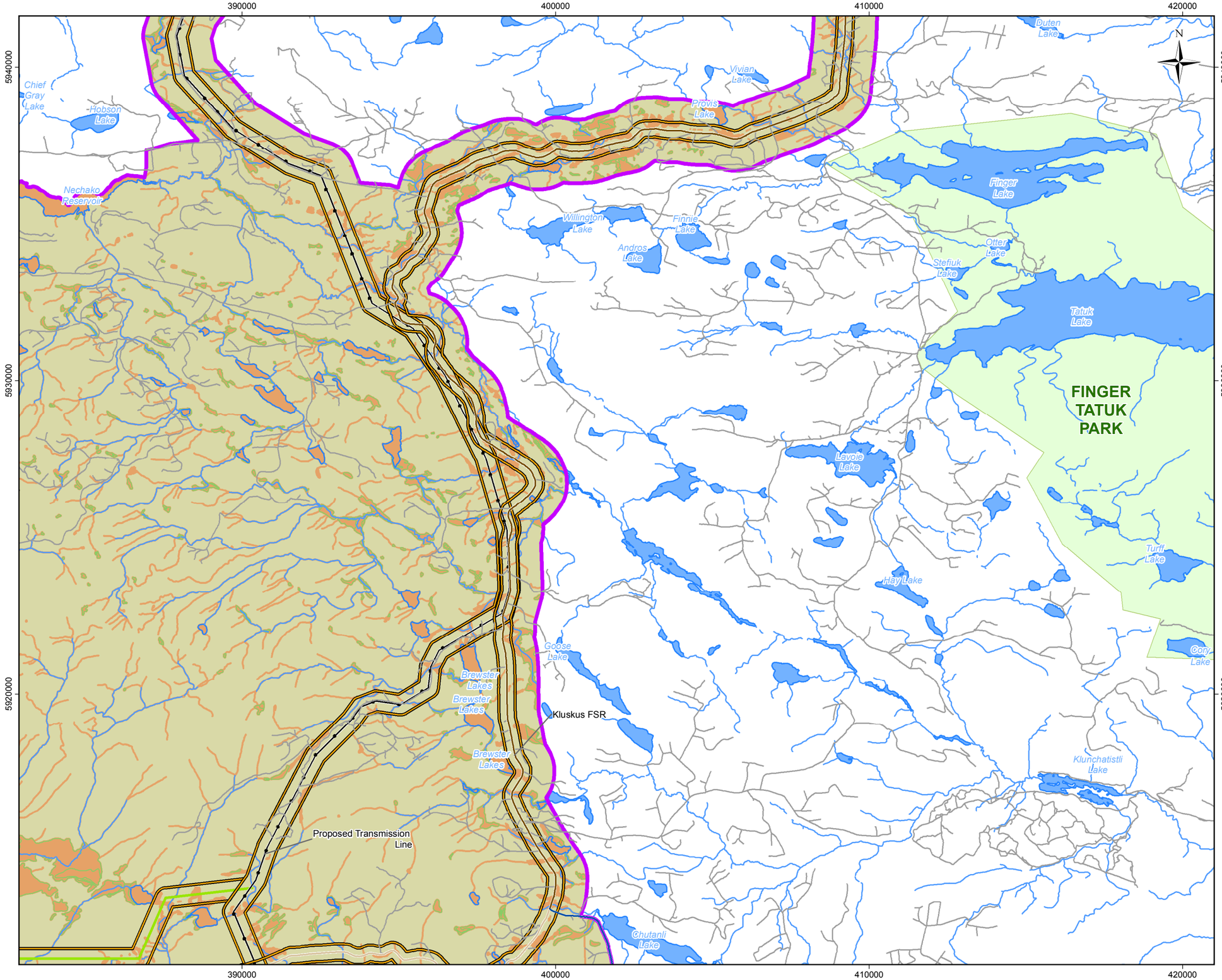


Legend

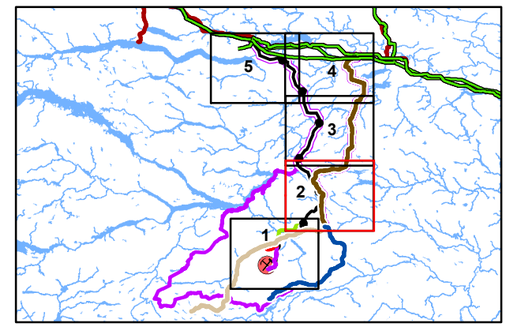
- Existing Road
- Kluskus FSR
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Proposed Transmission Line
- Proposed Transmission Line (Mills Ranch re-route)
- Stream (>=2nd Order)
- Waterbody (>= 4 Ha)
- Wetlands (within RSA)
- Parks and Protected Areas

Wildlife and Wildlife Habitat

- Local Study Area
- Regional Study Area

Wildlife Habitat Rating

- U - Useable
- X - Likely No Value



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Kilometres

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold™

PROJECT: Blackwater Gold Project

Wildlife Habitat Rating Invertebrates, 2 of 5

Life Stage/Season: = Living (LI) / Growing (G)

DATE:	ANALYST:	**Figure** 5.4.15-2b
September, 2015	MY	
JOB No: VE52277	QA/QC: MB	PDF FILE: 04-03-032_WHR_Invertebrates_5.4.15-2.pdf
GIS FILE: 04-03-032_WHR_Invertebrates_5.4.15-2.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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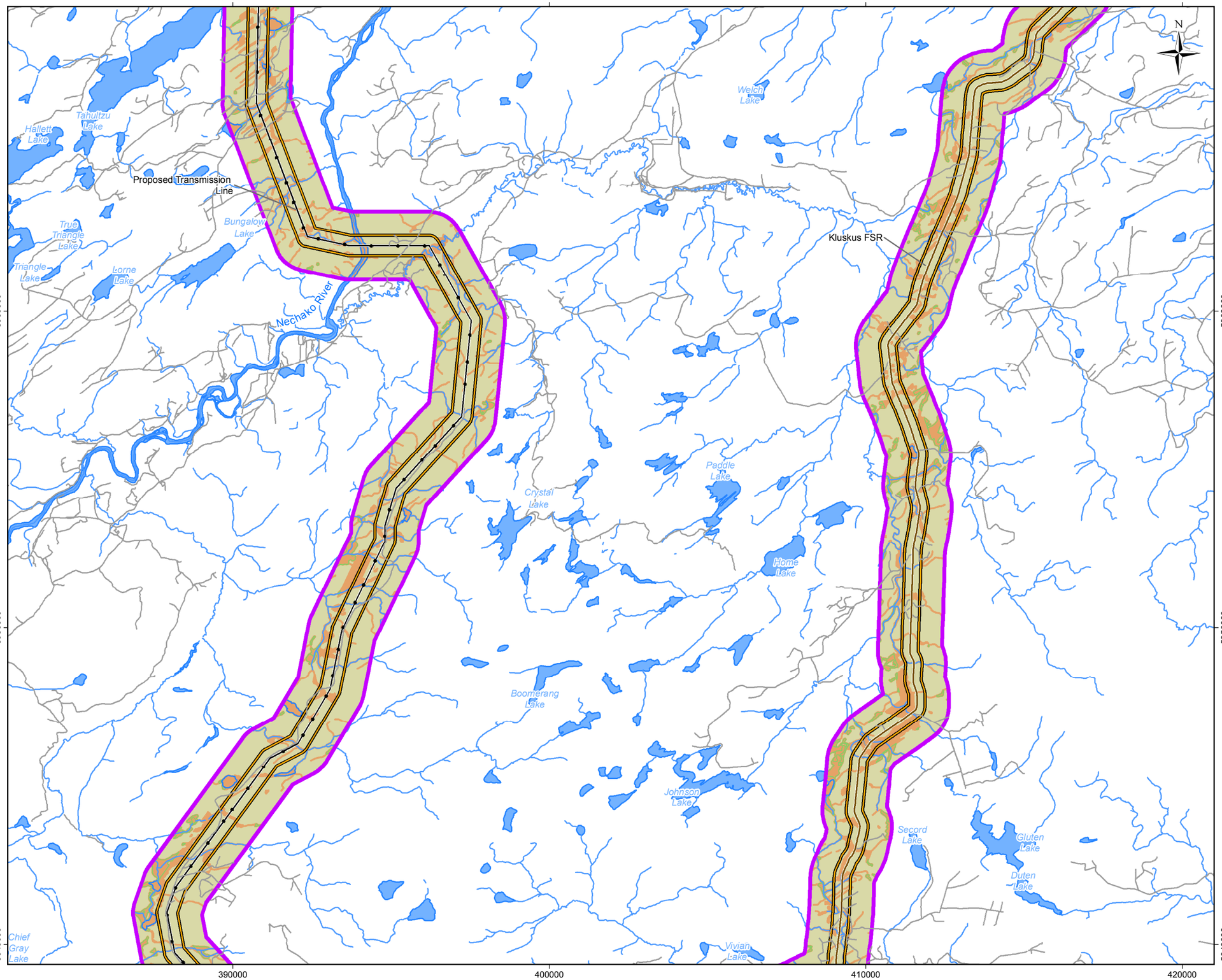

Legend

- Existing Road
- Kluskus FSR
- Proposed Transmission Line
- Stream (>=2nd Order)
- Waterbody (>= 4 Ha)
- Wetlands (within RSA)

Wildlife and Wildlife Habitat

- Local Study Area
- Regional Study Area

Wildlife Habitat Rating

- U - Useable
- X - Likely No Value

Scale: 1:120,000

0 1 2 4 6

Kilometres

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold™

PROJECT: Blackwater Gold Project

Wildlife Habitat Rating Invertebrates, 3 of 5

Life Stage/Season: = Living (LI) / Growing (G)

DATE: September, 2015	ANALYST: MY	**Figure** 5.4.15-2c
JOB No: VE52277	QA/QC: MB	PDF FILE: 04-03-032_WHR_Invertebrates_5.4.15-2.pdf
GIS FILE: 04-03-032_WHR_Invertebrates_5.4.15-2.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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390000 400000 410000 420000

5990000 5980000 5970000

DRYWILLIAM LAKE ECOLOGICAL RESERVE

BEAUMONT PARK

Fraser Lake
Nadleh Whuten
Fort Fraser
16
Seas Lake
Drywilliam Lake
Ronson Lake
Stag Lake
Klez Lake
Theda Lake
Rock Lake
Foster Lakes
Joseph Lake
Marten Lake
Engen
Leg Lake
Proposed Transmission Line
Chowsunkut Lake
Centre Lake
Milligan Lake
Kluskus FSR
Limit Lake
Tachick Lake
Dorman Lake
Nulki Lake
Tahultzu Lake
Welch Lake

N

Legend

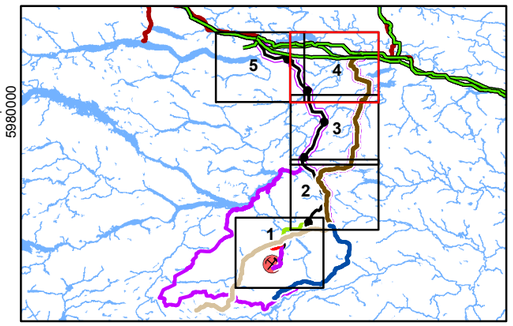
- Existing Transmission Line
- Highway
- Existing Road
- Kluskus FSR
- Proposed Transmission Line
- Stream (>=2nd Order)
- Waterbody (>= 4 Ha)
- Wetlands (within RSA)
- Parks and Protected Areas

Wildlife and Wildlife Habitat

- Local Study Area
- Regional Study Area

Wildlife Habitat Rating

- U - Useable
- X - Likely No Value



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Kilometres

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold™

PROJECT: Blackwater Gold Project

Wildlife Habitat Rating Invertebrates, 4 of 5

Life Stage/Season: = Living (LI) / Growing (G)

DATE: September, 2015	ANALYST: MY	**Figure** 5.4.15-2d
JOB No: VE52277	QA/QC: MB	PDF FILE: 04-03-032_WHR_Invertebrates_5.4.15-2.pdf
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PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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360000 370000 380000

5990000 5980000 5970000

Savory Lake
Endako
Deserter Lake
Fraser Lake
Stellako
Fraser Lake
Casey Lake
Seas Lake
Klez Lake
Foster Lakes
Chowsunkut Lake
Francois Lake
Stellako River
Anzus Lake
Borer Lake
Graham Lake
Cabin Lake
Laurie Lake
Twentysix Mile Lake
Tahultzu Lake
16

DRYWILLIAM L
ECOLOGICA
RESERVE

STELLAKO RIVER
WILDLIFE MANAGEMENT AREA

FRANCOIS
LAKE PARK

Proposed Transmission Line
(Stellako re-route)

Proposed Transmission
Line

N

Legend

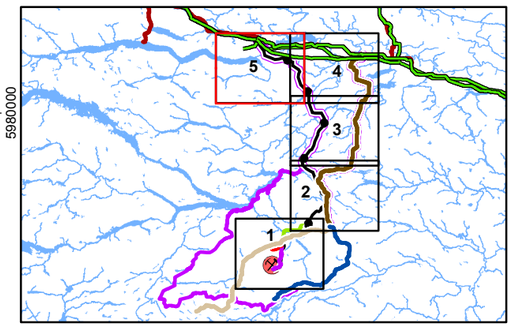
- Populated Place
- Existing Transmission Line
- Highway
- Existing Road
- Proposed Transmission Line
- Proposed Transmission Line (Stellako re-route)
- Stream (>=2nd Order)
- Waterbody (>= 4 Ha)
- Wetlands (within RSA)
- Parks and Protected Areas

Wildlife and Wildlife Habitat

- Local Study Area
- Regional Study Area

Wildlife Habitat Rating

- U - Useable
- X - Likely No Value



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Kilometres

Reference

BC Government GeoBC Data Distribution

CLIENT: newgold™

PROJECT: Blackwater Gold Project

Wildlife Habitat Rating
Invertebrates, 5 of 5
Life Stage/Season: = Living (LI) / Growing (G)

DATE:	ANALYST:	**Figure** 5.4.15-2e
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JOB No: VE52277	QA/QC: MB	PDF FILE: 04-03-032_WHR_Invertebrates_5.4.15-2.pdf
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PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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5.4.15.3.9.1 Habitat Loss and Alteration

The habitat loss and alteration category of effects is a method to account for areas of vegetation removal and/or ground disturbance due to placement of infrastructure. To simplify the effects assessment, all lost areas are combined, regardless of how long they are lost (even though the Project area will be reclaimed, except for some small features) to represent a worst-case scenario.

The distance used in this assessment predicts the potential effects to invertebrates beyond 50 m of the component footprints to be negligible because of the habitat specificity of the indicator species. Potential sources of habitat degradation include dust; invasive plants, wind throw, and altered local hydrology. Potential degradation of invertebrate habitat includes sensory disturbance, physical hazards, and chemical hazards. Potential Project effects on ecosystems and vegetation were assessed within the RSA to estimate potential degradations to invertebrates. The combination of these degradations is considered as one potential 'degradation' effect for a simplified approach. The loss of waterbodies and wetlands within the mine site will result in a temporal decrease of available habitat and potentially a decrease in the local number of invertebrates. No wetlands or waterbodies will be lost in areas other than the mine site.

Seventeen percent (49,265 ha) of the RSA was rated moderate to high in value for invertebrate habitat, and footprint components overlap approximately 3%. In the RSA, high elevation infrastructure associated with the mine site, airstrip, access road, and freshwater supply pipeline is not expected to be high in value as overwintering of invertebrates is limited. Overwintering habitat is a component of suitability as rearing and feeding are generally close to where adults or eggs overwinter. Most potential impacts on invertebrates are anticipated to be associated with the FSR and transmission line at lower elevations. High elevation Project infrastructure associated with the mine site, airstrip, access road, and freshwater supply pipeline overlaps negligible suitable habitat high in value, as these indicator species typically breed in open water and black spruce habitats at lower elevations.

The total maximum extent of the Project footprint (within clearing limits) categorized as lost habitat is 1,499 ha, 1,049 ha of which is attributed to the mine site, 13 ha to the access roads (including borrow areas), 4 ha to the airstrip, 18 ha to the freshwater supply pipeline, and 377 ha to the transmission line. The clearing limits represent maximum lost area, regardless if previously disturbed or not. Effects have the potential to occur from the start of Project construction to the end of closure.

The mine site, freshwater supply pipeline, and airstrip are predicted to overlay a maximum 1,070 ha, although potential habitat at these elevations is likely not used by the two indicator species for breeding and overwintering (C. Guppy, pers. comm.). The most important habitat areas affected are those along the transmission line (maximum 377 ha of moderate to high value habitat) because lower elevation habitat has a greater potential for overwinter survival of the indicator species adults and eggs (C. Guppy, pers. comm.).

5.4.15.3.9.1.1 Mortality Risk

There are low physical risks predicted for invertebrates through increased mortality caused by vehicle and aircraft collisions. Effects will have the potential to occur from the start of Project construction to closure.

5.4.15.3.9.1.2 Changes in Health

There are low physical risks to invertebrates through changes in water or air quality (dust deposition) from the Project. Effects will have the potential to occur from the start of Project construction to the end of closure.

5.4.15.3.10 Mitigation Measures

A range of habitat mitigation was adapted and applied to the Project as described in the Wildlife Management Plan (WLMP) (**Section 12.2.1.18.4.6**). The following habitat mitigation measures apply to all invertebrates and are specific to the potential effects carried through the assessment.

5.4.15.3.10.1 Habitat Loss and Alteration

The following mitigation measures will help reduce or eliminate habitat loss and alteration. Avoiding and/or mitigating loss and degradation effects to invertebrates and invertebrate habitat begins with the Project design. The design of the roads, transmission line, and mine site footprints include avoidance of high value riparian and wetland areas, with several iterative changes in the mine site and access road components already completed. The Kluskus FSR is an existing road for most of its footprint. Some mitigation measures already in place include:

- Road design using existing road and cleared areas, and the design of access roads and transmission lines away from wetland areas and riparian areas or spanning wetlands; and
- Movement of the facilities and topsoil piles within the mine site area away from wetlands, and/or minimizing ground disturbance footprint; and minimizing clearance of black spruce forest and maintaining hydrological regimes of wetlands near infrastructure.

To meet provincial and federal regulatory requirements for wildlife, vegetation, and aquatic resources relating to the conservation of species and ecosystems at risk, the WLMP will be implemented along with the LSVMRP (**Section 12.2.1.18.4.4)**, ISMP (**Section 12.2.1.18.4.5**), WMP (**Section 12.2.1.18.4.3**), SECP (**Section 12.2.1.18.4.1**), RCP (**Section 2.6**), and the ARMP (**Section 12.2.1.18.4.2**). These plans are designed to control invasive plant species, protect wildlife habitat, and protect in-stream resources. Implementing these management plans, including the wildlife and wetland specific best management practices (BMPs), will protect and minimize the potential effects of the Project on invertebrates not directly affected by the Project.

Mitigation for unavoidable loss of invertebrate habitat is limited to that of the footprint area and includes strategies discussed in the WLMP, WMP and LSVMRP. The LSVMRP and WMP provide

an outline of mitigation measures and compensation measures to reduce effects to vegetation and habitat from loss and degradation:

- Mitigating for loss and degradation of adjacent riparian wildlife habitats such as well demarcated no-work zones and management work zones (with restrictions, such as no heavy machinery, etc.) and setbacks in accordance with the Forest and Range Practices Act BMPs (BC MFLNRO, 2014);
- Clearing of transmission line ROWs may leave suitable habitat for invertebrates;
- Applying erosion and sediment control measures;
- Implementing progressive reclamation using local native vegetation wherever possible, or appropriate commercially grown, weed-free native species (LSVMRP **Section 12.2.1.18.4.4**, ISMP **Section 12.2.1.18.4.5**, RCP **Section 2.6** and WLMP **Section 12.2.1.18.4.6**);
- Discharging effluent that will meet guidelines for protection of aquatic life so that no adverse water quality effects to invertebrates are anticipated (Water Quality and Liquid Discharges Management Plan [WQLDMP] **12.2.1.18.4.10**);
- Implementing progressive wetland restoration during construction to achieve no-net-loss of wetlands will prevent potential high quality habitat loss (RCP);
- Implementing invasive plant management techniques as defined in the ISMP);
- Implementing dust control measures outlined in the Air Quality and Emissions Management Plan (AQEMP) (**Section 12.2.1.18.4.9**) include watering roads during the dry, high fugitive dust risk season and avoiding use of road salts during winter to reduce invertebrate habitat suitability;
- Reducing physical and chemical attractants, especially salts whenever practical, during construction and operations. Non-chemical dust suppression with water will reduce dust impacts to vegetation near roads and the mine site;
- Installing appropriate culverts where required and maintaining functioning water tables and drainage throughout all phases from construction to decommissioning will maintain wetland function to prevent changes in hydrology; and
- Maintaining black spruce and sedge meadow wetlands wherever feasible, openings near wetlands may enhance dragonfly and butterfly populations.

5.4.15.3.10.2 Effectiveness of Mitigation

Table 5.4.15-8 provides ratings for effectiveness of mitigation measures to avoid or reduce potential effects on invertebrates during mine site development. Mitigation measures will be based on site-specific information and construction engineering and are therefore preliminary at this stage.

Table 5.4.15-8: Mitigation Measures and Effectiveness of Mitigation to Avoid or Reduce Potential Effects on Invertebrates during Mine Site Development

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
Habitat Loss and Alteration	Construction, Operations, Closure, Post-Closure	Road design using existing road and cleared areas, and the design of access roads and transmission lines away from wetland areas and riparian areas or spanning wetlands	High
		Movement of the facilities and topsoil piles within the mine site area away from wetlands, and/or minimizing ground disturbance footprint; and minimizing clearance of black spruce forest and maintaining hydrological regimes of wetlands near infrastructure	High
		Mitigating for loss and degradation of adjacent riparian wildlife habitats such as well demarcated no-work zones and management work zones (with restrictions, such as no heavy machinery, etc.) and setbacks in accordance with the *Forest and Range Practices Act* BMPs (BC MFLNRO, 2014)	High
		Clearing of transmission line ROWs may leave suitable habitat for invertebrates	High
		Applying erosion and sediment control measures	Moderate
		Implementing progressive reclamation using local native vegetation wherever possible, or appropriate commercially grown, weed-free native species (LSVMRP **Section 12.2.1.18.4.4**, ISMP **Section 12.2.1.18.4.5**, RCP **Section 2.6** and WLMP **Section 12.2.1.18.4.6**)	Moderate
		Discharging effluent that will meet guidelines for protection of aquatic life so that no adverse water quality effects to invertebrates are anticipated (WQLDMP **12.2.1.18.4.10**)	High
		Implementing progressive wetland restoration during construction to achieve no-net-loss of wetlands will prevent potential high quality habitat loss (RCP)	High
		Implementing invasive plant management techniques as defined in the ISMP)	Moderate
		Implementing dust control measures outlined in the AQEMP (**Section 12.2.1.18.4.9**) include watering roads during the dry, high fugitive dust risk season and avoiding use of road salts during winter to reduce invertebrate habitat suitability	Moderate
		Reducing physical and chemical attractants, especially salts whenever practical, during construction and operations. Non-chemical dust suppression with water will reduce dust impacts to vegetation near roads and the mine site	High
		Installing appropriate culverts where required and maintaining functioning water tables and drainage throughout all phases from construction to decommissioning will maintain wetland function to prevent changes in hydrology	High
		Maintaining black spruce and sedge meadow wetlands wherever feasible, openings near wetlands may enhance dragonfly and butterfly populations	High

Note: AQEMP = Air Quality and Emissions Management Plan; BC MFLNRO = British Columbia Ministry of Forests, Lands and Natural Resource Operations; BMP = Best Management Practice; FSR = Forest Service Road; ISMP = Invasive Species Management Plan; LSA = Local Study Area; LSVMRP = Landscape, Soils and Vegetation Management and Restoration Plan; RCP = Reclamation and Closure Plan; ROW = right-of-way; RSA = Regional Study Area; WLMP = Wildlife Management Plan; WQLDMP = Water Quality and Liquid Discharges Management Plan

The mitigation/offsetting success ratings shown in **Table 5.4.15-8** are incorporated into the confidence ratings defined in **Section 4.3.5** and summarized in **Table 5.4.15-10**. In summary, low success rating means mitigation has not been proven successful, moderate success rating means mitigation has been proven successful elsewhere, and high success rating means mitigation has been proven effective.

In the case of invertebrates on the mine site, mitigation/offsetting success rating is classified as high overall because most mitigation measures are consistent with those proposed by BC MFLNRO and BC CDC for protection of identified rare invertebrate populations, and demonstrated as moderate to high in effectiveness in other locations.

5.4.15.4 Residual Effects and their Significance

Mitigation measures are predicted to be effective in protecting invertebrate focal species from significant adverse effects. **Table 5.4.15-9** presents a summary of the potential residual effects after mitigation, as well as management strategies by Project phase and component.

Table 5.4.15-9: Summary of Categories of Assessment and Mitigation Measures – Invertebrates

Project Phase	Project Component	Category of Assessment	Mitigation and Management of Effects	Potential for Residual Effect?
Construction, Operations, Closure and Post-Closure	Mine site, access roads, freshwater supply pipeline, airstrip and transmission line	Habitat Loss and Alteration	LSVMRP, progressive reclamation with appropriate species. Avoid black spruce bogs and wetlands when placing transmission line poles, or maintain hydrologic functions. Primary area of concern is at low elevations of the transmission line and FSR. Small forest openings near wetlands due to roads and infrastructure may enhance habitat quality for feeding	Yes
Construction, Operations	Mine site, access roads, freshwater supply pipeline, airstrip and transmission line	Mortality Risk	LSVMRP, progressive reclamation with appropriate species. Avoid black spruce bogs and wetlands when placing transmission line poles, or maintain hydrologic functions.	Yes
Construction, Operations	Mine site, access roads, freshwater supply pipeline, airstrip and transmission line	Invertebrate Health	Water management plan, BMPs (BC MFLNRO, 2014), Dust Management Plan	Yes

Note: FSR = Forest Service Road

5.4.15.4.1 Significance of Residual Project Effects

Each of the potential residual effects are characterized in terms of magnitude, or severity of effect, geographic extent of effect, duration of effect, reversibility, context/resilience of invertebrates or invertebrate habitat, probability, and confidence in the conclusions (**Table 5.4.15-10**).

Table 5.4.15-10: Characterization of Residual Environmental Effects for Invertebrates

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	The amount of change in a measurable parameter or variable relative to baseline case	Negligible — Effects are not measurable Low — A measurable change but within the range of predicted natural variation for habitat availability. Medium —A measurable change but less than high High[(1)] — A >20% change of density, abundance or distribution for listed species and >30% change of density, abundance or distribution for all other species
Geographical Extent	The geographic area in which an environmental, economic, social, heritage, or health effect of a defined magnitude occurs	Project footprint—Effect is restricted to the Project footprint – site specific Local: Within the LSA—Effect is confined to the LSA Regional: Within the RSA—Effect extends beyond the LSA into the RSA
Frequency	When the effect occurs and the number of times during the Project or a specific Project phase that an environmental effect may occur	Once—Effect occurs on one occasion Intermittent—Effect occurs several times Continuous—Effect occurs continuously
Duration	The period of time required until invertebrates return to baseline condition, or the effect can no longer be measured or otherwise perceived	Short-term— Less than two years (i.e., effects happens during the construction phase only) Medium-term—Not applicable for invertebrates Long-term— From more than 17 to less than 35 years (i.e., effect happens during construction, operations and closure) Chronic— More than 35 years and beyond (i.e., effect happens from construction through to post closure and beyond)
Reversibility	The likelihood that a measurable parameter will recover from an effect	Yes—Effect is reversible within part of a whole generation after the impact ceases No—Effect is not reversible over the time scales listed
Context	Resilience to stress due to ecological fragility and degree of disturbance of area in which the Project is located	Low – Invertebrates have high resilience to stress, have not been affected by other projects or activities or natural changes. No listed species or ecosystems identified Medium –Invertebrates have moderate resilience to stress, the VC has been affected by other projects or activities, or natural changes but still has capacity to assimilate more changes. Presence of blue-listed species or ecosystems

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
		High – Invertebrates have weak resilience to stress, the VC has been severely affected by other projects or activities, or natural changes. Presence of red-listed or SARA-listed species or ecosystems.
Likelihood of Effect	The likelihood that a residual effect will occur	Low – Low likelihood a residual effect will occur Moderate – Moderate likelihood a residual effect will occur High – High likelihood a residual effect will occur
Significance	Expectation of a residual effect on invertebrates that is above the suggested threshold	Not Significant (negligible) – Effects are local in geographic extent, or low context rating, and a negligible magnitude, short-term, reversible, and with a low frequency (once or intermittent). Not Significant (minor) – Effects are local in geographic extent, or low magnitude, and low context rating, short-term to chronic, reversible, and with a low frequency (once or intermittent).
		Not Significant (moderate) – Effects are local to regional in geographic extent, and medium in magnitude, medium context rating, medium-term to chronic, reversible, and occur at all frequencies.
		Significant – Effects occur with a medium to high context rating, high magnitude, regional in geographic extent, long-term to chronic, non-reversible, and occur at all frequencies.
Confidence Level	Confidence in the residual effects prediction	Low – Effects on invertebrates are not well understood, mitigation has not been proven effective Moderate — Effects on invertebrates are understood in similar ecosystems and effects documented in the larger regional area or in the literature, mitigation proven effective elsewhere. High – Effects on invertebrates are well understood, mitigation has been proven effective.

Note: LSA = Local Study Area; RSA = Regional Study Area; *SARA* = *Species at Risk Act*
(1) High: A threshold of 20% change or loss is proposed for high magnitude. This is a general environmental practitioner approach, which has been used and supported in the past for resource development projects, including the Joint Review Panel Report on the Jackpine Mine Expansion Project which decision statement was made under *CEAA 2012*.

Thresholds are based on the ability to detect change in local populations as a result of Project effects. Threshold effects levels to invertebrates were selected that reflect the ability of survey results to demonstrate change in local numbers and quantitative habitat changes (**Table 5.4.15-11**). Twenty percent (20%) was used as the precautionary threshold for determining significance of Project effects on moderate and high value habitat in the RSA.

Table 5.4.15-11: Threshold(s) for Determining Magnitude of Residual Invertebrate Habitat and Population Effects in the RSA

Category of Assessment	Proposed Threshold of Environmental Effect
Habitat Loss and Alteration	>20% reduction in relative invertebrate habitat abundance or habitat areas with a moderate to high suitability ratings (e.g., >20% change in amount of invertebrate moderate to high suitable habitat within the RSA, as estimated in suitability model). Evidence of lack of use or displacement due to sensory disturbance may be included as lost habitat if evident.
Mortality Risk	Qualitative measure of any concentration of mortalities of invertebrate species of concern. No specific threshold is proposed.
Invertebrate Health	Qualitative measure of any concentration of mortalities of invertebrate species of concern. No specific threshold is proposed.

Note: RSA = Regional Study Area

Table 5.4.15-12 provides the residual effects assessment summary for invertebrates based on the categorization of effects.

5.4.15.4.1.1 Mine Site

The residual effects of habitat loss and alteration are rated as Not Significant (minor) with moderate confidence and Not Significant (negligible) for invertebrate mortality risk and heath, based on the magnitude, geographic extent, frequency, and reversibility of the effect. Loss and degradation of invertebrate habitat will occur during the construction phase, and these effects will be evident until post-closure.

Within the mine site, the adverse effect is rated as low magnitude. A small fraction of available moderate and high quality habitat will be affected relative to habitats where dragonflies and butterflies occur at high elevations, although these habitats likely have lower value because of overwinter mortality (C. Guppy, pers. comm.). Regionally, these ecosystems are widespread and relatively common. The clearing of black spruce from wet forested habitats will generally make the habitat unsuitable for jutta arctic and other species that rely on this habitat (AMEC, 2013). The habitat impacts have a local effect. Once the habitat effect occurs during the construction phase, it will be approximately 17 years before closure and then at least 20 or more years post-closure for the ecosystems to recover to near baseline conditions. Therefore, the duration of the habitat effect will be chronic. The habitat effect will occur once, and will be reversible. There is a high probability that loss of some moderate and high value habitat will occur and moderate confidence that this will affect invertebrates in the area. Project activities are not predicted to affect the viability of invertebrates after mitigation measures.

The residual effects for mortality risk are rated as Not Significant (negligible) with high confidence due to the negligible magnitude, and site-specific and intermittent nature of the risk within the mine site. Early development of wetland compensation areas will reduce risk of additional mortality related to habitat loss. Traffic and access control, as well as early compensation works and mitigation measures, will mitigate any risk of additional mortality.

Table 5.4.15-12: Residual Effects Assessment Summary for Invertebrates

Project Phase	Project Component	Category of Assessment	Mitigation and Management	Potential for Residual Effect?	Residual Effect	Context	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Likelihood Determination	Level of Confidence for Likelihood	Significance Determination	Level of Confidence for Significance
Construction through to Post-Closure	Mine site, airstrip, transmission line, freshwater supply pipeline, and access roads	Habitat Loss and Alteration	LSVMRP, progressive reclamation with appropriate species, maintain forest function and vegetation cover	Yes	Unavoidable loss of habitat	Low	Low	Local	Chronic	Reversible	Once	High	High	Not Significant (minor)	Moderate
Construction through to Closure	Mine site, airstrip, transmission line, freshwater supply pipeline, and access roads	Mortality Risk	LSVMRP, progressive reclamation with appropriate species, dust control and adaptive management as per the WLMP and BMPs (BC MFLNRO, 2014)	Yes	Unavoidable mortalities	Low	Low	Site-specific	Ongoing	Reversible	Intermittent	Low	High	Not Significant (negligible)	High
Construction through to Closure	Mine site, airstrip, transmission line, freshwater supply pipeline, and access roads	Invertebrate Health	LSVMRP, progressive reclamation with appropriate species, dust control and adaptive management as per the WLMP and BMPs (BC MFLNRO, 2014)	Yes	Unavoidable mortalities	Low	Low	Site-specific	Ongoing	Reversible	Intermittent	Low	High	Not Significant (negligible)	High

The residual effects for changes related to invertebrate health are rated as Not Significant (negligible) with high confidence due to the negligible magnitude, and site-specific and intermittent nature of the risk within the mine site.

5.4.15.4.1.2 Access Roads and Kluskus Forest Service Road

The residual effects of habitat loss and alteration are rated as Not Significant (minor) with moderate confidence and Not Significant (negligible) for invertebrate mortality risk and heath, based on the magnitude, geographic extent, frequency, and reversibility of the effect. Loss and degradation of invertebrate habitat will occur during the construction phase, and these effects will be evident beyond the post-closure phase. The existing Kluskus FSR may be widened, with additional clearing area for borrow pits and laydown areas (to be progressively reclaimed throughout the life of the mine), until the access road is closed and reclaimed.

Within the proposed access road area and existing FSR, the adverse effect is rated as low magnitude. A small fraction of available habitat will be affected relative to habitats where invertebrates occur frequently, and the ability of these ecosystems to recover is high. Regionally, these ecosystems are widespread and relatively common, and the habitat effects have a local extent, limited to the vicinity (50 m) of the road.

The moderate to high quality habitat associated with black spruce bogs is relatively slow to respond and recover from disturbances. Once the habitat effect occurs during the construction phase, it will be approximately 17 years before mine closure and then at least 20 or more years post-closure for the ecosystems to recover to near baseline conditions. Therefore, the duration of the habitat effect will be chronic. The habitat effect will occur once, and will be reversible. The sensory disturbance may occur multiple times and be reversible in the short term. The recovery time from habitat disturbance results in invertebrates having a medium context. There is a high probability that loss of habitat will occur and a moderate confidence that this will affect invertebrates in the area. Project road activities are not predicted to affect the viability of invertebrates after mitigation measures.

The residual effects for mortality risk are rated as Not Significant (negligible) with high confidence due to the negligible magnitude, and site-specific and intermittent nature of the risk within the mine site. Early development of wetland compensation areas will reduce risk of additional mortality related to habitat loss. Traffic and access control, as well as early compensation works and mitigation measures, will mitigate any risk of additional mortality.

The residual effects for changes related to invertebrate health are rated as Not Significant (negligible) with high confidence due to the negligible magnitude, and site-specific and intermittent nature of the risk within the mine site.

5.4.15.4.1.3 Airstrip, Transmission Line, and Freshwater Supply Pipeline

The residual effects of habitat loss and alteration are rated as Not Significant (minor) with moderate confidence and Not Significant (negligible) for invertebrate mortality risk and heath, based on the magnitude, geographic extent, frequency, and reversibility of the effect. Loss and degradation of invertebrate habitat will occur during the construction phase in the airstrip, transmission line, and

freshwater supply pipeline areas, and these effects will be evident beyond the post-closure phase. The effect has a low magnitude rating because much of the area is already disturbed, and mitigation measures will minimize the majority of effects, however, the effects will remain indefinitely.

The effects have a local extent, limited to the vicinity (50 m) of the immediate airstrip, transmission line and freshwater pipeline footprint. The clearing of black spruce from wet forested habitats will generally make the habitat unsuitable for jutta arctic and other species that rely on this habitat (AMEC, 2013). The duration of the effect will be chronic, as black spruce and wetland ecosystems are slow to recover. The effect will occur once and will be reversible. Butterflies are likely to colonize parts of the transmission line area. The clearing of vegetation for the transmission line and associated access roads, and the long-term maintenance of those cleared areas, is likely to result in an overall increase in suitable habitat for the Assiniboine skipper identified during baseline studies (AMEC, 2013). Project activities are predicted not to affect the viability of invertebrates.

The residual effects for mortality risk are rated as Not Significant (negligible) with high confidence due to the negligible magnitude, and site-specific and intermittent nature of the risk within the mine site. Early development of wetland compensation areas will reduce risk of additional mortality related to habitat loss. Traffic and access control, as well as early compensation works and mitigation measures, will mitigate any risk of additional mortality.

The residual effects for changes related to invertebrate health are rated as Not Significant (negligible) with high confidence due to the negligible magnitude, and site-specific and intermittent nature of the risk within the mine site.

5.4.15.4.1.4 Project Area

The residual effects of habitat loss and alteration are rated as Not Significant (minor) with moderate confidence and Not Significant (negligible) for invertebrate mortality risk and heath, based on the magnitude, geographic extent, frequency, and reversibility of the effect. Loss and degradation of invertebrate habitat will occur during the construction phase and these effects will be reversible.

The effects have a local extent, limited to the vicinity (50 m) of the Project footprint. The clearing of black spruce from wet forested habitats will generally make the habitat unsuitable for jutta arctic and other species that rely on this habitat (AMEC, 2013). The duration of the effect will be chronic, as black spruce and wetland ecosystems are slow to recover. The effect will occur once and will be reversible. Butterflies and dragonflies are predicted to use openings from the transmission line area and other clearings. The clearing of vegetation for the transmission line and associated access roads, and the long-term maintenance of those cleared areas, is likely to result in an overall increase in suitable habitat for the Assiniboine skipper identified during baseline studies (AMEC, 2013). Project activities are not expected to affect the viability of invertebrates due to the widespread and common extent of suitable habitat within the RSA.

The residual effects for mortality risk are rated as Not Significant (negligible) with high confidence due to the negligible magnitude, and site-specific and intermittent nature of the risk within the mine site. Early development of wetland compensation areas will reduce risk of additional mortality

related to habitat loss. Traffic and access control, as well as early compensation works and mitigation measures, will mitigate any risk of additional mortality.

The residual effects for changes related to invertebrate health are rated as Not Significant (negligible) with high confidence due to the negligible magnitude, and site-specific and intermittent nature of the risk within the mine site.

5.4.15.5 Cumulative Effects

A Cumulative Effects Assessment (CEA) for the Invertebrate Valued Component (VC) is necessary because the Project is expected to have a Not Significant (minor) residual effect of invertebrate habitat loss and degradation. Residual effects on invertebrate habitat that could arise from other projects or activities in the region should be assessed to fully understand the context of the residual adverse effects on invertebrates by the Project. The spatial boundary for this assessment is the RSA. The temporal boundaries include historical, present, and certain and reasonably foreseeable projects within the RSA. Rationale for carrying forward into the CEA is shown in **Table 5.4.15-13.**

Table 5.4.15-13: Project Related Residual Effects; Rationale for Carrying forward into the CEA

Project Component	Project Phase	Residual Effect	Rationale	Carried Forward to Cumulative Effects Assessment
Mine site, airstrip, transmission line, freshwater supply pipeline, and access roads	Construction through to Closure	Unavoidable loss or alteration of habitat	Changes in the amount of habitat from baseline conditions	Yes

For the invertebrate CEA, the most relevant land uses in the RSA that could potentially interact with invertebrate habitat include forestry, mining, and agriculture activities. No singular reviewable projects were identified within the RSA. Current mineral prospecting could lead to mine projects in the future, but hypothetical projects are not to be considered during the CEA (BC EAO, 2013). Identified interactions between past, present, and future projects and land uses in the RSA for the CEA are presented in **Table 5.4.15-14**.

Table 5.4.15-14: Key and Moderate Interactions between Invertebrates and other Past, Present, and Future Projects/Activities

Potential Residual Effect	Historical Land Use		Representative Current and Future Land Use			Carried Forward into CEA?
	Forestry (cut blocks and woodlots)	Agriculture (range tenures	Mining (active, current prospecting,	Forestry (cut blocks and woodlots)	Agriculture (active range tenures)	
Loss of Invertebrate Habitat	I	I	I	I	I	Yes

Note: I = interaction, KI = key interaction, NI = no interaction

5.4.15.5.1 Potential Residual Cumulative Effects and Mitigation Measures

Forestry activities in the RSA have the potential to temporarily alter and degrade invertebrate habitat through habitat conversion, erosion and sedimentation, and invasive species introduction. Although forestry activities do not typically result in loss of invertebrate habitat, the temporary effects on invertebrate habitat from current and future forestry activities could result in the temporary degradation of invertebrate habitat.

Forestry activities in the study areas will likely result in degrading and removing some moderate to high value invertebrate habitat. Suggested mitigation measures such as Guidelines and BMPs in BC (BC MFLNRO, 2014) include: maintaining drainage pathways and wetland hydrology by installing appropriately sized culverts for stream and wetland crossings; avoiding harvesting in wetland and riparian areas; replanting native vegetation to expedite succession; road design to minimize erosion and maximize reforestation; maintaining buffers around wetlands and riparian areas; applying sediment control to areas around wetlands and other waterbodies; and implementing invasive plant control measures and monitoring systems. Given the adherence to these practices, the loss of invertebrate habitat to forestry is expected to be minor.

Agricultural activities in the RSA have the potential to cause the loss and degradation of invertebrate habitat. Conversion of natural habitat to agricultural habitat typically results in the loss of wildlife habitat and many species of invertebrates. Cattle grazing can alter invertebrate habitat in emergent habitats, and potentially introduce invasive vegetation species. Trampling can compact soils and cause erosion in riparian areas resulting in sedimentation of surface waters. Mechanical harvesting of vegetation can cause rutting and soil displacement. Farms and other agricultural operations can result in reduced water quality in invertebrate habitat due to fertilizer and pesticide use. Agricultural activities do not typically result in the direct loss of invertebrate habitat but may result in degraded invertebrate habitat.

Suggested mitigation measures for agricultural activities include: 1) establishing cattle exclusion zones to limit grazing to uplands, thereby minimizing erosion and sedimentation; 2) minimizing pesticide and fertilizer use around aquatic resources and before precipitation events to limit

chemical runoff from entering watersheds; 3) establishing protected riparian areas prior to clearing; and 4) controlling invasive species.

Mining activities (e.g., current prospecting, exploration) occur southeast and northwest of the proposed mine site, and are likely to continue into the future. Mineral prospecting can result in degraded invertebrate habitat through accidental discharge of drilling fluids, vegetation removal, and invasive species introduction.

Suggested mitigation measures for mineral exploration and prospecting, which are typical permit conditions under the *Mines Act* (Government of BC, 1996b), include: 1) pre-planning to avoid important wildlife areas (e.g., wetlands; 2) minimizing stream crossings for access roads; 2) avoiding work during critical breeding and rearing seasons for wildlife; 3) limiting the production of excess drilling fluids; and 4) avoiding discharges of drilling fluids into aquatic systems.

5.4.15.5.2 Significance of Potential Residual Cumulative Effects

The significance of the Project's contribution to cumulative effects in the RSA was determined at the post-closure phase for this assessment as forest and other habitat mitigation and compensation will occur primarily during closure.

The Project will contribute to additional loss of invertebrate habitat in combination with the past, present, and future activities (e.g., forestry, agricultural, and mineral exploration) identified in the RSA for this CEA. The significance of the Project's contribution to cumulative effects in the RSA was determined at the post-closure phase for this assessment as wetlands mitigation and compensation will occur prior to and concurrent with construction, and during operations and closure. Logging activities in the RSA have generated loss of habitat; however, application of BMPs (BC MFLNRO, 2014) will protect the key wetland habitats needed by invertebrate species by minimizing disturbance, increasing success of reforestation, and minimizing the duration of disturbance. Due to the minimal loss of invertebrate habitat associated with forestry, agricultural, and mineral exploration, the significance determination for residual cumulative effects is Not Significant (minor) as a result of Project implementation (**Table 5.4.15-15**) because of the mitigation and compensation measures for the Project. The level of confidence is moderate due to the risk associated with the invertebrate habitat mitigation measures.

Table 5.4.15-15: Residual Cumulative Effects Assessment for Loss of Invertebrate Habitat

Effect Attribute	Current/Future Cumulative Environmental Effect(s) without Project	Project Contribution Cumulative Environmental Effect
Context	Medium	Medium
Magnitude	Low	Low
Geographic Extent	Regional	Local
Duration	Chronic	Chronic
Reversibility	Yes	Yes
Frequency	Intermittent	Once
Likelihood Determination	High	High
Confidence Level for Likelihood	High	High
Significance Determination	Not Significant (minor)	Not Significant (minor)
Confidence Level for Significance	Moderate	Moderate

5.4.15.6 Limitations

The key limitation of this assessment is the limited surveys to quantify the invertebrate species presence over time as some species have cyclic population numbers. Regional abundance and habitat use are not known beyond habitat suitability models and professional judgment.

5.4.15.7 Conclusion

Invertebrates will be adversely affected through loss and degradation of habitat during the life of the Project. There is a high probability that lost habitat will recover to average baseline conditions upon closure, except limited portions of the airstrip and access roads. Loss and degradation effects include effects from direct habitat loss due to Project construction, dust deposition on vegetation and soil, and invasive species introduction and/or spread scale.

The potential residual effects of habitat loss and degradation will be primarily caused by the construction of new portions of the road; widening along the existing FSR; airstrip, freshwater pipeline, and mine site development; and clearing for the transmission line. Degradation will occur from all Project components. The maximum extent of these effects is local in context, with the loss pertaining to the clearing limits and degradation within 50 m of those limits, although the majority of the degrading effects will occur within 10 m to 30 m from the road edges.

Mitigation and adaptive management plans will avoid and mitigate the majority of adverse effects. Where it is not possible to mitigate completely, the effects will be minimized to keep the magnitude of effects at a maximum of low, with the majority at a negligible to low level. The most important mitigation measures for minimizing residual effects to invertebrates include:

- Maintain quantity and quality of adjacent wetlands and forest cover, particularly black spruce and sedge wetlands;

- Apply wildlife management plan measures to road use agreements with other commercial users of the access roads;
- Close and decommission access roads and trails after mine closure and reclamation are achieved; and
- Conduct habitat restoration of existing disturbed habitats affected by the current road and transmission line, including closure and decommissioning spur roads/trails.